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Rapid Urbanization and Infrastructure Pressure: Comparing the Sustainability Transition Potential of Water and Energy Regimes in Namibia

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Abstract: This article presents a comparative study of the urban water and energy sectors in the coastal city of Walvis Bay in Namibia, where the rapid urbanization places pressure on public infrastructure development. A multidata approach is used to study the ability of the energy and water sectors to adapt to this pressure. Theoretically, the analysis is guided by the systems transition framework. A comparison between the two regimes is made on four dimensions: (1) regime dynamics, (2) level of complexity, (3) level of coordination, and (4) multiplicity of perceptions. The energy regime was found to be more capable of transitioning towards more sustainable practices due to better outcomes in multi-stakeholder engagement, a higher level of transparency, and differing landscape and niche development. The energy regime is also more open for new service providers. The water regime, on the other hand, suffers from overlapping roles and practices as well as non-existent monitoring authorities, which together negatively affect the regime's transition potential. Both regimes suffer from lack of funding and weak institutional capacities. In conclusion, the transition potential of the studied regimes is found to increase when cross-sectoral governance is strengthened.

Keywords: energy; multi-level perspective; Namibia; urban development; water

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1. The Challenges of Urban Development

In the search of opportunities for improved livelihoods and access to services, people relentlessly migrate from the countryside to urban centers. Over half of the world's population lives in urban areas and it is estimated that this proportion will grow to 68% by 2050 [1]. Many cities are thus being confronted with challenges delivered from uncontrolled urban sprawl, including social inequality and environmental challenges [2]. On the other hand, rapid urbanization generates pressure on public infrastructure development and may provide adequate and fast-enough transitions responses.

In the water sector, infrastructure-related risks include safety hazards such as water-borne diseases caused by polluted water supply. Difficulties in providing safe water services also impact the countries' economy, social order, and external security. The energy sector, on the other hand, influences urban development in different ways, including infrastructure development, water distribution, transportation, business opportunities, and food production. Simultaneously, cities are responsible for more than 70% of global carbon dioxide emissions [3]. Thus, cities play a central role in urban development through their capacity to advance the sustainability agenda in diverse sectors.

Discussion on rapid urbanization in developing regions is typically tightly connected to mega-city developments [4]. It is important to recognize this trend, but at the same time, it is important to observe developments that urbanization triggers in smaller cities. In this article, we analyze the transition potential of the energy and water regimes in the coastal city of Walvis Bay, located in the Erongo Region in Western Namibia. Despite its relatively moderate population of 2.45 million and the population density of only 3 (people per km^2) [5], the rapid urban population growth creates pressure on infrastructures in Namibia as well. Walvis Bay, on the other hand, is an illustrative example of a small Southern African city, population-wise, in which rapid urbanization is generating pressure toward existing infrastructure.

The current population of Walvis Bay is about 35,500, and the Erongo Region about 150,400 [6]. These numbers are expected to grow significantly in the near future, because the recent opening of a new container terminal provides new employment opportunities in retail, tourism, and commercial facilities [7]. Because of the extensive road network to, e.g., Botswana, Angola, South Africa, Zambia, and Zimbabwe, and various shipping routes to other Southern African countries and beyond, Walvis Bay is strategically well positioned and is expected to serve as a logistics hub for Southern Africa.

Urbanization generates different pressures towards the city infrastructure in Walvis Bay and consequently the water and energy service providers—parastatal enterprises NamPower and NamWater—struggle to meet the growing resource demands resulting from the process. While the urban water regime is faced with a worsening drought in the country, especially in the central area of the country creating pressure also to the coastal area, the urban energy regime is facing challenges of energy dependency from other Southern African countries, which has an effect on its security of supply.

Theoretically, our analysis is based on the multi-level perspective (MLP) approach [8–10]. MLP identifies three societal levels that interact dynamically with each other in a system: the niche level (micro-level), the regime level (meso-level), and the landscape level (macro-level). Based on our analysis of the energy and water sectors in Walvis Bay, we identify aspects of the sectors that explain their capacity for sustainable transition. Based on our findings, we argue that the transition potential of the regimes seems to increase when cross-sectoral governance is strengthened.

The challenge with managing urban sustainability transitions is to understand the complexities of the systemic change, and consequentially take appropriate actions to strengthen the transition capacity of the sectors in question [11–13]. There can be differences in the pace of change due to differences in technological development, sectorial resources, and focuses in the political decision-making [14,15]. Additionally, infrastructure sectors are typically interconnected and changes thus need to occur in several sectors simultaneously to support adequate infrastructure development [16]. These aspects of urban sustainability transitions become emphasized also in this study.

The article is structured as follows. First, we introduce the challenges that rapid urbanization poses on city infrastructures. Next, we present the MLP approach, paying special attention to recent studies of city systems that employ the MLP approach in developing country contexts. In "MLP explaining the interplay between niches, regimes, and landscapes", we introduce the analytical framework and data used in the analysis. After the introduction of the analytical framework, we proceed to the modelling of examined systems, presenting their current developments, practices, and regime actor networks, and the selected niche and landscape forces influencing them. Finally, we discuss our findings related to regime comparison and present concluding remarks of the analysis.

2. Transition in Urban Systems

The MLP approach is a framework for the study of socio-technological system transition in complex systems [10]. It distinguishes between three levels of actions within a socio-technological system: socio-technological landscape, regimes, and niches (Figure 1). A transition occurs when developments and trends at the landscape level and novel technologies and new ideas at the niche level create pressure on the regime [9,10,17]. The regime, together with its internal structural developments, needs to be organized in a way that allows it to respond to the external forces influencing it [9,10,18].

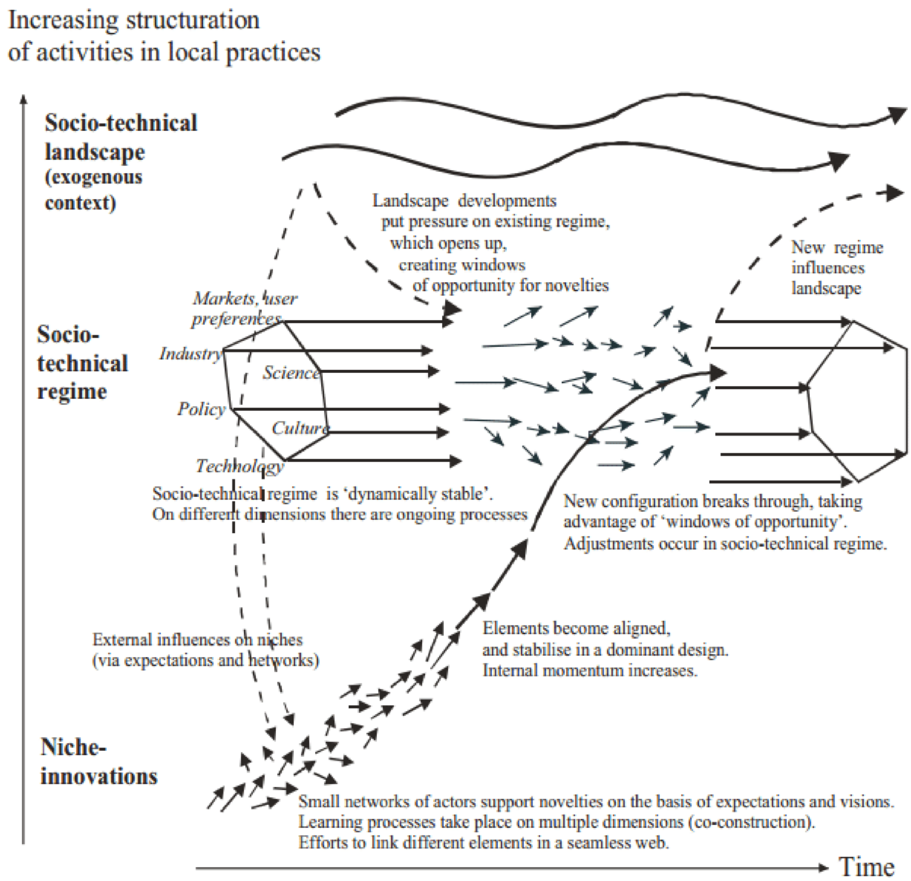

Figure 1. Socio-technical transitions [9,10].

2.1. MLP Explaining the Interplay between Niches, Regimes, and Landscapes

Niches offer conditions for the beginning of a systemic change, as they cater for interactive learning processes and institutional adaptation [19,20]. Niches are defined as protected spaces, in which actors, such as entrepreneurs and start-ups, work on innovations that differ from the technological solutions currently used in the regime [10]. These innovations offer an alternative way for the regime to fulfil its social functions. At the same time, however, niche innovations may be in a conflict with the regime's operational environment. Conflicts may occur, for example, due to lack of appropriate infrastructure, regulations, consumer practices, or differing cognitive frameworks regarding new ideas and innovations [9,10].

Socio-technological regimes are the deep structures of socio-technological systems that maintain the stability of these systems [9,10]. Regimes, which are led by social groups, create and fulfil socially valued functions [21]. Regimes consist of semi-coherent sets of rules, such as norms, regulations, shared beliefs, and cognitive routines, that coordinate the actions of social groups [10]. Regime members inherit material and immaterial capacities, which together with members' interactions and power relations determine the way the regime responds to external perturbations [22]. However, technologies do not get selected as a result of bilateral interactions but in a collective and dynamic social process, which engages different, competing actors and organizations [23]. The present study considers this aspect by taking the regime level as its focus point and by setting an analytical framework to explore regime qualities.

The landscape level is considered as the wider external environment or space that is defined in relation to the regime [9,10]. The socio-technical landscape might consist of factors such as economic decline and environmental trends, as well as cultural and normative values [17]. In the socio-technological transition, pressures from the landscape level—such as increased need to respond to climate change or global changes in food commodity prices—on the existing regime create 'windows of opportunity' for niche-innovations to break into the regime. Thus, in order to understand changes in the regime, understanding changes in the niche level and in the landscape level becomes crucial [9]. From an MLP viewpoint, cities may be conceptualized as socio-technological systems, which are embedded in complex networks of actors operating at multiple levels [24].

2.2. Criticism and Future Applications of MLP Approach

The MLP theory offers a functional framework to understand sustainability challenges, which are inherently occurring in complex urban settings. Successful studies on sustainable urban development that employ the MLP approach include, for example, those by Næss and Vogel [25] and Hernández-Palacio [24].

Despite its merits, the MLP theory has also been criticized for its ambiguity in defining the different levels of analysis, the lack of agency and politics in the transition process, its technological orientation in the analysis, and the dominant use of the theory in historical case studies [10,26]. Studies of urban systems from the MLP viewpoint are still limited in number [13].

Remarkably, previous studies on sustainability transition employing the MLP approach have traditionally been characterized by a focus on European countries [13,27]. There are a few examples where researchers have utilized the MLP approach in developing country contexts [21,28,29], but in general this research is very limited. Therefore, this article contributes to this empirical research gap.

Additionally, we wanted to shift the theoretical focus from the analysis of single regime's transitions into the comparison of transition potentials of different regimes as well as their mutual interactions. Comparing the different characteristics of the urban regime systems presents a new way of studying sustainability transitions.

2.3. Analytical Framework—Comparison of Urban Infrastructure Regimes

The MLP approach states that the socio-technological regimes are confronted with various pressures from the landscape and niche levels. This article takes the regime level as the unit of analysis and identifies the pressures arising from the landscape level and the innovative influences arising from the niche level in the Walvis Bay energy and water sectors. The regimes face different pressures and they differ structurally from one another. Regime dimensions are compared in their regime dynamics, level of complexity, level of coordination, and multiplicity of perceptions (Table 1). These categories are taken from our empirical data. The importance of each of dimension is explained more in detail.

In *regime dynamics*, we examine regime member relations and their positions and developments in the legislative frameworks that guide them. Regime members are organized in different ways, for example in public–private partnerships. Therefore, special focus is given in this article on the dynamics of the regimes' public and private actors, in which the supporting legislative framework plays a crucial role as an enabler of such partnerships.

The *level of complexity* refers to the multiplicity of structures embodied in the regimes. In human societies, differentiation in structure occurs in areas such as institutions, roles, technologies, and activities. Sustainability requires problem solving, and when aiming to solve such problems, societies tend to become more complex and energy consuming [30]. However, this article does not take the increasing complexity of the regimes necessarily as a hindrance to development, but instead focuses on the different embodiments of complexity in areas such as institutions, actors, and technologies.

Table 1. Regime dimensions.

Regime Dimensions	Analysis
Regime dynamics	Regime member relations and developments (public–private partnerships), legislative frameworks, and policies
Level of complexity	The multiplicity of structures embodied in the regimes, institutions, actors, and technologies
Level of coordination	Stakeholder engagement, clarity of roles and responsibilities, transparency in decision making, and access to data
Multiplicity of perceptions	Perceptions towards niches and landscape pressures, accessibility to and number of public forums

The *level of coordination* refers to the way stakeholder engagement is currently coordinated in the regimes through governmental investments and the way foreign investments are supported. Moreover, the level of coordination is related to the clarity of roles and responsibilities among regime members and is linked to transparency, for example, to openness in decision-making, access to information, and institutional capacity. Societies are embedded with actors' competing and cooperating visions and ideas about their futures [22]. Thus, *multiplicity of perceptions* refers to the modes of communication that assist actors in meeting and realizing their mutual learning and visions. The transition agenda is not only constituted of formal expertise but also of knowledge of local consumers, civil society, and communities [31,32]. Therefore, the question of participation is closely related to the aim of incorporating politics into the MLP [27,33,34]. These interactions are usually realized in arenas such as public forums and seminars.

3. Data

The study uses a multi-data approach. The primary data includes on-site observations gathered during the projects "NAMURBAN—Urban Resource Efficiency in Developing Countries—Pilot Walvis Bay, Namibia" (2015–2017) and Central Baltic Interreg project "SME Aisle—Exports of clusters of CB economic strengths shipbuilding, maritime, renewable energy, automation and ICT to Namibia as a stable point of entry to the Southern African markets" (2018–). The secondary data includes documentary sources: Namibia's national policy papers and reports [35–45], research articles [46–48], and books [49–51]. Primary data informed the analysis directly, while the secondary data improved the contextual understanding of the analyzed regimes.

Supportive data includes a questionnaire that was organized by the first author during her three-month fieldwork in Namibia (September to December, 2016). The questionnaire included six dimensions affecting urban development: political, economic, societal, technological, ecological, and legal influences (PESTEL), and it received responses from five respondents representing different professions relevant to the future development of water and energy regimes, such as city developers (both in the city of Windhoek and Walvis Bay), a public policy researcher, an economist, and a policy analyst.

3.1. Results

Next, we present the water and urban energy regimes of the city of Walvis Bay. The regimes consist of influential regime members and the laws, norms, and habits guiding them. We introduce different pressures related to actor network dynamics of the regimes and the technologies used in water management and energy production.

3.2. The Water Regime

Namibia is considered one of the most arid countries in Sub-Saharan Africa. Due to irregular and low rates of rainfall, ephemeral flows, and high levels of evaporation, the country relies heavily on groundwater reserves [38,46]. The recurring drought conditions since 2013 in Namibia have worsened the situation, especially in the central area of the country. On the 6th of May 2019, the President of the Republic of Namibia, Dr. Hage Geingob, declared a state of drought emergency in the country [52]. For example, the capital Windhoek has imposed measures restricting water use in accordance with the city's drought management plan [53]. The restriction approach follows years of scarce rainfall, resulting in poor recharge of the city's aquifers.

On the other hand, especially the northern parts of the country have experienced the effects of severe flooding caused by heavy rainfall in the area [54]. This is one of the examples of the country's irregular and skewed distribution of rainfall [55], which creates different challenges in urban development in different parts of the country.

Currently, the most common methods used in water collection are water abstraction, collection of surface and floodwater, and wastewater recycling. Wastewater recycling has been adopted as a viable practice in at least eight towns in Namibia and in the country's mining sector. To date, the capital Windhoek has represented the main city area to recycle water to a drinking-water quality. Other recycled wastewater, not fulfilling the requirements of drinking water, is mainly used for irrigation [46,56], which is the current method in Walvis Bay. Desalination has become a viable option in water provision, at least on a theoretical level. Namibia shares all its perennial rivers with its neighboring states. These rivers are considered to be the only viable option for the collection of surface water, and the management of these resources is defined by international water law [57,58].

The actor network of the urban water regime is presented in Figure 2. The water supply actor network demonstrates the scattered dynamics of the regime. The Department of Water Affairs (DWA) is responsible for rural water supply, regional authorities for small-scale water supply in small communities, local authorities for water supply to municipalities, and the private sector for supplying the agriculture, mining, and tourism sectors [57].

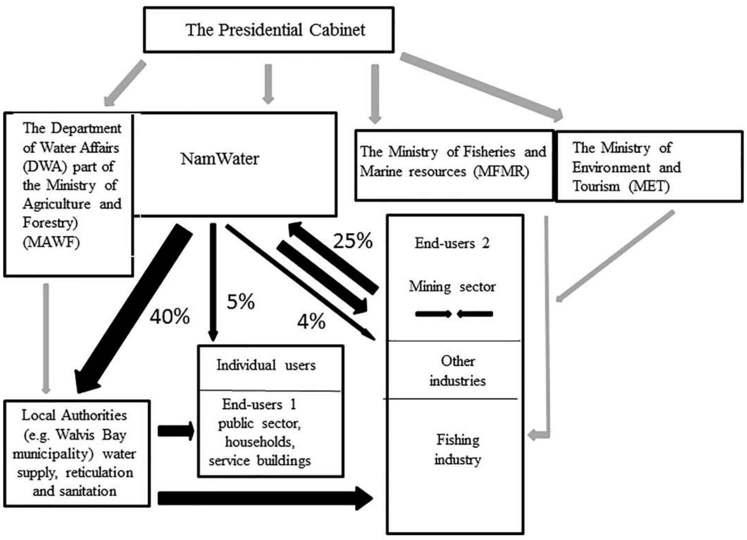

Figure 2. Water regime network in Walvis Bay. National level supply and tariffs are represented by black arrows, while permits, legislative authority, and licenses are represented by grey arrows.

In the sanitation sector, local authorities are solely responsible for sanitation services in their areas. The Namibia Water Corporation Ltd. (NamWater), a parastatal enterprise, has a legal responsibility to deliver bulk water to large units such as municipalities, mines, and other industries [36]. NamWater also regulates the usage of water through tariffs or by restricting the offer of new water supplies.

The city of Walvis Bay, together with towns of Swakopmund and Henties Bay, has so far been able to provide an adequate supply of water for its residents. It obtains water from coastal aquifers of the Kuiseb, Swakop, and Omaruru Rivers, which are ephemeral rivers [59]. The large aquifers, such as Kuiseb and Omdel aquifers, provide water through a network of boreholes, reservoirs, and pipelines [57]. This network is operated by NamWater. Walvis Bay Municipality purchases fresh water from NamWater and supplies it to public end users and to the fishing industry. The municipality sets the tariffs and fees for water consumption annually, and these are determined by tariffs set by NamWater and developments in the price of water and demand. An increase in demand correlates with an increase in the tariffs.

So far, estimations by NamWater suggest that water obtained from groundwater resources in the Kuiseb aquifer could currently sustain a demand of 9.5 Mm^3 for a period of ten years even to short periods of high demand of 11.4 Mm^3/annum. On the other hand, in the case of Omdel aquifer, the Department of Water Affairs and Forestry has reduced the permitted abstraction rate from this aquifer from 9 Mm^3/annum to only 4.6 Mm^3/annum [40]. The reduction is caused from a previous overuse of the aquifer. Although the situation in Walvis Bay and Erongo Region remains at medium risk in water provision, the growing demand of the central part of Namibia as well as local households and mining sector may impose a severe risk in water provision in the future.

The mining industry has found alternative ways to obtain water. Since November 2013, some mines have been using desalinated water supplied by NamWater, which purchases this water from the privately owned Areva desalination plant in Henties Bay, currently the only desalination plant operating in the country (opposing black arrows in Figure 2). The costs of desalinated water comprise 16% of NamWater's total costs [39]. Municipalities consume 40%, the mining sector 25%, and town councils 15% of NamWater's total water supply, while other industries consume 4%, Local Water Committees 4%, Ministries 3%, Regional Councils 2%, and Village Councils 1% of the supply. Individual customers consume 5% of the water delivered by NamWater and this percentage is increasing.

The Ministry of Environment and Tourism (MET), especially acting under the Environmental Management Act of 2007, has the overall responsibility for safeguarding the environment and promoting biodiversity, through mining licenses and environmental impact assessments. The Ministry of Fisheries and Marine Resources (MFMR) is responsible for managing capture fisheries and aquaculture. The thin arrows in Figure 2 between the MET and the mining sector and the MFMR and the fishing industry demonstrate the issue of implementation of environmental legislation. The Namibian government has been struggling to create a central environmental statute, which would cover all the environmental sectors and determine clearly the principles of environmental policies and their aims, objectives, and control mechanisms [60]. Thus, the impact of environmental conservation measures may be characterized as being generally weak, thereby threatening the rich biodiversity of Walvis Bay.

Moreover, some traditional methods such as water abstraction, collection of surface and flood water, and wastewater recycling may at worst lead to over-exploitation and to environmental degradation (Table 2) [56,61] and become insufficient due to poor performance of dams [62].

Table 2. Water regime: key factors.

Factor	Situation
Availability of resources	An arid country characterized by irregular and skewed distribution of rainfall, dependency on groundwater reserves, water provision in Walvis Bay and Erongo Region remains at medium risk
Examples of used methods	Aquifers, a network of boreholes, reservoirs and pipelines, desalination (mining sector), water abstraction, collection of surface and floodwater, and wastewater recycling
Challenges	Increase in demand, over-exploitation of resources (aquifers) and environmental degradation, poor performance of dams
Regime network	Scattered dynamics of the regime

3.3. The Energy Regime

Namibia is a country where the potential for renewable energy is high and the country is generously endowed with renewable energy (RE) resources such as solar, wind, and biomass. Despite the renewable energy potential in the country, and although in its recent report NamPower [45] has been successful in providing electricity at a rate of 99.83% nationally, the country still relies heavily on imported energy. Furthermore, the demand for electricity continues to grow, especially in the Erongo Region and Walvis Bay area, which may experience significant economic growth due to increasing mining activities and other economic activities [63].

The Namibian electricity supply is highly reliant on imports from different countries [64], with Eskom of South Africa providing up to 53% of Namibian electricity. Currently, 70% of Namibia's electricity requirements are imported through bilateral and day-ahead market contracts from the Southern Africa Power Pool (SAPP). A small but growing proportion of electricity is from solar energy [51,65]. Local electricity is generated by four NamPower stations—Ruacana hydropower station, Van Eck coal-fired power station, Paratus diesel-oil-fueled power station, and Anixas oil-fueled power station—accounting for 36.6% of the total energy/power supply in the country [66]. Hydropower currently constitutes the largest percentage (99%) of local electricity provision [43]. However, it is highly dependent on the water flow of Kunene River. All petroleum products in Namibia are imported [67].

In the future, the country is planning to increase cooperation with neighboring countries, for example with the Bayenes hydropower project involving cooperation between Namibia and Angola, as well as to increase its energy provision from renewable energy sources, for example with the Otjikoto Biomass Power Station project and the Lüderitz Wind Power plant project [45].

Nationally, industry consumes approximately 60%, the residential sector 20%, and the public and commercial sector 15% of the total amount of electricity [68]. The Erongo regional electricity distribution company (Erongo RED) distributes 15% of the total electricity requirements of the country [41]. In the case of Walvis Bay, the responsibility for electricity distribution has been shifted from the municipality to Erongo RED.

The actor network of the energy regime is centralized (Figure 3). The parastatal enterprise NamPower has a monopoly status in the electricity sector, acting as the buyer of electricity supply and Namibian grid operator. It is responsible for electricity production, delivery, and transportation. It also exports electricity to neighboring countries and is responsible for the overall stability of the national electricity network [66]. Governmentally established regional electricity distribution companies (REDs) hold licenses for electricity distribution and supply in the areas where they have been established.

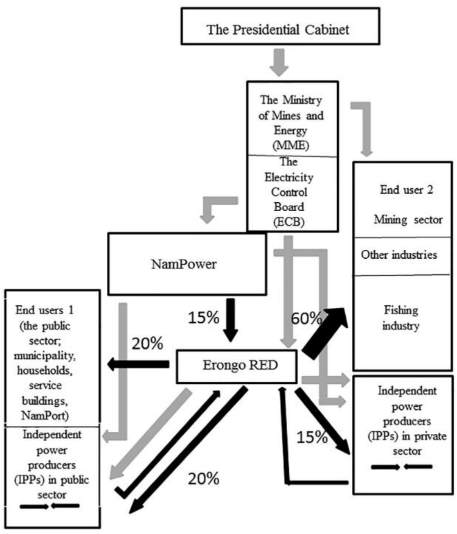

Figure 3. Energy regime network in Walvis Bay. Supply is represented by black arrows, while permits, licenses, and tariffs are represented by grey arrows.

The Ministry of Mines and Energy (MME) is responsible for overseeing the Namibian electricity sector and is the monitoring authority of the sector, the primary promoter and the implementer of energy policy [66]. The authority for granting, transferring, and renewing licenses lies with the MME, which exercises this authority based on the recommendation of the Electricity Control Board (ECB). The ECB grants licenses for all private actors, including independent power producers (IPPs), who participate in the production, distribution, and trade of electricity. The authority and independence of the ECB is limited in these delivery processes, as the permission to grant licenses ultimately comes from the MME.

In the past, the role of the IPPs has been minimal due to the market dominance of NamPower and the REDs and the difficulties in obtaining licenses through negotiations with NamPower or local REDs. Some minor self-production can be observed (opposing black arrows in Figure 3) by the IPPs, individual households, and industries, but this is still a small-scale activity. However, the regime seems to be changing in this regard. For example, in the NamPower reports, it is stated that the percentage of IPPs in total energy composition has risen from 2% to 6% in the period of 2016 to 2019 [44,45]. Despite a rather high percentage of electricity provision, NamPower has been facing some challenges both when importing electricity from other Southern African countries as well as in national supply (Table 3). For example, the dependence on hydropower from Kunene river and significantly lower river flows during 2017–2019 resulted in the second highest amount of imported energy over the past years. On the other hand, due to the Cyclone Idai in Mozambique and outages of interconnections in the region thereof, NamPower was unable to supply energy from Zambia and Zimbabwe [45].

Table 3. Energy regime: key factors.

Factor	Situation
Availability of resources	Electricity provision is at a rate of 99.83%, the country relies heavily on imported energy nationally, the high potential for renewable energy solutions
Examples of used methods	Imported energy, hydropower, coal-fired power station, diesel-oil-fueled power station, oil-fueled power station, solar, wind, biomass
Challenges	The demand for electricity continues to grow, especially in the Erongo Region and Walvis Bay area, distractions in energy import
Regime network	Centralized

4. Comparative Analysis

Namibia, unlike many other African countries, has not shown interest in privatization [69]. Hence, to date, most of the sectors in the country incorporate 35 state-owned enterprises (SOEs), and such enterprises are responsible for service delivery also in the water and energy regimes. The governance model of SOEs originates from the party politics of the South West Africa People's Organisation (SWAPO), which has held the presidency in the country since Namibia's independence in 1991. Instead of privatization, the government has concentrated on improving the efficiency and self-sustainability of the SOEs in operation.

In the water regime, the parastatal enterprise NamWater is responsible for bulk water supply, and in the energy regime, the parastatal enterprise NamPower acts as the buyer of electricity and Namibian grid operator. Both water and energy regimes are facing challenges in responding to the future growing demand for resources and services in urban areas. However, some characteristic differences may be found between the regimes.

We identified water recycling and desalination as the niche technologies most oriented towards sustainable outcomes in the water regime. We found solar energy, wind energy, and bioenergy as potential niches in energy system transition. According to external experts, water crisis is the most influencing factor in future urban development. Thus, in the case of urban water regime, the drivers include the current water crisis influencing especially the central area of Namibia, and the situation is harshened significantly by climate change. In the case of the urban energy regime, the drivers or trends are identified as follows: dependency on imported electricity from Southern Africa and the future security of supply and increasing global awareness and affordability of RE technologies. Both regimes are also being affected by the national economic turndown of the country, which in turn is being affected by changes in the international economic regime. Next, we discuss the pressures that these regimes are facing in the four dimensions introduced in Table 1.

4.1. Regime Dynamics

The regimes differ when it comes to their legislative frameworks. The water regime is characterized by outdated legislation, such as the Water Act No. 54 of 1956, which remains legally in force despite being drafted under apartheid rule, and which does not apply to Namibia in its entirety and does not cover all areas of the country's water law. The new Water Resources Management Act of 2013 has not yet been promulgated. Even though the Act of 2013 is practiced as a promulgated law, it still lacks legal enforcement in conflict situations, such as litigation processes, and raises uncertainty among the actors in the regime about which legislative framework should be applied in practice [70]. Moreover, the effects of the legislative uncertainty increase the uncertainty of the potential businesses both local and foreign to invest in the sector [48].

Unlike the City of Windhoek, which has prepared the local drought plan and has imposed several restricted measures in water use, the city of Walvis Bay has not been forced to draw similar policies in the past. However, this situation is changing due to the growing demand of water in households and among businesses, such as the mining sector.

The White Paper on Energy Policy, developed by the Energy Committee in 1998, sets the foundation for Namibia's energy policy. Since then, the regime has begun to shift towards an RE-supportive legislative framework. For example, new legislation/guidelines on renewable energy include the National Renewable Energy Policy of 2017, which addresses the growing importance of IPPs as service providers in the future.

Because of the Renewable Energy Feed-in Tariff system adopted in Namibia, the power utility (either NamPower or Erongo RED) and the ECB will accommodate small- to medium-sized businesses in the generation of power from differing RE sources from 500 kW to up to the maximum of 5 MW. If the generation exceeds 5 MW, an IPP needs to negotiate a power purchase agreement with an off-taker; in this case with NamPower or another distribution entity [51,63]. In the late 2016, net metering rules were promulgated by the government, which has opened doors for net metering of customers [71].

Unlike NamPower, NamWater is currently struggling to create a procurement system, which would both be as open to all suppliers as possible, including previously disadvantaged population groups, without compromising on the quality of water and services related [40]. However, its future cooperation includes the construction of a new coastal desalination plant, which would bring water both to coastal and central areas of Namibia. A financing agreement between the German Development Bank KfW (Kreditanstalt für Wiederaufbau) and the Namibian Government/NamWater has been concluded and a feasibility study on the desalination plant will be completed in year 2020 [40].

To summarize, the legislative framework and policies in the water regime are outdated, which in practice influences the way conflict situations are handled and the uncertainty of the potential businesses both local and foreign to invest in the sector. In the energy regime, the legislation and policies seem to create a better frame for investments.

4.2. Level of Coordination

The multi-stakeholder engagement, which includes both public and private actors, has resulted in better outcomes in the energy regime. For example, the Renewable Energy Feed-in Tariff initiative has opened opportunities for private sector engagement and investments. The privately owned 37 MW Alten solar park was connected to the grid in 2019 [45]. This demonstrates that not only have the number of IPP-financed projects increased, but also the extent of such projects. Today, the Ministry of

Mines and Energy's Solar Revolving Fund offers subsidized interest rates on loans to end users for the purchase of solar water heaters, which have also been installed in some houses and public institutions (such as vocational training centers) in Windhoek under the multi-stakeholder initiative [72].

The water regime, on the other hand, has benefitted from the expertise of private firms and consultancies in the case of the launch of the national Integrated Water Resource Management Act of 2010. However, as most of the implementation and project management occurs in the public sector, weaknesses in coordination and communication become apparent [48]. This underlines the weaker status of coordination between the public and the private sector in the water regime in comparison to the energy regime and in practice, it is shown in a difficulty to create an inclusive procurement system for supply and service providers in the water regime. Cooperation with KfW on a new desalination plant does seem to be a step towards sustainability transition.

Even though both regimes are characterized by challenges in access to data, such as several parameters including rainfall, evaporation, wind, and solar conditions in Namibia, they differ in transparency levels. For example, the annual reports of NamPower and Erongo RED are easily accessible online, whereas the NamWater annual report has not been made available online regularly in the past. Now the situation seems to have improved, as the latest report may be found on the organization's website. However, the past and recent water crisis in the central area of the country has demonstrated how transparency in decision-making and information flow has been neglected by the governmental actors [48]. NamPower seems to have succeeded more in transparency, of course keeping in mind that it has been able to provide a delivery rate of almost 100% since it still can rely on imported electricity. The water sector as a whole, on the other hand, has faced more severe pressure from the landscape forces in terms of water scarcity.

In conclusion, the Renewable Energy Feed-in Tariff initiative has opened opportunities for private sector engagement and investments. This underlines the weaker status of coordination between the public and the private sector in the water regime in comparison to the energy regime, and in practice, it is shown in a difficulty to create an inclusive procurement system for supply and service providers. Cooperation with KfW on a new desalination plant does seem to be a step towards sustainability transition.

4.3. Level of Complexity

The decision-making process in Namibia is illustrated by a fact that there are currently 23 different ministries operating in the fields of regulation and implementation, some of which are overlapping in their fields of authority and decision-making. There are three national strategy papers to address current development problems together with international commitments to the United Nations, the African Union, and the Southern African Development Community. However, this level of complexity in decision-making is even more present in the case of the water regime. The water regime is characterized by various sets of policies, plans, regulations, and responsibilities to protect scarce water resources, which are in many cases intersecting. The Water Act of 2013 outlines the need to establish key regulatory public institutions, such as the Water Regulatory, the Water Tribunal, and the Water Advisory Council, which are still either not constituted or not fully operational. The energy regime, on the other hand, is centralized and expected to become more complex due to the opening of markets for households and IPPs.

Both regimes are characterized by the lack of skilled workforce. For the water regime, the current condition of water infrastructure has been a major concern, especially the condition of the sewerage system in the city of Walvis Bay. It still covers 100% of the city area but is under constant pressure of vandalism and environmental factors such as underground seawater and ageing infrastructure. The construction of the pipeline would require experienced workforce or at least the exchange of such knowledge between those who are retiring and those who are just graduating from school. In the case of the energy regime, to ensure the operation and maintenance of RE technology in the areas where it is installed, there is a growing need for increased professional capacity in the form of vocational workforce training. This training could be profitable, especially for the youth in Namibia, as one of the main reasons for youth unemployment is the mismatch of skills. The energy regime, on the other hand, is centralized and expected to become more complex due to the opening of markets for households and IPPs.

The country's advantages have been political stability and robust microeconomic management [73]. However, the recent financial report from the government indicates that the growth of the total debt of a percentage of GDP has risen from 2017 (41%) to 45% in 2019, and is expected to grow to 53% in the period 2022/2023. Moreover, as the governmental debt increases, the growth of GDP in the country will not keep up with this development. The government will, in its future fiscal years, concentrate on job creation and private sector development [74]. Despite the government's focus on education, health, and employment, defense continues to receive a huge amount in budget allocation. Both regimes, the water and energy regimes, are competing with the defense regime, which receives a substantial share of governmental funding (6.8 billion Namibian dollars in 2020/2021).

To summarize, both regimes are characterized by the lack of skilled workforce and resources. However, the level of complexity in decision-making is even more prominent in the case of the water regime. The water regime is characterized by various sets of policies, plans, regulations, and responsibilities and it lacks key regulatory public institutions outlined in the Water Act of 2013. The energy regime, on the other hand, is centralized and expected to become more complex as a result of the increasing participation of the households and IPPs in the markets.

4.4. Multiplicity of Perceptions

The establishment of the parastatal NamWater was an effort to resolve a heavily subsidized water-tariff system and the incapability of the DWA to provide full cost-recovery for water-supply system [75]. However, NamWater is facing increasing pressure on demand and financial problems arising from difficulties in revenue collection, costs of replacing old water-supply infrastructure, and the lack of human resources within the company [40]. Therefore, its mandate as a service provider has been questioned in public debate. The lack of key regulatory public institutions in the sector has affected the number of public forums for such debate [48].

Due to a previous surplus of electricity, countries such as South Africa have been able to sell electricity at an extremely low price to Namibia. [63,76]. However, the situation has changed dramatically as South Africa has been suffering from a national energy crisis resulting in an annual tariff increase [77]. Other distractions in energy import such as Cyclone Idai in Mozambique have all in all provoked serious discussions in Namibia on a national level about the importance of self-sufficiency in electricity supply.

The RE technologies have aroused wide interest in Namibia. This is due to perceptions of the increasing profitability of such technology, which stems from a rapid technological development of RE on a global scale. On a national level, the change in perceptions is demonstrated by the commitment of the government in increasing the proportion of renewable energy in its national energy mix and several concrete supporting actions of the government nationally in the RE field. Especially in the case of solar energy, the perceptions on abundant amount of sun light have raised the keen interest of investors.

In the case of bioenergy, invader bush as a source of biogas, especially in the northern parts of the country, has been seen to offer remarkable potential to the country's energy mix, although the use of this resource is still in a research phase [51,67]. In an urban context, challenges include waste separation, such as the separation of organic waste from other substances such as rubble, and the current insufficient amount of waste in the city of Walvis Bay for profitable utilization. However, the plans on the new biomass power station in Otjikoto seem to demonstrate that biomass is still considered a strong candidate in the renewable energy production.

In coastal climate, wind is a dominating feature. According to the estimations of the SAPP, wind power potential in Namibia could cover the amount of 27,201 MW and 36 TW. At the moment, one of the wind turbines of 220 kW feeds the distribution grid in Erongo Region [67]. Wind power has been of interest to the Namibian government already in the 1990s, when the Ministry of Mines and Energy implemented the evaluation of wind potential in Walvis Bay and Lüderitz [78]. However, some challenges in the wind power sector include the lack of research and long distances in the country.

In contrast, even though the water crisis is considered a serious threat, it influences some areas more than others. As already stated, the city of Walvis Bay has so far been able to offer an adequate water supply to its residents. Thus, water issues might not rise high enough on the decision-making agenda locally. However, the water regime in Walvis Bay will face a growing pressure in the near future. Not only will the demand of water increase among households and enterprises, such as the mining sector, but also the demand of other urban water regime in the central Namibia, as the planned new desalination plant would also provide water to the cities such as Windhoek.

In Namibia, desalination technology is widely recognized as the most promising solution for the national water crisis. It has also been considered too expensive and in some cases not necessary, especially in Erongo Region. In addition to the different perceptions of the amount of water resources available, perceptions about the ownership of a desalination plant have varied in the past, although NamWater has continued purchasing desalinated water from the mining sector at an unnecessarily high cost. Cooperation between the government and KfW on a new desalination plant seems to offer a step towards alternative perceptions in the water regime.

To summarize, due to struggles in maintaining its operations, NamWater's mandate as a service provider has been questioned in public debate. On the other hand, the question of the importance of self-sufficiency in electricity supply on the national level in Namibia has been become a growing concern. The RE technologies have aroused wide interest in Namibia. This delivers from the perceptions of the increasing profitability of such technology, which stems from a rapid technological development of RE on a global scale. Desalination technology is widely recognized as the most promising solution for the national water crisis.

5. Discussion

In this article, we have used the MLP framework to analyze sectoral differences in transition towards more sustainable practices. Although we consider it as a useful guiding instrument for our analysis, given that the framework has originally been developed in European context, it may disregard certain characteristics of developing regions. When applying MLP in studies focusing on developing regions, we recommend that researchers pay extra attention to differing institutional and funding capacities, as well as to other differences between the contexts.

We have demonstrated that in Walvis Bay, the energy regime has more potential toward sustainability transition than the water regime. This difference between the regimes can be largely explained by diverse actions in the areas of legislation development, stakeholder engagement, niche maturity, perceptions towards the current situation, and the niche technologies (Table 4).

However, there still remain various challenges in both regimes, especially as both of them are expected to become more complex in the future. The energy regime will open some of its activities for new service providers while the water regime already has increasingly overlapping roles and practices—all this will require increased coordination capacities. Our analysis shows that both regimes also suffer from a lack of funding and weak institutional capacities, and their development constantly competes with other development issues in the country. In this competition, the energy regime may be more capable in attracting foreign investment through more efficient stakeholder engagement.

It is important to understand that landscape forces and niche developments influence sectoral regimes differently. In Namibia, water-related landscape pressure affects some areas more than others, whereas energy-related pressure seems to affect equally the whole country. On the other hand, the level of the landscape pressure in the water regime may increase remarkably in the future compared to the pressure affecting the energy regime. The global trend towards increasing affordability of RE technologies may be one driving force supporting the shift towards sustainable ends, which is also supported by the increase in license provision of the new IPPs in the RE sector. Globally, RE technologies are rapidly becoming more affordable, whereas in the case of the water regime, desalination is still considered energy-intensive and expensive. Thus, global scale perceptions of niche maturity may influence local regime actors and investors.

Table 4. The comparison of regime dimensions.

Regime Dimensions	Water Regime	Energy Regime
Regime dynamics	Cooperation between public and private is limited, outdated legislation	More dynamic cooperation between public and private, legislation in place
Level of complexity	Complex decision-making processes (some institutions not established)	Less complex decision-making processes (defined institutions and their roles)
Level of coordination	Procurement processes in development, less niche maturity (limited options, expensive technology), lack of research, recent increased level of transparency	Procurement processes in place, niche maturity (rapid development of various options internationally), research from national (and international) institutions, transparency
Multiplicity of perceptions	More severe landscape pressure, lack of trust towards institutions	More public forums, understanding the potential of renewable energy (RE) business-wise, electricity may still be obtained externally

The two regimes are also deeply interlinked in various ways, and climate change adds complexity to the sectoral management in Namibia due to unforeseen development paths. For example, hydropower plays a significant role in local electricity provision, and some water technologies and practices, such as desalination, are high consumers of electricity. From a regional perspective, the increasing water scarcity in Namibia and its neighboring countries may result in disputes over shared watercourses, which may in turn have an influence on regional cooperation in the energy sector. Thus, the transition process is also related to the interaction between these regimes and their interactions with other regimes that have not been considered in detail in this article.

6. Conclusions

This comparison between urban water and energy regimes of Walvis Bay has demonstrated that the transition process towards more sustainable city systems is a process in which governmental actions, a supportive legislative framework, investments, coordination, and perceptions towards the current situation and technologies are deeply interconnected. Urban development is a dynamic process in which diverse urban regimes are strongly influenced by regional and global developments. By exploring the differences in sectoral regime qualities, we have shed light on complex sustainability transitions in urban environments, where the sustainability transition potential increases as the governance across multiple regimes improves. In addition, as rapid urban development tends to occur in areas with notable socio-economic challenges and lack of institutional capacity, there is a strong need for external capacity building and stakeholder cooperation.

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