City-to-city learning to enhance urban water management: the contribution of the City Blueprint Approach

Authors: Carel Dieperink[a,d], Stef H.A. Koop[a,b]), Mado Witjes[a,c,c], Kees Van Leeuwen[a,b] & Peter P.J. Driessen[b],

Corresponding author: Carel Dieperink (c.dieperink@uu.nl)

[a] Copernicus Institute of Sustainable Development, Utrecht University, Princetonlaan 8a, 3584 CB Utrecht, The Netherlands

[b] KWR Water Research Institute, Groningenhaven 7, 3433 PE Nieuwegein, The Netherlands

[c] Province of Utrecht, Archimedeslaan 6, 3584 BA Utrecht, The Netherlands

[d] The Netherlands Institute of Ecology (NIOO), Droevendaalsesteeg 10, 6708 PB Wageningen, The Netherlands

Declarations of interest: none

Funding: This research was partially funded by the POWER project; the European Commission is acknowledged for funding POWER in H2020-Water under Grant Agreement No. 687809.

CRediT author statement

Carel Dieperink: Conceptualization; Formal analysis; Investigation; Methodology; Supervision; Roles/Writing - original draft; **Stef Koop**: Conceptualization; Data curation; Formal analysis; Investigation; Methodology; Roles/Writing - original draft; **Mado Witjes**: Formal analysis; Investigation; Methodology; Roles/Writing - original draft; **Kees Van Leeuwen**: Conceptualization; Funding acquisition; Writing - review & editing **Peter Driessen**: Funding acquisition; Writing - review & editing.

City-to-city learning to enhance urban water management: the contribution of the City Blueprint Approach

Highlights

- The potential of city-to-city (C2C) learning to address water issues is largely untapped
- We reflect on the role of C2C learning in water governance
- The City Blueprint indicator framework is suggested as a city-matching methodology
- The City Blueprint's main strengths & limitations for C2C learning are outlined

Abstract

Cities face several water challenges which ask for more pro-active governance approaches. One option that cities have is to start networking and build learning alliances with other cities. Forming meaningful alliances however asks for clear and easily accessible city-matching methodologies which are based on a standardised assessment approach and the presence of structured and large databases. The City Blueprint Approach is an example of such a methodology. Aim of this paper is to show the potential of this approach as a substantive methodology for enhancing urban water management. This is done by illustrating the use of the approach in four cities, which were studied in the H2020 project POWER (Political and sOcial awareness on Water EnviRonmental challenges) and by comparing the results found with good practises present in the City Blueprint database. These good practises however cannot simply be copy-pasted from one city to another. We therefore outline in what way more in-depth city to city learning results can be achieved and be tailored to best-fit particular urban areas. The paper concludes with some suggestions for enhancing the potential for city-to-city learning in urban water governance networks.

Keywords: City-to-city Learning - Water Governance - City Blueprint - Governance Capacity, social learning, twinning, city networks

1. Introduction

The future is urban. In 2009, the number of people living in cities surpassed the number of people living in rural areas. Cities are projected to grow with an unprecedented 2.7 billion people amounting to two third of the projected world population of 9.7 billion in 2050 (UN DESA, 2009). Already approximately 80% of the world's GDP is produced by cities, and 75% of the global energy and material flows are consumed here too (UNEP, 2013). As a result, cities face many environmental challenges (Koop and Van Leeuwen, 2017). According to a global survey, one in four large cities (population > 750,000) is water stressed (water use / availability ratio > 0.4; McDonald et al., 2014). Prime examples, such as the nearly emptied water reservoirs in Melbourne in 2007, São Paulo in 2014 and Cape Town's threat of day zero in 2018, are likely to unfold more frequently, with far-reaching consequences. On the other end, too much water, in the form of floods already pose a projected 15% of the global population at risk. This is mainly the case in urbanities including almost all the mega-cities that are situated along the world's coast, delta's and rivers (Ligtvoet et al., 2014). Sea level rise, extreme weather events and land-use change only further exacerbate their vulnerability. Cities are also a key source of pollution. Plastics, untreated sewage discharge, combined sewer overflow and stormwater runoff pollute local water bodies, rivers and oceans, causing eutrophication, biodiversity loss, threatening drinking water, fisheries, aquaculture and tourism (Zarf et al., 2011). Also the vulnerability to heatwaves is amplified by both climate change and the urban environment which often lacks a cooling effect of vegetation and water bodies (Yu et al., 2020). As such, the pressure exerted on cities but also their innovative potential are likely to increase exponentially (Meijer and Bolıvar, 2016).

Although each city has its unique contextual setting (Koop et al., 2018), there are many cities facing rather similar challenges related to water, waste and climate change. The almost unlimited potential of sharing know-how between these cities is widely recognised in academia (e.g. Shefer, 2019; Kern and Bulkeley, 2009) and acted upon by Transnational Municipal Networks (TMNs) such as C40, 100ResilientCities, the Climate Alliance and Energy-Cities. The exchange of knowledge, experiences, learning practises, policies or governance models - within TMNs or bilaterally - is generally referred to as city-to-city (C2C) learning (though many authors point out the difference between knowledge exchange and learning) (Haupt et al., 2019). However, against the often praised learning potential, many studies show that actual C2C-learning generally provides a somewhat more disappointing picture (Kern and Bulkeley, 2009; Haupt et al., 2019; Castanho, 2019). The time, effort and thoughtfulness required to translate general expectations into a specific set of learning targets and activities that can bring about mutual learning, is all too often underestimated (Dolowitz and Marsh, 2000). In addition, based on the organisational structure of many TMNs, it may be observed that cities are often treated as being a single actor instead of the network of actors that they are. In order to learn from other city networks, it may be necessary to first identify development priorities together with local stakeholders. Only then, specific city alliances may be established where various professionals representing different organisations can mutually learn from one another. Such a content-based 'city-matching' methodologies are however hardly addressed in the literature on urban water governance, TMNs or C2C learning. Hence, we aim to address this knowledge gap by showing the potential of the City Blueprint Approach (CBA) for enhancing C2C learning. The CBA consists of the Trends and Pressures Framework (TPF) that identifies the main social, environmental, financial and governance challenges that may affect water management, the City Blueprint Framework (CBF) that assesses the city's water management performance, and the Governance Capacity Framework (GCF) that assesses the required capacities to govern water-related challenges (Koop and Van Leeuwen, 2020a, b, c) (Figure 1). Central to the paper is the following research question. In what way can the CBA methodology contribute to C2C learning and thus to better urban water management?

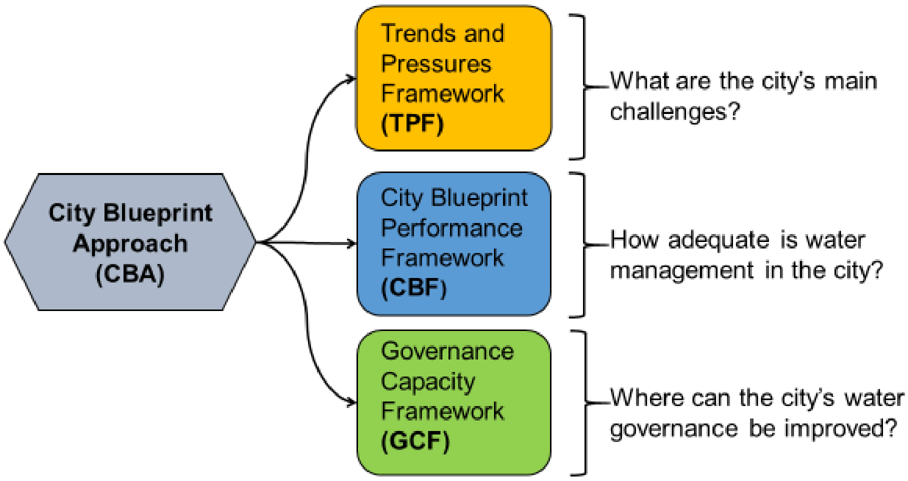

Figure 1 Overview of the City Blueprint Approach which consist of three separate but complementary assessment frameworks (Koop and Van Leeuwen, 2020a, b, c).

In order to answer this question, we first review literature on the potential role of TMNs for enhancing C2C learning and improving urban water management and policy. Next, section 3 clarifies the CBF as a city-matching methodology. Section 4, 5 and 6 illustrate how it can be used to improve water management in four cities – Leicester, Milton Keynes, Sabadell and Jerusalem. These cities have been selected as illustration cases because (i) they are actively seeking to seize C2C learning opportunities, (ii) they represent a diversity in water management foci and hydrological and socioeconomic contexts that is common of TMNs collaboration, and (iii) they are the key demonstration cities that have been engaged in the H2020 POWER-project (Political and sOcial awareness on Water EnviRonmental challenges) (https://www.power-h2020.eu/) which aims to strengthen digitally-supported citizen engagement in local urban water management and enhance the potential for comparison, benchmarking and ultimately learning between cities. The results of our application are provided in section 4 and 5 whereas section 6 provides for the discussion and section 7 for the conclusion.

2. The role of transnational municipal networks in C2C learning

Literature reveals that TMNs' added value is largely determined by their ability to provide tangible results for their members (Fünfgeld, 2015; Haupt et al., 2019). Such results may include the enhancement of lobby and bargaining powers. TMNs however could also offer learning opportunities by enabling the exchange of knowledge, experiences and good practises.

TMNs may strengthen lobby and bargaining powers of like-minded cities that aim to get issues (like climate adaptation) higher on political agendas. International high-profile TMNs like the C40 network are an example of this. Due to their size, they may be an easy access to decision-makers. They however lack enforcing bodies that can ensure compliance of member cities through common policies and guidelines. Regionally-oriented TMNs such as the Climate Alliance and Energy-Cities seem to be able to provide more incentives for members to develop a climate action plan than the international high-profile C40 network (Hakelberg, 2011). TMNs can also provide access to financial resources (Betsill and Bulkeley, 2004). By joining TMNs, cities may get access to first-hand information about funding opportunities and new legislation (Fünfgeld, 2015).

The learning opportunities that TMNs may offer are not restricted to possible funding opportunities or emerging legislation. Water governance may differ between different cities in a TMN. Within TMNs frontrunners and laggards may be found. Implementation of innovative policies generally requires larger administrative staffs and in-house expertise typically associated with larger and wealthier cities that can allocate the necessary resources (Collier, 1997; Mathy, 2007; Rashidi and Patt, 2018; Den Exter et al., 2014; Dannevig et al., 2012). Typically, these early adaptors or front-running cities are the ones that are strongly committed to TMNs (Hawkins et al., 2016; Krause, 2012) resulting in TMNs that are effectively becoming 'networks of pioneers for pioneers' (Kern and Bulkeley, 2009; Aall, 2012). Within the TMN, the frontrunners may offer learning opportunities by exchanging their knowledge, experiences and (good) practises. Based on these knowledge exchanges, benchmarking or certification systems can be developed. Cities regularly use such systems to improve their reputation and visibility. The latter may be helpful for attracting additional funding for existing projects or ambitions (Heinrichs et al., 2013).

Regional networks can be established around frontrunner cities that can share tailored solutions to their neighbouring cities (Den Exter et al., 2014) that face similar regulations, often speak the same language and can also strengthen each other with a coordinated approach for regional challenges such as a joint lobbying, monitoring, education and professional training programmes. In this way, smaller municipalities with limitations in staff and resources can benefit from the know-how of frontrunners.

Another more intimate option of C2C learning is twinning. Twinning is a form of collaboration between institutions that have largely similar tasks and responsibilities through a peer-to-peer exchange of staff (Bontenbal, 2013; Jones and Blunt, 1999). The personal exchange of like-minded professionals is an important C2C learning strategy especially in the context of long-distance collaboration (Johnson and Wilson, 2006; Bontenbal, 2013; Baud et al., 2010). Since most adult learning occurs at the workplace and is largely self-directed (Brookfield, 1987; Tough, 1971), the exchange of professionals is arguably more promising in changing work routines and organisational approaches than professional training or the exchange of only information. Such a twinning approach focuses on establishing personal relationships, constructive dialogue and trust which forms the basis for long-term mutual learning (Johnson and Wilson, 2006).

In both large or small size networks good urban water governance practises may be a source of inspiration for water governors in other cities. Mukhtarov (2014) for instance points at the travel of ideas like Integrated Water Resources Management across the globe. He stresses however that such a travel of ideas does not mean a (copy paste like) transfer of policies from one area to another, but that initial ideas serve as a source of inspiration for domestic political processes and will therefore be tailored – translated – to a particular context (see also Dolowitz and Marsh, 1996, 2012). Such a policy translation must therefore be understood as a "process of modification of policy ideas and creation of new meanings and designs in the process of cross-jurisdictional travel of policy ideas" (Mukhtarov, 2014, p. 6). Minkman et al. (2018) refer to several factors, such as transferability, process design and adoptability, that can have an influence on such translation processes.

So cities may be inspired by other cities' objectives, strategies, action plans, implementation, or monitoring and evaluation approaches. In order to learn or translate policies from another city to meet their own needs, cities however first have to get a holistic view on their water governance challenges, performance and capacities. Next they have to find comparable cities to learn from. The CBA can help them to structure these processes of C2C learning.

3. A city-matching methodology: the City Blueprint Approach

We argue that in general city-matching methodologies consist of four steps. First water-related performances and challenges have to be assessed. Next frontrunner cities must be identified that may offer learning opportunities. Third the frontrunner cities have to be further studied in order to find out what governance capacities are present. The latter form the starting point for the development of programmes for policy translation.

1 *Assess a city by identifying water-related performances & challenges*

Water governors that are willing to learn must first develop an understanding of the key-water related challenges of their city and how well they perform in addressing these challenges. The CBF can be used for this. This framework consists of 24 performance indicators that are divided over seven broad categories covering key components of urban water management: i. basic water services, ii. water quality, iii. wastewater treatment, iv. water infrastructure, v. solid waste, vi. climate adaptation, and vii. plans and actions (Koop and Van Leeuwen, 2020a, b, c) (see Figure 1). The indicators are scored from 0 (ample room for improvement) to 10 (high performance) and are scored through an indicator specific standardised scoring method that is available online: https://library.kwrwater.nl/publication/61397318/.

The scoring of the indicators is done in co-production with local stakeholder such as utilities, municipalities, regional water authorities and private stakeholders. In this way, the most accurate and timely information available is collected and early involvement of relevant stakeholders is guaranteed. The City Blueprint results are presented in a spider web (Figure 2) with a simple message that aims to facilitate strategic decision-making. The message is 'the bluer the better'. The geometric average of the 24 indicators provides an overall score named the Blue City Index or BCI.

At present, the method has been applied in 135 cities in 57 countries and published in academic papers (Koop et al., 2015a; 2015b; 2017; Koop et al., 2022) as well as through popular media such as the Urban Water Atlas for Europe (Gawlik et al., 2017).

2 *Find comparative cases to learn from*

The priorities identified by the application of the City Blueprint indicators may form the starting point to consult the database of 135 city assessments to find a match with another city that scores higher on particular indicators. Even the best performing cities such as Singapore, Seoul or Amsterdam, still show ample room for improvement in their indicator scores (e.g. Kim et al., 2018). However, when the highest CBF scores of each indicator for all cities assessed so far are plotted, a completely blue CBF spider diagram is obtained (see figure 2). This implies that for all indicators good practises can be found and that know-how, experiences and policy approaches are available. These good practices can serve as a source of inspiration for cities that want to improve their performances. As a first step some more insights in the frontrunners' good performance can be got by exploring the frontrunners' scores using data from retrieved by search engines like Google Scholar or Scopus.

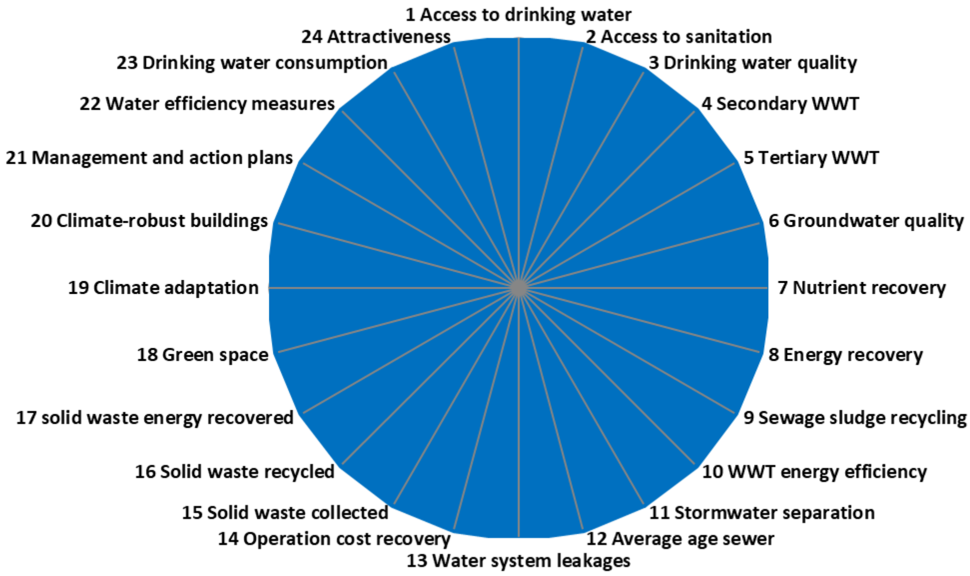

Figure 2 Best indicator scores of 135 cities for each of the 24 indicators of the City Blueprint Framework. It shows that for all indicators good practises can be identified for C2C learning.

3 Identify transferable lessons by assessing governance capacities

In a next step it must be found out why the best practice could have emerged. How have the frontrunners managed to get things done?' Which societal and institutional conditions were needed to make it happen? Akhmouch (2016) has stressed the importance of institutional conditions for water management in a clear statement. ""If you want to fix the water pipes, you must fix the institutions" and in line with this the OECD (2015a, b) states that water crises are mainly governance crises and refers to causes like institutional fragmentation, ambiguous legislation, poor implementation of multi-layered governance, as well as matters such as limited capacity at local level, unclear allocation of roles and responsibilities, fragmented financial management and uncertain allocation of resources. Often, long-term strategic plans and sufficient resources to be able to monitor performance and implementation are lacking, which leads to weak accountability and little transparency. These challenges tend to result from a lack of coordination between goals and a lack of steering of the interactions between relevant stakeholders. Plans are developed but , all in all, they do not add up to a clearly signposted route heading in a common sustainable direction (Romano and Akhmouch, 2019; Makarigakis and Jimenez-Cisneros, 2019). Frontrunner cities however have overcome these issues by developing good governance capacities.

So, in order to find more in-depth and more encompassing transferable lessons the existing governance capacities in the frontrunner cities must be analysed and explained. The dimensions, conditions and indicators of the GCF (Koop et al., 2017; Koop and Van Leeuwen, 2020c) can be used as an diagnostic tool for supporting this. Table 1 gives an overview of the GCF dimensions, conditions and indicators. The indicators are scored from very limiting,(1) to very encouraging (5)) for the overall capacity to govern water challenges.. In order to find out what is needed to implement a good practice (and what a learning city needs to improve) correlations can be sought between the good practice indicator and the capacity indicators shown in table 1. Capacity indicators that have a moderate or high positive correlation with the good practices indicator are relevant and need a more in-depth analysis. This selection of most positively correlated capacities can form a basis for more in-depth contextual learning and the translation of policies that enabled good practices in the frontrunner city. The correlations are based on a growing number of governance capacity assessments across the globe (n = 27 at present).

Table 1 The Governance Capacity Framework (Koop and Van Leeuwen, 2020a, b, c). Details about the meaning and scoring of the indicators can be found here: https://library.kwrwater.nl/publication/61397218/.

Dimensions	Conditions	Indicators
Knowing	**1 Awareness**	1.1 Community knowledge 1.2 Local sense of urgency 1.3 Behavioral internalization
	2 Useful knowledge	2.1 Information availability 2.2 Information transparency 2.3 Knowledge cohesion
	3 Continuous learning	3.1 Smart monitoring 3.2 Evaluation 3.3 Cross-stakeholder learning
Wanting	**4 Stakeholder engagement process**	4.1 Stakeholder inclusiveness 4.2 Protection of core values 4.3 Progress and variety of options
	5 Management ambition	5.1 Ambitious and realistic management 5.2 Discourse embedding 5.3 Management cohesion
	6 Agents of change	6.1 Entrepreneurial agents 6.2 Collaborative agents 6.3 Visionary agents
Enabling	**7 Multi-level network potential**	7.1 Room to maneuver 7.2 Clear division of responsibilities 7.3 Authority
	8 Financial viability	8.1 Affordability 8.2 Consumer willingness to pay 8.3 Financial continuation
	9 Implementing capacity	9.1 Policy instruments 9.2 Statutory compliance 9.3 Preparedness

4 Develop programmes for policy translation

Good practises and related capacity indicators from other cities might serve as a source of inspiration for urban water governors that want to perform better. We do not argue that a complete copy-pasting of the good practice will be an option, as local contexts may differ substantially (Mukhtarov, 2014). The good practice found elsewhere has to be tailored to deal with local peculiarities and capacities. By organising exchange programmes, a more in-depth understanding of the frontrunner's capacities and the possibility to translate them, can be identified.

The lessons learned from the frontrunner city can serve as inspiration and input in societal debates with important stakeholders at the municipal level. In these debates the lessons from elsewhere will be confronted with the local peculiarities and translated into new policy design options. Leading question in the deliberations that follow will be to what extent the identified success conditions are already present in the municipality, which are lacking and what leverage points can be identified in order to change things for the better. This asks for an in-depth analysis of the local situation for which the indicators of table 2 can be used.

For getting societal acceptance of the design it is important to involve relevant stakeholders early on in this process (OECD, 2015a,b; Koop et al., 2017; Romano and Akhmouch, 2019). In this way "water-only" or "water-smart" discussions that overlook other policy challenges in cities can be avoided and options for co-creation and effective and efficient win-win solutions can be found (Koop and Van Leeuwen, 2017). Last but not least, the general public must be involved. This can be done by organising hearings, referenda or by using online platforms (Mukhtarov et al., 2018). Melbourne and Rotterdam offer good practises for online public participation.

Finally for the actual implementation, a tender procedure may be organised which creates competition between potential implementing agencies. The best offer will be selected and turned into the final policy and technological design.

In section 4, 5 and 6, we illustrate how this can work out in practice.

4. Step 1 & 2: The identification of key challenges and learning cases in four cities

Table 2 summarises the results of the CBF analyses of urban water governance of the cities of Leicester and Milton Keynes (United Kingdom), Jerusalem (Israel) and Sabadell (Spain).

Table 2 City Blueprint indicator scores for the cities of Leicester (Lei) in the United Kingdom (UK), Milton Keynes (Mil) in the UK, Jerusalem (Jer) in Israel and Sabadell (Sab) in Spain (Source: Koop and Van Leeuwen, 2019).

Category	Indicator	Lei	Mil	Jer	Sab
I Basic water services	1 Access to drinking water	10.0	10.0	10.0	10.0
	2 Access to sanitation	10.0	9.9	9.9	10.0
	3 Drinking water quality	10.0	9.9	10.0	10.0
II Water quality	4 Secondary WWT	10.0	9.9	9.0	8.7
	5 Tertiary WWT	5.0	9.9	5.0	6.8
	6 Groundwater quality	6.0	10.0	5.0	6.9
III Wastewater treatment	7 Nutrient recovery	4.5	0.0	8.2	0.0
	8 Energy recovery	1.0	0.3	7.0	1.0
	9 Sewage sludge recycling	8.6	10.0	8.2	8.7
	10 WWT energy efficiency	8.0	10.0	9.0	4.0
IV Water infrastructure	11 Stormwater separation	0.0	5.0	10.0	0.0
	12 Average age sewer	2.0	4.0	7.4	0.0
	13 Water system leakages	5.1	7.8	7.5	6.2
	14 Operation cost recovery	7.4	5.3	4.1	1.9
V Solid waste	15 Solid waste collected	3.6	2.9	1.4	3.0
	16 Solid waste recycled	6.4	5.6	1.4	3.7
	17 solid waste energy recovered	4.5	5.4	0.0	1.5
VI Climate adaptation	18 Green space	2.0	10.0	1.3	3.8
	19 Climate adaptation	9.0	10.0	10.0	6.0
	20 Climate-robust buildings	8.0	10.0	9.0	7.0
VII Plans and actions	21 Management and action plans	8.0	10.0	10.0	7.0
	22 Water efficiency measures	6.0	10.0	10.0	4.0
	23 Drinking water consumption	7.9	9.9	9.4	10.0

	24 Attractiveness	4.0	10.0	9.0	4.0
Blue City Index (BCI)		**5.3**	**6.7**	**6.1**	**4.0**

Table 2 shows that none of the four cities has got the maximum BCI score of 10. For some indicators however maximum scores are given. The table also shows that each city performs far from optimal on particular indicators (0-2 points). For these priorities that need to be strengthened, improvement options can be elaborated based on other cities in the world that have excellent performance scores on the priority indicators (8-10 points). By screening the 125 cities in the CBF database, it was possible to identify forerunner city's that can serve as a source of inspiration. Table 2 shows what cities could serve as sources of inspiration for the improvement of urban water management in each of the four cases. Some additional desk research has been conducted to further explore the high scores of the frontrunner cities.

Table 3 Overview of water governance improvement options for the four case studies.

City	Improvement Options	Forerunner network cities	Best practices
Leicester	Improving stormwater separation & increasing green space	Melbourne Amsterdam Malmö	Stormwater is separately collected. Comprehensive stormwater harvesting schemes where stormwater is collected, treated and used to irrigate gardens, sport fields or public parks. Green roofs that create green space, have a cooling impact, enhance biodiversity and store the stormwater (Van Leeuwen, 2017; Van der Hoek et al., 2014; Kruuse and Verchou, 2005)
Milton Keynes	Improving nutrient and energy recovery from waste water	Amsterdam	Biogas installation for sewage sludge. Local heating system using waste water and production of struvite which can be used to produce fertilisers (Van der Hoek et al., 2016)
Jerusalem	Improving solid waste recycling and energy recovery from solid waste	Copenhagen Oslo Stockholm	Prevention, preparing for reuse, recycling, other recovery and disposal approach for solid waste treatment (City of Copenhagen, 2014). Campaigns for waste reduction and separation (Luccarelli and Røe, 2013). Efficient biogas and bio-fertiliser production from separately collected food waste (Scandinavian Biogas, n.d.)
Sabadell	Strengthening public participation Minimising the average age of the sewer	Rotterdam Melbourne Amsterdam	Citizen's jury to make recommendations about the 10 Year Financial Plan to address climate change and promote long-term liveability, including new strategies for waste management and recycling, drainage, tree coverage and adoption of new technologies (Dean et al., 2016).

			Real-time sewer control system and multi-value creation and multi-benefit planning for long-term sewer refurbishment plans (Van der Hoek et al., 2014)

4.1 Leicester

In Leicester, a city with approximately 330,000 residents (ONS, 2011a), the performances on stormwater separation and green space could be strengthened to minimise flood risk in cases of downpours and to improve urban water quality. In cases of downpours, sewers have to process so much water in a short time that they overflow. As a result dirty sewage is discharged into the surface water. By disconnecting stormwater from the waste water sewer, peak volumes in the sanitary sewers will decrease. Consequently, wastewater treatment plants will perform better and rainwater can be infiltrated into the soil and thus supplement groundwater.

If we check the City Blueprint database we see that both Melbourne and Amsterdam score high on the priority indicators and therefore could serve as good practises in stormwater separation (Van Leeuwen, 2017; Van der Hoek et al., 2014). In Melbourne, the State Government of Victoria together with the local water supplier “Melbourne Water” have developed a “Stormwater Strategy”. As a result of this urban stormwater is collected and treated to irrigate gardens, sport fields and golf courses (State Government of Victoria, 2021). The percentage of households with a rainwater harvesting tank also increased substantially. With advanced water storage control systems based on storage monitoring and weather forecasts, rainwater can be optimally used to mitigate drought and flatten peak water demands. Amsterdam is pioneering with a strategy that combines flood adaptation with infrastructural renovations and with measures to reduce heat stress, air pollution or water issues as a result of extreme precipitation (Koop et al., 2018; Dai et al., 2018). Amsterdam is implementing a real-time sewer control system that optimises the storage capacity of the sewer to ensure a constant flow to the wastewater treatment plant (De Korte et al., 2009). Moreover, new gutters and storm water collection systems are constructed to temporarily store rainwater (Van der Hoek et al., 2014). In Amsterdam’s new neighbourhoods, rainwater and waste water flows are separated (Waternet, n.d.). On the online platform “Amsterdam Rainproof”, ideas, initiatives and information on how to make Amsterdam rainproof are shared.

The implementation of Urban Green Infrastructure (UGI), e.g. parks, green roofs as well as blue and green spaces can make a significant contribution to reduce stormwater runoff (Zimmermann et al., 2016; EEA, 2012), facilitate temperature reductions in cities while delivering co-benefits such as pollution alleviation and biodiversity (Norton et al., 2014). In order to achieve a certain amount of green space and to minimise sealed areas, the city of Malmö uses a “green space factor’’. Different types of surfaces are given credits. No credits are given to sealed surfaces, whereas plant beds, climbing plants, green roofs and ponds get high credits (Kruuse and Verchou, 2005). Developers can use the tool for calculating green space requirements for new developments (Lehner, 2017). To educate people about green roofs, guided tours and in-depth technical visits are organised. The rooftops in the Augustenborg Botanical Garden contain more than 20 vegetated areas with “inspiration gardens for urban farming and biodiversity” (SGRI, n.d.).

4.2 Milton Keynes

Milton Keynes is a relatively new city with approximately 249,000 inhabitants which is expected to increase considerably in the future (ONS, 2011b). Despite its high BCI score energy and nutrient recovery from waste water remain as Milton Keynes’ main water governance challenges. Wastewater has for a long time been considered a human health concern and environmental hazard, but the paradigm is shifting towards a proactive interest in recovering nutrients and energy from waste water. Nutrients especially phosphorus and potassium are finite resources and will become increasingly expensive and more difficult to mine (Cordell and White, 2011; EC, 2014). Zeeman (n.d.) calculated that recovering phosphates from black and grey water could satisfy “a quarter of the present worldwide artificial phosphorus fertiliser use". Nutrient recovery is also beneficial for decreasing surface water pollution. Subsequently, treated waste water can be reused for various purposes which in turn can provide ecological benefits, reduce the demand of potable water and augment water supplies (Van der Hoek et al., 2016). The reuse of nutrients can either be done by using the sewage sludge as fertiliser on agricultural land or by producing struvite (a phosphate mineral) from wastewater (Van Leeuwen et al., 2018).

Amsterdam could serve as a source of inspiration for Milton Keynes as it has adopted the circular city concept and has specified it in documents like the "Sustainability Agenda Amsterdam" (Waternet, 2016). Recovery of resources and materials is one of the targets mentioned in this document. Waternet, Amsterdam's public water utility has invested in the recovery of resources from the city's waste water (Van der Hoek et al., 2016). Waternet produces 13 million m^3 biogas per year at 12 wastewater treatment plants. This biogas is used to heat Waternet's buildings, in the sludge digestion process at the treatment plant. Most of it (80%) is distributed to households or used as fuel for company cars (van der Hoek et al., 2016). Waternet has also developed an installation (called "Fosvaatje") for recovering struvite. Fosvaatje is one of the pilot projects of the "Energy and Raw Material Factory" program, in which regional water authorities, businesses and universities try to boost innovation and explore new markets for the recovered materials (Van Leeuwen et al., 2018).The installation produces 2,500 kilos of struvite per day (enough for the annual fertilisation of 10,000 football fields) (De Jong, 2017; Nutrient Platform, n.d.). Waternet is also actively exploring the possibilities of thermal energy in the Buiksloterham district. By linking heat exchanger to a heat-cold storage at each household or apartment block, heat is extracted from greywater and transported back to the households for reuse. Furthermore, a bio-refinery is developed within this district which is a small-scale treatment unit in which materials and energy can be recovered from black waste water (Waternet, 2019).

4.3 Jerusalem

Jerusalem (882,700 residents (JIPR, 2018) is situated in a dry climate. The city has a low score on indicators related to green space and indicators related to solid waste. The per capita waste production is relatively high, whereas the recycling of waste is low and there is no energy recovered from the collected solid waste. Issues related to solid waste - air, water and soil contamination (Rahmasary et al., 2020) - form a key point for improvement. For addressing these challenges the city may find inspiration in Copenhagen, Oslo and Malmö.

Copenhagen sends less than 2% of waste to landfills. Approximately 60% of the waste is recycled and maximum use is made of residual waste to generate heat for the city's district heating network. The city has six local recycling hubs (City of Copenhagen, 2014). All households separate recyclable waste like paper, cardboard, metal, rigid plastic, hazardous waste, glass and electronic waste. Bulky waste and garden waste can be collected from the households by agreement with the municipality or be delivered at the recycling stations (Urban Waste, n.d.). The international demand for Danish waste solutions is growing (Copenhagen Capacity, 2012).

In 2006, Oslo established the "Waste Management Strategy towards 2025". This strategy sets ambitious goals linked to a circular economy (EC, n.d.). The strategy mainly focuses on waste reduction, reuse and recycling and is considered to be inspirational as the European Commission has awarded Oslo the European Green Capital 2019 title (City of Oslo, 2019). In Oslo (and Norway at large) landfills are prohibited since 2009. Household waste is separated at source and collected accordingly in order to get homogenous waste streams which can be better recycled. A green bag is used for food waste, a blue bag is used for plastic waste, and a white bin is used for paper and cardboard; whereas there are also separate containers for other waste including glass, fabric, electronic and hazardous waste (City of Oslo, n.d.; Ruhm, 2016). In the world's biggest optic sorting plant the various coloured bags are separated by means of optic recognition. In order to support waste separation Oslo has initiated several awareness raising activities including advertising campaigns in media and public spaces, involving celebrities and door-to-door campaigns. The City of Oslo is also considering sanctioning housing cooperatives if waste separation rates are low (EU, n.d.). Waste handling is fully financed by citizens, the "pay as you throw" principle is applied as household charges depend on the bin size, beginning at 443 Euros per year for 140 litre bins with weekly collection.

Collected waste is recycled. Garden waste is composted and sold to citizens as soil for their gardens. Oslo also has its own biogas plant, which can process 50,000 tonnes of biological substances into biogas and bio-fertilisers. Biogas is used as fuel by buses and garbage collection trucks in the city, while the bio-fertilisers are used by farmers to produce food (Luccarelli and Røe, 2013; EU, n.d.).

Sweden recovers more energy from each tonne of waste than any other country (SCS, n.d.). In Stockholm landfills are almost non-existent. Most of the household waste is incinerated. The City is ambitious its "Waste Management Plan" for 2017-2020 since one of the objectives mentioned in this plan is that at least 70% of food waste is to be collected for biogas production and nutrient recovery (Stockholm Vatten och Avfall, n.d.). In 2015, a new plant was taken into operation for the digestion of food waste in Stockholm. On an annual basis the plant can convert 50,000 tonnes of food waste into biogas and biofertilizer (Scandinavian Biogas, n.d.), approximately one third of all food waste created in Stockholm. The plant has a capacity of 80 GWh biogas which equalises 8.8 million litres of petrol. Moreover, approximately 14,000 tonnes of bio-fertiliser can be generated every year (ibid).

4.4 Sabadell

Sabadell (211,000 residents, GENCAT, 2018) faces several challenges including stormwater separation, a high average age of the sewer, energy and nutrient recovery and public participation. Here we will focus on best practices concerning the average age of the sewer and in public participation.

Sabadell's sewage infrastructure is old. Degradation of the city's sewer pipes can lead to seepage of eroded fine particles to the surrounding soil which may lead to pipe cracking and groundwater pollution. Water losses can amount up to 19.4% (Šteflová et al., 2018). Amsterdam has an extensive sewage system (1,658 km) which functionality is tested on a regular basis. As said before Amsterdam aims to separate stormwater from waste water. New gutters and stormwater collection systems are constructed to temporarily store rainwater (Van der Hoek et al., 2014). Amsterdam is also implementing a real-time sewer control system that optimises the storage capacity of the sewer to ensure a constant flow to the wastewater treatment plant (De Korte et al., 2009). In order to make the sewage infrastructure more resilient and sustainable, the local water utility Waternet has set out various objectives in the "Municipal Sewage Plan Amsterdam" (Waternet, 2016).

For improving its performance on public participation Sabadell may find inspiration in Melbourne or Rotterdam. In Melbourne public participation is considered an essential part of planning projects and decision making. The City of Melbourne has developed the platform "Participate Melbourne" where people can sign up and join the conversation to influence the plans like the "City River Strategy". Such participation guides the Council's future planning of the inner section of the river. Citizens can provide feedback by attending an in-person meeting, completing an online survey and by submitting an idea to the Ideas Forum. All ideas submitted are publicly displayed and citizens can like the ideas that they support (City of Melbourne, 2019). In 2014, the City of Melbourne implemented a citizen's jury to make recommendations about its 10 Year Financial Plan. The jury provided recommendations to address climate change and promote long-term liveability, including new strategies for waste management and recycling, drainage, tree coverage and the adoption of new technologies. Evaluations showed that jury members supported greater citizen involvement in policy making. Moreover, increased levels of trust and confidence in the Council were reported, as well as a greater satisfaction with future plans for the city of Melbourne (Dean et al., 2016).

Public participation is very much embedded in Rotterdam's decision-making processes. There are multiple networking initiatives to share opinions and ideas, such as "Blue City". This initiative focuses on the idea of circular entrepreneurship and the circular economy, and gives start-ups space, guidance and a network. There are also citizen initiatives in Rotterdam, including the citizen jury. This 150 members strong jury provides the municipality with recommendations twice a year. In cases of neighbourhood changes a process of public participation always takes place (City of Rotterdam, n.d.).

5. Step 3 & 4: The identification of transferable lessons and the development of programmes for policy translation

In the previous section we have shown have cities can find learning opportunities by identifying frontrunner cities they can learn from. In this section we will illustrate how the governance capacity indicators can be used to identify more in-depth transferable lessons. This will be done for improving solid waste recycling and energy recovery from solid waste, which is an important challenge for Jerusalem.

So far the governance capacities for 27 cities have been assessed. As a result we are able to show that there is a correlation between solid waste recycling and energy recovery and the overall governance capacity score capacity – the Governance Capacity Index. Advanced waste management tends to coincide with higher levels of governance capacity. A more in-depth analysis provides insights into the governance capacity indicators that correlate with advanced waste recycling and energy recovery. Although these correlations are not proven to be causal, they are an important pointer for determining transferable lessons and C2C learning strategies. Figure 3 shows six indicators from the GCF that correlate most with both indicators.

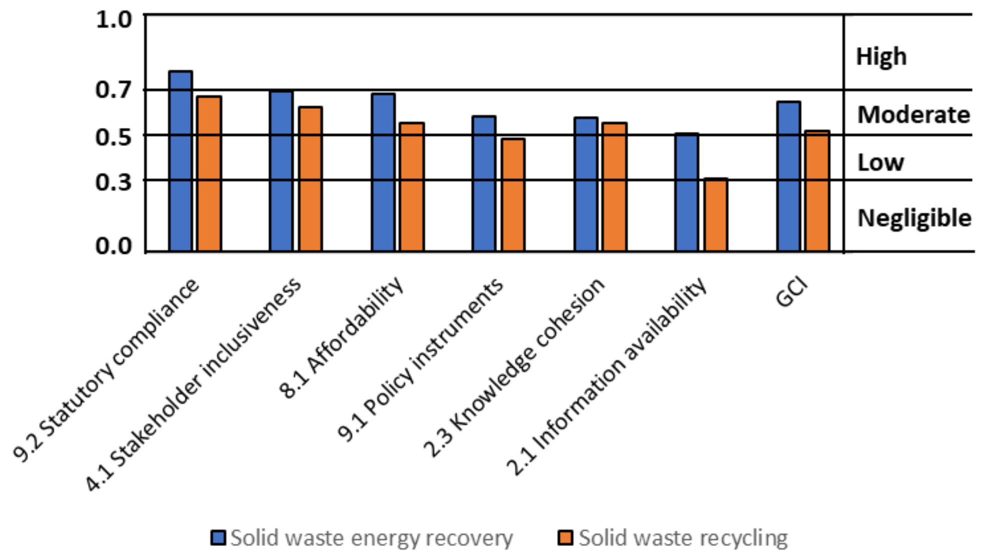

Figure 3 Governance capacity indicators with the highest correlation with solid waste energy recovery and solid waste recycling based on 27 city assessments[1]. The numbers of the indicators refer to their listing in table 1.

[1] The 27 cities used to explore the correlation between governance capacity and the recycling and energy recovery of solid waste are Ahmedabad (Aartsen et al., 2018), Amsterdam, Rotterdam, Utrecht (Koop et al., 2017; Brockhoff et al., 2019), Antofagasta (Šteflová et al., 2021), Bandung (Rahmasary et al., 2020), Cape Town and Durban (Madonsela et al., 2019), Cork, Jerusalem. Lagos, Leicester, Milton Keynes (Koop et al., 2018), Libreville, Lusaka, Melbourne, New York City, (Feingold et al., 2018), Quito (Schreurs et al., 2018), Sabadell (Šteflová et al., 2018), Rio de Janeiro (Okumura et al., 2021), Seoul (Kim et al., 2018), Seville, Taipei (Rahmasary et al., 2019), Tianjin (Chang et al., 2020), Toronto, Ulaantaabar (Munkhsuld et al., 2020) and Windhoek.

Figure 3 shows that advanced waste recycling and energy recovery turn out to be associated with statutory compliance, stakeholder inclusiveness, affordability and knowledge. By outlining what these indicators entail we can identify pointers to focus on for a more in-depth C2C-learning.

Statutory compliance
The extent that legislation and compliance is well-coordinated, clear and transparent, and that stakeholders respect agreements, objectives, and legislation seems to be an important for both energy recovery from solid waste and waste recycling.

Stakeholder inclusiveness
The level of interaction with all relevant stakeholders in the decision-making process – ranging from

being only merely informed, stakeholder consultation up to having the opportunity to be actively involvement correlates with solid waste recycling and energy recovery. More active stakeholder engagement coincided with more waste recycling and energy recovery. An active engagement of stakeholders is an important conditions for setting up a separate collection and in turn recycling of both industrial and domestic solid waste.

Affordability
Availability and affordability of waste management services shows to be moderately correlated with both indicators too. Affordability issues particularly limit waste recycling and energy recovery in poorer cities like Ahmedabad (Aartsen et al., 2018), Bandung (Rahmasary et al., 2020) or Naivasha (Ddiba et al., 2020). In some cases, the tariffs of waste collection are kept low to ensure a larger service coverage. However, these low tariffs limit investments in waste separation and treatment infrastructure. Thus, our data indicates that affordability can be understood as a precondition for implementing more advanced waste recycling and energy recovery.

Policy instruments

Presumably, compliance with legislation is achieved through the effective use of policy instruments. Indeed, the use of advanced policy instruments such as price incentives, permits and quality requirements for solid waste collection and treatment correlates with the actual level of recycling and energy recovery practices. These correlations emphasize the important role of policy implementation.

Knowledge cohesion and information availability
Last but not least, the role of knowledge and information coincides with higher levels of waste recycling and energy recovery. Especially, the extent that the use, production and sharing of information from different sources is cohesive is important. Different methods are used and an integration of short-term targets and long-term goals amongst different policy fields and stakeholders can be found. For waste recycling, the cohesion of knowledge can be decisive in identifying new resources, applications and markets.

For a city such as Jerusalem that may want to improve its solid waste recycling and energy recovery, these indicators can form key foci in their C2C learning efforts and policy translation to their own context. The indicators must be used in a more in-depth studies to figure out how they are manifest in (one of) the frontrunner cities Copenhagen, Oslo or Stockholm. Exchange programs must be set up and in-depth reporting on the capacities of the frontrunners must be organized. These reports can provide inputs for the multi-stakeholder discussions to be started in Jerusalem. The ideas that result from matching activities however are no panaceas but must be tailored in order to deal with local particularities and context factors of the city that wants to learn.

6. Discussion

Transnational Municipal Networks are often being criticised for their focus on sharing of information instead actually achieving professional learning (Haupt et al., 2019). In order to overcome such barriers, good diagnoses of water governance performance and underlying capacities are critical in creating advantageous conditions for mutual C2C learning between experts and decision-makers.

So, successful C2C learning starts with knowing what to learn. Here the CBF may help by providing benchmarks and showing improvement options that are already realised in other cities. Cities that score high on the practices that a city would like to improve form an important pool for more meaningful C2C learning. Next, understanding what capacities are associated with these good practices is important in order to focus learning activities beyond exchanging general experience or technologies. The limited number of cities for which a governance capacity analysis has been done (n = 27) does not allow to identify significant correlations and moreover if these correlations would be significant they are not proven to be causal relations. Hence, the proposed approach is only meant as a supportive exercise for strengthening contextual learning. The alternative would be to rely on anecdotal information only. Although anecdotical information can be valuable, we think that it is essential to bring a bit more focus to strategic learning processes. Empirically-based diagnoses based on the CBA can support this effort.

Literature however reveals that cities not always focus on frontrunners as partners for a initiating a learning alliance. Other factors are also relevant in the selection of partners. Practical factors such as language, logistics and similarities in social, economic or environmental contexts play an important role in determining from who to learn in what way. Particularly, compliance to similar legislation and policies, increased access to joint funding sources(getting access to first-hand information about funding opportunities) as well as allocating the resources to exchange personnel and collaborate in long-term programmes seems to play a key role (e.g. Bontenbal, 2013; Fünfgeld, 2015; Betsill and Bulkeley, 2004).

Some authors suggest that particularly regional C2C learning programmes seem to be most promising for multi-level learning because they can build on already existing networks, do not face substantial logistical or financial barriers and need to align with similar policy requirements and contextual conditions (Bontenbal, 2013; Fünfgeld, 2015; Betsill and Bulkeley, 2004). Long-distance exchange programmes can also be established, particularly between frontrunning cities that have sufficient resources and are primarily interested in expanding their already advanced practices by collaborating with other frontrunners (Betsill and Bulkeley, 2004). Twinning of cities may occur for this. Long distance learning programmes may also be set up in the context of aid programmes. For such exchange programmes to succeed, long-term exchange of personnel seems to be key as well as establishing clear mutual expectations (Bontenbal, 2013).

The approach outlined in this paper may sound appealing but can also be criticised as being too rational and forward-looking. In many real world cases the policy focus is short-term based on the political life cycle and not proportional to the life cycle of people or the life cycle of cities (Koop and Van Leeuwen, 2017). Practice also teaches that changes in urban water management often take place after shock events like a storm (New York; Feingold et al., 2018), water scarcity (Melbourne and Cape Town; Van Leeuwen, 2017; Madonsela et al., 2019), urban heat incidents (Aartsen et al., 2018) took place. In our opinion however, urban water governance is of such a high importance that more proactive approaches are needed in which C2C learning can play an important role.

7. Concluding remarks

In this paper we have shown and illustrated how the CBP-approach can contribute positively to city-to-city (C2C) learning and thus to better urban water management. Four steps must be taken to apply the CBP-approach to enable C2C learning. Cities first must identify their water related performances and challenges. The CBF-approach is helpful for doing this and for the identification of frontrunner cities from which other cities can learn. After having identified these frontrunner cities an in-depth study of the frontrunner's capacities can be undertaken by focusing on capacity indicators that have been found to correlate with the key challenges. Next in-depth learning must be organised and facilitated by the development of exchange programmes. The lessons learned however have to be translated to deal with local peculiarities of the city that wants to improve performance. Multi-stakeholder dialogs must be set up to do this.

Large open-access data bases – like the CBA - can be used as a starting point for identifying improvement options and city matching options. International city networks can play a role in this if they set up network secretariats that actively facilitate such a city-matching approach and support the development of (long term) exchange programs. However, the cities also have an active role to play by investing time, resources and expertise.

The City Blue Print approach is now based on 51 indicators which we believe are key in understanding urban water governance challenges. However, our selection can be criticized. We therefore invite other researchers to do so and to revise or complement our set of indicators. In this way they can contribute to a further enabling of C2C learning and a better urban water management.

References

Aall, C., 2012. The early experiences of local climate change adaptation in Norwegian compared with that of local environmental policy, Local Agenda 21 and local climate change mitigation. Local Environ. 17, 579-595.

Aartsen, M., Koop, S.H.A., Hegger, D.L.T., Goswami, B., Oost, J., Van Leeuwen, C.J., 2018. Towards meaningful science-policy interaction: Lessons from a systematic water governance analysis in the city of Ahmedabad, India Regional Environmental Change 18, 2445–2457.

Akhmouch, A., 2016. Before fixing the urban water pipes, fix the institutions. Water Conference Leeuwarden, the Netherlands. https://www.dutchwatersector.com/news/cities-water-conference-before-fixing-the-urban-water-pipes-fix-the-institutions [Accessed 11-10-2021]

Baud, I., Hordijk, M., Van Lindert, P., Nijenhuis, G., Van Western, G., Van Ewijk, E., Bontenbal, M., 2010. Towards improved local governance through strengthened local government – Evaluation of the LOGO South Programme. Den Haag: VNG International

Betsill, M.M., Bulkeley, H., 2004. Transnational networks and global environmental governance: the cities for climate protection program. Int. Stud. Q 48, 471-493.

Bontenbal, M., 2013. Differences in learning practices and values in North-south city partnerships: towards a broader understanding of mutuality. Public Admin. Dev. 33, 85-100.

Brockhoff, R.C., Koop, S.H.A., Snel, K.A.W., 2019. Pluvial Flooding in Utrecht: On Its Way to a Flood-Proof City. Water 11, 1501.

Brookfield, S.D., 1987. Understanding and facilitating adult learning. A comprehensive analysis of principles and effective practices. Open University Press, Milton Keynes, United Kingdom.

Castanho, R.A., 2019. Identifying Processes of Smart Planning, Governance and Management in European Border Cities. Learning from City-to-City Cooperation (C2C). Sustainability, 11, 5476.

Chang, I.S., Zhao, m., Chen, Y., Guo, X., Zhu, Y., Wu, J., Yuan, T., 2020. Evaluation on the integrated water resources management in China's major cities – Based on City Blueprint® Approach. Journal of Cleaner Production 262, 121410.

City of Copenhagen, 2014. *Resource and Waste Management Plan 2018.* Copenhagen: City of Copenhagen.

City of Oslo. (n.d.). Waste and recycling statistics. https://www.oslo.kommune.no/english/politics-and-administration/statistics/environment-status/waste-and-recycling-statistics/#toc-1 [Accessed 11-10-2021].

City of Oslo. 2019. Oslo European Green Capital 2019. https://www.greencapital2019.com/ [Accessed 11-10-2021].

City of Melbourne. (2019). Participate Melbourne. Retrieved June 19, 2019, from https://participate.melbourne.vic.gov.au/about

City of Rotterdam. (n.d.). Meedenken en meedoen. https://www.rotterdam.nl/wonen-leven/participatie/ [Accessed 11-10-2021].

Collier, U., 1997. Local authorities and climate protection in the European Union: putting subsidiarity into practice? Local Environ. 2, 39-57.

Copenhagen Capacity. 2012. Danish waste could become new export bonanza. http://www.copcap.com/press-room/press-archive/danish-waste-could-become-new-export-bonanza [Accessed 11-10-2021].

Cordell, D., White, S., 2011. Peak phosphorus: clarifying the key issues of a vigorous debate about long- term phosphorus security. Sustainability, 3, 2027–2049.

Dai, L., Wörner, R., van Rijswick, H.F.M.W., 2018. Rainproof cities in the Netherlands: approaches in Dutch water governance to climate-adaptive urban planning. Int J Water Resour. D 34, 13600648.

Dannevig, H., Rauken, T., Hovelsrud, G., 2012. Implementing adaptation to climate change at the local level. Local Environ. 17, 597-611.

Ddiba, D., Andersson, K., Koop, S.H.A., Ekener, E., Finnveden, G., Dickin, S., 2020. Governing the circular economy: Assessing the capacity to implement resource-oriented sanitation and waste management systems in low- and middle-income countries. Earth System Governance 4, 100063.

Dean, A.J., Fielding, K.S., Ross, H., Newton, F., 2016. Community engagement in the water sector: an outcome-focused review of different engagement approaches. Melbourne: Cooperative Research Centre for Water Sensitive Cities.

De Jong, R., 2017. Governance of phosphate recovery from wastewater in Amsterdam. Amsterdam: University of Amsterdam.

De Korte, K., Van Beest, D., Van Der Plaat, M., De Graaf, E., Schaart, N., 2009. RTC simulations on large branched sewer systems with SmaRTControl. Water Science & Technology, 60, 475-482.

Den Exter, R., Lenhart, J., Kern, K., 2014. Governing climate change in Dutch cities: anchoring local climate strategies in organization, policy and practical implementation. Local Environ. 9, 1062-1080.

Dolowitz, D., Marsh, D., 1996. Who learns what from whom: a review of the policy transfer literature. Political studies, 44, 343-357.

Dolowitz, D.P., Marsh, D., 2000. Learning from abroad: the role of policy transfer in contemporary policy-making. Governance: An International Journal of Policy and Administration 13, 5-24.

Dolowitz, D.P., Marsh, D., 2012. The future of policy transfer research. Political studies review, 10, 339-345.

EC., 2014. European Commission: The European critical raw materials review. MEMO/14/377 26/05/2014. http://europa.eu/rapid/press-release_MEMO-14-377_en.htm [21-12-2021].

EEA., 2012. European Environment Agency: Urban adaptation to climate change in Europe: Challenges and opportunities for cities together with supportive national and European Policies. *(EEA Report 2/2012).* Copenhagen: European Environment Agency.

EU. (n.d.). Oslo takes an integrated approach to treat waste into circular bio-resources. https://circulareconomy.europa.eu/platform/en/good-practices/oslo-takes-integrated- approach-treat-waste-circular-bio-resources [21-12-2021].

Feingold, D., Koop, S., Van Leeuwen, K., 2018. The City Blueprint Approach: Urban Water Management and Governance in Cities in the U.S. Environ. Manage. 61, 9–23.

Fünfgeld, H., 2015. Facilitating local climate change adaptation through transnational municipal networks. Environ. Susain. 12, 67-73.

Gawlik, B.M., Easton, P., Koop, S.H.A., Van Leeuwen, C.J., Elelman, R., 2017. Urban Water Atlas for Europe. European Commission, Publication Office of the European Union, Luxembourg.

GENCAT. 2018. Sabadell. https://www.idescat.cat/emex/?id=081878&lang=en [21-12-2021].

Hakelberg, L., 2011. Governing Climate Change by Diffusion, Transnational Municipal Networks as Catalysts of Policy Spread. Forschungszentrum Für Umweltpolitik, Freie Universitaet Berlin, FFU-Report 08-2011.

Haupt, W., Chelleri, L., Van Herk, S., Zevenbergen, C., 2019. City-to-city learning within climate city networks: definition, significance and challenges from a global perspective. International Journal of Urban Sustainable Development, DOI: 10.1080/19463138.2019.1691007.

Hawkins, C.V., Krause, R.M., Feiock, R.C., Curley, C., 2016. Making meaningful commitments: Accounting for variation in cities' investments of staff and fiscal resources to sustainability. Urban stud. 53, 1902-1924.

Heinrichs, D., Krellenberg, K., Fragkias, M., 2013. Urban responses to climate change: theories and governance practice in cities of the global south. Int. J Urban Reg. Res. 37, 1865-1878.

JIPR. 2018. Statistical Yearbook of Jerusalem. https://jerusaleminstitute.org.il/en/yearbook/#/147/8254 [21-12-2021].

Johnson, H., Wilson, G., 2006. North-south/South –north partnerships: closing the 'mutuality gap' Public Admin. Dev. 26, 71-80.

Jones, M.L., Blunt, P., 1999. 'Twinning' as a method of sustainable institutional capacity building. Public Admin. Dev. 19, 381-402.

Jong, R. De., 2017. Governance of phosphate recovery from wastewater in Amsterdam. Amsterdam: University of Amsterdam.

Kern, K., Bulkeley, H., 2009. Cities, Europeanization and Multi-level Governance; Governing Climate Change through Transnational Municipal Networks. JCMS 47, 309-332.

Kim, H., Son, J., Lee, S., Koop, S., Van Leeuwen, K., Choi, Y.J., Park, J., 2018. Assessing Urban Water Management Sustainability of a Megacity: Case Study of Seoul, South Korea. Water 10, 682.

Koop S.H.A., Van Leeuwen, C.J., 2015a. Assessment of the sustainability of water resources management: A critical review of the City Blueprint approach. Water Resour. Manag. 29, 5649–5670.

Koop, S.H.A., Van Leeuwen, C.J., 2015b. Application of the improved city blueprint framework in 45 municipalities and regions. Water Resour. Manage. 29, 4629–4647.

Koop, S.H.A., Van Leeuwen, C.J., 2017. The challenges of water, waste and climate change in cities. Environ. Dev. Sustain. 19, 385–418.

Koop, S.H.A., Koetsier, L., Doornhof, A., Reinstra, O., Van Leeuwen, C.J., Brouwer, S., Dieperink, C., Driessen, P.P.J., 2017. Assessing the governance capacity of cities to address challenges of water, waste, and climate change. Water Resour. Manage. 31, 3427-3443.

Koop, S.H.A., Monteiro Gomes, F., Schoot, L., Dieperink, C., Driessen, P.P.J., Van Leeuwen, C.J., 2018. Assessing the capacity to govern flood risk in cities and the role of contextual factors. Sustainability 10, 2869.

Koop, S.H.A., Van Leeuwen, C.J., 2019. Trends, pressures and performance of UWCS in lead and partner cities. Political and sOcial awareness on Water EnvirRonmental challenges – POWER project deliverable 4.5, https://dspace.library.uu.nl/handle/1874/389709/ [Accessed 10-11-2021].

Koop S.H.A., Van Leeuwen C.J. 2020a. Indicators of the Trends and Pressures Framework (TPF). Version August 2020. KWR Water Research Institute, Nieuwegein. https://library.kwrwater.nl/publication/61396712/ [Accessed 10-11-2021].

Koop S.H.A. Van Leeuwen C.J. 2020b. Indicators of the City Blueprint performance Framework (CBF). Version August 2020. KWR Water Research Institute, Nieuwegein. https://library.kwrwater.nl/publication/61397318/ [Accessed 10-11-2021].

Koop S.H.A., Van Leeuwen C.J. 2020c. Indicators of the Governance Capacity Framework (GCF). Version August 2020. KWR Water Research Institute, Nieuwegein. https://library.kwrwater.nl/publication/61397218/ [Accessed 10-11-2021].

Koop, S.H.A., Grison, C., Eisenreich, S., Hofman, J. Van Leeuwen, K. 2022. The global transformation to water-wise cities: II. Solutions. npj Urban Sustain. (in review).

Krause, R.M., 2012. Political decision-making and the local provision of public goods: The case of municipal climate protection in the US. Urban Stud. 49, 2399-2417.

Kruuse, A.F., Verchou, A., 2005. Wit Transactions on Ecology and the Environment, 81, 171-179.

Lehner, M., 2017. The Malmö tools: green space factor and the green points system. https://nextcity.nl/the-malmo-tools-green-space-factor-and-the-green-points-system/ [21-12-2021].

Ligtvoet, W., Hilderink, H., Bouwman, A., Puijenbroek, P., Lucas, P., Witmer, M., 2014. Towards a world of cities in 2050. An outlook on water-related challenges. Background report to the UN-Habitat Global Report. PBL Netherlands Environmental Assessment Agency.

Luccarelli, M., Røe, P.G., 2013. Green Oslo: Visions, Planning and Discourse (Urban Planning and Environment). London: Routledge.

Madonsela, B.T., Koop, S.H.A., Van Leeuwen, C.J., Carden, K.J., 2019. Evaluation of Water Governance Processes Required to Transition towards Water Sensitive Urban Design—An Indicator Assessment Approach for the City of Cape Town. Water 11, 292.

Makarigakis, A., Jimenez-Cisneros, B., 2019. UNESCO's Contribution to Face Global Water Challenges. Water 11, 388.

Mathy, S., 2007. Urban and rural policies and the climate change issue: the French experience of governance. Environ. Sci. 4, 159-169.

McDonald, R.I., Weber, K., Padowski, J., Flörke, M., Schneider, C., Green, P.A., Gleeson, T., Eckman, S., Lehner, B., Balk, D., Boucher, T., Grill, G., Montgomery, M., 2014. Water on an urban planet: Urbanization and the reach of urban water infrastructure. Global Environmental Change 27, 96-105.

Meijer, A., Bolivar, M.P.R., 2016. Governing the smart city: a review of the literature on smart urban governance. Int Rev Adm Sci. 82, 392–408.

Minkman, van Buuren, A., Bekkers, V., 2018. Policy transfer routes: an evidence-based conceptual model to explain policy adoption. Policy Studies, 39, 222–250.

Mukhtarov, F., 2014. Rethinking the travel of ideas: Policy translation in the water sector. Policy and Politics, 42, 71-88.

Mukhtarov, F., Dieperink, C., Driessen, P.P.J., 2018. The Influence of Information and Communication Technologies on Public Participation in Urban Water Governance: A Review of Place-based Research, Environmental Science & Policy 89.

Munkhsuld, E., Ochir, A., Koop, S., Van Leeuwen, K., Batbold, T., 2020. Application of the city blueprint approach in landlocked asian countries: A case study of Ulaanbaatar, Mongolia. Water 12

Norton, B.A., Coutts, A.M., Livesley, S.J., Harris, R.J., Hunter, A.M. & Williams, N.S.G., 2014. Planning for cooler cities: A framework to prioritise green infrastructure to mitigate high temperatures in urban landscapes. Landscape and Urban Planning, *134,* 127-138.

Nutrient Platform. (n.d.). Fosfaat uit afvalwater Amsterdam. https://www.nutrientplatform.org/succesverhalen/waternet/ [21-12-2021].

OECD. 2015a. Water and cities: Ensuring sustainable futures. Paris: Organisation for Economic Cooperation and Development.

OECD. 2015b. OECD Principles on water governance. Paris: Organisation for Economic Cooperation and Development.

Okumura, C.K., Locke, M., Fraga, J.P.R., de Oliveira, A.K.B., Veról, A.P., de Magalhaes, P.C., Miguez, M.G., 2021. Integrated water resource management as a development driver – Prospecting a sanitation improvement cycle for the greater Rio de Janeiro using the city blueprint approach. Journal of Cleaner Production 315, 128054.

ONS. 2011a. Leicester Local Authority. https://www.nomisweb.co.uk/reports/localarea?compare=E06000016 [21-12-2021].

ONS. 2011b. Milton Keynes Local Authority. https://www.nomisweb.co.uk/reports/localarea?compare=E06000042 [21-12-2021].

Rahmasary, A.N., Robert, S., Chang, I.S., Jing, W., Park J., Bluemling, B., Koop, S., Van Leeuwen, K., 2019. Overcoming the Challenges of Water, Waste and Climate Change in Asian Cities. Environ. Manag. 63, 520–535.

Rahmasary, A.N., Koop, S.H.A., Van Leeuwen, C.J., 2020. Governing Indonesia's urban challenges of water, waste and climate change: Lessons from Bandung. Integrated Environmental Assessment and Management DOI: 10.1002/ieam.4334.

Rashidi, K., Patt, A., 2018. Subsistence over symbolism: the role of transnational municipal networks on cities' climate policy innovation and adoption. Mitig. Adapt. Strag. Glob. Change 23, 507-523.

Romano, O., Akhmouch, A., 2019. Water Governance in Cities: Current Trends and Future Challenges. Water 11, 500.

Ruhm, D., 2016. Norway now has the most efficient recycling plant on Earth. https://www.goodnet.org/articles/norway-now-has-most-efficient-recycling-plant-on-earth [21-12-2021].

Scandinavian Biogas. (n.d.). Södertörn, Sweden. http://scandinavianbiogas.com/en/project/sofielund-3/ [21-12-2021].

Schreurs, E., Koop, S., Van Leeuwen, K., 2018. Application of the City Blueprint Approach to assess the challenges of water management and governance in Quito (Ecuador). Environment, development and sustainability 20, 509-525.

SCS. (n.d.). Waste to energy. https://smartcitysweden.com/focus- areas/waste-to-energy/ [21-12-2021].

SGRI. (n.d.). About green roofs. https://greenroof.se/en/about-green-roofs/ [21-12-2021].

Shefer, I., 2019. Policy transfer in city-to-city cooperation: implications for urban climate governance learning, J Eviron. Pol. Plan. 21, 61-75.

State Government of Victoria. 2021. Stormwater harvesting and use. https://www.epa.vic.gov.au/your-environment/water/stormwater/stormwater-harvesting-and-use [21-12-2021].

Šteflová, M., Koop, S., Elelman, R., Vinyoles, J., Van Leeuwen, K., 2018. Governing Non-Potable Water-reuse to Alleviate Water Stress: the Case of Sabadell, Spain. Water 10, 739.

Šteflová, M., Koop, S.H.A., Fragkou, M.C., Mees, H., 2021. Desalinated drinking-water provision in water-stressed regions: challenges of consumer-perception and environmental impact lessons from Antofagasta, Chile. International Journal of Water Resources Development 1-24.

Stockholm Vatten och Afvall (n.d.). Waste management plan for Stockholm 2017-2020. https://www.stockholmvattenochavfall.se/globalassets/pdf1/riktlinjer/avfall/avfallsplan/sva072-avfallsplan_en.pdf [21-12-2021].

Tough, A.M., 1971. The adult's learning projects. A fresh approach to theory and practice in adult learning (2nd ed.). Austin, TX: Learning Concepts.

UN DESA. 2009. United Nations Department of Economic and Social Affairs: World Population Prospects: The 2008 Revision, Highlights, Working Paper No. ESA/P/WP.210.

UNEP. 2013. United Nations Environment programme: City-level decoupling. Urban resource flows and the governance of infrastructure transitions. A Report of the Working Group on Cities of the International Resource Panel.

Urban Waste. (n.d.). Copenhagen. http://www.urban-waste.eu/520-2/ [21-12-2021].

Van der Hoek, J.P., Hartog, P. & Jacobs, E., 2014. Coping with climate change in Amsterdam - A watercycle perspective. J Water Clim. Change 5, 61-69.

Van der Hoek, J.P., De Fooij, H. & Struker, A., 2016. Wastewater as a resource: strategies to recover resources from Amsterdam's wastewater. Resources, conservation and recycling 113, 53-64.

Van Leeuwen, C.J., 2017. Water governance and the quality of water services in the city of Melbourne. Urban Water Journal 14, 247-254.

Van Leeuwen, C.J., de Vries, E. & Koop, S., 2018. The energy & raw materials factory: role and potential contribution to the circular economy of the Netherlands. Environ. Manage. 61, 786-795.

Waternet. 2016. Gemeentelijk rioleringsplan Amsterdam. Amsterdam: Waternet.

Waternet. 2019. Thermische energie. https://www.waternet.nl/innovatie/co2-reductie/thermische-energie/ [21-12-2021].

Waternet. (n.d.). Average water use. https://www.waternet.nl/en/our-water/our-tap-water/average-water-use/ [21-12-2021].

Yu, Z., Yang, G., Zou, S., Jorgensen, G., Koga, M., Vejre, H., 2020. Critical review on the cooling effect of urban blue-green space: A threshold-size perspective. Urban Forestry and Urban Greening 49, 126630.

Zarf, L.C., Fleet, D., Fries, E., Galgani, F., Gerdts, G., Hanke, G., Matthies, M., 2011. Microplastics in oceans. Marine pollution bulletin 62, 1589-1591.

Zeeman, G. (n.d.). Recovering nutrients from waste water. https://www.wur.nl/en/show/Recovering-nutrients-from-waste-water.htm [21-12-2021].

Zimmermann, E., Bracalenti, L., Piacentini, R. & Inostroza, L., 2016. Urban flood risk reduction by increasing green areas for adaptation to climate change. Procedia Engineering 161, 2241-2246.