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How cities prepare for climate change: comparing Hamburg and Rotterdam

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Abstract

This paper compares the different ways in which the cities of Hamburg and Rotterdam are taking preemptive action to adapt to climate change. Literature, interviews, secondary data, official statistics, project reports and policy briefs were used to identify institutional arrangements used by the city governments to encourage innovations in climate adaptation strategies and involve the private sector in climate change policy implementation. We focus on cases that create positive opportunities; exploring how innovations are facilitated within the theoretical frameworks of the Porter Hypothesis and eco-innovation. We examine two possible pathways of climate change governance, firstly strict regulation and formal enforcement, and secondly institutional eco-innovation and voluntary measures. We found that different emphasis is placed on the preferred pathway in each of the case studies. Hamburg focuses on formal enforcements while the Rotterdam city government encourages institutional eco-innovation by acting as a platform and also providing incentives. Our findings suggest that a well-designed institutional framework can enhance innovation and increase environmental and business performance. The framework could vary in instruments and patterns, using both formal constraints and incentives to increase voluntary actions to shape policy. The formal rules could be stringent or incentivising to shape the climate change measures. The research aims to contribute to both practice and science by providing examples that might motivate and inspire other cities to design appropriate institutions for climate change policy implementation.

Keywords: climate change; mitigation; adaptation; institutional framework; Hamburg; Rotterdam

Introduction

Future climate projections predict an increase in extreme weather events, such as heat waves or heavy precipitation, as well as continuing rise of global mean sea level (Pachauri, Mayer, & Intergovernmental Panel on Climate Change, 2015). The most vulnerable societies are in coastal and river floodplains, and those whose economies are closely linked with climate-sensitive resources, especially where rapid urbanization is occurring. Currently more than half of the world's population lives in coastal areas, and 75% of all large cities are located on the coast. IPCC projections indicate that Europe will be subject to increased storm frequency; and sea level rise will cause increased risk of tidal and storm floods with greater erosion. Many European and East Asian cities have defences against flooding and erosion in coastal areas, particularly in cities where climate change impacts are likely to be costly, for example Tokyo, Shanghai, Hamburg, Rotterdam and London (Field & Intergovernmental Panel on Climate Change, 2012). However, in many cities there is little action compared to the level of threat (Aylett, 2013). Implementing climate change policy, such as mitigation and adaptation, requires well designed institutional frameworks (Adger, 2000; Bakker, 1999; H. John Heinz III Center for Science, Economics, and the Environment, 2002; Næss, Bang, Eriksen, & Vevatne, 2005; Tol, 2005). In this paper we explore the institutional frameworks that two cities, Hamburg and Rotterdam, use to mitigate and adapt to climate change.

The following section briefly reviews relevant literature. The theoretical framework section discusses the theoretical foundations used in the paper. The methodology section describes the methodology; and the results and discussion section provides an overview of the results with detailed discussions comparing the two case studies in the context of the Porter hypothesis and eco-innovation. In the conclusion we discuss the significance and implications of the case studies in terms of the research question: how are institutional frameworks designed to transform climate change from a challenge to an opportunity in Hamburg and Rotterdam? To answer this question we examine policy instruments used in Hamburg and Rotterdam to efficiently implement climate change policy; and compare the role of strict regulation and formal enforcements versus eco-innovation in influencing performance and competitiveness.

Literature review

Much of the existing climate change governance literature focuses on the global level. For example, regime theory scholars discuss how international climate instruments, such as the United Nations Framework on Climate Change Convention, could affect the behaviour and commitment of states. Less attention has been paid to regional, national and sub-national levels (Doelle, Henschel, Smith, Tollefson, & Wellstead, 2012). Importance of the participation of local authorities in climate change has been highlighted (Gibbs, 1997; Tuxworth, 1996; Welford & Gouldson, 1993). If there is to be a shift towards a polycentric solution to climate change, then case studies at municipal level are needed to demonstrate appropriate pathways (Biermann et al., 2010; Bulkeley & Newell, 2010; Ostrom, 2010). Ostrom (Ostrom, 2010) emphasised the key role of civil participation at community level to

manage natural resource and climate change problems with the goal of achieving efficient economic outcomes. However, Gibbs (Gibbs, 1997) argues that urban sustainability and economic competitiveness are incompatible and considers that implementing local competitiveness strategies will to lead to degradation and exploitation of the environment. Conventional environmental management and economics literature assumes that strict environmental policy imposes costs for companies, which affects their competitiveness, and hence has negative economic impacts such as lower employment and worse economic performance (Brännlund & Lundgren, 2009). However, this conventional perspective has been challenged by the Porter hypothesis, which proposes a positive causal link between regulation and encouraging innovations, which then enhance business performance (Lanoie, Patry, & Lajeunesse, 2008; Porter, 1990, 1991; Porter & Van der Linde, 1995). Evidence for the Porter hypothesis indicates that both strictness of environmental policies and flexibility have positive effects (Lanoie et al., 2008). For example, according to studies by Berman and Bui (Berman & Bui, 2001) and Alpay et al. (Alpay, Kerkvliet, & Buccola, 2002), refineries in the Los Angeles area perform significantly better than other U.S. refineries despite stricter air regulation; similarly, food-processing industries in Mexico have higher productivity when under pressure from environmental regulation (Ambec, Cohen, Elgie, & Lanoie, 2013).

In addition to use of strict formal enforcements, another approach is that stimulation of 'eco-innovation' by institutions for climate change governance. The definition of eco-innovation (OECD, 2009; OECD & Eurostat, 2005; Reid & Miedzinski, 2008) is the implementation of renewed, or greatly improved products, services, processes, methods, organisational structures or institutional arrangements which (with or without intent) lead to environmental improvements. Rennings (2000)suggests that eco-innovation also has social and institutional aspects, in that it involves changes in institutional structures with actors working in partnership, including governments and the private sector, to leverage more environmental benefits from the innovation. Eco-innovation literature also provides case studies to show that competitiveness can co-exist with pro-environment strategies (Demirel & Kesidou, 2011; Kesidou & Demirel, 2012; Lovett et al., 2012). In searching for efficient and effective ways for cities to adapt to climate change, this paper seeks to use a theoretical framework based on the Porter hypothesis and institutional economics to look at both formal arrangements and eco-innovation for climate change governance at the city level. As an important part of the institutional framework, policy instruments are central to effective enforcements (North, 1990) and so we identify policy instruments implemented in both cities.

Theoretical framework

A theoretical framework based on institutional economics is used in this research (North, 1990), with the Porter hypothesis and eco-innovation concept used in the analysis (Ambec et al., 2013; Porter, 1990, 1991; Porter & Van der Linde, 1995). Institutions are as defined by North (North, 1990, p. 360): "the humanly devised constraints that structure human interaction". The institutional matrix that provides the incentive structure for human society

consists of formal rules, informal constraints, and the characteristics and effectiveness of enforcement (North, 1990). Formal rules include laws, regulations, codes and formally established rules in societies. In addition to formal instruments, other informal constraints are often the factors that shape decision making. For example, climate change impacts, high labour costs, conservative local government, lack of an internal market, or high standards of technology can often lead to governments making different decisions. The informal instruments, for example, habits, perception, and awareness, come from socially transmitted information and are a part of the culture.

In order to analyse the case studies, we developed a framework to ascertain if a particular institutional pathway leads to a more efficient economic and environmental outcome (Figure 1).

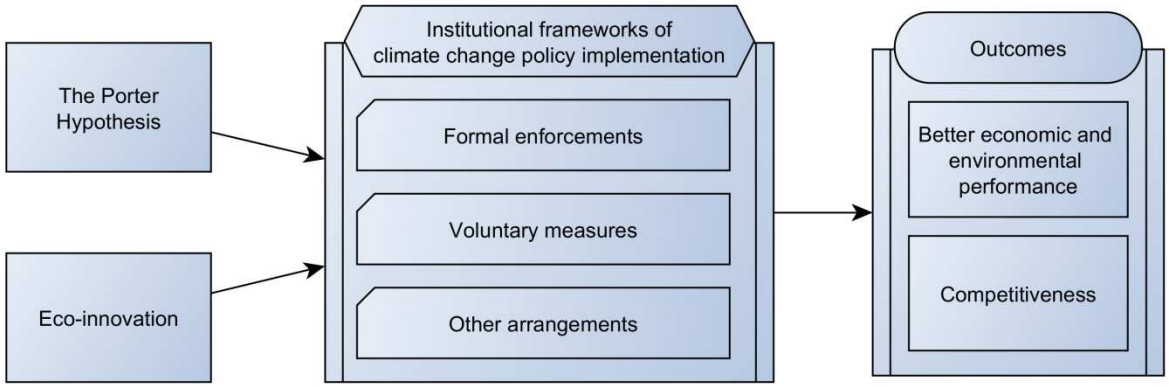

Figure 1: Theoretical framework based on the Porter hypothesis and institutional economics (adapted from North, 1990b; Porter, 1990)

The Porter hypothesis proposes that stringent environmental regulation in a well-designed institutional framework can motivate innovations in firms and enhance competitiveness. Properly designed environmental regulation can trigger innovations if strict regulations are performance based with clear goals and flexibility. This provides freedom and incentives for them to use the most efficient and effective strategies to achieve the goals. If correct, this approach would lead cities and local industries to achieve better environmental and/or better business performance and thus enhance competitiveness.

In addition to the emphasis on strict regulations, the alternative approach, promoting eco-innovations through institutional structures (OECD, 2009; Rennings, 2000), proposes that a partnership with the actors involved, such as government and the private sector, could leverage more environmental benefits from an innovative structure. An institutional eco-innovation is defined as any change in institutional structure, including structural change, which redefines the roles and relations across involved actors (OECD, 2009). By looking at how the two cities plan and implement their climate change strategies, we expect to see into the institutional framework to observe whether the cities implement renewed, or greatly improved processes, methods, organisational structures or institutional arrangements that

lead to environmental improvements. In this study we aim to examine whether such institutional frameworks could encourage a synergy of economic competitiveness and environmental sustainability.

Methods

We analyse two project-based climate change strategies, using the cities of Hamburg and Rotterdam as case studies. The justifications for choosing Hamburg and Rotterdam are: (1) The case studies should have an institutional framework, including formal and informal arrangements with enforcement characteristics; (2) the cities should have accomplished both structural and non-structural adaptation measures; (3) the cities should have global recognition of their climate change efforts; (4) similar characteristics which are comparable, in this case, harbour cities mitigating and adapting to climate change. In terms of global recognition, Hamburg City won the title of European Green Capital in 2011 on the basis of its integrated planning strategy for flood protection and efficient use of the land at the port of Hamburg, and both Rotterdam and Hamburg are members of C40 Cities Climate Leadership Group.

The research presents an analysis to test if both cases conform to our proposed theoretical framework. A mixed method approach is applied: (a) desk research reviewing official statistics and reports, (b) supplementary unstructured interviews, (c) participant observation, and (d) categorizing the selected data. The main source of data for this paper is literature, since this paper focuses on policy analysis. The literature included policy brief reports, official statistical data, academic papers, etc. The interviews and participants' observations are supplementary data to confirm consistency of observations derived from the literature with the perceptions of experts and civil society. In Rotterdam we conducted one unstructured interview with a private sector actor and carried out participant observation with citizens. In Hamburg we conducted two unstructured interviews (public institution and private sectors) and participant observation with citizens and academia. The data collection period was from July 2011 to November 2014.

The list of reports reviewed to study the context of climate change strategies and institutional frameworks of each city at the municipal level is presented in Table 1. The focus was on decision making and implementation processes, as well as how the private sector was motivated to participate in climate change projects. Mitigation and adaptation measures in the two projects were coded in order to reveal how formal and informal instruments shaped the outcomes of climate change projects and their potential innovations and opportunities. The variables included were the formal and informal instruments in the institutional frameworks and the innovations and opportunities (including social, economic, environmental benefits) resulting from climate change projects.

Table 1. List of reports reviewed

Year	Title	Produced by
2015	Essentials quarters projects	HafenCity Hamburg GmbH
2015	HafenCity – facts and figures	HafenCity Hamburg GmbH
2011	Insights into current developments	HafenCity Hamburg GmbH
2011	Investing in sustainable growth – Rotterdam programme on sustainability and climate change 2010-2014	Rotterdam Office for Sustainability and Climate Changes & City of Rotterdam/Rotterdam Climate Initiative
2010	Connecting delta cites	Dircke, Aerts, & Molenaar
2010	Sustainable construction in HafenCity and ecolabel	HafenCity Hamburg GmbH
2010	Adaptation programme 2010 Rotterdam climate proof	Gemeente Rotterdam et al
2009	RCP adaptation programme Rotterdam climate proof	Gemeente Rotterdam
2009	Waterplan 2 – summary	Municipality of Rotterdam et al., Hollandse Delta Water Board, Higher Water Board of Schieland and Krimpenerwaard, & Higher Water Board of Delfland
2006	Masterplan Hafencity Hamburg	Hamburg State Ministry of Urban Development and Environment & Hamburg State Ministry of Labour and Economic Affairs

The facts and figures were cross-checked with official statistics in federal and municipal data to confirm their accuracy, such as the Eurostat database and public organisations. In Rotterdam, an interview was conducted with a private project development manager; and we also used a previously recorded interview script[1] with an architect who designs floating housing. In Hamburg, several rounds of field studies were undertaken in the Hamburg HafenCity area to conduct informal interviews with the inhabitants and observe the physical environment and climate-related educational activities.

Results and discussion

[1] Interview script source: http://inhabitat.com/interview-koen-olthius-of-waterstudionl/waterstudio-waterstudionl-koen-olthius-amphibious-house-houseboat-floating-house-flood-resistant-houses-interior-2/

Climate change projects in Hamburg and Rotterdam

Hamburg's HafenCity project has invested 10.9 billion Euro during the period 1997 -2013 (with around 8.5 billion Euro from the private sector)[2] and Rotterdam plans to invest 13 billion Euro on the climate proofing project by 2025.[3] A comparison of project-based climate change strategies in Hamburg and Rotterdam is provided in Table 2 and further details on each city are given in the following two sub-sections.

Case of Hamburg

Hamburg has a population of 1.76 million and its greater metropolitan area has 4.3 million inhabitants. It is estimated that by 2030, Hamburg City will need to accommodate at least 103,300 more people (Munich RE, 2010; Statistisches Amt für Hamburg und Schleswig-Holstein, 2015). By population, Hamburg is the second largest city in Germany, and is exposed to natural flooding threats from the North Sea and Elbe River. The city experienced a catastrophic storm surge in 1962, which caused 61 dyke failures, with 347 dead and 370 sq km flooded (Munich RE, 2010). Vulnerability to storm surges, floods and similar challenges led Hamburg City to initiate a flood protection project. Combined with the challenges of natural disaster, climate change and growing business in the port of Hamburg with its need for more space for housing, logistics, and industrial development, Hamburg started an urban development project in 1997, aiming to make Hamburg flood-secure. The project is named HafenCity, which ambitiously aims to achieve good living quality with high standards of sustainability.

Case of Rotterdam

The objectives of Rotterdam are for both mitigation and adaptation. These include the reduction of CO2 emissions by 50% by the year 2025 compared to 1990, as well as the goal of making the city climate proof by 2025. According to the Rotterdam climate program, the definition of climate proof is "climate resilience, an adaptive strategy, in which Rotterdam adapts itself proactively and flexibly to changing circumstances"(Gemeente Rotterdam, 2009).

Table 2: Comparison of Project-based Climate Change Strategies in Hamburg and Rotterdam.

[2] Source: HafenCity – facts and figures http://www.hafencity.com/en/overview/hafencity-facts-and-figures.html

[3] Source: Rotterdam Climate Initiative http://www.rotterdamclimateinitiative.nl/documents/20110223%20speech%20Ger%20van%20Tongeren%20Japan.pdf

Background	**Hamburg**	**Rotterdam**
Population	1,814,597[4]	616,260[5]
Population density	2,312[6] inh./km²	2,961[7] inh./km²
Project	HafenCity	Rotterdam Climate Initiative
Project timeframe	1997-2025	2007-2025
Project budget	10.4 billion Euro	13 billion Euro
Objectives of climate adaptation	Flood proof by 2025	Climate proof by 2025
Mitigation targets (compared to the emissions level in 1990)	40% CO2 emission reduction by 2020, and 80% by 2050, i.e. 4 million tonnes of CO2	50% CO2 emission reduction by 2025
Area of Municipality	755[8] km²	325[9] km²

Differences

Rotterdam and Hamburg use different institutional frameworks. Hamburg places emphasis on formal enforcement of institutional design while Rotterdam provides a voluntary platform for partnerships and incentives to encourage the private sector to innovate. Hamburg designs mechanisms involving the private sector and encourages them to comply with high environmental standards through a tendering process that seeks attainment of high environmental performance. A voluntary certification mechanism (Ecolabel) was launched in order to recognise higher building standards. As a result, both businesses and society benefit from the creation of an urban area that is setting high standards of sustainability.

Rotterdam has ambitious goals in climate change mitigation and adaptation, in particular climate proofing by 2025 and 50% of CO2 emissions reduction by 2025. In order to facilitate different stakeholders to achieve these ambitious goals, Rotterdam city supported the private sector by offering them a marketing platform for newly developed innovations, such as the floating city concept. The development of a floating city is considered revolutionary in European flood strategy. Dutch tradition premised on building dykes to withstand higher river discharges. The expected extreme future weather events caused reflection on the dyke

[4] Source: Eurostat Hamburg population 2013 (http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=demo_r_pjanaggr3&lang=en) Last update: 16-12-2014

[5] Source: Eurostat Rotterdam population 2012 (http://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=urb_cpop1&lang=en) Last update: 03-12-2014

[6] http://www.citypopulation.de/php/germany-admin.php?adm2id=02000

[7] http://www.citypopulation.de/php/netherlands-admin.php?adm2id=0599

[8] Source: Statistical Office for Hamburg and Schleswig-Holstein facts and figures 2013 (https://www.statistik-nord.de/fileadmin/Dokumente/Faltbl%C3%A4tter/Faltblatt_Stadtportrait_2013_E_Internet.pdf)

[9] Source: City of Rotterdam facts and figures 2013 (http://www.rotterdam.nl/Clusters/Stadsontwikkeling/Document%202014/Informatiepunt%20Arbeidsmarkt/ZigZag2013-Engels-DEF.pdf)

building planning strategy leading to new planning strategies of giving land back to the water (Lu & Stead, 2013). To meet the increasing demand for residential area, floating housing is favoured. It is considered a win-win strategy for the land developers because a close relationship with the water is associated with higher house prices. In the Netherlands, living on houseboats on canals is already a normal way of housing, so the concept of a floating city in the sea is an expansion of this tradition. After the international brand of 'water city' or 'floating city' was created and marketed, Rotterdam created an overseas market and the companies benefitted from increased consulting and technology transfer business.

Similarities

Rotterdam and Hamburg identified floods as their main climate change related challenge. Other challenges mentioned included competition with other commercial ports and population growth. Both cities share the same social experience: with severe floods in Hamburg in 1962 and in Rotterdam in 1953. Public authorities, the private sector and citizens all mentioned floods when they recall climate change risks and this memory becomes a motivation for climate change adaptation because they want to avoid the same disaster. Social experience as an informal motivator is significant in both cases. For example, Rotterdam city related that some businesses hesitated to invest in Rotterdam due to the high flood risks. In North's institutional economics theory, informal arrangements are pervasive due to society's collective learning. This perception of risk appears to be an important contributor stimulating implementation of climate change adaptation strategies.

Institutional frameworks of Hamburg and Rotterdam

The overview of institutional frameworks in the two cities is shown in Table 3. Both cities have ambitious goals (set higher than the EU commitments in the Kyoto Protocol and current climate change negotiations under the UNFCCC, which aim for a 20% reduction target for 2020 comparing to 1990). Hamburg has higher targets than Rotterdam.

Mitigation has a clearer goal and more formal regulation; while adaptation has generic objectives. The difference in nature between mitigation and adaptation could be due to adaptation receiving attention only when extreme weather events occur. Therefore, adaptation as a policy is underdeveloped compared to mitigation (Biermann et al., 2010; Doelle et al., 2012; Hof, de Bruin, Dellink, den Elzen, & van Vuuren, 2010). However, even though the goals set by both cities are generic, they set high standards as they promise 100-year-flood protection as well as creating a climate proof city.

Compared to Hamburg, Rotterdam does not use strict regulations or formal enforcements as policy implementation instruments; instead, guidelines are provided that local governments are expected to meet (both national and municipal guidelines).

Table 3: Institutional Frameworks of Hamburg and Rotterdam Project-based Climate Change Initiatives

	Hamburg	**Rotterdam**
Climate change mitigation goal	Cut emissions by as much as 50 percent by 2020 compared with 1990.	50% CO2 emission reduction by 2025 compared to 1990. Companies aim to increase average 2% of energy efficiency annually. The Netherlands has set a target of covering 14% of energy demand from renewable sources in ten years, while Rotterdam's target is 20%.
Climate change adaptation goal	Flood protection from 100-year flood standard. Best urban quality.	Climate proof by 2025. National implementation agenda 'make space for climate'. National programme 'adaptation to climate change in spatial planning'(named ARK).
Strict regulations and formal enforcements	Rules in tendering contract and sales of the land. Intervening period: the city retains the right to intervene in the development to ensure the project follows the original concept.	Meeting the national climate agreement[10]: - 75% green procurement in 2010 and 100% in 2015; - share of renewable energy in the city to 20% in 2020; - new housing to be climate neutral by 2020; - the energy use in residences and office buildings to decrease 50%;
Incentives and voluntary measures	Introduction of Ecolabels: certificates require undercutting 30 to 45% of energy demand standard. Information centre to raise awareness.	Subsidy to green roofs of 30 euro per sqm with at least covering 40%. Task Force to raise awareness.
Informal arrangements	Social experience: flood in 1962	Social experience: flood in 1953
Positive	All newly built areas are elevated above	Estimated 3600 jobs directly linked to climate

[10] The climate agreement is called 'Climate agreement municipalities and Dutch government 2007– 2011: working together on a climate-proof and sustainable Netherlands'. The agreement is taken from the Dutch Climate Policy: Local challenge supported by the national government published by the Dutch Ministry of Housing, Spatial Planning and the Environment. Available at: rwsenvironment.eu/publish/pages/100182/dutch_climate_policy.pdf

outcomes in environmental or economic performance	sea level at least 8 to 8.5 meters which accounts for the sea level rise according to future climatic scenarios projected by IPCC (HafenCity Hamburg GmbH, 2015a; HafenCity Hamburg GmbH, 2015b). Infrastructure (mix of climate change and development project) covering 157 hectares (HafenCity Hamburg GmbH, 2015a; HafenCity Hamburg GmbH, 2015b). 70% of buildings in the east of 'Magdeburger Hafen' quarter have received the gold Ecolabel (HafenCity Hamburg GmbH, 2015a; HafenCity Hamburg GmbH, 2015b). 49 completed projects, 1700 residents, 8400 people working in more than 300 companies (HafenCity Hamburg GmbH, 2015; HafenCity Hamburg GmbH, 2015b).	change adaptation (e.g. construction, consultancy, information and communications technology industries) (City of Rotterdam, 2013). Additional 4 to 5 billion euro will be generated (City of Rotterdam, 2013). Floating housing and other technical innovations established as international consulting businesses (City of Rotterdam, 2013). Water storage in urban area (City of Rotterdam, 2013). 100,000 sqm of green roofs (City of Rotterdam, 2013).

Strict formal enforcements and competitiveness

The Porter hypothesis proposes that stringent environmental regulation can lead to better performance and competitiveness. Setting clear goals in regulation, without specifying the means, can successfully trigger innovations. In our analysis, we found that Hamburg has set regulations for buildings and formal rules in the bidding process. Rotterdam, conversely, does not have strict regulations for mitigation or adaptation but rather issues generic guidelines and vague terms with visions with a longer term perspective. Nevertheless, both cities have high standards in their climate change mitigation and adaptation goals. In both Rotterdam and Hamburg's cases, very clear goals are set, for example compliance with future climate scenarios, including sea level rise and flood risks for another century. Being fully climate proof and adapting to 8 meters of sea level rise are ambitious and performance based goals. The means for achieving the goals are not specified. The private sector, such as project developers, are given freedom to develop the efficient and effective strategies complying with these stringent environmental standards.

Case of Hamburg

The government of Hamburg is managing the climate change project in a top-down management style with formal enforcements. At the beginning of the project, a completely government-owned subsidiary company was established in order to improve the efficiency and quality of the project by concentrating non-official functions. Commissions, official authorities and formal rules were set up and established in order to retain public accountability and decision-making power. The members and their roles are described in Table 4.

Table 4. The members and roles HafenCity Hamburg GmbH

Members	Supervisory board: senators, Land Commission, Hamburg parliament, and the Urban Development Commission.
Roles	Manager of development, property owner, developer of infrastructure, vehicle to represent public interests, influencing factor of market conditions.
Responsibilities	Administration of the special city and port fund under public law, communication, public relations, event management, promotion of cultural activities, and the arts.
Functions	Sales of the land, planning and building the infrastructure.
Activities	Clearing and preparing sites, planning and building infrastructure and public spaces, acquiring and contracting real estate developers and large users, running architectural competitions.

The city government finances most of the public investment of the project by selling the land. Since the majority of the project's land belonged to the City of Hamburg, the property was transferred first to the City and Port Special Assets Fund, and then to the government-owned company created in 1997 to manage the development project, which in 2004 became known as the HafenCity Hamburg GmbH[11]. The responsibilities are stated under public law: "sales of land owned by the City of Hamburg finance the public investment, including roads, bridges, squares, parks, quays, and promenades. In addition to the financing responsibility, it also needs to prepare the sites, plan and build infrastructure and squares; and contract real estate developers and large users (HafenCity Hamburg GmbH, 2015a; HafenCity Hamburg GmbH, 2015b)."

The Hamburg City government has adopted an approach to manage the project efficiently and avoid bureaucracy. HafenCity Hamburg GmbH is a company with limited liability, representing the public good component of Hamburg's development, involving stakeholders from authorities taking care of different aspects. The most important power HafenCity

[11] The English translation of GmbH is "company with limited liability". Due to the reason that "HafenCity Hamburg GmbH" is a registered name and widely used in the official documents, this paper will use the German term for consistency.

Hamburg GmbH has is to design the bidding mechanism and run architectural competitions. This encourages innovation and achievement of goals with sustainability objectives.

Hamburg has utilized formal institutions by designing exclusive options in the bidding contracts and tendering through architectural competitions, to set high standards without specifying the methods to achieve them, for example flood protection for the next century and creating a mix of land use. Eligible companies as bidders are those planning to staff 60-70% of a building or site for their own purposes. The highest bidder is not necessarily selected, but rather the applicant providing the best concepts meeting the objective of mixed land use. The objective of the competition is setting high standards and at the same time abstract: achieve the best urban quality.

In the tenders all investors are required to accept the stated objectives and the building permit is only granted when quality and secure finance are ensured. The city only sells the land after the company receives the building permit, thereby preventing real estate development without addressing climate impacts and gentrification. The city retains the right to intervene in the development for 1.5 years to ensure the project follows the original concept submitted. This has led to the buildings and infrastructure being designing for flood protection with the standard of 8 metres elevation above sea level (the projections for 2100 are 2.1 metres at the worst scenario[12]) and 24% public open space (commonly suggested public open space is 15-20% [13]). From this we could see that the project in Hamburg has achieved the standard higher than the commonly accepted standards as a result of their strict but abstract formal rules.

Requiring land developers to meet higher standards than those in existing rules (for instance, meeting future scenarios predicted by the IPCC) requires strategies. Instead of changing the current building codes, which requires a change in legislation in federal, State and local governments (and which could take years passing through parliament and legislative bodies), embedding the higher standards in bidding processes for private sector developers is less time consuming, and so more efficient. The lesson to be learned from Hamburg's institutional structure is that the formal arrangement of architectural competitions and the tendering process can be used to encourage or even force the private sector to achieve higher standards than the existing laws and building codes require.

Case of Rotterdam

In order to make Rotterdam climate proof by 2025, the city government initiated a series of programs to deal with existing and future climate change impacts. The program mainly

[12] Jevrejeva et al. (2014) Upper limit for sea level projections by 2100, Environmental Research Letters, doi:10.1088/1748-9326/9/10/104008

[13] The percentage of open space area suggests 15-20 percent: https://nextcity.org/daily/entry/how-much-public-space-does-a-city-need-UN-Habitat-joan-clos-50-percent

focuses on prevention, adaptation and recovery. The whole adaptation program (as shown in Figure 2) is supported by three pillars: actions, knowledge and marketing communication. The stakeholders involved include the city government, the private sector, and governmental bodies including the Port of Rotterdam, City of Rotterdam, DCMR Environmental Protection Agency Rijnmond, Deltalinqs, Delta Committee, and local communities.

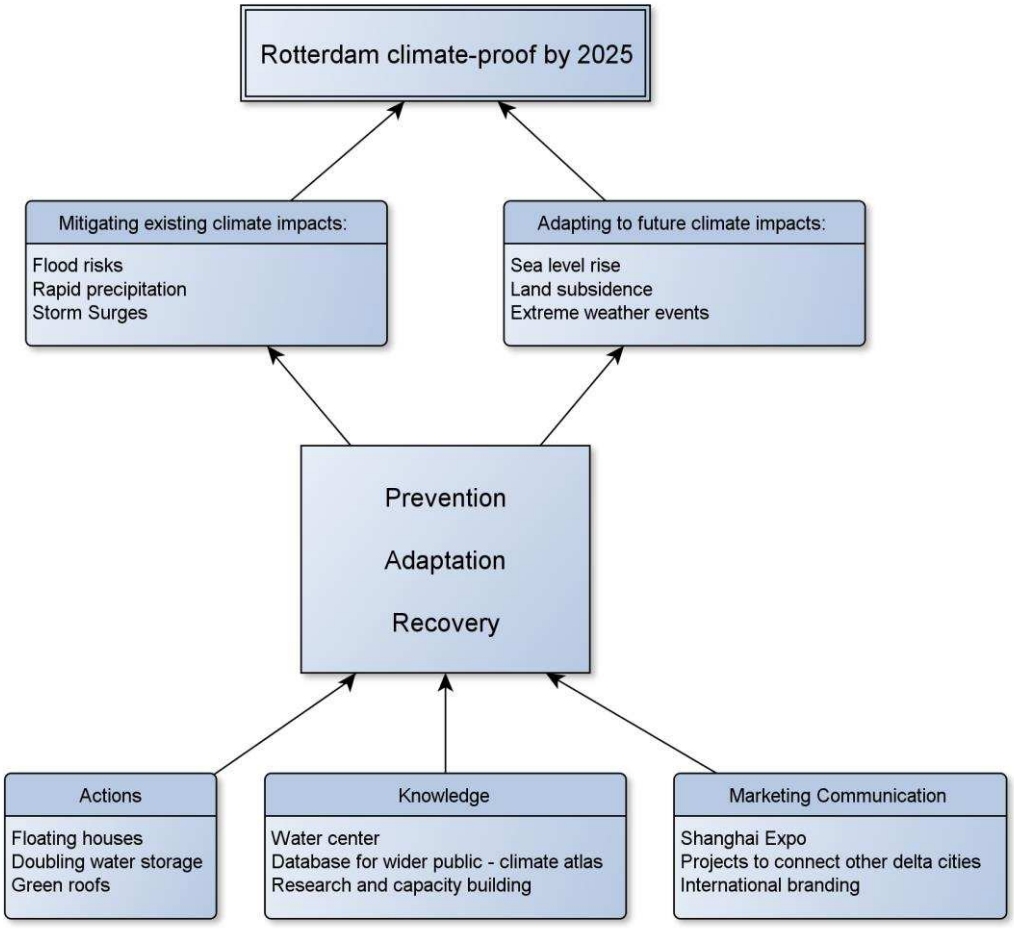

Figure 2. Adaptation Measures of Rotterdam Climate Initiative

Unlike the case of Hamburg, Rotterdam does not place emphasis on strict formal rules. However, there are some formal institution elements in Rotterdam. Local government motivates the private sector to comply to higher sustainable development standards by providing incentives for bidders to include sustainable development indicators in their projects. For example, instead of selecting the lowest cost possible in the bidding process, they also consider quality in the selection criteria. The projects include, for instance, green procurements and sustainable land development. Another interesting characteristic of the Rotterdam climate strategy is that the focus on opportunities instead of risks. Integration of water related issues into spatial planning and land development is done in a way to not just reduce risks, but also to achieve a better quality of life (Lu & Stead, 2013).

Eco-innovation and competitiveness

An institutional eco-innovation is defined as any change in institutional structure, including structural change, which redefines the roles and relations across involved actors (OECD, 2009). The Hamburg projects utilise the voluntary eco-labelling system to successfully encourage mitigation actions of the private sector. In contrast, the Rotterdam case is an institutional eco-innovation as their municipal governments changed their top-down role and replaced it with a platform to provide incentives for the private sector to innovate.

Case of Hamburg

To ensure continuous enforcement, Hamburg has designed a mechanism to encourage sustainable achievements in the long-term development process and keep strengthening higher standards. The Ecolabel certificate mechanism awards sustainability certificates for buildings that contribute to Hamburg's CO2 reduction goal of a 40 percent cut by 2020 compared with 1990. Silver and gold-level standards for special and excellent achievements in sustainability have been reached by 70 percent of the new buildings in eastern Hamburg. In 2007, the Ecolabel certificates were first launched as a voluntary mechanism, attracting major organisations such as Greenpeace Germany, the Spiegel publishing group, and Unilever's headquarters, to comply with gold standards. Eventually, more than 50 percent of newly planned and developed residential buildings in eastern Hamburg have obtained the gold Ecolabel certification. The number of buildings complying with the Ecolabel sustainable standards is expected to grow, because Hamburg City has announced that, in the future, all residential buildings are required to achieve gold Ecolabel standards. Through the informal arrangement of Ecolabel certification more than 300,000m² of building has been improved to reach the gold standard within four years. At the same time, the process also stimulates urban planners to achieve higher standards: a two hectare increase of public space, 500 meters of waterfront, and an innovative heat supply concept has also been encouraged by Ecolabel (HafenCity Hamburg GmbH, 2010).

Case of Rotterdam

As presented in Figure 3, Rotterdam has an innovative approach. Unlike a top-down style with management imposing a series of formal rules, Rotterdam decided to act as a platform

for companies, knowledge institutes, citizens, national government and local government bodies and other organizations and link initiatives for marketing (Gemeente Rotterdam, 2009). The role of Rotterdam's municipal project developer is different from Hamburg. The Rotterdam climate initiative is established as a platform to be a facilitator, and encourages innovations, links initiatives and focuses on marketing; while Hamburg plays the role as the manager: designing, monitoring and forming the rules. The local government of Rotterdam announced ambitious goals and aimed to maximize added value from social and economic perspectives.

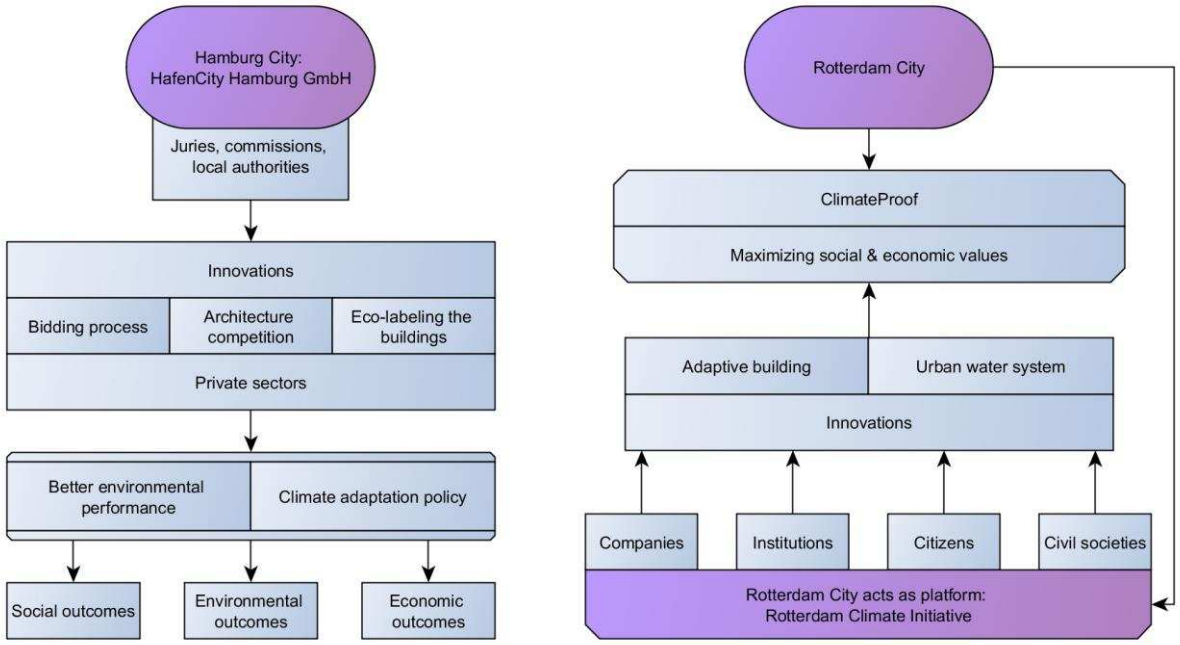

Figure 3. Comparison of institutional eco-innovation in Hamburg and Rotterdam

The principles for maximizing social and economic value with the objective of making the city climate proof are given in the Rotterdam Climate Proof Adaptation Programme report:

1. Rotterdam will develop into and present itself on a national and global scale as one of the world's leading water knowledge and climate cities.
2. Innovations and knowledge will be developed, applied, exchanged and marketed as export products.
3. The investments will make the city and the port more attractive for citizens, businesses and knowledge institutes (Gemeente Rotterdam, 2009).

The approach adopted by Rotterdam contains two key elements in the climate strategies that Hamburg does not have: global scale and innovations marketed as export products. Instead of focusing on designing institutions at the local level, Rotterdam has chosen to encourage innovations by providing economic incentives. The Rotterdam climate proofing strategy states "It is necessary to enhance protection against flooding and guarantee accessibility. In addition, we need to adjust our design and construction concepts both at the level of urban

planning and with respect to individual buildings. This will generate innovations that can also be marketed elsewhere in a later phase" (Gemeente Rotterdam, 2009). Rotterdam developed plans to increase their competitiveness through a floating housing concept, which is described in detail below. Rotterdam, as the largest port in Europe, and as a city located in a delta below sea level, had already seen the need for solutions for delta cities in future decades. Therefore, Rotterdam is pooling knowledge and innovation power, delta technology, and architectural solutions to reinforce climate adaptation of businesses and port activities. Rotterdam aims to be an international knowledge centre for water and climate issues in order to open an international market in climate change adaptation for consultancy, engineering firms, research agencies, knowledge institutes and climate related high-tech industries (Gemeente Rotterdam, 2009). The reason why Rotterdam has to present its climate change strategy as an economic strategy is that new businesses are apparently avoiding the city because of its flood-prone profile. Lack of jobs and suitable housing are also disincentives for high-income citizens. To reverse the trend, Rotterdam decided to make large investments in spatial development and industry over the next decade, and present itself as a global leader in delta cities preparing for increased flooding risks (Groven, Aall, van den Berg, Carlsson-Kanyama, & Coenen, 2012).

The Rotterdam case presents an innovative concept: a floating city. Instead of building more dykes and reclaim more land, Rotterdam decided to transform the threat of sea level rise into an opportunity by building floating houses, which have a long history in the Netherlands. They promote floating constructions and floating communities. A floating pavilion was being built in Rotterdam as an exhibition centre for visibility and the high standard of technical innovation was not only an adaptation strategy for future housing, but also a marketing strategy to make their expertise mobile (Fehrenbache, 2011).

The second program "Connecting Delta Cities" was then launched, which is a network that enables delta cities all over the world to exchange experience and knowledge. This has become a platform for Rotterdam to provide consulting services, technical support and also to establish new projects in other countries. Rotterdam thus improves its local economy and competitiveness by creating international markets.

Conclusion

Both Hamburg and Rotterdam have developed effective pathways. However, there are also concerns. For example, over emphasis on strict formal rules for land development provides less opportunity for citizens to participate, and therefore the local residents express concerns about low stakeholder engagement and gentrification. On the other hand, relying heavily on a market-oriented pathway could also lead to higher housing and land use prices. Less initial stakeholder engagement might later require more efforts in time and resources to resolve. To overcome the potential concerns, the key is stakeholder engagement and local participation at all stages, from initial planning to implementation. From an institutional economic perspective, open access to information will reduce transaction costs in communication.

The findings demonstrate that appropriately designed institutional frameworks can enhance innovations in city adaptation and lead to both increased environmental and business performance. Climate change governance arrangements tend to be diverse, unpredictable and more 'messy' than a simple pattern of governance (Doelle et al., 2012; Howlett, Rayner, & Tollefson, 2009). There is no one successful model but many pathways for designing governance arrangements to achieve more efficient climate change policy making. The two case studies present different institutional frameworks by using both formal and informal arrangements. A good institutional framework could use a mix of arrangements, combining strict regulation and eco-innovations. Future research using a quantitative approach to assess environmental and economic performance in more detail is needed. The purpose of this paper is to provide case studies of positive outcomes from climate change governance and it is hoped that the key findings will contribute to designing institutional arrangements for climate change governance and adaptation in other cities.

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