Resource-extraction, urban infrastructure, and resilient planning:
Addressing the impact of the LNG industry in Soyo, Angola.

A Thesis Presented to the
Graduate School of Architecture, Planning, and Preservation
COLUMBIA UNIVERSITY
in the City of New York

In Partial Fulfillment of the Requirements for the Degree
Master of Science in Urban Planning

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May 2019

Abstract

In many resource-rich countries, a common ground is the interplay of lack of infrastructure and high social inequalities that are critical for climate vulnerability. This thesis intersects frameworks of resilience and sustainability to study the impact of urban development that comes along with oil and gas industry investment in infrastructure and social responsibility.

This research discusses the impact and spatial implications of oil and gas industry involvement in the city of Soyo located in Angola, which is the second largest hydrocarbon exporter country in South Saharan Africa. The study incorporates mixed methodologies including qualitative analysis, mapping, and spatial analysis. It starts by analyzing and mapping the gas-industrial landscape of Soyo to visualize the industrial plant and ancillary infrastructures that shape the city (roads, airports, etc.) Next, it includes a land cover analysis to describe and quantify the urban expansion between 2002 and 2017. And finally, it includes a qualitative analysis based on interviews with local stakeholders such as urban planners, professionals from gas industries, academics, and nonprofit organization leaders. Findings discuss the positive and negative impacts of the LNG industry in Soyo through the lens of equity.

The study concludes by providing recommendations about mobility-related infrastructure, housing accommodations, and spatial implications of gas-founded infrastructure. Using the case of Soyo the study informs policymakers, urban planners, and public officials of relevant issues to consider when regulating and incentivizing sustainable and resilient planning in coastal resource-extraction cities.

Keywords: Resource-extraction, urban infrastructure, sustainable development, resilient planning, coastal cities, LNG, Soyo.

Acknowledgments

I would like to especially thank my advisor professor Leah Meisterlin for her guidance and support, my reader professor Thaddeus Pawlowski, and to all the professors and faculty at GSAPP that allow me to further develop this research with their thoughtful advice.

I am especially grateful of all the professionals that took the time to be interviewed for this thesis generously sharing their knowledge and expertise: António Órfão, Telma Inglés, Daniel Rocha, Laurentino Silva, Helena Miranda, Jonas Costa, Zuela Capilo, Patricia Baptista, Allan Cain, Cupi Batista, Massamba Dominique, Filomena Cornelio, António Gama, Miguel Silva, Manuela Duarte, Carla De Almeida, Tchama Alfredo, Paulo Armando, Joao Massanga and Yerminha Nunes.

This thesis would not have been possible without the support of Henda D Morais Claro, who as a local expert provided tremendous insight from her experience living and working in Soyo. I appreciate her vision, passion, and perspectives toward social equity shared in multiple conversations and the logistic help in collaboration with Lourenço Nicolau and Manuel Domingos.

Last, but not least, thank you to my classmates and friends in the Urban Planning program, for their support, constructive critics, and profound reflections about intersections and evolving roles of design, architecture, and planning. Finally, I would like to thank my family, my parents, and especially José Luis Mateluna for the unconditional support, and for embarking on this journey together.

Table of Content

List of tables and figures

List of Figures

List of Tables

List of Abbreviations

DRC	Democratic Republic of Congo
DW	Development Workshop
ESHIA	Environmental, Socioeconomic and Health Impact Assessment
GIS	Geographical Information System
IFC	International Finance Corporation
ITA	International Trade Association US Department of Commerce
LNG	Liquefied Natural Gas
NGO	Non-Governmental Organization
NOC	National Oil Company
PERNORTE	Program for the Development of Fishing Communities of the North of Angola
PGZ	Provincial Government of Zaire
REIs	Resource Extractive Industries
SONANGOL	Angolan State Oil Company
SSA	South Saharan Africa
UNDP	United Nations Development Program
WRS	Worldwide Reference System

Chapter 1. Introduction and Background

Sustainable development and resource-extraction in Africa have been a primary concern for international multilateral institutions, governments, private enterprises, and scholars. Resource extraction industries usually incorporate investment in community benefits, job creation and urban infrastructure, depending on the local content agreements. However, they have high impacts on the degradation of ecosystems, pollution, and the centralization of local economies that compete with the aims of sustainable development.

Angola as the second-largest exporter of oil and liquefied natural gas (LNG) in Sub-Saharan Africa built a world-class LNG processing facility located in Soyo, 350 km north of Luanda, at the mouth of the Congo River. According to the Environmental, Socioeconomic and Health Impact Assessment Report (ESHIA) developed by Angola LNG in 2006, the plant is projected to have a 20 years lifespan after construction is finished[1]. Multiple investments in infrastructure and social programs have already been implemented by the gas industry has a large impact on the development of the city.

However, the current conditions of Soyo are still represented by a lack of urbanization and lack of access to essential services for most of the population. Therefore, the purpose of this research is to analyze the positive and negative impact of urban infrastructure and social programs supplied by the gas industry in Soyo, understanding the relationship between local government and corporate multinationals in efforts to support urban development. As previously mentioned, due to the existing conditions of Soyo, and its location in coastal region prone to flooding, the framework of this thesis includes resilient planning, climate adaptation, and equitable growth.

[1] The LNG plant was built between 2008 and 2012 and the commercialization and exports in 2013. The expected lifetime of the plant is at minimum until 2033 according to ESHIA Report and interviews with ALNG management team.

This thesis includes a background description from global to local scale, as the topic echoes multiple countries in the region and among other regions dedicated to resource-extractive markets. The methodology and findings are presented in one combined section analyzing positive and negative impacts of the presence of the gas industry in Soyo at different scales. Finally, the discussion and conclusions identify themes and considerations related to the development of urban infrastructure coupled with community benefits, aiming to provide insights for future policies and strategies to achieve sustainable development, resilient urban planning, and poverty reduction in Sub-Saharan African coastal cities.

1.1 Research Question

This thesis aims to analyze and discuss the positive and negative impact driven by the LNG industry in Soyo focusing on urban infrastructure, sustainable development, and urban resilience. Hence, the overarching research question for this study: 'What has been the impact on urban infrastructure and sustainable development propelled by the LNG industry in Soyo?' Focusing on equity and resilience due to the conditions and coastal/riverine location of Soyo the research question is followed by two sub-questions: Who is negatively impacted, benefited or left out by these investments? To what extent does urban development support or hinder resilient planning in Soyo?

A second research objective for this study is to identify the interplaying factors behind the spatial configuration of Soyo, expanding our understanding of resource-extractive geographies and its urban settings. The significance of this research relies on the reflection on how gas-funded infrastructure projects and social programs impact urban development and local communities. Furthermore, documenting, discussing and visualizing the impact of the gas-industrial landscape in Soyo permits urban planners to raise awareness about the spatial implications when envisioning planning for future resource- extractive cities.

1.2 Limitations

This thesis focuses on the urban development of Soyo in relationship to the location of the LNG industry and the extension of Soyo municipality. The identification of the infrastructure and social projects funded by Angola LNG come from different sources including interviews and websites as the Investment Contract signed in 2007 focuses mostly on the dollar amount. Therefore, there is a possibility that not all the projects are included in this research.

The methodology includes spatial analysis, interviews, and observations during the site visit (10 days) to Soyo and Luanda in January 2019. Further research could consist of interviews and open discussion with urban planners from the public sector at regional and national levels of administration, and interaction with the local population and traditional leaders in Soyo. This research did not include the latter stakeholders due to time constraints and limited accessibility, but in order to have a more robust understanding of the local impact of the LNG industry, their participation is critical.

The land cover analysis did not considered milestones in the period in between 2002-2015 due to high cloud coverage in the area that limited access to satellite imagery scenes. The study of urban growth could offer better results using scenes from other satellites and with higher resolution.

The themes discussed in this thesis are mainly related to spatial implications, which are part of a systemic configuration of economic, social, and political aspects. The analysis of the impact of urban infrastructure and the extractive urbanisms in Soyo is not intended to fully explain social problems as isolated consequences of the built environment or to "fetishize the spatial geography" as Agnotti (2013) warns architects and urban planners, but to acknowledge themes and spatial configurations that take part of a systemic analysis.

1.3 Background

1.2.1 Sustainable development and resource extraction in SSA

Sustainable development in resource-rich economies represents a major challenge discussed broadly by international multilateral institutions, governments, private enterprises, and scholars worldwide. In a general context, since 2003 the international framework of sustainable development and resource extraction advanced towards more sustainable practices. The World Bank Group released the "Extractive Industries Review Report" in 2003 addressing recommendations to ensure compatibility and prioritization of (1) pro-poor public and corporate governance, (2) effective social and environmental policies and; (3) respect for human rights. The same year, The African Union Convention (AUC) and the African Peer Review Mechanism (APRM) were created as two structures for effective governance of extractive industries in Africa (Afful-Koomson, 2013)

In 2006, the United Nations Office of the Special Adviser on Africa (UNOSAA) held a meeting called "Natural resources and Conflict in Africa: Transforming a Peace Liability into Peace Asset." At this meeting, the discussion promoted socially responsibility in economic resource management in post-war countries in Africa (Annan, 2006). Subsequently, in 2008 the UN General Assembly adopted a resolution on the Extractive Industries Transparency Initiative (EITI) promoting transparency and accountability to maximize the contribution of the private sector into people-centered sustainable development (UNGA, 2008). From 2003 to 2008 a clear role of multilateral institutions have supported a shift from a resource-extraction based on conflict to an avenue for sustainable development highlighting the relevance of corporate governance, regulatory structures, and corporate social responsibility.

Resource extractive industries (REIs) normally invest in urban infrastructure and job creation for their business feasibility. However, they generate multiple impacts related to environmental degradation,

centralization of the local economy and social conflicts. The balance between positive and negative implications based on the government's legal frameworks have the potential to direct revenues from extractive resources to sustainable development. As Afful-Koomson (2013) claims, the South Saharan Africa (SSA) region has great potential supporting sustainable development by capturing resource extraction revenues and enhancing the contracting systems between governments and multinationals, reinforcing regulatory mechanisms, increasing institutional and human capacity and better managing coordination. From this approach, social programs and infrastructural projects become a way of capturing resources and investing in local communities.

Currently, oil and LNG are primary sources of a global energy supply, and the world's consumption of these fuels is expected to increase by 2030 as they are implementing newer technologies for offshore extraction. The leading oil and gas producers in SSA are located in the west coast, where four countries are participating in the Organization of the Petroleum Exporting Countries (OPEC): Nigeria (1971), Angola (2007), Equatorial Guinea (2017) and Congo (2018.) Angola is the second largest exporter in the region, and since the civil war ended in 2002, the country has developed a local content framework that enables the business environment to attract investment into the extractive sector (Mushemeza, 2016). According to Mushemeza´s analysis on the local content frameworks (LCF) for oil and gas sector in Africa, Angola provides a valuable example promoting Angolan employment and national industry for the provision of products and services to oil and gas sectors aiming to strengthen the local economy. Additionally, environmental efforts to reduce impacts, skill development for local communities and privately funded infrastructure have been promoted following local content frameworks and social responsibility initiatives.

1.2.2 Characterization of Oil and Gas Extraction in Angola

As previously mentioned, Angola is the second-largest oil producing country in sub-Saharan Africa with an estimated production of 1.55 million barrels of oil per day (bpd) and 17,904.5 million cubic feet of natural gas (ITA, 2018.) Angola has great potential for further development of oil and gas industries holding proven oil resources for 9 billion barrels and 11 trillion cubic feet of natural gas reserves (ITA, 2018). The Angolan economy is highly dependent on the production of oil and gas which contributes about fifty percent of the nation's gross domestic product and around ninety-two percent of their exports (OPEC, 2018). The significant drop in oil prices in 2014 impacted Angola´s economy resulting in a constraint on the public budget, currency devaluation, and high inflation levels. At the date, Angola is expecting to increase production by 2020 going through a political, legal and economic reform to pursuit an industry reorganization.

Angola´s commercial production of oil initiated on-shore close to Luanda in 1956, and its first offshore oil field was discovered ten years later in Cabinda (1968). The political and economic context of Angola is tied to the development of the oil and gas industries. Starting with the war of liberation to obtain independence from Portugal (1961-1975), and followed by twenty-seven years of civil war ending in 2002. The oil and gas explorations focused in offshore fields during the war and continued preparing studies for future development. Angola´s devastated infrastructure and the urgency to improve social conditions pointed out a reconstruction process based on oil and gas revenues as primary inputs for funding. However, the reconstruction process of Angola is marked with high levels of corruption[2] that merged with the misuse of oil revenues, unclear benefits from public infrastructure and essential services to local communities, and the contrast of government elites enrichment (Ferguson, 2006; K. Reed, c2009.)

[2] Angola is ranked 165 out of 180 in the corruption perceptions index (CPI) 2018 published by Transparency International, a non-governmental organization that ranks countries by their perceived levels of public sector corruption determined assessments and opinion surveys.

The first regulatory frameworks were developed in 2002, by the Angolanisation policy supporting the Petroleum Decree Law 20/80 setting targets for the operations of oil companies in terms of job creation (70% to 90% of their workforce to be Angolan) and local supplier markets. Unfortunately, the Angolanisation targets were not achieved, but it impacted the economy positively rising local employment, skills development and national industry participation (Oyewole, 2018). Additionally, the procedures and rules for oil and gas operations are stated in the Decree 38/09 of August 14, 2009, in accordance with Angolan laws. The Ministry of Mineral Resources and Petroleum is responsible for regulating oil exploration and production activities. The National Concessionaire Sonangol EP holds the concession rights to award oil operations in Angola, and all international companies are required to operate through a partnership with Sonangol (ITA, 2018).

In the case of ALNG, the government entity provides its share of the investment and participates in the financing and profits from operations after the project is completed. The Angolan local content framework mandated ALNG to incorporate a percentage of nationals in a foreign company's workforce, a list of goods and services reserved for nationally owned vendors only, a list of goods and services requiring partnerships with foreign companies and local companies, a list of goods and services with no restrictions, and local content integrated into contract award by operators implementing their own tender procedures. (US Department of Energy, 2017)

This research analyzes the case study of the city of Soyo in Zaire province, in the north of Angola, where the largest LNG plant in the country was built between 2008 and 2012 by U.S companies Bechtel and ConocoPhillips. Angola Liquefied Natural Gas (ALNG) is a joint venture that incorporates a national company called Sonangol owning 22.8 percent of the shares, Chevron owning 36.4 percent, BP and ENI each with 13.6 percent (Órfão, Molinard, & Ríos, 2010). The plant in Soyo corresponds to an investment of over ten billion dollars, starting the production in 2013 producing 5.2 million tons of LNG per year.

Between 2015 and 2016 the plant was temporarily shut down due to technical difficulties, restarting in early 2017 exporting mainly shipments to Brazil, China, South Korea and France (ALNG, 2018).

1.2.3 Geography and Characterization of Soyo Municipality

Soyo municipality is located in the northwest area of the Province of Zaire, bordering in the north with Congo River and with the Democratic Republic of Congo (DRC), in the south with Tomboco municipality, the Atlantic Ocean to the west and the municipality of Noqui to the east (Figure 1). Administratively the municipality of Soyo is divided into five "comunas" called; Soyo, Pedro de Feitiço, Sumba, Mangue Grande, and Quelo. This analysis focuses on the comuna of Soyo where the LNG plant is located approximately 480 km from the Zaire provincial capital Mbanza Congo. According to the municipal plan of Soyo (2014), the municipality has about 116.000 inhabitants, and Soyo city has 65.000 inhabitants being the largest city in the province in terms of population. (Figure 2 and Table 1).

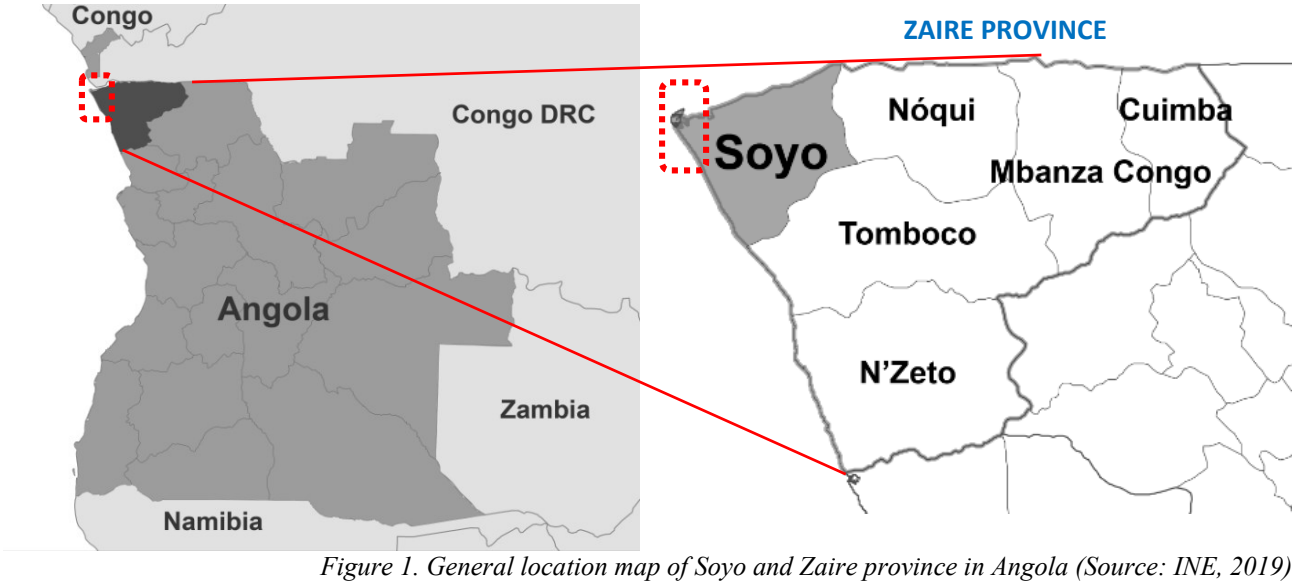


Figure 1. General location map of Soyo and Zaire province in Angola (Source: INE, 2019)

Comunas in Soyo Municipality	Surface (km2)	Distance Sede (km)	Bairros	N° of people
Soyo (Sede)	**1.036,86**	-	**39**	**65.340**
Sumba	1.044,08	48	35	34.589
Pedra do Feitiço	1.081.08	145	20	3.656
Kelo	1.519.08	121	18	4.937
Mangue-Grande	1.038.74	85	12	7.478
Total	**5.722.00**	**399**	**124**	**116.000**

Table 1 and Figure 2: Soyo Municipality and Comunas (Source: Plano Director Municipal de Soyo 2014)

The climate conditions and location of Soyo determine the exposure of the city to flooding issues that overlay with urban growth making relevant to consider frameworks of resilience and climate risk reduction in urban planning practice in this location. Soyo has humid tropical weather with a rainy season (from June to October), and a dry season (November to May), the average temperature is around 24 / 26º C. Soyo is covered with savannah vegetation, and shrubs and underbrush form the overall landscape of the municipality, with mangrove forests in the northeast along the Zaire River. Soyo is characterized by moderate slopes on the coast and rising to about 250m on the eastern periphery making inland areas less exposed to flooding events.

As the municipality of Soyo has played a leading role in the national economy related to the exploitation of oil (on-shore and off-shore) since the 1960s its socio demographic characteristics are tied to this history. A large number of expatriates serving the Kwanda oil base or ALNG, professionals for the health sector, as well as immigrants as refugees and traders constitute the demographics of Soyo (Plano Director Municipal de Soyo 2014). The official language in Angola is Portuguese, but most of the population in Soyo speaks Kisolongo (local Bakongo), or Lingala language by migration influence from

RDC (Development Workshop & Terra Group, 2015). Zaire Province is inhabited by people of Bantu origin which is a heritage that goes beyond the official linguistic divide of the Congo. (K. Reed, c2009.)

The economic activity in Soyo is mainly dependent on oil and gas production, and commercial small-scale trade and imports of consumer goods through the border with DRC. Soyo has services to offer to the province in terms of commercial activity and banking. Additionally, in Soyo, artisanal fishing is an important economic activity that represents income in the majority of families in coastal areas (Development Workshop & Terra Group, 2015)

Soyo LNG plant represents one of the most significant single investments in Angolan history (US$ 10 billion) (Jover, Lopes Pintos, & Marchand, 2012). Soyo is a relevant case study that intersects multinational investment with urban development including the following investments in infrastructure: the renovation and expansion of the Soyo municipal hospital, refurbishment and extension of the School in Bairro da Marinha, pavement of roads, upgrades to Soyo airport; a new bridge connecting Kwanda Island to the Soyo industrial zone, and a gas-fired power plant to serve the local community. ALNG funds other projects related to community liaison and conservation of biodiversity. Nonetheless, this research will center the scope in urban infrastructure and community benefits in the area.

Chapter 2. Literature Review on extractive geographies and urban planning

This literature review includes three main aspects that build the theoretical framework for resource extraction and its impact on urban development. First, a revision on the debate of resource extraction in developing countries commonly discussed as a "blessing" or a "curse." Second, an overview of urban planning frameworks related to sustainability and resilience related to resource extractive areas and urban planning, and finally a section that discusses the role of urban infrastructure, corporate social responsibility, and equity in the context of resource extraction.

2.1 Resource extraction in developing countries. "A Blessing" or a "Curse"?

Oil and gas extraction has led a significant economic growth for some countries, while at the same time it has caused large geopolitical conflicts. A relevant academic debate has questioned whether resource extraction is a blessing or a curse. A dominant perspective that defines resource extraction as a curse takes arguments related to economic stagnation, political turmoil, corruption, and weak governance (Collier, 2006; King, 2009). According to Afful-Koomson (2013), there is great potential to direct revenues from extractive resources into sustainable development in SSA region, but the challenges of deficient contracting systems, weak regulatory mechanisms, low institutional and human capacity and lack of coordination have encouraged negative impacts in health, ecological and social externalities that need to be addressed.

Saskia Sassen (2016) explained in a lecture called "New Geographies of Extraction," that the world has transitioned from multiple forms of imperialism to a global extractive model of global capitalism where the focus of investment is purely extractive minimizing the need to integrate local communities. Moreover, Sassen (2016) focused in the context of resource extraction in Angola to argue about the difference between the visual order of the city (physical form) and their global city function, which is defined as a platform for wealth extraction in the form of natural resources and for other economic activities to happen. Therefore the goal of resource extractive companies in cities residing only to "being a platform for wealth extraction" raises profound concerns on the ethical intentions to engage within a geography and local communities.

According to Reed (2002), resource-extraction processes have changed since the 80s, from small operations to intensive transnational corporations that through globalization and the liberalization of the economies have shifted their operations from developed to developing countries. Developing countries compete for REIs offering multiple incentives, tax breaks and concessions in environmental regulation

to ensure the multinational investments in their territory (Reed, 2002). In the context of limited access to urban infrastructure and lack of public funds for service provision, there is an open space for private parties to invest and contribute in these urban infrastructures (Koppenjan & Enserink, 2009). However, the tendency to let the private sector dictate rules and plans, where lack of governance structures and lack of information related to existent communities does not necessarily lead to sustainable or resilient planning efforts.

The negotiation process between corporations and governments could risk becoming a "race to the bottom" when compensations do not extend positive impacts for communities on a long-term basis. However, job creation, increase in commercial activity and the social projects invested in communities could lead to equitable economic development depending on the vision, implementation and governance structures in place. Therefore, the impact related to extraction-driven urbanism could reflect as a blessing or curse, or the co-existence of both in a contested arena (Obeng-Odoom, 2013).

2.2 Sustainable Development and Resilient Planning

According to Folke et al. (2002), the role of resilience is essential to achieve sustainable development in societies, and it has been studied in a large number of cases demonstrating the tight connection between resilience, diversity, and sustainability of social-ecological systems.

The framework for sustainable development uses the definition of the Brundtland Commission in 1987 "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" to maintain prosperous societies considering social, economic, cultural and ecological conditions (UNISDR, 2012, p. 92).This definition supports a long-term notion of achieving stability, practicing effective management and controlling variables to foresee a "prosperous" future. The UN created Sustainable Development Goals (SDGs) in 2015 to strengthen a call for action

including measurements, guidelines and evaluation process promoted and institutionalized by many multilateral agencies, corporations, and academia among others. In 2017, IPIECA[3], UNDP and IFC launched a report stating the implications of the UN SDGs for the oil and gas industry and their expected contribution to sustainable development[4], including recommendations and best practices to support local communities, increase access to energy and services for poverty reduction, strengthen resilience and adaptive capacity to climate change impacts, among others.

In this context, sustainable development encircle the definition of resilience proposed by UNISDR which defines resilience as "the ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions (UNISDR, 2012, p. 92).''

The latter definition reflects on what it means "to return" or "to return to normal" especially if the original conditions were not desirable or vulnerable (Campanella, 2006), and its relationship with the apparatus of planning that produces the "unplanned" and "unplannable" conditions (Roy, 2005). Moreover, the impact of climate change and policies are differentiated among the population being expected to exacerbate poverty and inequality in vulnerable communities (IPCC, 2014). In these lines, Béné et al. (2017) argue that the intersection between resilience and urban growth raise questions about the distributional and equity dimension of urbanization.

[3] IPIECA is a not for profit organization established by United Nations Environment Program (UNEP) in 1974, to be the primary channel of communication and representative of the global oil and gas industry with UNEP and the United Nations Framework Convention on Climate Change (UNFCCC)

4 Contrasting with the framework of sustainable development it is relevant to acknowledge that the discourse of "development" and "underdevelopment" is not neutral. This classification was installed to build an artificial division between the West and the rest of the world in 1950´s in the context of decolonization and cold war, generating discourses of temporality were cities and countries are constantly trying to "catch up"(Bou Akar, 2018). The relationship between progress and a linear perception of time intersects the rational of sustainable development though economic growth and the assumption that wealth creation trickle down benefits to alleviate poverty, which is not consequential.

In order to compile a definition of urban resilience, Meerow et al. (2016) studies first the tensions related to the definition of "urban systems", the notion of equilibrium, the timescale of action, adaptation, among others themes that bring the complexity involved in the definition or urban resilience as "the ability of an urban system-and all its constituent socio-ecological and socio-technical networks across temporal and spatial scales-to maintain or rapidly return to desired functions in the face of a disturbance, to adapt to change, and to quickly transform systems that limit current or future adaptive capacity (Meerow, Newell, & Stults, 2016 p. 45)"

The latter approach based on including the complexities and multivariable to define resilience could be criticized from the perspective of Fainstein´s article called Resilience and Justice. Fainstein (2015) explains that resilience frameworks are likely to avoid addressing conflict, power, race, culture and socio-political structures enforcing a multivariable approach where we can all agree about "working together to overcome a climate crisis" but overlook the need for a justice and resilience approach in planning that first look at vulnerable population. In this context distributional equity and justice are critical factors for resilience, as well as change and adaptation placing in the center those vulnerable communities, informal areas in cities, and a low-income population that lack of infrastructure and services that constrain their capacity to respond and recover.

In terms of guiding planning action Jabareen (2013) developed a Resilient City Planning Framework (RCPF) which incorporates four concepts: ´urban vulnerability matrix analysis' which is spatial and socio-economic mapping of future risks and vulnerabilities, 'urban governance' suggesting holistic management and integrative governance, 'prevention' of environmental hazards and climate change impacts (mitigation measures, adaptation of clean energy, and urban restructuring methods), and 'uncertainty oriented planning' which demonstrates that planning "should adapt its methods in order to help cities cope with uncertainties in the future" (Jabareen, 2013, p 227). Other main tools for resilience-building in social-ecological systems are "structured scenarios" and "active adaptive management" which

permit to facilitate flexibility and open institutions encouraging multi-level governance systems to increase adaptive capacity (Folke et al., 2002)

Finally, considering that Africa is expected to experience the highest rates of population growth and urbanization in coastal cities in the coming years (Angola Habitat III Report, 2016), particularly in Western and Eastern Africa, Sub-Saharan countries and Egypt (Angola Habitat III Report, 2016). And at the same time, Angola is listed as one of the least developed countries (LDC), according to the United Nations, which implies low indicators of socioeconomic development in comparison to all countries in the world. The frameworks of sustainable development and resilience are complementary and relevant to guide urban planning specifically in the context extractive industries and climate vulnerable urban areas.

2.3 Urban Infrastructure, Corporate Social Responsibility, and Equity

In order to ensure the investment in local communities from multinational corporations, governments design a local content framework stating their requirements — for instance, the use of domestically manufactured goods, job creation, and infrastructure among others. Usually, resource-extractive corporations are required to invest in social capital and local communities through corporate social responsibility (CSR). In the context of Angola, UNDP (2013) recognizes that the oil and gas sectors are mature and have experience implementing projects in the social sphere mentioning a transition in the paradigm of CSR shifting from an assistance and charity approach that included donations and construction of infrastructure to integrated projects focusing on people development.

Contrasting the vision of CSR propelled by multilateral organizations, Hannah Appel (2014) argues that the role of CSR and public service infrastructure built by multinational resource extraction is to create a patchwork of private enclave development supporting a process of abdication of responsibility

and marketization. Therefore, infrastructures and CSR play a role in the disentanglement of the production of profit from the place in which happens, supporting urban enclave structures and a violent phenomenological distance between the ones that work for the industries and the communities. In these lines, Angotti (2013) illustrates how the elite residential enclaves are a form of urbanism that produces and reproduce urban inequalities by a conscious design to develop fragmented and exclusive urban space. Angotti and Appel´s reflections on exclusion are tied not only to residential enclaves but to the access to urban areas, services and infrastructure in general, which in many cases partially benefits the communities but mostly specific groups.

In terms of urban infrastructure, the physical component related to mobility, transportation, and provision of essential services (water, electricity, sewage) is the most predominant and accounted to incentive and measure urban development. However, Diouf and Fredericks (2014) definition of "infrastructures" as "manifestations of technologies and performance which have a meaning beyond their technical functions but to what they generate, connect and include/exclude" expands the functional aspect of infrastructure to the recognition of its implications and background (Diouf & Fredericks, 2014, p. 6) . For instance, roads and bridges have a technical function to transport and circulation, but they also have a role in consolidating a desire for modernity[5] (Larkin, 2013).

Through a different lens, Simone (2004) argues that considering "people as infrastructure" as well as their urban life reconfigures territories and resources in place increasing economic collaboration among residents. In the case of African cities, many people live without following delineated parameter

[5] Global and local tensions of economic development are at play in the definition of modernity and modernization. According to Omezi (2014) citing Heynen (2003) the definition of modernization refers to a process of technological advances, industrialization, and the expansion of market and communications, while modernity is the life attitude of a continuous process of evolution and transformation towards the future. In these lines, modernity corresponds to an internal process on "making sense", which can be influenced by modernization driven by an exported modernity (international ideals and expectations). In the context of resource- extractive projects most of the decisions take place at a national level, therefore a modernity built by the state and not by its people could impose modernization processes and infrastructures that are not necessarily grounded in a local context.

to operate in the city, having flexible, mobile, and provisional intersections of residents (Simone, 2004). Simone´s framework questions the assumption that service provision requires megaprojects for its implementation, arguing that multiple institutions at different scales are providing services from the bottom approach where informality does not impede for communities to have functional systems in place for service distribution. For instance, the implementation of the Community Water Management Model[6] (MoGeCA) in Angola has ensured financial sustainability of the water stand posts in Luanda. By socializing and accustoming people to paying for public services, incorporating mobile technology to ensure functionality, and strengthening the capacity of local structures to be accountable for residents and water consumers (Cain, 2018).

In the context of megaprojects (including resource-extractive industries), those considering special regulatory conditions between private and public stakeholders to bring public good. However, main criticisms can be found about how these projects relate to a top-down planning approach impacting specific communities in exchange to gain an advantage for others. Susan Fainstein (2010) questions top-down planning process and address issues of justice through a distributive approach based on three evaluative criteria democracy, diversity, and equity which are all contextual and in tension with each other. Fainstein proposes a framework of planning to lead it into more just outcomes, while this thesis focused on the component of equity where the difference between equity and equality are necessary considering that equity related to fairness. A more just city, according to Fainstein is one where equity should have priority (material equity or income equity), and planners should press for egalitarian solutions and block the ones that only benefit the well-off. In this regard, Fainstein argues that

[6] The MoGeCA model based in water committees formed for each stand post to being accountable to residents and water consumers. The committees collect revenue, oversee operations and maintenance, monitor and register the number of days of water flow, and ensure that records of all payments and expenses are kept.

megaprojects should include direct benefits to the low-income population in forms of employment provision, public amenities, and a living wage.

In a continuous conversation, Fainstein (2015) discusses the framework of resilience and justice and the role of planners that "can contribute to a more just city by using the information at their disposal to show clearly what are the stakes in any particular decision regarding environmental protection or economic development and advocate for policies that are more equitable (Fainstein, 2015, p. 116)." In these lines, recent literature has been developed around both terms resilience and equity. Matin et al (2018) refers to "equitable resilience" when resilience practice "takes into account issues of social vulnerability and differential access to power, knowledge, and resources; it requires starting from people's own perception of their position within their human-environmental system, and it accounts for their realities and for their need for a change of circumstance to avoid imbalances of power into the future (Matin et al., 2018, p.202)."

Chapter 3. Methodology and Findings

This research aims to assess the impact and contributions towards urban infrastructure, sustainable development, and resilient planning propelled by resource extraction industries. To discuss resource extractions impact in urban development for medium cities, the research methodology focuses on a descriptive case study to obtain knowledge of a phenomenon in its context (Yin, 2002.)

The methodology analyzes the transformation of the city of Soyo with the location of an LNG plant and revises the urban infrastructure projects and social programs offered to compensate local communities. Based on the qualitative and spatial analysis the research describes the changes in the landscape, the infrastructures related to the gas industry, and their implications within the perspective of urban planning, sustainability, and resilience. The methodology considers three methods: (1) Analysis of the gas-industrial landscape in Soyo, (2) Land cover analysis of the built and unbuilt areas in Soyo (2002-2018), and (3) Summary of interviews. Each one of the method previously described is specified below presenting details about the method and their respective finding. However, even if the methods are presented separately, this research is based on the triangulation of observations and findings that permit a further understanding of the case study including different approaches and scales.

3.1 Analysis of the gas-industrial landscape in Soyo

The following analysis incorporates mapping techniques, observations from the site visit, and information gathered by semi-structured interviews with local government planners, professionals from ALNG, and non-profit organization leaders to visualize and describe the gas-industrial landscape in Soyo. This study is based on the petroleumscapes study developed by Carola Hein and Arnoud de Waijer in Rotterdam/The Hague where they highlighted different layers of oil-related infrastructure to illustrate their relationship and the influence in the development of the city (Hein, 2018).

The mapping exercise was applied to the analysis of infrastructure related to the LNG industry in Soyo bringing together self-mapped polygons based on the site visit and observations and geographic information of roads and polygons retrieved from Open Street Maps 2019. The boundaries and built areas were obtained using a remote sensing analysis based on Landsat imagery scenes acquired in US Survey USGS. The findings highlight the narrative of places and infrastructures addressing benefits and impacts for the city and the community in four specific themes; the consolidation of an oil and gas industrial area, mobility-related infrastructures, LNG housing compounds, and community-oriented buildings.

Results and Findings

The "gas-industrial landscape" map (Figure 3) details four categories of infrastructures that interplay in the configuration of the city. First, the category of "industrial and operational infrastructure" including the oil and gas terminals located in Kwanda Island, storage tanks, pipelines and housing compounds where LNG employees live. A second category for "retail" consider gas stations and the commercial buildings (banks, hotels, and supermarkets) that take place mostly on primary roads. Thirdly, a category for "ancillary gas-founded infrastructure" including the investments in schools, hospitals, connectivity, energy, and public housing. Finally, the category for "general areas" which visualizes the types of roads in the city, wetland and mangrove areas, built areas, coastal settlements, the ports for local trade, and amenities related to religion and education.

Recognizing the spatial features at play in Soyo and their relationships the thesis discusses the impact and benefits entailed by the gas industry at different scales. To further develop the proposed map and the complex set of relationships promoted by a "gas-industrial landscape" in Soyo multiple discussions are required to take place including a broader group of stakeholders. For instance, a discussion about motivations, actions, and issues behind these infrastructure projects to understand if they entailed a positive, negative or double-sided impact for the city at different scales.

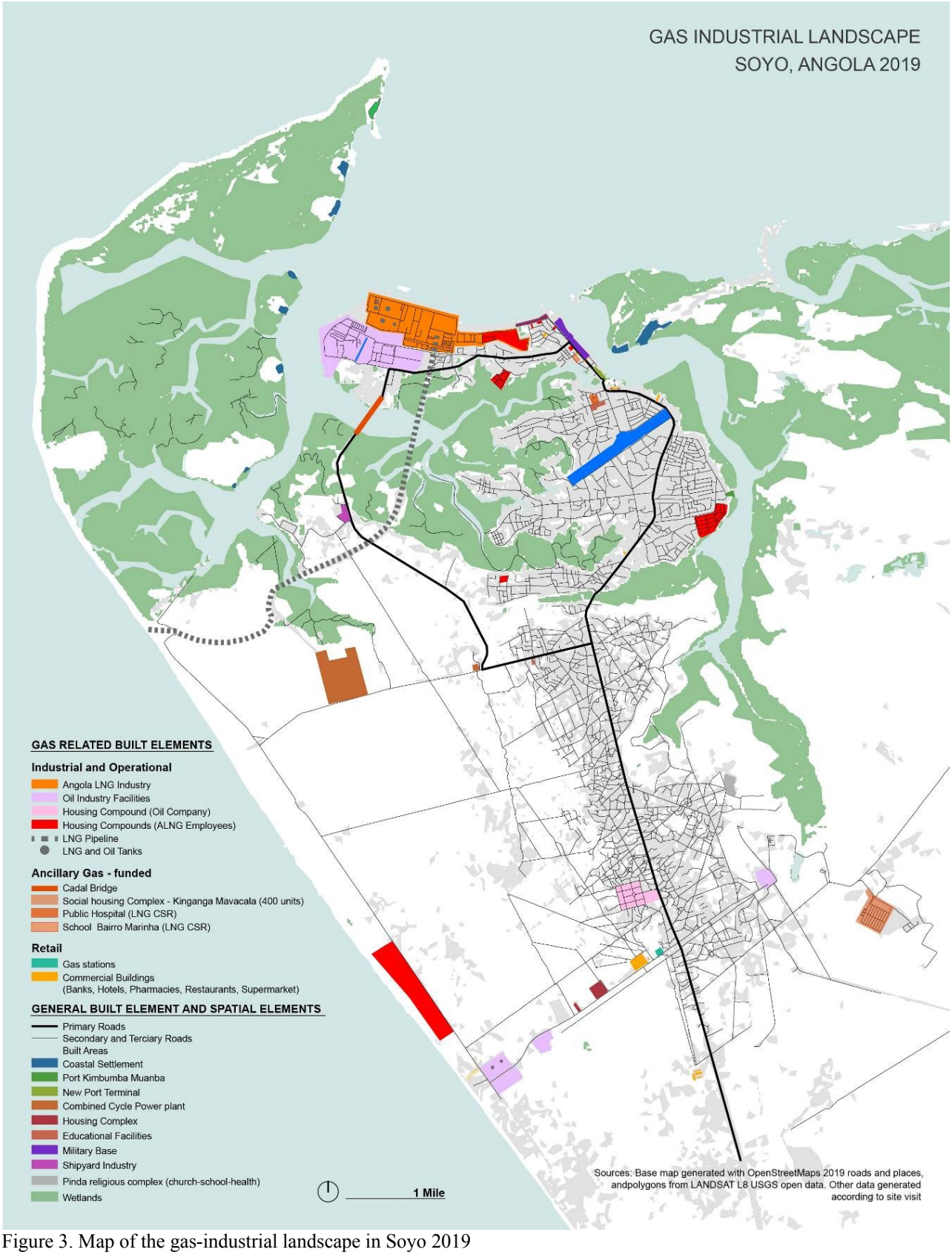


Figure 3. Map of the gas-industrial landscape in Soyo 2019

3.1.1 Impacts of consolidating the oil and gas industrial pole in Kwanda Island

The gas-industrial landscape map (Figure 3) illustrates the concentration of residential areas in the central area of Soyo surrounding Kwanda Island´s industrial area and the municipal airport Comandante Ndozi. Kwanda Lda[7] and Angola LNG are oil and gas companies settled in Kwanda Island in the northern area of Soyo having a privileged location with protected access to the mouth of the Congo River and a primary location for port industrial activities.

In terms of locations, the LNG gas plant considered other places different from Soyo as Luanda and Cabinda. Finally the LNG plant was built in Soyo at Kwanda Island between 2008 and 2012 as a decision to decentralize economic development in Angola supporting other provinces as Zaire. The strategic location of Kwanda Island facilitated the collection of gas from Cabinda and from multiple blocks offshore having great access to the ocean for commercialization purposes.

Additionally, the good soil quality and surface land use rights[8] awarded by the government to Sonangol facilitated the operations and site selection for ALNG. The existing presence of Kwanda benefits ALNG transferring knowledge as an on-shore facility in Soyo, renting units of housing and accommodations, and helping with an existing relationship with the communities (Figure 4).

In 2006 ALNG developed an Environmental, Socioeconomic and Health Impact Assessment (ESHIA) subcontracted from ERM to assess the impact of building and operating the plant located in Kwanda Base. This ESHIA was the first study of this type in Angola including an environmental analysis and community consultations to determine levels of vulnerability and expected impact generated by the construction and operation of the LNG plant[9].

[7] Similar to Angola LNG, Kwanda Lda is a joint venture between Sonangol (Angolan National Oil Company), Saipem, Casoy and Sagemetal that has been in place since the 1970s focusing on logistic port operations, vessels transit, crew changes, and ship loading and unloading.

[8] In 1992, Law 21C approved to regulate "surface land rights use" and Decree 46A gave provincial government the right to concession as land was under state control. This form of usufruct for 25 min and 60 years maximum, and was renewable(Cain, 2010)

[9] Information from interviews with ALNG professionals in charge of ESHIA

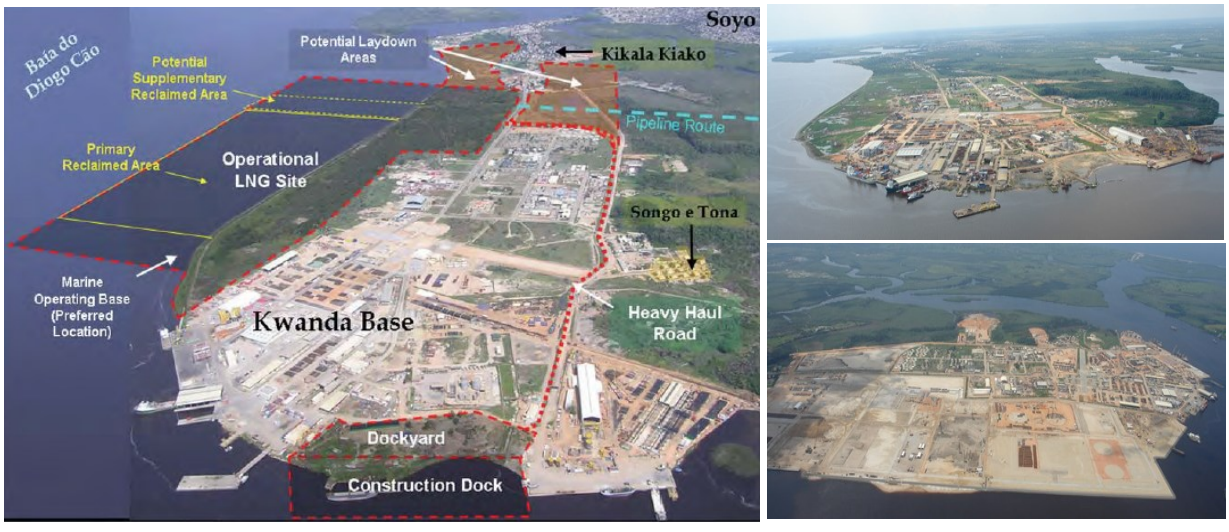


Figure 4. Kwanda Base site analysis 2006 and ALNG platform in the building process in 2009. (Source: ESHIA, 2006)

The ESHIA report listed various negative impacts considering the loss of habitat and biodiversity due to the location of pipelines and land reclamation to operationalize the construction site, hydrodynamics and seabed processes, environmental quality issues (landscape, visual, light, noise, air, and water quality, wastes), and the disruption in fishing environments and routes (ESHIA, 2006).

Additionally, the report mentioned the seasonal environmental sensitivity is related to the use of Atlantic beaches by nesting turtles, and the migration of humpback whales (ESHIA, 2006.) The environmental and social vulnerability of Soyo population is reported by the ESHIA report through a "spatial sensitivity map." Figure 5 represents a zoom of the sensitivity map in Diogo Cão´s Bay illustrating the fishing routes exposed to disruption, and the dense mangrove habitat intervened for the site preparation and pipeline connections to oil blocks and Kwanda Island. As artisanal fishing is the second most important economic activity in Soyo, giving labor to men and women, catching fish, and drying, smoking and marketing them respectively. When a fish catch decrease due to disruptions propels by the company, the impact goes to the household economy of coastal communities. Therefore, these families are most likely to shift from fishing to agricultural activities to supplement their income.

On the other hand, the exploitation of fish and timber in coastal communities that are not affected has the potential to scale up from a subsistence scale to an unregulated market that threatens the environment and mangrove forest in Soyo (Development Workshop & Terra Group, 2005).

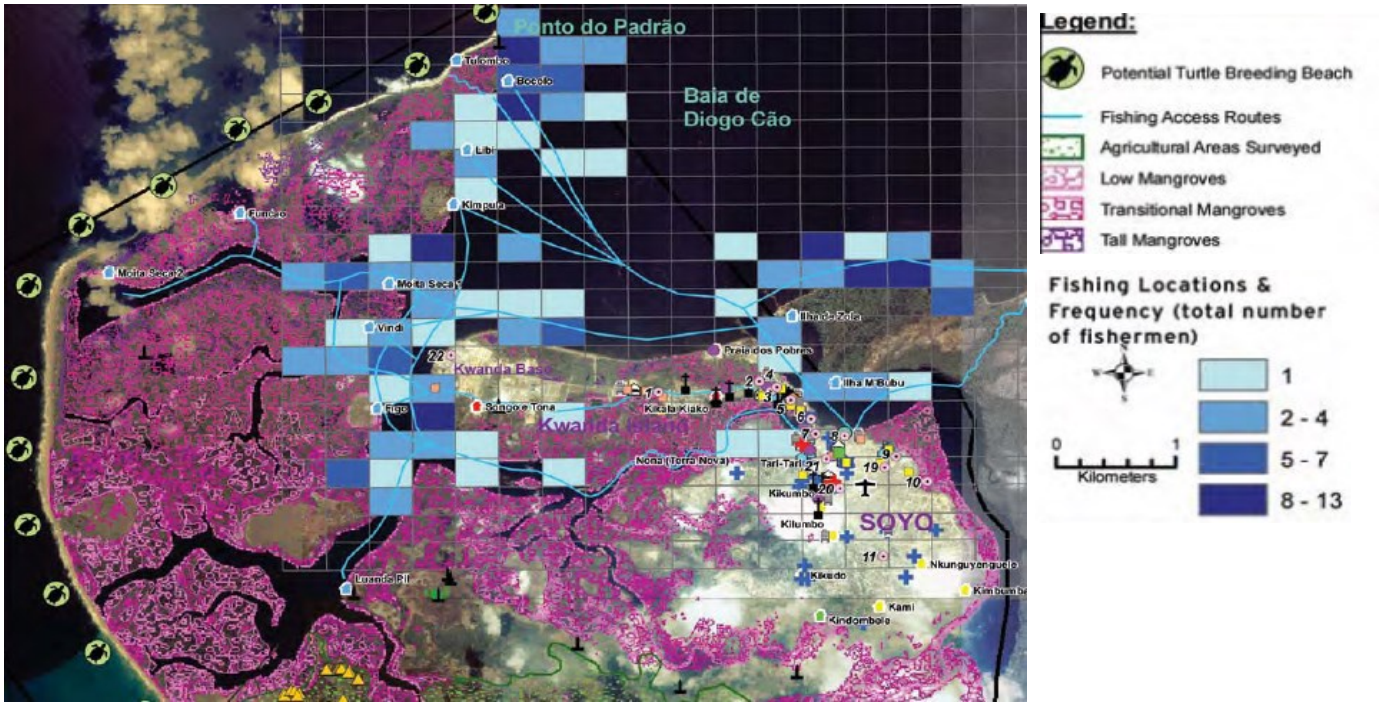


Figure 5. Spatial sensitivity map (Source: ESHIA 2006)

The legal framework to implement the LNG plant is determined by The Project Decree Law and the Investment Contract signed by ALNG and the national government in 2007. According to these documents, the implementation of the LNG project in Soyo expected benefits at a national and local level. First, the LNG plant contributes to environmental mitigation of gas flaring in Angola being the first plant worldwide to use associated gas (a byproduct of crude oil) as input for LNG production from nearby offshore blocks. Second, the availability for the government to use gas and energy produced to support the creation of an industrial area aligned to the national plan supporting economic and social development in Angola. Finally, the creation of jobs and skill development for workers related to construction and operations, and the upgrades in local infrastructure and ports to attract domestic and international investors to expand the industrial area.

Additionally, compensations and social projects were developed by ALNG acknowledging the social and environmental stresses and the negative impact of the construction and operations phases. For instance, in the case of coastal communities, a specific impact mitigation development plan (IMDP) provisioned a cash compensation and equipment to enable fishers to operate safely and effectively at sea away from the Kwanda Base area. Contrarily, given the location and the scale of the oil and gas industrial facilities, the visual impact is constantly perceived by many viewpoints in the city without possible compensations.

3.1.2 Ancillary gas-founded infrastructure, connectivity, and road improvements

In the earliest phases of the LNG project, Soyo was considered a remote area, requiring a high investment in connectivity at a national, provincial and local level to ensure the gas plant construction and functionality. Therefore, ALNG invested in upgrading the airport which became a high standard infrastructure nationwide, road infrastructure at a local level and the construction of the Cadal Bridge which strengthened the road infrastructure network at a city level. The investments in connectivity and road improvements are generally perceived as a benefit for the Soyo population. However, further analysis describes the extent to which mobility-related infrastructure impact local communities.

Road infrastructure improvement at a local level

According to the building classification in Angola, there are three types of road infrastructure: the principal or main roads, secondary roads, and tertiary roads depending on their characteristics and connectivity. The main roads support national, provincial or municipal infrastructures and exploration facilities, tolls, signage, lighting, parking areas and security on motorways. The secondary roads comprise streets within the housing conurbations, and main rural roads, the tertiary roads include rural roads and all kinds of paths, alleys, unpaved roads and pedestrian paths (INE, 2005).

The structure of the main roads encloses the center of the city and the industrial area intersecting the principal road that gives access to Soyo from Luanda — conforming to the analysis of the road network approximately 19 miles represent primary roads and 285 miles to secondary and tertiary roads. According to site visit observations, the paved areas are mostly found in main roads that at the same time have higher levels of local commerce and administrative buildings (Figures 6-10). Based on the land cover analysis, approximately ninety percent of the network in Soyo remains unpaved considering that most of the secondary and tertiary roads have this condition (Figures 7, 10 and 13-15). However, the condition of "paved or unpaved" is only one parameter to define the quality of the road, while in many cases security for pedestrians and vehicles, the level of infiltration, lightning, and others can be the priority. According to an interview with a planner from the local government in Soyo, one of the current priorities to support resilient and sustainable development for the municipality is to improve secondary and tertiary roads.

From the 115 million dollars that ALNG dedicated to social projects in Soyo, 20 million dollars were designated for the improvement of roads.[10] During the construction phase of the LNG plant, the roads connecting Kwanda Base, port areas and Soyo center were replaced to ensure the circulation of trucks and the access of material to the construction site. According to interviews with ALNG managers, the existing roads at that time were deteriorated, and communities surrounding the main roads received the negative impact of acoustic pollution and dust.

In LNG -funded roads in Soyo, the improvements included pavements with different standards depending on the contract and type of road. For instance, the main roads in Kwanda Island, the access to the airport and roads to access the housing complexes related to LNG employees have a higher standard than the main traditional access road (Figures 11 and 12). The road improvements concentrated in main streets,

[10] Interview with ALNG professionals

closer to the airport, city center and industrial area of city increase connectivity but do not necessarily increase accessibility for Soyo residents and local communities. Additionally, the presence of sidewalks, universal accessibility, and pedestrian prioritization seems not to be fully included within the design and implementation of roads. According to interviews with ALNG professionals in charge of infrastructure, the coordination and provision of higher standards were not required in the contract, which essentially opens the question on the importance of guidelines and standards to align efforts to comply the need of the communities and the industries.

F*igure 6 and 7. Primary and Secondary roads in Kwanda Island funded by ALNG*

Figure 8, 9 and 10. Hotels, banks, and supermarkets in primary roads


Figure 11 and 12. Primary roads in the central area of Soyo

Figure 13. Secondary roads in central areas of Soyo

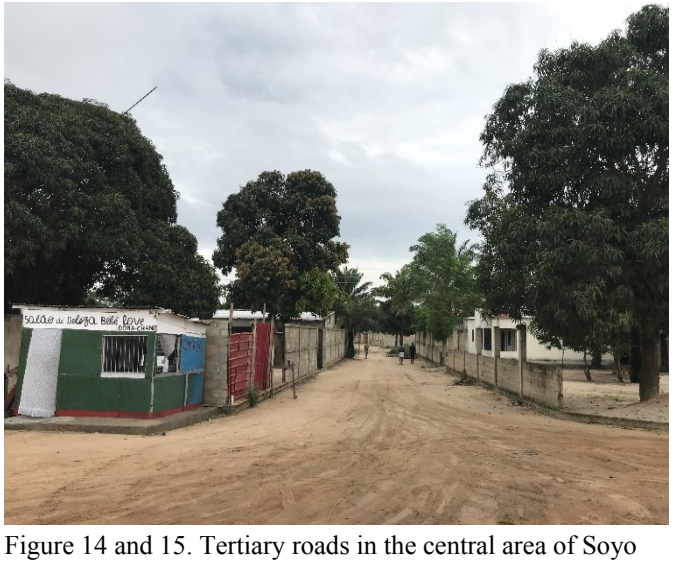



Figure 14 and 15. Tertiary roads in the central area of Soyo

Finally, flooding is recurrent in Soyo due to a low level of the absorption capacity of the ground and visible lack of drainage (Perdon et al., 2018). The basal weather conditions (rain and humidity), and the lack of maintenance increases the damage in the paved infrastructure (Figure 13).

The Cadal Bridge construction to increase the road network at a city level

The Cadal Bridge represents an LNG-funded investment that increased road connectivity in Soyo adding second access to the city (Figure 16). The coordinated action between ALNG and the public sector permitted to extend this road to connect the public-owned combined cycle power plant located (3 miles south from the bridge). The road maintains a high standard during all the trajectory becoming an expedited road. The quality and the construction of the bridge were several times mentioned as a success within the interviews. This road connection works as a bypass to access directly from the highway connecting Luanda and Soyo to the plant without going through Soyo central areas.

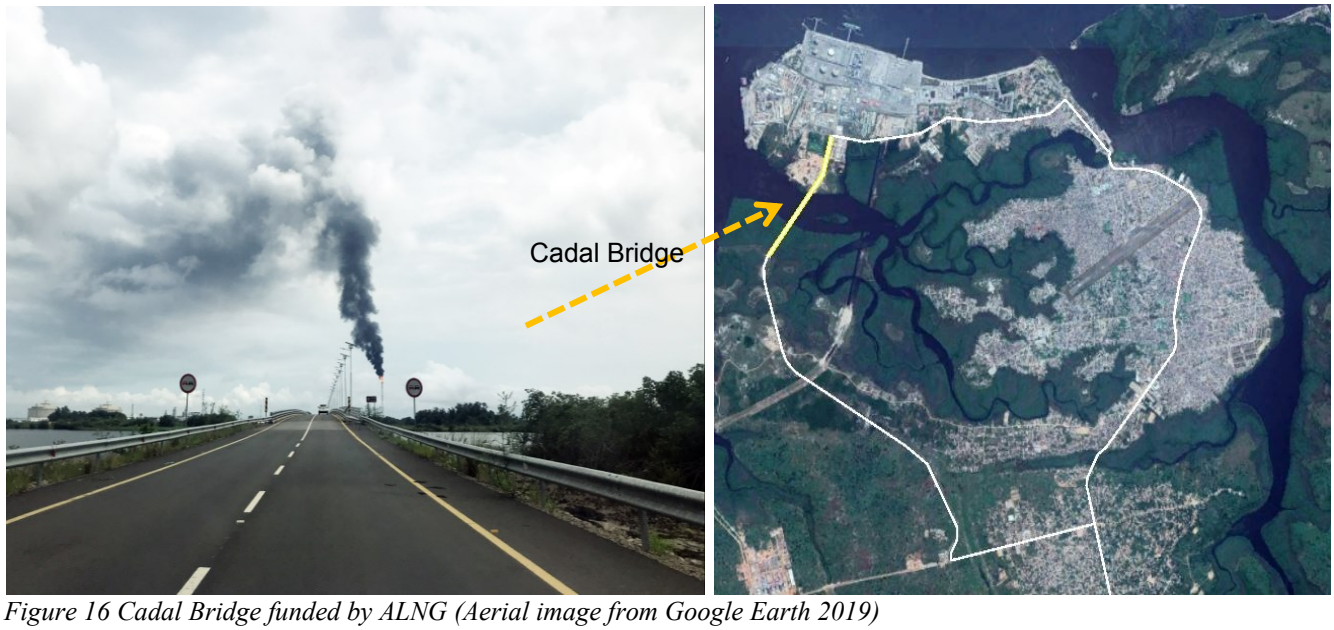


Figure 16 Cadal Bridge funded by ALNG (Aerial image from Google Earth 2019)

Multiple narratives can be written around the development of the Cadal Bridge. First, the increase in connectivity related to efficient and safe access to the plant supporting the consolidation of Soyo's industrial zone. On the other hand, the motivation to build Cadal Bridge was to ensure efficient mobility for employees' temporary housing camps and permanent residential project (PRH) to be located in the

southern area of Soyo. The calculations in 2008 considered that about 5.000 workers would be commuting from camps to the plant through the existing roads each morning plus the trucks loaded. This scenario did not happen completely as expected due that as a large part of the employees lived in camps inside of the LNG plant or in rented housing units in the city center. The PRH is in construction since then, but it is not completed. However, after ALNG did the studies to build the Cadal Bridge and the excitement of the public partnering to complete road infrastructure, the project continued. Cadal Bridge was built in 2014 based on its benefits in connectivity and without the need to support housing enclave projects.

Finally, the Cadal Bridge connected geography based on "practically an archipelago" prone to flooding and surrounded by vast mangrove forest. In this context, the bridge is beneficial ensuring redundancy in connectivity adding to the existing road network in Soyo. However, the increase in population and the lack of housing provision reflects on a disperse growth of urban settlements mainly located around main roads, or in available land in flood-prone areas. In this case, the location of Cadal Bridge could have a secondary impact driving urban development in areas that are vulnerable to flooding. According to Soyo´s Municipal Action Plan for 2019, they are focusing on identifying areas of dispersive construction and elaborate urban redevelopment plans.

Rehabilitation and expansion of the Soyo Municipal Airport Comandante Ndozi.

The extension of the airport and interventions to upgrade its infrastructure were crucial for the gas industry to ensure that their employees would access Soyo. From multiple interviews, Soyo was considered a remote area due to the lack of effective road connectivity from other cities. The Luanda-Soyo Highway was not completed until 2018 improving the connectivity of Soyo with the national road network moving from approximately a 15-hour ride to 4-hour drive.

The airport renovation increased connectivity to Soyo benefiting the oil and gas companies directly, and in minor relevance to the local business and tourism in Soyo as these are growing economic sectors. Besides oil and gas production, Soyo is a border-coastal city that centers large part of its economy in maritime and terrestrial trade especially with Cabinda province, Democratic Republic of Congo, and internally with other localities in Zaire province.

The renovation of the airport extended the runaway allowing access to large capacity planes. At some point, the ALNG and public sector considered upgrading for international standards which finally did not occur. A round-trip from Soyo-Luanda cost about 200 to 300 dollars. Therefore the access is limited to a high-income population which is mostly represented by business owners, public servants, and gas and oil employees.

The airport´s central location in Soyo has been in place from before the 70s. This infrastructure was consolidated and expanded by ALNG in partnership with the public sector in 2013 (Figures 17 and 18). The most accessible streets surrounding the airport are located in the northeast area consolidating the city center (Rua Central and Rua Manuel Antonio).

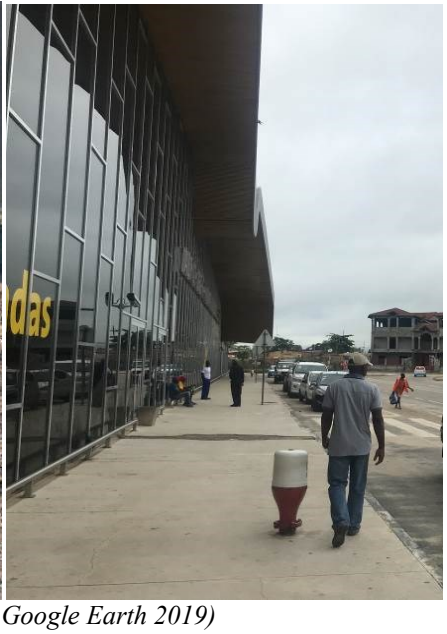


Figure 17 and 18. Soyo Municipal Airport Comandante Ndozi *(Aerial image from Google Earth 2019)*

The location and road infrastructure surrounding the airport separates the city in subareas and raises questions about safety and risk for local communities in cases of failures during flights take-off and emergency landings. According to DRR Report (2018), the extension of the runaway paved large areas blocking drainage in adjacent neighborhoods (Barrio Parroquia) increasing flooding issues.

3.1.3 Housing accommodations for the gas-industry employees

The gas industry applied different strategies to accommodate their employees in residential areas according to various stages of the project´s implementation and depending on their working contracts. From information gathered in interviews and site visit observations, there are three main housing allocation types: residential units located inside of the industrial compound (camp), rental units in residential complexes in central Soyo, and ALNG permanent residential housing project (PHR.)

Residential units located inside of the industrial compound (camp)

Bechtel and Angola LNG built the residential camp project with a capacity for 6,500 workers. The project was completed in April 2010 considering a contract value of 116.38 million dollars. The compound incorporated accommodation units, dining area, kitchen unit, recreation areas, a clinic, security centers, a guard house and buildings for meetings or training. Additionally, the compound provided infrastructure for power generation and distribution, water treatment, sewage collection and solid waste facilities (Figure 19).

Figure 19. Red sea housing project in Soyo. (Source: Bechtel online report)

Rented units in residential complexes in central Soyo

The LNG project has the scope of developing and industrializing the city of Soyo, becoming the driver for more industries to come. Because if price convenience and also under the idea of locating employees close form services and community the strategy of renting units available or incentive contactors to build with secure leases related to the contractor made the deal safe[11]. In this model of renting units, the first location, Kimbumba, represents the first area where they decided to settle employees to live outside of the compound (Figures 20 and 21).

Afterward, Figueria 1 was rented and refurbished for employees to come. This complex is not being used anymore, and the constructions are damaged. An adjacent housing complex is called Figueria 2 which is currently in use by ALNG employees. The project has approximately 80 units and amenities for childcare and primary school (Figures 22 and 23). These housing enclaves count with security systems and one point access with guards. Additionally, isolated buildings were rented by ALNG to lodge employees for different periods, considering guest houses located close for "Praia dos pobres" beach, rented rooms in Nempanzu hotel and Kinwika resort, and leases in housing buildings with high constructive standards (Figures 24-25).

Figure 20 and 21. Kimbumba housing complex built in 2006. (Aerial image from Google Earth 2019)

[11] Interview with executive manager and professionals from ALNG

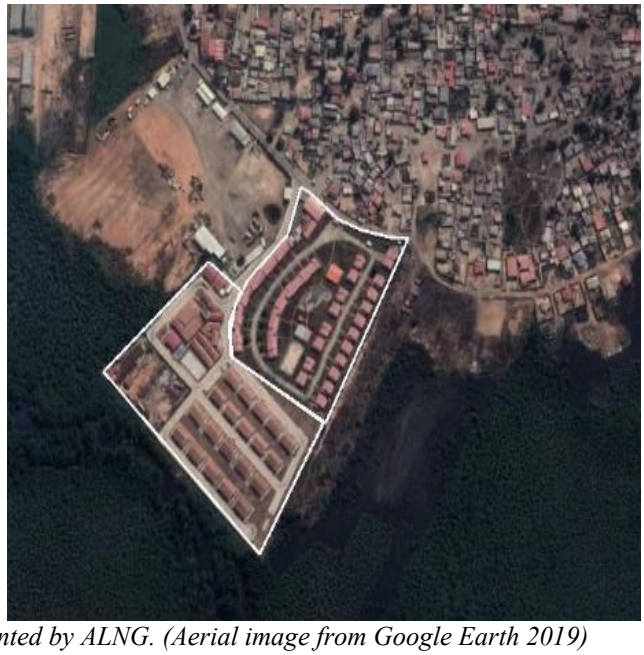



Figure 22 and 23. Figueira 1 and 2. Large housing complex rented by ALNG. (Aerial image from Google Earth 2019)

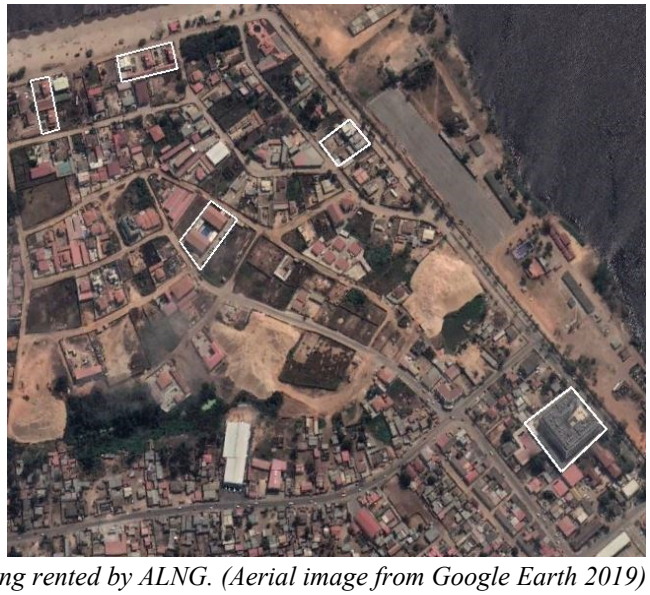



Figure 24 and 25. Guest Houses, hotel rooms and housing building rented by ALNG. (Aerial image from Google Earth 2019)

ALNG Permanent Residential Housing project (PHR)

The ALNG PRH project is located in the southwest coast of Soyo considering 317 residential units, two schools, a clinic, and sports facilities estimating a total construction area of 51.000 sqm[12] (Figure 26). This housing enclave intends to have exclusive facilities, security, and a convenient location to access the plant using Cadal bridge to ensure that the workers are comfortable and have an efficient commute. This project has not been completed yet presenting multiple issues related to management strategies and profitability of the gas industry. [13]

Figure 26. Permanent residential housing (ALNG PRH) (Aerial image from Google Earth 2019)

These three models (camps, rented units located in the city and housing enclaves) generate different relationships between the communities. The first one corresponds to a consumer/ visitor relationship where most of the workers are rotational having only a short period outside of their labor. The second model based on rentals allows employees to become residents for the city, having more interaction with the community, buying their food in local markets and getting access to the street anytime without permission needed. This model engages with a local economy and investors for the development of these

[12] ALNG PRH was confirmed and considered of regional importance having a ground breaking ceremony that included ALNG, Traditional Authorities, and Soyo Municipal Administration. (http://www.msfsgps.pt/en/item/24-news/694-ground-breaking-ceremony-at-the-alng-permanent-residential-housing-in-soyo)

[13] Information obtained from Interviews with ALNG professionals, executive manager and OPCO general manager.

buildings, hotels and guest houses extending the economic benefit. However, these buildings depend on the leases with the gas industry. Finally, the enclave housing supports the creation of a gated community without the need for interaction with communities as it´s form represents a complete isolated infrastructure with high-security levels. In terms of housing, it becomes relevant to understand the impacts of each model and the reasons why those are in place and the benefits for local communities.

3.1.4 Investment in buildings directed to local communities

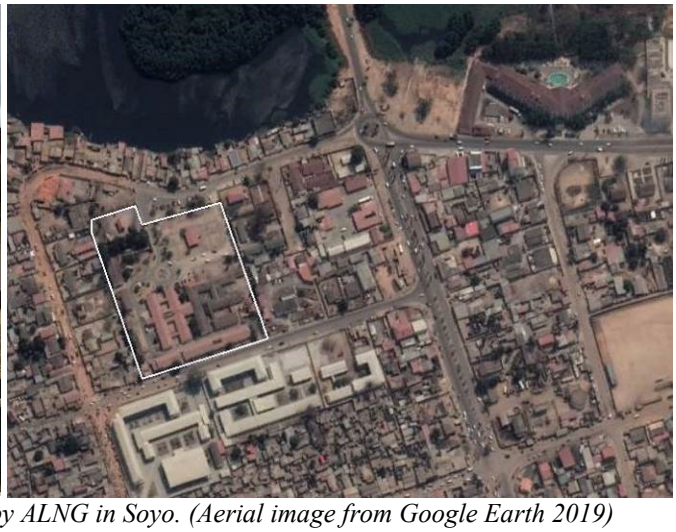
In many cases, the investment of corporations is directed to buildings serving relevant functions for communities, such as addressing health, education, and access to essential services. In the case of ALNG, it is not different. The principal investment in specific buildings are:

Renovation of the Public Hospital in Soyo

ALNG funded a 20 million dollars expansion of the Soyo Public Hospital increasing its capacity from 60 to 150 beds. The new building and the renovation incorporated a maternity section, installation of an oxygen generation unit, installation of new laboratory facilities, laundry, and canteen. The installations included a power generation unit, new treated water supply, and sewage system, and equipment to ensure essential services to operate (Figures 27 and 28). ALNG´s had a contract to manage and support the hospital for five years.

Afterward, management responsibilities were transferred to the public sector. At the moment the hospital is not receiving support from ALNG, but the negotiations of the yearly budget that ALNG needs to allocate to social benefits may be allocated to the third phase of renovations in the future. Moreover, ALNG engaged with the public hospital considering a program for local professional training related to health services. This program focused on the hospital but also in the branches of local health service facilities in Soyo working with communities and traditional leaders to focus on prevention and diagnosis.

After the site visit and interviews, it was possible to recognize a consistent positive perception of the benefits related to the extension of the hospital being is meaningful serving the residents of Soyo and incorporating higher standards compared to the previous state of the building. However, at the date, the hospital still lacks supplies, professionals, and necessary conditions for treatment related to limited access to water that has become one of the highest expense in the hospital´s budget. A planned transition from a private to a public managed building had an impact on the quality of service and conditions. The budget for maintenance and operations is a challenge that raises questions about the levels of sponsorships of programs and ways to create capacities and funding for long-term.

Figures 27 and 28. Renovation of Public Hospital founded by ALNG in Soyo. (Aerial image from Google Earth 2019)

Renovation of Public School "Escola Bairro Marinha"

ALNG invested 5 million dollars in upgrading the Bairro da Marinha School located in Kwanda Island including 12 new classroom buildings and a separate multi-purpose facility with a library, science laboratory, IT suite, teachers' lounge and principal's office (Figures 29 and 30). This project included a partnership between Angola LNG and the Soyo Municipal Authorities to provide the improvements required for better educational provision to the local community. Similar to the case of the public hospital

in Soyo, Angola LNG provided a package of maintenance and operations besides construction for a cost for 3-5 years, reflecting a model of sponsorships to be effective long-term.


Figures 29 and 30. Renovation of School Bairro Marihna founded by ALNG in Soyo (Aerial image from Google Earth 2019)

Construction of "The Small Power Plant"

ALNG invested 22 million dollars in improvements in electricity supply for local communities in Soyo by building a power plant with two turbines (2x11 MW) that use domestic gas[14] provided by ALNG. The "small power plant" is located in Kwanda base, serving main critic facilities (hospital, schools). In this project, the role of the private sector was to build the infrastructure (supply) while the public sector would be in charge of the distribution.

At the moment, the "small power plant" is implemented, but working in a low capacity serving only some critical facilities. The distribution network has not been implemented precluding the delivery of the service for the community. Therefore, according to interviews, the municipality of Soyo is not being benefited by the "small power plant," and they expect that the energy produced by ALNG will

[14] ALNG provides 125 million standard cubic feet per day of treated natural gas that Sonangol for free. The "domestic gas" corresponds to part of this asset.

reach consumers through the Soyo Combined Cycle Project which is a public project in construction[15]. The failure of delivering energy from the small power plant to residents questions the commitment of the partnership and the capacities in place to implement the network to distribute electricity, which remains a challenge for the municipality.

In parallel to the provision of gas to generate energy, Soyo is improving the limited lighting to some streets through solar power. The current distribution of power in Soyo is centralized to urban headquarters of the municipality and supplied by generators that provide light to some roads, residences, and institutions.

However, some of the main streets in the city have poor public lighting at night, putting people's safety at risk. Many areas have poor technical efficiency in the installations and passages of low voltage cables that do not comply with safety standards of recommended heights and type of installation, which is critical in the road where heavy vehicles transit and in cases of precipitation. (Plano Director Municipal de Soyo 2014). The provision of energy in Soyo remains one of the main challenges of the city is directly related to the design and implementation of roads.

3.1.5 Summary of Findings

The following section presents the main findings obtained in the analysis of the gas-industrial landscape organizing by categories and descriptions depending on the type of impact (Table 2). The impacts are classified in direct or indirect, and positive or negative depending on their main characteristics and the effects produced. These findings will be further developed in Chapter 4.

[15] Interview with the Municipal Administration with the function of Deputy Administrator for the Technical and Infrastructures area in Soyo

What is the impact propelled by the LNG industry in Soyo? Main finding of Analysis of the gas-industrial landscape	
INDUSTRIAL ZONE "Impacts of consolidating the oil and gas industrial pole in Kwanda Island."	• **Direct positive impact** of the environmental mitigation of gas flaring (first LNG plant worldwide to use associated gas from nearby offshore blocks for its production process) • **Direct positive impact**. The availability of government to use gas provided by LNG to support economic development national plan. (Construction of the combined cycle plant) • **Direct negative impact** of burning the gas is when the plant is inoperative. Also, the LNG plant is visually perceived from many viewpoints in the city. ***** Direct impact** to coastal communities dedicated to fishing is specifically impacted by the construction and operations of the LNG plant. Mitigation program with cash and equipment compensations to operate away from the Kwanda Base area. Further study is needed to define the extent of the compensation and impact *****Indirect impact** related to **t**he location of the LNG plant is beneficial and strategic for ALNG, but not necessarily the best for the expansion of an industrial zone. Further study is needed to define the type of impact
MOBILITY RELATED INFRASTRUCTURE "Ancillary gas-founded infrastructure, connectivity, and road improvements."	• **Direct positive impact**. Increase in connectivity at a city level (Cadal Bridge- Airport) • **Direct negative impact**. The increase in connectivity does not imply an increase in accessibility for Soyo residents and local communities. The road improvements are concentrated in main streets closer to the airport, city center and industrial area of city while 90% of the roads are secondary and tertiary roads and remain not paved. • **Direct negative impact**. The quality and standards of local road improvements do not comply with the need of the city. Lack of sidewalks, universal accessibility, and pedestrian prioritization, sewage and lightning were not included in the design and implementation of roads by ALNG. (The road infrastructure is damaged by flooding recurrently in Soyo)
HOUSING COMPOUNDS "Housing accommodations for the gas-industry employees."	• **Indirect positive impact.** The model based on rentals or smaller housing complexes in the city supports the interaction of the community and allow employees to become residents of the city. The engagement with local investors to develop housing buildings, hotels, and guest houses extends the economic benefit. However, it requires a mid-term view to ensure that the local business does not only of the gas industry for its operations. • **Indirect negative impact.** The camps inside the plant support a consumer/ visitor relationship where most of the workers are rotational having only a short period outside of their labor. And housing enclaves isolated from cities (without the need of interaction with communities) generate a space of exclusion supporting the disconnection that is prejudicial to build equitable cities.
COMMUNITY ORIENTED BUILDINGS "Investment in buildings directed to local communities."	• **Direct positive impact.** Increase in access to health and education services. • **Indirect negative impact.** The investment in energy supply did not ensure access to electricity to the population. Ensure procedures to invest in infrastructure that will perform at a local level considering partnerships and participatory strategies. *****Indirect impact**. Lack of transition from private managed services to public managed services after a significant period (5 years). A strategy to ensure the quality of services. (Support the creation of local capacities and designing funding structures), the budgets for operations, and levels of sponsorships as key elements to improve timing and conditions for these transitions. Further study is needed to define the type of impact

Table 2. Summary of findings of gas-industrial landscape Analysis

3.2 Land cover analysis of the built and unbuilt areas in Soyo

Land cover change can be attributed to human activities such as road network development, population growth, and change in economic activities. The construction of the LNG plant in Soyo between 2008 and 2012 drove large economic growth related to job creation and infrastructure investments, triggering urban growth around main roads and in central areas of the city which are visible in satellite images. Considering that until 2002 a civil war took place altering the geopolitical context of the country, the time frame for this analysis focuses on the period between 2002 until 2018.

The objective of this land cover analysis is to recognize the built and unbuilt areas in Soyo using remote sensing technology[16] to determine the rate in which built areas increased. Moreover, this analysis recognizes the location of these growing urban areas and discusses their specific conditions. This study analyzed satellite images from the United States Geological Survey's Landsat missions 7 and 8 incorporating scenes from 2002, 2015 and 2017 with a resolution of 30m pixels. Soyo is covered completely by one Landsat scene corresponding to the worldwide reference system (WRS) path 183 and row 64, and the satellite images acquired had less than 10% cloud coverage. The scenes were analyzed using false color composite (Appendix 1). Multiple training samples and supervised learning were used to classify built, unbuilt, water, and mangroves. Finally, a reclassification process and raster calculations using map algebra were performed between 2002, 2015 and 2017 to obtain the change in those periods.

Landsat scenes between 2002-2015 and 2018 - 2019 were not included due to high cloud coverage in the area. This analysis could improve by acquiring satellite images from another source and including higher resolution. However, the current analysis identifies an approximate change in the built

[16] Remote Sensing is defined as the science and technology by which characteristics of objects and areas of interest can be identified and obtained without direct contact, typically from aircrafts or satellites. (Leah Meistelin 2017)

environment and observe urban growth in specific areas in Soyo that can be contrasted with observations during the site visit.

Results and Findings

According to the land cover analysis in 2002 approximately 4.503 acres corresponded to build areas, which increased to 8.432 acres in 2017 (Figure 31). The estimated change rate in built areas for this 15-year period corresponds to a 53.4 percent increase, which means that the city doubled its land coverage (Table 3).

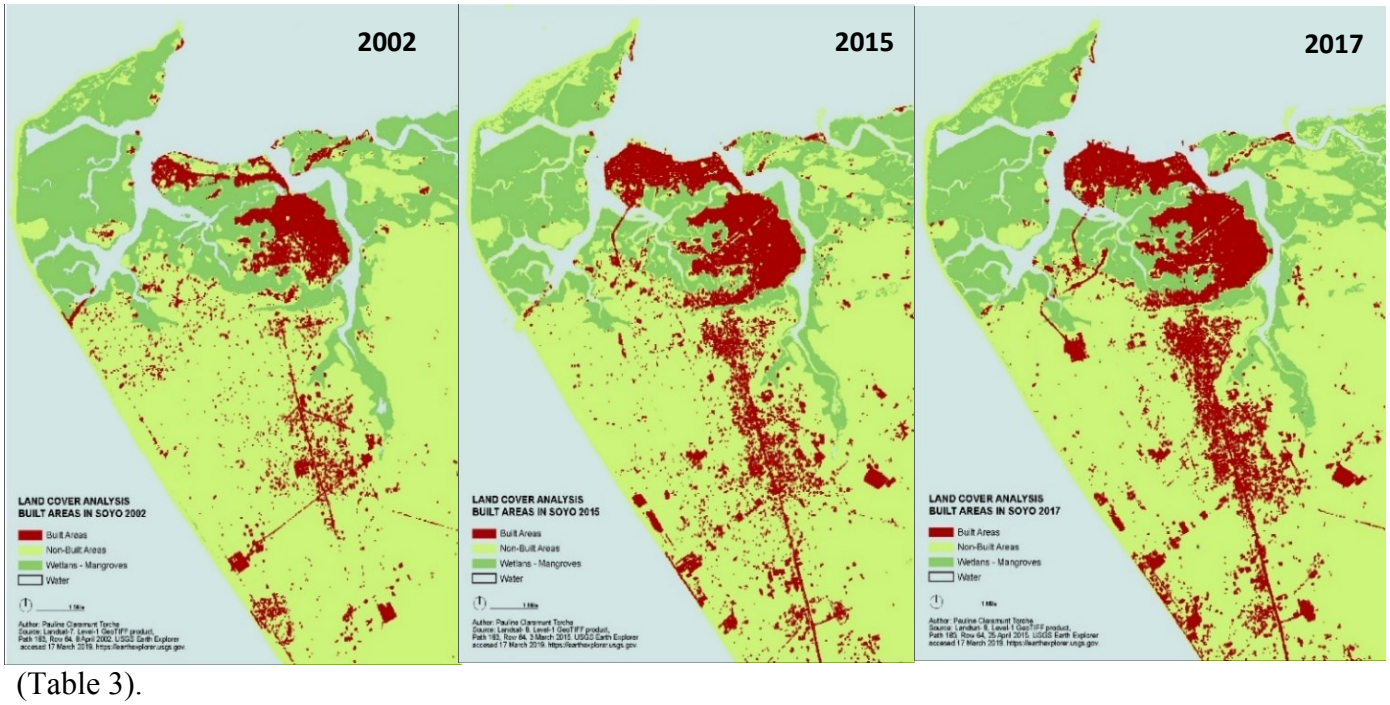


Figure 31. Land cover maps of Soyo in 2002, 2015 and 2017

Estimated built areas in Soyo - Land cover analysis results

By year	Milestones	Built areas (acres)
2002	Agreement signed between ALNG and operators	4503
2015	ALNG plant construction completed and productive *LNG plant building phase 2008-2012 *LNG production phase 2013-2018 (Technical issues in 2014 and 2016 stopped production)	7403
2017	Plant re-started operations	8432
By period	% increase built areas	
2002-2017	**53.4%**	
2002-2015	39.2%	
2015-2017	12.2%	

Table 3. Comparative Land cover results

As mentioned previously, the scenes selected correspond to the years 2002, 2015 and 2017. In 2002 ALNG signed and agreements with the block operators, but it is not until 2007 when the Decree of Law and Investment contract are signed developing the construction phase of the plant from 2008 until 2012. Therefore it is expected that land cover changes between 2002 and 2007 do not have relevant changes. The aerial view of Kwanda Island in 2006 and 2009 shows that major changes occurred within the construction of the LNG plant (Figures 32 and 33) in 2008 when the scenario changed and the process of construction incorporated a high pressure in the city due to a large influx of people that upraised the housing prices, increases the demand for amenities and infrastructure among others.

Figures 32 and 33. Google earth images from 2006 and 2009 showing the period of LNG plant construction

The land cover scene selected from 2015 corresponds to a fully operational period of the LNG plant, after the first exports of LNG to Brazil in 2013. In the period 2014 to 2016, the LNG plant had to shut down twice due to technical issues, the first shut down was for three months, and the second one for about a year. According to interviews, the technical challenges affected the revenues expected from ALNG, and the drop in oil and gas prices impacted the anticipated revenues for ALNG modifying the internal structure of the company and applying cost-saving strategies decreasing the number of workers

living in Soyo to rotator workers. The analysis of Soyo´s built area between 2015 and 2017 results in a 12.2% change in two years illustrating that urban growth continued in time, now driven by the commercial activity generated in the previous year that supports trade from Soyo to Cabinda and DRC.

According to interviews and the analysis of built areas increasing surrounding the main roads, populating agricultural areas and expanding residential units within mangroves areas. The expanded build areas not necessarily located in the convenient areas which are a negative impact on the population location in risk areas and a secondary negative impact for the municipality that needs to conform to this situation.

Additionally, the long term perspective of the LNG project in Soyo and the increasing buying power acquired by residents motivated many families to build single-family houses according to their specific needs in the surrounding areas of Soyo. It is common to find houses that are in construction for long periods because the timeframe to complete this construction depends on the cash flow available of the owners, skilled labor and materials, which in many times are not all in place at once (Figure 34).

Figure 34. New residential area in Soyo (Aerial image from Google Earth 2019)

The last observation that responds to interviews and a general perception of people in Soyo is the change in building techniques and construction materials over the previous 5-10 years. The access to metallic roofs, local production of brick and cement blocks are the most common building materials and other local building technologies as "Bordão" are not common anymore (Figure 35). The change in construction material could be related to a secondary impact of economic development in the area, but further research is needed to determine this relationship and weather is beneficial in terms of maintenance, and durability or prejudicial in terms of losing traditional building techniques.

Figure 35. Bordão buildings in Soyo

3.2.2 Summary of Findings

The following section presents the main findings obtained in the land cover analysis of the built and unbuilt areas in Soyo during the period 2002-2017 (Table 4). All the impact recollected from for this method of analysis are indirect because even if the method is weaving remote sensing land cover analysis, observation from the site visit and interviews, the causes or consequences of urban growth and disperse growth are part of a more complex scenario. The criteria to determine positive or negative

impact depends on the main characteristics and the effects produced. These findings will be further discussed in Chapter 4.

What is the impact propelled by the LNG industry in Soyo? Method 2: Land cover analysis of the built and unbuilt areas 2002-2017	
LAND COVER ANALYSIS SOYO 2002-2017 "53.4% increase in built areas land coverage from 2002-2017."	• **Indirect negative impact.** The construction of LNG plant (2008-2012) incorporated a high pressure in the city due to a large influx of people that upraised the housing prices, increases the demand for amenities and infrastructure among others. • **Indirect negative impact.** Built areas are increasing surrounding the main roads, populating agricultural areas and expanding residential units within mangroves areas — negative impact on the population at risk. • **Indirect negative impact.** The spread and disorganized urban growth is a challenge for the municipality that it has been included in their action plan. (Secondary negative impact) *****Indirect impact.** 12.2% increase in built areas land coverage from 2015-2017 illustrating a continuous urban growth at the moment driven by commercial activity and trade from Soyo to Cabinda and DRC. Further research is needed to determine the type of impact. *****Indirect impact**. The materials of homes have changed because of the accessibility to metallic infrastructure and the local production of brick and other technologies (Hard to find building made with Bordão anymore). There is needed further study to determine the type of impact.

Table 4. Summary of findings land cover analysis of the built and unbuilt areas 2002-2017

3.3 Additional Findings from interviews

The third portion of this study consists of semi-structured interviews with local government planners, professionals from ALNG, ALNG contractors, non-profit organization leaders, professionals from multilateral agencies, and scholars based on a set of questions attached in Appendix 2.

Twenty interviewees were completed, and most of them were executed face-to-face in Luanda and Soyo, while others were phone calls. All the interviews were authorized, recorded and analyzed, while the participants remain anonymous for the purpose of this thesis.

3.3.1 Decision making and implementation of ALNG´s social projects in Soyo

Soyo municipality has two main instruments for urban planning practice, the Municipal Master Plan (in progress since 2015), and the Annual Action Program issued every year including the prior projects and municipal budgets estimated for each of them. Angola LNG consults with the Municipal Administration for the elaboration of its social responsibility program.

As previously mentioned, the legal framework to implement the LNG plant is determined by The Project Decree Law and the Investment Contract signed by ALNG and the national government. According to the article 44 of the Investment Contract, the maximum dollar amount required to spend by ALNG in initial social projects correspond to 65 million dollars in the five years after the Investment Contract was signed, and afterward 3 million dollars each year as long as the contract is in force. For ALNG it is unlawful to provide monetary or financial contributions to the local government unless there is a specific agreement between ALNG and Sonangol. Therefore the LNG Company must carry out the projects ensuring the administration and management of the social projects applying the same rules required for the implementation of the LNG project. In the case where the yearly amount is not reached or overpassed the different moves for the next period to be added or discounted.

The decision to allocate ALNG´s budget for social projects in specific actions depends on the consultation with the administration and the action plan. After the agreement and negotiation between ALNG and the municipality, the company is fully responsible for the implementation of projects on the monitoring of Soyo Municipal Administration.

On the other hand, the location of oil and gas industrial facilities, especially in Soyo which has been defined as an "economically strategic area" in Angola and do not depend on the municipality; those decisions are made at a regional and national level. As one planner described "the municipality does not have any participation in contracting decisions in the economically strategic areas (such as the oil area).

What happens often is that the municipality is advised to indicate/reserve a space for the implementation of a particular project. The municipality has no access to the contract, nor ways to monitor compliance with agreements that have been made."

In several interviews with the public and private sector, it was reiterated that urban plans were not in place when LNG was implemented. Therefore ALNG made proposals and projects based on its vision for local development instead of following an existent plan. A professional leading ALNG stated that "It is important to explain that most of the important social contributions provided by ALNG to Soyo area that had been implemented were not part of any government plan, but the result of the vision and leadership of [professionals from Sonangol], involved and committed to make this Project an important piece for the development for Angola in general and Soyo in particular…. it did not happen because of a well-laid plan from above."

The decision making processes and implementation of LNG was mainly directed by private efforts unveiling the need for urban planning strategies and local plans to guide these processes and ensure standards and access to communities. A professional from ALNG explained that "Regarding the investment in roads, drainage and sanitary works were not included since they were not in the contract, but they are undoubtedly necessary and should have been negotiated to make a real benefit to the community." In multiple interviews with the public and private sector, both highlighted that stronger guideline for the investments and design of infrastructure could lead to better outcomes and greater benefits for local communities.

3.3.2 Perception of LNG´s actions in terms of compensations and sustainable development

All the interviewees (20) mentioned that ALNG supported sustainable development in Soyo, pointing out their perceptions and examples including the improvement of the airport, the hospital, road infrastructure, social programs, and job creation. In the context of Soyo where the local government is challenged to face large infrastructure issues the support provided by ALNG implementing infrastructure and social programs seems to be very well received and valued. As a local urban planner explained "ALNG contributes to sustainable development. With the investment and support of Angola LNG in the municipality of Soyo, much has improved, because, within the framework of its social responsibility, Angola LNG has done actions that help improve the quality of life of many families."

However, most of the interviewees considered that the ALNG investment in social projects and infrastructure is not visible, not sufficient or that faded with time. A professional from ALNG that lived and worked in Soyo for long time described this issue critically by stating "I see an improved for a period of time, but I am disappointed seeing how a huge project is in place, and we don't see more of what could have been a positive impact for that town. You don't see the positive impact. Once it is done it is like a secret, ALNG was this beautiful moment; and then in the steady state, you only see the flame."

Also, urban planners and professionals working at local non-profit organizations explained that the companies working in resource extraction should ensure the development of the municipalities being more open dynamic and committed to the social reach with the poverty problems in Soyo. For instance, an NGO leader made the point that "It should be a big difference between a municipality and another that has or not these large industries. They [Angola LNG] could have a more substantive impact in Soyo."

For some interviewees a more explicit plan and guidance from the public sector at the city-level could have impacted the outcomes of the investments in infrastructure positively. A professional working in ALNG stated this argument by saying “It has undoubtedly been a contribution to sustainable development, but if there had been a clearer government plan and strengthened structures, this contribution could have been better focused along with greater benefits for the community.”

3.3.3 Contingency for resilient planning in Soyo

Interviews with professionals from Soyo municipality and Workshop Development (DW) were crucial to understanding the current challenges at the municipal level. The provision of services to the residents of Soyo is one of the main concerns including access to water, energy, and drainage, among others. Soyo is highly vulnerable to flooding due to the geographic and socioeconomic conditions; many families build their houses in mangrove areas having an impact of deforestation. The multiple aspects in which the municipality is not being able to cope for a response has direct implications decreasing the resilience of Soyo residents.

One of the main challenges for the municipality is related to being able to control urban growth and manage risk reduction, as local urban planners described “The crowded and disorderly growth of the city led to many homes being erected in inappropriate places, such as lines and channels of water drainage. The municipality of Soyo is "practically" an archipelago, and its growth associated with the construction of many homes is a cause of mangrove deforestation. The soil is saturated in some areas, and others are blocked for the drainage of rainwater which has caused flooding in some neighborhoods in Soyo.”

As a call for action, in November 2018, the Governor of Zaire and the Ministry of Energy and Water asked the Dutch Risk Reduction (DRR) Team to develop a mission report for flooding risk in Soyo. The team addressed health issues, flooding, and access to potable water, sanitation, and urban

planning urgent matters. An NGO leader explained that "The challenge in Soyo is mostly to bring technology and capacities to improve sustainable plans." At the same time, analyzing the municipal action plan for 2019, most of the activities in the section of urban planning are related cadasters, mapping and gathering information about households living in areas of risk, disperse growth, waste management among others. This example illustrates that municipality acknowledges that data collection and mapping activities are necessary to develop plans and strategies, but more technical capacities are needed to advance urban planning practice and especially the approaches in resilience and equity.

Chapter 4. Discussion

The analysis of Soyo´s urban development and the outcomes of LNG industry investments in the city represents a meaningful case study for urban planning, in the sense that permits us to discuss spatial implications and its impact. Combining the literature presented in Chapter 2 and the findings obtained through the methodology this discussion focuses on two main topics: first an impact assessment based on the observations of the positive, negative, direct and indirect impact of the urban infrastructure and social programs invested by ALNG; and second, a discussion about the limitations of private-funded infrastructure related to connectivity and housing to leverage agendas of equitable, sustainable development and resilient urban planning in resource-extractive cities.

4.1 Impact Assessment based on equity

The following impact assessment considers observation from sections 3.1 (Analysis of gas-extractive landscape) and 3.2 (Land cover analysis) identifying positive and negative impacts related to the location and investments done by the LNG industry in Soyo. Depending on the effects of the impact they are characterized as direct or indirect. Based on Susan Fainstein (2010) understanding of justice and

equity, megaprojects should include direct benefits to the low-income population, while at the same time distribute the negative impact without compromising the most vulnerable population.

Four direct positive impacts were identified in the analysis (Table 5). Out of them, only the increase in access to health and education services is specifically centered on Soyo´s most vulnerable population (4). In the case of impact (3) increase in connectivity at a city-level (Cadal Bridge- Airport), the benefit is at a city scale, but due to design, it has a focus on car-owners and population with higher income level. The positive impact of environmental mitigation of gas flaring (1) and the availability of government to use gas provided by LNG to support economic development national plan (2) require further analysis to better determine the extent of their implications. However, they represent a city-level impact not particularly focused on vulnerable populations specifically.

One indirect positive impact was identified which related to the housing rental model in the city (hotels, guest houses or smaller housing complexes) (5) supporting the interaction of gas industry workers with local communities.

POSITIVE IMPACT	**Direct positive impact** 1. Environmental mitigation of gas flaring (first LNG plant worldwide to use associated gas from nearby offshore blocks for its production process) 2. The availability of government to use gas provided by LNG to support economic development national plan. (Combined cycle plant - construction of the in progress) 3. Increase in connectivity at a city level (Cadal Bridge- Airport) 4. Increase in access to health and education services. --- **Indirect positive impact** 5. The housing rental model based on hotels, guest houses or smaller housing complexes in the city supports the interaction of the community and allow employees to become residents of the city. The engagement with local investors to develop housing buildings, hotels, and guest houses extends the economic benefit. However, it requires a mid-term view to ensure that the local business does not only of the gas industry for its operations.

Table 5. Summary of findings by type of impact

In contrast, the negative impact assessment (Table 6) included three direct impacts. First, LNG invested only in primary roads only which does not ensure accessibility for the most vulnerable population in Soyo (1). Low-quality solutions for road infrastructure impact the most vulnerable

population (lack of sidewalks, universal accessibility, lack of sewage and lighting infrastructure) (2). The burning gas when the plant is inoperative has a direct impact as well the LNG plant is visually perceived from many viewpoints in the city (3). In this case, the formers are directly related to vulnerable populations in Soyo, while the latter has a general impact requiring more extensive research in the field of public health to specify the affected communities.

All indirect negative impact affects the most vulnerable population in Soyo including; increase in demand and housing prices (4), disorganized urban growth and increase of population at risk (expanding residential units within mangroves area) (5 and 6), existing power plant is not being used to bring electricity to the population (7), and permission for housing enclaves that exclude local population (8).

NEGATIVE IMPACT	**Direct negative impact** 1. The increase in connectivity does not imply an increase in accessibility for Soyo residents and local communities. The road improvements are concentrated in main streets closer to the airport, city center and industrial area of the city while 90% of the roads are secondary and tertiary roads and remain not paved. 2. The quality and standards of local road improvements do not comply with the need of the city. Lack of sidewalks, universal accessibility, and pedestrian prioritization, sewage and lightning were not included in the design and implementation of roads by ALNG. (The road infrastructure is damaged by flooding recurrently in Soyo) 3. Burning the gas is when the plant is inoperative. Also, the LNG plant is visually perceived from many viewpoints in the city. --- **Indirect negative impact** 4. The construction of LNG plant (2008-2012) incorporated a high pressure in the city due to a large influx of people that upraised the housing prices, increases the demand for amenities and infrastructure among others. 5. The spread and disorganized urban growth is a challenge for the municipality that it has been included in their action plan. 6. Built areas increasing surrounding the main roads, populating agricultural areas and expanding residential units within mangroves areas. Negative impact on the population at risk. 7. The investment in energy supply did not ensure access to electricity to the population. Ensure procedures to invest in infrastructure that will perform at a local level considering partnerships and participatory strategies. 8. The camps inside the plant support a consumer/ visitor relationship where most of the workers are rotational having only a short period of time outside of their labor. Housing enclaves isolated from cities (without the need of interaction with communities) generate a space of exclusion supporting the disconnection that is prejudicial to build equitable cities.

Table 6. Summary of findings by type of impact

In this case, most of the negative impacts are burdening the vulnerable population in Soyo, while the positive impacts benefit the wealthier population. From a perspective of equity, the presence of LNG in terms of infrastructure and urban development does not represent a model for equitable growth. Assessing the impact of future expenditures in infrastructure in Soyo under the framework of equity could advance resilient planning and sustainable development.

4.2 Limitations of private-funded road infrastructure in connectivity and accessibility.

The analysis of the urban infrastructure and social projects implemented by the LNG industry in Soyo reveals impact and benefits in multiple dimensions. The primary outcome of mobility-related infrastructures is an increase in connectivity at a local and national level through road improvement, construction of a bridge and renovation of the airport. They are increasing connectivity benefits economic development at a local scale promoting commercial activity along roads. At the same time, increasing connectivity supports resilient urban planning by increasing road network and adding new access to the city through the Cadal Bridge.

Despite ALNG´s investment in increasing the road network and connectivity in Soyo, adding mobility-related infrastructure to the system does not necessarily imply an increase in accessibility for people. In this case, the infrastructure is specifically located on primary roads and mostly related to the needs and functions required for the gas industry to operate. Therefore, the increase in access serves specific purposes benefiting greatly a specific population in primary locations and not necessarily increases the level of access to other communities of residents in Soyo that are mainly served by secondary and tertiary roads.

In the case of roads and amenities, the focus in economic and social development is key to ensure that the access to services for the community supports equity and long term planning. For instance, the main road that gives access to supermarkets and relevant services has no continuous

pavement impacting the accessibility of the population along with increasing flooding vulnerability. Usually, pavement stops in a higher level than bare soil accumulating rainwater in unpaved areas, which according to the last report from DRR-Team in 2018 lack of a drainage capacity in as the quality of soil do not facilitate infiltration.

4.3 Housing and contract typologies impact equitable economic development

The experience of having ALNG implementing mechanisms of rental housing for their employees in Soyo central areas was unexpected and surprisingly has been a way in which the gas company and the city are obtaining benefits. According to interviews and observations, the rental housing units promoted the integration between LNG employees and the community. In this case, the location of these units within the city permitted casual encounters, commercial activity and awareness of local conditions, having an indirect positive impact in terms of activating local economy.

The engagement between local investors and the company to develop housing buildings, hotels, and guest houses extended economic benefits that contributed to the local economy and diversity of services offered in Soyo. Additionally, the typology and location of the housing compounds have shown to be relevant to avoid exclusionary practices. According to theories of enclave urbanism Angotti (2013) explains that isolated compounds reinforce exclusion, and Appel (2012) argues that enclaves create infrastructural disconnection, where a specific population related to production of the commodity (LNG) and the global market are being supplied, but most of the local communities do not have access to gas or electricity. The distance between the ones that work for the industries and the communities (inside/outside of the walls) can be considered a form of violence is questioning the role of public and private sectors for its permission and promotion. In this case study, LNG started the construction of an enclave isolated housing projects (PHR) which have not been finalized, leading to an alternative system of rental housing that brings more benefits in terms of increasing diversity and equity in Soyo.

The housing model implemented by the LNG industry is related to the type of contract for their workers. In a presentation about CSR related to the gas industry in Soyo, D Morais (2013) explains that rotator[17] workers living in camps do not have incentives to engage with the local community or participate in the local economy as they spend most of their time inside of the camps. In contrast, the 5/2 working system[18] over prolonged periods ensures that workers become residents creating tangible benefits to the local community. The fact that the amount of money spent by LNG workers does not need to be significant, but the immediate and constant character of these expenditures result in activation of the local economy and empowers the people (D Morais, 2013). D Morais explains that making a change to the terms and conditions of both nationals and expatriate workers to live in local oil and gas producers' communities could benefit the local community.

Even if this research differentiates the housing compounds for its potential to promote a higher level of interaction between employees and local communities. The fact that the access to infrastructures, facilities, and installations remains only for the ones living in this compounds could stress "infrastructural violence" making more visible the exclusion and absence of services and commodities between population. Appel argues that "where its presence is possible, basic infrastructure's absence is a form of violence (Appel, 2012, p. 22)." However, the empirical experience described in interviews and by De Morais (2013) calls into question and suggest further research to revise the impact and potential of a rental housing models for resource extractive industries.

[17] People who work 28, 21, 14 or 7 days and have the same amount of days off, generally live on camp or offshore.
[18] Employees live and work in a weekly regular basis Monday to Friday having Saturdays and Sunday off.

Chapter 5. Conclusion

Considering that the urban population in African countries and other regions are growing rapidly, climate events are increasing, and access to urban infrastructure and services is not ensured for everyone. The investment related to extractive-industries has the potential to play a key role in resilient urban planning if it is paired with long-term benefits for local communities, including equitable growth and climate vulnerability reduction. Recommendations based on Soyo´s experience can serve to inform urban planners working in other rich resource extraction communities, particularly in small and medium cities located in coastal areas.

Local content frameworks and investment contracts are context-specific varying on the regulations, dollar amount negotiated and terms for implementation. Communities would benefit significantly from more specific negotiations that include an assessment of spatial implications behind the infrastructure projects and a focus on the outcomes and processes instead of the dollar amount of the investment contract only. The following considerations serve urban planners to foresee the type of impact and outcomes at a local level and influence negotiations for more resilient and equitable cities in the context of resource-extraction.

Considerations and recommendations

Request Impact assessment of infrastructure and social programs through the lens of equity

To ensure equitable economic development, the impact assessment is a tool to unveil expected and unexpected impacts of private-funded investments. This assessment should incorporate an analysis of spatial implications and the lens of equity to determine the type of impact (positive or negative) and the consequences for communities.

Ensure Multi-user and multipurpose urban infrastructure.

The investments in road infrastructure need to create a more evenly distributed road network, including standards to cope with accessibility and flooding issues. In order to ensure the distribution of connectivity and access to infrastructure across the population, the US Department of Energy (2017) recommends that ancillary infrastructure projects be designed "multi-user" and "multipurpose" which means they need to be used by local entities for purposes other than servicing the gas project.

Incorporate guidelines and standards into requirements for private-funded infrastructure.

Defining the expected outcomes of social investment is essential to ensure equitable economic development and engagement with communities. For instance, contracts should incorporate technical requirements for urban infrastructure to upgrade street standards. Also, planners should focus on negotiation and partnerships that will implement these projects beyond the dollar amount to ensure comprehensive interventions that benefit local communities.

Promote the implementation of integrated housing compounds.

The housing typologies in place for resource extractive cities tend to be enclaves which hurt local communities. In the case of Soyo, planners should promote contracts that have fewer rotators and more workers that are permanent residents to ensure industry commitment to the city in urban planning decisions and implementation.

Strengthen local government to implement and guide equitable and resilient urban development.

Build capacities and ensure that the local urban planning team (at the municipal level) is equipped to guide urban development in that area at a fast pace. Mapping, data collection, and scenario thinking are relevant inputs that can be advanced with CSR and public funds. Investing in local capacities, training and consultancy is critical to achieve equitable growth and perform resilient planning.

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Appendix

1- Landsat imagery scenes source and band classification.

Data Source	Dates Operation	Bands	Wavelength (micrometers)	Path/Row	Scenes Selected (Date)	False Color Band classification
Landsat 7 Enhanced Thematic Mapper Plus	April 1999 to Present	Band 1: Blue Band 2: Green Band 3: Red Band 4: Near Infrared Band 5: Shortwave Infrared 1 Band 6: Thermal Band 7: Shortwave Infrared 2 Band 8: Panchromatic	0.45 - 0.52 0.52 - 0.60 0.63 - 0.69 0.77 - 0.90 1.55 - 1.75 10.40 - 12.50 2.09 - 2.35 0.52 - 0.92	Path: 183 Row: 64	04/08/2002	7-5-3
Landsat 8 Operational Land Imager (OLI) and Thermal Infrared Sensor (TIRS)	February 2013 to Present	Band 1 - Ultra Blue (coastal/aerosol) Band 2 - Blue Band 3 - Green Band 4 - Red Band 5 - Near Infrared (NIR) Band 6 - Shortwave Infrared (SWIR) 1 Band 7 - Shortwave Infrared (SWIR) 2 Band 8 - Panchromatic Band 9 - Cirrus Band 10 - Thermal Infrared (TIRS) 1 Band 11 - Thermal Infrared (TIRS) 2	0.435 - 0.451 0.452 - 0.512 0.533 - 0.590 0.636 - 0.673 0.851 - 0.879 1.566 - 1.651 2.107 - 2.294 0.503 - 0.676 1.363 - 1.384 10.60 - 11.19 11.50 - 12.51	Path: 183 Row: 64	03/03/2015 04/25/2017	7-6-4

Data Sources and Classification Band (Source: USGS)

2- Interview Questions (Semi-structured interview)

Matrix 01 | Summary and Takeaways	Local Government Planners	Professionals from LNG Industry	Non-Profit Organization Leaders	Scholars
N° of Interviews by Sector				
What **urban infrastructure projects** has been implemented by Angola LNG in Soyo?				
What **social benefits** has been supplied by Angola LNG for the local communities in Soyo?				
Who are these projects serving or benefiting ? And how can they be improved?				
What are the **negative impacts o**f having Angola LNG in Soyo?				
Would you say that Liquefied Natural Gas **(LNG)** investments contributes to the **sustainable development of Soyo**? If so, to what extent?				
5. How does the government promote the idea of a **sustainable development in Soyo**? What policies, programs or infrastructural projects so you think should be a priority?				

*This structure for questions was used to start the conversation, but specific questions were considered as interviews were semi-structured and open ended.

3- Referential Image of Soyo "New City Master Plan"

Image by Sigma Group: http://www.sigmagroup.ao/index.php?option=com_content&view=article&id=79&Itemid=55&lang=en