From oil to soil
time-space speculations for ecological regeneration in operational landscapes

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Master thesis

RESEARCH REPORT

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To my studio friends, for the inspiration, the collective brainstorming, the countless matrixes and for making even the unbearable days bearable - and very fun.

To the friends who have made Delft feel like home these past two years.

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To two-year-ago middle-of-the pandemic me, who questioned herself - 'is this it?' about Architecture. Gladly, it wasn't.

To my family, my lighthouse even an ocean away. No words will ever be enough.

Apicum is the tupi guarani word that denotes the hipersaline plain in the mangrove ecossystem. While it may seem depleted of all life forms due to the cracked soil surface and sparse vegetation, the apicum is in fact the breeding ground for the estuarine system and for much of marine biodiversity. Many look at it and see a dead zone, but in the very small scale, emerges a rich assemblage of interdependent worlds.

ABSTRACT

Extractive and productive landscapes are the backbone to contemporary urban life. However, they are commonly overlooked by the fields of spatial studies and practices. One amongst many, Cubatão's petrochemical hub reveals the systematic ecological degradation resulting from resource-intensive commodified politics, couched in the widely diffused rhetoric of development and progress and distinctly linked to events of the Global North. Impending global shifts, such as the retreat of fossil fuels and the increase in renewable energy sources, raise questions on the vulnerability of these places and on their abilities to evolve spatially, ecologically and socially. Through a critical review of what has been conducted so far in terms of design, planning and policies and a reflection on the agency of Architecture, the research speculates over new forms of space production that engages with the complex spatial conditions and the diversity of actors on site.

keywords: post-development; operational landscapes; onto-cartographies; speculative design; construction ecology

CONTENTS

RESEARCH STRUCTURE

INTRODUCTION

From the second half of the 20th century, Brazil underwent an intense national development project. During this period, there was an emphasis on resource politics, with the founding of several state companies, most of which were focused on the extraction of minerals, such as iron-ore and nickel. Not much later came the discovery of oil reserves and Petrobras, the state oil company, began to lay bases across national territory. All across the country, construction sites popped up, either to build the industrial compounds which would process the extracted raw materials or to develop and expand road and railway infrastructure to serve them. A side effect of this push towards development are its ecological implications, with the introduction of new human settlements in often 'unconquered' territories and the damages to non-human species. These new ecologies manifest through idiosyncratic spatial conditions, but likewise, they also structure new relations between humans, non-human species and the natural environment.

Often developed under a modernist and technocratic logic, these sites showcase how extraction zones typically do not benefit from the wealth produced by the system they are such fundamental parts of. Moreover, they illustrate a clear disconnection between the social, environmental and technological dimensions that are juxtaposed in productive territories. For most of these cities, the extractive or industrial activity is the dictator of the spatial and social structures, hindering the existence and functioning of any other articulations and networks. This is what Macarena Gomez-Barris (2017) describes as the extractive zone, where capitalism "reduces, constrains, and converts life into commodities" and that is also discussed by Kiel Moe's (2021) concept of "asymmetric metabolic tensions" (p.70).

Places like these acquire new meanings and require attention in face of significant changes to the global energy and resource market. Will they be able to indicate new paths towards stabilizing the unequal exchanges between humans and the natural environment and to the core-periphery relationship? Will they face even more severe processes of social environmental depletion, assuming the roles of sacrifice zones? Or will they become ruins of a time that has passed, while humans move on to the exploitation of the next 'gold mine'?

CONTEXT

This is not an isolated phenomenon. Cubatão is one amongst many places that can tell a similar story. Situated 60 kilometers east of São Paulo, the city gained prominence in the late 1950's as Petrobras, the national oil company, inaugurated one of their biggest oil refineries in the city. But it observed an exponential population growth due to the construction of the Rodovia dos Imigrantes, an impressive highway

infrastructure with tunnels and elevated stretches over the Serra do Mar. Back then and still today, the city played an important part in the national developmentalist project and international trade, as it connects São Paulo and the country's vast hinterland to Santos, where Latin America's biggest port is located. Enabling further access to the global resource market, Cubatão became a spot of high interest of state companies, in the oil and chemical business. The exponential growth of the petrochemical hub led Cubatão to be considered the most polluted city in the world in the 1980's, with acute soil and water contamination, which led to a series of public health issues, eventually shutting down some of the industries. Since then, Cubatão has been known as an example of environmental reparation, a process that, on the outside, appears to be true, but that under further examination can be questioned.

Petrobras is still a major player in the city and the future of its operation and installations with the energy transition poses important questions, especially if considered that it stands at the top of the 'industrial ecology' chain, with its byproducts serving as inputs for several other companies in the area.

PROBLEM STATEMENT

Petroleum extraction is one of the many sides of the multifaceted resource politics observed in Brazil and in Latin America. Extractive zones are scattered all around the continent and they recount a colonial past while evidentiating the enduring character of the colonial matrix as a structure that governs economical, social and environmental policies. The adoption of a modernist discourse towards planning under the pretext of neo-liberal reforms, deepened the disconnection between the social-environmental-technological dimensions and deviated Brazil, and its Latin American neighbors, from the construction of a self-evolving future. The enduring rhetoric of 'progress and development' as a way to develop the so-called 'underdeveloped' countries and its material implications have created idiosyncratic spatial patterns and formations. Not only does it have its spatial manifestations, but it has also shaped and constrained relations between place, people and the encircling natural environment.

Thus, as a counterpoint, the overarching objective of this graduation project is to speculate and test out alternative forms of space production, that challenge the culturally-constructed contrast between technology-infrastructure and nature. Cubatão is a geographically complex site and an assemblage of a multiplicity of networks of many disciplines and scales. An investigation of the site calls for a multiscale and interdisciplinary approach. It is necessary to shift from a technocratic stance, which often posits money, time and resource intensive processes, towards working with the dynamic conditions of natural cycles and the metabolic systems of human inhabitation.

The general problem at stake is what happens to the physical, natural and social resources in these infrastructural landscapes in face of the upcoming societal transitions. Will they become obsolete, leaving

behind the heavy social, spatial and environmental impact of extraction and refining activities? How can Architecture intervene upon these sites, working in the liminality of different ecologies? Once deemed the 'Valley of Death', Cubatão is one of many places that raises these questions and that hopefully can indicate paths towards the agency of Architecture in the post-developed world.

RESEARCH QUESTIONS

Considering the problem described above, the main research question is:

How can architecture and design create and set in place structures for new forms of inhabitation in a post-oil future in Cubatão?

To aid the main question, the supporting sub-questions are:

What are the discontinuities in developmentalist discourse and how do they manifest on site?

What sort of Architectural structures can aid Cubatão towards establishing a self-evolving narrative, evading the constraints of a core-periphery relationship?

How can the 'whole' be transformed through localized interventions?

THEORETICAL FRAMEWORK

On a general level, the research aims to investigate the role of Architecture as a creator and inductor of transformation. To do so, it is necessary to first understand the conditions which generate the demands for transformation and then to examine approaches that might suitably respond and engage with them. Below are brief definitions of the most relevant concepts and scholars that engage with these matters, which are also illustrated in the concept cloud that follows.

UNDERDEVELOPMENT

In the scope of the current research, I analyze how underdevelopment can be seen as a practice-discourse that produces a set of structural spatial conditions of depletion and degradation that impact humans and extra-human geographies.

Kiel Moe (2019) describes the asymmetric tensions between core-periphery, opposing energy intensive economies against energy-losing extractive economies. The notion of core-periphery can be thought of in view of places within the same political establishment (states, regions, nations) but is fruitfully expanded to understand the effects of a Global North-South relationship. Moe (2019) states that these asymmetric tensions are largely observed within the building discipline, but also draws attention that this asymmetry has an architecture itself. What is the structure of these unequal exchanges and how do they manifest in

4 The Zapatista Army of Liberation, situated in the state of Chiapas, Mexico is a militant group, composed mainly of indigenous people, that stands in opposition to the government and military. They define the pluriverse as "a world where many worlds fit".(Kothari et al.,2019)

the territory?

Brenner and Katsikis (202o) define the 'hinterlands of the capitalocene' as the operational landscapes that sustain life in city spaces and unpack on the conditions encountered in these places. By pointing out how the field of urban studies often tends to disregard these peripheric places, focusing only on their metabolic exchanges with the core, they discuss possible approaches for studies and interventions.

In her work 'Uncommoning Nature: Stories from the Anthropo-Not-Seen', Marisol de La Cadena (2019) describes the conditions of underdevelopment and the reflexes of resource-intensive economies in the context of Latin America. The author has a post-colonial stance, pointing out the limitations of using Euro-modern frameworks to rethink post-development.

ONTO-CARTOGRAPHIES

The central concept to understand the relational approach taken towards both research and design in my graduation project comes from Levi Bryant's 'Onto-cartography: an ontology of machines and media.'(2014). It points towards looking at the inputs and outputs produced and exchanged and on how these, constituting assemblages, organize and structure 'social and ecological relations' around. Thus, an 'orto-cartography' refers to the mapping of these relations, their inputs/outputs and of how they transform the world of others.

In his work, 'Latin America at Crossroads', Arturo Escobar (2010) calls out for a relational approach to the post-developed world. In opposition to the dualism characteristic of liberal modernity, relational ontologies, according to Escobar (2010) "are not built on the divides between nature and culture, us and them, individual and community". These are seen as culturally constructed divides and I hope to challenge them throughout the research and design exercise. With the research I have conducted so far, I have found that Cubatão is an assemblage of discontinuous geographies - whether they are natural, technological, human, extra-human, etc. Therefore, there are important relations which exceed the limits of 'territory', so mapping these relations through their effects, exceeding the material dimension seems like an interesting path.

ECOSOPHY

Guattari's notion of ecosophy (Guattari, 2000) works as a departure point for initiating the theoretical discussion. Understanding the conditions described above and the stated problem as results of the fragmentation between the three ecological registers Guattari describes - the environment, social relations, and human subjectivity; his idea of an ecosophy is to be seen as call to action in face of a scenario of intense techno-scientific transformations.

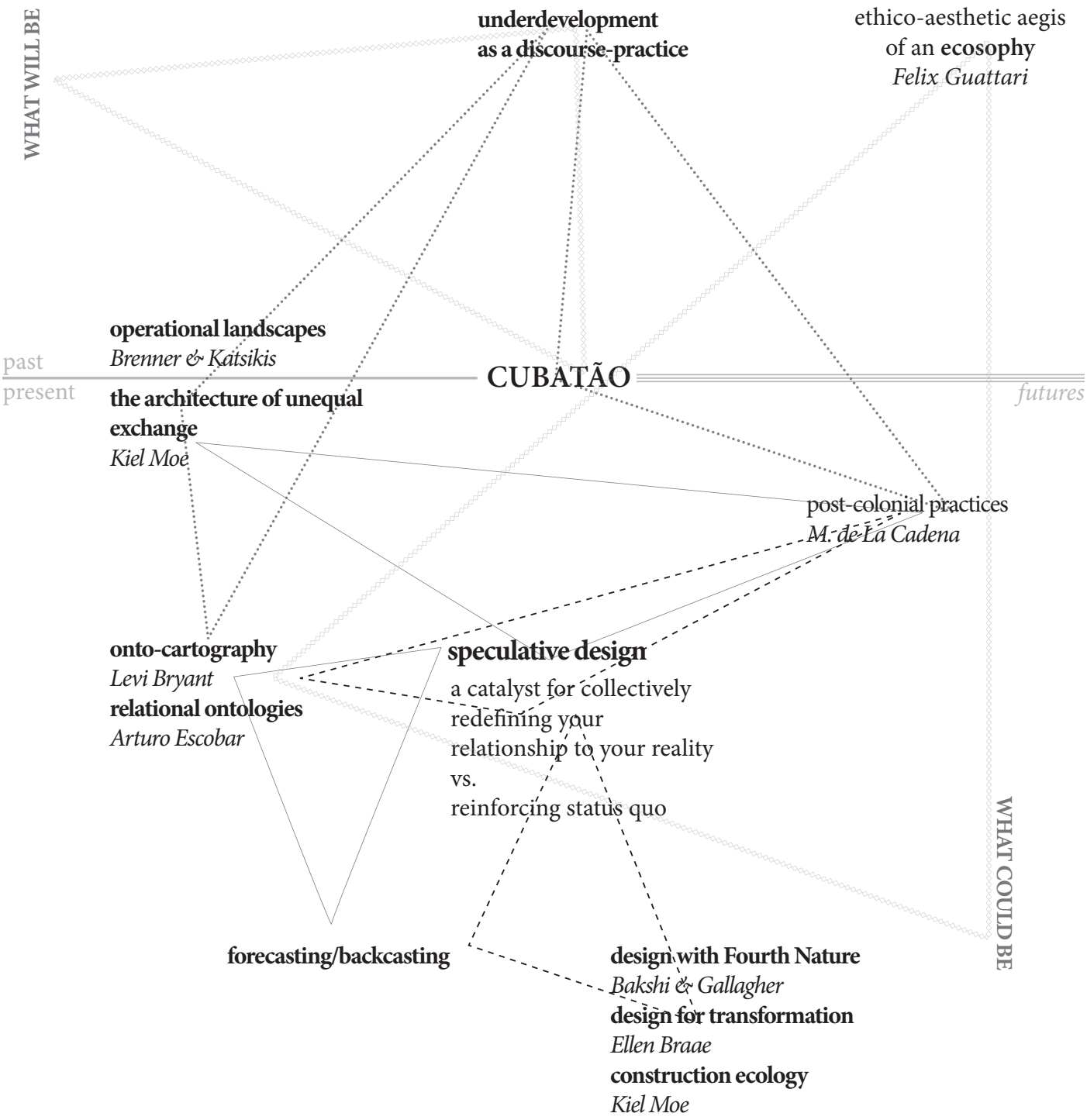
The theory that follows is used to bridge research, as described above, to the design exercise. Rather than highlighting one main concept, I will list some of the authors used and their contributions to my research.

In their work 'Design with Fourth-Nature', Bakshi and Gallagher (2020) discuss the shift from reactive towards proactive strategies of design, that is, strategies that are able to respond and engage with unpredictability. It refers to the acknowledgement of the dynamic and unstable nature of ecologies and questions the use of a 'restoration' endpoint in design practices. Furthermore, it sheds light on how mechanisms for environmental protections are commonly influenced by romanticized views of nature, which is both unrealistic and unproductive for the field. It presents itself as a very useful design position given the unstable nature of the chosen site, whether of the metabolic human systems or the natural cycles.

Ellen Braae, in 'Beauty redeemed : recycling post-industrial landscapes' (2015) defends a practice of design that allows for nature's systems to work with the city's systems. In an analysis of post-industrial sites, Braae describes the industries as enclaves and highlights elements which she calls 'armatures', which bind the different enclaves and heterotopias (using Foucault's concept). She also describes a theory of design for transformation (which is not acknowledged or disseminated as a discipline) as making 'something' become 'something different', before and after conditions which are both non-static. She says that "Architecture is primarily spatially oriented, while transformation is organized both in time and space." (p. 280, 2015). Her approach can be linked to the idea of forecasting and backcasting, tools that are central to the development of my design idea. The book also contains an interesting compilation of precedents.

Kiel Moe (2014,2021) refers to the process of building as a problem of thermodynamics. His concept of construction ecology and his metabolic approach both on an urban level and on the scale of the building itself is highly valuable to my research. He states that the accounting for the energetic and material inputs as well as their geographical displacements need to be incorporated in the design practice. For this graduation project, I am consulting his works 'The Nonmodern Struggle for Maximum Entropy' (2014) and 'UNLESS: the seagram building construction ecology' (2021).

CONCEPT CLOUD
own authorship, 2023



METHODOLOGICAL POSITIONING & FRAMEWORK

Thinking of ways to respond to the main research question, I found myself within a semantic dilemma. Recognizing Architecture's agency in regards to contemporary issues and demands in a rapidly transforming world, I ask myself two questions.

What ***will*** Cubatão become in face of the discussed transitions?

&

What ***could*** Cubatão become in face of the discussed transitions?

The difference is subtle and semantic, but very significant. The first question relates to the maintenance of the status quo. Understanding Cubatão as materialization and part of a discourse, what does this discourse envision for its future? But in asking "What could Cubatão become?" I posit Architecture's role in changing the course of an ongoing narrative, of pointing towards a different direction in order to reach a 'sounder' future. I also acknowledge that the reflections that arise from this research, as well as a design proposal, are one amongst many possibilities, and that they point towards one of many (possible) futures.

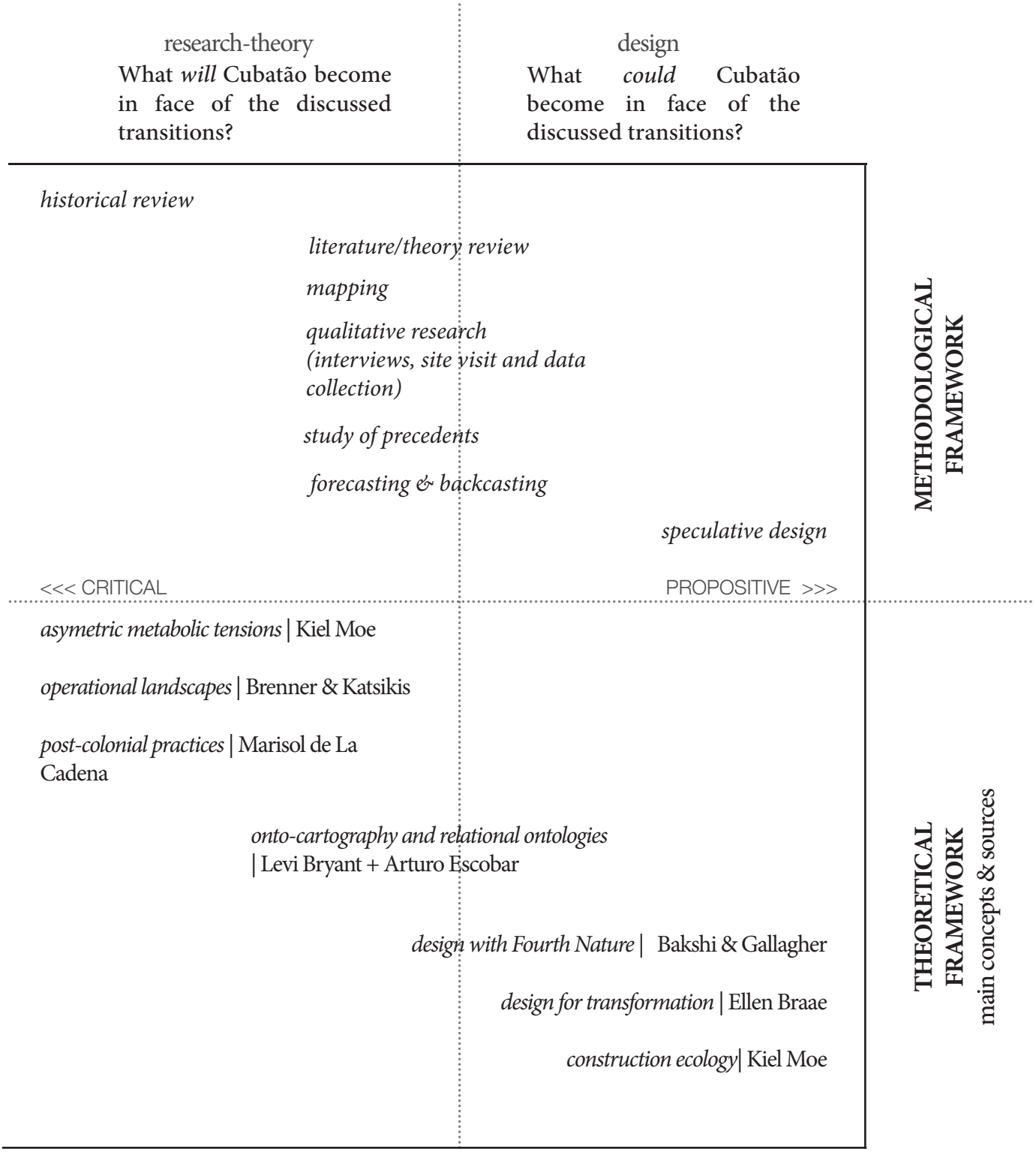
Thus, for both questions, forecasting and backcasting becomes an essential method and speculative design as the emerging practice. To engage with protocols of speculative design and backcasting means to emphasize process over outcome, accepting and working with the unstable, dynamic and open-ended nature of inhabitation. I establish 2025 as the 'future' and describe the 'end' of petroleum trade in 2050 as the disruptive trigger event. Based on that, I open out possible scenarios that might play out. Such analysis provides enlightenment of the fragilities and potentials within the existing systems and indicates when, where and how Architecture can intervene, incrementing and reconfiguring space, connections, and networks in order to prescribe a sounder future for this locality and its agents.

The exercise of fore/backcasting is supported by a brief historical review that focuses on mapping connections, increases and decreases rather than pinning down events in time. A second mapping is a survey of objects or artifacts encountered on site. conducted virtually, using available imagery and Google Maps, but that I expect to complement after the site visit (post P2). The exercise focuses on highlighting materializations of the practices identified in the territory – whether they are part of an industrial logic, to cultural practices described by the population, or to the natural aspects which are so significant in this locality – and classifying them into micro, meso and macro scales. The aesthetics of Cubatão is a big part of my fascination with this site, and I see these artifacts as 'landmarks'. This also helped with selecting a site for the design intervention.

Additionally, the research will be aided by literature and precedents

5 As defined by Anthony Dunne and Fiona Raby (2013): 'design speculations can act as a catalyst for collectively redefining your relationship to your reality by encouraging - for instance - through what-if scenarios - the imagination of alternative ways of being. Such critical design can go a long way, in their view, against design that reinforces the status quo' (Escobar, 2018)

review and by qualitative research on site, with the aim of collecting and documenting data. Through the research conducted so far, I have found that the multiscale, complex and layered nature of the site translates into a difficulty of representation - conventionally used tools such as timelines are not useful in organizing the found data. Therefore, I make use of different sorts of diagrams to compile, organize and communicate information, so I would list diagrammatic thinking as a method for this project. The methods listed above, and how I intend on using them can be found systematized in the diagram that follows.



METHODOLOGICAL FRAMEWORK
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RESEARCH SCHEDULE DIAGRAM
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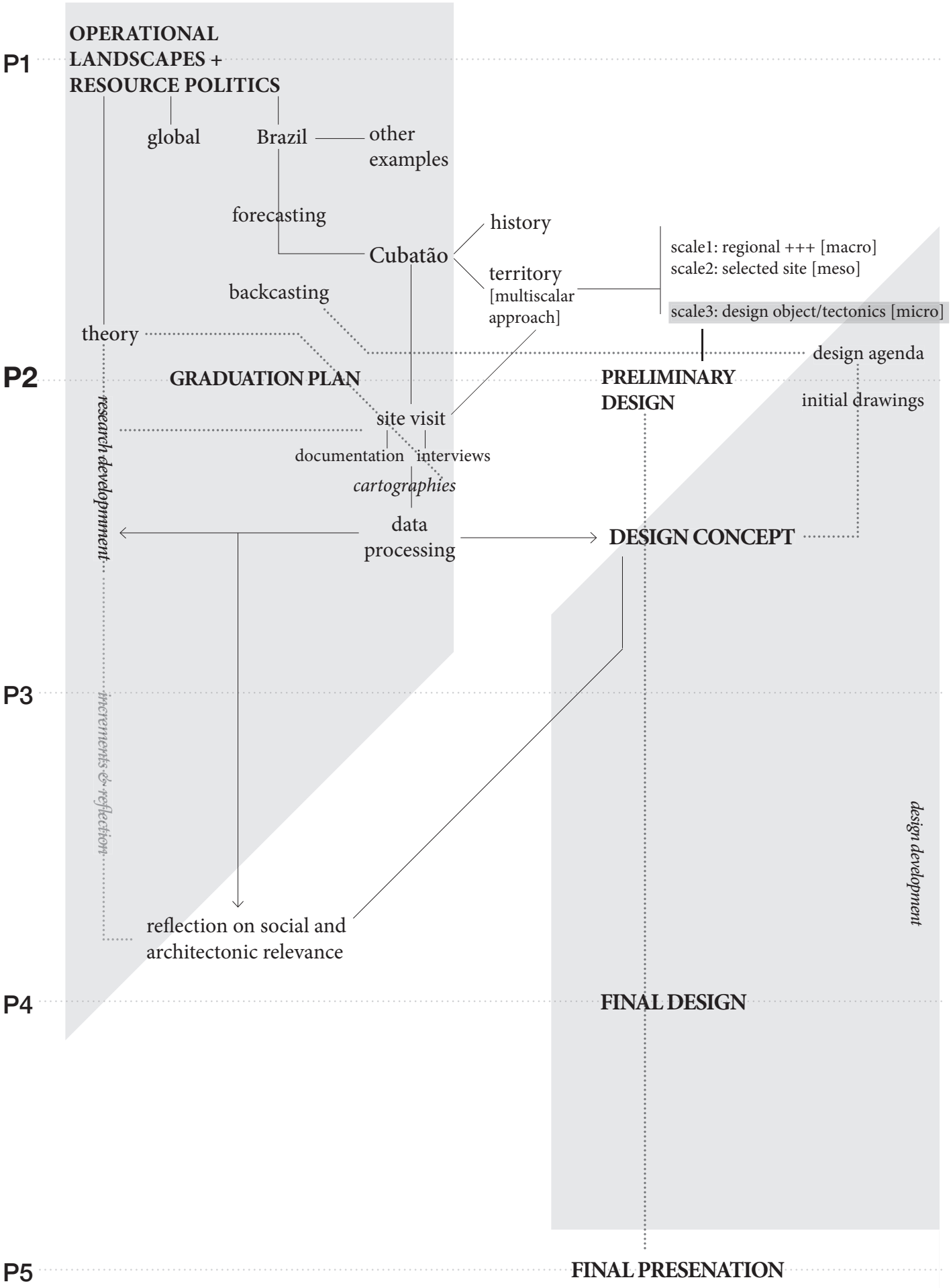


EXPECTED OUTCOMES

In the case of this project, I see the design as a testing ground for the research's findings. Research should precede but also follow and inform the design decisions. A large part of this research is about engaging with different ways of practicing Architecture (or ways that are new to me). Therefore, it is about testing out different approaches that may elevate the role of Architecture in working with complex environments. Beyond the design exercise, it is also about trying to answer questions that I have about the possibilities of a career with a design degree and how to engage with the interdisciplinarity of it. Thus, the expected outcomes are:

1. a speculative design proposal, on a micro-meso scale, but that should induce new forms of inhabitation that exceeds the scale of the architectural object per se. The design proposal should be seen as a module of a larger scale intervention;
2. a post-design reflection that comprises
   a. an assessment of the design's response to the context elaborated through the research;
   b. a reflection on the role of Architecture in devising novel solutions for contemporary demands and on the possibilities and limitations of the discipline.

ARGUMENT ON RELEVANCE

The next major energetic transition is already in course. Europe expects to have completely switched to clean energy by 2050. Globally, there are camps, sites and cities dedicated to oil extraction, most of which serve this decelerating market. What happens to these places and to these people once this transition gains force? All around the world we will encounter the problem of obsolete infrastructure, exhausted ecologies and depleted social and political structures.

With this research, I expect to shed light on these places, which are born as collaterals to the 'pursuit of progress' and that are overlooked by the field of urban studies and design. Interstitial sites such as Cubatão will be left behind with the social, spatial and environmental degradation resulting from the extractive activities. In the context of Brazil, and more generally Latin America, these places are also linked to a developmentalist rhetoric that was once a driver of public planning and policies. The ideology might have changed, but these sites still bear witness of that time and I question myself if they are able (and if they wish to) adapt to what is coming next. Additionally, the imminent depletion of resources and the unsustainability of the extractive model needs to be accounted for within the construction disciplines. It is urgent to incorporate agendas of building ecology and circularity and this theme is still very sparsely explored in Brazil.

In all of the topics described above, I also see an opportunity to contribute by expanding the exiguous literature focused on the Latin American and Brazilian context.

Using speculative design as a tool, I expect to be able to exceed conventional processes that have up to this point produced known and expected results and as the research critique's points out, not so

sustainable for the long run. In his book Designs for the Pluriverse, Escobar says:

> To nourish design's potential for the transitions, however, requires a significant reorientation of design from the functionalist, rationalistic, and industrial traditions from which it emerged, and within which it still functions with ease, toward a type of rationality and set of practices attuned to the relational dimension of life." (Escobar, p. X, 2018)

1 Underdevelopment as a practice-discourse

The petroleum business is one of many sides of the multi-faceted resource politics observed in Brazil and Latin America. Extractive and productive zones scattered around the continent are a reminder of its colonial past and point out the extent to which its enduring structures have penetrated economical, social and environmental policies.

Mining, cattle-farming and intensive agriculture (monocrops) are some amongst the other market practices that, alongside the oil business, currently underpin the Brazilian economy. However, they rely on environmental conducts such as fires for soil clearing/renewal and deforestation, which have a series of consequences such as soil erosion and nutritional impoverishment; decrease in biodiversity; changes to the rain cycles and desertification; contamination, obstruction and silting up of water springs, and so on. The spiral of environmental degradation is relentless. But it often happens far from the eyes - distant from the metropolis and the urban centers most densely populated, which makes it easy to neglect the extent of the damage. But the recurrence of disasters such as the ruptures of tailings dams in Minas Gerais expose the fragility and pervasiveness of the extractive and productive system.

Brenner & Katsikis (2020) use the term "hinterlands of the capitalocene" (2020, p.24) to describe the plethora of non-city spaces that support our current ways of life - whether related to the 'city-building' or to international trade chains. The authors point out that even though the hinterlands spread out over 70% of the planet's surface, planning disciplines still trivialize them - focusing on the metabolic exchanges between city/non-city spaces, without however acknowledging the spatial implications in the latter.

A machine-like understanding makes it clear. Cities are often viewed as 'self-sustaining' mechanisms but in reality, they are contingent on a variety of external inputs (water, food, materials, labor, energy, etc) and generate an array of (also) external outputs (waste; air, soil and land pollutants). Both inputs and outputs tend to originate from and return to the non-city spaces described by Brenner & Katsikis (2020), or at least those which are quantifiable and monitored.

In his work 'The Non-modern Struggle for Maximum Entropy" (2014), Kiel Moe unpacks on the feedback reinforcements of modern metabolisms. He outlines both the 'goods' of these metabolisms, including "liberating, powerful systems of knowledge, mobility and industrial production" and the 'bads', which he describes as "counterproductive, ultimately power-draining systems of capital accumulation, chronic carbon cycles, resource degradation, amongst other externalized costs and system effects" (2014, p.176). In his subsequent work, "Unless" (2021), Moe expands on the "asymmetric metabolic tensions between core and periphery" (p.70). He points out that the concentration of the 'bads', as he describes in his previous works, in the periphery (or non-city spaces as coined by Brenner&Katsikis (2020)) inhibits its capacity to evolve ecologically and socially. At the expense of environmental and

occasionally sociopolitical degradation, these places are structurally hindered from 'self-development' and are continuously constrained to a dialectic relationship with the core. In practical terms, this means that they do not profit from the wealth generated in the systems they support, while also not benefiting from the cultural and social opportunities that come with it. With this, core and periphery engage in antagonic processes of complexification and simplification. According to Moe (2021), simplification means less adaptability and flexibility, and the ultimate result is an increase in vulnerability.

Yet another form of impairing the periphery's development is what Michael Serres (2011, as cited in De La Cadena, 2019) coined as "appropriation through pollution". Not only does it impair development, but the polluter also inhibits others from establishing any form of relation to the polluted medium or environment. This becomes even more relevant once we understand that the hinterland, not benefiting from the wealth that flows out from the extractive/productive systems, needs to set in place other economic practices, which might be contingent on the polluted terrestrial elements. In Cubatão, this condition is exemplified by the mutual use of the Piaçaguera Canal both by the industries and by subsistence fishing communities. Other perspectives to be considered are those of biotic and abiotic agents in the polluted ecosystems.

DISAGREEMENTS AND EQUIVOCATIONS

The conflictual understanding (or misunderstanding) of terrestrial elements from the perspective of different agents is further unpacked by Marisol de La Cadena. The author uses the concepts of 'disagreement' and 'equivocations' to refer to this multiplicity of understanding, which is essentially ontological. 'Disagreement' refers to the occurrence of different understandings in a condition where one of the parties holds power over speaking, or, more specifically, over "the capacity to define what is and how that is" (de La Cadena, 2019, p. 39). Misunderstandings in this case are epistemic – the conflict is over the conditions for naming things in a shared world. In the case of 'equivocations', as described by de La Cadena, the conflict is ontological. The misunderstanding arises because both (or more) of the involved parties have named something, and it might be the case that they agree on the naming per se, but because they belong (ontologically) to different worlds, their understandings will diverge. The author describes as an example the conflict between the Awajun Wampis indigenous people and mining companies in Peru. Territory, as proclaimed by the Awajun Wampis, refers to both the piece of land under their feet, but mostly to an entity that emerges through their practices of life. It is not solely a relationship of use, of care, but of being. Therefore, in trying to displace the indigenous people from their land, i.e. territory, the mining company, which sees it exclusively for its material dimensions, denies the existential dimension that is within Awajun Wampis and that is performed through their understanding of the terrestrial elements. This conflict, which is essentially ontological, becomes "impossible to solve without engaging in the terms that make the territory other to the state's ability to understand and therefore other to its recognition." (de La Cadena, 2019,p. 37). The Awajun Wampis and their understandings of the Earth exceed the Modern language and that increases the complexity of the conflict. The rule of Law might not

be enough to respond to it, because it would, by its nature, primarily deny the existence of the terms of the Awajun Wampis.

Thus, it is possible to argue that 'disagreement' and 'equivocation' are at the root of the natural and social depletion and degradation in Cubatão. While the place is on one hand viewed in face of its instrumental location and access to the Santos Estuary (which means in a technocratic understanding, an abundant supply of water for the industrial operations), this overlaps with and suppresses the understanding of the caiçara indigenous people, which are connected to the estuary through relations of geography, proximity, but mostly, culture and identity. They speak of the same thing (water) but it has different, if not antagonic, meanings to each of the speakers.

Underdevelopment is a deliberate practice-discourse and is connected to colonial narratives, which sacrifice one part of a system to favor another, usually backed by the narrative of progress and modernization (Moe, 2021).

A recent case that illustrates this asymmetry took place in Yasuní National Park, in Ecuador, as reported in a piece from the New York Times (Einhorn & Andreoni, 2023). In 2007, an oil reserve in the Amazonian rainforest, close to isolated indigenous grounds, was denominated as 'Block 43'. As an alternative to the drilling of Block 43, government officials at the time proposed the creation of an international fund that would roughly add up to half of the estimated value of oil in the reserve, determined to hold approximately one billion barrels. Countries would invest in the fund as a compensation towards Ecuador for leaving the reserve untouched. Oil money amounts to ⅓ of the Ecuadorian government's revenue. However, the 'compensatory fund' did not gain force and no significant contributions were made. Rising debt made Ecuador turn to China for loans, part of which will be paid in oil - ironically, drilled from Block 43. This episode in Ecuador epitomizes how countries which house the natural resources are often pushed into capitalizing on them, even when they seek a different way out. The periphery is seen first as a resource, and ultimately as a 'sacrifice zone'.

AN ENDURING STRUCTURE-PRACTICE - critical junctures in Brazilian history

The story repeats itself in analogous ways in Latin America. In the case of Brazil, this 'sacrificial' relationship began back in the colonial period. To construct the brief historical review that follows, I have consulted "Brasil: uma biografia" by Lilia Schwarcz and Heloisa Starling (2018).

Portuguese colonization was based on exploration, domination and conquering - of land, people and resources. From early on, this impacted the territorialization of land - the first land regulation system put into place in the 16th century was the 'Capitanias Hereditárias', which sectioned the country into fourteen horizontal strips, starting from the coast towards the hinterland (Schwarcz & Sterling, 2018, p. xx) . The system ensured that every grantee would be entitled to a portion of both land and sea, valuable resources for agriculture and defense of the territory.

By the end of the 17th century, with an economic crisis erupting in Portugal, the bandeirantes ventured even further towards the hinterland in search of precious stones. This would later culminate in the establishment of the capitania of Minas Gerais, which, as its name states, is a region of intensive mining. Due to the colonial logic of capital and land accumulation, the descending generations of the Capitania grantees would later become large estate land-owners and get into the coffee and sugar-cane business. The prominent coffee and sugar elites would later assume a central role in the industrialization period, funding the first industrial developments in the Southeast during the 20th century.

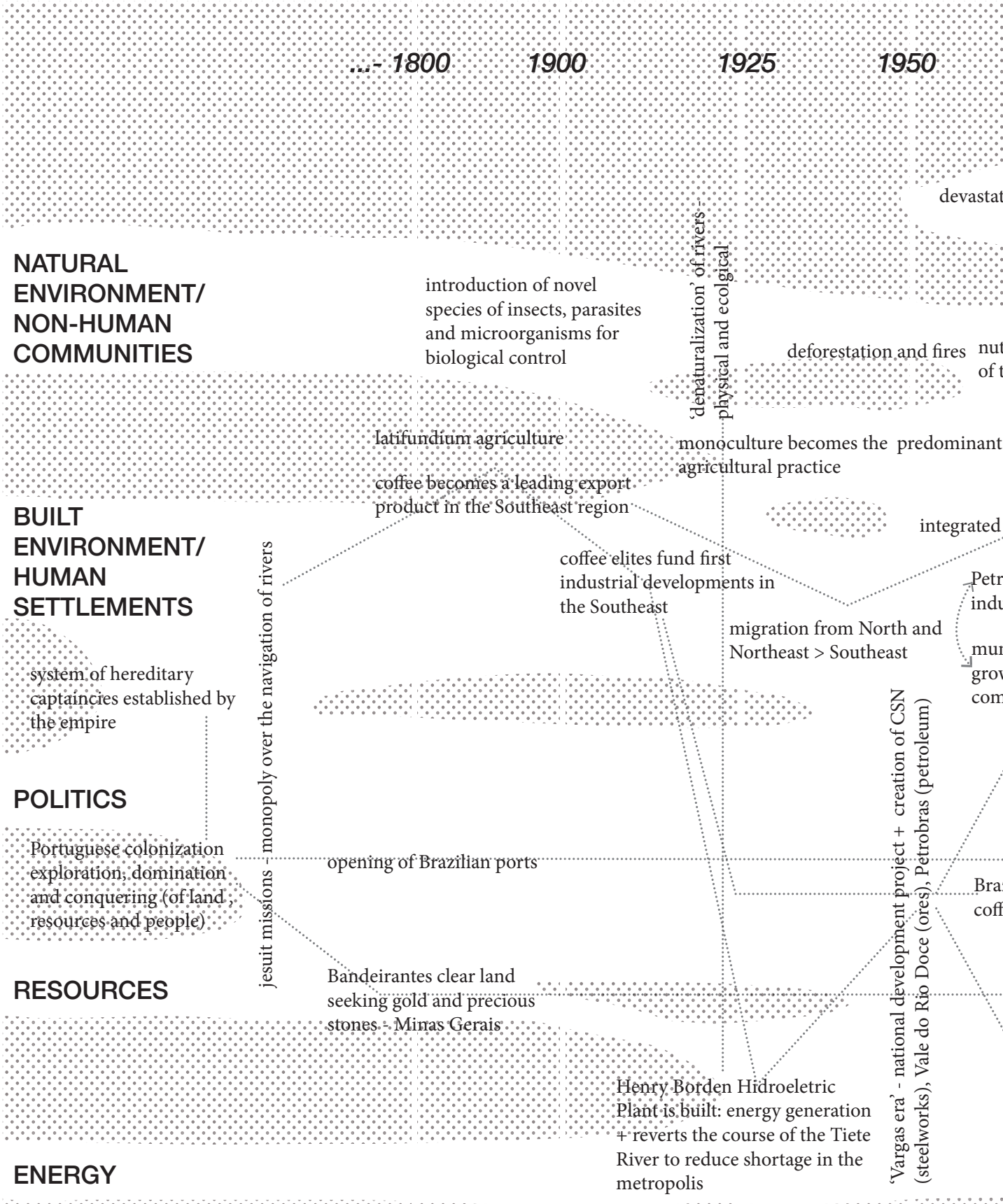
The second half of the 20th century was a period of intense growth for Brazil. Names such as Getulio Vargas and Juscelino Kubitschek gain prominence for their conduction of a project for national development and progress. As president, Vargas inaugurated Petrobras, the national oil company, in 1954, and laid out a widespread network of infrastructure for electric energy production, aiming on the establishment of a national electricity company as well. Under Vargas' government, the developmentalist project sought to overcome the agrarian-exportation character Brazil had in the international scene - something that was fought back by the agrarian elites (2018, p. 516).

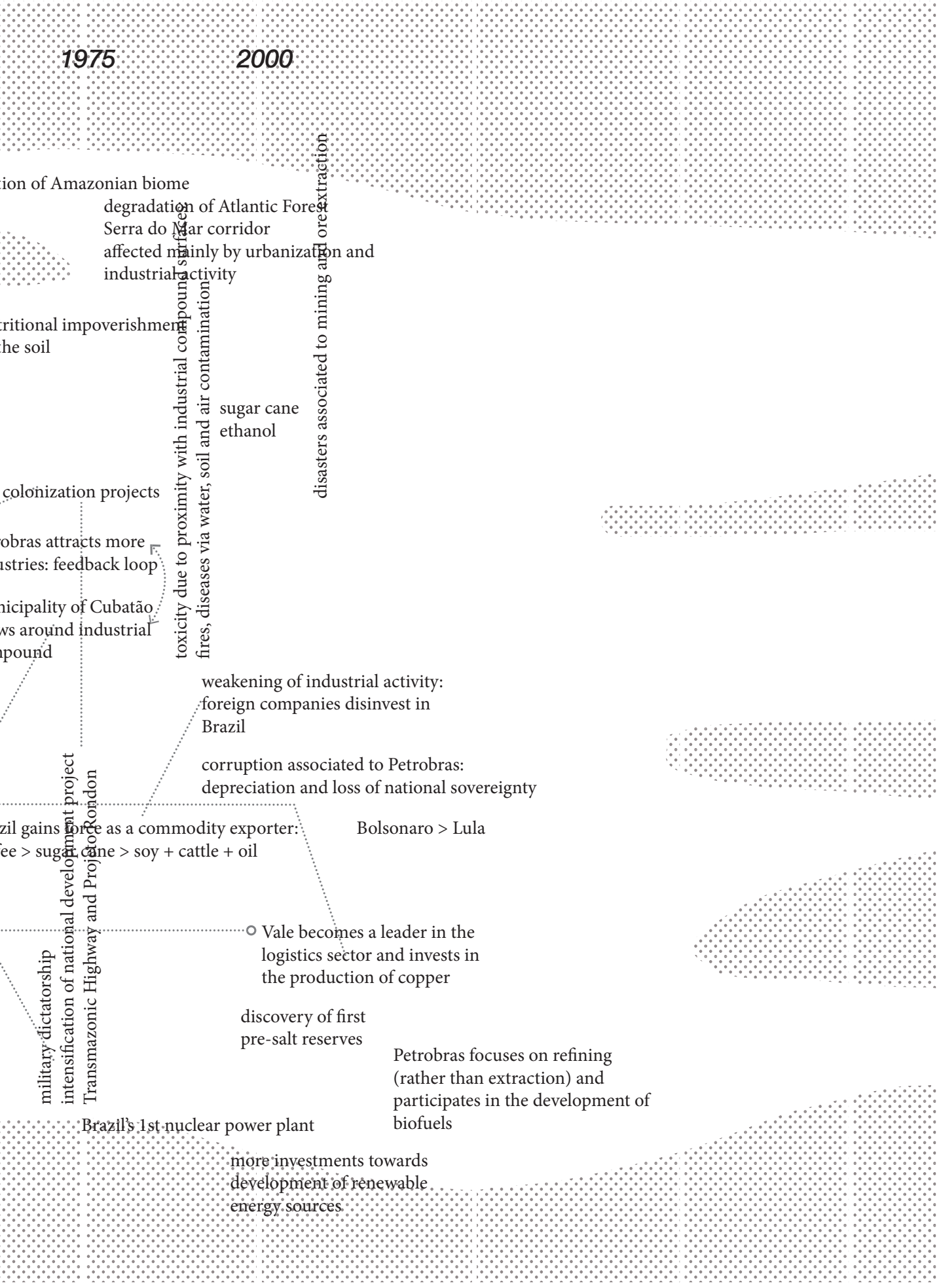
But Vargas' period in office was succeeded by Juscelino Kubitschek (referred to as JK), who is remembered under the slogan 'Fifty years in Five'. He governed through an instrument called 'Plan of Goals' (in Portuguese, Plano de Metas), where he listed actions to be conducted under his leadership. The goals could be categorized in four sectors: automobile industry, energy, heavy industry and food production. Schwarcz and Starling (2018) point out that 'underdevelopment' was a recurring term in government discourses and was used both to justify and to convince Brazilians of the importance of expanding the country towards the hinterland and strengthening industrial activity. However, JK allowed the increase in international investments in Brazil's industries and is still criticized by many for being too servile. Schwarcz and Starling point out: "To Juscelino, 'what mattered was 'where the factory was' and not 'where the investor lives'." (2018,p. 542) Additionally, large estate agriculture and the resistance from the agrarian elites was an important factor in the structural condition of underdevelopment, but it was also a significant source of power and legitimacy for his government. Even though he spoke of the problems of underdevelopment, he failed to address one its main foundations.

A third period of Brazilian history worth highlighting is the military dictatorship (1964-1985). The military implemented a bold project for national development, which had as its main exponent the Rodovia Transamazonica. The project described two main objectives, of economic development and of internal security, which can be compared to the Portuguese colonial system. In fact, an important feature of the Transamazonic project were the 'PICs', integrated projects of colonization (in Portuguese, projetos integrados de colonização), which deployed hundreds of families from the Northeast to populate the margins of the highway during its construction.

A review of critical junctures in Brazilian history (illustrated in the

flowchart) demonstrates how, since the colonization period, the manipulation and domination of the land and the commodification of natural elements has been a political spatial practice. More than four hundred years separate the arrival of the Portuguese from the dictatorship period, but in both cases, power was asserted through the exploration of land and natural elements as a means of economic benefit and defense. Practices which are aggravated given the accumulative character of the slave colonial regime, which has concentrated wealth and land in the hands of the same families for centuries at a time. Additionally, decades of a political project that imposes and operates through a technocratic logic has further oppressed and marginalized the indigenous ways of life and its related knowledge and practices.


...- 1800
1900
1925
1950
devastat
NATURAL ENVIRONMENT/ NON-HUMAN COMMUNITIES
introduction of novel species of insects, parasites and microorganisms for biological control
'denaturalization' of rivers - physical and ecolgical
deforestation and fires
nut of t
latifundium agriculture
monoculture becomes the predominant agricultural practice
coffee becomes a leading export product in the Southeast region
BUILT ENVIRONMENT/ HUMAN SETTLEMENTS
integrated
coffee elites fund first industrial developments in the Southeast
Petr indu
migration from North and Northeast > Southeast
mur grov com
system of hereditary captaincies established by the empire
jesuit missions - monopoly over the navigation of rivers
POLITICS
Portuguese colonization exploration, domination and conquering (of land , resources and people)
opening of Brazilian ports
Bras coff
RESOURCES
Bandeirantes clear land seeking gold and precious stones - Minas Gerais
'Vargas era' - national development project + creation of CSN (steelworks), Vale do Rio Doce (ores), Petrobras (petroleum)
ENERGY
Henry Borden Hidroeletric Plant is built: energy generation + reverts the course of the Tiete River to reduce shortage in the metropolis


1975
2000
tion of Amazonian biome
degradation of Atlantic Forest:
Serra do Mar corridor
affected mainly by urbanization and
industrial activity
tritional impoverishment
the soil
toxicity due to proximity with industrial compounds, fires, diseases via water, soil and air contamination
disasters associated to mining and ore extraction
sugar cane
ethanol
colonization projects
obras attracts more
ustries: feedback loop
nicipality of Cubatão
ws around industrial
mpound
weakening of industrial activity:
foreign companies disinvest in
Brazil
corruption associated to Petrobras:
depreciation and loss of national sovereignty
zil gains force as a commodity exporter:
ee > sugar cane > soy + cattle + oil
Bolsonaro > Lula
military dictatorship
intensification of national development project
Transmazonic Highway and Projeto Rondon
Vale becomes a leader in the
logistics sector and invests in
the production of copper
discovery of first
pre-salt reserves
Petrobras focuses on refining
(rather than extraction) and
participates in the development of
biofuels
Brazil's 1st nuclear power plant
more investments towards
development of renewable
energy sources

2 The importance of relational thinking

What follows is a compilation of concepts associated with the idea of relational thinking. I am not proposing an in-depth analysis of these authors and their theories (which come from the fields of philosophy and anthropology), because to do so would require much more time and study. But they are part of this research report because their ideas have allowed a broader understanding of the problem this research states, as well as it has provided me with tools for surveying the site and proposing a design intervention.

ECOSOPHY

In his work 'The Three Ecologies' (2000), Guattari's main argument is that only an "ethico-political articulation" (p. 28) would begin to circumvent the growing ecological disequilibrium we live in. The danger, and perhaps the failure, in current attempts of addressing this crisis is that it departs from a technocratic stance. Guattari says:

> So, wherever we turn, there is the same nagging paradox: on the one hand, the continuous development of new techno-scientific means to potentially resolve the dominant ecological issues and reinstate socially useful activities on the surface of the planet, and, on the other hand, the inability of organized social forces and constituted subjective formations to take hold of these resources in order to make them work. (2000, p. 31)

Guattari conducts a discussion about 'ecosophy', as he calls the ethico-political articulation between the three ecological registers: the environment, social relations and human subjectivity. The fragmentation between the three registers is at the same time the base of contemporary crisis as it is key for rethinking future practices. The center of it, for Guattari, is the production of subjectivity, "that is, of knowledge, culture, sensibility and sociability that come under an incorporeal value system at the root of the new productive assemblages" (2000, p. 49). Not only should these productive assemblages be rethought, but their objectives need to be reinvestigated as well. Beyond 'visible relations of force', they need to be concerned with the 'molecular domains of sensibility, intelligence and desire.'

ONTOCARTOGRAPHY

Levi Bryant developed his theory of onto-cartography as a 'renewal of materialism'. The need for renewal comes from the reduction to discursivity that has spread upon the discipline. It is not about denying that matter does in fact convey ideas, meaning, discourses, but by focusing only on the discursive qualities, Bryant argues, one neglects the power matter has in itself. A clarification is welcome on what Bryant describes as matter:

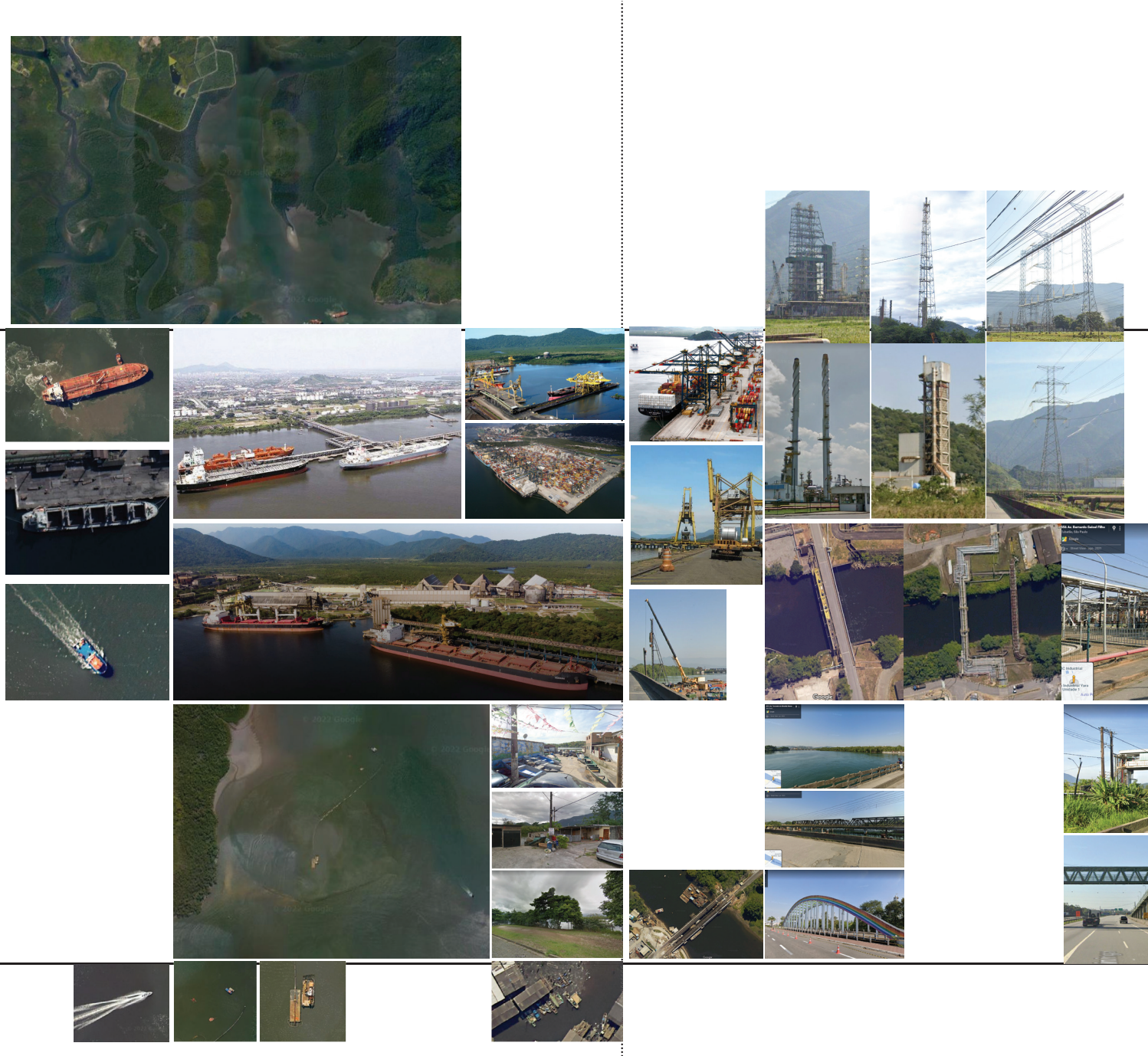
The world, I contend, is composed entirely of "stuff" and "stuff" comes in a variety of different forms. Even ideas and concepts have their materiality. What this stuff might turn out to be is an open question. It might turn out to be various forms of energy, strings, fundamental particles, and so on." (2014, p. 6)

Bryant's initial premise is that the world is made of entities (of multiple scales) that themselves are composed of and compose other entities. The agency of these entities in organizing social and ecological relations - which can be either at a discursive and/or physical level - manifests through the production of inputs and outputs. In that sense, Bryant also refers to these entities as machines. Thus, onto-cartography relates to the mapping of relations between machines in order to understand how "these assemblages organize the movement, development, and becoming of other machines in a world" (Bryant, 2014, p. X). This means mapping the produced inputs and outputs, without losing sight that these relations, processes and exchanges are inscribed within time and space, and that time and space are also shaping factors in these relations.

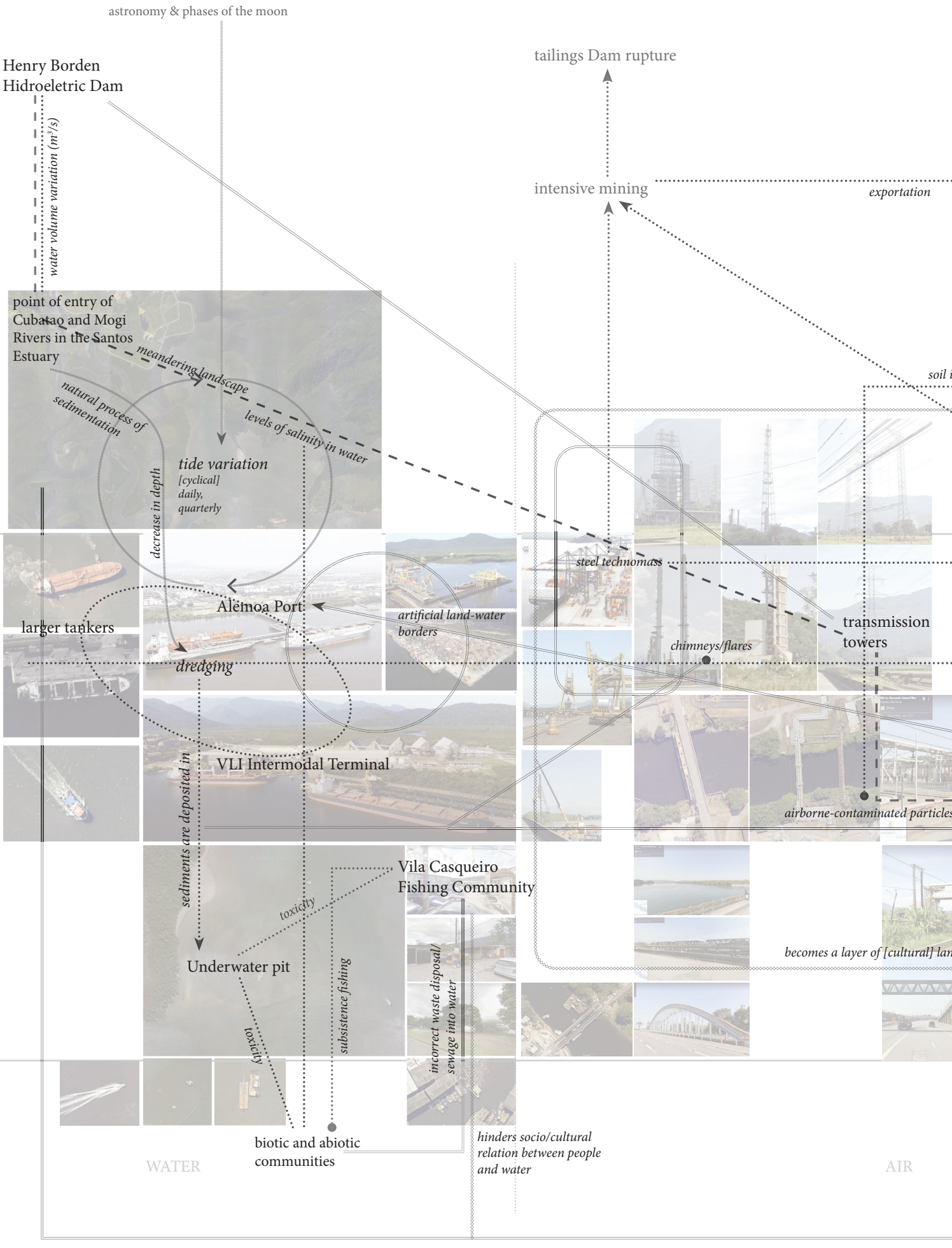
RELATIONAL THINKING FOR POST-DEVELOPMENT

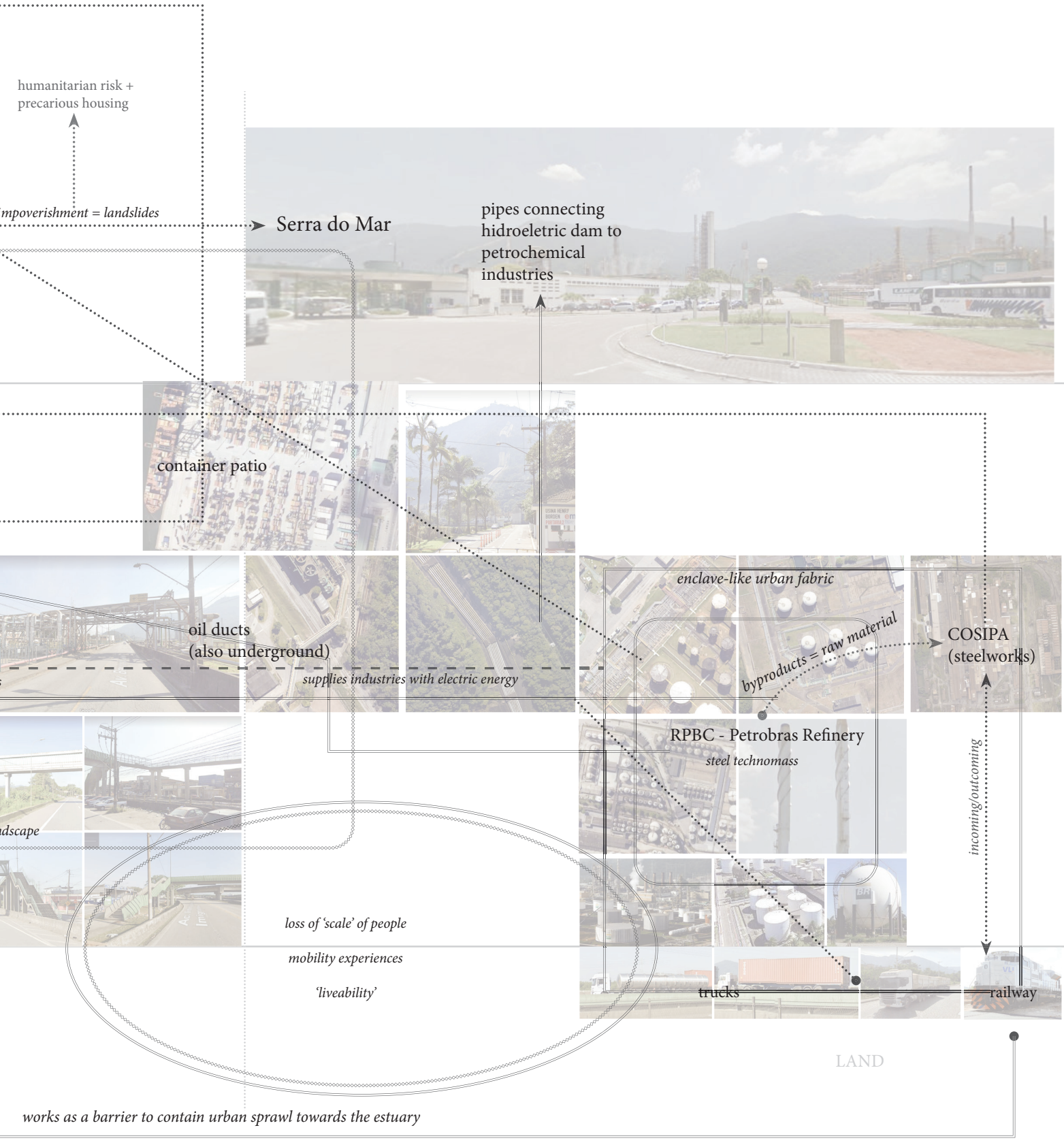
Anthropologist Arturo Escobar defends relational ontology as necessary in a 'post-development' era. His understanding of 'post-development' refers to the possibility of visualizing a time "where development ceases to be the central organizing principle of social life" (2010, p. 12). This would require a decentering of Euro-centric frameworks that implicate social, political and economical organizations and their agendas for 'progress' and 'development. The dominance of these frameworks for centuries, accentuated with Modernity, has marginalized and discredited other institutions, bodies of knowledge and social experiences, favoring an anthropocentric perspective versus attempts at an ecological one. Correspondingly, Escobar posits relational ontology as a counterpoint to the dualisms set in place by Modernity, which has diametrically separated nature from culture, individual from community, 'us from them', and whose project is contingent and founded on these separations. Therefore, any attempt at new forms of 'world-making' needs to seek the overcoming of the dualisms of Modernity. The cornerstone of Escobar's work is the notion of a pluriverse, which he adopts from the Zapatistas of Chiapa, whose definition for it is "a world where many worlds fit". (Kothari et al, 2019). The notion of a pluriverse is defended by the author not as a political structure or institution, but as an alternative form of thinking that emphasizes "relationality and reciprocity; the continuity between the natural, the human and the supernatural (and between being, knowing and doing; (Maturana & Varela 1987, as cited by Escobar, 2010, p. 9)

In his work 'Latin America at Crossroads' (2010), Escobar mentions geographer Doreen Massey's concept of geographies of responsibility, defined as "the ethics of connectedness that follow from any relational conception, and which calls on us to act responsibly towards those entities with which we are connected, humans and not." (Massey, 2004, as cited in Escobar, 2010, p. 42). A relational approach must recognize the embeddedness of humans in a larger world and the factors of culture, subjectivity, and nature that unfold in relations with others.


MACRO
MESO
MICRO
WATER
AIR

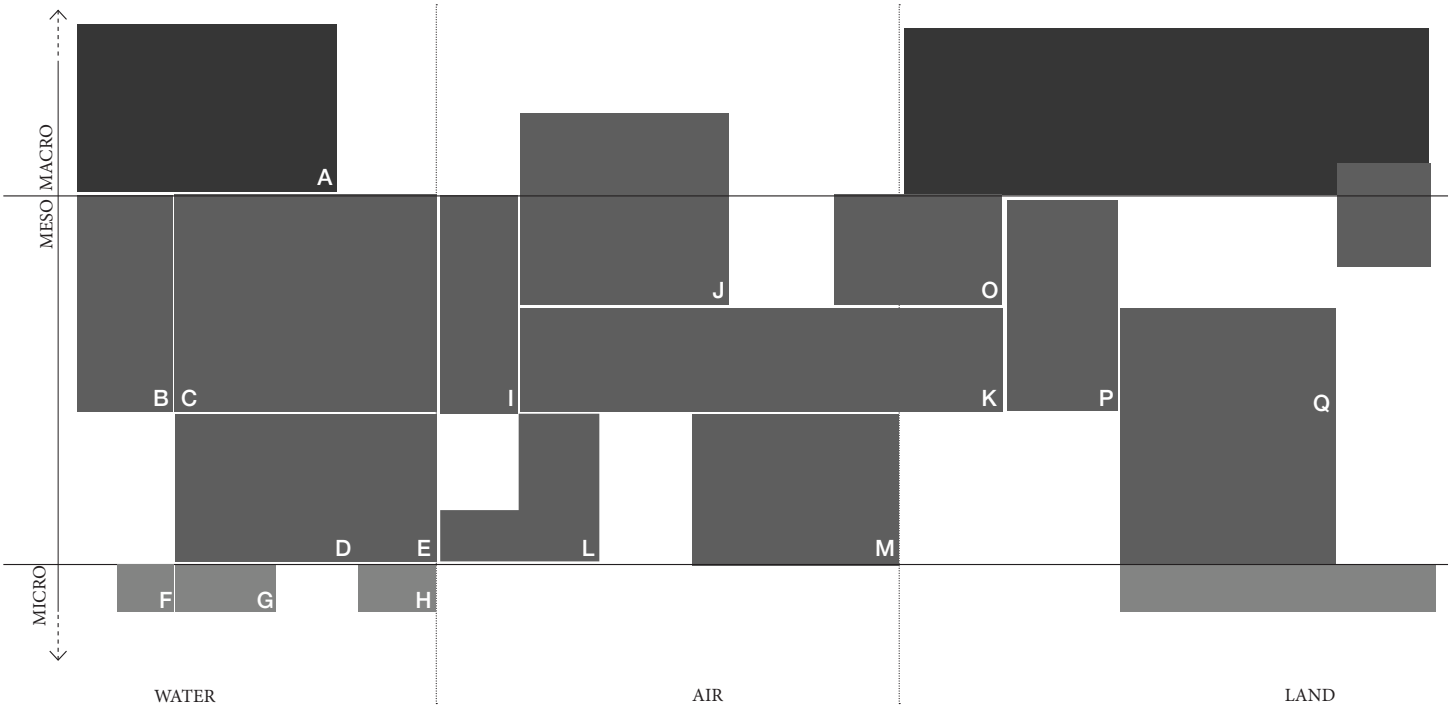
LAND


astronomy & phases of the moon
Henry Borden
Hidroeletric Dam
water volume variation (m^3/s)
tailings Dam rupture
intensive mining
exportation
point of entry of
Cubatao and Mogi
Rivers in the Santos
Estuary
meandering landscape
natural process of
sedimentation
levels of salinity in water
tide variation
[cyclical]
daily,
quarterly
decrease in depth
MACRO
MESO
MICRO
steel technomass
Alemoa Port
artificial land-water
borders
larger tankers
dredging
chimneys/flares
transmission
towers
VLI Intermodal Terminal
airborne-contaminated particles
sediments are deposited in
Vila Casqueiro
Fishing Community
toxicity
Underwater pit
subsistence fishing
incorrect waste disposal/
sewage into water
becomes a layer of [cultural] lan
toxicity
biotic and abiotic
communities
hinders socio/cultural
relation between people
and water
WATER
AIR
KEY
nodes
effects
material interactions
nature-bound cycles
meanings, memories - immaterial aspects
energy
'generator' points
points of 'impact'



RELATIONAL MAPPING
own authorship, 2023

LEGEND FOR TWO PREVIOUS GRAPHICS
own authorship, 2022



A: rio Cascalho mangrove
B: industrial ships
C: industrial and logistic ports
C1. Porto Alemoa
C2. Usiminas IV
C3. BTP - Brasil Terminal Portuario
C4. VLI TIPLAM
D: underwater pit with dredged waste from canal Piacaguera
E: community harbors
F: commercial boat
G: dredging boats
H: fishing boats
I: ship-loading equipment
J: towers, chimneys and transmission lines
K: pipelines
L: bridges
M: pedestrian elevated crosswalks
N: Serra do Mar mountain formation
O: container patios
P: Henry Borden Hidroeletric Plant pipeline
Q: Oil tanks
R: sheds in Usiminas steelworks
S: Vehicles

3 Transformation as design practice

Before introducing the design approach, some clarifications are valid. Through mapping out relations, inputs, outputs and metabolisms overall, I was able to compile a set of data that I believe will better respond to the questions I have proposed. Even though I intend on ultimately designing an architectural object per se, my first approach towards the site is more related to the discipline of landscape architecture. Hence, the theoretical references objectively related to the design consist mostly of scholars from that field. A second note to add is that I will refer to Cubatão as a post-industrial site, based on the understanding that decades of industrial activity have produced effects that are measured on the municipality (and its encircling environment) as a whole, not constrained only to the (to-be) decommissioned industrial grounds.

Making use of the same flowchart through which I systematize the past critical junctures, I speculate on what is yet to happen, or better, what should happen. 2025 is when I transition from past to future time and in 2050 comes the grand disruption - the end of petroleum. Around that 'central event' and making use of the relational mapping that is described in chapter 2, I indicate parallel events, increases and decreases which somehow relate to or reflect in Cubatão. The end of petroleum itself it not the focus of the current research, as I am sure that that topic has been extensively covered and inquired upon. The center of this research is understanding the spatial implications of a drastic change. Understanding Cubatão as a system which was initially constructed around the petrochemical activity and in which oil still plays a structuring role, how is said system reconfigured after this change? How can design disciplines play a part in this reconfiguration? As shown before, Cubatão is made of discontinuous geographies that may not begin or end there, but which nonetheless have their effects on territory. It is through and targeting these effects that I intend on structuring my design intervention. Within that approach, I use the tools of forecasting - i.e. projecting future events and their effects - and backcasting, in order to design protocols which will allow us from going to point A (present) to point B. Acknowledging the non-linear character of history and the dynamic nature of all the systems involved - politics, energy, humans, nature (biotic and abiotic), means that the protocols should also consider and engage with that instability.

FOURTH NATURE LANDSCAPES

In 'Design with Fourth Nature' (2020), Bakshi and Gallagher alert to some of the limitations in the practice of landscape architecture. Most of these limitations are essentially linked to the Modern separation of nature and culture, which is also discussed by de La Cadena (2019), Guattari (2000), and Escobar (2010). The first issue is an idealized vision of nature (and its aesthetics) and the idea that "natural refers to a previous ideal state" (Bakshi & Gallagher, 2020, p. 25). Romantic and nostalgic views of nature and the focus on pristine landscapes end up excluding sites of former human use as potential sites for the contribution of the discipline. Even more marginalized are what the authors call 'Fourth Nature', landscapes of intensive former human

use, such as industrial grounds. The second point to which Bakshi and Gallagher (2020) draw attention is the definition of a fixed endpoint to be achieved. Doing so means disconsidering the unprecedented pace at which the world is changing and still interpreting nature as a 'stable' entity, which is also misleading as the increasing rate of environmental changes of the Anthropocene makes it no longer possible to assertively predict the cycles of nature.

The results of these misconceptions, according to Bakshi and Gallagher (2020) are resource, time and energy-intensive approaches, focused on restoration and that have limited social ecological benefit. In addition, these approaches deepen the rift between nature and culture, "placing nature into the domain of science, where it remains off-limits to culture, that is, society, history and the human." (2020, p. 26). But then how should landscape architecture engage in practices in a complex and unstable context?

Bakshi & Gallagher (2020) and Braae (2015) agree on the need of shifting from a reactive approach towards a proactive one. The unpredictable and unstable character of nature and of its ecological relations with human occupations should be seen as assets rather than as restraints. This unpredictability might reveal itself in the outcome but also during the process. Conciliating the processes of human occupation with the cycles of nature, beyond bringing more effective and cohesive solutions, is also a form of regenerating the nature-culture rift. This reconnection should acknowledge the layering of three forms of heritage: cultural, material and ecological. Ecologists demonstrate that definitions from the field of heritage such as 'natural', 'historic' and 'altered' are socially determined through cultural values, which shows that the cultural dimension needs to be reintroduced both in the process and the outcome (Bakshi & Gallagher, 2020). Design should, rather than imposing, create room for "unexpected interactions between natural, cultural, industrial and social systems" (Bakshi & Gallagher, 2020, p. 30).

DESIGN FOR TRANSFORMATION

In 'Beauty Redeemed: Recycling Post-industrial Landscapes', Ellen Braae defends that a landscape design approach to post-industrial sites should define protocols instead of strategies. Thinking through protocols means that the procedures and objectives of the design remain open, accepting that they may be altered throughout the process. In that sense, Braae asserts that the first question asked should be "what effects can we expect of the intervention?" (2015, p. 286). With that, supported by the process of backcasting, it is then possible to trace objectives and then protocols that would allow us to reach/produce said effects. By thinking of effects rather than results, we acknowledge both the dynamic character of the involved elements and the relational nature of inhabitation building disciplines. Another interesting point discussed by the author is the lack of a theory of transformation. Theories of preservation push for the restoration to a former state and theories of re-use are based on the value of utility. Thus, neither of them fully address the conditions for designing in post-industrial landscapes, especially if one is willing to incorporate nature and ecological factors into it. According to Braae (2015), a theory of transformation is a theory of change, it refers to changing "(...) 'something' into 'something else', in full awareness that

neither 'before' nor 'after' are static conditions." (2015, p. 278). She states:

As design praxis, transformation is fundamentally different from the understanding and practice of design on which architectural tradition is built. Architecture is primarily spatially oriented, while transformation is organised in both time and space. (...) Central for the transformational line of thought is the actual change as both produce and process. (2015, p. 280)

The establishment of a transformation epistemology, as Braae (2015) describes, changes the way we face architectural production and architectural history. Rather than focusing only on the products, transformation theory requires us to pay attention to the driving forces and exchanges that are revealed in transition periods and that suscitate change. Once again, the need for a relational approach is evidentiated.

She then defines the data - the 'raw material' for transformation design - which is a composite of material, processes and immaterial aspects (Braae, 2015). The material aspects should not be overtaken only through their physical dimension, but also looking at the material organizations that engender structures. Processes refers to the reestablishment of an ecological cycle, which might not coincide with the restoration of a former one. I see one of the great challenges in transformation design is achieving balance between nature's cycles and the 'externally introduced' cycles, striving for stability without perhaps knowing exactly what 'stability' means. Even in conditions that may otherwise be considered unstable, there have been observations of the eruption of novel species.

In fact, Cubatão has its own example, as reported by Diário do Litoral (Bernardes, 2022) . Methylopila oligotropha is a bacteria discovered by scientists from the Research Center for Greenhouse Gas Innovation and the Escola Politecnica of the University of São Paulo in the mangrove ecosystem in the Santos Estuary. In its metabolic process, the bacteria produces polyhydroxyalkanoates, a biodegradable material with properties similar to plastic.

The notion of 'stability' is neither universal nor given. The third part of data described by Braae refers to intangible aspects such as meaning, memories and atmospheres (2015, p. 290). Through an analysis of a series of precedents, Braae describes a spatial approach to post-industrial sites, which I have incorporated with a few adjustments. She describes industrial sites as 'enclaves' and points out a series of characteristics common to them. She then uses Foucault's concepts of heterotopias as a driver for design - transforming an enclave into a heterotopia requires first, the dissolution and opening up of its physical boundaries and an introduction of new players which will re-use the site's possibilities. What is interesting in Braae's spatial analysis (which she bases on David Shane's 'Recombinant Urbanism') is that she points out that a site's heterotopias and enclaves are bound together by an 'armature' (2015, p. 95). An armature is a linear organizing element, which reinforces the large-scale nature of the territory and that, by being connected to the 'industrial enclaves', is also under potential transformation itself. In my interpretation, the binding element in the case of Cubatao is the Santos Estuary, a body of water that appeals to industrial players for its navigation possibilities and that has been targeted under the influence of the 'industrial enclaves' which are connected to it.

CONSTRUCTION ECOLOGY - setting a design (and discipline) agenda

Building is in fact a problem of thermodynamics. Buildings, cities, ecosystems are non-isolated and non-linear structures, which will tend to achieve three things: "circulate and transform the most available energy, at the fastest rate possible, and with the most reinforcing feedbacks." (Moe, 2014, p. 175). Humans assert their power in ecological systems through the dissipation of energy and the development of data circulation. The increase in petroleum consumption and of neoliberal modes of production are someexamples of that. However, these dissipative structures created by humans target the circulation and the transformation of energy, but lack the feedback reinforcement. Feedback reinforcement should encompass both the 'goods' and the 'bads' of metabolic relations, but as a consequence of this lack of feedback reinforcement, the bads are overpowered and the "power-draining systems of accumulation" gain force (Moe, 2014, p 176). The reverberations of this process are discussed in Chapter 1.

In relation to the construction activity, accounting for material and energetic inputs, which are often dismissed as externalities, is a form of targeting this lack of feedback reinforcement. In 'Unless: the seagram building construction ecology' (2021), Moe draws a picture of what he calls "the thermodynamic basis of unequal exchange", that is "how forms (which emerge to dissipate energy in specific ways) are organized to accumulate and concentrate exergy in one place and entropy in another part of a system" (2021, p. 83). Thus, designing architecture is at the same time designing the architecture of these exchanges, and this cannot be seen as an externality.

Moe provides a framework that allows visualization of which material systems of a building would entail further analysis. To describe it briefly, this is assessed through an equation of volume of the components and material density, which would indicate the mass of each material in the system. This data should then be juxtaposed with the emergy of each component, to reach the mass-emergy deltas. To make it simple, the higher the delta, the more inspection that component demands (Moe, 2021, p. 139). What I find interesting about this process is that the results, and the design decisions, in face of that analysis are not universal nor obvious. I'd like to highlight two examples given by the author in that sense. The first is Stackhaus, a project designed by himself and Ron Mason, which is analyzed by the author in 'Non-linear Struggle for Maximum Entropy' (2014). What I find particularly striking about this project is its intensive use of wood, something that would initially be seen by the field as 'inefficient' and 'wasteful'. But Moe demonstrates that, as the mass of wood is working as structure, enclosure, insulation, and finishing it is in fact reducing the need for any other energetic inputs, thus, revealing wood as the most balancing factor in the ecology of the building (2014, p. 180). Furthermore, the employed wood is retaining twice the carbon employed in its construction and it sourced from an adjacent site, which means that the building is "likewise an accumulation of regional feedbacks" (p. 182, 2014). The second example worth sharing is Moe's analysis of the use of granite stone in the Seagram (2014, p. 170). He points out that even though it does not have a notable participation in the global emergetic analysis of the project, by tracing the related bio-geophysical networks, it is possible to see that the

employment of that particular stone is actually a positive contributor to the ecology of building. Because the stone is sourced from a family-run quarry in Maine it describes "somewhat less ecologically destructive set of processes" (Moe, p. 170, 2021) while also providing feedback reinforcements into a regional system. It highlights how the study of construction ecology is also instrumental in elevating the 'goods' in metabolic relations.

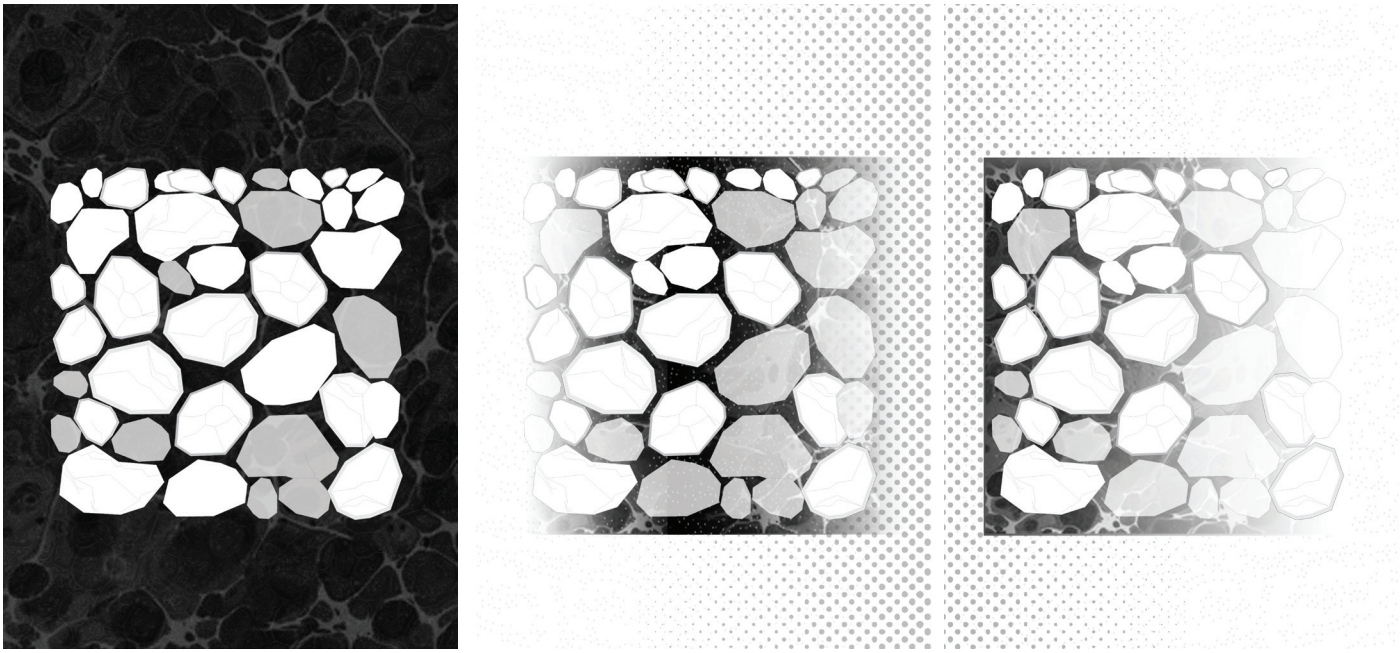
With the two examples above, I aim to show that construction ecology is not a precise science; an equation of mathematical variables, and it should not be employed as so. The methodology described by Moe, if anything, shows the responsibility in acknowledging the energetic dynamics involved in construction and the transformative potential design can achieve by doing so. It should not be seen as a method of 'optimization', a feature of 'sustainable design', or a strategy for 'circularity', all words which are banally employed in the design discipline. Solutions for more balanced construction ecologies are not universal and without an adequate mapping of their displaced geographies, might be deceiving. Moe gives the example of 'net-zero buildings', a concept widely publicized in Western Europe as the future of building, but heavily reliant on "environmental load displacements" (Moe, 2021, p. 81) that extend far out to the Global South. The in-situ 'net-zero' condition dismisses the energy employed in the harvesting, production and transportation of inputs such as batteries, photovoltaic panels and other devices which serve to reduce the building's on site footprint. Hence, a solution that presents itself as 'sustainable' is in fact feeding back negatively into a connected system. Energy studies should support design decisions through revealing the geographic, historical, political, and ecological systems and subsystems of building. It should be a factor of transformation for the discipline. Moe states:

In emergetic terms and methods, routine procedures in architecture as a discipline - such as detailing, specifications, drawing from the ground up as Kahn suggests - attain novel thermodynamic, ecological, and political depth. Rather than an imposition on the project of architecture, when so constructed, energy methods pose deep theoretical and practical questions about the discipline of architecture. (2021, p. 106)

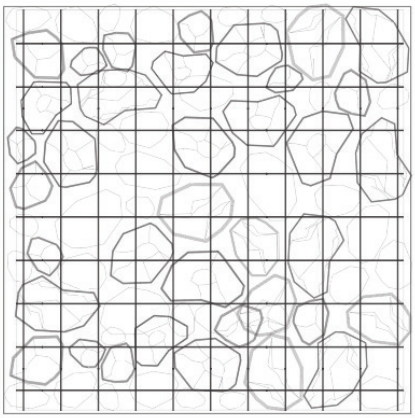
In this context, I hope to, in the design exercise, investigate building components and processes in order to understand which may have a greater emergetic impact and then question what are the effects of different materialities, different assembly processes, different building strategies? How does it reflect aesthetically? How does it affect the thermodynamics of the object?

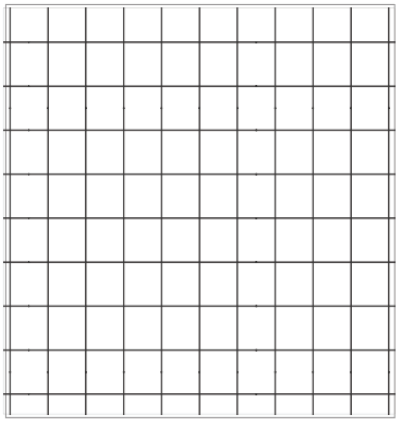
Moe (2021) does a thorough analysis of Mies van der Rohe's Seagram Building, and that is not what I am proposing to do, firstly because I do not have an existing building to analyze and second because I do not think it fits within the scope of the current research to dive deep into energetic calculations. However, my takeaway from Moe's work is the discipline's need to reflect upon the environmental load displacements and the . The abstraction and externalization that came with Modern Architecture have been detrimental to advancements in the field, in a sense that we are building in ways that downscale the potential of Architecture as a reorganizer of the way we inhabit this planet in face of the increasing rate at which it's changing.

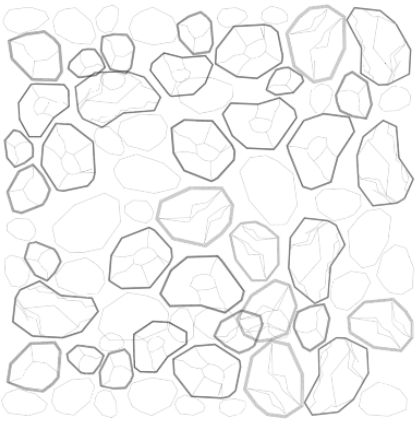
a wall but not only



a non-isolated interface







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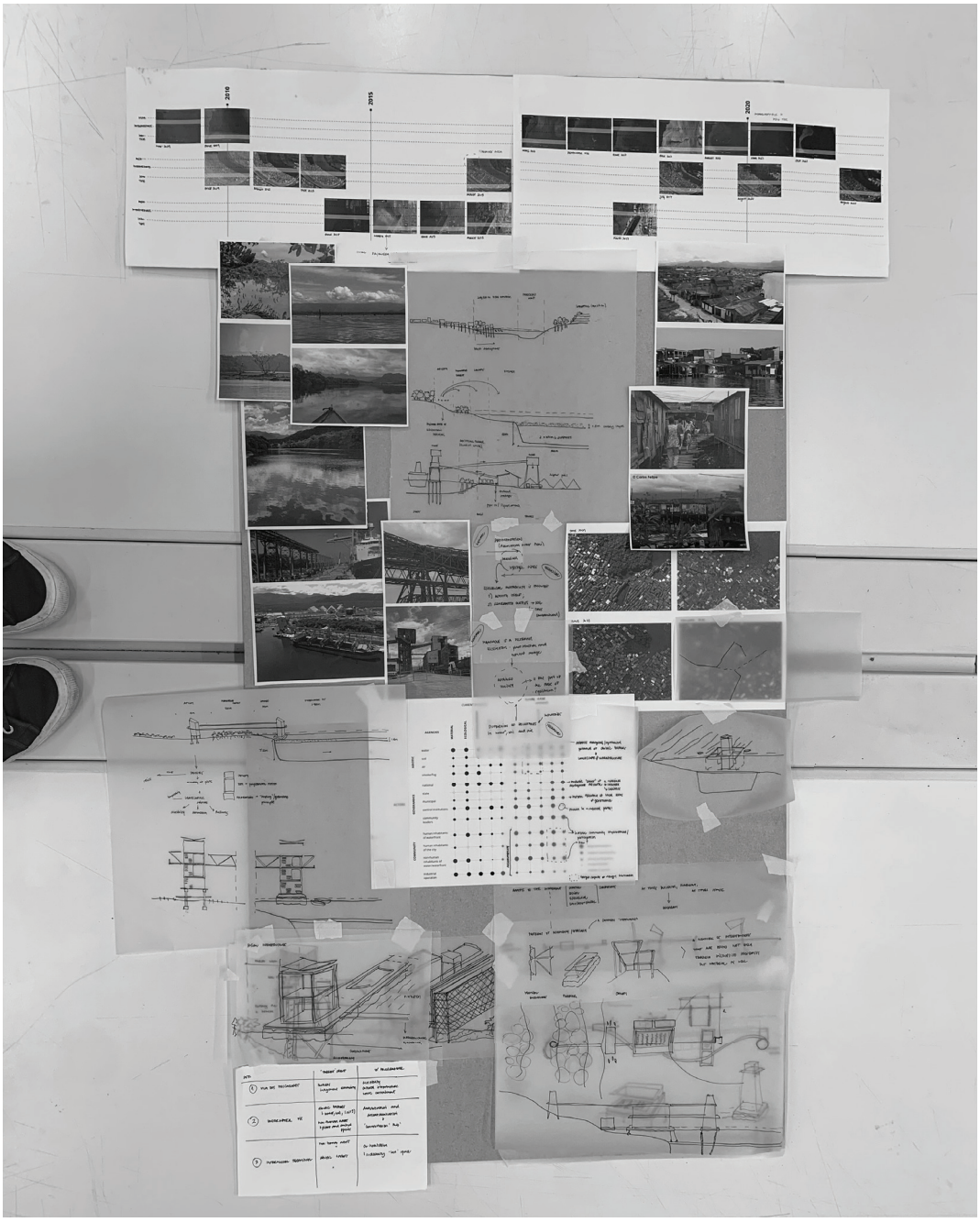
own authorship, 2023



Process investigation board

4 Proposal | Design for transformation

I present this project as a *design for transformation*. Design for transformation acknowledges change as the only certain variable, departing from known circumstances of the present and past towards a future that is still unravelling and that is liable to be affected by variables that we are not yet aware of. This means that, more than aiming for a fixed end state or for a defined set of objectives, the project aims to design the process through which this change will take place, having in sight a 'desirable future'.

design for transition acknowledges the change from point A to point B, aware of the conditions presented in each case

design for transformation acknowledges ***change***, departing from the known conditions of point A and emphasizing t**he process of spatially transforming 'something' into 'something else'**, without quite knowing what the outcome should be

Thus, the development of the project is supported by soft codes, which give a margin of flexibility and adaptability to certain values and elements of the design, both material and discoursive. In order to do so, I referred to tools such as backcasting, speculative design and scenario thinking.

A NEW DISCOURSE

Cubatão's past and present have defined it as an operational landscape. However, I argue that the problem is not in the operational character per se, but in the detrimental aspects produced by the two-fold relationship between urban and beyond-urban landscapes, whose aspects I have discussed in chapter 2 of this report. In that sense, the attempt is not to redefine the character of Cubatão through this project, but to reshape the understanding of operational sites, their positioning within the urban/beyond-urban binary and their contribution towards the climate emergency and ecossystemic degradation. We must revoke from paradigms of economical welfare that rely on extractivism and commodification, while questioning the notions of growth that we pursue. Particularly in the case of the majority world, it is urgent to adjust the parameters for growth and wellbeing to self-determined ones, that ressonate with its own vocations, desires and opportunities, rather than chasing values backed by the idea that the 'Global South' needs to reach up to the 'Global North', which are in most cases, dictated by the latters interests in the first.

In these circumstances, the project can be analysed through its discoursive and material layers. In the first case, this entails:

1. a shift from resource and energy-intensive processes that are driven by the idea of growth;
2. a re-evaluation on the forms of knowledge and scientific production, including how and by whom they are produced;
3. a revision of the stakeholders who formulate and conduce operations happening in these locations, questioning who are the ones who actually profit from it, how they profit and who are the ones who are impacted negatively by it;
4. accountability towards depletion and degradation processes that impair human and extra-human lives.

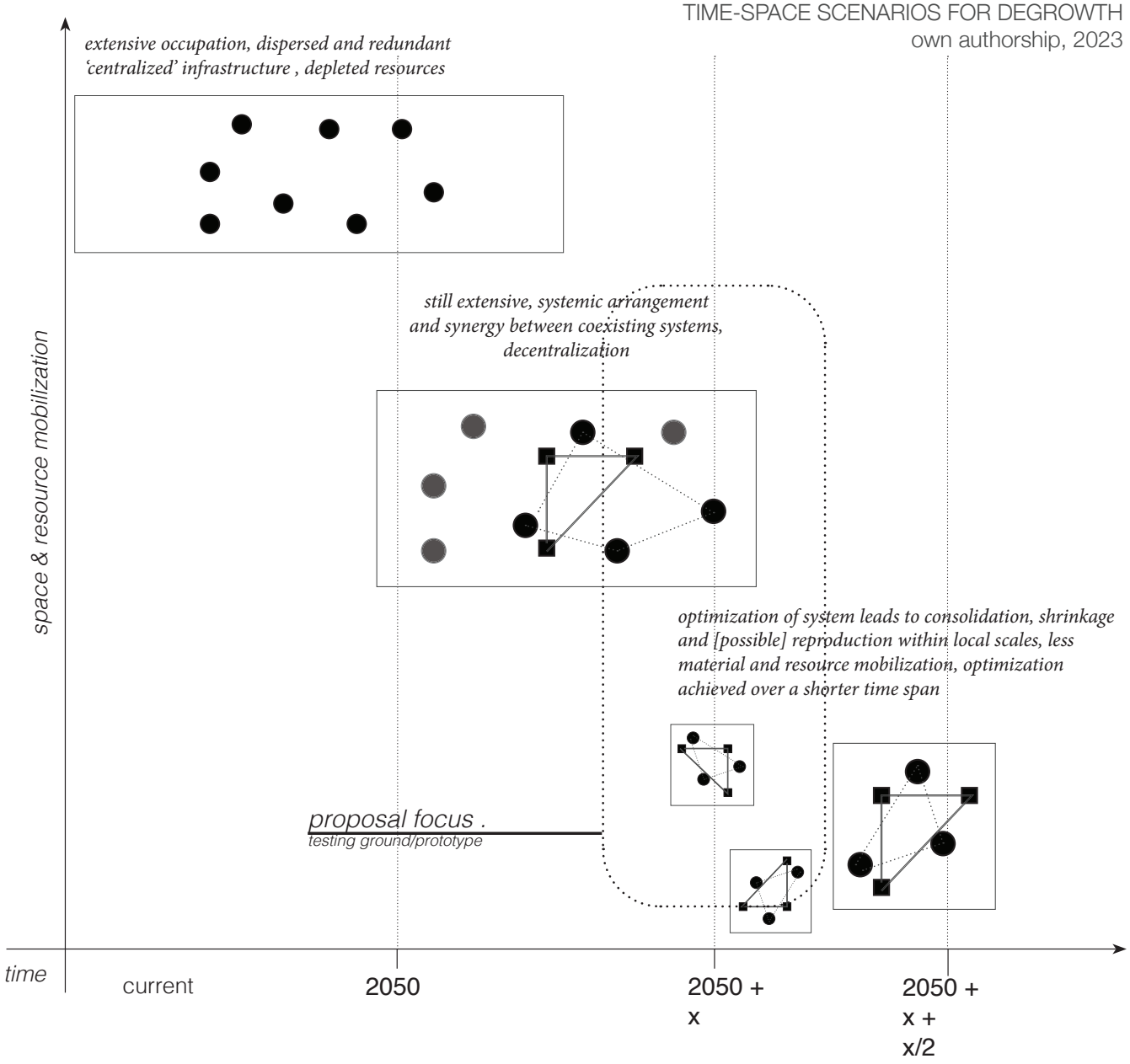
In summary, the research posits, as a counterpoint to the paradigm of growth, the co-creation of futures which are based on the notions of collectively caring, repairing, regenerating and safekeeping of cultural and natural values and human and extra-human lives. It is an ethico-political project that attempts to circumvent structures of power, exclusion and depletion, presenting alternative systems and structures in order to restore an array of potential futures, based on the idea of commoning. Arturo Escobar (2015) mentions Vandana Shiva's work on post-carbon economies, in which she calls for a transition 'from oil to soil' - that is, from a mechanical-industrial paradigm towards a 'people and planet centered one'. In effect, this would mean decentralizing and diversifying food and energy chains, increasing reliance and empowerment of local economies and political organizations. All of the supracited are key aspects in the discussion of degrowth as a transition discourse.

TIME-SPACE SCENARIOS FOR DEGROWTH

Degrowth theories, that stem from the Club of Rome's publication Limits to Growth, from 1972, point out the danger of pursuing ilimited economic growth amidst growing awareness of the finitude of the planetary boundaries and its resources. It defends a downscaling of excess production and consumption and a shift from global towards localized, but connected, economies. It criticizes the technocratic indexes through which growth and development are assessed, such as the Gross Domestic Product (GDP).

However, a possible limitation for theories of degrowth are that they overlook that, in fact, there is still a demand for growth in certain places, especially in the majority world. In that case, we need to question what growth translates to in these contexts, and then set new parameters and possibilities to achieve it. In these cases, the need for growth not necessarily translates into the notions set by global capitalist system, but into achieving a level of security, wellbeing and autonomy for systems, beings and the environment. These are places which so far have been developed and depleted through an extractive-commodified narrative imposed by the Global North and once again it may find itself swooped into the narrative of degrowth. Hence, degrowth will only become a driver of change if it is able to overturn the North-South dialectic relationship, empowering the majority the world to grow and develop according to self-determined parameters. This means transitioning from quantitative to qualitative measures of growth.

DIAGRAM
TIME-SPACE SCENARIOS FOR DEGROWTH
own authorship, 2023



In the scope of this project, the notion of degrowth enables regeneration and creates a framework for rethinking systems, in this case, of infrastructure. It serves as a driving concept for transition, as shown in the diagram on the following page. This transition relies on an optimization and synergetic integration of different systems, but they will only be truly efficient as long as they take into account the four points towards a new discourse that I have presented above. Accordingly, the proposal focuses on this transition moment, prototyping a new system that factors in social, political and ecological interdependencies which are often overlooked in operational landscapes and infrastructural systems.

ON METABOLISMS AND TERRITORIAL ECOLOGY

Cubatão, as other beyond-urban territories, can be interpreted as a landscape assembled through a complex array of flows and processes,

1 Here I make use of the term 'extra-urban' because territories like Cubatão cannot be analyzed through the urban/rural binary. They do not characterize as rural landscapes, and some might even be classified as urban settlements. However, the differentiation is necessary and it is through the differentiation that we can begin to analyze how these sites are shaped, transformed and constrained by the urban, which hinders them from ever achieving its same 'urban'. The suffix extra emphasizes the argument that it is towards sites like these that all which is not desired, does not fit and cannot exist within urban spaces, is directed to.

most of which do not originate or terminate in place. Landscapes which are depleted, shaped and transformed under the influence of the urban/extra-urban[1] binary, show the complexity of the interaction of multiple scale and multi-ecological processes - with less account for the social and environmental than our current state of affairs calls for.

In this context, a metabolic approach is key to understanding the embededness of relations of production and accumulation in space. In his essay 'Towards a Singular Metabolism', published in New Geographies (NG) 06 'Grounding Metabolism, James Moore (2014) says, in relation to the work of Marx and Engels about the urbanization of the countryside:, "(...) metabolisms are always geographical. Capitalism relations move through, not upon, space, which is to say through, and not upon, nature as a whole" (2014, p. 15). Moore posits the danger of the dualist categorization of Nature/Society and how it generates an 'epistemic rift'. As described by the author, this rift was instrumental for early capitalism to consolidate the separation of producers from the means of production, as by separating 'society' from 'nature' it supresses essential relations in each node and with each other.

In a conscious stance to overcome the 'Nature/Society' dualism, I argue that at the threshold between these two domains, or perhaps their main affection, lie material and energetic exchanges. From my perspective, this is where Architecture is called to action and specifically in the case of operational landscapes, where there is an opportunity to address the ecological implications of capitalism urbanization and growth paradigms, which build on the abstractions that originate from the 'nature/society' epistemic rift.

Beyond the discussion of urban metabolism and urban ecology, which is thoroughly debated in NG 06 'Grounding Metabolism', (2014), the notion of territorial ecology might be more constructive for the current research. As defined by Sabine Barles (2014):

Territorial ecology emphasizes the importance of the spatial dimension in socio-ecological interactions; it studies territorial metabolism considered as the result of two sets of intertwined processes: natural (biogeochemical, physical) and anthropogenic (social, technological, political, cultural). It stresses the fact that both the natural functioning and the social dimension of the territory under study have to be taken into account to understand (and transform) the territorial metabolism. (2014, p. 65)

In practical terms, this translates into the incorporation of material and substance flow analyses and energy balances and the investigation of the interdependencies between them, but not only. As underpinned by the notion of territorial ecology, it is critical to look at these more 'objective' factors under the light of the sociopolitical relations that create and permeate them.

RETHINKING SYSTEMS

Taking into account the considerations above about degrowth and metabolisms, the project aims to set in a place a new greywater treatment system that is able to address the contamination left behind by the oil industry. The selected site i.e. testing ground, is Porto Alemoa, an oil storage and shipping hub used by Petrobras, located in the Southern bank of the Santos Estuary.

In the speculative scenario of 2050, the oil industry withdraws from the site, stripping it of the large metallic components which can be molten and leaving behind an assemblage of concrete and contaminated soil. Thus, remediation and stabilization strategies are devised, in order to avoid further contamination of the surrounding environment and to reclaim the land. In this case, I refer to it as process of land reclamation inspired by Michael Serres' (2011, cited by de La Cadena, 2019) concept of 'appropriation through pollution': "to pollute is to possess; it is to exclude other from access to the resources that the polluter appropriates.". So if there has been a possesion through pollution, this project proposes that it is through the inverted binary, reclamation through decontamination, that we are able to initiate an ecological regeneration process. Thus, this land reclamation (which may be interpreted both literally and figuratively) is described by two, parallel but connected systems:

A) a water and soil decontamination system:
The first point on the agenda in order to reclaim the site is to decontaminate it, as possible, or to stabilize the levels of contamination preventing that it spreads or mutates. For that purpose, techniques of bioremediation deployed. Through the cultivation of specific species, we are able to depurate the hydrocarbons related to the oil industry, while reverting the nutritional impoverishment of the soil. Meanwhile, the greywater system is first set in place to maintain the new crops, but admitting future uses that may occur in the site, ranging from agriculture, livestock, new forms of industry up to new human settlements. Within the project, these uses are not programmed but speculated on, as I focus on the transition moment. However, there is an acknowledgment of the site's character as an operational landscape and the human and material resources which are part of it. Supported by the concept of [urban] metabolism, the implementation of the new technical systems in synergy with existing natural cycles works towards mitigating enviromental degradation, inviting to this formulation and operation local stakeholders which are usually marginalized from decision-making and knowledge-creation processes.

B) an enviromental monitoring network:
The proposed system also enables the monitoring and measuring of the concealed layers of toxicity that are present in the water, air and soil of Cubatão. In order to break the cycle of degradation, it is key to redistribute and facilitate access to information about the health and decay of natural and cultural ecologies. The current state of affairs in what refers to monitoring (portrayed in the diagram below) shows a fragmented comprehension and survey of the enviroment, with the work of important actors such as CETESB, the enviromental agency, being compromised by

political influence of the industrial sector.

The proposed monitoring system seeks to circumvent existing structures of power which might compromise the integrity of data collection, surveillance and fining, while also making the collected data available for public knowledge and use. It incorporates new forms of measuring, such as the particular forms of interpreting and understanding the estuary observed within the fishermen community, but it also widens the indicators through which the health and wellbeing of systems are assessed.

STAKEHOLDERS & ENVIRONMENTAL MONITORING
own authorship, 2023

STAKEHOLDER	TYPE OF DATA	DOCUMENTED?	ACCESS TO DATA
CETESB **environmental agency** *measurements and inspections are done in a way to condone industrial activity*	technical	data is recorded and documented	available for public access
industry hi-tech sensors and meteorological data, used to ensure security and productivity of logistics operation	technical	data is recorded and documented	internal use only
population indigenous groups - fishermen are able to verify natural unbalance and toxicity through changes in biodiversity patterns	sociotechnical	data is neither recorded nor documented	collectively diffused
PROPOSED **collective management** system is built through a combination of skills and devices	sociotechnical + cultural	data is recorded and documented	open access

While techno-scientific measurements are instrumental to define parameters for reparation and regeneration, I defend that assessing the soundness of cultural relations to the natural enviroment (for example, if people are able to fish, to swim, to navigate in the estuary) is as important, especially in a context where the connection of indigenous groups to the water goes beyond the domain of geographical, functional and cultural relations. As described in the works of De La Cadena (2019), Escobar (2010) and others, the way indigenous groups relate to ecology is part of a larger cosmology, a vision that exceeds the possibilities of modernity. This notion is approached by Macarena Gómez-Barris in her concept 'submerged perspectives'. In the essay 'Tidalectics' (Space Caviar, 2021), the author writes:

I employed this notion in order to attend to those sensibilities, forms of perception and material practices, that are organized below the modern colonial ordr. and that also go undetected by the regime of state power. (...). Perceiving other ways of knowing, feeling and being, submerged perspectives unsettle assymetrical relations of land and water that are so central to speculative capitalist projects at the sea's edge. (Gómez-Barris, 2021, p. 184)

Thus, I see the implementation of a new monitoring network as an opportunity to revert the marginalization of indigenous perspectives and give voice to these groups in the co-creation and safeguarding of their futures.

A REMARK ON COMMONING

In that sense, the notion of commoning is expanded not only to the use of land and resources, but to the participation in the described systems. In a time where infrastructure is redundantly reproduced and extensively privatized, it is critical address the commoning of technical systems, which are essential to the reproduction of life (whether human or extra-human), and the establishment of social infrastructures which are founded on values of community and collectivity. Some examples of how this commoning could be applied are the co-participation of different groups in the monitoring network, the creation of shared material banks and the collective management of water and soil systems, in order to ensure 'decontaminated' futures for all. Fostering the pluriverse, as described by Escobar (2015) does not mean that we forego the notion of productivity, but that it should be fundamentally reinterpreted on the basis of a non-capitalist framework which can be informed by the many forms of communal economy. Ana Maria Duran Calisto (2020) describes a similar scenarion in her research about the Ecuatorian Chakras system, a land-use model focused on agroforestry in the country's Amazonian region. A technical process, which is however informed by social structures intrinsic to the indigenous peoples of Ecuador. The chakras are one amongst many examples of communal organization systems in Latin America which bring up the idea of commoning and which are critical to advance and ground the discussion of degrowth in the Global South.

ON PROTOCOLS, PRINCIPLES AND PURPOSES - A MULTISCALAR DESIGN FRAMEWORK

Inspired by Stan Allen's work Points + Lines (2012) and his defense of Architecture as a material practice, I elaborated the design framework on the following page. Through the concept of infrastructural urbanism, and even though the name may indicate otherwise, Allen argues that infrastructure allows an architectural approach to problems of the larger scale. The author assembles a series of propositions which ressonate with the process and finidings of this research, such as temporality, flexibility and adaptability, collectivity, all of which to me are central to the practice of Architecture.

Material practices (ecology or engineering for example) are concerned with the behavior of large scale assemblages over time. They do not work primarily with images or meaning, or even with objects, but with performance: energy inputs and outputs, the calibration of force and resistance. They are less concerned with what things look like and more with what they can do. Although these material practices work instrumentally, they are not limited to the direct manipulation of given material. Instead they project transformations of reality by means of abstract techniques such as notation, simulation or calculation. Material practices organize and transform aggregates of labor, materials, energy and resources, but they work through necessarily mediated procedures - operations of drawing and projection, that leave their trace on the work. Material practices deploy an open catalog of technique without preconceived formal ends. (Allen, 2012, p. 52)

The territory is approached through three scales, used as layers of analysis and intervention, but that should be understood as coexisting, coinciding and interconnected. As an alternative to defining objectives, I work with protocols, principles and purposes, understanding them as less constraining alternatives which allow for a variation of the process and that engage with the uncertainty of the outcome.

MACRO | Protocols

The macro scale primarily dwells on the relations between the different ecologies - Cubatão as a human settlement, Cubatão as an industrial hub and the natural feature, with emphasis on the Santos Estuary. But in doing so, it exceed the limits of Cubatão by carefully looking at the material relations entailed through the urban/extra-urban binary. Proposals for this scale, which I will refer to us as ***protocols***, aim to guide and support interventions on the micro and meso scales and relations that are manifested through them. Instead of designing a physical superstructure or a large-scale scheme that tries to play by the scale of the territory, the proposed protocols seek to define a consistent discourse that will steer what might be physical interventions on the smaller scales.

MESO | Principles

For the meso scale, the project focuses on an extensive port area as an opportunity for land reclamation after the withdrawal of the oil industry and that enables a closer observation of the edge conditions between city-industry-water. The selected site, Porto Alemoa, gives the chance of adressing the issue of soil contamination with petroleum hydrocarbons and of the material remains left behind by the oil industry. The design is a greywater treatment system that initiates a process of land reclamation, through processes of decontamination and stabilization of soil and water. It defines a buffer between the natural conditions of the estuary and the constructed site conditions of the port and industry infrastructure and futher back, the city. Therefore, by designing and implementing a new system for this site, we are able to analyse new possibilities for a both spatial and discoursive buffer condition between technology and nature, repositioning human and extra-human experiences within this buffer.

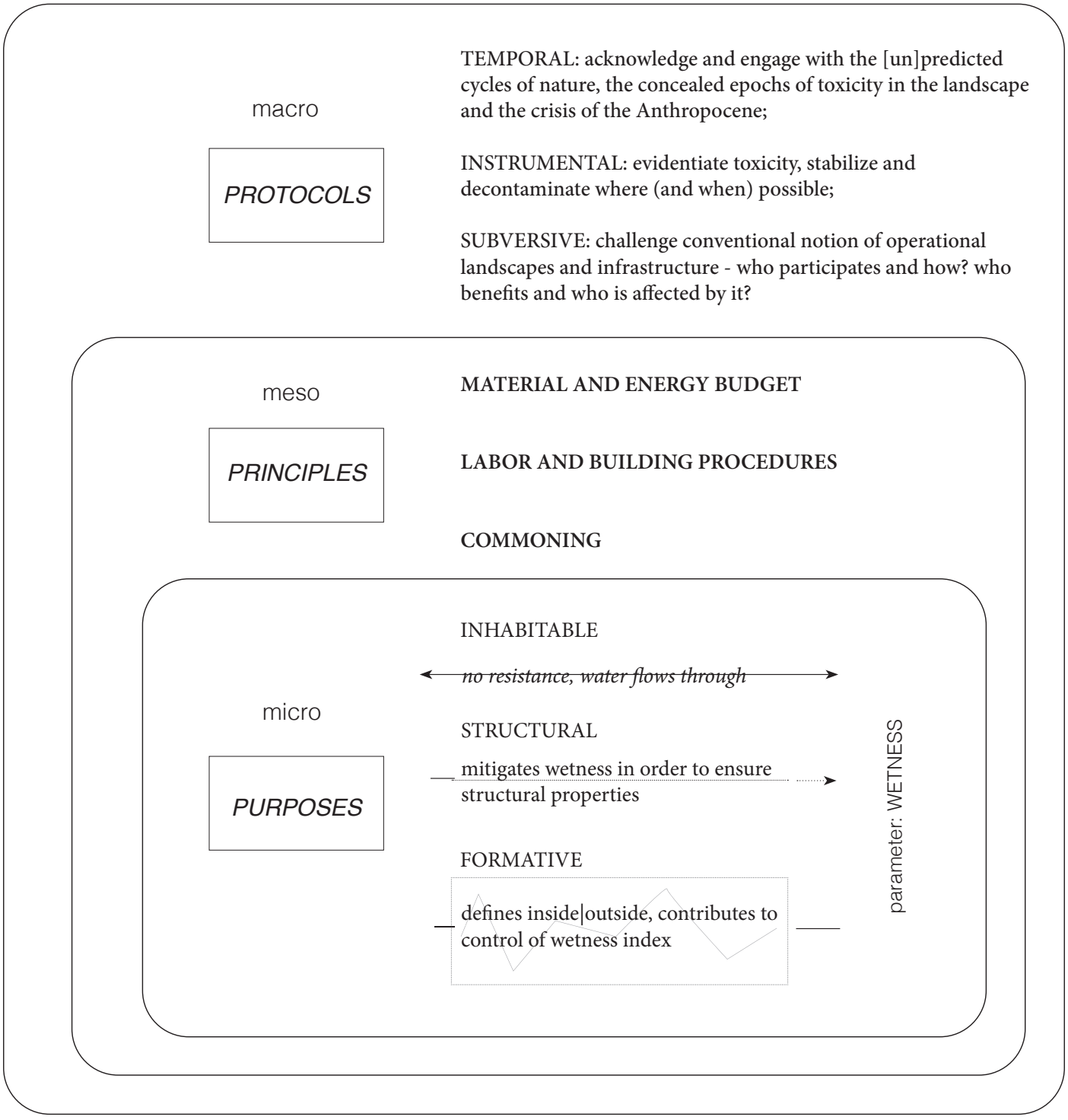
In order to structure this system, I defined the following principles:

1. material and energy budget: *All input and output should be accounted for. All 'bulk' material should be sourced locally; the system should not be a contributing source towards further environmental degradation; offset between energy demand and supply on site should be 'nearly zero'.*

2. labor and building procedures: *All assembly should be done on site using local workmanship. Processes should take into account local building technologies and skills or provide opportunities for skill-developing and training.*

3. commoning: *All operations, whether extracting, building, maintaning, disposing, etc, should be supportd by the notion of commoning - that is,*

MULTISCALE DESIGN
FRAMEWORK
own authorship, 2023



collectively caring for and managing the natural, cultural and technical systems on site.

MICRO | Purposes

Lastly, the micro scale is defined by proposed objects that emerge to support and manifest the system, whether through their spatial properties or through the suggested programs. Using the different conditions of wetness encountered on the site as a parameter, they engage with water in different ways in order to provide experiences of spatial quality. The interventions depart from the use of a common element - gabion walls that have an infill of demolished concrete debris - which assumes different purposes throughout the system.

Purpose 1 | Habitat: Wetness at 100%, in the submerged enviroment of the Santos Estuary. In this case, the element poses no resistance to water and in fact benefits from the porosity and fluidity in order to provide shelter for extra-human species underwater.

Purpose 2 | Structure: As retaining walls that delineate and support soil and planting operations, the element should mitigate levels of wetness in order to ensure the proper functioning as a structural element, preventing issues such as soil runoff or excessive water accumulation.

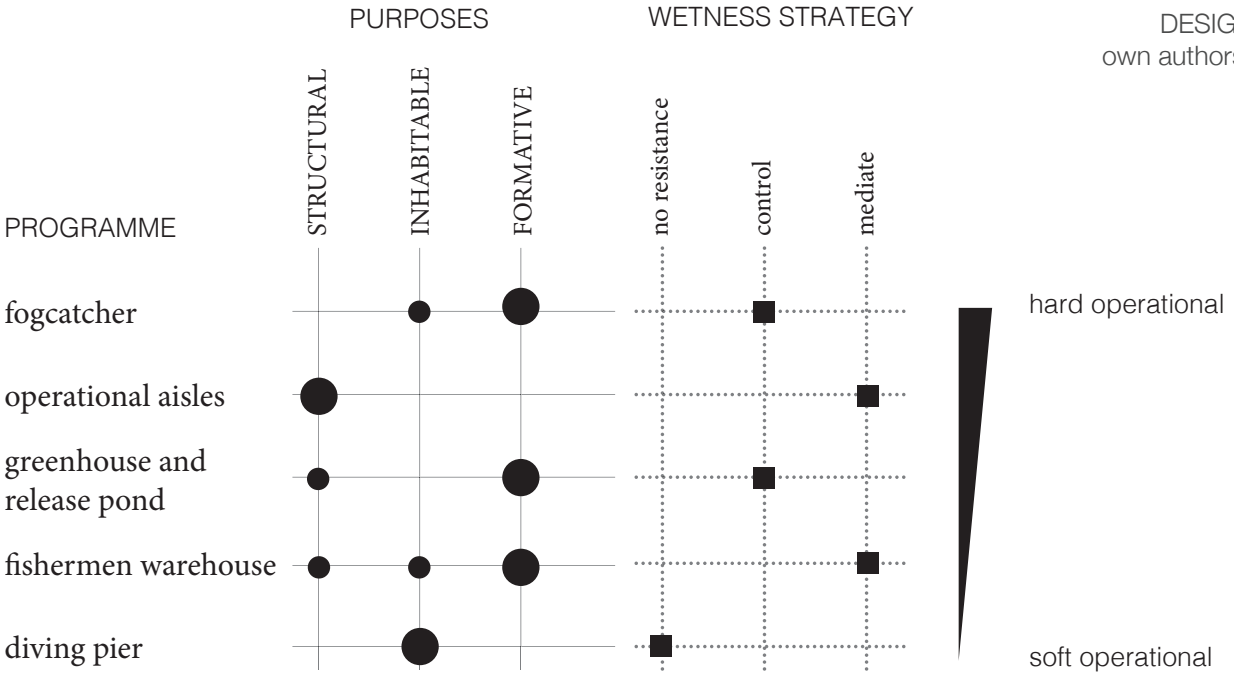
Purpose 3 | Formative element: In this case, the element is used to define a relation of inside-outside and needs to act towards the control of wetness index. It is designed for a critical use, a greenhouse, where climate control is essential to the performance of the programme.

EMERGING OBJECTS

When designing for the micro scale, I refer to purposes because from early on in this research+design process, I avoided making arbitrary choices, especially when it regards programme and placement of the 'architectural objects'. It took me some time (and a lot of deconstruction) to realize that rather than pinning down a site within the Porto Alemoa area, it was through mapping out repeating conditions that I would indeed be able to engage with metabolisms and systems.

By establishing purposes, I am able to delineate how each of these objects contribute to the overall assemblage represented by the system. In this case, both programmatic and spatial opportunities are conditioned by the larger system, but the Architecture allows for unique experiences within the system. Their performative capacities are elevated when integrating a system, even though they might function in isolation.

Hence, the architectural objects in the proposal emerge as a result of the synergy between the given site conditions, whether natural and constructed, and the new proposed system.



DESIGN MATRIX
own authorship, 2023

5 Reflection

ON THE RESEARCH PROCESS

I believe that the opportunity to extensively research and survey literature that discusses 'future-making', both within and outside the field of Architecture, have transformed and inspired both this project and my future practice. It has shown me the need for always adopting a critical stance and it has highlighted how our skills as Architects can allow us to engage in problems that exceed our disciplines.

I cherised the opportunity to dive deep into Cubatão and the Santos Estuary, a place close to home and that grew close to my heart. This is a site I studied during my high school education, the place where I learnt about the importance of having an endless supply of questions about the world, the ways in which we are making it (or them) and about who gets to make them. So it was incredibly special to revisit it, almost ten years later, now under the lens of Architecture, that if anything, has supplied me with the ability to ask more and more questions...

It began with an old fascination, but combined with my theoretical research, I was able to work through new methodologies, trying out new tools and this was a very valuable learning moment which allowed me to expand my repertory beyond the conventional analysis tools we often refer to as a discipline.

SHIFTING TO DESIGN

The translation to design was a challenging moment and perhaps still is, because it unpacks onto the larger issue of reshaping my (and perhaps a collective) understanding of Architecture. I have said that this was more about unlearning old ways that trap us and push us towards solutions that are not necessarily what the situation, or even the world, requires. Specifically in the case of Architecture, this means that I questioned myself several times on the need of building, and for this same reason, I see the urgency and importance of a collective reinterpretation and transformation of the discipline.

From the beginning of this graduation project, I had posed the challenge of engaging with the complexity of a multiscale site and I did not exactly know how that would figure into the design proposal. I am educated as an Architect and we are taught that the 'large-scale' belongs to the urbanists or the landscape architects. But in my mind (and as a discipline) we need to rethink that. Of course there are expertises and my experience with professional work has taught me that collaboration is both welcome and necessary, but as curiosity-driven person, I am glad that I did not constrain myself to the scale of the object. The moment I made peace with the fact that perhaps the emphasis of this project would not be on the object per se, but perhaps on a proposed system that would coordinate the objects

that emerge from it, was the moment I feel I was finally able to transition from research to design. However, this 'eureka' moment did take a while to find me and I wish I had more time to dwelve further in the specifics of programme and design. Within the scope of this project I had to assume a holistic comprehensive approach, but many of the proposals sparked my interest and could lead onto further research and investigation.

Looking back on the research questions I posed at the beginning of this project, I believe that I am able to begin elaborating answers about the role of the Architect in the 21st century. Architecture can bring singular contributions towards society-transforming issues such as the one I describe throughout this research, and of which Cubatão is just a small part of, however we need to actively engage in this process of redefining, widening and transforming the discipline.

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FIGURES & IMAGES

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Image 1. Rede de proteção. [Photography of hipersaline plain]. (Black and white edit by author). (2015). Pesquisa FAPESP. https://revistapesquisa.fapesp.br/rede-de-protecao-2/

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Image 2. Black and white image of Cubatão. From "24 empresas são condenadas por poluir Cubatão" by G. Girardi, 2017 September 30th, Estadao. https://img.estadao.com.br/fotos/crop/1200x1200/resources/jpg/1/9/1506733579591.jpg . Copyright year by name of copyright holder.

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Image 3. Aerial view of the Imigrantes-Anchieta highway system. From "Sistema Anchieta-Imigrantes deve receber até 440 mil veículos durante o feriado de Tiradentes" by Mobilidade Sampa, 2022 April 19th. Mobilidade Sampa. https://mobilidadesampa.com.br/2022/04/sistemaanchieta-imigrantes-veiculos-feriado-tiradentes/. Copyright Ecovias.

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Image 3. Rede de proteção. [Photography of hipersaline plain]. (Black and white edit by author). (2015). Pesquisa FAPESP. https://revistapesquisa.fapesp.br/rede-de-protecao-2/

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