Spring 2025

EARTH STUDIO

LANDSCAPES OF REPAIR



COLUMBIA GSAPP URBAN DESIGN

COLUMBIA CLIMATE SCHOOL
MA in Climate and Society

COLUMBIA CRCL

In Collaboration With:

Federal University of Brazil Rio de Janeiro, FAU
Universidad Diego Portales, FAAD
Santiago Global Center *and* Rio De Janeiro Global Center

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EARTH STUDIO

This innovative program brings together design, policy, communication, and climate science to explore climate action in communities facing the most severe impacts of climate change.

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Seminar speakers: High Voltage! Landscape, Energy and Industry in the Aconcagua Valley

Paola Bolados, Pablo Mansilla, Tomas Ariztía, Nicolás Diaz, Juliet Vielma, Paula Livingstone, Tomas Folch, Claudio Astudillo, Matias Honour

Landscapes Of Repair Rio Roundtable

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COLUMBIA GLOBAL CENTER SANTIAGO

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INTRODUCTION

Earth Studio: Landscapes of Repair

The race to decarbonize is driving large-scale landscape change, and its intersections with climate adaptation and climate justice.

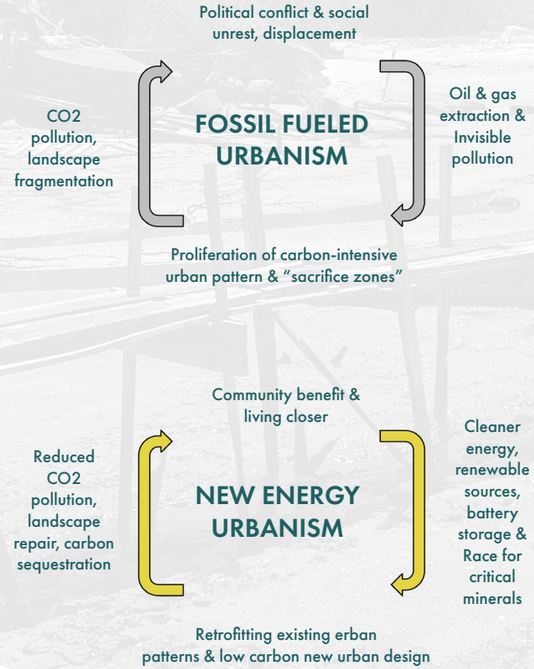
While a rapid transition to a clean energy economy is urgent and necessary, it also requires wholesale changes in both existing built patterns and rapid change in the mining frontiers where minerals for batteries and technological devices are extracted. Rapid urbanization necessitates at once a consciousness about the material demands of what hasn't yet been built as well as the retrofitting and adapting of what is already there. While critical minerals need to be unlocked to spark a low carbon future, this must be done in a manner that does not ravage communities and their landscapes - inside AND outside of the "city" - and doesn't define the same 'self-devouring' urbanism that define the current paradigms. For example: lithium, cobalt, manganese, nickel, and graphite mining are concentrated in Chile while Brazil, cobalt mining is concentrated in the Congo, and small Pacific Island states like Papua New Guinea are grappling with deep sea mining.

The water bodies, bays, and rivers, in both Santiago (Aconcagua River Valley) and Rio (Guanabara Bay) that we visited and studied are in a period of transition, where extraction infrastructure is present but the new energy landscapes are in formation. This studio explored how the race to decarbonize will drive future landscape change and future practice of urban design. We also examined urban design's relationship to the past century of fossil fuel extraction. The relative abundance of cheap, subsidized oil has shaped settlement patterns of self-devouring growth, locking in carbon dioxide emissions at dangerously high levels and imperiling life on planet earth (Petrochemical America, 2012).

We explored two water bodies in two contexts (Chile and Brazil) and traced their relationship to energy including sites of former oil extraction, processing and refinement. We also investigated how and where positive investments in urban design and in local, national, global policy and practice can be coupled with the clean energy transition in the form of community benefit agreements and landscape repair strategies.

The Studio developed bold and layered concepts for retrofitting existing urban patterns and imagining new urban and landscape forms that are less carbon consumptive and more just.

Pedagogical Approach to Action

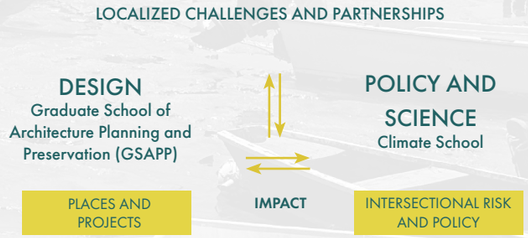


Uniting the disciplines of urban design and climate science can powerfully support and harmonize the living planet's massive critical ecosystems with people and power. With an increasing proportion of the world's population living in cities, and the pressure of urbanization impacting urban and non urban places alike, the built environment is central to both emission reductions and adaptation. These challenges demand new and intersectional pedagogies to train the next generation of designers, policymakers, and change-agents while also meaningfully supporting municipal, civil society, academic, and community-based partners on the ground.

Earth Studio is an inter-school course taught jointly between GSAPP MS Architecture and Urban Design and Climate School Masters of Climate and Society. Over the Spring semester, a cohort of urban design students and Climate School students work together to create urban design, spatial analysis and visions for an adapted and new energy future that responds to local challenges and planning efforts. Students accepted into the program travel to global cities each spring, and work in collaboration with local governments, industry actors, community organizations, and local academic partners, explore the entanglements of urbanization, design decisions in the built environment, climate policy, and social justice at global and local scales.

Conceived as one large initiative, Earth Studio imagines next century urbanism that co-exists with ecosystem revitalization and justice. Our class worked with colleagues, to whom we owe our gratitude and amplification. Each was invaluable and generous with their time, knowledge, and insight and helped us to pull the classroom and the local stakeholders outside the University a step closer together. As colleagues, we explored the successes and failings of case studies globally, workshopped and tested policies and practices to support implementation, and tested a set of design scenarios and policy principles that can inform a climate just future.

Columbia University and our class does not exist outside of or independent from the systems of power that perpetuate climate change and its risks. So, along the way we inquired into our own roles and identities as these relate to the work of climate justice and engagement with impacted communities. While these may never disentangle fully in our lifetimes, we practiced the process and ethic of multidisciplinary, international, and multiscalar learning, partnership, and activism as a Columbia GSAPP and Climate School community and future collaborators. We entrust our ideas and learnings to the administration, faculty, and future students as we urgently work together to create a non-extractive and connected community of learning and partnership. Latin America is a major voice on the global stage and can help redefine the priorities and approaches to the global climate crisis.





PRINCIPLES FOR A JUST FUTURE | CLIMATE x DESIGN

Throughout Earth Studio, we worked together to hone a value system that reflects what we learned, the relationships we built, and the assumptions that underpin our work - today and into the future.

IMPACTS OF CLIMATE RISK ARE ASYMMETRICAL

While the most vulnerable and marginalized communities have contributed the least to the crisis, they are the ones who bear the brunt of its effects and have the least capacity to adapt. Vulnerability is not static, but dynamic.

PATH DEPENDENCY UNDERMINES CLIMATE ACTION

Features of the political, financial, and infrastructural systems that guide urban development in a short-term and site-based paradigm undermine the ability to imagine post extractive landscapes and can subvert climate goals.

DESIGN AT THE LANDSCAPE SCALE

Historically, extractive industries like mining and fossil fuels have been designed as massive scales that cut across ecologies, infrastructure sectors, economics, and cultures. Our thinking, alternative proposals, and actions must match these scales to inform change.

INFORMALITY CAN INFORM DESIGN

Underserved and informal urban settlements – often seen as 'sacrifice zones' usually a result of political 'othering' - are not necessarily at odds with climate goals. Vulnerable communities should be equal partners in climate action, urban design, and policy making. Informal processes – whether physical or social – can be looked to for design inspiration.

ABUNDANCE AS AN INSTRUCTOR OF RESILIENCE

Approaching policy through the lens of resilience and abundance for all invites innovative solutions that harness available resources sustainably. It results in stronger and more adaptable systems for the future that do not replicate fragility or lack.

TRANSITIONS OVER TIME AND SYSTEMS

Responses to the climate crisis are temporal. However, being bound only to short-term targets, such as profit margins or political elections, takes away the focus on long-term and systemic solutions. We need to transition fast as well as right.

ACCOUNT FOR EXTERNALITIES OF RISK

Financial and adaptive risks are often too narrowly defined, ignoring social and environmental externalities and real costs to society, businesses, and physical assets. Addressing one risk may create new, unforeseen challenges. So, we must broaden our understanding to include these broader impacts.

POLICY NEEDS TO BE 3D

Policy cannot and does not just exist on paper. Designing and implementing policy multi-dimensionally means incorporating historically marginalized people, places, and thinking. In this way it will be more relevant, more feasible, and more resilient over time.

COMPETING INTERESTS ARE INEVITABLE

The systems of extraction, specifically of critical minerals, is currently driving our global economy and the transition to a post-fossil fuel economy. The challenge lies in finding more sustainable and just legal, financial, and political mechanisms to manage competing interests.

IMAGINARIES CAN BECOME REALITIES

The environmental and social crises today demand innovative and big ideas. We do not need to be bound by current limitations of knowledge but be bold in imagining a resilient future for all, while balancing practicality and urgent incremental actions.

STUDIO SITES & CHALLENGES

This map shows the studio study location within the **Aconcagua Valley** and highlights a network of interconnected environmental risks. These include sea level rise along the coast, intensive industrial activity such as sand mining and energy production, and the heavily polluted "sacrifice zones" of Quintero Bay. Further inland, the drying of the Aconcagua River signals growing water scarcity and stress on local ecosystems and agriculture. Together, these overlapping threats expose a vulnerable and highly impacted landscape, underscoring the need for integrated, resilient approaches to planning and development.

Nogales

Ventanas

Quintero

SEA LEVEL RISE + COASTAL SACRIFICE ZONE

TAILING STORAGE IN THE EARTHQUAKE ZONE

ACONCAGUA VALLEY

CONTESTED WATER RIGHTS

Quillota

PACIFIC OCEAN

Estuary

Concon Dunes

DEPLETING RIVER WATER RESOURCE

POLLUTION FROM OIL REFINERY

REAL ESTATE DEVELOPMENT PRESSURES

TECTONIC AND TSUNAMIS

Nazca Plate

South American Plate

N

0

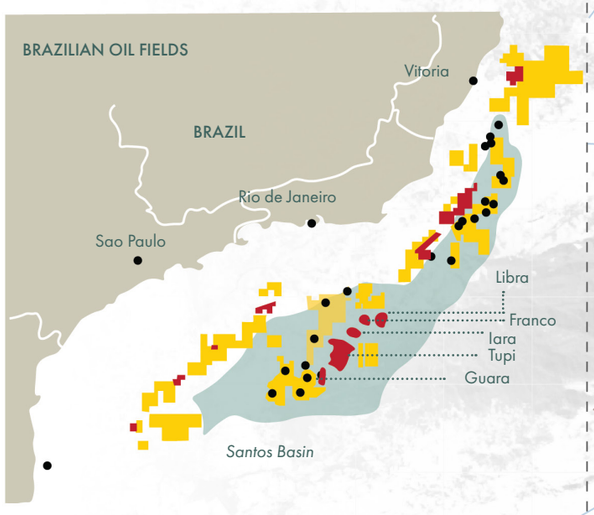
5m

LEGEND

- Tailing - Active
- Tailing - Inactive
- Water Treatment Plant
- Water Bodies
- Industrial Area
- Residential Area
- Sea Level Rise
- Power Line
- Roads
- Interconnected Risks

STUDIO SITES & CHALLENGES

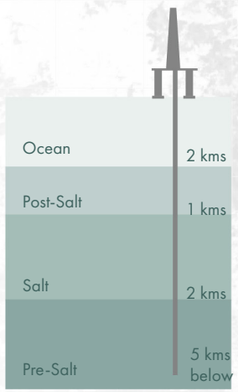
Guanabara Bay is a site of intense environmental conflict, where industrial development, urban sprawl, and inadequate infrastructure collide with ecological and social systems. The Bay suffers from chronic pollution due to untreated sewage, industrial discharge, and oil spills, despite decades of public cleanup pledges. Surrounding communities bear the brunt of health and environmental risks, underscoring deep social inequalities. The Bay embodies the struggle between economic priorities and environmental justice in an urbanizing coastal landscape.



Exploration Blocks
Oil Fields
Pre-Salt Region

LEGEND

Landfill
Industry
Pipeline
River
Sea Level Rise
Interconnected Risks



POLLUTION FROM THE FOSSIL FUEL REFINERY

REDUC

Gramacho

LACK OF CONNECTIONS AND OPPORTUNITIES AMONG ISLANDS

Oil Archipelago

MILITIA CONTROL OVER COMMUNITY WASTE MANAGEMENT

Ilha do Governador

RIGID URBAN-INDUSTRIAL ZONES THREATEN ECOTONES

Ilha da Conceicao

ABANDONED BOATS, POLLUTION AND LOSS OF LIVELIHOODS

Niteroi

LACK OF PUBLIC TRANSPORTATION AND PUBLIC SPACES

N

WHERE THE OIL IS:

Oil is stored in the pores of the reservoir rock layers in the pre-salt layer.

LIBRARY OF (DIS)REPAIR

Processes and projects - be them physical, legal, cultural, or financial - that attempt to reconcile harm are layered and complex. **The Library of (Dis)Repair** includes case studies that explore where lines are drawn between extraction and what earth can support and what society is willing to accept.These cases unpack the processes that are set in motion to manage the risks or correct if/when the balance has been skewed and position our collective understanding of solutions, implementation, and inevitable tradeoffs.

ECOLOGY AS INFRASTRUCTURE

CLIMATE ADAPTED HOUSING IN TETO VERDE FAVELA
What locally-led adaptation initiatives are being performed in Rio De Janeiro?

Pablo Yañez-Mena



MID-BARATARIA SEDIMENT DIVERSION
A genuine adaptation and restoration strategy or guise to sustain fossil fuel dependence?

Caroline Sacher



FRESHKILLS PARK
How can we engineer nature's resilience in dense, urban environments?

Samantha Dady



VALE ENCANTADO
How can decentralized sanitation and waster-management solutions empower community-led initiatives?

Samantha Dady



DECENTRALIZED SUSTAINABLE RURAL WATER – HAITI
Bridging crises: From environmental devastation to resilience in the Yanomami Territory and Haiti

Anar Amarjargal



AGROFORESTRY IN CÔTE D'IVOIRE
How might climate finance be reimagined to strengthen rural communities.

Amina Diop



SUSTAINABLE FAVELA NETWORK AND CITY-WIDE NATURE-BASED INFRASTRUCTURE
How do favelas instruct pluriversal solutions?

Tatianna Sitounis



ARCS OF RESTORATION – AMAZON RAINFOREST
How does data, theory, and policy translate to practice?

Julia Goldsamt



LEGAL AGREEMENTS AND LITIGATION

POST-BRETTON WOODS AGENDA
What are the consequences of the Bretton-Woods consensus and what role do Brazil's cities play in its transformation?

Pablo Yañez-Mena



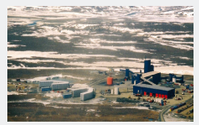
LEGAL EMPOWERMENT FUND
How is climate litigation being used by communities and Brazil to repair extractive practices?

Jarrod Sims



THE RAGLAN AGREEMENT – NUNAVIK CANADA
What might be the role of community beneits agreements in guaranteeing compensation?

Jarrod Sims



HERMOSA MINE – PROMISES ON PAPER
How are community benefit agreements developed in mining towns?

Ches Rotich



LABOR AND INDUSTRY

ILLEGAL GOLD MINING IN THE YANOMAMI TERRITORY
Bridging Crises: From environmental devastation to resilience in the Yanomi territory and Haiti

Anar Amarjargal



GUANABARA BAY OIL SPILL
How do industries of extraction shape physical and abstracted landscapes?

Tatianna Sitounis



GRANGEMOUTH REFINERY
How does labor transition as fossil fuels phase out?

Ches Rotich



SOMOS CHOAPA
What prompts private investment in vulnerable communities?

Carissa O'Donnell



THE ANTHRACITE COAL STRIKE OF 1902
What is the role of organized labor in extraction and repair?

Carissa O'Donnell



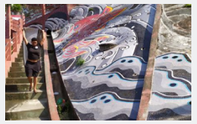
NARRATIVE AND SOCIAL LICENSE

DEEPWATER HORIZON
How did BP use the deepwater horizon disaster to reshape its public image, control narrative, and reinforce its dominance in offshore drilling?



FAVELA PAINTING – RIO DE JANEIRO
How does puboic art enact physical and social repair?

Julia Goldsamt



FUNDING AND CAPITAL

LOSS AND DAMAGE FUNDS
How might loss and damange funds be a vehicle for local action?

Amina Diop



INVISIBLE RIO – MARACANA MULTIETHNIC VILLAGE
How much land trusts for relocation and environmental restoration be operationalized?

Amina Diop





EMERGENCE OF FORM

SITE SPECIFIC URBAN CHANGE & THE MATERIALITY OF EXTRACTION

How can we understand Chile and Brazil's cultural and material landscape – where cities, towns and villages nest within bays, mountains, beaches, thick lush tropical forests and desert plateaus? Land, for indigenous scholar Max Liboiron, ***"the unique entity that is the combined living spirit of plants, animals, air, water, humans, histories, and events."*** We documented and traced the materials of the energy transition, their relationships to the built environment, and the climate justice imperatives that overlay across geographic scales and modes of power. In-so-doing, we aim to establish a state-of-play of policy, practice, and movements.

MINING AS HEGEMONY: FROM SALTPETER TO RIO TINTO AND ENERGY MINERALS
Pablo Yanez-Mena



SALTPETRE

Saltpeter's trajectory in Brazil—from a key ingredient in imperial warfare to a strategic fertilizer mineral—reveals how extractive practices shape and are shaped by hegemonic geopolitical forces. Today, corporations like Rio Tinto and Vale carry forward these legacies through mining operations that often deepen local vulnerabilities under the guise of energy transition. Achieving climate justice in this context demands not only safer and more inclusive mining practices, but also a radical shift in how resource extraction aligns with indigenous knowledge, equity, and planetary well-being.

THE NEW RUSH: IRON AND STEEL
Jarrod Sims



IRON

Mineral extraction—particularly in Brazil—supports urbanization and renewable infrastructure while perpetuating environmental harm and social injustice, particularly as it relates to the global iron and steel industry. This research analyzes the geopolitical dynamics of iron ore trade, especially Brazil's relationship with China, and the systemic inequities experienced by local and Indigenous communities affected by mining. As decarbonization efforts increase global mineral demand, the paper argues for integrating climate justice principles—recognitional, procedural, and distributive—into mining and urban development policies.

CLAY IS EVERY~~WHERE~~ THING: MAPPING CLAY AS EXTRACTION, HERITAGE, AND RESISTANCE THROUGH THE TRANSATLANTIC SLAVE TRADE
Julia Goldsamt



CLAY

Clay is both a vital natural resource and a vessel of cultural heritage, embodying stories of climate, colonization, and resistance. Tracing its journey from the riverbanks of West Africa to Brazilian quilombos and enslaved communities in the U.S., this work reveals how clay has been used not only for construction and industry but as a medium of survival, spirituality, and decolonial expression. In confronting the extractive practices of modern clay mining, it calls for a return to land connection, sustainability, and the material memory embedded in clay as a form of climate justice.

EXTRACTION AND SOCIAL MOVEMENTS: HOW CRUDE OIL INFORMS ENVIRONMENTALISM
Tatianna Sitounis



CRUDE OIL

This paper examines the complex entanglement of Brazil's crude oil industry with national identity, global economic systems, and social movements and NGOs. Through a historical overview and a case study of the Guanabara Bay oil spill, it highlights how Petrobras's actions have undermined environmental justice and weakened civil society capacity. It argues that advancing climate justice in Brazil requires reimagining extractive landscapes through inclusive design, community resilience, and institutional empowerment.

SALT EXTRACTION IN BRAZIL: FLOWS, POLICIES, AND CLIMATE JUSTICE IMPLICATIONS
Amina Diop



SALT

Salt extraction in Brazil reveals deep entanglements between natural resource flows, climate vulnerability, and socio-environmental injustice. This work traces how saline landscapes—particularly in the Northeast—are shaped by colonial legacies, state policies, and contemporary industrial practices that disproportionately impact marginalized communities. By examining extraction through a climate justice lens, it challenges dominant development models and calls for more equitable and ecologically attuned approaches to managing Brazil's salt economies.

MINING, REFINING, & SELLING CONCEPTS OF COPPER "EXTRACTION" OVER TIME & SPACE
Samantha Dady



COPPER

Copper is both a linchpin of the global energy transition and a vessel of complex socio-economic extraction, particularly in Chile and Brazil, where its mining symbolizes the entwined histories of national independence, labor exploitation, and imperial control. As demand for copper rises sharply due to its indispensability in renewable energy technologies, the challenges of declining ore quality, supply chain vulnerabilities, and environmental injustices grow increasingly urgent. This study traces copper's material and symbolic journey—from the mining town of Chuquicamata to geopolitical trade agreements and climate injustices—revealing how its extraction continues to shape power, place, and people across time.

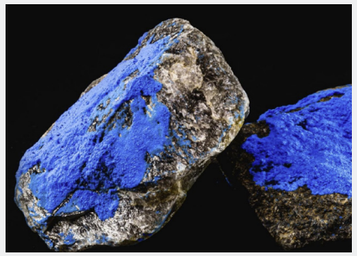
NICKEL, CONSENT, AND THE COST OF EXTRACTION
Chesang Rotich



NICKLE

Nickel mining in Brazil sits at the heart of the global energy transition, yet its extraction is marked by deforestation, pollution, and Indigenous rights violations. As demand for Class 1 nickel grows, tensions between corporate interests and community sovereignty highlight the urgent need for stronger enforcement of Free, Prior, and Informed Consent (FPIC) and ethical sourcing practices. A just transition requires centering Indigenous leadership, improving regulatory accountability, and transforming the nickel supply chain to align with climate justice principles.

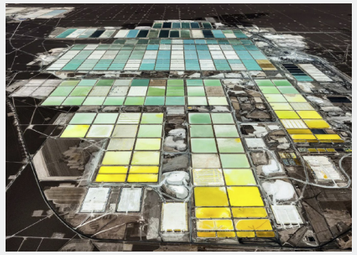
EXTRACTION AND SOCIAL MOVEMENTS: HOW CRUDE OIL INFORMS ENVIRONMENTALISM
Carissa O'Donnell



COBALT

Cobalt is not the root of exploitation, but a mirror reflecting deep-seated systems of greed, global power asymmetries, and neocolonial labor practices. Tracing cobalt's transformation from a cursed impurity in European silver mines to a critical mineral powering the clean energy transition, the paper critiques the moral and economic contradictions embedded in its global supply chain. By analyzing historical legacies, contemporary market dynamics, and geopolitical shifts—particularly in the DRC and Brazil—it calls for a reframing of responsibility away from the mineral itself and toward the human decisions that shape its value and impact.

BEYOND EXTRACTION: THE SOCIAL AND ENVIRONMENTAL TRADE-OFFS OF LITHIUM MINING
Anar Amarjargal



LITHIUM

This paper examines the paradox of mineral extraction in Brazil—specifically lithium and iron—as essential inputs for the global energy transition, yet deeply entangled with environmental degradation, community displacement, and social injustice. As extraction zones transform into industrialized landscapes governed by global demand, the benefits of decarbonization are unevenly distributed, often bypassing the communities who bear its greatest costs. By centering climate justice and exploring tools like Community Benefit Agreements, the paper argues for a more equitable transition—one that acknowledges the ethical trade-offs of sustainability and prioritizes human rights alongside emissions reduction.

THE PARADOX OF SAND: A CATALYST FOR DESTRUCTION AND PROGRESS
Caroline Sacher



SAND

Sand is both a driver of development and a source of deep ecological and social harm, underpinning everything from coastal infrastructure to high-tech manufacturing. In cities like Rio de Janeiro, sand is essential to climate adaptation and urban growth, yet its extraction accelerates environmental degradation, water insecurity, and inequality—often through illegal and violent means. This paradox reveals how sustainability goals can be undermined by the very materials meant to achieve them, demanding a reimagining of development that centers justice, regulation, and alternative futures.

ACONCAGUA VALLEY

CHILE

INTRO AND PARTNERS

ACONCAGUA RIVER & QUINTERO BAY, CHILE

The Aconcagua River Basin, located north of Santiago, extends 142 km from the Andes Mountains to the Pacific Ocean. With a population of 630,000, the region faces various socio-ecological conflicts due to the activities of mining, industrial agricultural, and energy industries. Copper is the biggest export of Chile, but copper mining led by companies like Codelco and Anglo American, while central to the local economy, has extractive practices that have caused severe environmental and social degradation over the past three decades. Memories of the 1965 El Cobre Tailing Dam collapse, where Anglo America currently operates in El Melon and the devastation that communities downstream suffered from this and similar incidents in other regions, are still fresh in people's minds. Meanwhile, critical infrastructures, such as the cargo and passanger railroad built to connect Santiago and the Port of Valparaiso have been discontinued, leaving communities stranded or dependent on expensive transportation alternatives to reach bigger towns for employment. Due to the water-intensive operations of these companies, they have priority in extracting ground water and often pollute aquifers. This has caused downstream communities to increasingly suffer from water scarcity and health issues.

While the mining companies promise jobs to the neighboring communities, these jobs are few compared to the thriving agricultural economy that was once the mainstay for the people along the fertile Aconcagua River Valley given the region's temperate climate. However small-scale farming has given way to water-intensive cash crops like avocados. Prolonged droughts in Chile have added to the water stress, so that the Aconcagua River now runs dry in many more months than in the past. The expansion of cash crops and urbanization is also placing additional pressure on endemic ecosystems in the valley that still support rich but dwindling biodiversity.

Minerals extracted from the Andes are processed in coastal areas, where industrial complexes, such as copper foundries, oil refineries, and thermoelectric plants have been located for easy access to shipping for exports and imports. These complexes are concentrated around the Aconcagua River estuary and in nearby coastal regions such as Ventanas. These areas, now known as "sacrifice zones," have had a devastating effect on local ecosystems and communities. From being celebrated beachside tourist resorts of the past, they have now become deserted places where severe pollution is causing health hazards and economic hardship for local communities struggling to survive.

Furthermore, Aconcagua River Basin and the estuary have endured the negative externalities of the needs of nearby metropolitan areas, such as Santiago and Gran Valparaíso, suffering from pollution and environmental degradation caused by illegalsand mining and landfills. The closure of coal-fired thermoelectric plants and the Codelco- Ventanas foundry offers an opportunity for a wholesale rethink of the region's energy and environmental future that needs to be environmentally sustainable,financially viable, and social just.

Investigating these material heritages and historical narratives across diverse urban contexts, students worked in collaboration with local stakeholders to explore pathways for repair and regeneration. On the field visit to Chile, Columbia students and faculty worked alongside their counterparts at the Universidad de Diego Portales. They also engaged with Anglo American Company, community groups including Muzosare, Mujeres y Rios Libres among other organizations, as well as officials from the Municipalities of Quillota Municipality and Concon.

During the semester and their field visit, Columbia student groups analyzed five sites along the Acancagua Basin and the estuary. They explored the role that urban design envisioning can play in shaping the future of energy, climate, and sustainable symbiosis between species (including humans) and nature.

COLUMBIA GLOBAL CENTER SANTIAGO
Antonio Campaña
Chirs Molinare

UNIVERSIDAD DE DIEGO PORTALES, FAAD
UDP FACULTIES
Alejandra Celedón
Carolina del Campo
Nicolas Stutzin
Margarita Jans
Elizabeth Wagemman
Nicolas Navarrete
Magdalena Bustamante

UNDERGRADUATE STUDENTS
Luna Figueroa
Vicente Sierra
Cristobal Mallea

CHILE SITE VISIT HOSTS
Concon
Ilen Saez (Former Councilwoman)

Concon Minicipality
Marcela Roman (Director - Parque Ecologico La Isla)
Belen
Dr. Roberto Thomson (Ornithologist and Adjunct Professor at University of Chile)

Patrimonio Vivo Costa (NGO)
Fabiola Ruiz (President of Patrimonio Vivo Costa)
Pia Morales (Treasurer of Fundacion Cidemar)

Mujeres en Zonas de Sacrificio en Resistencia (MUZOSARE)
Mercedes Yovera
Cristina Ruiz

Quillota Municipality
Margot Leticia Flores Correa

Mujeres y Rios Libres (NGO)
Valeska Barrera

Quintero Municipality
Claudia Ebensperger (Geographer, Urban Advisor)
Victor Azocar (Quintero Citizen)

Kennedy Foundation
Felipe Celedon (Project Manager, Wetlands Conservancy)

Anglo American
Tomás Barros

Cerros Resilientes Foundation
Mauricio Guerra

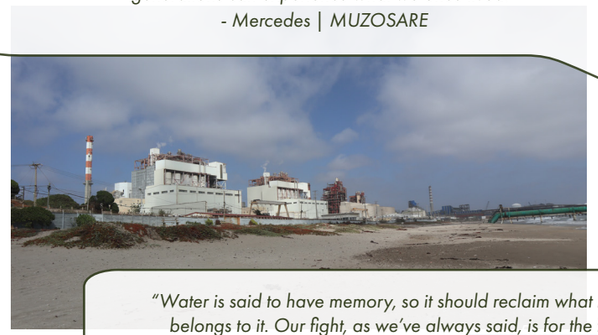
CHAO CARBÓN
Ladislao Palma

SEMINAR SPEAKERS
High Voltage, Landscape, Energy and Industry in the Aconcagua Valley
Paola Bolados
Pablo Mansilla
Tomas Ariztía
Nicolás Diaz
Juliet Vielma
Paula Livingstone
Tomas Folch
Claudio Astudillo
Matias Honour



SITE VISIT DOCUMENTATION & AGENTS OF CHANGE

"The factories have affected the whole region, humans, animals, nature, everything... We will fight for our rights against the big industries and wish that our future generations can experience what we once lived."
- Mercedes | MUZOSARE





"Water is said to have memory, so it should reclaim what rightfully belongs to it. Our fight, as we've always said, is for the future. Everything we do isn't just for us—it's for the generations to come".
- Nicole & Lesly, Mujeres y Ríos Libres







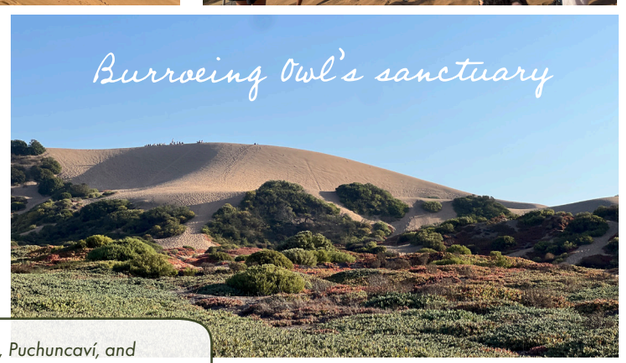


"Coastlines should not be defined by political boundaries but seen as a living landscape" - Dunes Team









"Cóncon is a sacrificial zone just like Quintero, Puchuncaví, and Ventanas - it's the same thing. But here people don't like when you talk about it because this is a touristy city and people don't like to acknowledge it. But it's really important because this is about our health!"
- Fabiola Ruiz | Patrimonio Vivo Costa President





CLIMATE x DESIGN FRAMEWORK

Santiago

El Melón

The Nogales Valley Alliance:
A Regenerative Framework For Post-Mining Futures

Aconcagua Valley/Quillota

Agua Para Todos:
Restorative Urbanism In The Aconcagua River Valley

Concón Estuary

Reimagining Concon Estuary:
Reclaiming Concon With Community-Led Catalysts

Concón Dune

Living Coast, Breathing Dunescape:
From A Road That Broke The LAndscape To Trails That Build It

Ventanas

Quintero Bay, A Breakthrough:
From Sacrificial Zones to Living Territories

Quintero

H.E.A.L Quintero:
Restoring Health, Environment, Access and Livability

El Cobre

La Calera

Quillota

Aconcagua River

Quintero Bay

Dunas de Ritoque

Concón

Bahía Concón

Viña del Mar

Bahia de Valparaiso

N

UD Studio Sites

VENTANAS

ACONCAGUA VALLEY, CHILE

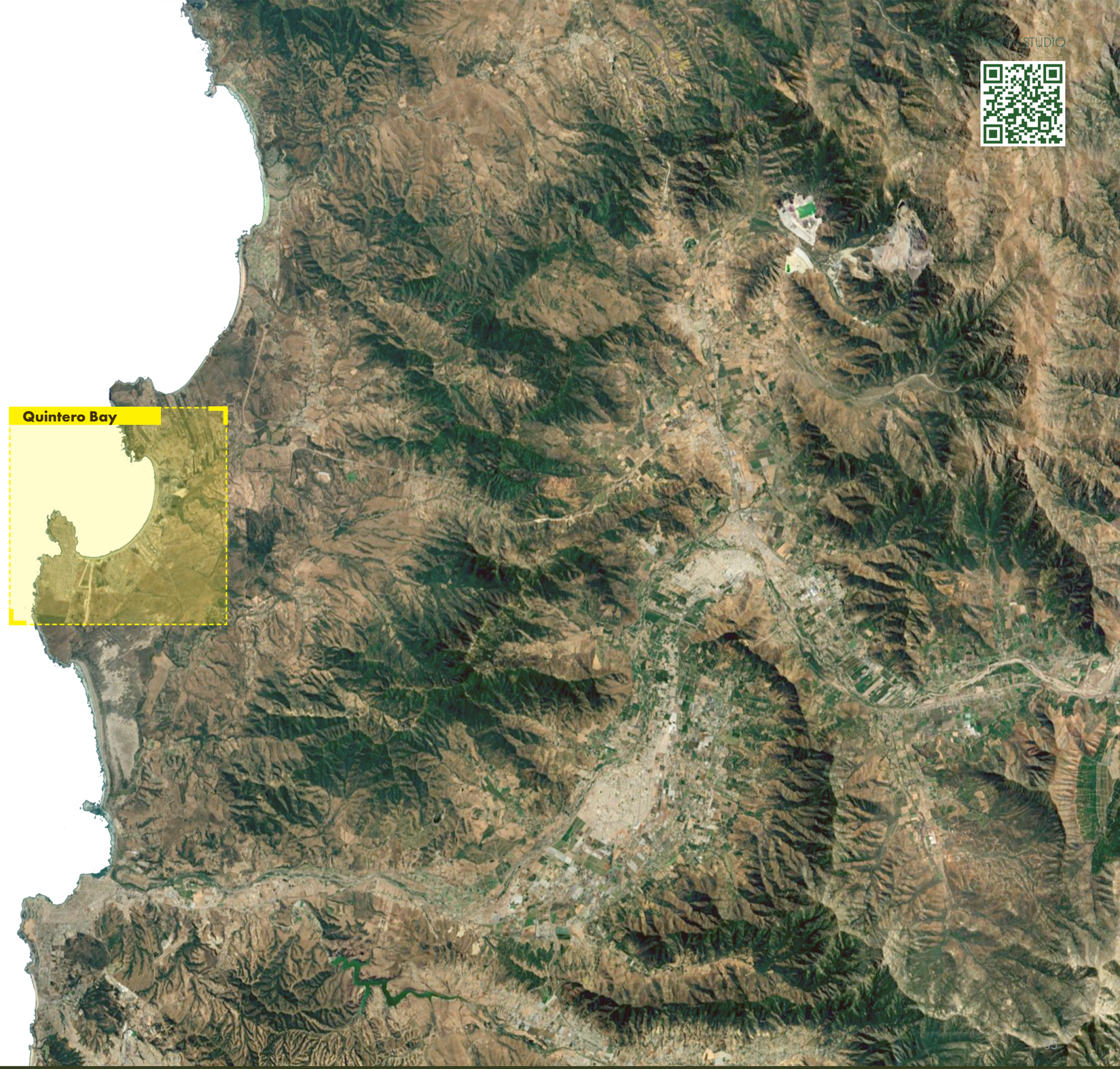
Spatial Visions

ACONCAGUA VALLEY, CHILE

QUINTERO BAY: A BREAKTHROUGH

FROM SACRIFICE ZONES TO LIVING TERRITORIES

Maissa Eid / Georgia Fernandes / Patricio Munoz / Dutt Patel



WHAT IF THERE IS A SYMBIOTIC RELATIONSHIP BETWEEN NATURE, INDUSTRIES AND COMMUNITY?

In Quintero Bay, one of Chile's most damaged sacrifice zones, industry has left deep scars on the land and people's lives. The Quintero region powers the nation but offers little in return to its people only pollution, illness, and loss.

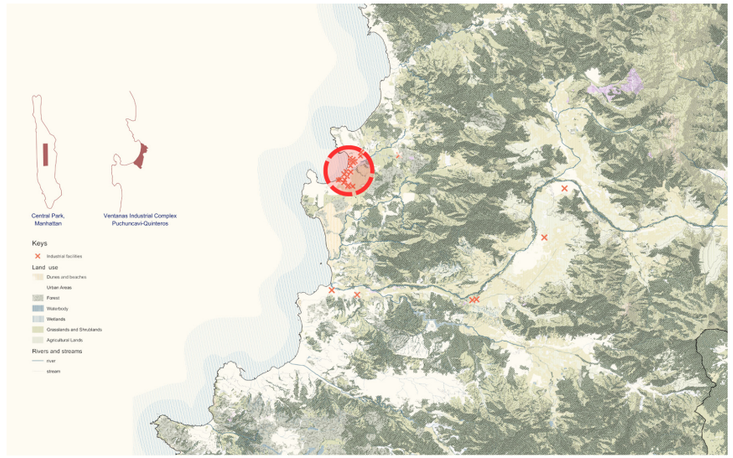
Yet, hope grows. Inspired by grassroots groups like MUZOSARE, designers and residents are reclaiming the landscape.

Wetlands are being restored and abandoned factories are being reimagined and transformed. Together, they are building a new model- one rooted in repair, care, and shared futures.

This is not just recovery; it's a quiet revolution to turn zones of harm into places of healing, where community and ecology thrives side by side.

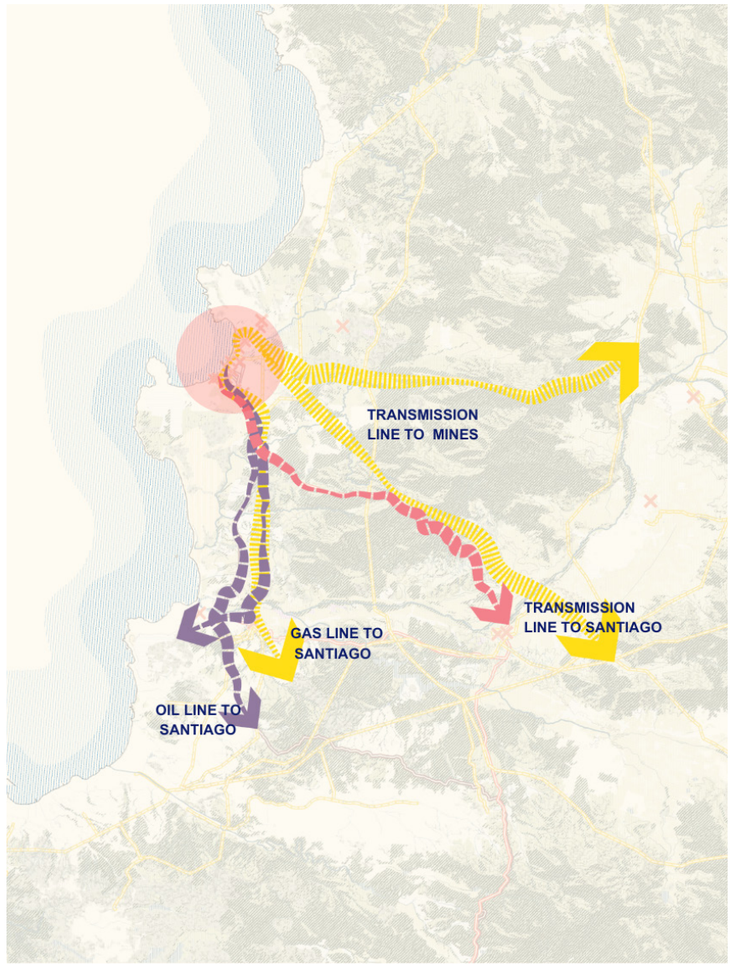


01 | Reclaimed Wetland And Spaces For The Community



02 | Ventanas Industrial Complex

The Chilean coast is dotted with numerous “sacrifice zones,” areas heavily impacted by industrial activity and environmental degradation. One of the most prominent is the Ventanas Industrial Complex, located near major mining operations and a busy port.

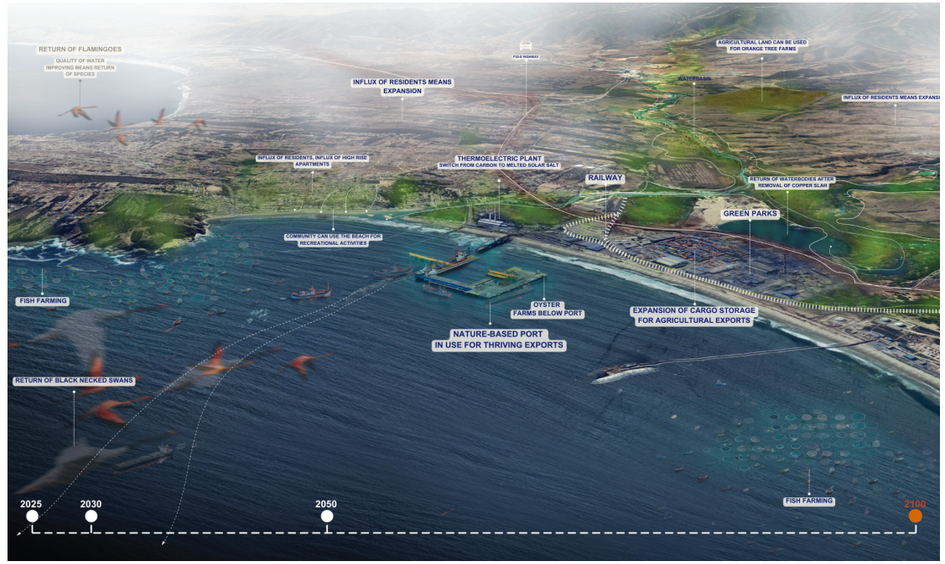


03 | Connection To The Region

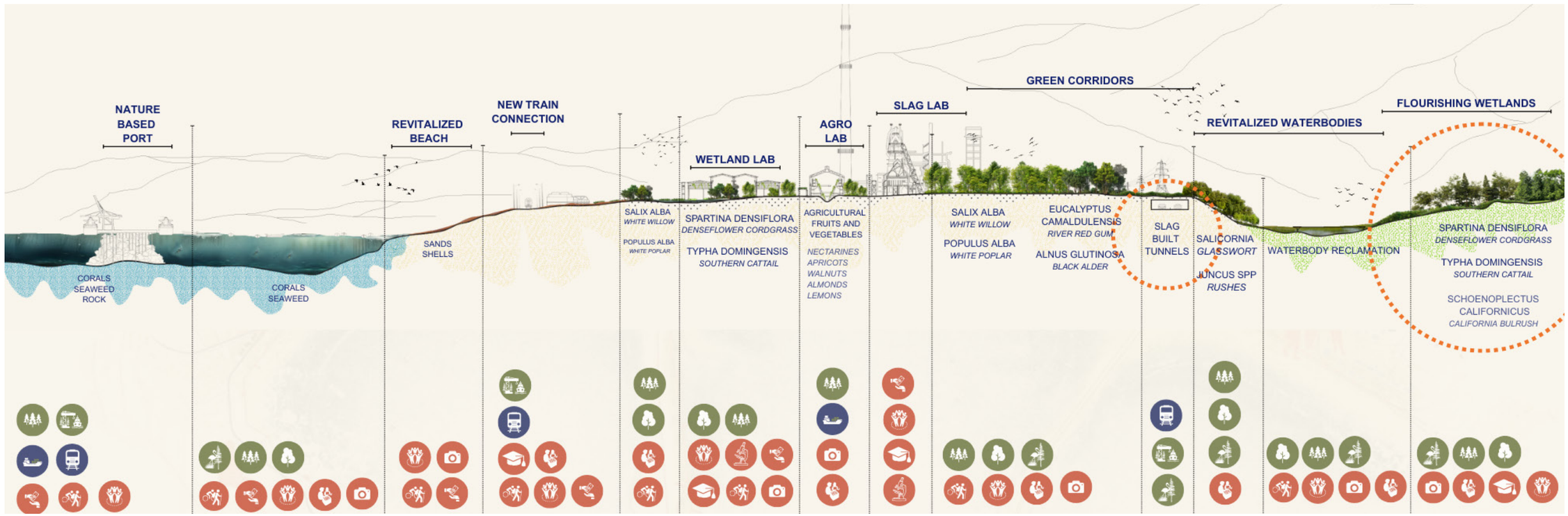
This bay plays a critical role in national infrastructure, supplying approximately 7% of Chile’s energy. Its significance is further underscored by a vast network of transmission lines, railways, and roads that connect it to the rest of the country.



04 | Landscape's Current Condition



05 | Landscape's Condition In 2100



06 | Repurposed Industrial Complex Programming



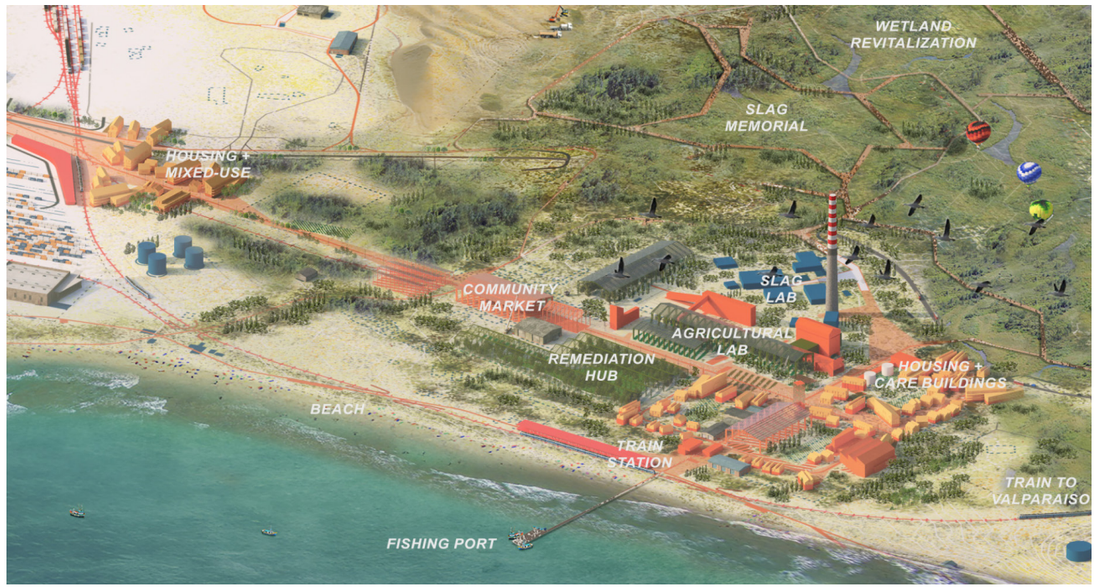
07 | From An Industrial Complex

Currently, people fear these industrial complexes due to the heavy pollution they've caused, leading to disease and high cancer rates. Through our design, we aim to restore the balance by helping the ecology, community, and industry coexist in harmony.

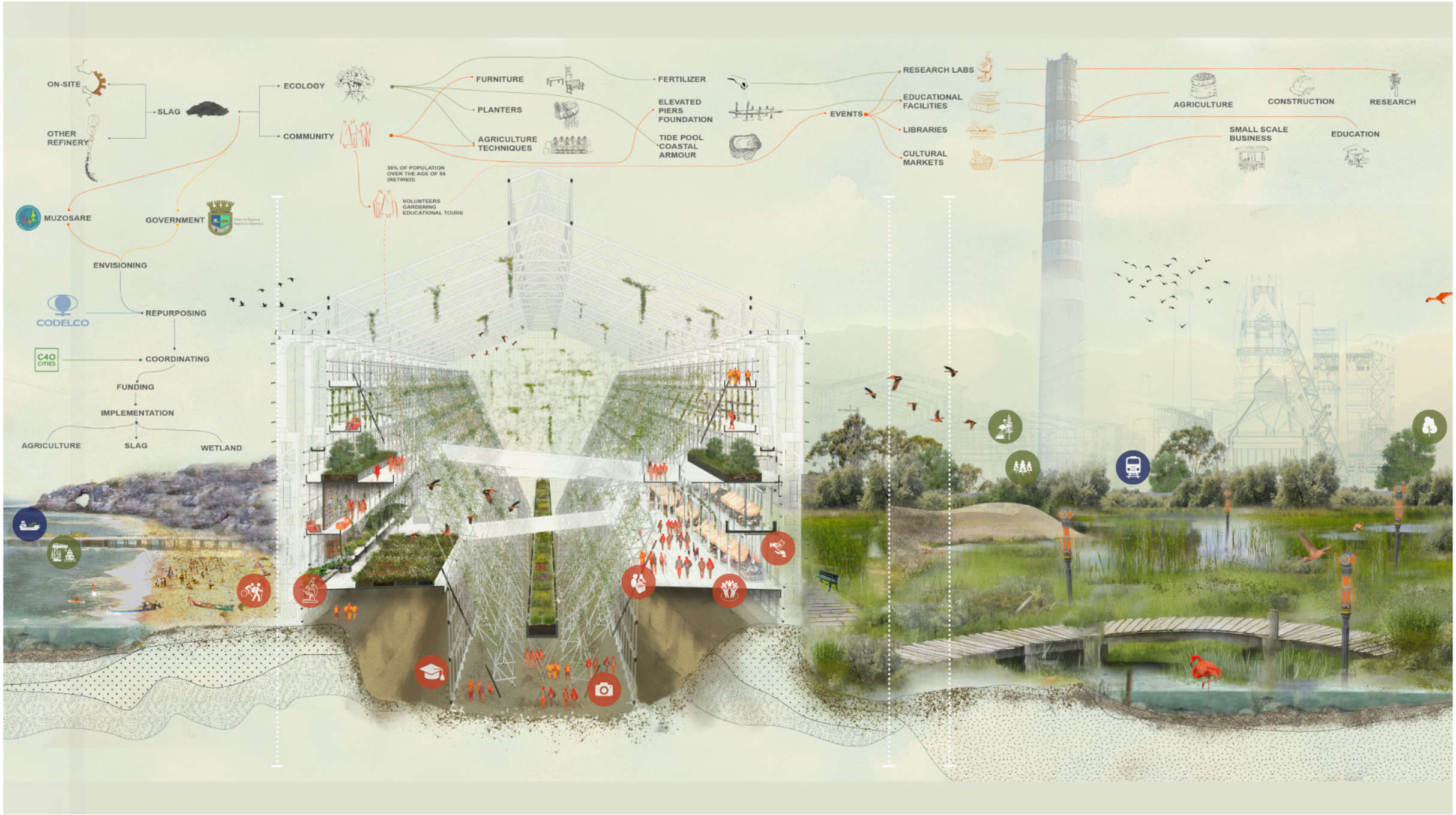


08 | To A Living Ecological & Social Hub

The massive industrial structures will be repurposed into spaces that serve the community and environment creating slag labs and phytoremediation testing sites, supporting both education and ecological restoration, hosting cultural markets that foster local economic exchange.







09 |Transforming Industry For Ecological and Community Renewal

QUILLOTA

ACONCAGUA VALLEY, CHILE

Spatial Visions

ACONCAGUA VALLEY, CHILE

AGUA PARA TODOS

RESTORATIVE URBANISM IN THE ACONCAGUA RIVER VALLEY

Suzanne Alphonse / Tanishka Kelkar / Vaibhav Gurung

ACROSS THE CHANGING LANDSCAPE OF ECOLOGY, POLITICS, AND ECONOMY, HOW DO WE RESTORE THE RIGHTS OF THE RIVER?

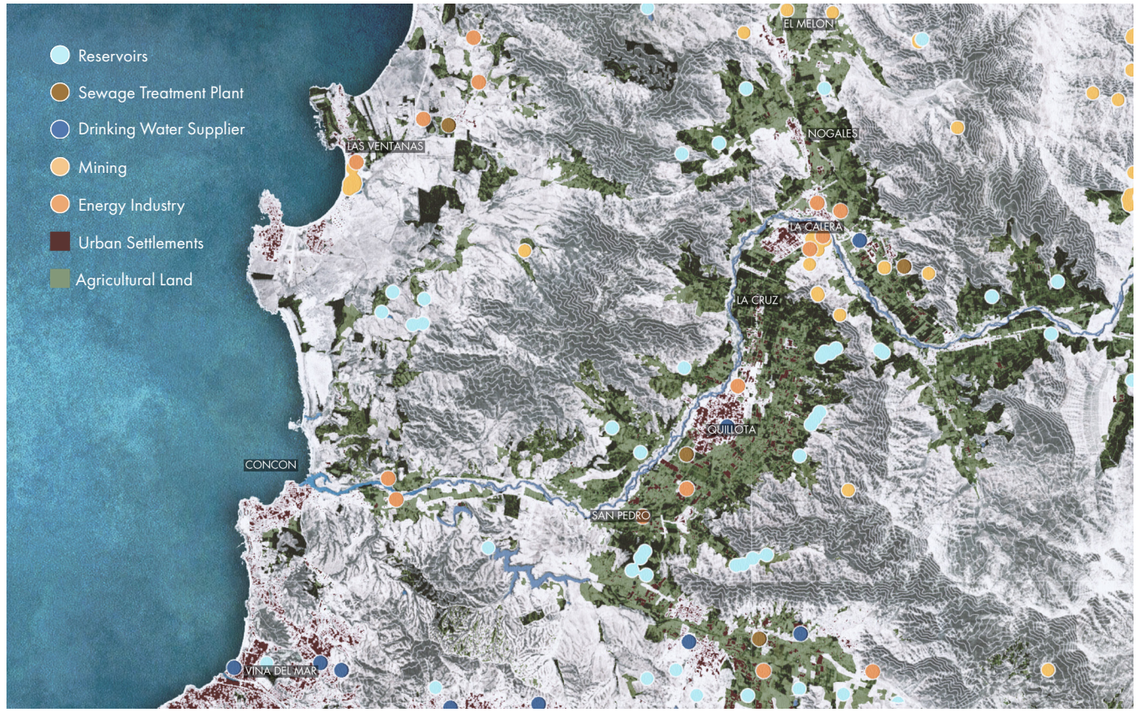
In the heart of Chile's Aconcagua River Valley, the commune of Quillota stands at a critical crossroads. Once home to free-living rivers, today these waterways have been turned into commodities—bought, sold, and squeezed dry. Over centuries, the river's meandering course has shaped settlements, but now the water has lost its flow, creating a disconnect between the water and the communities it fosters.

The Agua Para Todos (Water for All) project proposes a valley-scale alliance and toolkit to restore the minimum flow of the river, restore the wetland, and reimagine industry, not as a drain, but as a partner in resilience. The initiative is a collaborative network of authorities, citizens, and corporations taking collective responsibility for the Humedal making water a shared resource. The Agua Para Todos toolkit includes multi-scalar river-first strategies to restore the agency of the river by stitching together divided lands into cohesive multi-functional spaces.

The proposal also flips the power script to ensure the Aconcagua River gets to flow first, making sustainability not just a memo, but a mandate.Our approach integrates multi-stakeholder partnerships, ensuring a broad and sustainable impact for policy support, infrastructure development, and grassroots activism.

As the strategies get implemented across the valley, the Alliance grows stronger, making each participant an equal stakeholder. The Agua Para Todos project treats the river as a political and legal subject with rights. The project stands in support of the larger national movement to de-privatise water and takes a step forward in rebuilding the flow.





02 | Water Ownership In The Valley

Agriculture dominates the landscape in the valley, using close to 80% of the consumable water available. However, private transactions of water rights are more prevalent, and mining sites pay the highest average amount for individual water rights, even though they own the least percentage. Corporations like ESVAL extract water unchecked and sell it to the urban communities at variable rates.

$3.5MIL-
7MIL/YEAR

As per Ecosystem Services Value, it costs the city upto 70 thousand US dollars per hectare of lost wetland, which is around 3.5 - 7 million US dollars annually.



Agricultural & industrial expansion enroaches on the Humedal land



Arid landscape closer to the urban edge of the Humedal

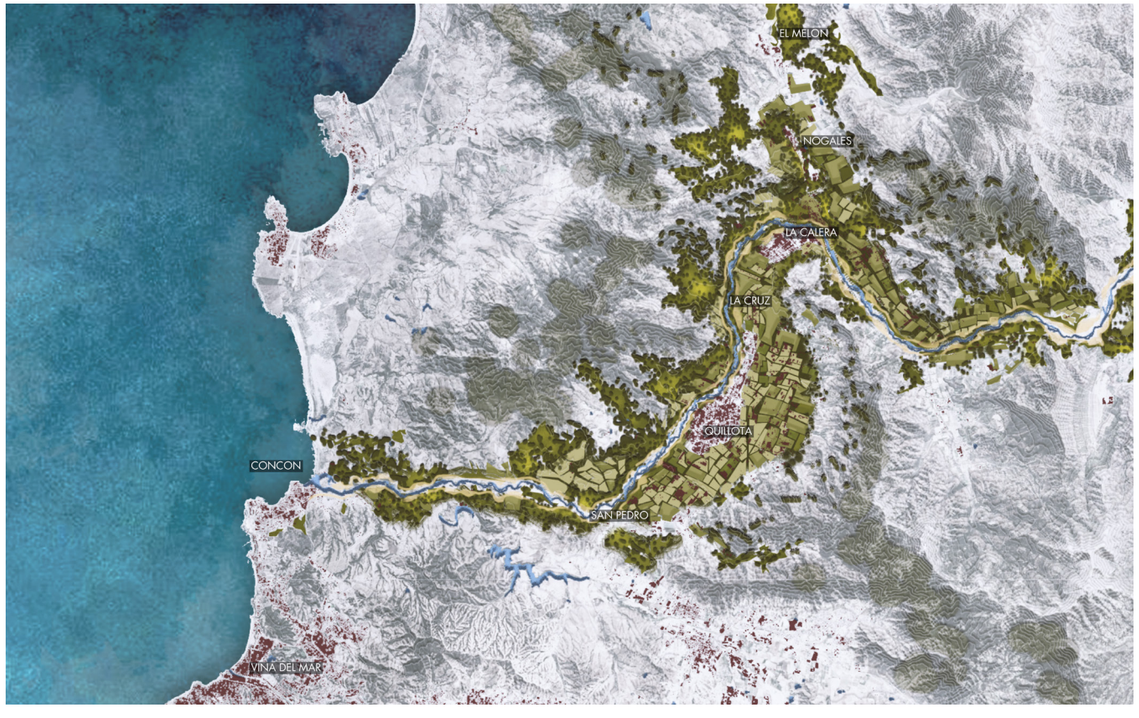


Rivulets of the Aconcagua River remain in the central area of the Humedal



Gated Communities with Rigid Boundaries at the Edge

03 | River Edge Conditions



04 |Valley Alliance Plan

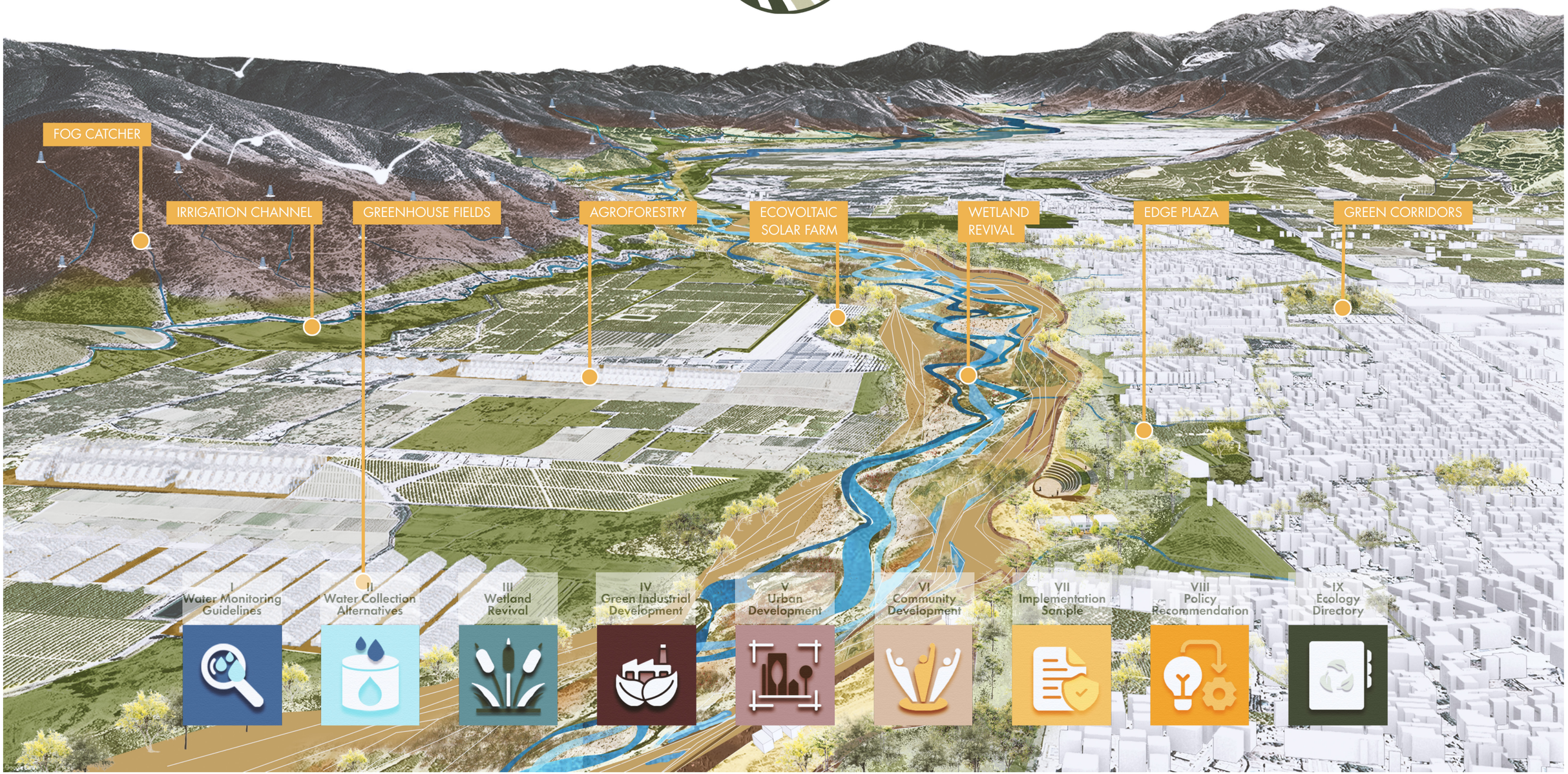
AGUA PARA TODOS

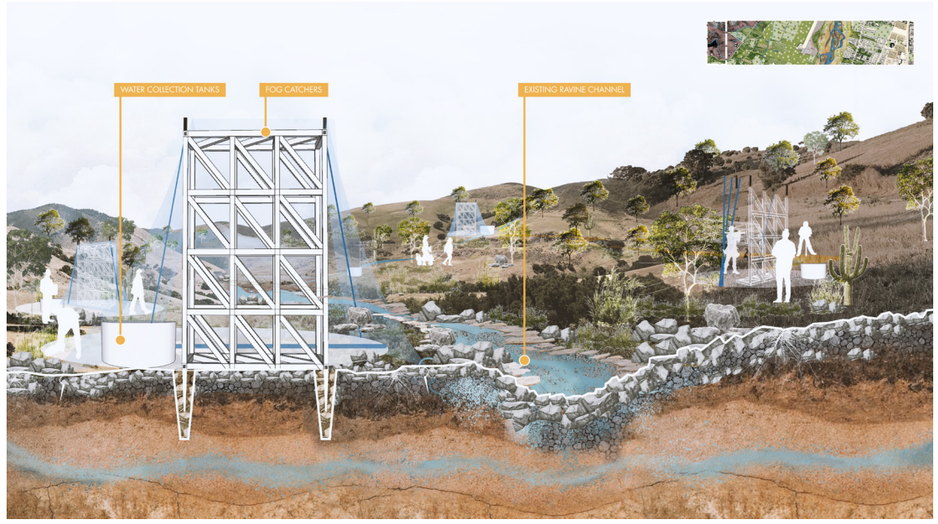
The Agua Para Todos Alliance, a collaborative network of authorities, citizens, and corporations, each takes a collective responsibility for the Humedal at a municipal level to make water a shared resource within their administrative boundaries.



05 | Quillota City Plan

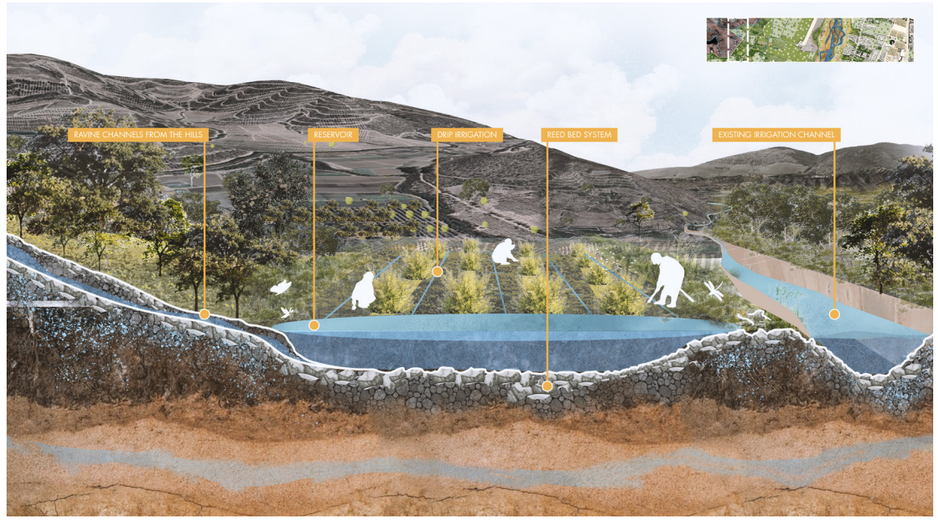
AGUA PARA TODOS





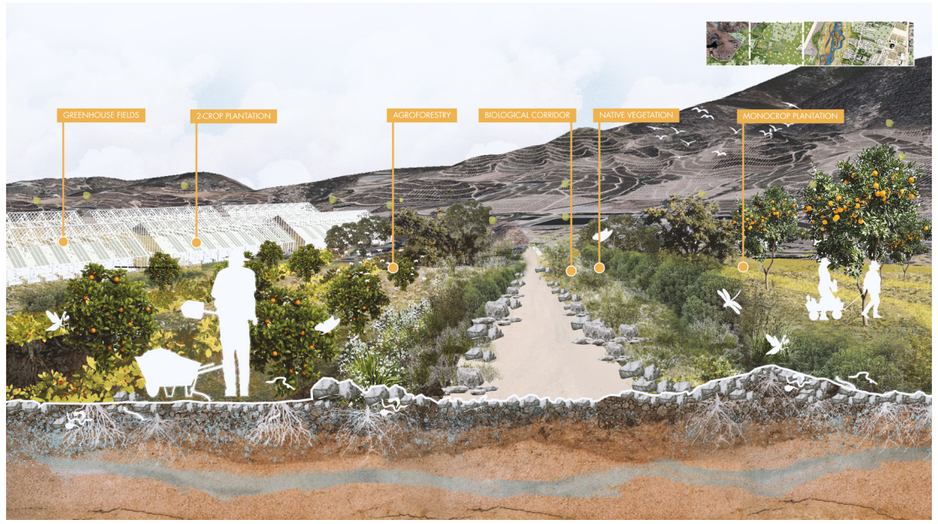
07 | Strategy A: Catching Fog

Fog catcher units located on top of the hills have been designed to produce up to 320 liters of water per day, which may be collected in earthen container pots or directed towards natural ravine channels to flow downhill and recharge the aquifer. The minimal design can be replicated as per demand and built by locals in exchange for social capital credits. The natural ravine channels host native vegetation that can trap additional water from the moisture and help with bioremediation of the channels.



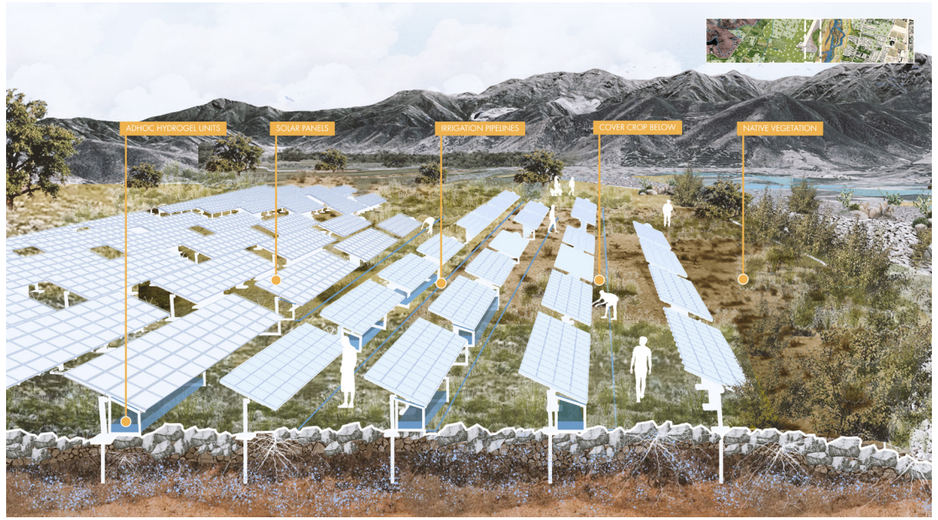
08 | Strategy B: Ravine Irrigation

The water collected is then channelised using the existing irrigation systems at the foothills for agricultural use. The existing reservoir expands to accommodate additional inflow of water and subsequently limits its intake directly from the river. Currently, the reservoir is contained using plastic sheets to avoid percolation. However, we propose a reed bed system underneath the reservoir for slower permeability and a move towards a post-scarcity irrigation network that works in tandem with the natural water cycle.



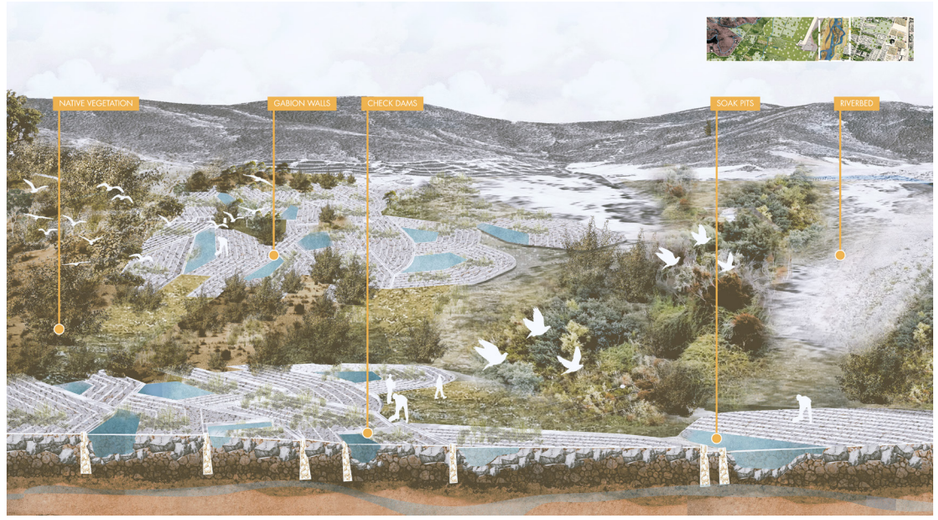
09 | Strategy C: Green Agriculture

Sustainable agricultural practices integrated with agroforestry, strategic crop rotation for soil restoration, hydrogel films for enhanced water retention, and optimised greenhouses to maximize productivity. A biological corridor bordering agricultural fields and irrigation channels enhances wildlife habitats and promotes natural propagation. These practices turn the existing challenges of ecological decline into opportunities for smarter and cleaner innovations in agricultural activities.



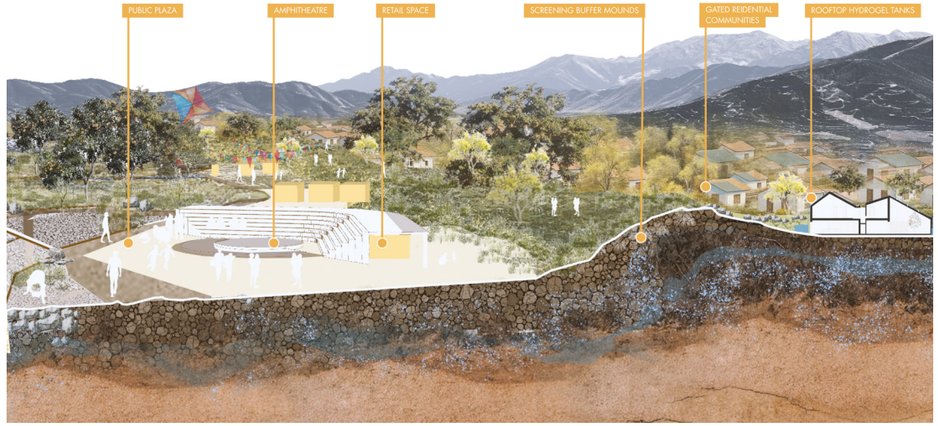
10 | Strategy D: Ecovoltaic Farms

Greener industrial practices extend to the existing solar farm site. With a combination of native vegetation and hydrogel collection units, the solar farm is optimised for greener energy production through eco-voltaic farming. The hydrogel component absorbs water from the air and produces 20 liters per square meter a day. The water collected may be used for irrigation and to regenerate the aquifer. These components also make the solar panels are 9% more efficient by absorbing heat.



11 |Strategy E: Recharge Riverbed

For the main riverbed, the strategies are limited to the edges. With a pattern of check dams, soak pits, and natural landscape, the edges become storage tanks for the river that can contain water during wetter conditions and allow for slower percolation into the groundwater during drier months. Soak pits at the end of the check dams ensure further recharge of aquifers and also create microbiomes for wildlife to thrive on the riverbed.



12 |Strategy F: Urban Edge

At the urban edge, the residential edges are made more permeable by introducing mounds to maintain privacy while bringing a natural landscape as a feature. Anchor nodes are created for daily activation, like amphitheaters, walkways, retail activities, and play areas. These connect to arterial roads leading into the city. These internal networks connect to existing public spaces within the city. Adhoc rooftop Hydrogel Tanks for private residences may help in meeting household water requirements.



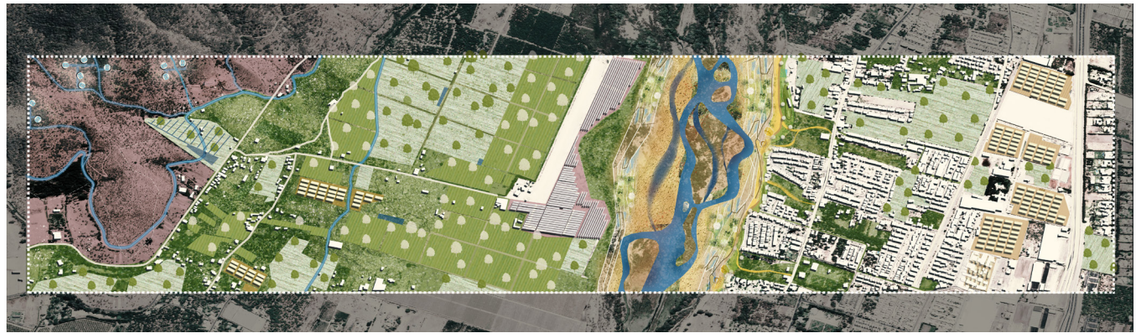
13 | Policy Recommendation

Rather than indefinite water rights, the proposal calls for a fixed period contract for water rights between private organisations and the water authorities. Each revision moves closer to water as a shared public resource.

14| Agua Para Todos Toolkit

The Toolkit poses as a thought starter module that has the potential to engage ecological, political, and social conversations between different cities and communities, forming a Valley-Scale Alliance.





15 | Implementation Sample Plan

CONCON DUNES

ACONCAGUA VALLEY, CHILE

Spatial Visions

CONCON, CHILE

LIVING COAST, BREATHING DUNESCAPE

FROM A ROAD THAT BROKE THE LANDSCAPE TO TRAILS THAT BUILD IT

Bimo Wicaksana / Jiali Jia / Rajiv Ribeiro / Seunghu Kim

WHAT IF THE COASTAL ROAD THAT ONCE BROKE THE LANDSCAPE NOW BUILDS IT?

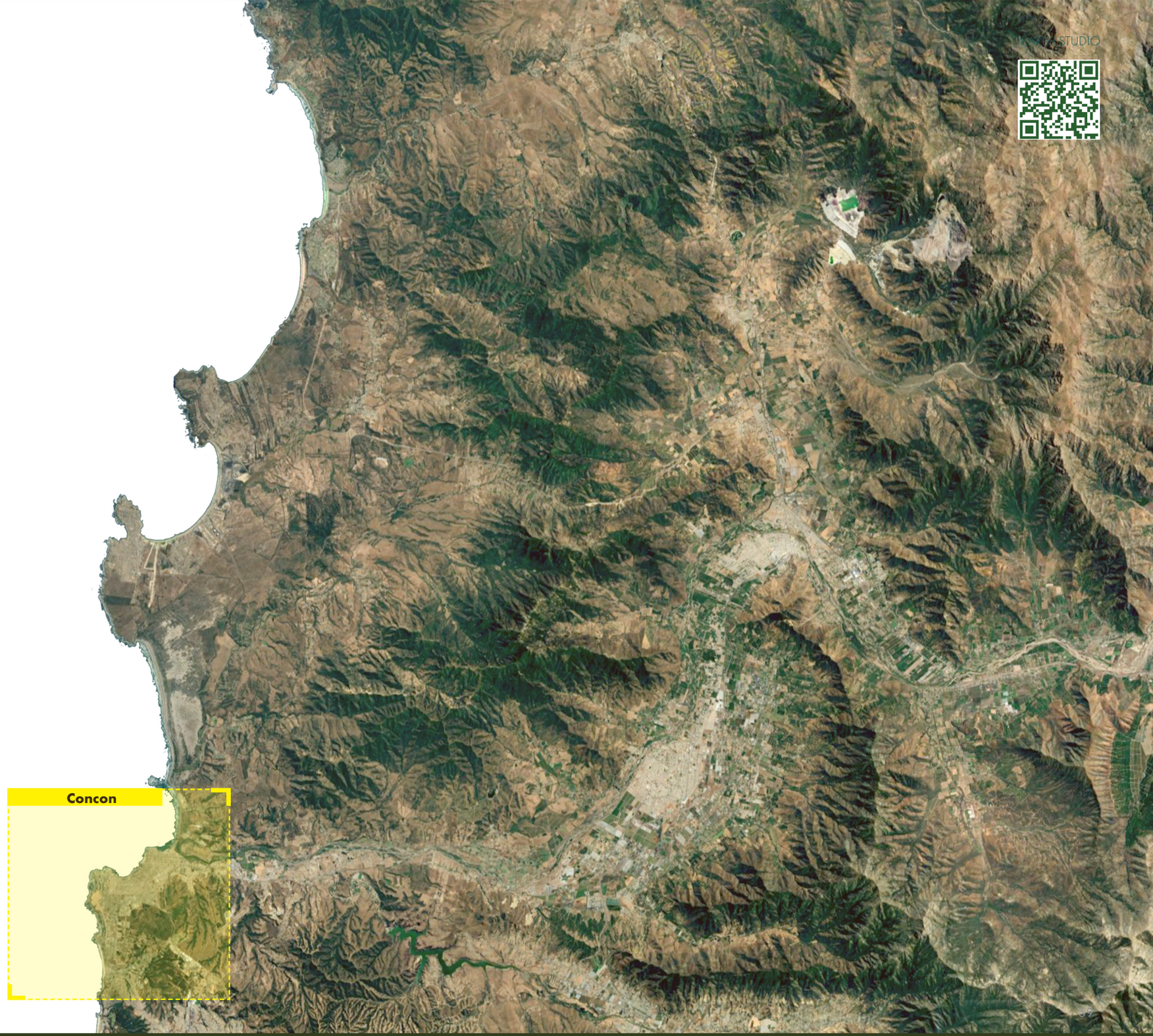
"We believe we are a country, but the truth is we are just a landscape"—Nicanor Parra.

Chile's coastal landscape is sculpted by its volatile political history. Once a vast and continuous geological formation, the coast has been reduced and marginalized by speculative real estate development triggered by the construction of the Concon Coastal Road in 1915. This road catalyzed urban expansion, weakening the coastline and erasing public memory of its ecological value.

Protecting the weakened coast against climate challenges require a fundamental paradigm shift. What if the act of unmaking become the genesis of change? What if boundaries connect instead of separate? The project aims to transform the same road that fragmented the landscape into a trail and park system that reconnects and regenerates it. This trail will re-purpose abandoned buildings into public spaces, integrate nature education elements, and foster biodiversity through protected no-go zones.

The project begins at Concon Dune where urbanisation has isolated the fossil dune and disconnected it from the city. Through the process of rezoning, the project will re-strategize development away from ecologically sensitive zones and blur the boundary between, the dune and the coastal road. The coastal road will become a park that replenishes the dunes and becomes a public space for the citizens of Concon.

The project will enable equitable socioeconomic dynamic including inclusive urban nodes, shared pathways, and better job opportunities. The creation of a consortium between municipalities, private entities, and local communities will ensure economic and political sustainability through public-private partnership, integrated maintenance framework, and routine community engagement.

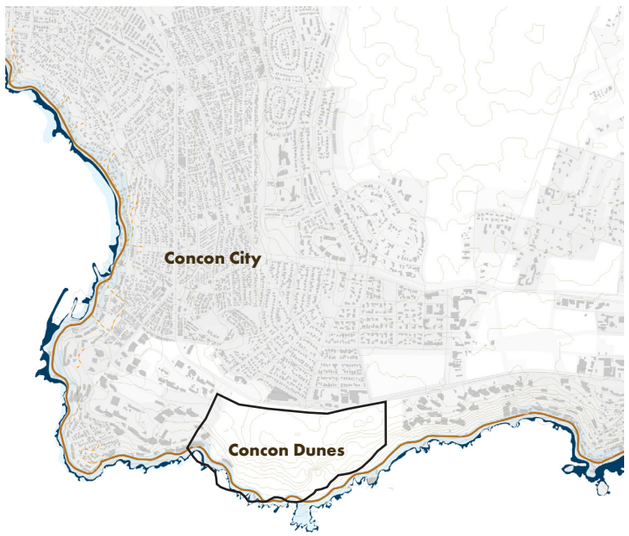












01 | The Fragmented Coast

The Pressure of Motorized Vehicles

The introduction of cars a the primary mode of transportation in Chile created an opportunity to connect the connection the cities of Valparaiso and Concon. However, the construction of coastal road disrupted the natural landscape, drawing a harsh line through the environment.

Coastal roads became a catalyst for urban expansion, bringing massive real estate pressure to destroy Chile's coast line. Over time, it slowly consumed nature particularly affecting Concon City and the hanging dune. In light of the global climate crisis, the vulnerable coastal environment, already disrupted by the road, now demands urgent attention.



1919

15km coastal roads was built to connect resorts in Vina del Mar to Concon city.



1976

New coastal road became a catalyst for urban expansion, consuming dunes with luxury second-home apartments.



2017

The lack of protection resulted a poor edge condition, threatening the dune's function as a coastal defense.



2025

A paradigm shift, closure of coastal road became catalyst to living coast and free dunes to benefit the entire coast.



2070

Transformation of surrounding road and abandoned buildings protects the remaining dune.



2100

The initiative rippled out to the entire coast of Chile, creating a coastal network for resilience and recreation.



Coastal Trail

The Coastal Trail runs through a series of scenic nodes along the shoreline. It also acts as a key interface, reconnecting the dunes with the coastline.



‘Sanday’ Trail

The Sanday Trail primarily connects the city with the dune landscape. Here, we focus more on creating interactive landmarks and public play space, like the Sand Catcher.



Biodiversity Trail

Biodiversity education trail that follows natural contours and no-go zones, gently leading people to wildlife and scenic points like a nature park journey through the dunes.

02 | Coastal Braces

Zooming out, Concón city itself will have a network of experiences—connecting its unique dunescape, Roca Oceánica, and the dismantled coastal road—to weave the city back into the coastal landscape.

The intervention in this pilot project will serve as a spark for change, with its impact rippling along the central coast to neighboring territories such as the Concón estuary, home to a remarkable nature sanctuary, and the Ritoque dunes, offering a distinct experience that blends forests, dunes, and beaches.

This transformation continues to places like Ventanas, shaped by its post-industrial landscape, and Valparaíso, known for its vibrant sense of urban escapism.



03 | A Paradigm Shift

The Coastal Trail runs through a series of scenic nodes along the shoreline. It also acts as a key interface, reconnecting the dunes with the coastline.

Along the trail, we reused the exist vacant coastal buildings. By removing their solid walls, we transformed them into layered platforms for viewing and public activities.

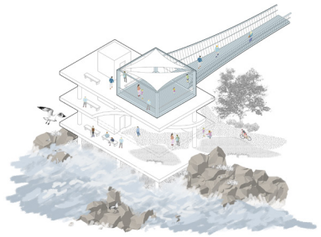
A bridge on the rooftop connects the dune summit with the coast. The closure of the road will enable nature to grow back and will create a place to enjoy coastal views, outdoor activities or just take a stroll. Native vegetation, sand berms and seaside ponds will protect against the ever more frequent storm surges and circulation between dunes and costal park is seamless, creating a vibrant coastal life that integrates the coast and the dune.



1 Boardwalk



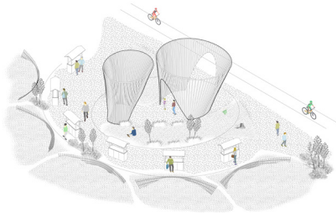
2 Buggy



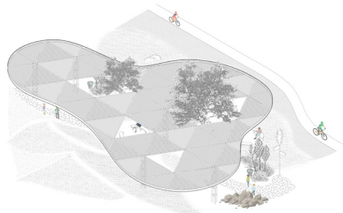
3 Building



4 No-Go Fences



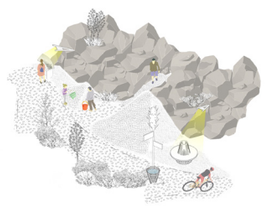
5 Landmark



6 Pavillion



7 Inter-Tidal Pond



8 'Sanday'



9 Sand Catcher



10 Seating



11 Viewpoint



12 Walkway



“We believe we are a country, but the truth is we are just a landscape” - Nicanor Parra

ACONCAGUA VALLEY & QUINTERO BAY, CHILE

CONCON ESTUARY

ACONCAGUA VALLEY, CHILE

Spatial Visions

ACONCAGUA VALLEY, CHILE

REIMAGINING CONCON ESTUARY

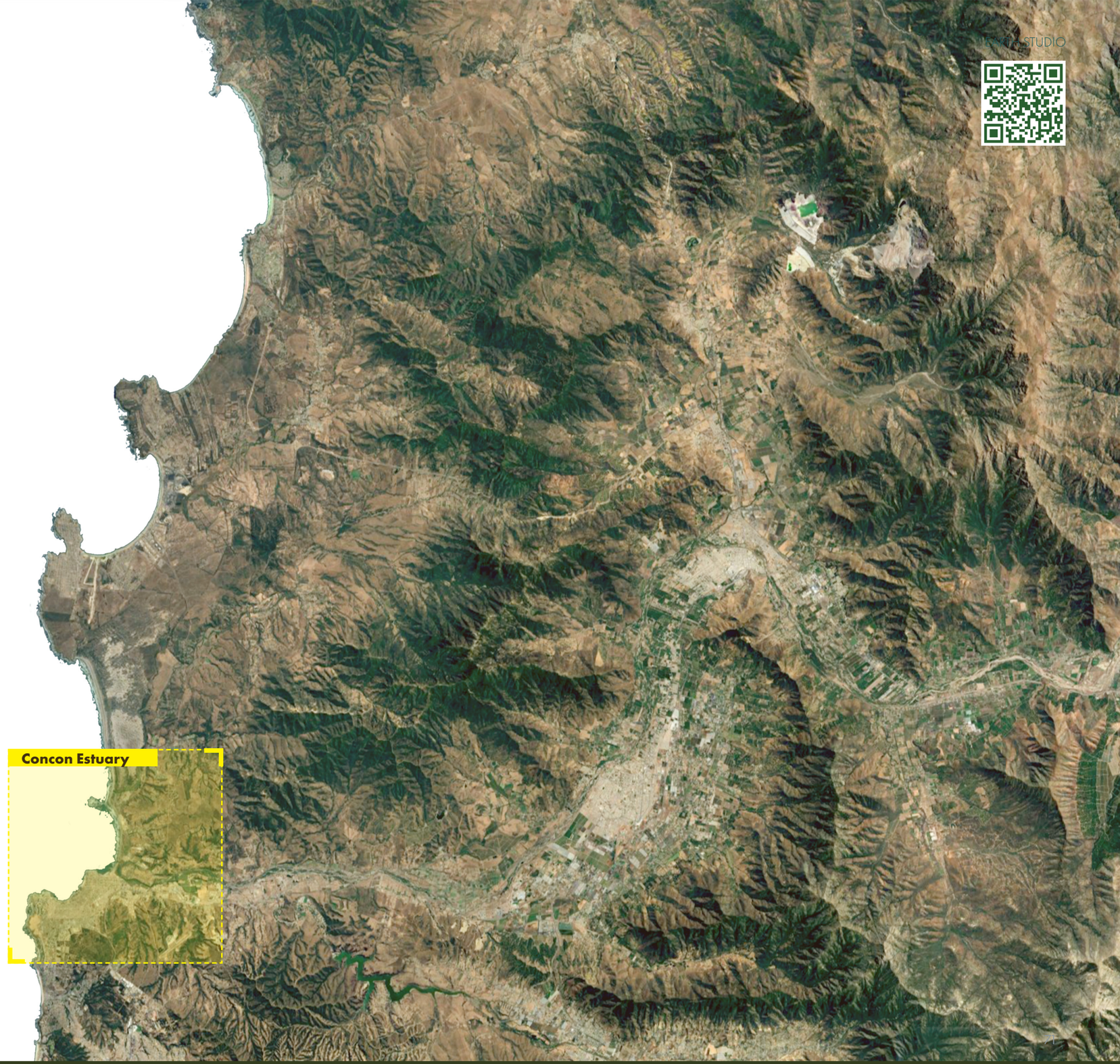
RECLAIMING CONCON WITH COMMUNITY-LED CATALYSTS

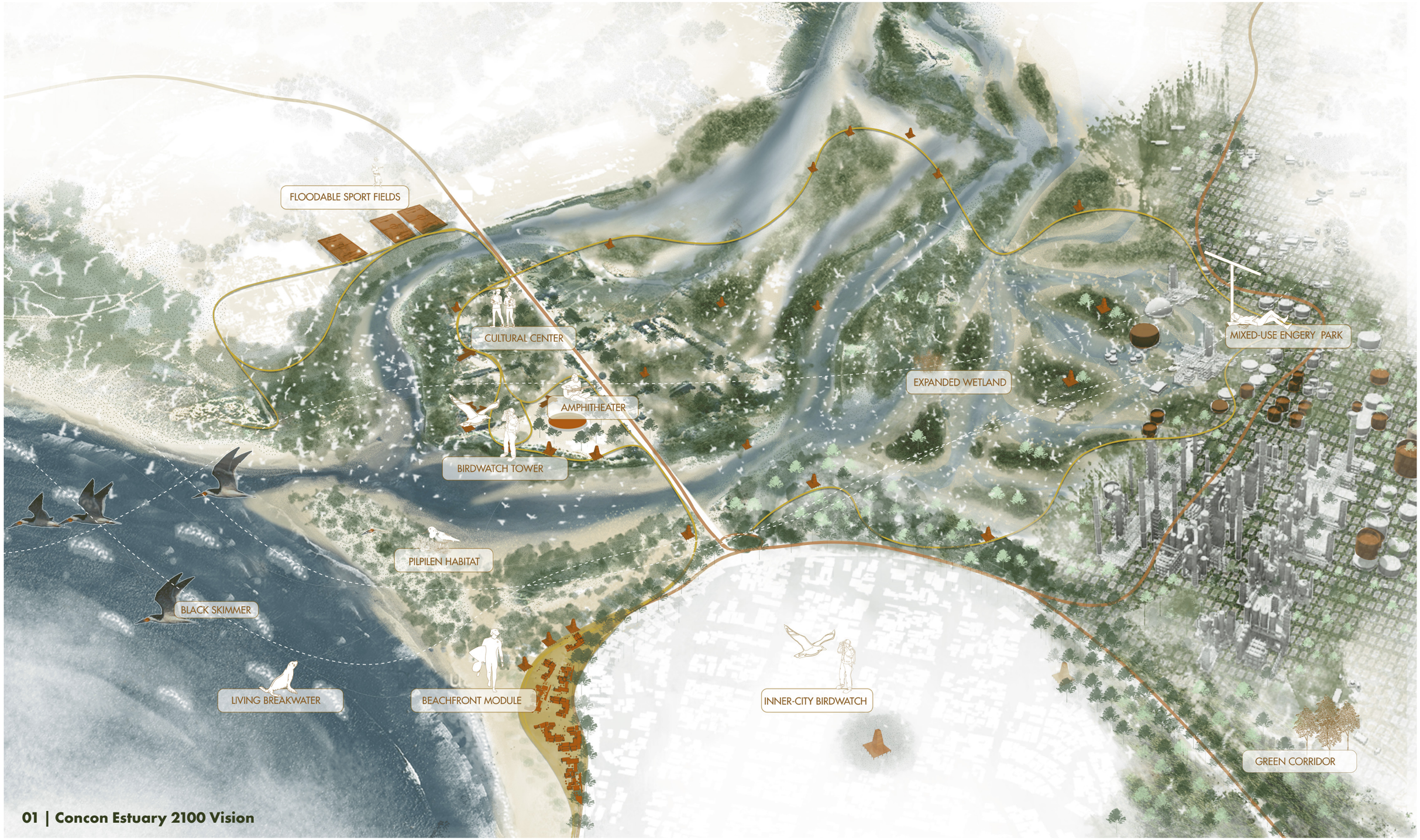
Mutita Ouk / Vicky Sindac / Daisy Castro / Qingyi Gan

WHAT IF THE CONCON ESTUARY AND THE SURROUNDING WETLAND ECOSYSTEM WERE RESTORED TO ENHANCE THE WELLBEING OF LOCAL FLORA, FAUNA, AND COMMUNITY?

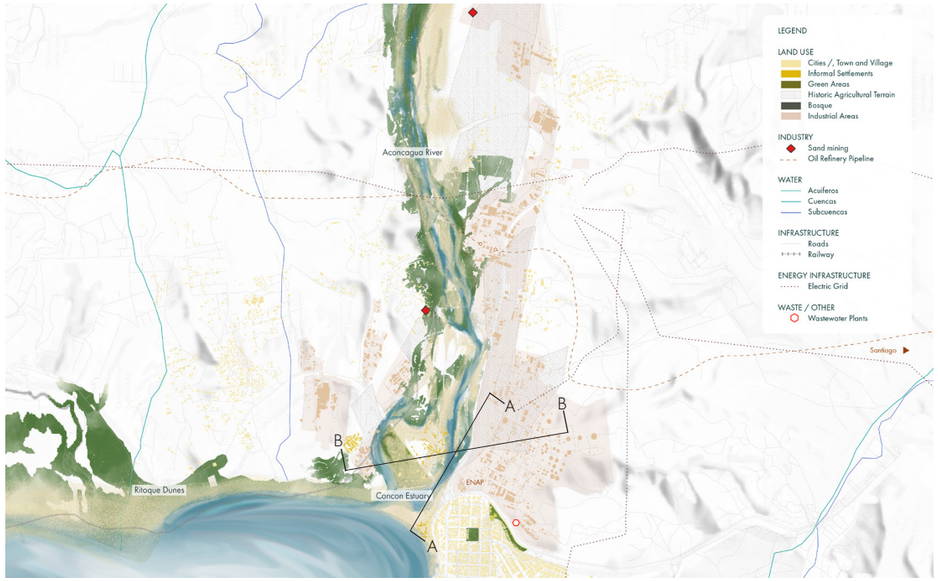
The Concon Estuary, located in the coastal region of Valparaiso, Chile, is a vital transitional zone between the Aconcagua River and the Pacific Ocean. It boasts rich biodiversity and a dynamic landscape that constantly changes throughout the days, seasons and years– where river meanders, ocean tides fluctuate, sediment flows, and birds are free to come and go. However, human activities, including urban development, pollution from the ENAP oil refinery, the Asfalcom cement factory, sand mining, waste dumping, and unregulated recreational activities, have placed significant pressure on the ecosystem. This constant resource extraction and exploitation has led to more frequent and intense storm surges, increased flood risks due to rising sea levels, habitat loss, saltwater intrusion, shifting river course and unregulated activities.

ENAP, the primary polluter, contributes little to the local economy. Locals rely on small businesses along the beach that are poorly constructed and are exposed to flood risks due to the abrupt transition between the coastline and urban area. Given Chile's policy goals of replacing fossil fuels with renewable energy and the risk of sea level rise, we envision a future where ENAP is gradually phased out, paving the way for sustainable energy sources. Throughout this transition, the existing industrial structures and operations will be integrated into the design process to mitigate pollution and environmental impacts. Additionally, sand mining will be banned to facilitate the regeneration of the wetland ecosystem and restore its natural space. This will also create new job opportunities, supporting a more resilient and sustainable way of life for the community.

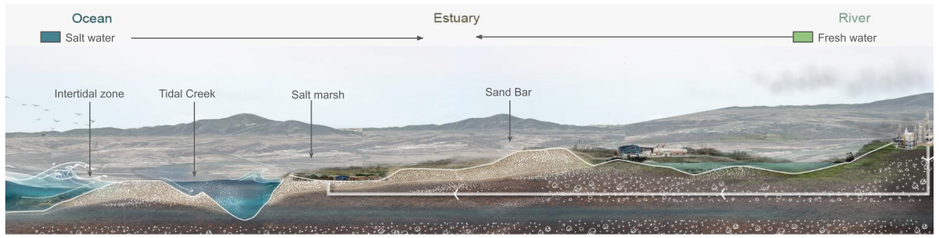




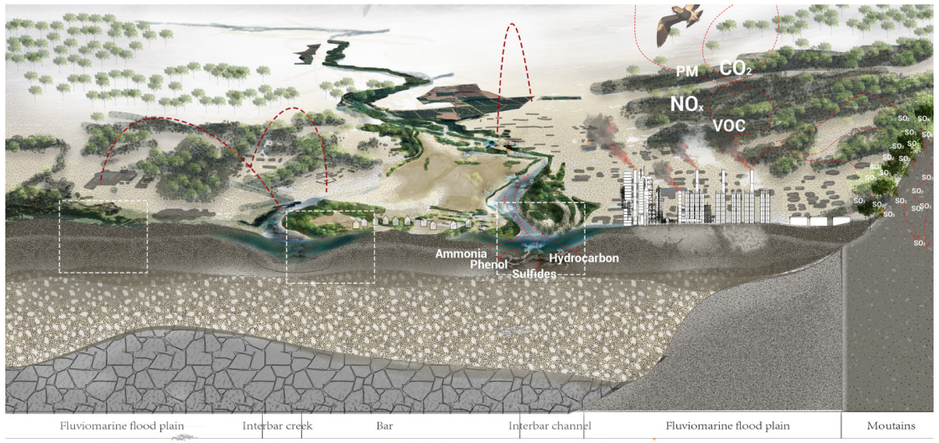
01 | Concon Estuary 2100 Vision



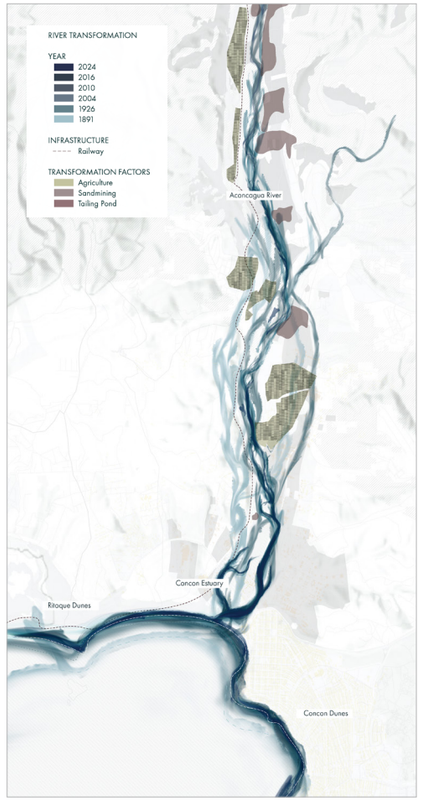
02 | Mapping Human Activities in Dynamic Estuarine Landscape



03 | Transect AA



04 | Transect BB



05 | River Meander And Coastal Erosion (1891-2025)

RESTORE

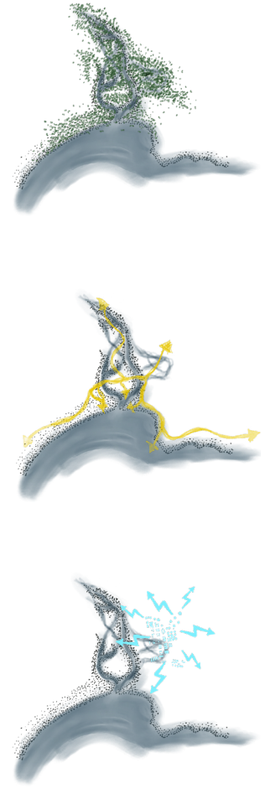
Restore the river's space along with its wetlands, bird and marine habitats; improve salinity gradients, and remediate pollution to support a healthier and more resilient ecosystem.

RECONNECT

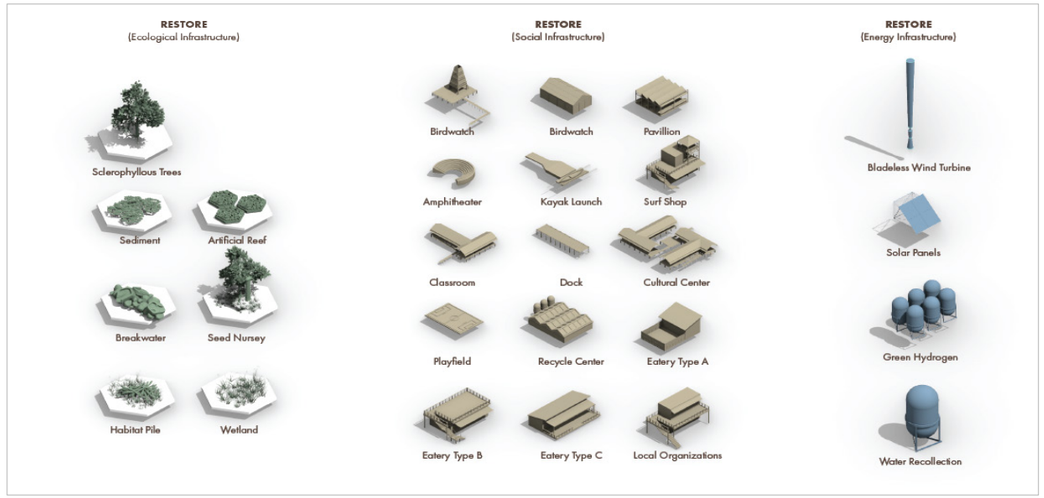
Reconnect the urban areas with nature through educational programming, sustainable recreational opportunities, and proper zoning and environmental regulations.

RENEW

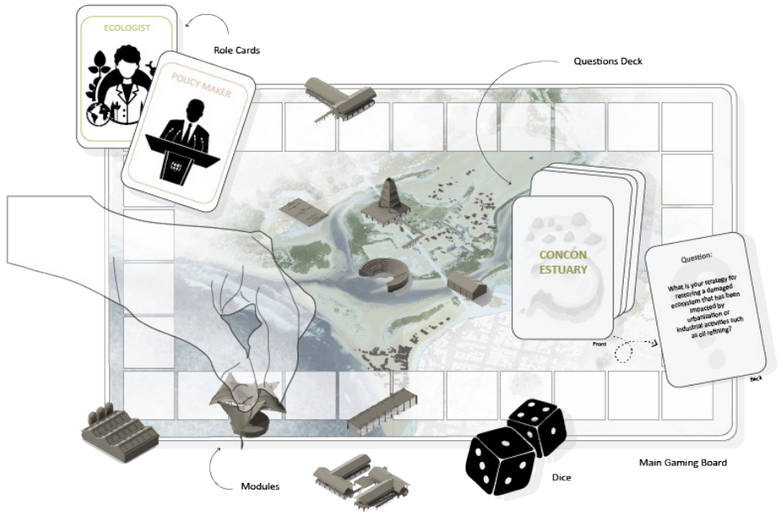
Renew energy sources and revitalize the economy through the creation of green jobs and the adaptive reuse of existing infrastructure.

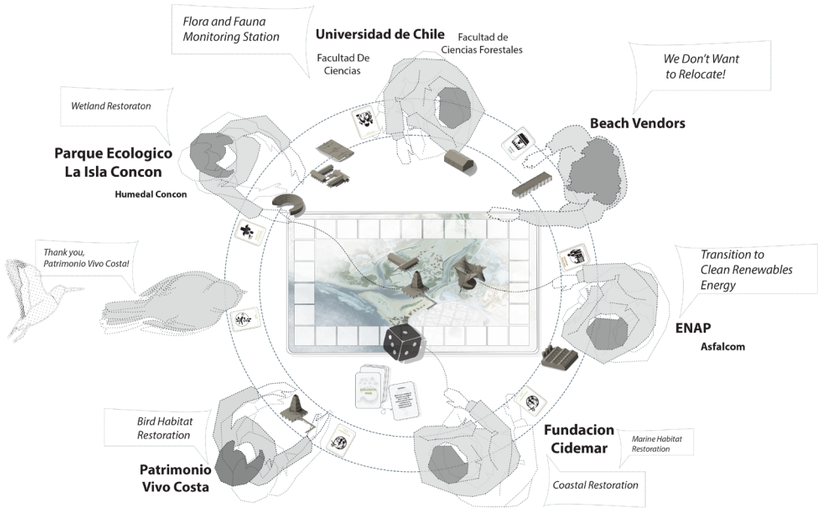


06 | Design Framework



07 | Catalyst Modules: Transitional Multi-functional Urban Acupunctures



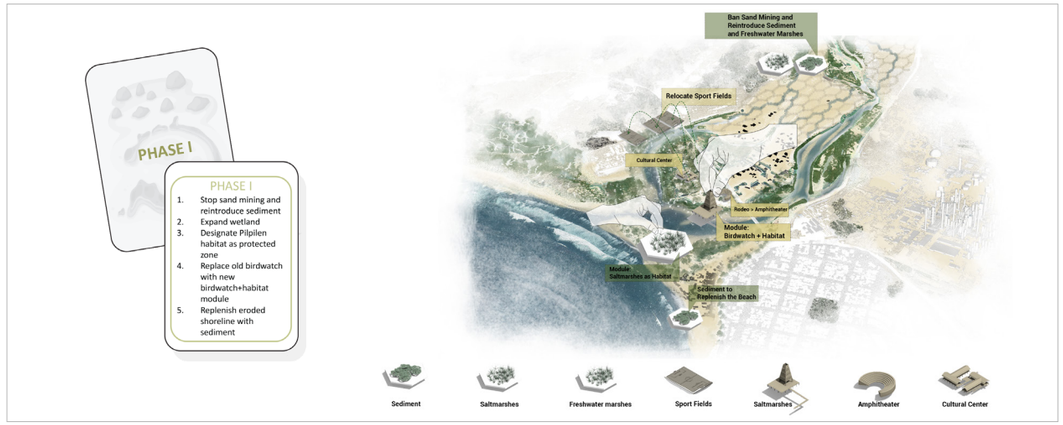


The Catalyst Modules, envisioned as units of change, embody flexibility, adapting to different combinations of activities and evolving needs across different times of day, season, and years.

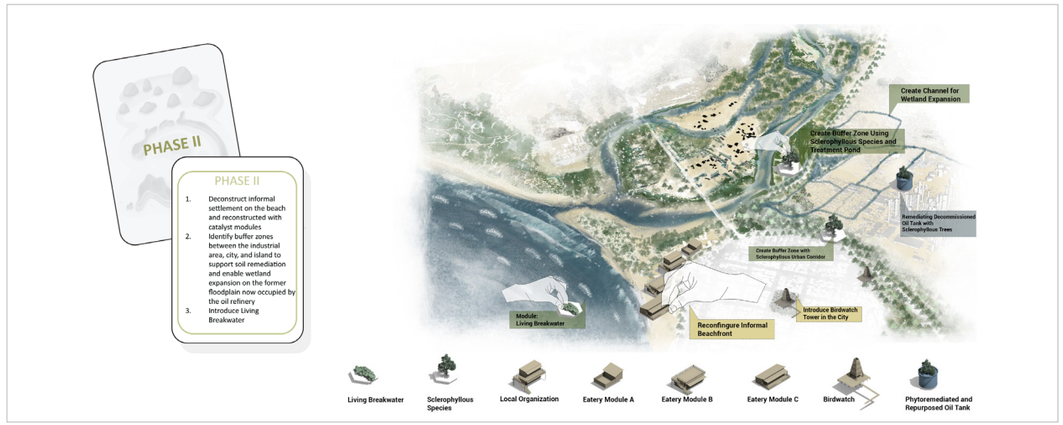
The participatory game is designed to actively engage communities in reimagining the Concon Estuary. It mimics a roundtable process by inviting players to take on roles like beach vendors, oil workers, or birdwatchers and potential key stakeholders and navigate real-life challenges facing the Concón Estuary. Through playful decisions and "Catalyst Modules," players collaborate, argue, and imagine how to balance human and ecological needs.

There's no single winner—only a shared goal of building a thriving future for both people and nature.

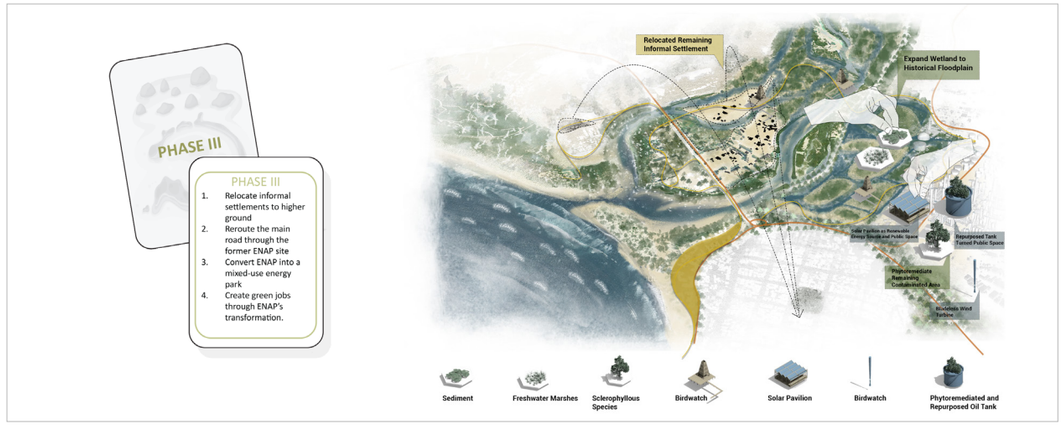
08| Catalyst Modules Board Game: A Community Engagement Tool



09 | Phase I: 2025-2035



10 | Phase II: 2035-2050



11 | Phase III: 2050-2100



12 | Ecological Park: Bird Habitat And Wetland Restoration



13 | Concon Beach: Redefining The Informal Business Ecologies



14 | Oil Refinery: Energy Landscape As Public Space

EL MELON

NOGALES

ACONCAGUA VALLEY, CHILE

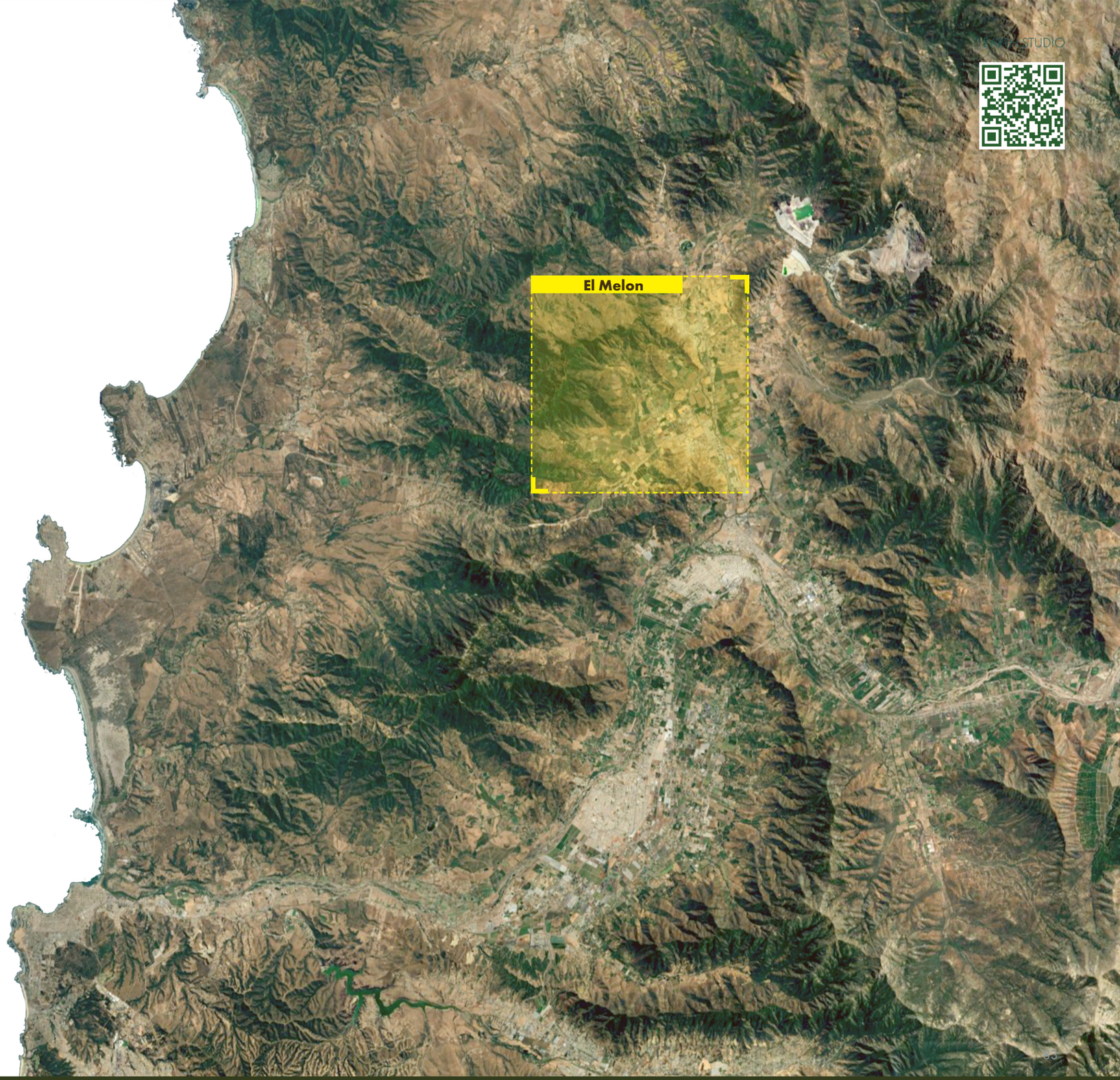
Spatial Visions

ACONCAGUA VALLEY, CHILE

THE NOGALES VALLEY ALLIANCE

A REGENERATIVE FRAMEWORK FOR POST-MINING FUTURES

Tanvi Ashok / Anirudh Bopanna Iychettira / Bing Li / Chih Hao Liu

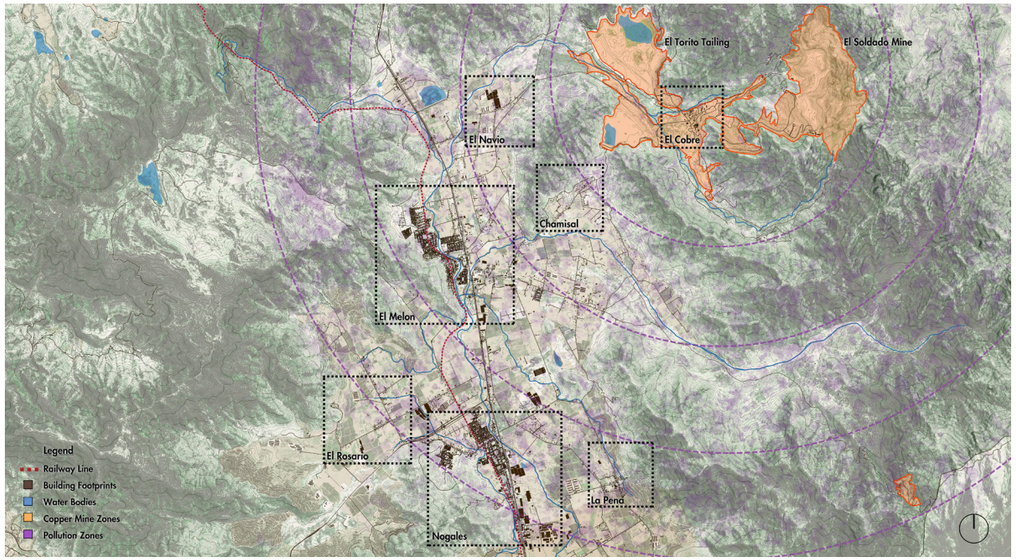


WHAT IF A COMMUNITY-LED ALLIANCE SHAPED A MINE'S CLOSURE PLAN, TURNING A HISTORY OF EXTRACTION INTO A FUTURE OF REPAIR?

Towns like El Melon situated in the Nogales Commune stand at a pivotal moment, where stronger regional communication offers a path toward unity. Shaped by industrial mining, voices from Anglo American and local activists reflect the region's dual narratives. The mining company, Anglo American emphasizes its role in employment, reforestation, and sustainable mining, while communities call for deeper engagement on social and environmental concerns.

Despite pollution, water scarcity, and desertification, momentum is growing to turn these challenges into opportunities for renewal. Even with the potential closure of the El Soldado mine in 2037, its legacy demands urgent attention through strategic regional intervention. Rather than leaving behind obsolete infrastructure, this transition can prioritize long-term community resilience and ecological restoration.

Imagine the Nogales Commune uniting with Anglo American through the Nogales Valley Alliance (NVA), forming a coalition to champion water justice, ecological renewal, and economic reinvention. Through a Community Benefits Agreement, conservation efforts could gain new grant access, supporting environmental monitoring, citizen science, workforce retraining, and restored water access. The commune could leverage these partnerships to transform the Nogales Valley into a model of sustainable post mining development, led by and for its communities.



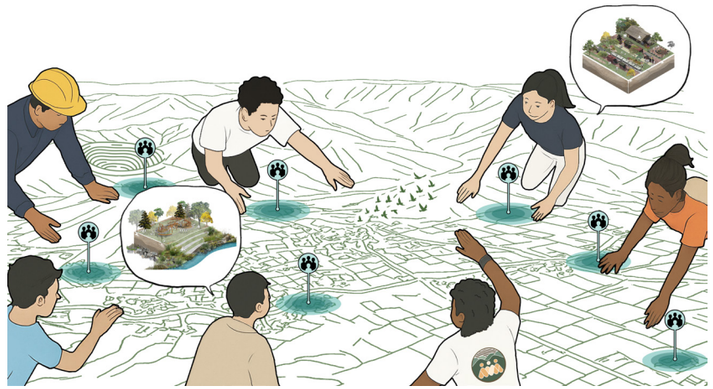
01 | Pollution, Environmental Degradation, and the Legacy of Mining

Decades of copper extraction at Anglo American's El Soldado mine have polluted the environment, drained water resources, and worsened desertification, deepening social and ecological divides. The Nogales commune must bear these burdens for now, but a unified alliance can confront these challenges and empower them to shape the future.



02 | The Nogales Valley Alliance: Strategies for a Nature-Based Restorative Economy

EARLY ACTION STRATEGIES | 2025-2037



03 | Formal Establishment

The foundation of the NVA begins with establishing neighborhood councils in smaller towns. These councils will empower local voices to shape decision-making from the outset, ensuring that the framework and goals of the alliance are grounded in community needs and led by those most affected.



04 | Spreading Awareness

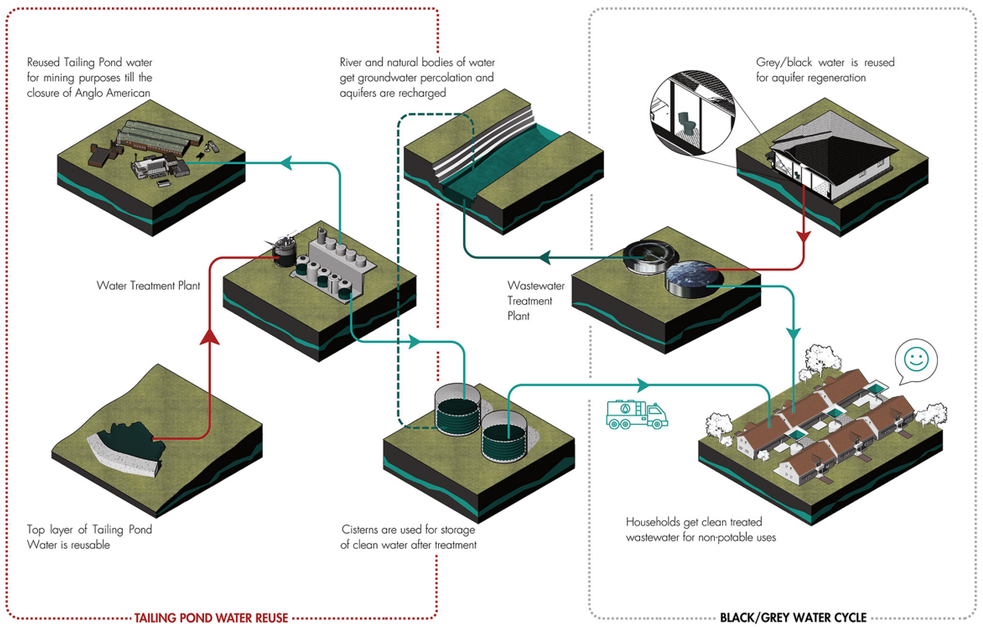
Gathering spaces will become sites for ongoing community dialogue. These public areas will host regular discussions and pollution data from local monitors are displayed openly. Transparent communication will help build collective awareness, trust, and accountability across the community.



05 | Vocational Pathways

Existing public activators will serve as vocational training centers, host vaccination drives and health checkups. This will improve public health resilience and create economic opportunities in green industries, creating a workforce prepared for environmental and social challenges.

IMPLEMENTATION STRATEGIES | 2037-2050



06 | Reducing Groundwater Dependence Through Circular Water Use

Water from the tailing ponds will be treated and reused within the mine, easing pressure on local groundwater. At the household level, a decentralized treatment plant in Nogales, will enable greywater recycling, supporting daily use while helping to recharge the aquifer. Small-scale rainwater harvesting will also provide a valuable supplementary source.

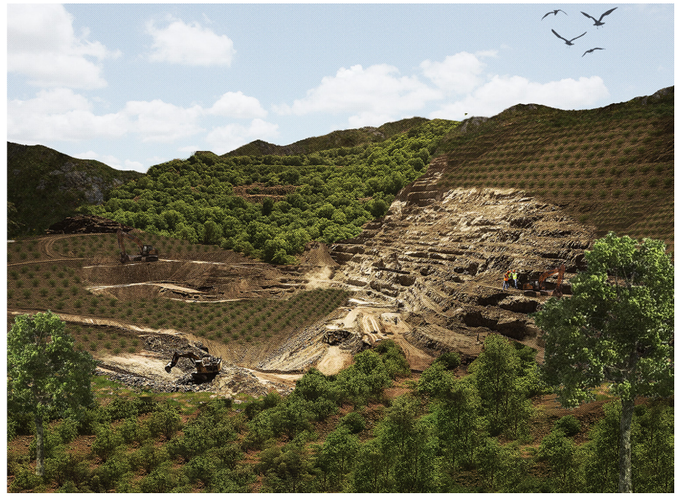


10 | Revitalizing The River As A Thread Between Communities

Initial excavations will improve water retention, create habitats, and remove invasive plants. Native riparian vegetation will be restored, with the riverbed functioning as a wetland in dry seasons and returning to its natural flow in wet seasons, allowing the aquifer to recharge over time. The NVA will define a native plant palette to support this restoration.



07 | Phase 1: Phytoremediation of Hills Surrounding The Mine



08 | Phase 2: Phytoremediation of Land Mine Land Post-Closure



09 | Phase 3: Mine Transformation And Solar Grid Development

LONG-TERM RESTORATION STRATEGIES | 2050-2070+





11 | Cultural Center/Light Rail

The restored railway will help reconnect the towns. Copper slag will support infrastructure, while the cultural center and museum celebrate heritage and craftsmanship. The bike network will further enhance connectivity.



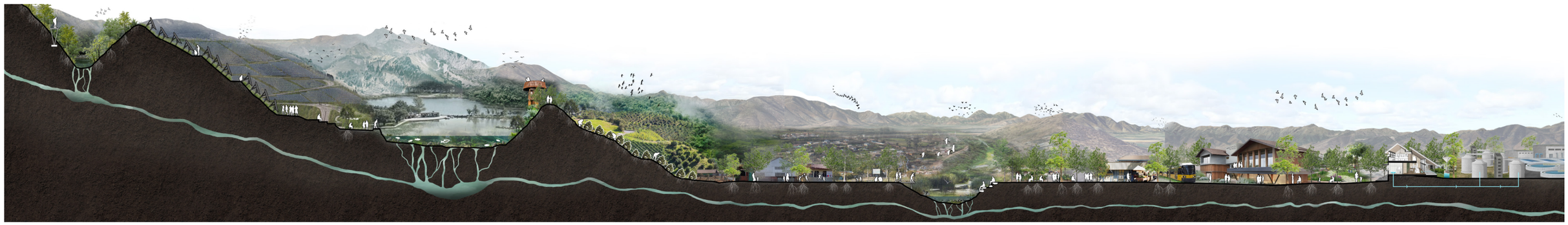


12 | Tailing Pond Restoration

The tailing pond will transform, featuring hyperaccumulator plantings, viewpoints, and eco-trails. El Cobre's current identity as a mining town will shift as former structures are repurposed into visitor centers, maintenance hubs, and rest points, supporting tourism and stewardship.



14 | Restoring Access to the Mountain Trails



13 | Weaving Interventions for a Holistic Transformation of the Nogales Valley



15 | Uniting Communities, Nature, and Industry For A Shared Future







16 | The Nogales Eco-Valley Tourism Experience

The transformation through the NVA will lay the foundation for the Nogales Eco-Valley Tourism Experience, guiding visitors through interconnected transit systems, ecological corridors, and mountain trails through the region.

By strengthening connections between people and nature, the NVA aims to shape a new shared future for Nogales. As many mines across Chile approach closure, Nogales has the opportunity to set a national precedent by showing how Anglo American's responsible transition can become a model for sustainable post mining development across the country.

At its core, the NVA is a framework for regeneration — not only of landscapes, but of relationships, of economies, and of a collective identity.

QUINTERO BAY

ACONCAGUA VALLEY, CHILE

Spatial Visions

ACONCAGUA VALLEY, CHILE

H.E.A.L QUINTERO

RESTORING HEALTH, ENVIRONMENT, ACCESS AND LIVABILITY

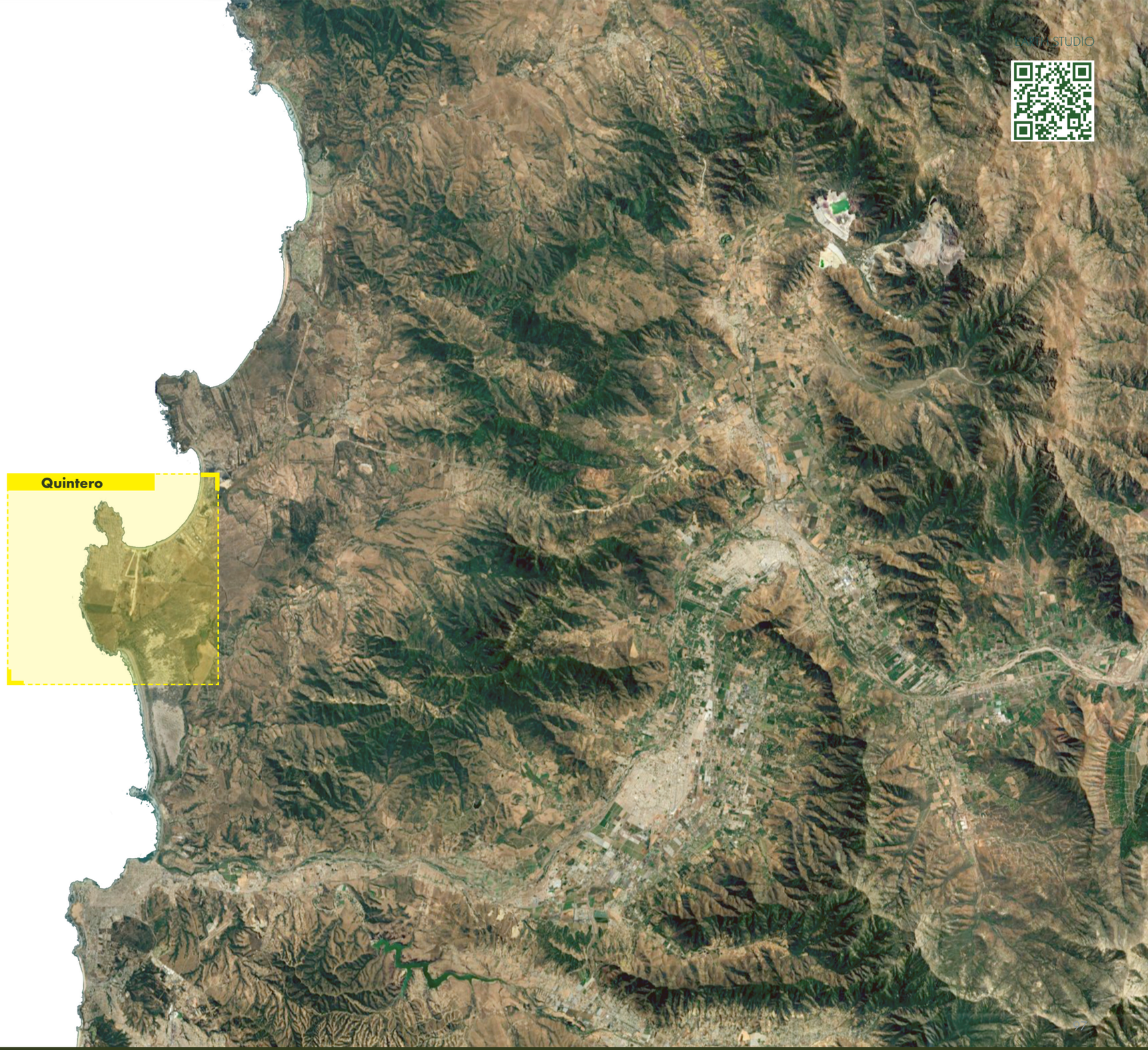
In Hwangbo / Chaeyoon Lee/ Yi Lu / Rachana Thokala

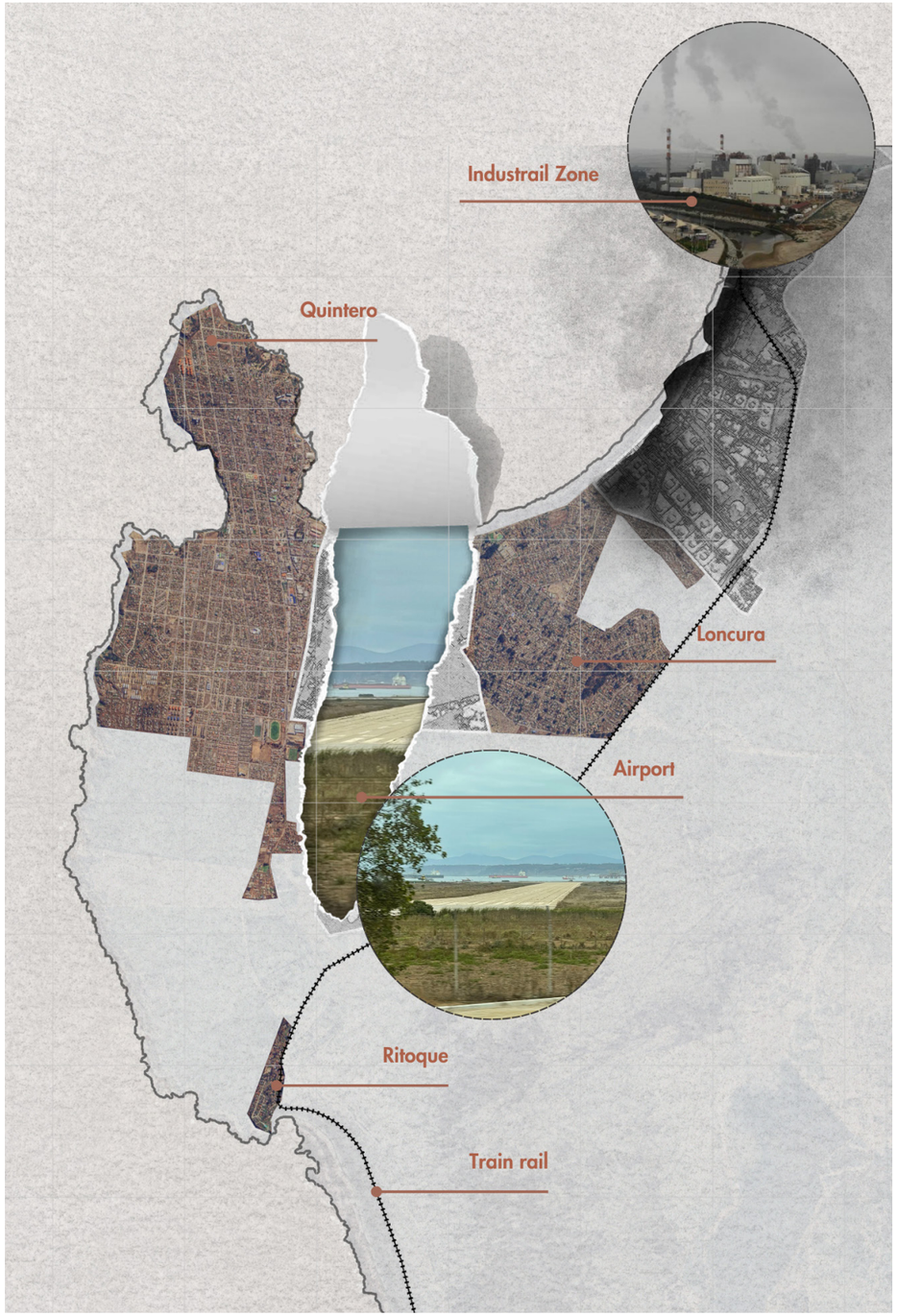
WHAT IF WE CONNECT THE DIVERSE COMMUNITIES OF QUINTERO BY RESTORING ECOLOGICAL ASSETS, ECONOMIC OPPORTUNITIES, IDENTITIES, AND HOPE?

Quintero, once a vibrant coastal town in Chile, now faces severe challenges stemming from pollution, ecological degradation, and social inequality brought by industrial expansion issues that are expected to worsen with future urban development. This proposal imagines a regenerative future by connecting the splintered landscapes of Quintero, Loncura, and Ritoque through ecological restoration and creating inclusive, resilient urban and social infrastructure. It proposes a shift from a sacrifice zone to a model of coexistence and thriving between people, nature, and the economy.

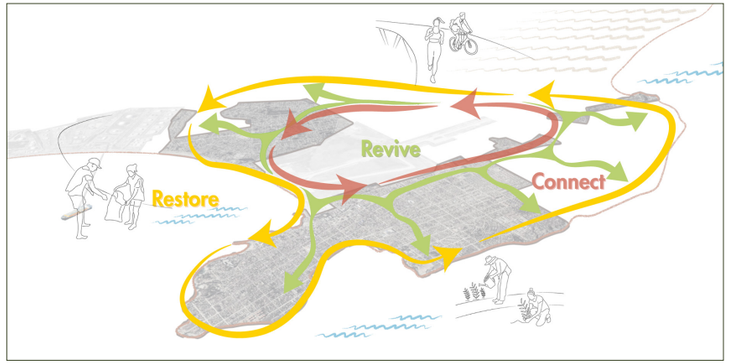
According to interviews with local municipality members and organizations, pollution has severely impacted agriculture, fishing, and tourism in Quintero, contributing to population decline and a worsening ecological and economic situation. This crisis is further deepened by mistrust and a lack of communication between industrial companies, community members, and the Quintero municipality.

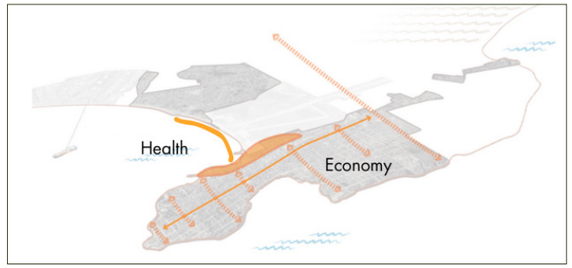
Our strategy proposes a multi-scalar, phased approach co-developed with and for the local communities -- including fishers, women activists, surfers, and municipal workers while also engaging external stakeholders such as ecologists, developers, policymakers, international institutions (UNDP, World Bank), and industrial companies (GNL, Copec..). Through this collaboration, the project envisions a future where all stakeholders can coexist and thrive in a mutually beneficial way. To ensure this vision is realized, we will also propose policies that would mandate industrial companies to implement and financially contribute to programs that benefit the communities they impact.



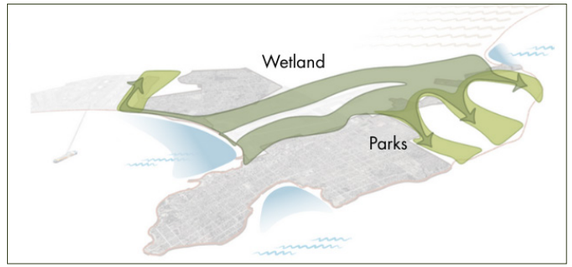


01 | Poor relationship between Quintero and its neighboring communities

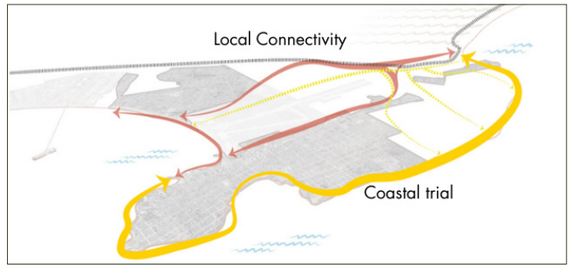




Restore Quintero Community



Revive Ecological Assets



Connect Diverse Communities

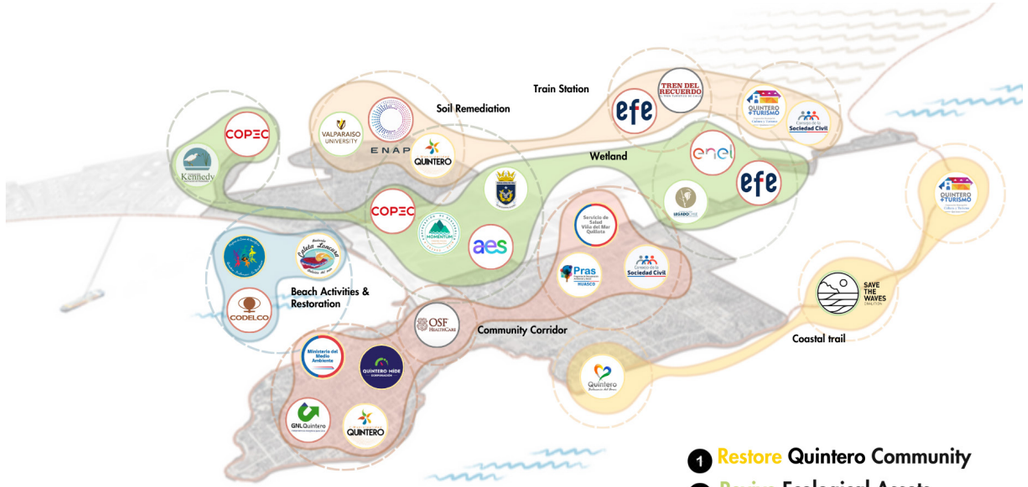
02 | Vision

The vision is to connect and empower Quintero by addressing its most pressing challenges. Through a unified approach built on three pillars Restore, Revive, and Connect. This will breathe new hope fostering a vibrant, resilient, and inclusive future for the region.

03 | Strategies

Quintero's transformation begins by restoring economic opportunities, reviving ecological assets, and connecting its diverse communities. Each of these goals is deeply interconnected. Progress in one area supports and strengthens the others, creating a holistic path forward. The strategic plan outlines targeted interventions across key zones: a Community Corridor to foster social and commercial activity; Wetland Trails that promote environmental education and ecotourism and Coastal Trails that reconnect people with the shoreline. Together, these initiatives form a cohesive, place based strategy to empower and renew Quintero.


Proposed Train Station
Soil Remediation
Wetland Trail
Heavy Industry Area
Airbase
Beach Activities & Restoration
Coastal Trail
Community Corridor
Ecological Assets
Train Station
Tour Spot
School
Community Market
Clinic
Fishing Industry
Plaza
Hotel
Park
Restaurant



1 Restore Quintero Community
2 Revive Ecological Assets
3 Connect Diverse Communities

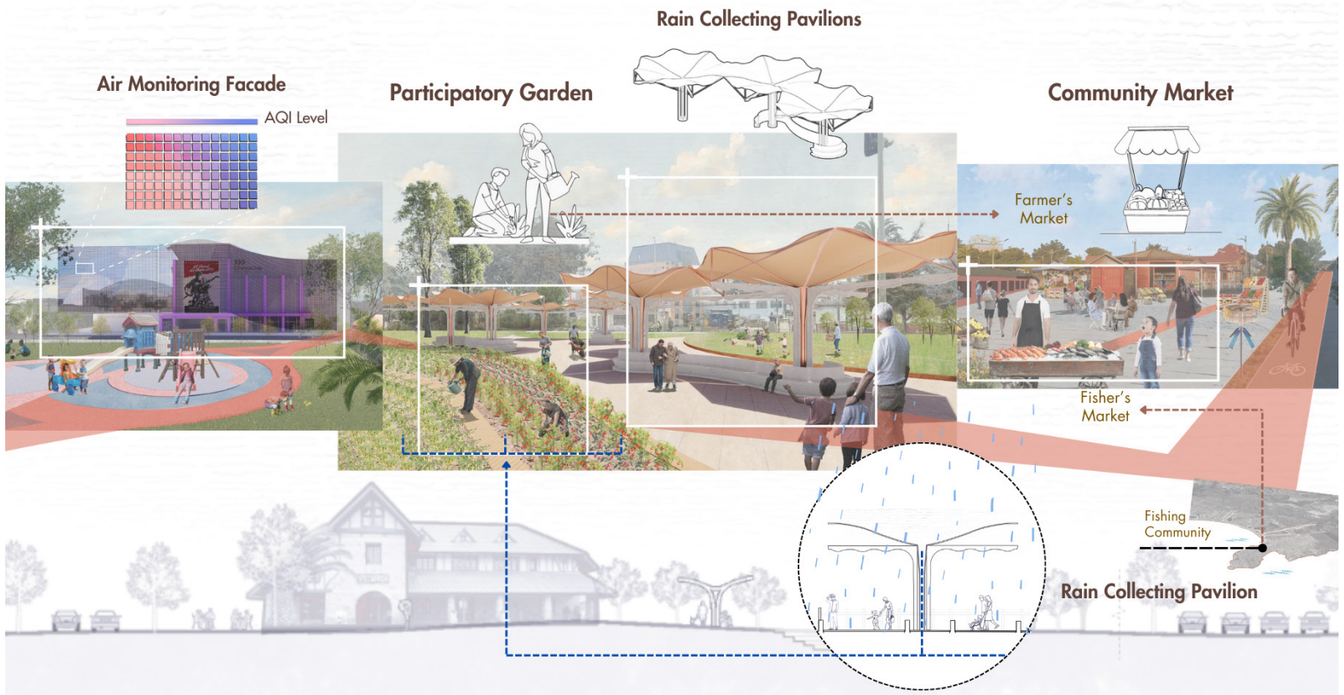
05 | Stakeholder Map



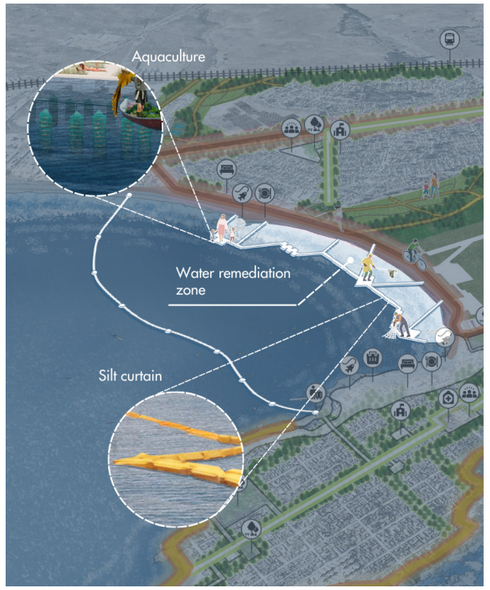
07 | Proposed Community Market



06 |Participatory Garden

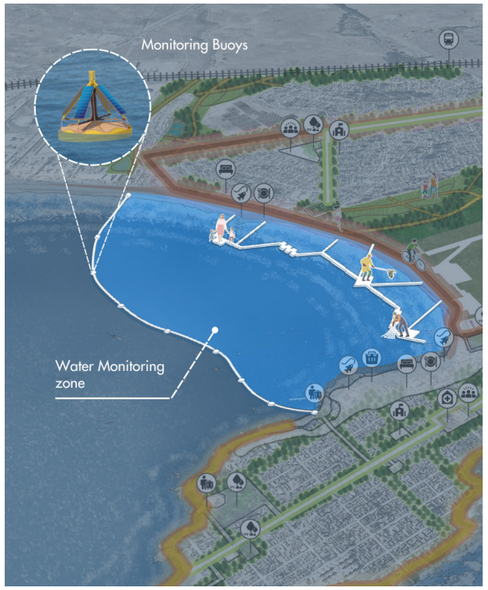


08 | Community Corridor



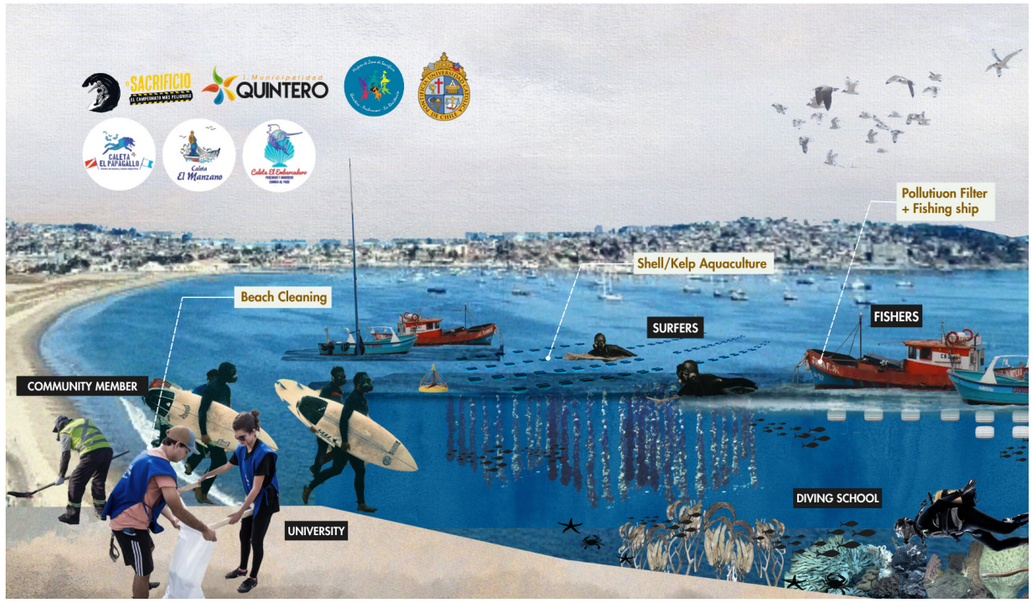
09 | Water Remediation Zone

The initial phase of waterfront development integrates several natural strategies, including a filtering system, floating pathways with a floating treatment garden, and an aquaculture farm to rebuild the ecosystem.



10 | Water Monitoring Zone

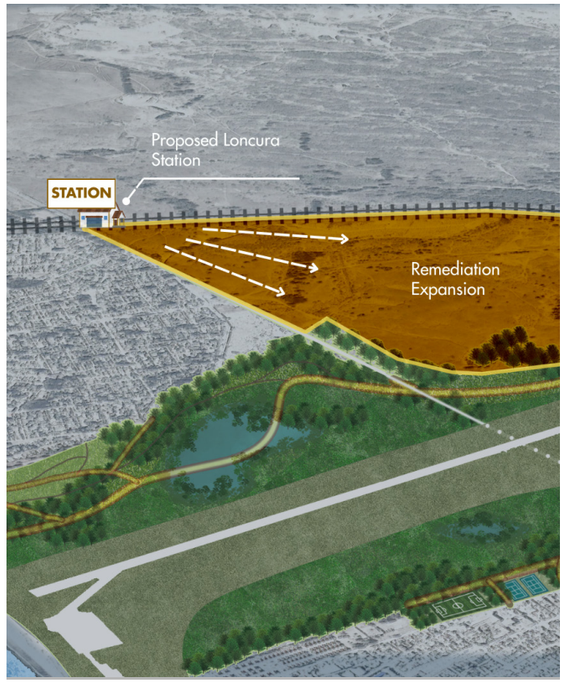
A broader water monitoring zone with buoys, which collect real-time data for long-term monitoring. The water monitoring buoys and silt curtain make beach activities safer for everyone.



11 |Participatory Restoration



12 | Beach Activities & Restoration



13 | Soil Remediation

Planting Miscanthus x giganteus as a biofuel crop which can bring in more economic benefits. This clean up process is then further expanded to the contaminated zone, pairing this with a new train station at the intersection nearby Loncura, promoting eco-tourism and regional accessibility.

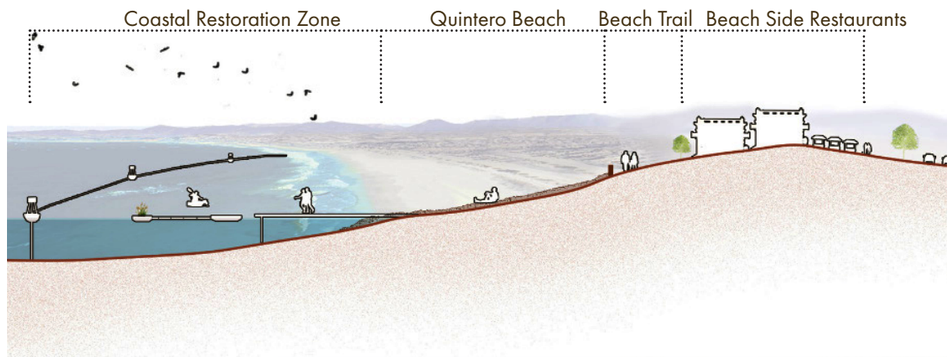


14 | Grid sampling

With grid sampling, dividing the land into small, equally sized sections to systematically test soil contamination levels. This helps identify the most polluted areas and monitor how effective the remediation process is over time.



15 | Proposed Train Station





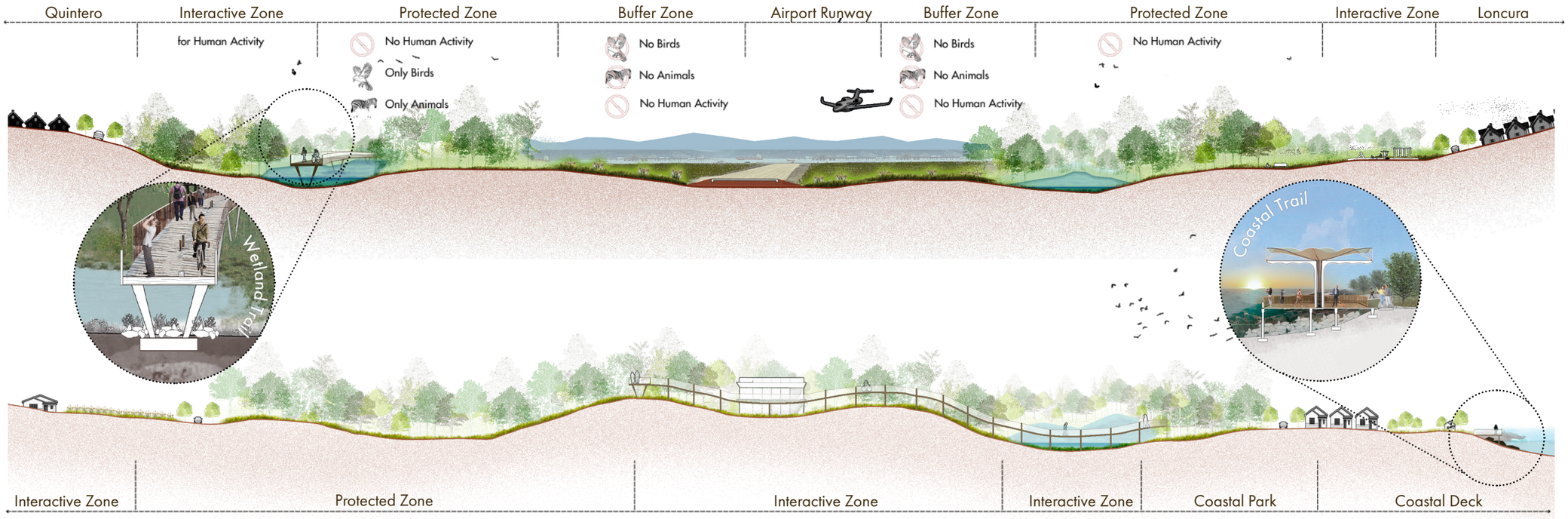
16 | Beach Restoration & Activities



17 | Wetland Trail



18 | Coastal Trail & Park



19 | Urban Section


Zenaida Meloda
Agelaioides Thilius
Habitat
Habitat
Habitat

GUANABARA BAY

BRAZIL

INTRO AND PARTNERS

GUANABARA BAY, BRAZIL

A spectacular city sprawled between mountains and sea, Rio de Janeiro's builtenvironment has been shaped through centuries of resource extraction, producingvarious forms of social and environmental degradation and inequities.

The Studio work was focused on Guanabara Bay, an area at Rio de Janeiro's core and borders, spatializing complex interplays of inter-municipal connection, infrastructural contestation, and socio-environmental recalibration. Once a pristine land and waterscape, Guanabara Bay is now heavily polluted. The species, including Dolphins, that have lived in the Bay for generations are now threatened, with some already extinct. The Bay is no longer a recreational asset to the residents of Rio like it used to be. Communities around the Bay are also suffering from pollution, waste and sewage disposal issues. In the wake of this legacy, while major Brazilian fossil fuel companies are continuing to expand their extraction and exports, Rio's inhabitants are also beginning to construct robust cultural, economic, and political networks of solidarity, resistance and activism, demanding their right to a healthy environment to live in.

At the scale of the region, with growing global interest in Minas Gerais for mining minerals and lithium needed for green energy transition, Rio holds significant potential to redress sites of industrial exploitation and show ways that energy production andenvironmental protection do not have to be exclusive. At the scale of the planet, Brazil's position as a global leader in climate action, highlighted by its role as host of COP30 in the Amazon nearly 40 years after Rio's COP92, makes the nation, and Rio specifically, a critical site for confronting extractive histories and envisioning reparative futures.

Investigating these material heritages and historical narratives across diverse urban contexts, students worked in collaboration with local stakeholders to explore pathways for repair and regeneration. On the field visit to Rio, Columbia students and faculty engaged with their counterparts from the Universidade Federal do Rio de Janeiro. They also met with CTDUT Technology Research and Development, Transpetro Islands and Refineries, Experts from the Estaleiro Mauá Shipyard, residents of Ilha de Conceição
and several local community groups. Student groups analyzed five sites in and around the Bay, paying special attention to the transformative impacts and potentials of Petrobras' oil infrastructure.

Considering the current situation and these practices, student explored the role that urban design and policy envisioning can play in shaping the future of energy, climate, and sustainable symbiosis between species (including humans) and nature.

FEDERAL UNIVERSITY OF RIO DE JANEIRO, FAU

Faculty
Cauê Capillé, Alexandre Pessoa, Elvina Maria Ferraz Sousa Martins, Bruno Kraemer Paragó

Graduate Students
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RIO SITE VISIT HOSTS

CTDUT - Technology Research and Development
Byron, Aldo Cesar Azevedo
Maria Elisa Silva

Transpetro Islands and Refineries
João Luiz Lavoura Correa
Nadine Serra Soeiro Silveira
Felippe Thiago Camilo Reis

Estaleiro Mauá Shipyard
Heitor Ciuffo Miro Arantes (CEO)
Ana Larronda Asti (Sub Secretary of Water Resources for the City of Rio)
Luciana Neves Lopes (Environmental Analyst for the Shipyard),
Alte. Walter Lucas da Silva (President of the Navy Technology Cluster)
Douglas Mendonça Soares (Safety Supervisor)

Ilha da Conceição
Nadia Coelho (Resident)
Lagoa Rodrigo de Freitas - Mangrove Restoration
Mario Moscatelli (Biologist)

Guanabara Bay - History and City
Bruno Amadei

Museum of Modern Art - Rio - Formas das Águas
Paula Correa

SEMINAR SPEAKERS

Washington Fajardo, InterAmerican Development Bank
Tatiana Castelo Branco, Rio City Hall
Anne Heloise, Brazilian Center for Climate Justice
Thaynara Fernandes, Brazilian Center for Climate Justice
Maria Clara Salvador, Brazilian Center for Climate Justice
Thiago Soveral, World Bank
Ana Duran, Yale University
Martin Dietrich Brauch , Columbia Center for Sustainable Investment
Stephanie Smith, Industrial Mining Response Santa Cruz County
Rob Pitman, Natural Resource Governance Institute
Kira Akerman, Hollow Tree
Tori Bush, The Climate Museum
Priscila Coli, UC Berkeley
Ana Lucia Britto, UFRJ

LANDSCAPES OF REPAIR RIO ROUNDTABLE

Participants
Brazil Ministry for Environment and Climate Change
Casa Fluminense
Brazilian Center for Climate Justice
CEBRI (Centro Brasileiro de Relações Internacionais)
Columbia University Center for Sustainable Investment
Columbia GSAPP Urban Design
Columbia, Climate School
Columbia University Rio Global Center
Instituto de Arquitetos do Brasil
Instituto Decodifica
Yakara'na and P.A
Rio City Hall - International Secretariat
Rio City Hall - Planning Secretariat
UFRJ, PROURB



SITE VISIT DOCUMENTATION & AGENTS OF CHANGE

"We see the mobility system not just as a tool for efficiency but as a means to make the city healthier, more walkable and vibrant." - Students





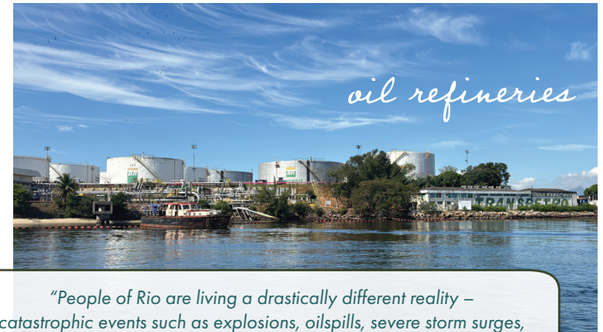




"Dramatic change from self-sufficient fishing communities to struggling, polluted environments"







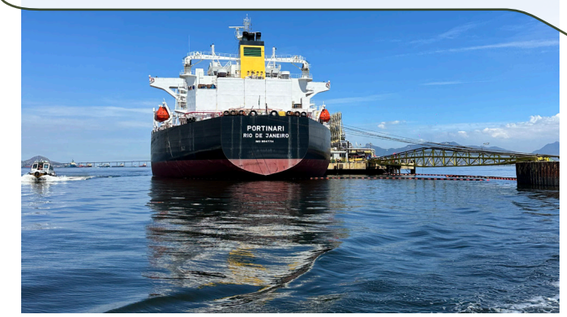


"People of Rio are living a drastically different reality – catastrophic events such as explosions, oilspills, severe storm surges, and flash floods are frequent and becoming more and more severe"
- REDUC Team





"The fishermen do not have far to look for the cause of their village's demise. They, too, know that the bay is not the problem but the consequence. The problem comes from the river".
- Gilson Alvarenga | Guanabara Bay fisherman of 30 years | NYC Times





ROUNDTABLE WORKSHOP

Earth Studio Roundtable as held on March 20th, 2025, at Instituto de Arquitetos do Brasil - Rio de Janeiro (IAB-RJ). This roundtable explored the relationship between existing petrochemical extraction and processing in the Guanabara Bay and its relationship to the energy landscapes of the future, resilience, and climate justice.

- Articulate the overlay between mitigation and adaptation in Brazil in advance of COP30
- Foster dialogue between students, faculty, policy makers, and the private sector
- Place corporate, policy, academic, and climate action in conversion to ground truth assumptions, particularly related to cities and the built environment
- Support on-ground planning and project efforts in Rio related to the Plan for Sustainable Development and Climate Action

STAKEHOLDER SPEAKERS AND PRESENTERS



DANIEL MANCEDO
RIO CITY HALL



LÉA REICHERT
CEBRI



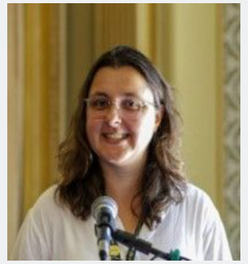
KAYO MOURA
DECODIFICA



ARIANE EVALD
UFRJ



THAIS BATISTA
CEBRI



TATIANA C. BRANCO
RIO CITY HALL



ALEXANDRE PESSOA
UFRJ



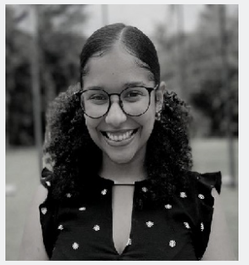
THAYNARA FERNANDES
CBJC



MARTIN BRAUCH
COLUMBIA G. CENTER



TOM TREBAT
COLUMBIA G. CENTER



LARYSSA NUNES
COLUMBIA G. CENTER

ENERGY PAST AND PRESENT

MUNICIPAL POLICY AND REGIONAL CONTEXT

Despite Rio's ambitious climate commitments, including carbon neutrality by 2050 and a 20% GHG reduction target by 2028, a critical governance gap threatens progress. While Rio maintains a permanent environmental team and conducts annual GHG inventories, the discussion revealed that surrounding municipalities lack both technical capacity and integrated planning.

This fragmentation creates a patchwork of policies where the state of Rio and many municipalities operate without comprehensive environmental plans, inventories, or adaptation strategies.

This governance challenge is compounded by competing jurisdictions, with energy regulation divided across federal, state, and municipal levels. The resulting disconnect means that critical vulnerabilities—such as sea level rise affecting petrochemical infrastructure—remain unaddressed.

COMPETING PRIORITIES: BASIC NEEDS V. ENERGY TRANSITION

A fundamental tension emerged between long-term energy transition goals and immediate community needs. Brazil's structural issues often overshed the discussion of topics such as energy transition. This perspective was reinforced by community representatives who emphasized how energy (particularly gas) affects mobility, access, and daily life. The discussion revealed how extractive industries often control essential resources and the complex relationship between extraction, power, and basic services.

Brazil's energy context differs significantly from global norms. While energy typically dominates global emissions, in Brazil it comprises only 18%, with land use and forestry being the primary contributors. This creates a different calculus for transition priorities and timelines, especially given the economic importance of oil exports to Brazil's GDP and municipal economies.

NEW ENERGY FUTURES

"JUST TRANSITION" IN BRAZILIAN CONTEXT

The discussion challenged conventional understanding of just transition, with participants arguing that energy transition plans must include job creation strategies to be viable. This acknowledges the reality that in Brazil's economically vulnerable regions, environmental objectives cannot be separated from economic security.

The conversation expanded beyond employment to include community agency in decision-making. Participants emphasized that sustainable solutions must be developed collaboratively with affected communities rather than imposed from above, recognizing that marginalized communities need meaningful involvement for transitions to be both just and effective.

THE HIDDEN COSTS OF "CLEAN" ENERGY

A fundamental tension emerged between long-term energy transition goals and immediate community needs. Brazil's structural issues often overshed the discussion of topics such as energy transition. This perspective was reinforced by community representatives who emphasized how energy (particularly gas) affects mobility, access, and daily life. The discussion revealed how extractive industries often control essential resources and the complex relationship between extraction, power, and basic services.

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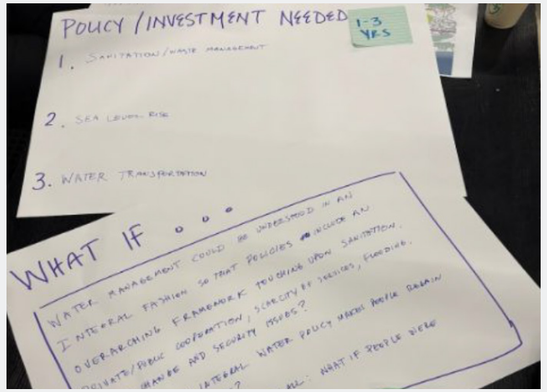
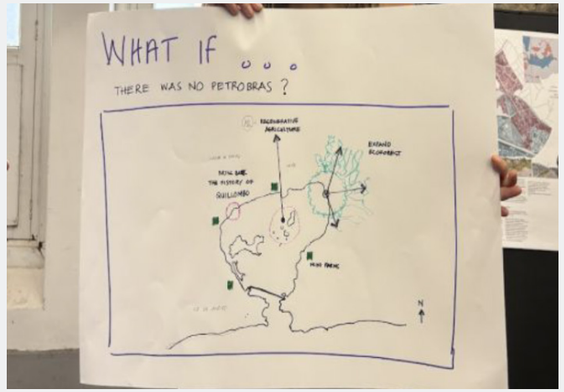
FINDINGS | DESIGN AND CLIMATE ACTION WORKSHOP

A design visioning workshop challenged participants to envision Guanabara Bay's future across different time frames. Groups tackled distinct temporal horizons that reflect climate change projections, political moments, as well as infrastructure and asset life cycles.



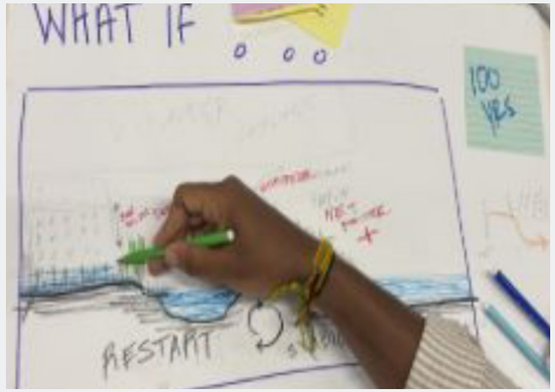
1 -3 YEARS
Leading up to COP30 and Brazil's National elections



20 YEARS
Petrochemical facility maintenance cycles



50 YEARS
Transition mineral supplies projected to have more than doubled and pre-salt oil supply is past peek



100 YEARS
100-year climate impacts of potentially surpassing 1.5°C average warming.

What if climate change and security considerations were addressed simultaneously?

- Sanitation/waste management, sea level rise adaptation, and water transportation systems.
- Integrated water management within an overarching framework that could coordinate policies across multiple dimensions—connecting sanitation infrastructure with climate change response, public-private cooperation, and security concerns.
- Water policy as a shaper of public trust in government and whether the voices most affected by environmental decisions are truly being heard in the lead-up to COP30 and Brazil's elections.

What if sea level rise and asset upgrades were used to cycle in regenerative systems and reduce risk?

- Regenerative agriculture, circularity/circular economy initiatives, and decentralization, with ecotourism as a comple mentary focus area.
- Reference the history of Quilombo communities and proposing to expand eco forests
- Model post-petroleum land use that can revitalize the bay's ecosystem and create sustainable economic alternatives.
- Prototype decentralized development models to transition petrochemical infrastructure to regenerative systems

"Most municipalities don't have technical knowledge or personnel to join projects and develop future solutions."

"The sea level rise is something not really taken into consideration for petrochemical industries."

"Where there's water, there's Petrobras."

Nature as Industry? What is oil could no longer be king in Rio's industrial economy?

- Acknowledges the dual challenges driving this future—energy transition and resource depletion
- Emphasize the importance of maintaining economic stability through a deliberate reimagining of how wealth is generated and distributed.
- Scale biodigesters and nature-based technologies, creating ecological edges around Governor's Island and developing a new EPA near UFRJ
- Invest in community education and workforce development

Radical Reimagining? What if we understood we were all one species that was only a small part of the ecosystem?

- Transformative "restart" built on principles of symbiosis, balance, and dynamic equilibrium between human systems and natural processes
- Adaptation structures with restored wetlands
- Policy frameworks are legally binding, environmental education becomes necessary
- Industries collaborate, and engineers work alongside social scientists.
- Human rights and basic needs guaranteed through nature-designed solutions.

"There's a lack of integration between environmental policies across the state, with each municipality operating independently."

"An energy transition plan without a job transition plan is not possible."

"The transition to electric vehicles and solar panels is creating new extraction frontiers in Brazil with impacts that disproportionately affect indigenous communities and biodiversity hotspots."

CLIMATE x DESIGN FRAMEWORK

GRAMACHO

Waste to Value:
Decentralizing Waste Management In Rio De Janeiro's Disputed Territories

REIMAGINE BRIDGING KNOWLEDGE AND FINANCE

REARTICULATE LABOR AS INFORMATION

REDUC

REDUC REDUX
Rethingking Energy: Decarbonizing & Uniting Communities

REPURPOSE LESS STRANDED, MORE ASSET

REINVENT PETROCHEMICAL TRANSFORMATION

Oil Archipelago

New Archipelago
A Vision For The Islands Of Gunabara Bay

RETHINK URBAN FOREST KNOWLEDGE

Ilha do Governador

Guanabara Bay: Ecotones of Repair
Multiplying, Diversifying & Complexifying The Edges

RETHYTHM POLICY AS ECOSYSTEMIC

RECIRCULATE ISLANDS AS CIRCULAR

Ilha da Conceição

From Wrecks To Wonders
Reclaiming Shorelines, Enriching Communities

RECLAIM CIRCULAR INCENTIVES

Downtown Niteroi

Connecting Niteroi: A Multiscalar Response
A New Urban Mobility Framework To Reduce Heat, CO2 Emissions & Social Fragmentation

REFRAME COLLABORATIVE KNOWLEDGE

REPARATE PROFIT AS A PLATFORM

Guia de Pacobaiba

Duque de Caxias

Ilha do Fundão

Centro

São Gonçalo

Estação Ecológica da Guanabara

Icaraí

Copacabana

Rocinha

Guanabara Bay

Itaipuaçu

N

Spacial Visions

Cimate Policy Provocations

UD Studio Sites

NITERÓI



GUANABARA BAY, BRAZIL

Spatial Visions

NITERÓI, BRAZIL

CONNECTING NITERÓI: A MULTISCALAR RESPONSE

A NEW URBAN MOBILITY FRAMEWORK TO REDUCE HEAT, CO2 EMISSIONS, AND SOCIAL FRAGMENTATION

Diana Cecilia Fernandez-Borunda
Yu Lin (Rachel) Hsu
Yujeong Rhee
Jinxian (Jessie) Yang

WHAT IF WE DON'T HAVE TO RELY ON CARS?

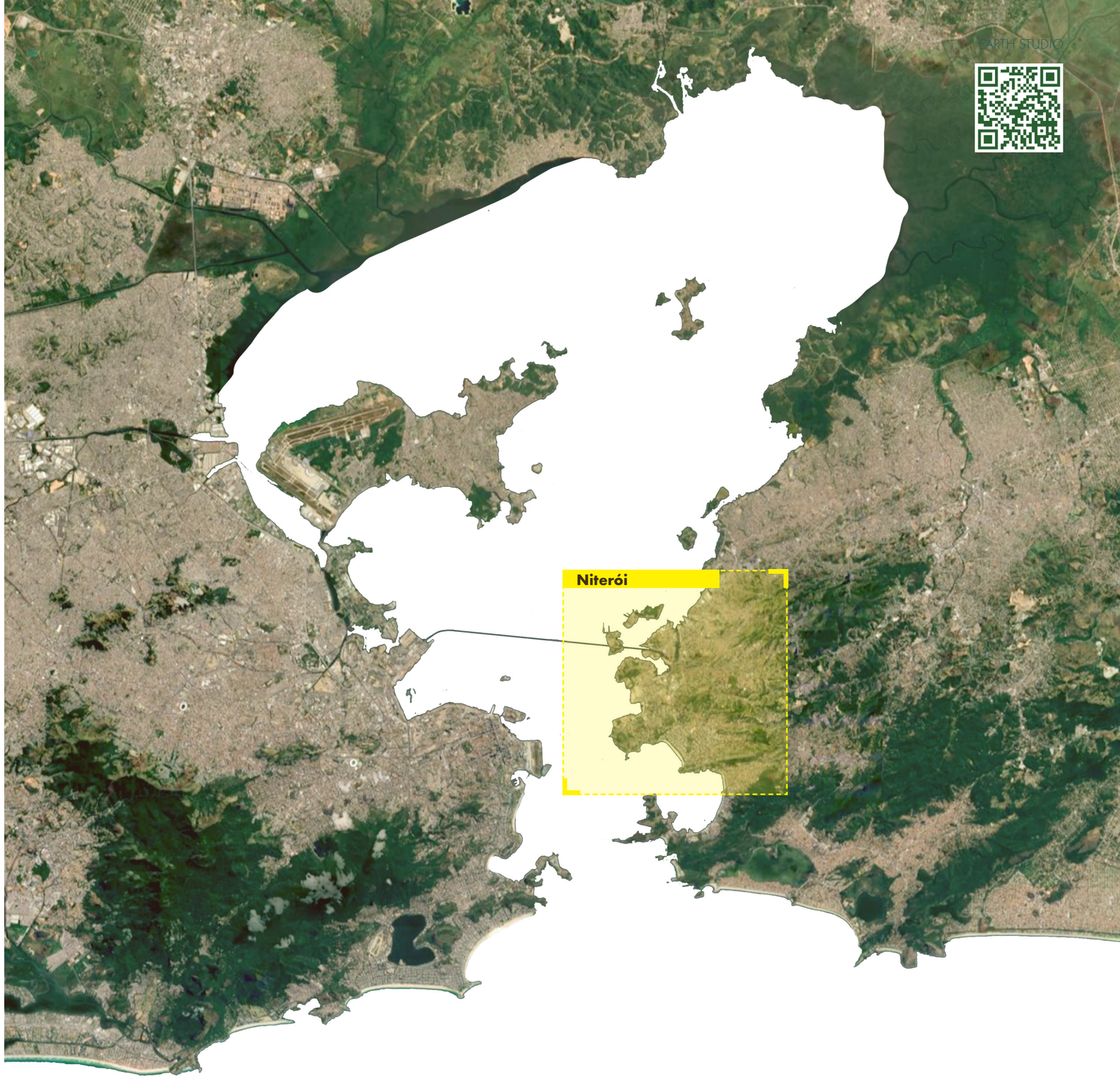
Niterói's urban expansion, catalyzed by its bridge to Rio de Janeiro, has stimulated rapid growth while deepening dependence on Rio's economy and transport.

This reliance has bred complex urban challenges: chronic congestion, heat islands, reduced walkability, and rising public health concerns.

Our project responds with multiscale solutions that include master planning, urban design, and architectural interventions to transform mobility networks and reinterpret infrastructure.

By shifting focus from car-based systems to integrated, mass transportation strategies, we aim to alleviate spatial discomfort and support a just transition to renewable energy.

This reimagined urban framework fosters autonomy, resilience, and a healthier, more connected Niterói.





01 | Background

Before the Rio–Niterói Bridge was constructed, people had to either drive five hours from Rio to Niterói or take a 20-minute ferry ride. This led to the question: What if we could drive there in just 20 minutes? The Rio–Niterói Bridge was eventually completed in 1974.

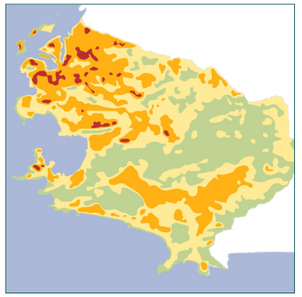
This beginning also signaled Niterói's growing dependence on private cars and buses. The bridge accelerated the city's development, but the heavy reliance on private vehicles shaped an urban plan centered around cars. As a result, people lost their culture of walking and living actively in the streets.



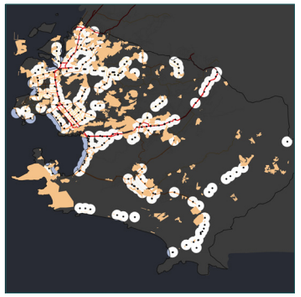
02 | Design Strategies



Ferry usage decreased after the bridge constructed



The reliance on cars has led to urban heat island effect



Some areas are not served by the bus system



By elevating the experience and increasing Ferry routes



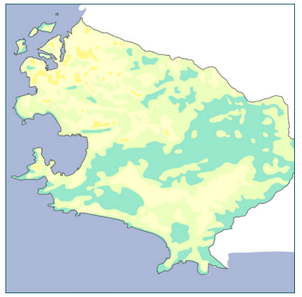
By redesigning the streets, replacing asphalt with green cover



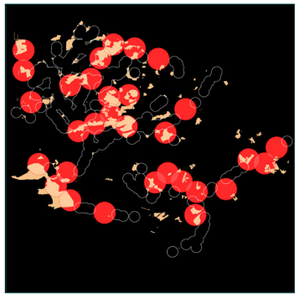
By reimagining bus stop as unit of change



The goal is to maximize the opportunity to move, and minimize the need of moving



Walkable and livable streets to cool the city



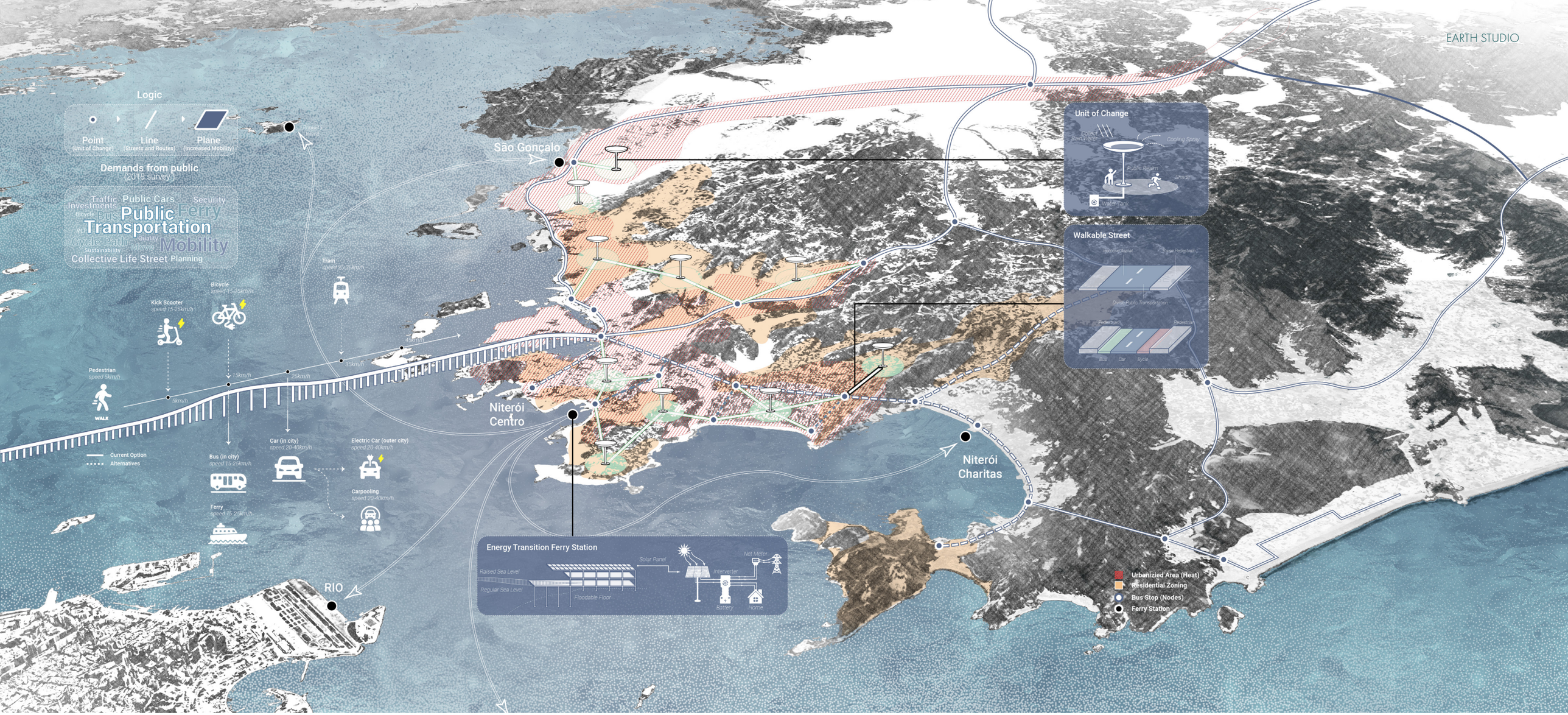
Attractive and multifunctional bus stops can serve more people

point

line



plane



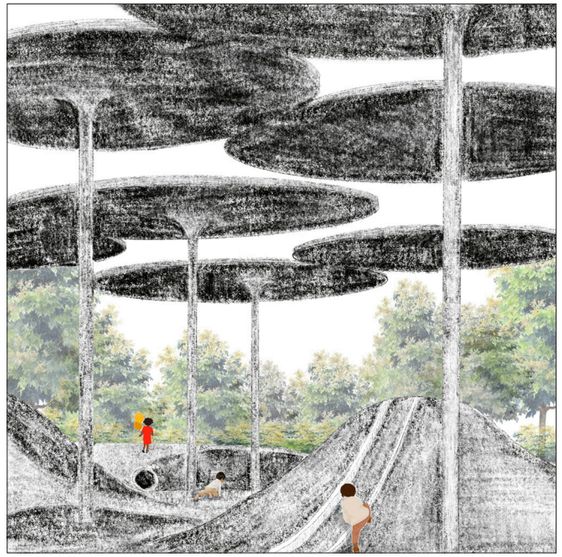
03| System Map and the New Street life

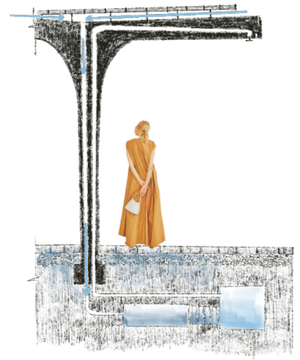
This system diagram illustrates how we plan to implement the previously mentioned strategies in the context of Niterói.

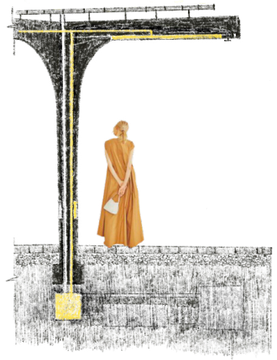
From umbrella-shaped bus stops to rethinking street layouts, adding new ferry routes, and elevating ferry stations, we propose multiscalar design strategies and thinking to push transportation beyond mere efficiency. By reducing car usage and turning streets into active parts of urban life, transportation can become a system for energy transition and contribute to mitigating the urban heat island effect.









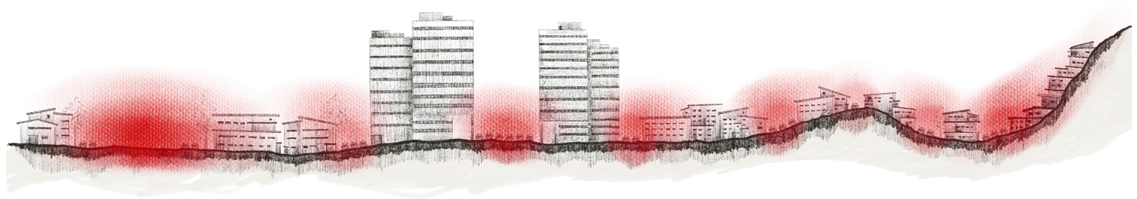


04| Unit of Change

As we walked through the streets of Niterói, the combination of intense sunlight, heat radiating from the asphalt, and lack of shade made the city feel much hotter than it actually was.

This experience shaped the core of our bus stop design, which prioritizes providing shade and thermal comfort. But beyond its basic function, we envision the bus stop as a multifunctional space—one that can serve as a small library, a playground, or a gathering spot for the community.

It is also designed to collect rainwater for cooling sprays during hot days and harness solar energy to power lighting, making it both climate-responsive and socially inclusive.





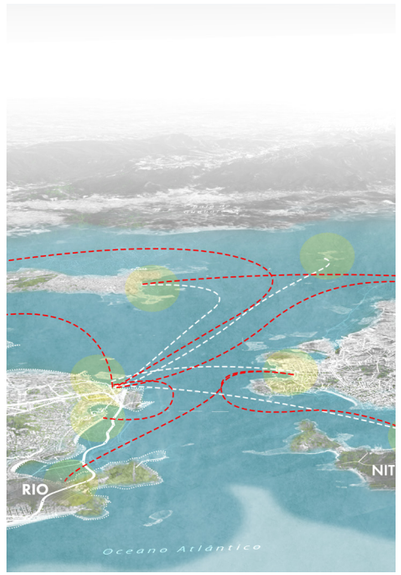
05| Walkable Streets

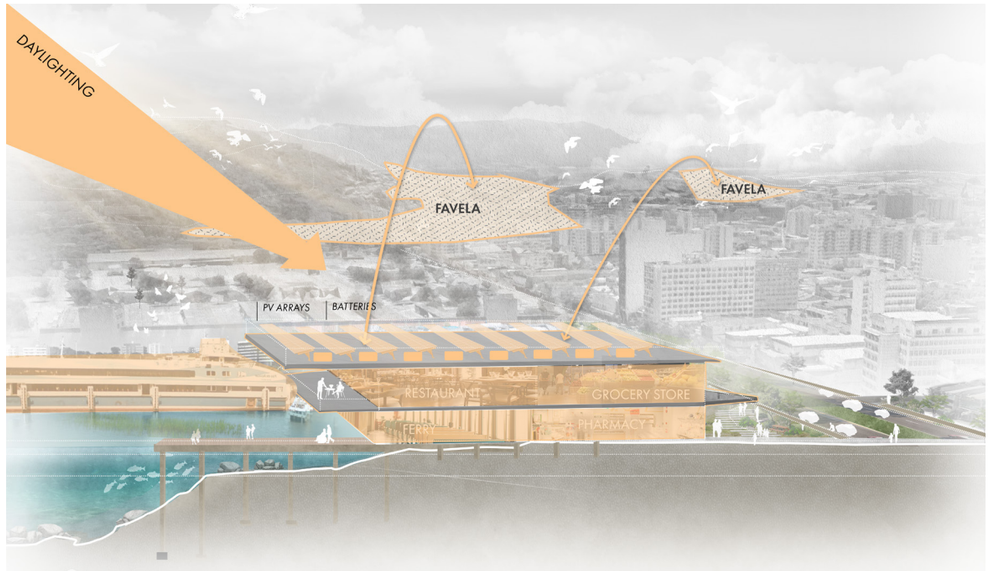
We envision the streets of Niterói not just as corridors for vehicles, but as active and inclusive urban spaces that support everyday life. To achieve this, we propose reducing the amount of asphalt-covered surfaces, increasing green coverage to improve environmental quality, and integrating public transportation systems powered by clean energy.

Our goal is to transform the street into a space centered around people rather than cars. By prioritizing pedestrians, greenery, and sustainable mobility, we aim to create a healthier and more livable city. Streets should serve as places for community interaction, leisure, and daily activities, instead of functioning solely as routes for traffic.











06| Ferry Station

Our design concept for the ferry system is: "Maximize the opportunity to move, and minimize the need to move."

Ferries are more eco-friendly and ferry stations can be closer to communitites. In addition to expanding ferry routes, we aim to enhance the functionality of ferry stations by integrating services such as pharmacies, grocery stores, and cafes. By making ferry stations a part of everyday urban life, we hope to encourage more residents to use the ferry.

Furthermore, the ferry stations will serve as key hubs for the energy transition. They will not only collect renewable energy but also function as research centers for clean energy. This initiative is expected to create more job opportunities and reduce the need for Niterói residents to commute to Rio for work.



SARAPUÍ

GUANABARA BAY, BRAZIL

Spatial Visions

SARAPUÍ RIVER, RIO DE JANEIRO

WASTE TO VALUE

DECENTRALIZING WASTE MANAGEMENT IN RIO DE JANEIRO'S DISPUTED TERRITORIES

Bria Miller / Dolyagritt Wonggom / Tzu-Yu Jason Huang/ Xinyu Zhang

WHAT IF WE DESIGNED AN URBAN FRAMEWORK THAT HELPED FACILITATE MULTILATERAL EFFORTS TO ADDRESS RIO'S WASTE CHALLENGE, USING THE SARAPUI RIVER AS A PILOT?

Rio de Janeiro's waste crisis is defined by the hyperaccumulation of waste in landfills and waterways, intensified by a hybrid system of governance in which militia control coexists with the state. These armed territorial groups shape everyday life by seizing land and monopolizing essential services such as water, cooking gas, and internet access.

Waste to Value moves from top-down models of waste management, instead proposing a neighborhoodbased, decentralized, and malleable urban strategy that reimagines waste as the engine for social, economic, and environmental transformation. By empowering people to serve as the infrastructure of this alternative system, the project builds collective capacity to challenge extractive powers and reclaim agency and stewardship over their lived environment.

Using the Sarapuí River as a pilot site, its design adapts to local power dynamics, employing varying degrees of visibility and embeddedness depending on the intensity of territorial control in neighborhoods along the river.





01 | Mapping Power and Pollution



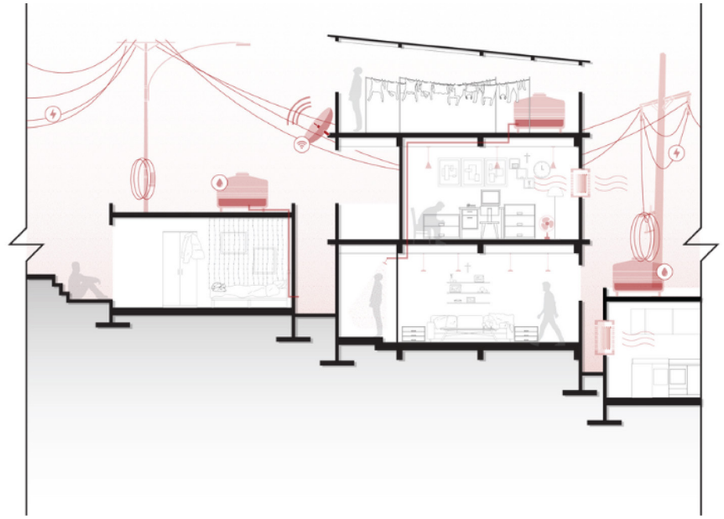
02 | Lived Experiences

Militia control may be invisible to outsiders, but for many, it shapes daily life. This proposal centers the lived experiences of those in contested territories, examining how these forces impact urban space and quality of life.



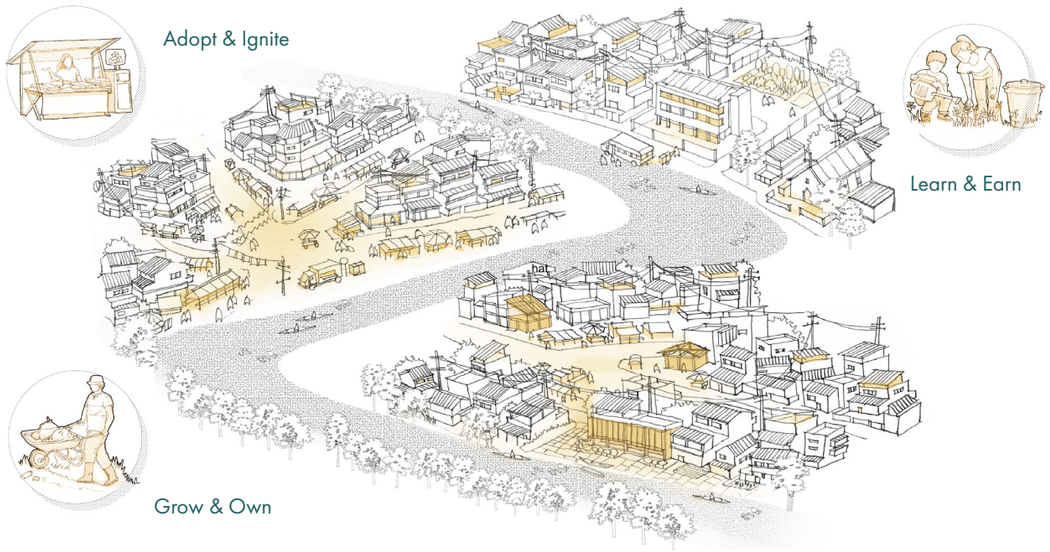
03 | History of Ecotones

Map shows snapshot of GIF which animates how territorial boundaries are not fixed, but rather fluid, necistating an approach that deploys varying levels of visibility and degree of fluidy as bournaries are constantly negotiated and in flux.



04 | Under the Veil

The section highlights the pervasiveness of militia control over critical infrastructure such as electricity, water, internet, and cooking gas.



01 | A Multi-Scalar and Multilateral Framework



02 | Building Power at the Household Scale



03 |Neighborhood Activation



01 |Commercial Corridor as Catalyst



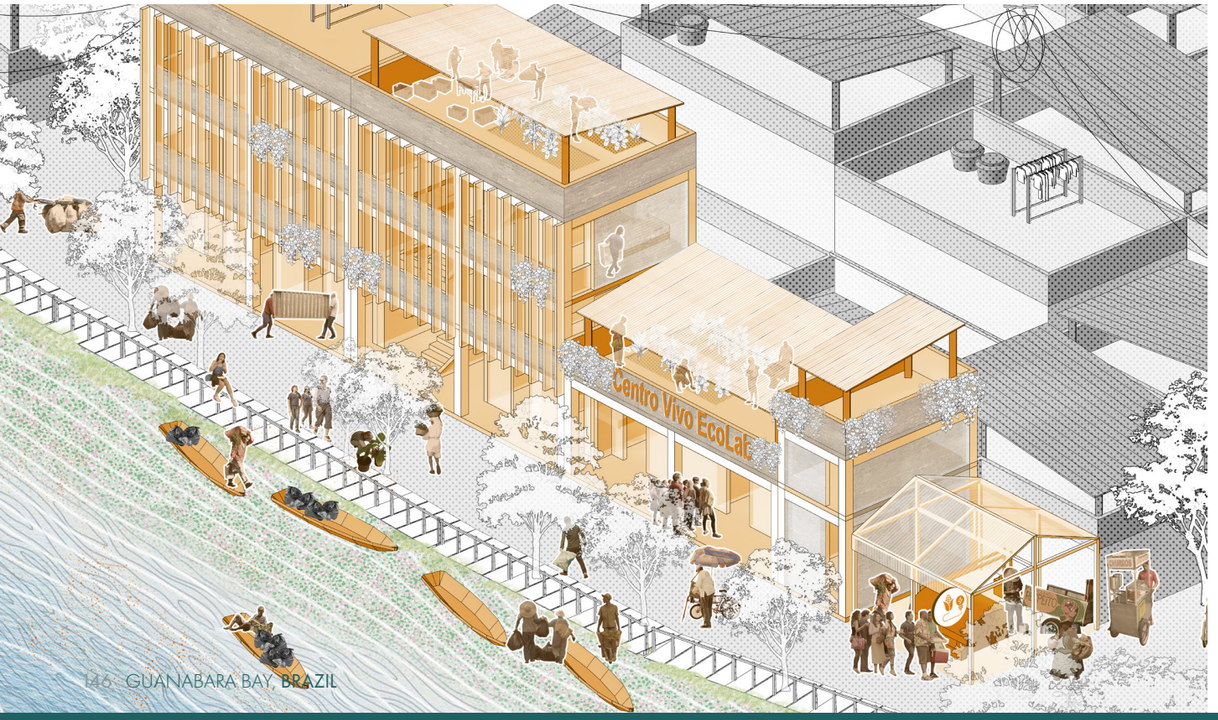
01 | Community Kitchen

One of three pillars in our “Green Waste Ecosytem”scenario, a community kitchen fosters a neighborhood-scale food economy and showcases the value ofrepurposing organic waste into local, healthy food options.



02 | Training Center

Another pillar of the “Green Waste Ecosystem,” the training center offers workshops, tools, and community space to anchor sustainable initiatives in the neighborhood. It connects directly with the EcoLab Residency Center (pictured below), a year-round program supporting river clean-up efforts.



ILHA DO GOVERNADOR

GUANABARA BAY, BRAZIL

Spatial Visions

RIO DE JANEIRO, BRAZIL

GUANABARA BAY: ECOTONES OF REPAIR

MULTIPLYING, DIVERSIFYING AND COMPLEXIFYING THE EDGES

Octave Bourgeois / Yasmina Hamdan / Megan Haralovich / Penny Lee

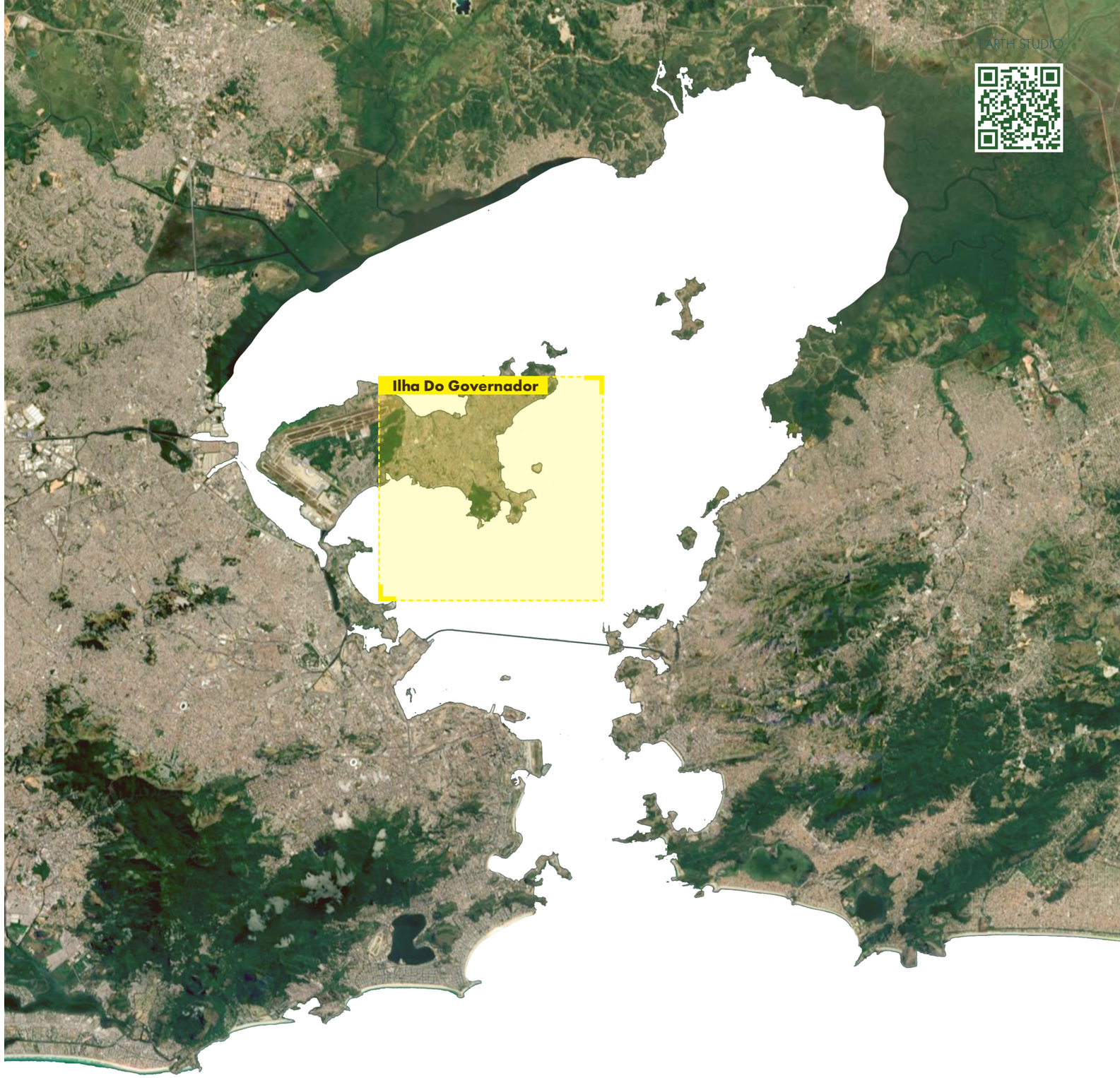
WHAT IFWE RESTORE, MULTIPLY, AND DIVERSIFY THE ECOTONES TO REPAIR THE BAY?

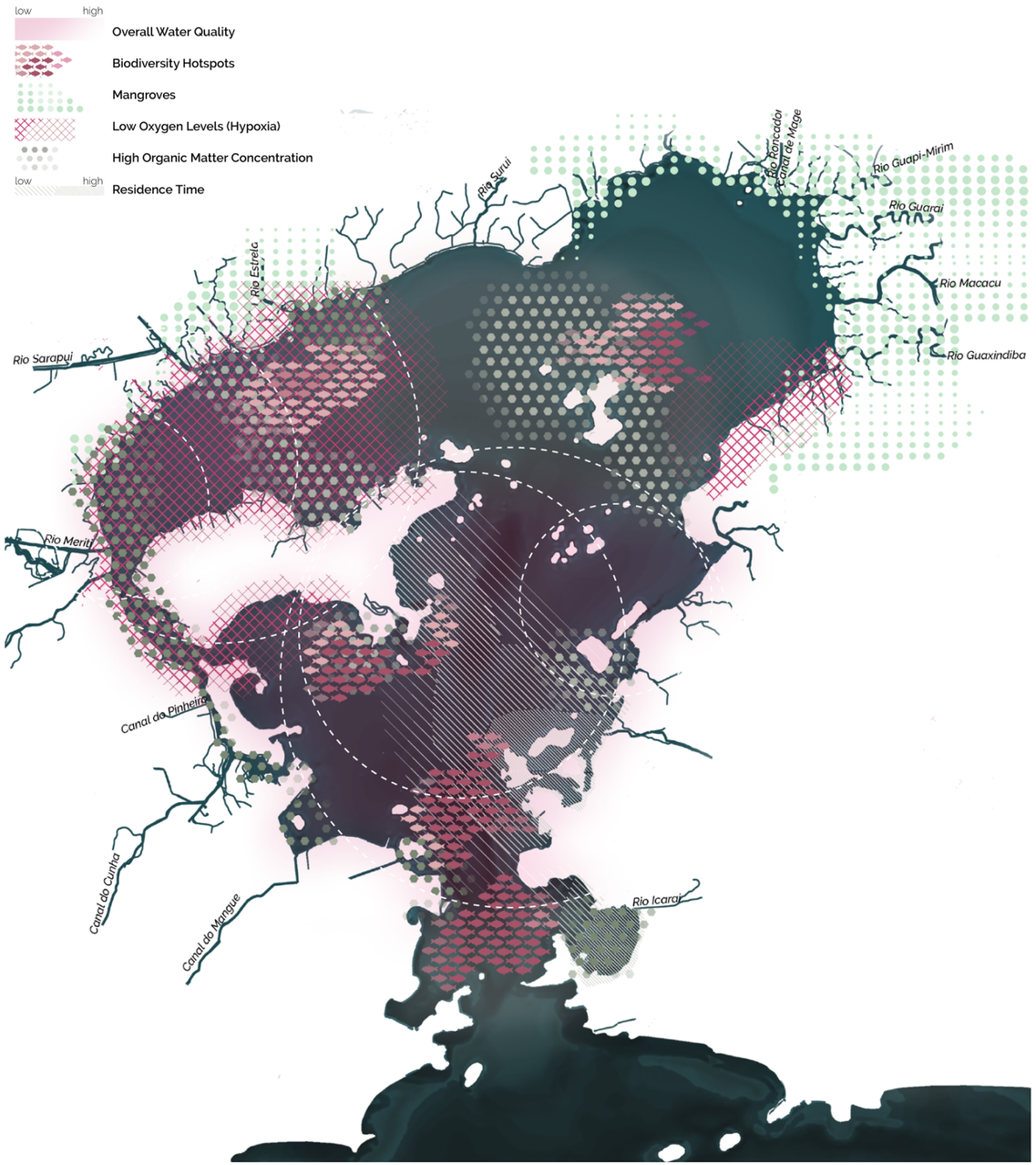
Guanabara Bay faces ecosystem collapse. Historically, it was surrounded by diverse ecotones between urban, aquatic, and terrestrial ecosystems that supported a web of biodiversity, economy, and social infrastructure.

Ecotones are transitional zones between two distinct ecosystems or biological communities, where blurred edges create overlaps. This in between space always holds more biodiversity than either of the adjacent ecosystems. However, the elimination of these ecotones, replaced by hard edges, sewage, garbage, and the oil industry, has stripped the Bay of its sustainability.

Ecotones of Repair boldly proposes to multiply and diversify the ecotones of Guanabara Bay to multiply and diversify its ecosystems, economy, and social relationships. The initiative includes constructing a range of ecotones, focusing on the critical urban-water ecotone through vegetated edges, deconstructed hard barriers, green energy infrastructure, habitat creation, green infrastructure jobs, fishing industry restoration, and ecotourism, where species and nature

co-design the future of Guanabara Bay.





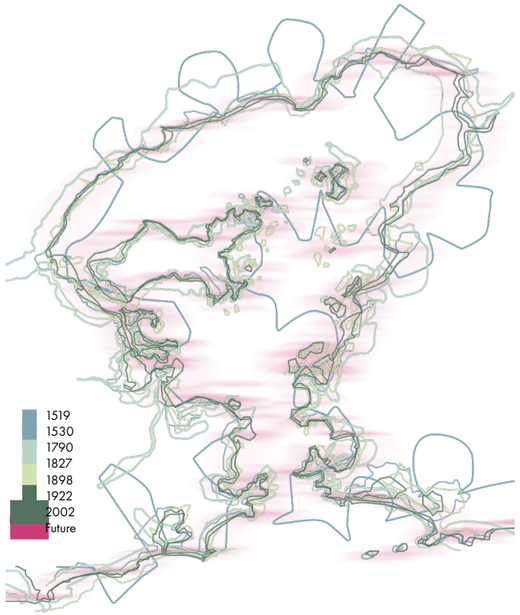
01 | Around Ilha Do Governador, water quality is extremely poor due to high pollution, and slow circulation.





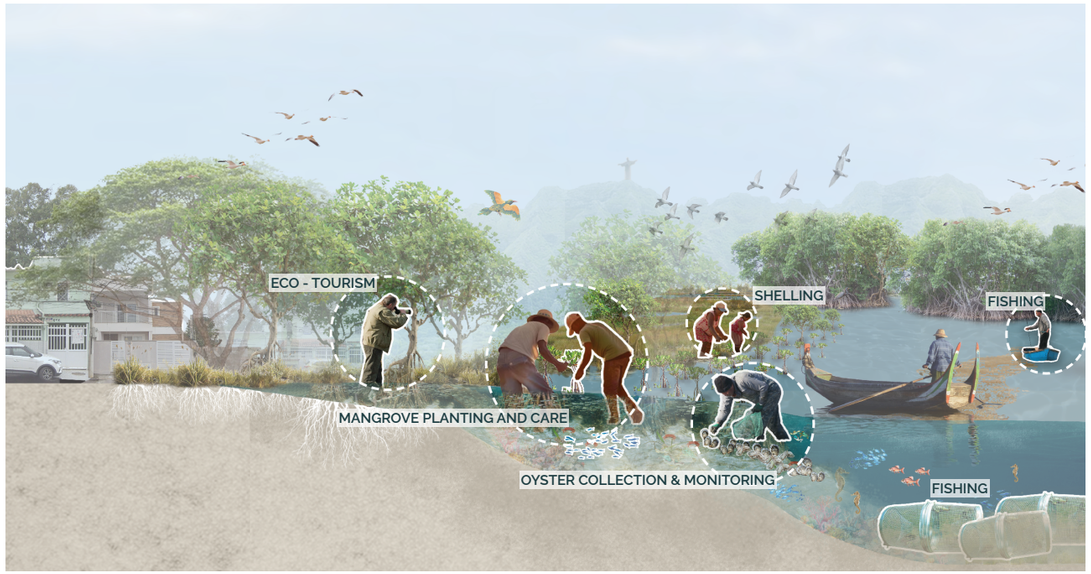
02 | Current Edge Condition

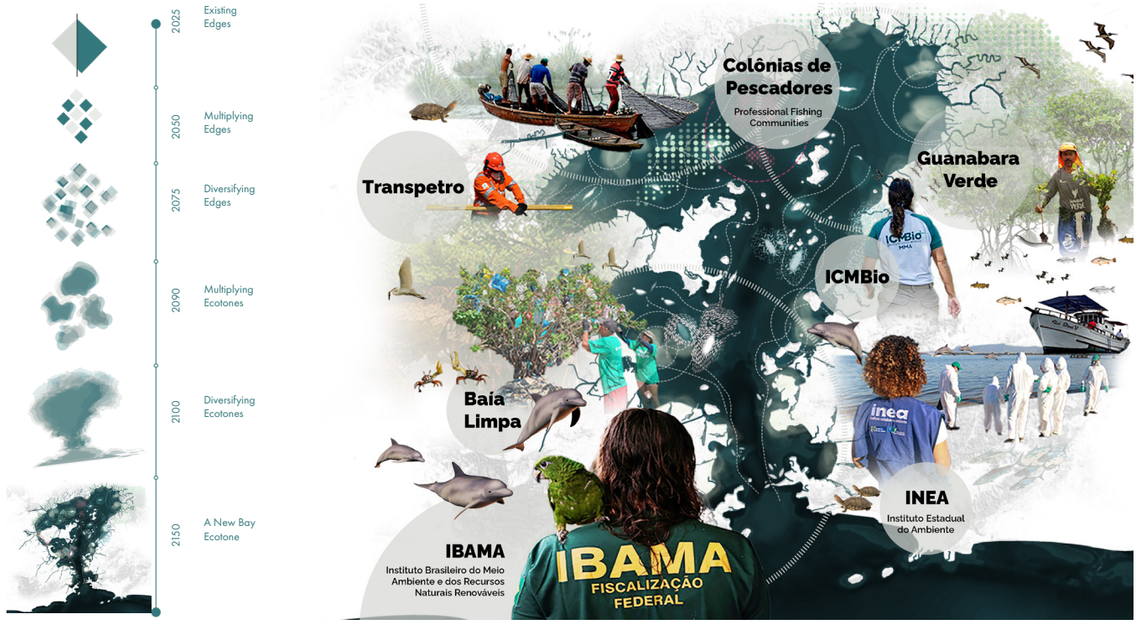
Guanabara Bay is currently shaped by hard edges and lines. Humans have long reshaped these shifting ecotones through dismantling of mountains infill and dredging.



03 | History of Ecotones

Previously, human and non-human species once coexisted along Guanabara Bay's ecotones through shared practices like fishing and leisure. However, urban development has disrupted this balance, replacing vibrant natural edges with hardened infrastructure and leading to significant ecological degradation.





04 | Regenerative Timeline

From 2025 to 2075, Guanabara Bay can gradually transform through the restoration of soft edges and natural habitats. As ecotone revival continues into 2090, the bay will be surrounded by community parks, green infrastructure jobs, and the return of migratory species, ultimately shaping a resilient and co-designed future by 2150.

05 | Collaborative Stewardship

The restoration of Guanabara Bay depends on active collaboration among stakeholders. There are currently massive efforts occurring in the bay to restore ecotones. This project aims to play a part in this effort through collaboration of community, organizations, species, and policy initiatives.

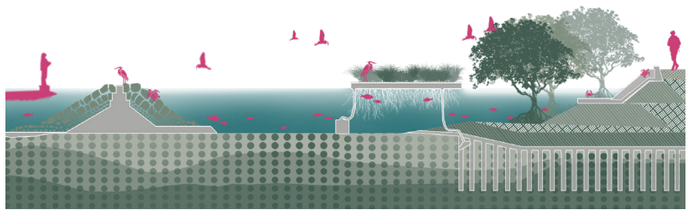




06 | Boto Cinza Inlet

Named after the native dolphin species, the project seeks to revive biodiversity and reconnect low, medium, and high-income communities currently separated by infrastructure.

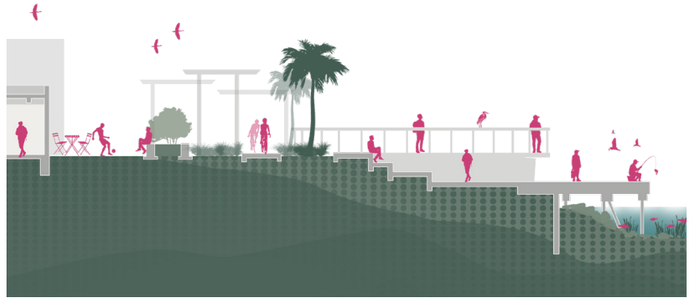
1 New Sediment Island Formation



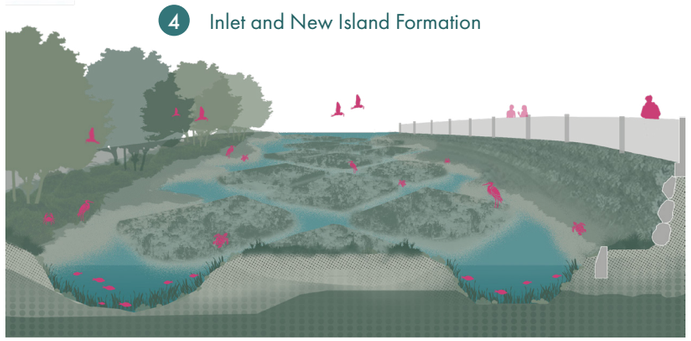
2 Energy Transformation to BioFuel



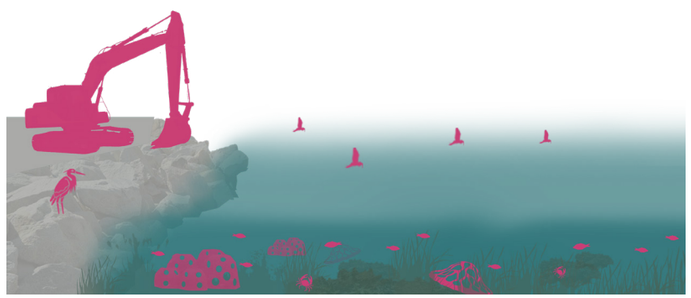
3 Connection to Water



4 Inlet and New Island Formation



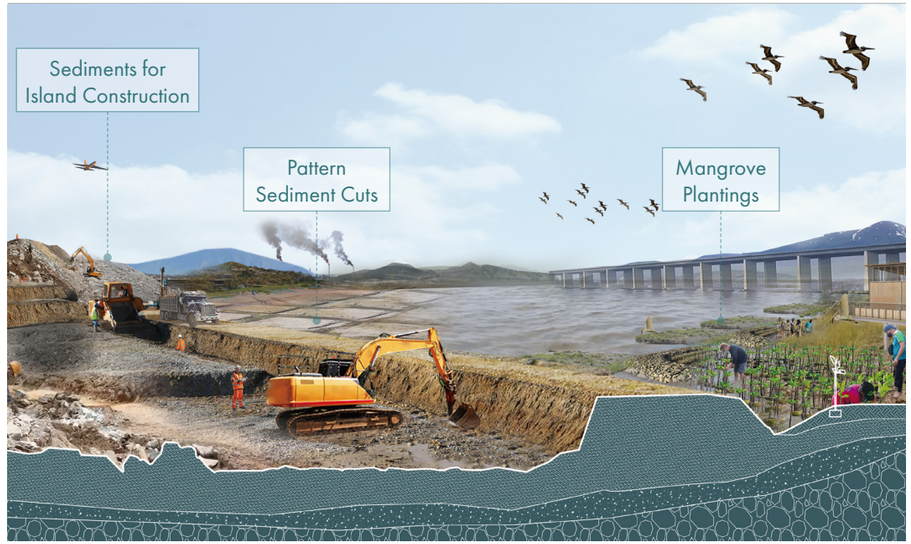
5 Deconstructed Edges and Oyster Reefs



6 Mangrove Nursery and Fisher Economy



07 | Ecotone Typologies



08 | Recreation - Water Ecotone:
First Phase of Inlet Ecotone Construction (yr 2030)



09 | Residential - Water Ecotone:
Recreational Amenities and The Urban - Water Ecotone are Formed



10 | Re-Forestation - Water Ecotone: Water Energy, Erosion, Dispersal, and Decay Shape the Inlet

REDUC

GUANABARA BAY, BRAZIL

Spatial Visions

REDUC, BRAZIL

REDUC REDUX

RETHINKING ENERGY: DECARBONIZING & UNITING COMMUNITIES

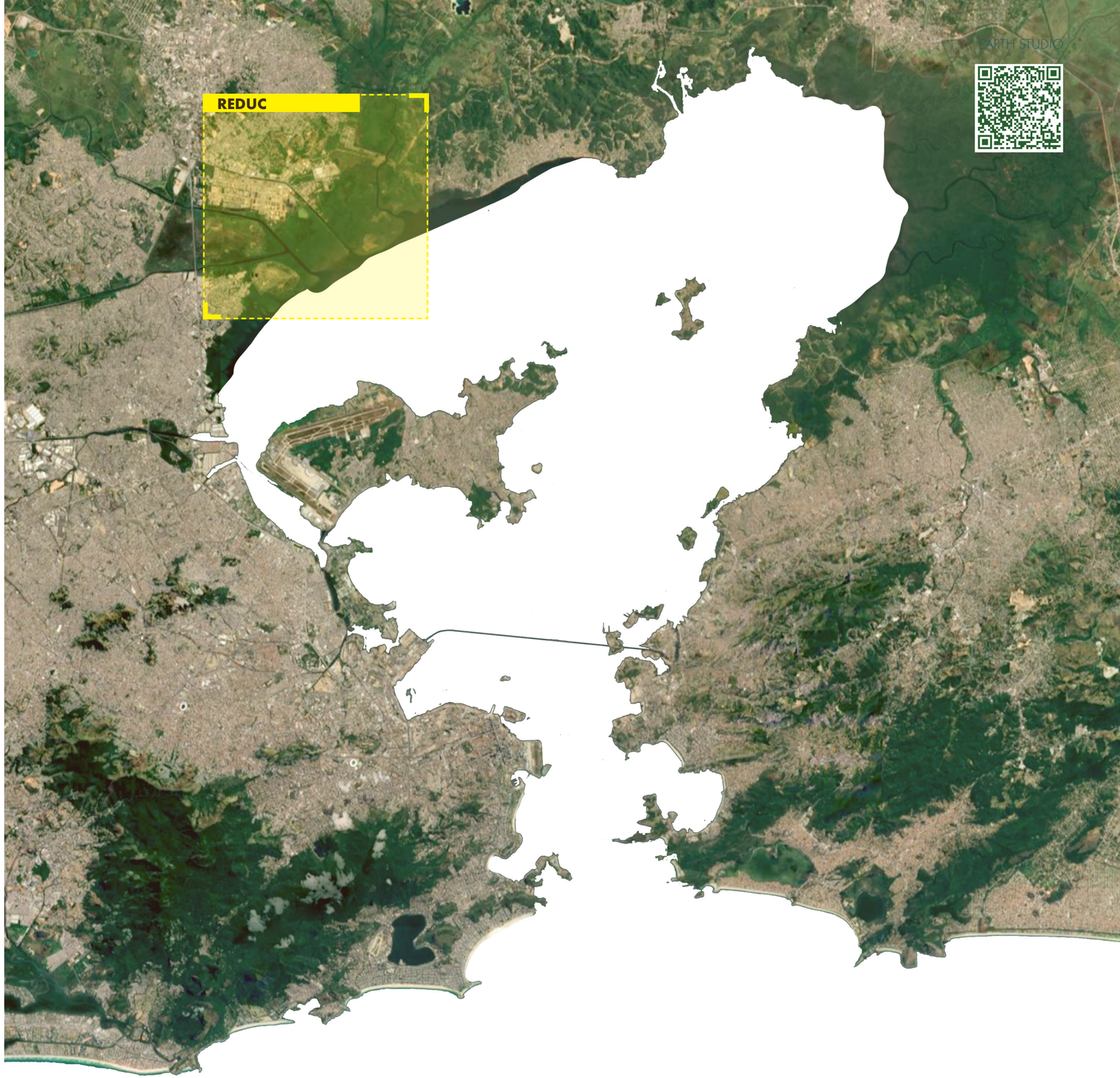
He Dong / Chunyuan Hu / Wentong Huang / Jahlik Parkes

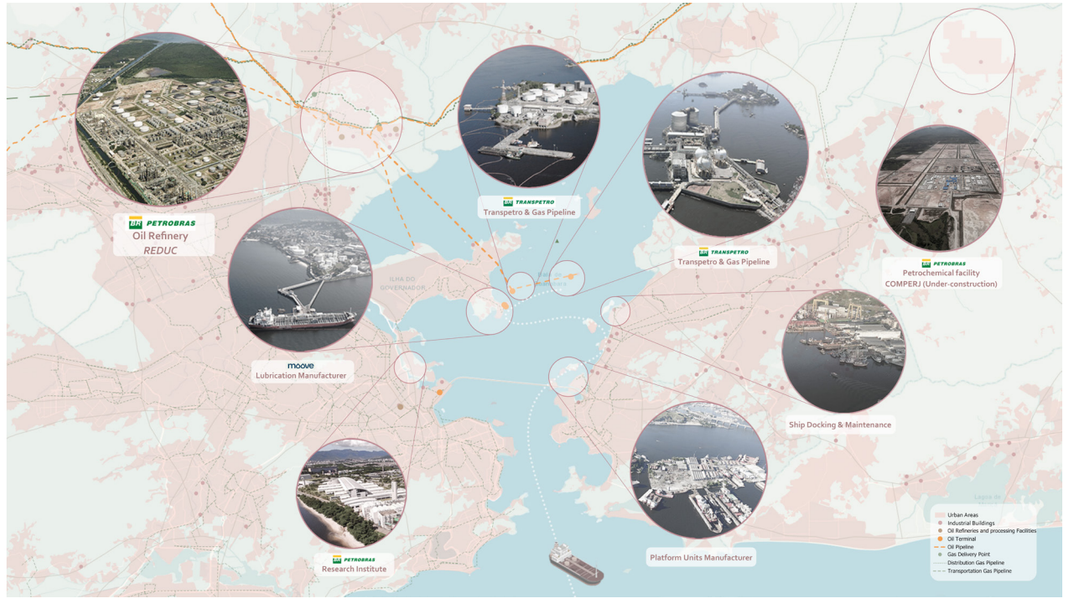
WHAT IF PETROBRAS TOOK THE LEAD IN BRAZIL'S CLEAN ENERGY TRANSITION BY TRANSFORMING GUANABARA BAY INTO A GLOBAL MODEL FOR SUSTAINABLE INNOVATION?

With the REDUC site—projected to be mostly underwater by 2050 and at high risk of catastrophic events like major oil spills and industrial fires—the need for transformation is urgent. Designating REDUC (Refinaria de Duque de Caxias) as first step would allow Petrobras to prioritize decarbonization and safety by replacing fossil fuel operations with renewable energy solutions while preemptively addressing critical environmental vulnerabilities.

However, within this fragility lies a powerful opportunity: to transform REDUC from a symbol of extraction into a beacon of regeneration. The most flood-prone zones can be carefully decommissioned, giving way to healing through soil restoration, reforestation, and flood-able landscapes. These renewed spaces would welcome community use, offering access to nature and the water's edge. At the core, REDUC can shift toward innovation, repurposing industrial remnants to power clean energy futures. With bold investment in hydrogen, micro algae farms, and bio-energy, REDUC could seed a new era rooted in resilience, equity, and Rio's leadership in a post-carbon world.

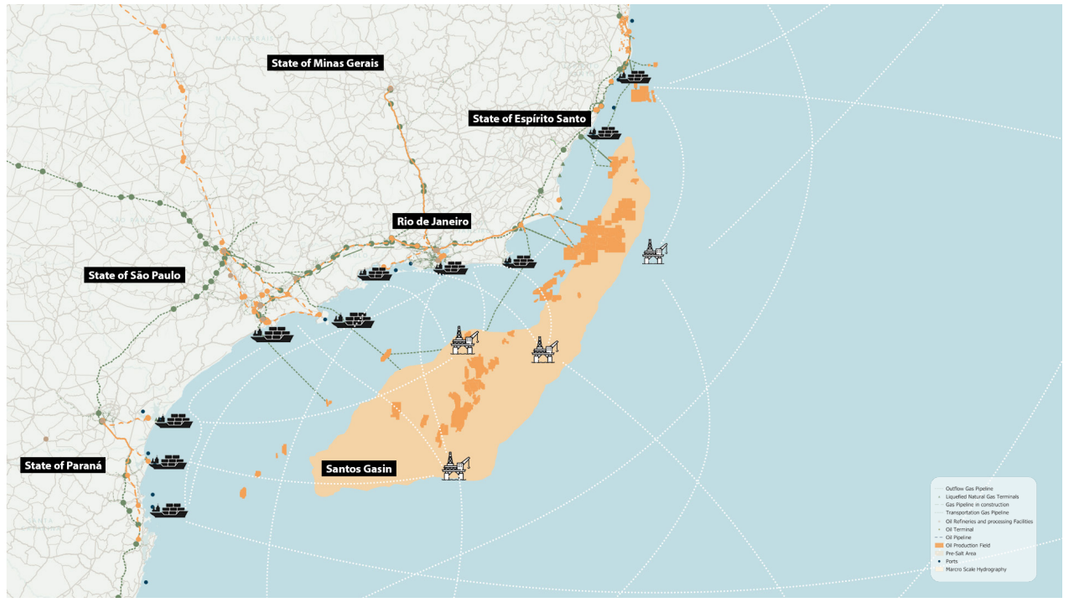
By reimagining REDUC not as a relic of the past, but as a seedbed for regenerative futures, Petrobras has the power to lead by example, demonstrating that the transition to clean energy is not only necessary for safety and sustainability but also an unparalleled opportunity for economic resilience, social equity, and environmental justice.





01 | Oil Industry Network in Guanabara Bay

REDUC is one of the most critical assets in Petrobras' refining network and a cornerstone of the Guanabara Bay area and Brazil's national energy infrastructure, accounting for 12% of Brazil's total refining capacity.



02 | Brazilian Oil Industry Network

Elements of the oil infrastructure in the Bay are connected to a larger infrastructure that stretches via pipes throughout the country and across Brazilian borders.



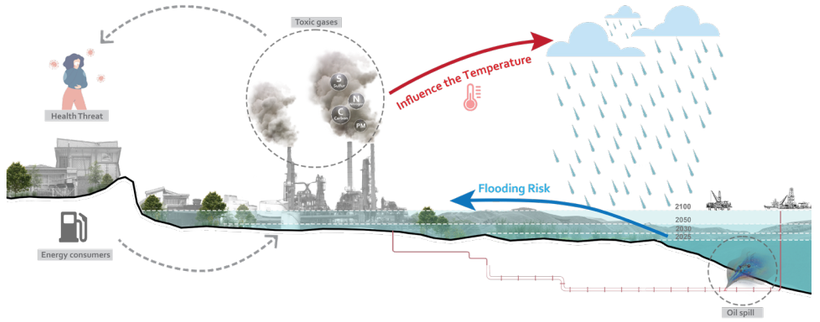
03 | Oil Refinery Site

The REDUC oil refinery is composed of large crude oil storage tanks, where the raw oil undergoes multi-stage distillation and refining through a series of processing units. The output is converted into more than 50 different petroleum-based products, stored in smaller tanks and distributed to households and industries.



04 | Flooding Risk

Flooding poses a major challenge. By 2050, nearly 50% of REDUC oil refinery is at risk, and projections for 2100 show almost the entire site underwater. Our site is located adjacent to the waterways feeding the bay, increasing the threat to bay ecosystems. The cause and effect relationship pollution has on severe rainfall and sea-level rise have needs to be understood and designed for.



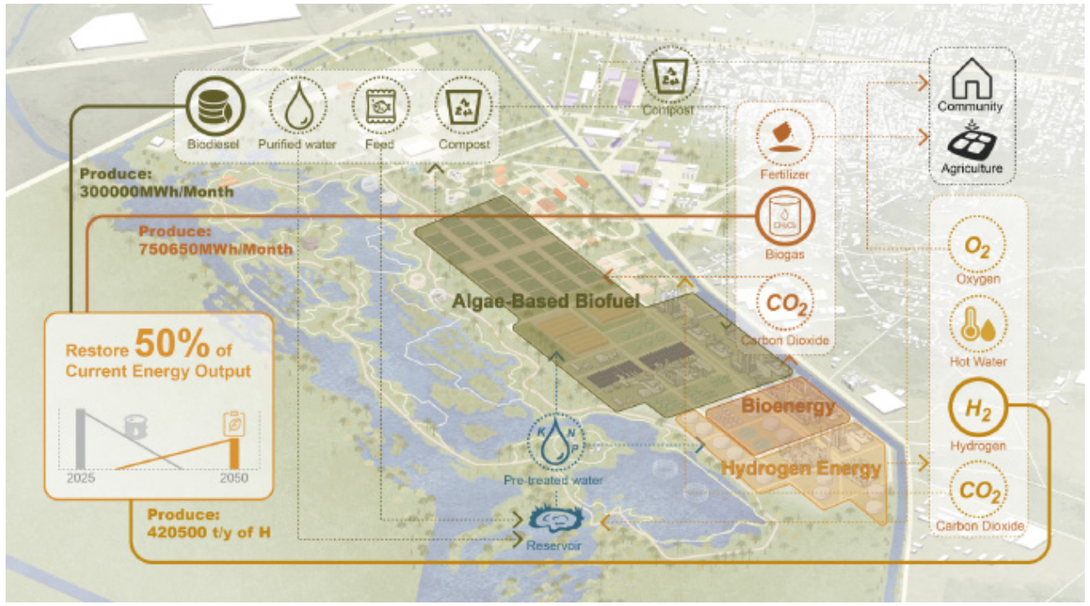


05 | Strategy

By 2100, the area can evolve into a global model of green energy-producing, and community-centered ecological hub fully integrated with its environment and resilient to future climate challenges. This proposal is a long-term phased development plan, integrating water restoration, ecological regeneration, renewable energy system, environmental education, and community-based economic models to ensure a sustainable and inclusive transformation.

06 | Renewable Energy Transition

Looking ahead, with advancements in green technologies, we envision the former refinery structures being repurposed into micro-algae biofuel farms, bio-digester facilities, and hydrogen energy production plants. Together, these systems can restore 50% of REDUC's original output by 2050 while advancing circular, community-integrated energy production.













11 | Visitor Center



12 | Community Activities



13 | Breaking the "Wall"

ILHA DA CONCEIÇÃO

GUANABARA BAY, BRAZIL

Spatial Visions

ILHA DA CONCEIÇÃO, BRAZIL

FROM WRECKS TO WONDERS

RECLAIMING SHORELINES, ENRICHING COMMUNITIES

Hongxiang Wang, Karunia Ayu, Tianqi Zhao

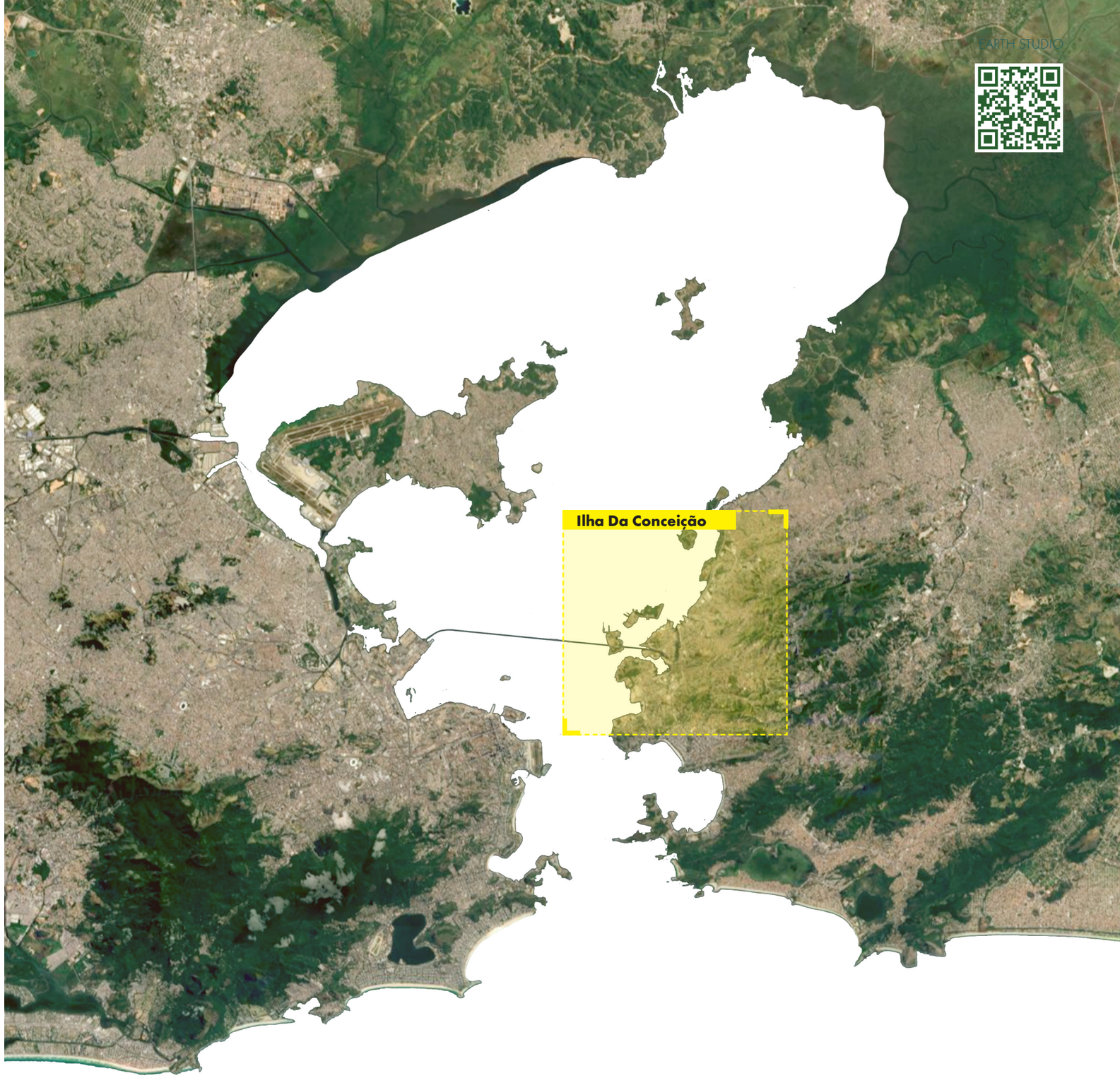
WHAT IF THE WATERWAY IS REOPENED, BRINGING COMMUNITY ACTIVITIES TO ITS SHORES, AND REVITALIZING THE ECONOMY AND INDUSTRY ALONG THE BANKS?

In the past, the island of Ilha da Conceição was composed of three separate islets located within Guanabara Bay. The construction of Niterói's port and the later Rio–Niterói Bridge, which was driven by the expanding oil industry, filled in the channels that separated the two islands. This effectively annexed the islands to the city while also obstructing the natural flow of water. In addition to the accumulation of derelict ships, this land reclamation has caused the accumulation of wastewater and industrial runoff, which has resulted in the transformation of once clean currents into polluted pools of stagnant water.

The shoreline is now dominated by industrial activity, which has cut off communities from the water and undermined both the quality of the fish catch and traditional ways of making a living, where previously local fishers used to thrive in this area.

The 'what if' scenario that we have envisioned involves reestablishing water circulation without displacing any industry. By relocating factories to nearby locations and innovatively repurposing vessels that have been abandoned, we can bring back a canal that is cleaner and flows more freely. Residents of Ilha da Conceição and Niterói would be brought together through the creation of new public spaces along its banks. These spaces would serve as natural filtration zones and social connectors.

What is the end result? improved water quality, revitalized community fishing, and parks along the water's edge that serve the communities. The ways that industry, ecology, and community can coexist in harmony would be demonstrated by the fact that improved access to the bay would stimulate the creation of jobs, broaden access to goods and services, and supporting local economic growth.



01 | 1930

Ilha da Conceição started its modernization process, and the population began to grow. Some industrial activities also started to develop around that time. However, back then, the water was clean since it flowed naturally, and the residents could freely enjoy the island's beaches.



02 | 1970

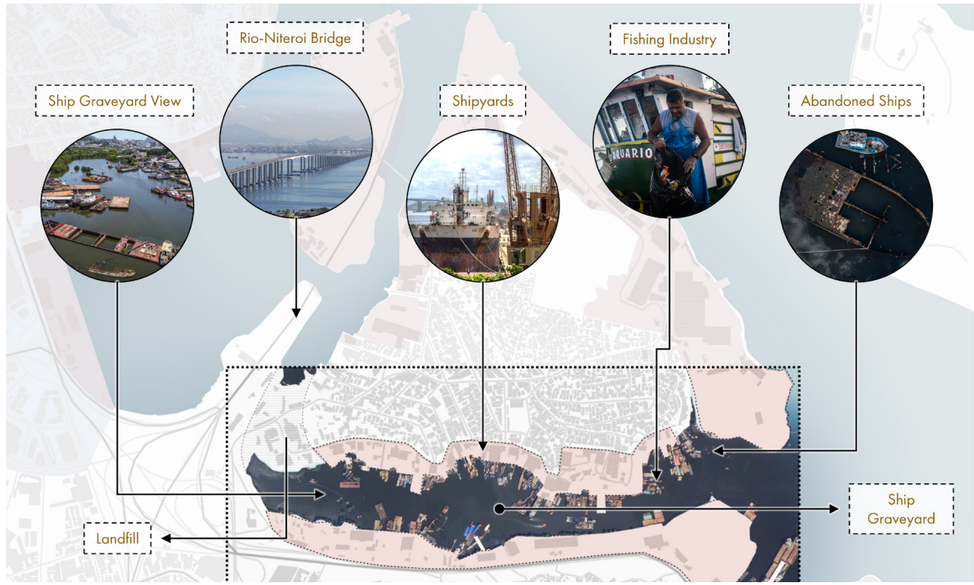
To make way for Rio-Niterói Bridge construction, the island was "attached" to the city of Niterói by infill. The pollution problem started to happen as the waterway was blocked, making the water stagnant.



03 | Now

Since then, all problems have become visible over time. The stagnant water makes the water chanel the 'back of the house' where vessels are abandoned without regulation. Coupled with dense shipbuilding activity it has led to not only serious water pollution issues, but the declining economy and public health issues as well.

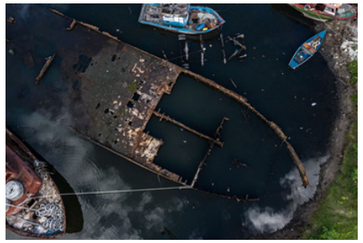




03 | Existing Condition

Encircled with dense industry activities, this water body gradually became a large ship graveyard in the entire Guanabara Bay.

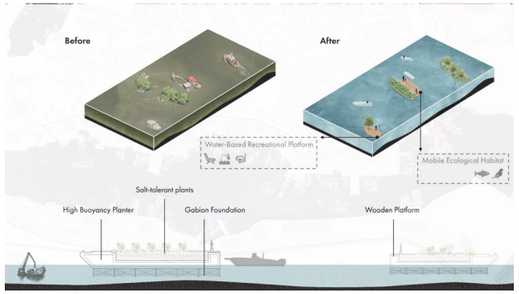






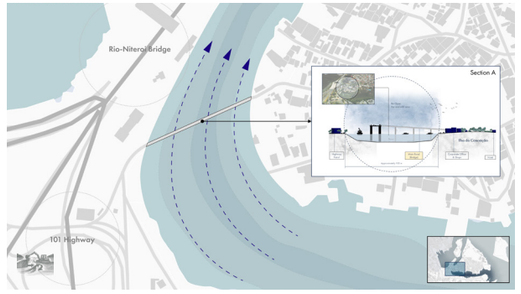






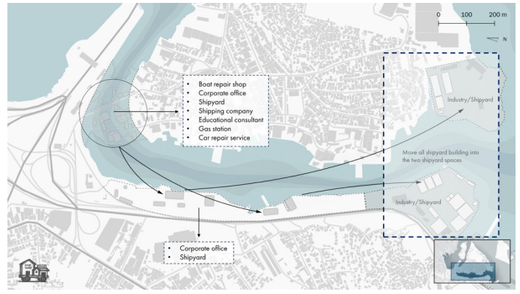
04 | Use Abandoned Ships to Enhance Ecosystem

Acknowledge and leverage existing potential to enhance biodiversity.



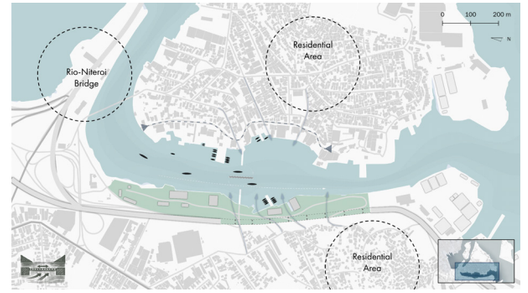
05 | Reopen The Waterway

Reestablish tidal flow, reduce water stagnation, eliminate pollution.



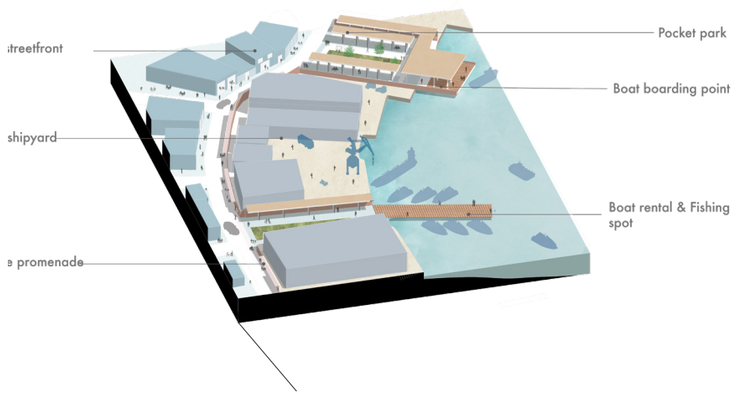
06 | Reconfigure Building Zones

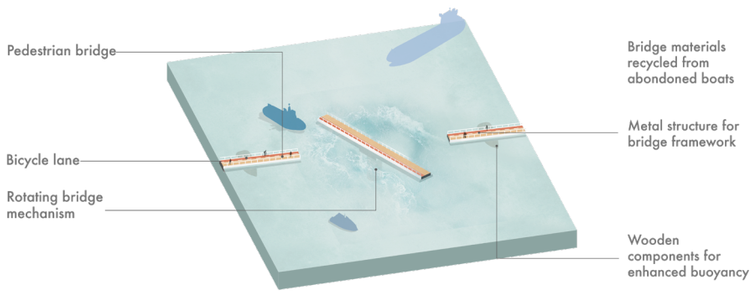
Relocate commercial activities and stimulate the econonomy by diversifying businesses.

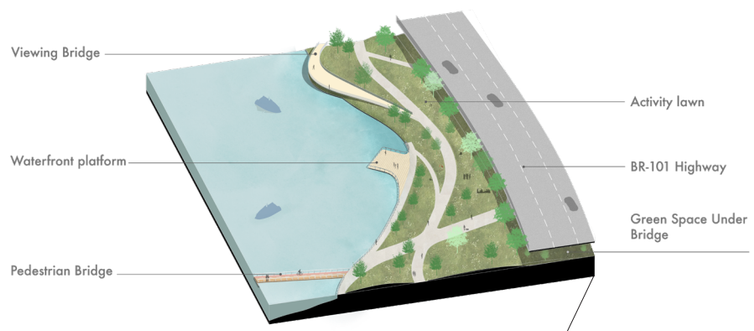


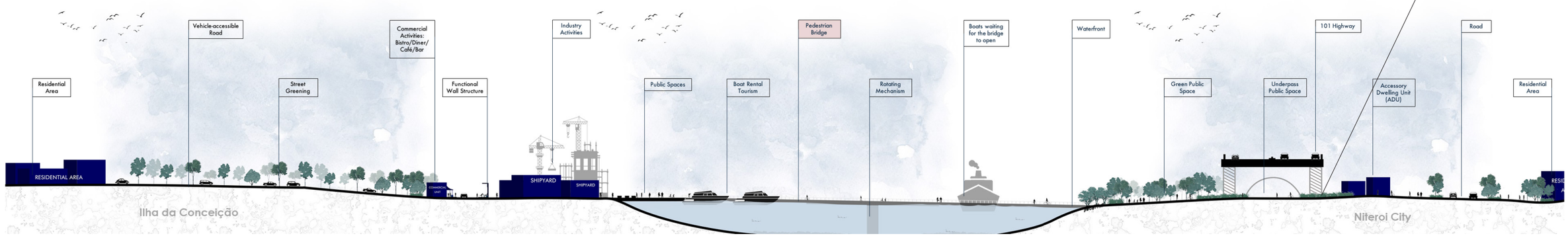
07 | Open Land-Water Connection

Foster community engagement, supports local business and cultivates waterfront identity.









08 | Ilha da Conceição - Niterói Section



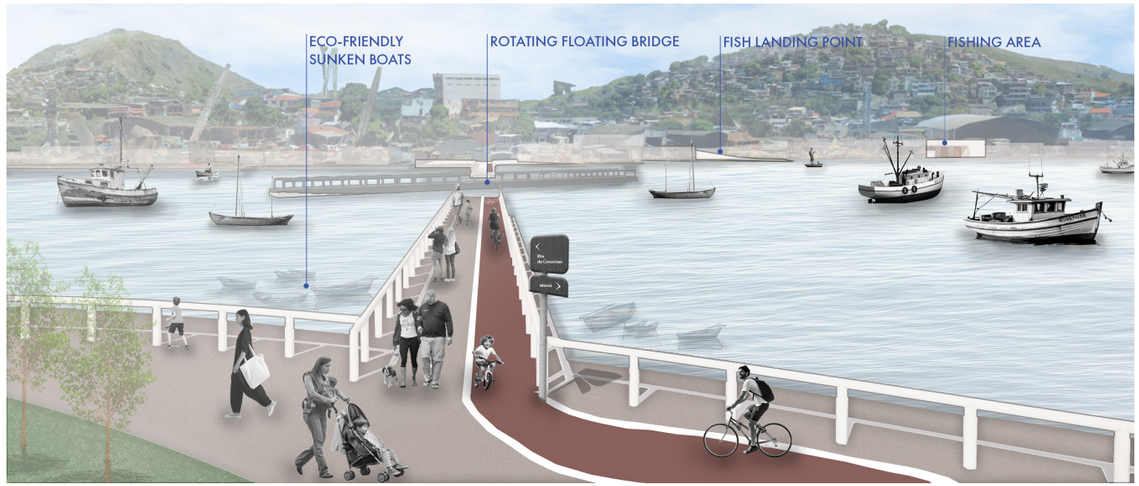
09 | Boat Rental and Fishing Spot

Providing the community with public spaces. While repurporsing some of the vacant unused shipyards, this public space will be a new asset for generating new economy, adding new stormwater catchment, and engaging the community.



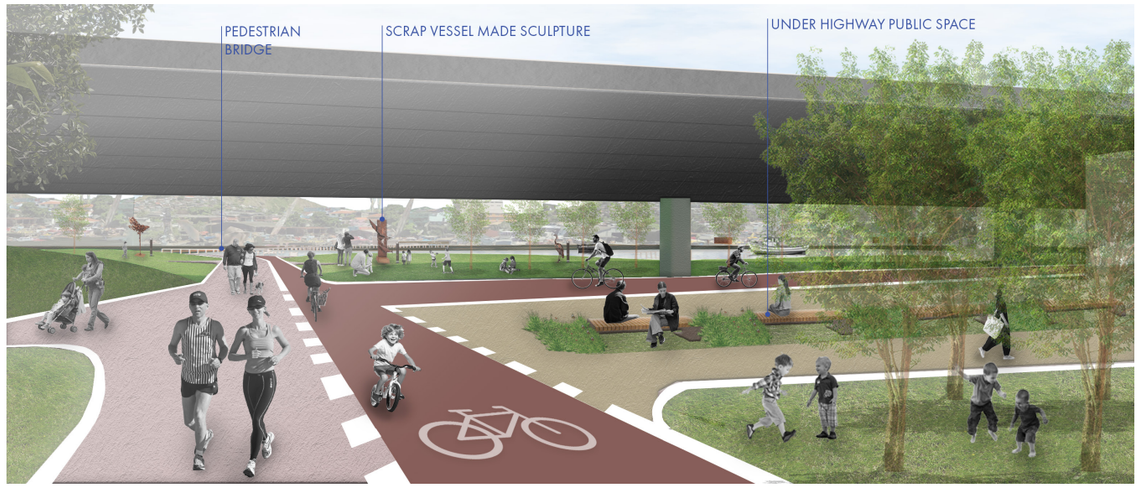
10 | New Street Front Stores

Reimagining the once a fragmenting wall for public activities. This allows the remaining industry to still have privacy and give this wall a new function for public goods.



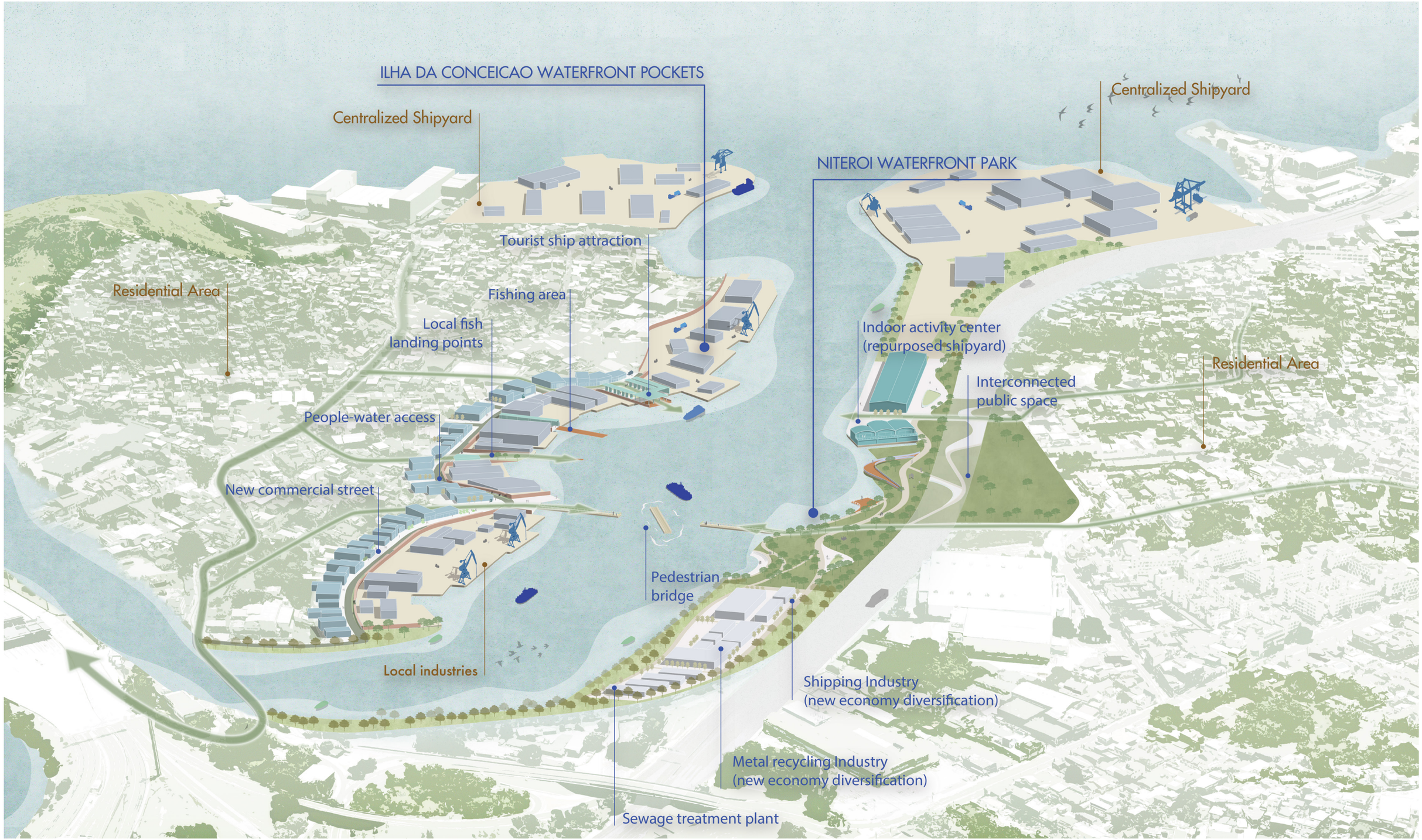
11 | Pedestrian Bridge

Connecting the two waterfronts, provide new access to get in and out of the island.



12 | Underpass Green Space

Large public green park will connect residential areas with the water. This proposal aims to reactivate the dead space under the highway with additional natural water filtering features in the waterfront.


ILHA DA CONCEICAO WATERFRONT POCKETS
Centralized Shipyard
Tourist ship attraction
Residential Area
Fishing area
Local fish
landing points
People-water access
New commercial street
Local industries
Pedestrian
bridge
NITEROI WATERFRONT PARK
Centralized Shipyard
Indoor activity center
(repurposed shipyard)
Interconnected
public space
Residential Area
Shipping Industry
(new economy diversification)
Metal recycling Industry
(new economy diversification)
Sewage treatment plant



ARCHIPELAGO

GUANABARA BAY, BRAZIL

Spatial Visions

GUANABARA BAY, BRAZIL

THE NEW ARCHIPELAGO

A VISION FOR THE ISLANDS OF GUANABARA BAY

Guo Xiu / Yikai Zhang / Ziheng Zhou

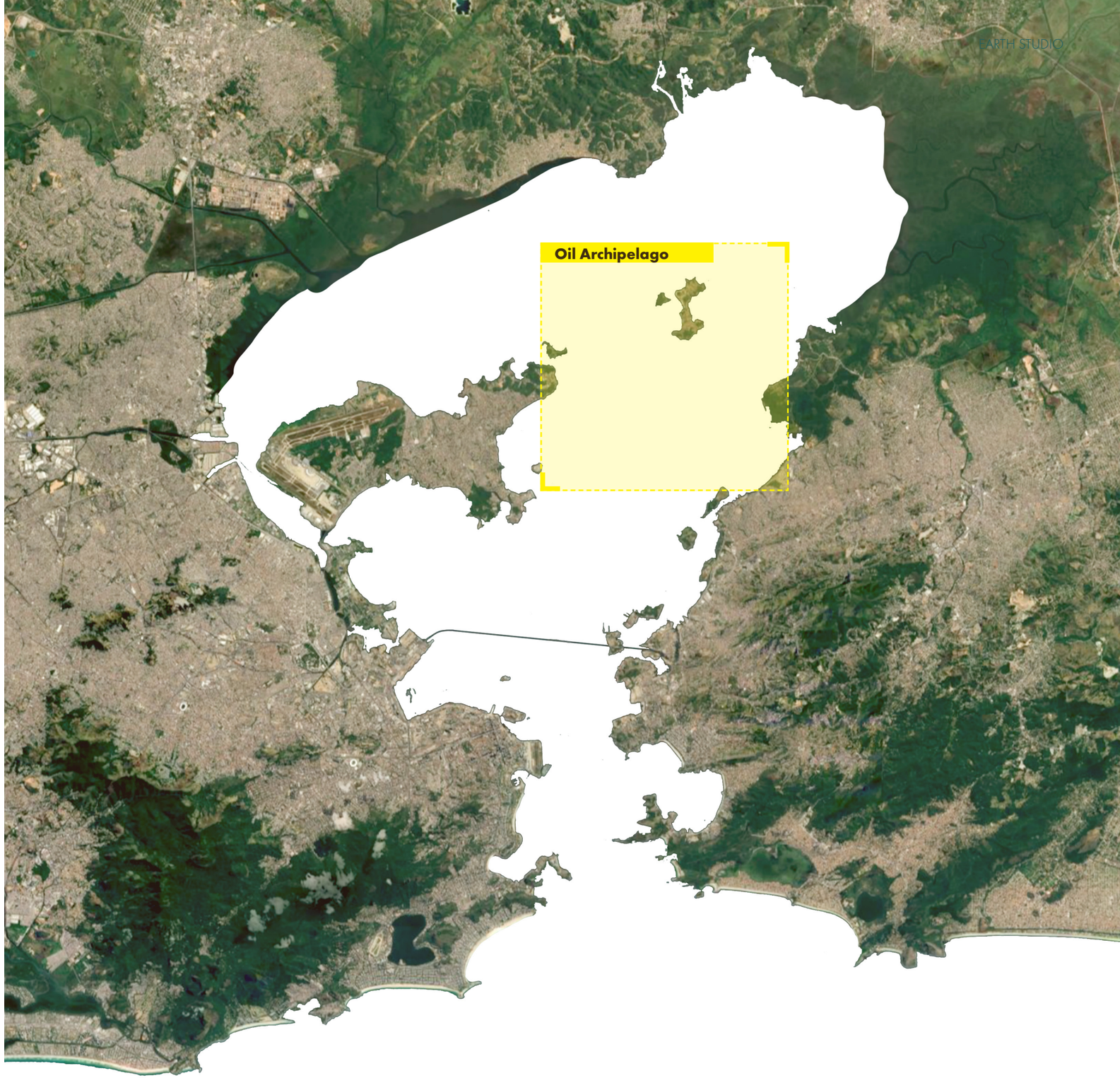
WHAT IF WE RETHINK THE ARCHIPELAGO AS AN URBAN SYSTEM TO ENHANCE ECOLOGICAL, SOCIAL, AND ECONOMIC VALUES OF THE GUANABARA BAY?

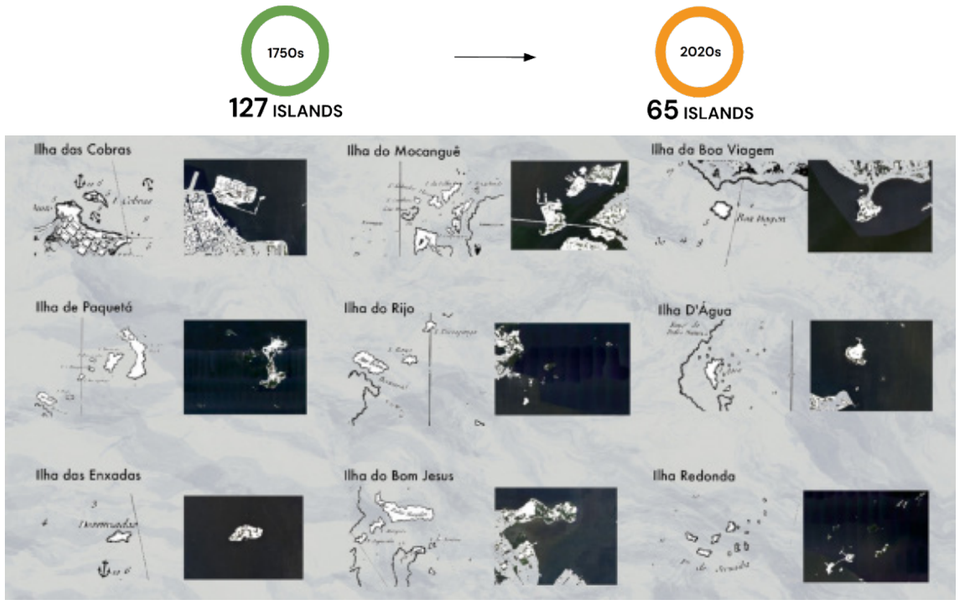
We redefine archipelago as not just a set of physically stationary islands, but also including all ecological, social, and economic activities related to it.

Our project aims to redefine and redesign the archipelago at Guanabara Bay, creating urban systems that will enhance it's ecological, social, and economic value.

In the short term, it is feasible to create public access to these oil islands, and gradually add renewable energy facilities to the oil rigs. With purifying, utilizing, and strengthening the reef area, we propose creating education and leisure spaces that urban residents can use. Furthermore, this project will enable the Bay to contribute to the future energy trasition.

In the long run, a post industrial park, a floating walkway,and mobile urban spaces created by transforming supertankers will emerge and the archipelago will truly become a civic assets.

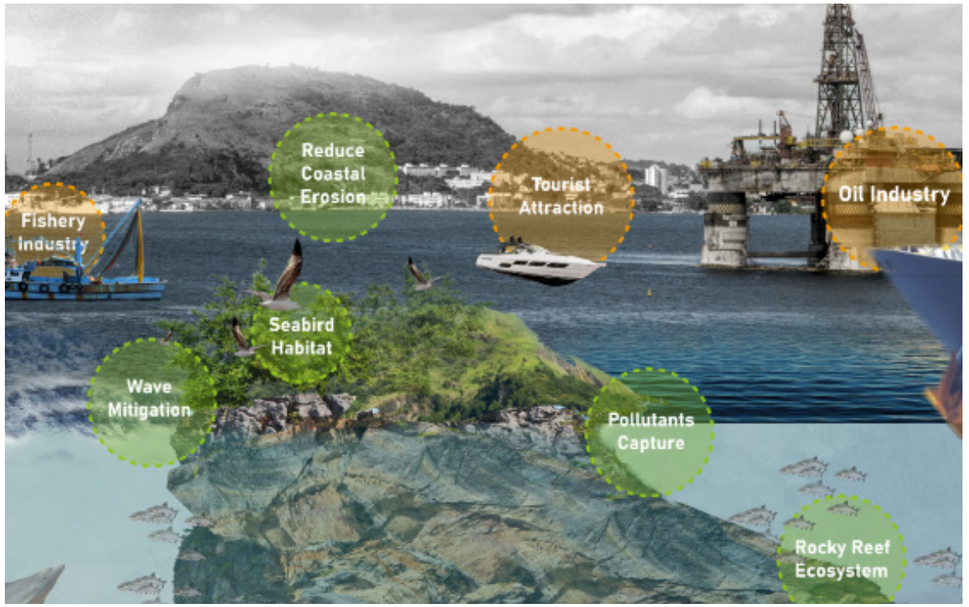




01 | Changes In Islands Over The Past 200 Years

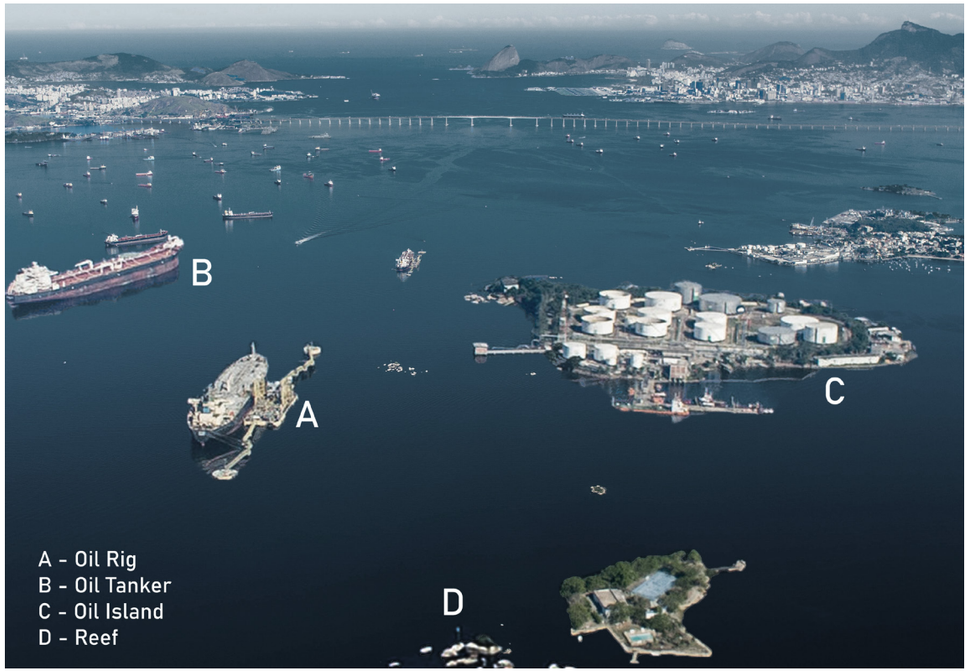
Guanabara Bay was once an island-studded and vibrant tropical Bay. However, sea level rise, coastal erosion, and human activities have led to a 50% reduction in the number of islands.

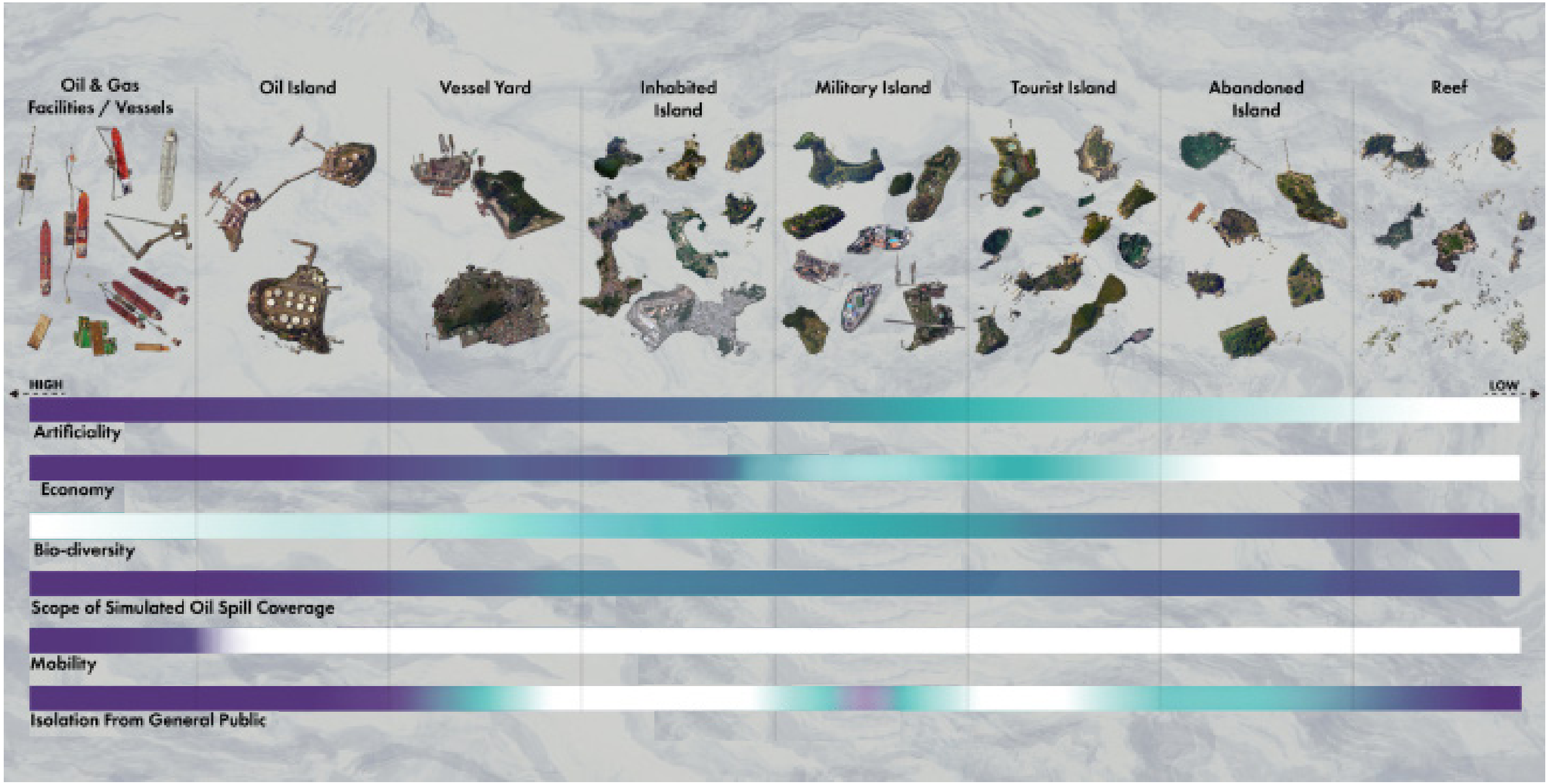




03 | Values Of The Archipelago In Guanabara Bay

The islands of Guanabara Bay are rich in economic, ecological, and social values. However, there are conflicts between these values, such as the oil industry has dealt a blow to fisheries and ecosystems while contributing to the economy.





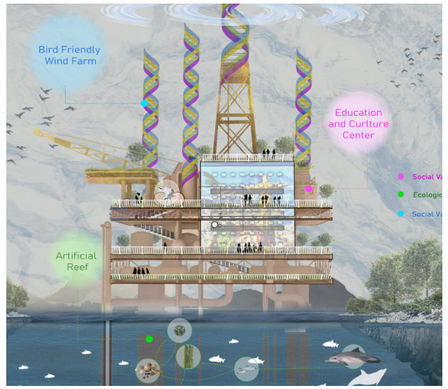
05 | Island Typologies And Analysis

The analysis of these island types indicates that the higher the degree of artificialization of the islands, the higher their economic value, but lower their ecological value.

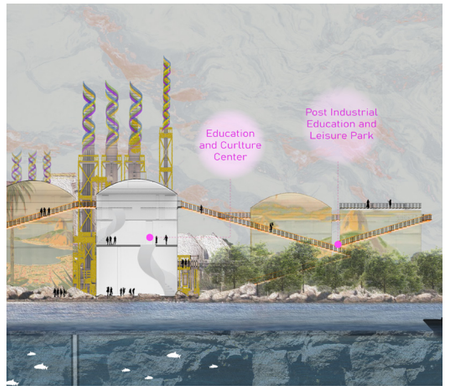
Although the oil industry in Guanabara Bay has made significant economic contributions, it has also caused serious damage to the ecosystem. The negative impact of oil spills, low biodiversity, and busy oil tankers on underwater life is sufficient evidence of this.

A more important conclusion is that the higher the artificialization of the island type, the higher the degree of isolation it has. The highest artificial island types lack public access, such as to oil facilities, ships, and oil islands. Guanabara Bay is not short of tourists and vitality, but these islands are like forbidden zones, lacking public access and social attributes.

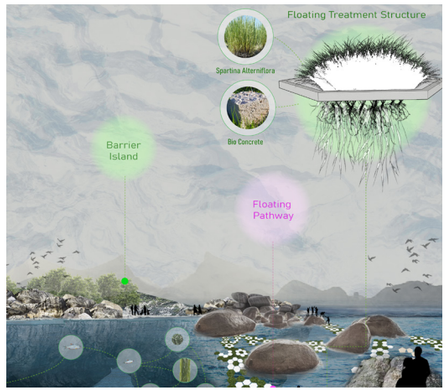
Therefore, this project aims to enhance the public access, energy producing potential, economic, ecological, and social values of different island types based on their characteristics.



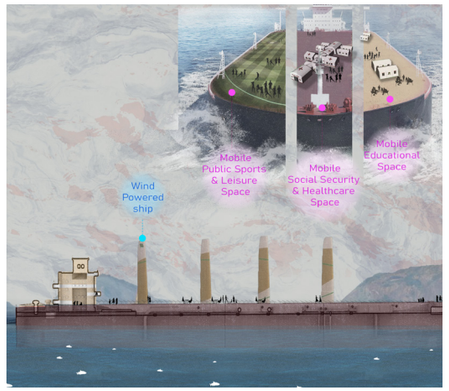
06 | Proposed Oil Rig Site



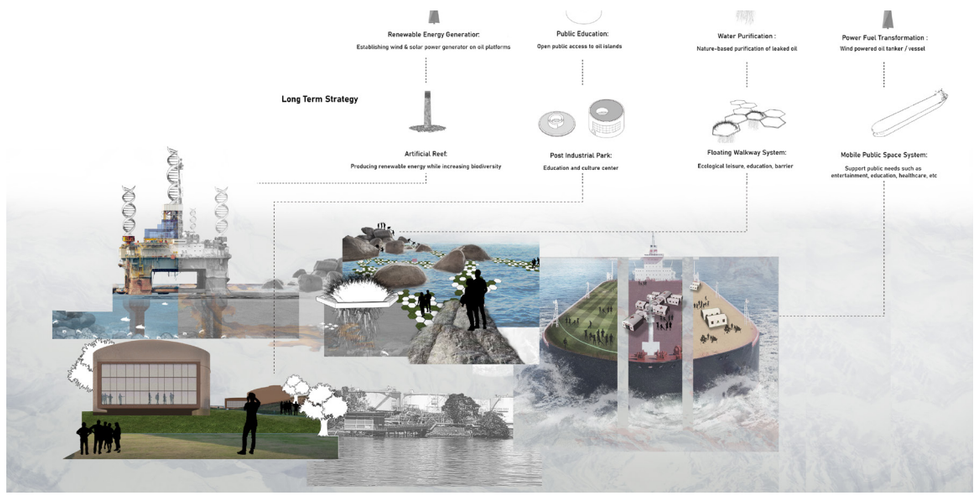
07 | Proposed Oil Island



08 | Proposed Reef Site



09 | Proposed Mobile Public Space





10 | Post Industrial Park At Oil Island



11 | Energy Education Center



12 | Floating Pathway In Reef Zone



13 | Archipelago As Urban Networks

TOWARDS IMPLEMENTATION



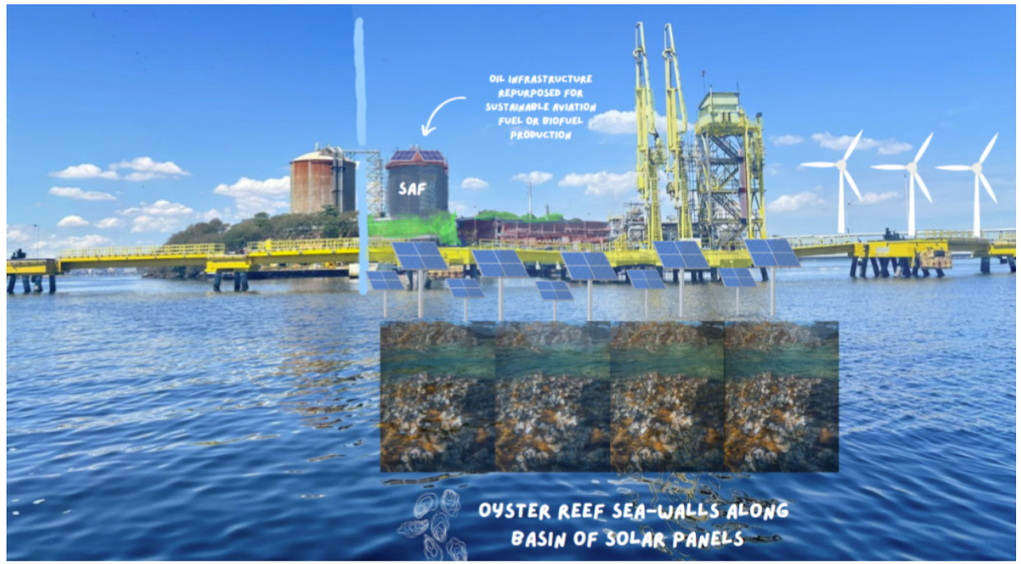
CLIMATE POLICY PROVOCATIONS

Layers of Action

CARISSA O'DONNELL

REPURPOSE

LESS STRANDED, MORE ASSET



The Guanabara bay faces two main challenges with it's pre-existing infrastructure:

1. Climate change compromising the Bay's functionality and operations as a port;
2. The fear of stranded assets if oil production were to relocate/dissipate.

Oil companies that have built the infrastructure must be incentivized to repurpose it in support of the energy transition; they must be penalized for stranding it. Other companies must be incentivized to repurpose this infrastructure should it be stranded. This would entail creating a policy that protects and preserves the relevance of the Bay as an energy hub of Rio while also ensuring that adaptation strategies are intentionally designed with nature-based solutions in mind.

Should an oil company decide to disband operations in the bay (preferably because the demand for oil declines as renewable energy technology becomes more cost effective), they cannot just leave stranded assets– **they must clean up their mess.** The Bay already has an energy-based workforce and generation capacity; it calls for a similar industry to replace fossil fuels in order to continue driving economic growth for the state and country.

Stranded assets will be subject to a fine proportional to the mass of the infrastructure, while any organization or company that chooses to adopt and repurpose the infrastructure—whether for Sustainable Aviation Fuel, agriculture, biodiesel, or another use—will receive a similarly scaled subsidy to support retrofitting and repurposing efforts. There is no limit on what the infrastructure can become, only that it must have a sustainable and nature-based approach that accounts for necessary climate adaptation.

LAYERS OF ACTION

SETTING THE FEE

- Conduct a comprehensive audit of existing industrial assets in the Bay; identify which are stranded, underutilized, or at risk due to climate, regulatory, or economic shifts.
- Introduce legal definitions of stranded assets; set criteria for taxation assessing the infrastructure:
    - **Evaluate Retrofit Costs and Residual Value:** Calculate the full cost of repurposing each asset—including decommissioning, remediation, and upgrades—while assessing its current salvage value to ensure fair and balanced pricing.
    - **Set a Scaled Fee:** Price the fee proportional to the asset's mass or size; adjust by infrastructure type and complexity.
- Support retraining and reskilling programs for workers affected by asset transitions; support localized involvement and incentivize social buy-in
- Work with Petrobras, Companhia Docas do Rio de Janeiro (CDRJ), and Shipbuilding and Maritime Firms to accomplish the above.

POLITICAL BACKING

- Introduce a Stranded Asset Fee (SAF) aligned with international Carbon Border Adjustment Mechanism (CBAM) principles; frame
  this as a pre-emptive alignment with EU CBAM regulations to protect Brazilian exports from future penalties.
- Form a bay transition multi-stakeholder agreement between government, industry, and civil society on asset transition and repurposing.
- House stranded asset repurposing legislation under Brazil's federal climate framework; embed this law within existing instruments like Brazil's PNMC and subnational environmental codes.
- Announce this initiate at COP30; pitch the Bay as a "living lab" for urban-industrial transitions.
- **Frame/Angle the Bay as a global leader in stranded asset repurposing and clean energy production.**

COMMUNITY-CENTRIC INVESTMENT

- Establish a Guanabara Bay Climate & Transition Research Network housed at UFRJ or FIOCRUZ.
- Provide courses on environmental engineering, climate risk management, coastal resilience, and just transition skills that can directly be applied to the bay. Have these programs feed into the workforce to keep labor skills local and applicable.
- Launch a Guanabara Bay grant program that funds research into how to best repurpose stranded assets
- Use open-source platforms for data sharing and co-development with local communities
- Incorporate traditional knowledge and cultural heritage into repurposing design; Use cultural mapping and community storytelling as planning inputs.
- Collaborate with cultural NGOs for place-based regeneration projects.

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AMINA DIOP

REIMAGINE

BRIDGING KNOWLEDGE & FINANCE



"Forest education can be the solution to the problems generated by coloniality and modernity."

Pr. Monica Lima Mura Manau Arawak | Professor-Maracana University

FROM SALT EXTRACTION TO URBAN REPAIR

This project began with an investigation into salt extraction's physical and symbolic presence in Rio de Janeiro, both a literal resource and a legacy of extraction embedded in urban landscapes. Salt, as a material and metaphor, revealed deep layers of displacement, fractured land rights, fragmented climate adaptation, and deepening urban inequalities. Using indigeneity as a critical lens, this research reveals how urban Indigenous communities, like those at Maracanã Multiethnic Village, remain systematically excluded from resilience planning and land tenure protections, despite being frontline stewards of ecological repair.

The opportunity lies in the reconciliation of knowledge and finance: integrating Indigenous governance and ecological knowledge into emerging financial frameworks like the Loss and Damage Fund (LDF). The case for action is multifaceted: economically, investing in community-driven adaptation reduces disaster costs; socially, it repairs historical exclusions; politically, it operationalizes international climate justice commitments; and ecologically, it restores damaged urban ecosystems.

Actors at every scale are motivated to act by the urgent need to build equitable, climate-resilient cities. Redirecting LDF flows to support Indigenous-led land trusts, education initiatives, and green infrastructure projects in post-extractive urban zones offers a replicable model for systemic change.

LAYERS OR ACTION

LOCAL

- **Governance Reform:** Amend Loss and Damage Fund (LDF) operational guidelines to directly fund community land trusts and Indigenous-led adaptation.
- **Legal and Financial Empowerment:** LDF to protect land rights and democratize climate finance to support Traditional Ecological Knowledge and long-term community-led ecosystem restoration. Embed justice and accountability into climate recovery
- **Networks and Incentive Alignment:** Strengthen alliances between urban Indigenous networks (e.g., Maracanã Village) and international climate justice movements to share best practices and advocate for direct finance access.
- **Industry Commitment:** Extractive industries (e.g., Petrobras) to integrate decommissioning-for-repair pledges tied to global climate investment incentives.

NATIONAL

- **Opportunity:** Leverage Brazil's 2030 Net Zero Amazon commitment to include urban Indigenous land demarcation.
- Negotiating Strategies: Integrate Community Benefit Agreements (CBAs) into national LDF-related contracts and urban planning reforms.
- **National Law and Standards:** Pass urban Indigenous land rights legislation extending protections beyond rural Amazonian territories.
- **Reforms of Economic Policy:** Include community land trusts as eligible recipients under national green infrastructure and resilience investment programs.
- **Information Aggregation:** Build an open Urban Indigenous Climate Risk Atlas to drive informed policy and funding priorities.
- **Safeguarding Indigenous Land and Climate Policy Integration:** Strengthen the Ministry of Indigenous Peoples to secure land rights, prevent exploitative deals, and embed Indigenous priorities in national climate strategies.

GLOBAL

- Local Laws and Codes: Implement zoning reforms to formally recognize Maracanã Village and similar Indigenous urban communities.
- Research and Study: Fund localized research on extraction impacts and Indigenous restoration practices.
- Technological Advancement: Use GIS mapping and participatory data platforms to document Indigenous land use and climate risk exposure.
- Education: Expand partnerships with universities (e.g., Federal University of Rio) to institutionalize Indigenous knowledge systems in climate education.
- Citizen Science Program: Funded by LDF streams, launch a Citizen Climate Monitoring Program run by community-led and youth organizations in vulnerable urban zones.
- Partnerships: Build public-private-community-academia partnerships to align green infrastructure projects with Indigenous land stewardship goals.
- Securing Urban Indigenous University: Grant land rights to Maracanã Village and dedicate 1% of the education budget to expand the university, securing its campus and training 500+ Indigenous climate mediators annually.

SOURCES

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SAMANTHA DADY

REARTICULATE

LABOR OF INFORMATION



Knowledge is the commodity at the heart of our most deeply rooted landscapes of extraction. Traded in academic journals, leveraged for technological development, and employed to shape policy and urban planning, knowledge extraction guides the flow of power, influence, and resources globally. In Rio de Janeiro, Brazil, organizations, such as Decodifica and the Brazilian Center for Climate Justice, rearticulate the historical shape of knowledge production and data collection.

Historically, academic studies on climate resilience have centered around the "more-educated" researcher designing and executing studies on a community's experience of a hazard or implemented policy. Though these studies are generally executed with the positive intention of spotlighting a community's vulnerability to climate shocks, they tend to extract Indigenous knowledge and strip the researched community of its voice in telling its climate story. To truly restore justice to the climate conversation, we must reimagine how the data so essential to decision-making is collected.

Participatory research methods and citizen-generated data collection offer a transformative shift. These research models focus marginalized groups as the protagonists of the data-collection process rather than mere means to an end. This data is often co-produced with or produced outside traditional research institutions, such as universities, and infuses targeted communities with autonomy over who conducts the research, what is being researched, and how the research is presented, ensuring that their perspectives shape data collection decisions from the beginning. These research methods garner greater statistical accessibility and have the potential to generate new job opportunities as people become trained in data-collection processes. Of course, the data produced from these methods are not a replacement for traditional city-, state-, or country-level data but rather a supplement, providing a more comprehensive, inclusive, and accountable picture of a community's vulnerability, needs, and the effectiveness of adaptation interventions.

At present, the organizations undertaking participatory research and citizen-generated data collection are funded piecemeal and compete for limited resources. This inconsistent flow of capital prevents them from scaling effectively and creating a lasting impact. Thus, we can make visible these historically invisible knowledge production methods through channeled funding mechanisms that recognize the value in the labor of information.

LAYERS OF ACTION

LOCAL

To establish a consistent flow of capital for participatory research and citizen-generated data collection in Rio de Janeiro, the city could:

- Partner with Inter-American Development Bank (IDB) to establish a Debt-for-Resiliency-Research Swap (DFRRS) between Rio de Janeiro and its greatest debtor, the Brazilian Federal Government.
- Employ DFRRS funding to scale adaptation-focused research aimed at identifying the most critical regions for risk and vulnerability in the Plan for Sustainable Development and Climate Action of the City of Rio de Janeiro, through community-led participatory research and citizen-generated data collection initiatives.
- Collaborate with organizations, such as Decodifica and the Brazilian Center for Climate Justice to establish criteria to receive funds, such as collected data must be uploaded to an independently operated, public database.

NATIONAL

To establish a consistent flow of capital for participatory research and citizen-generated data collection in Brazil, the country could:

- Issue Social Sovereign Bonds in accordance with Brazil's Sovereign Sustainable Bond Framework to fund research aimed at achieving its National Adaptation Plan (NAP) goals 3.6-3.8, diagnosing degrees of vulnerability across populations at greatest risk to specific climate shocks.
- Imbue participatory research and citizen-generated data with a leading role in meeting the country's NAP goals 3.6–3.8.
- Call on local and national organizations to submit proposals for conducting participatory research or citizen-generated data collection across the country's most vulnerable populations
- Convene collectively, both government and research officials, at a conference to co-produce final vulnerability findings.

GLOBAL

To establish a consistent flow of capital for participatory research and citizen-generated data collection globally,
parties to the UNFCCC could:

- Allocate a portion of adaptation-focused funds (e.g., Green Climate Fund and Adaptation Fund) to support participatory research and citizen-generated data collection initiatives in Least Developed Countries (LDCs) and Small Island Developing States (SIDS).
- Use collected data at the next COP to develop citizen-led, global vulnerability rankings.
- Reserve Loss and Damage funding based on global vulnerability rankings for approved adaptation projects in the most vulnerable populations.
- Integrate local participatory research and citizen-generated data into the measurement, monitoring, and verification (MMV) of the approved adaptation initiatives.

CHESANG ROTICH

REINVENT

PETROCHEMICAL TRANSFORMATION



“The energy Transition isn’t necessarily green, they need petrochemicals” Lea Reichert, CEBRI

Brazil’s proven oil reserves, totaling 15.9 billion barrels, are projected to deplete by 2035 at the current production rate of 3.47 million barrels per day. Brazil aims to deploy 17 new oil platforms by the end of the decade, but its current reserves may not support expanded production beyond the following decade, emphasizing the critical need for discovering additional oil fields. This impending decline places urgent pressure on oil-dependent economies like Rio de Janeiro to envision alternative development paths. Yet petrochemicals remain deeply woven into daily life in medicine, packaging, construction, and agriculture. While a fossil-free future is essential, the transition must also address sectors where alternatives remain limited.

Petrochemicals are a major contributor to plastic pollution, carbon emissions, and environmental injustice. At the same time, global industries, especially in healthcare, aviation, and specialized manufacturing skills, rely on them. Simply banning petrochemicals risks economic disruption and supply chain breakdowns. A circular, decarbonized petrochemical economy could offer a bridge: maintaining industrial function while reducing environmental harm. In this vision, Rio becomes a hub for sustainable petrochemical innovation.

Carbon-negative plastics are developed using captured CO_2, bio-based polymers replace fossil feedstocks in packaging, waste-to-fuel technologies turn plastic waste into energy and advanced recycling creates closed-loop supply chains. Drawing on Brazil’s Ecological Transformation Plan and the Nova Indústria Brasil framework, Rio leads a national push toward low-carbon industry, supported by targeted planning and green infrastructure investment. The city also aligns with Brazil’s priorities under the Industrial Transition Accelerator (ITA), with chemicals and aviation positioned as core sectors for decarbonization.

LAYERS OR ACTION

LOCAL

- Launch carbon markets to enforce petrochemical circularity.
- Scale Industrial Transition Accelerator (ITA) projects, especially in chemicals and aviation.
- Standardize sustainability criteria for petrochemical innovation through an international taxonomy (Benchmark with EU model).
- Leverage Brazil’s COP30 presidency to position Rio as a leader in climate-era petrochemical reform.

NATIONAL

- Expand special economic zones for green industry replication (e.g., Green Energy Park in Piauí).
- Advance implementation of the Ecological Transformation Plan and Nova Indústria Brasil framework.
- Strengthen Extended Producer Responsibility (EPR) laws to hold firms accountable for petrochemical waste.
- Mobilize targeted green infrastructure investment to support low-carbon manufacturing.

GLOBAL

- Repurpose aging oil pipelines and processing facilities into renewable hubs and innovation labs.
- Nationalize and expand the Neutral Carbon Rio Strategy for city-wide decarbonization.
- Accelerate the Solário Carioca solar initiative, linking energy transition with social inclusion.
- Empower fence line communities in planning processes, ensuring equitable distribution of green investments.
- Partner with Petrobras, UFRJ, and CTDUT to pilot circular petrochemical innovations in Rio.

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JULIA GOLDSAMT

REFRAME

COLLABORATIVE KNOWLEDGE



"No one is outside of the blue economy."

The Guanabara Bay is deeply impacted by and deeply impacts both local community and industry in Rio. From an economy and ecology dominated by the oil industry to infrastructure struggling to keep up with a changing climate, from communities reliant on fishing to the polluted nature of the Bay, these industrial and ecological extremes exist at odds with each other, causing social, economic, and political tension surrounding the livelihoods of and on the Bay. Local communities have historically been deprioritized in the face of industrial economic progress and development, which has accelerated the destruction of the Bay, both ecologically and culturally. The current pollution in the Bay reveals a failure to integrate local knowledge and equity into urban climate and coastal planning; the climate crisis amplifies these tensions and pressures for communities that rely on the Bay's ecosystem and infrastructure. The Rio Blue Metropolis plan aims to address this destruction and mitigate impacts of future climate disasters, with goals including a water safety and security program, improved sewage treatment and water management, and employment of nature-based solutions and "Green Belt" conservation areas throughout the city. This project confronts the above tensions by exploring the question: What if Rio's blue economy governance incorporated climate justice frameworks and co-production of knowledge in its policy and decision-making?

As the state of Rio de Janeiro implements the Blue Economy Management Project within its "Blue Metropolis: Water at the Heart of Rio's Agenda" plan, this project advocates for the centering of co-production of Indigenous and local knowledge and uplifting of previously silenced voices in alignment with climate justice frameworks. Through 1) a proposed partnership with the Brazilian Center for Climate Justice (CBJC) to assist in the development of a local knowledge database, 2) establishment of participatory governance frameworks for communities on the Guanabara Bay, such as Ilha de Conceição, and 3) implementation of climate education and political advocacy workshops for local communities, Rio's Blue Economy Management Project has the potential to not only address current environmental degradation on the Bay, but to rewrite injustices at the root of the climate crisis.

The Blue Economy Management Project seeks to improve the sustainability, resilience, inclusivity, and circularity of the state's blue economy, which is responsible for an estimated 27-44% of the state's GDP. Reframing the blue economy as a driver of climate justice rather than a strategy for economic growth and reimagining the Rio Blue Metropolis policy not only as an environmental initiative, but as a justice-centered framework that empowers local communities promotes opportunities for economic growth and international financial investment, as well as political, social, and ecological incentives for community involvement. Local, national, and global actors are motivated to act in support of improved resilience, community agency, accountability, and justice.

LAYERS OF ACTION

LOCAL

- Establish community advisory councils to improve representation for favelas and fishermen communities impacted by the Rio Blue Metropolis plan.
- Involve universities, such as UFRJ, to support community-driven educational initiatives.
- Include local communities, including favelas and fishing villages on the Guanabara Bay, in imagining, implementation, and sustained protection of sewage treatment, water management, and climate adaptation plans.
- Invest in localized, nature-based solutions for climate resilience throughout the city of Rio de Janeiro.
- Employ participatory budgeting and other methods of shared governance within the Blue Economy Management Plan.
- Develop climate education and political advocacy workshops and resources for underrepresented communities on the Guanabara Bay.
- Enable rezoning and political restructuring that supports political agency, independence, and accountability for informal settlements and historically disadvantaged communities in Rio de Janeiro.

NATIONAL

- Prioritize investments for climate adaptation in historically marginalized communities experiencing disproportionate harm from localized and global impacts of the climate crisis.
- Hold polluters, such as the oil industry, financially accountable for their historic and current emissions, following the "polluter pays" principle.
- Invest in the Brazilian Center for Climate Justice (CBJC) and other aligned climate justice centers and initiatives.
- Establish a framework for legal recognition of informal/illegal settlements and improved land tenure for these communities.
- Include climate justice and participatory governance in national development plans, including the NDC, SDG implementation, and future climate policy.
- Adopt national renewable portfolio standards that disempower the oil industry in Rio de Janeiro and the Guanabara Bay.
- Establish a database of local knowledge and scalable initiatives for environmental and ecological monitoring.
- Develop an archive of local/Indigenous knowledge for ecological protection and economic investment on the Guanabara Bay and throughout Brazil.
- Align national water management and climate justice frameworks with global SDGs.

GLOBAL

- Prioritize co-production of local and Indigenous knowledge on the global scale through planning, implementation, and publicity of COP30.
- Leverage Brazil's COP30 and G20 tenure to promote integration of climate justice movements and local knowledge in global climate policy.
- Partner with international organizations such as the UNEP, the UNFCCC Adaptation Fund, and the Green Climate Fund for technical and financial support.
- Mobilize the Loss & Damage Fund to provide funding for local climate initiatives.

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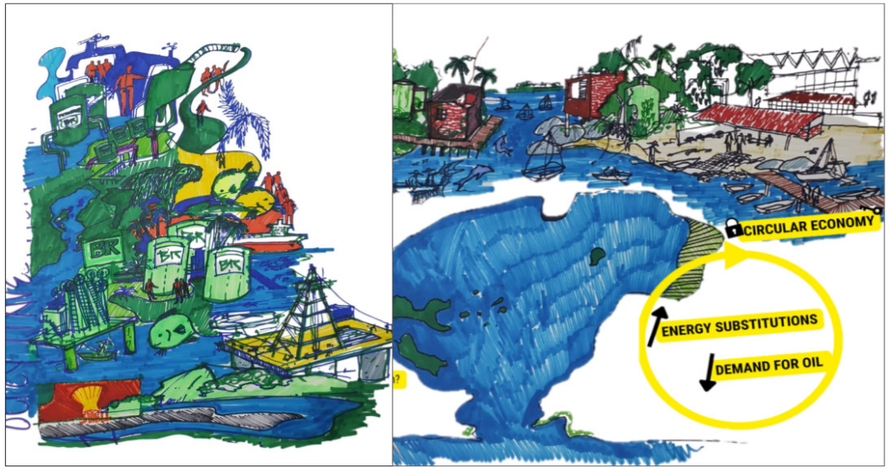
TATIANNA SITOUNIS

RECIRCULATE

ISLANDS AS CIRCULAR



"Nuclear and wind area **alternative energies** - build technologies to **overcome oil**." - Petrobras Employees

The impact, good and bad, that the oil industry has had on global, national, and local livelihoods and environments cannot be understated. Petrobras is deeply embedded within Brazilian identity and nationality, as the oil company is also largely responsible for much of the urban development around the country, such as the founding of towns, the building of public goods (i.e., hospitals and schools), and the provision of jobs/economic gain (Peyerl, 2021). The concept of 'Islands as Circular' aims to solve for the need to redesign the energy industry as one that becomes of mixed use and circular for the assurance of a just, sustainable future for all. There is an opportunity here, economically, environmentally, socially, and politically to be a leader in the future of sustainable energy and industry, setting the standard for what an efficient, sustainable, and profitable just energy transition looks like. Tangible actions can and should include: adaptive and mitigation policy framework implementation with clear targets and binding commitments, community outreach and education on a just energy transition and participatory engagement, and industry collaboration/public-private partnership relationship building between the energy industry/companies, various levels of government and governing institutions (i.e., federal or state environmental regulation agencies with energy corporations), and local communities to ensure an integrated network of access and resource resilience. There are countless motivators for actors across backgrounds to be motivated to act, including, but not limited to: 1) economic incentives as it relates to the continued threat posed by climate change on assets and investments, placing them increasingly at risk (Bressan et al., 2024; Cisagara, 2024). This necessitates proper investments in renewable, circular energy and economic systems; 2) renewables continue to become more affordable and cost-effective as compared to fossil fuels (IRENA, 2024; IRENA, 2023). This is a large motivator for the transition, as energy industries and investors alike seek to retain profitability and; 3) socio-political benefits such as increased resiliency, better governance, and economic stability through a commitment to coupling climate change approaches through both high-level governance and community-led contributions (Kehler & Birchall, 2021). In these ways, and others, 'Islands as Circular' can become a lived reality, based in the need to restructure our everyday systems of energy.

LAYERS OR ACTION

INDUSTRIAL

- Policy framework redesign and implementation
- Complementarity between governing institutions and policy mechanisms of transition
- Integration across levels of energy sector of circularity practices and renewable energy
- Investments and funding for the just transition and its longevity
- **Industrial targets that are legally binding**
- Incentivize investment and ambition to scale up targets
- Partnerships with NGOs, government, and local stakeholders/community members

POLITICAL

- Prioritizing the long-term financial and economic benefits to transitioning away from fossil fuels
- **Creating laws and standards that industrial actors must adhere to**
- Maintain transparent information on targets, emissions, and progress
- Embedding circularity and regeneration within legislative action
- Collaboration at various levels of governance (local, national, and international)
- Implementing multiple political frameworks so as to increase resilience and diversity in approach

COMMUNAL

- Co-creation of policy and legal frameworks with local and regional stakeholders
- **Outreach, data collection, and study of local needs, exposure, vulnerabilities of community members in resilience building and adaptation/mitigation efforts**
- Educational and informational sessions for inclusion and consent
- Relationship building with diverse groups, especially marginalized and highly vulnerable groups
- Funding allocated for community resilience projects and reinvestment from industry

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JARROD SIMS

REPARATE

PROFIT AS A PLATFORM



"What do you see when you look out the window?"

What if investment was aligned to strengthen communities instead of increasing profits?

As Rio de Janeiro strives toward carbon neutrality by the mid-century and the country contends with protecting the amazon, the world is moving down a path of increased natural resource reliance. Historically, the financialization of resource extraction has perpetuated environmental degradation and disinvestment in frontline communities in Brazil, especially in areas impacted by oil, gas, and mining industries. To repair this imbalance, a target intervention is proposed: reform and expansion of Brazil's oil and gas sector R&D clause to mandate reinvestment into climate adaptation, resilience initiatives, and community-driven initiatives. To guide reinvestment, these profits will align with Brazil's Climate Fund modalities, especially energy transition and social development, creating a stable financial bridge to accelerate climate action. The economic, social, and political case is strong: national government obligation to align to the Paris Agreement; corporations can gain a social license to operate; and communities gain pathways to wealth retention. By leveraging legal precedent, regulatory reform, and local participation, Rio can turn profit into a platform for reparative climate justice.

LAYERS OF ACTION

GLOBAL

- Leverage supranational and supralegal status of international agreements like the Paris Agreement to align reinvestment from extractive profits (PSB et al. v. Brazil, 2022)
- Incorporate international human rights rulings or advising from the Inter-American Commission on Human Rights and Inter national Court of Justice to mandate climate reparations
- Build coalitions between international climate finance mechanisms and national climate funds

NATIONAL

- Reform the R&D Clause to mandate reinvestment aligned with climate risks
- Enforce constitutional obligations by linking Climate Fund management to extractive sector profits
- Enhance Institutional coordination to standardize regulator frameworks to close gaps and
- Mandate that companies must acquire consent from the impacted community in form of community benefit agreements
- Utilize funds designated for the climate to study and develop a plan for the potential expansion of mining operations

LOCAL

- Establish community monitoring councils to oversee resource extraction impacts
- Fund citizen legal empowerment initiatives to hold extractive industries accountable through local courts.
- Partner with local universities to connect communities with technical resources
- Negotiate binding Community Benefit Agreements (CBAs) that mandate reinvestment of profits aligned with community needs

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ANAR AMARJARGAL

RECLAIM

CIRCULAR INCENTIVES

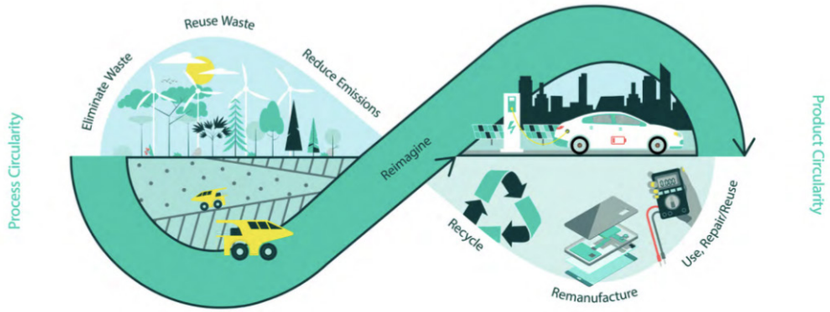

Figure 1: **Process and product circularity**
Source: ICMM 2023.[1]

Minerals-as-a-Service – Reclaiming Brazil's Natural Resources for a Just Energy Transition

The global shift to clean energy is intensifying demand for critical minerals, yet traditional extractive practices continue to exacerbate ecological degradation, social injustices, and economic inequalities, particularly in mineral-rich countries like Brazil. Historically, Brazil's mining sector has prioritized short-term profits over long-term sustainability, often at the expense of Indigenous land rights, biodiversity, and community resilience. At the same time, climate goals and the environment are increasingly at odds: we urgently need minerals like lithium to enable electrification and decarbonization, yet sourcing them risks deepening the very crises we seek to solve.
This project proposes the Minerals-as-a-Service (MaaS) model as an innovative solution: a circular leasing approach that retains mineral ownership and promotes reuse, repair, and recovery across the supply and value chains. Instead of selling raw minerals outright—only to later import expensive end-products like batteries—Brazil can lease critical resources like lithium throughout the value chain. By doing so, Brazil ensures that when minerals inevitably return embedded in goods, they can be recaptured, reused, and reinvested, reclaiming wealth that otherwise would have been permanently lost. This closed-loop system prioritizes national resource sovereignty, economic value retention, and community reinvestment, fundamentally challenging the conventional assumptions of linear trade.
Most importantly, the cost of reclaiming minerals domestically through recycling and urban mining is far lower in the long run than perpetually extracting new resources or importing high-value products at global market prices. MaaS offers Brazil a pathway to secure cheaper, more sustainable access to critical minerals, ensuring the country captures value at every stage rather than surrendering it. By investing now in mineral leasing models, processing capacity, and recovery infrastructure, Brazil can leapfrog extractive dependence and build an economy that is resilient, just, and aligned with its environmental commitments. Actors from municipalities to ministries, from private firms to multilateral institutions, are motivated to act because MaaS delivers both climate justice and competitive advantage.

What if Brazil were to reclaim its natural resources that ultimately comes back to them?

LAYERS OF ACTION

FINANCIAL

- Establish a Green Minerals Investment Framework
  National policy that defines "sustainable minerals" and prioritizes low-carbon, circular extraction and processing
- Create incentives for domestic value chain expansion
  Offer tax breaks, concessional financing, and targeted subsidies to companies investing in domestic mineral processing, battery manufacturing, and recycling by prioritizing public-private partnerships that commit to circularity, innovation, and local job creation
- Launch a Sovereign Mineral Leasing Fund
  Create a state-owned leasing entity that retains ownership of critical minerals and reinvests leasing revenues into infrastructure, clean technologies, and maintaining community development
- Leverage blended finance for circular mining innovation
  Use concessional loans, risk guarantees, and green bonds – particularly through development banks – to de-risk investments in low-carbon mining technologies, mineral reuse platforms, urban mining initiatives, and closed-loop logistics networks

GLOBAL

- Leverage Brazil's G20 Presidency and COP30 platform
  Highlight ethical sourcing frameworks and the MaaS model as critical pillars of the global energy transition, highlighting Brazil's leadership in sustainable mineral practices
- Embed local value chain requirements into foreign investment contracts
  Mandate clauses requiring local processing, job creation, skills transfer, and technology sharing in all mineral sector foreign investments
- Establish a "Green Mining Standard"
  Align Brazil's mineral extraction and trade practices with global ESG, biodiversity, and climate commitments
- Deepen South-South collaboration on mineral governance
  Lead initiatives across Latin America for policy harmonization, joint ventures in value-added processing, and resilience building

NATIONAL

- Adopt local emissions caps and decarbonization requirements
  Set regional emissions ceilings for mining operations and require companies to submit credible decarbonization and land reclamation plans as part of licensing agreements
- Create "Living Labs" and "Citizen Science Hubs" in mining regions
  Partner with universities, local governments and communities to pilot sustainable extraction, reclamation, and circularity innovations through hands-on, participatory research
- Provide incentives for closed-loop mining and low-impact technologies
  Offer public grants, tax incentives, and fast-track permitting to companies that integrate closed-loop designs, eco-friendly extraction techniques and recycling infrastructure
- Fund reskilling programs and just transition programs
  Establish national workforce retraining programs for fossil fuel sector workers, emphasizing transferable skills for fossil fuel sectors to renewables
- Develop a participatory budgeting mechanism for reinvesting a portion of mining royalties at the municipal and regional levels

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CAROLINE SACHER

RERHYTHM

RHYTHMIC GOVERNANCE





"The ocean gave us life, it's our turn to return the favor"
- Staircase mural, Ilha de Conceição, Brazil

ABSTRACT - POLICY AS ECOSYSTEMIC

In Guanabara Bay, Brazil, climate adaptation efforts are undermined by a hidden contradiction: the very infrastructure designed to protect vulnerable shorelines is built on extractive practices - informal sand mining, mangrove clearance, and linear development models, that degrade the same ecosystems they claim to safeguard. This project addresses that contradiction by asking: What if we built climate infrastructure like the sea itself, rhythmic, and regenerative?

We propose a framework for Tidal Infrastructure Governance, an intervention that reimagines coastal adaptation through marine ecological principles. Inspired by the cyclic flows of tides, gyres, and sediment transport, this approach aligns construction and restoration with ecological rhythms using "tidal calendars," circular material economies, and community co-governance. It shifts infrastructure from an extractive pipeline to a living system, one that restores ecosystems while generating dignified work, especially in historically disinvested communities like Ilha de Conceição.

The opportunity is both ecological and systemic: to use climate finance, adaptation planning, and public procurement as tools to foster regenerative design at the municipal, national, and eventually global scale. Economically, this model reduces reliance on illegal supply chains and creates localized employment in nature-based restoration. Politically and socially, it empowers frontline communities to co-author their own adaptation futures. Ecologically, it strengthens buffers against sea level rise while restoring biodiversity and sediment flows.

For actors at every scale like Rio's planners or global climate financiers, this approach offers a compelling alternative to greenwashed extraction. It meets adaptation targets while redistributing power, resources, and agency. It speaks to climate justice not just in outcomes, but in process, embedding reciprocity, rhythm, and resilience into the heart of our infrastructure systems.

LAYERS OF ACTORS OR ACTION

GLOBAL

Enablers of regenerative infrastructure: Multilateral institutions, international finance, Global North governments, supply chain regulators

- Align critical mineral supply chains with mandatory ecological and social safeguards (e.g., expand OECD Due Diligence Guidance, UN Global Compact standards) to support regenerative material sourcing, de-risk infrastructure investments, and reinforce national circular procurement reforms.
- Support global networks of regenerative cities by funding knowledge exchanges, co-developing rhythmic planning toolkits (e.g., tidal calendars, circular construction guides), and connecting citizen science data platforms for coastal resilience across cities facing climate risk.

NATIONAL

Public works, climate agencies, the Brazilian federal government

- Amend national public procurement laws to embed circularity and ecological timing as core requirements, aligned with global regenerative standards.
- Create a national blue adaptation fund to scale municipal regenerative coastal infrastructure projects and connect them to global city networks.
- Standardize ecological and social impact reporting for sand and mineral sourcing tied to climate adaptation projects, requiring full lifecycle assessments that account for biodiversity loss, sediment disruption, informal labor, and carbon impacts, in order to align with evolving international critical mineral supply chain reforms and ESG frameworks.
- Negotiate inter-ministerial agreements (Environment, Labor, Infrastructure) to build transition pathways for informal workers displaced from extractive industries.
- Aggregate data on informal extraction and material flows to support national policy reform and global supply chain accountability.
- Convene a national roundtable on "Infrastructure as Ecosystem" to generate political will and position Brazil as a leader in regenerative adaptation at COP30 and beyond.

LOCAL

Guanabara Bay, Ilha de Conceição, other frontline communities

- Establish a pilot Tidal Infrastructure Council composed of local community leaders, planners, and ecologists to model regenerative, participatory governance.
- Design and implement a seasonal tidal calendar to guide timing of construction and restoration projects, creating replicable tools for other coastal cities.
- Launch regenerative jobs programs to retrain informal miners in coastal restoration and sediment stewardship, reducing informal extraction pressure.
- Create circular material sourcing protocols for municipal infrastructure contracts (bio-concrete, recycled sediments) as pilots for national procurement reform.
- Facilitate community mapping workshops to document ecosystem cycles and material flows, generating data to feed into national and global monitoring systems.
- Fund citizen science initiatives to monitor mangrove health and sediment dynamics, building public ecological datasets that link into international networks.

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PABLO YANEZ MENA - NICOLE SAIDLER BANDEIRA

RETHINK

URBAN FOREST KNOWLEDGE





"The future lies in the pursuit of ancestral knowledge" - Ailton Krenak

Due to climate change Rio de Janeiro has been experiencing recurring record-breaking heatwaves.

Annual temperature means from 1990-2022 reached 22ºC with a mean relative humidity of 79%, which already created dangerous wet-bulb conditions. Since 2023, though, temperatures have reached over 40ºC on occasion.

This phenomenon doesn't affect every inhabitant equally. Local communities, in favelas and among urban indigenous groups, have taken the matter into their own hands striving for adaptive solutions. Teto Verde Favela and Tekohwa Marakana are two locally led adaptation initiatives which require closer inspection and support, both through funding and through policy enabling, striving to upscale in order to improve daily livelihoods and resilient landscapes in the face of heatwaves.

By taking these locally-led initiatives as starting point for the Green Corridors project, as laid out in the Rio SDS Plan, implementation will benefit from improved buy-in and capacity to deal with daily maintenance

LAYERS OR ACTION

GLOBAL

- Reforming global climate and humanitarian funding mechanisms, uprooting the legacy of Bretton-Woods institutions which entrenches debt when receiving financial assistance to fund necessary climate justice initiatives
- Strengthening global south collaborative networks such as BRICS, with Brazil playing leading role.
- Leveraging COP30 in Brazil to set agenda regarding making funding accessible for reforestation and locally-led climate adaptation projects, internalizing human's interdependence with nature.
- Partnering among States, UNFCCC and the International Council on Mining and Minerals (ICMM) and Initiative for Responsible Mining Assurance (IRMA) in creating finance scheme in which a percentage of critical minerals projects profits are reinvested towards local-led adaptation projects.
- Internalizing interdependence between human beings and nature when developing policy, funding frameworks and state-based treaties.

NATIONAL

- Leveraging role of Amazon in global climate systems by imposing stricter conservation measures and setting agenda in regards to reforestation projects and expansion of green cover in cities.
- Partnering with locally-led organizations such as Teto Verde Favela and Tekohwa Marakana in order for funding of foresting solutions to flow directly into communities.
- Supporting local communities in the face of real estate pressures, particularly in tourist hotspots such as Rio de Janeiro, where windfall should be equitably distributed
- Understand the problem of armed militias as a national issue within the context of interlocking wealth redistribution and educational access
- Create national policy of Green Corridors, building of proposal in Rio Sustainable Development Plan, including local knowledge on nature-based solutions.

LOCAL

- Reassessing the benchmarks on which development is measured, taking circular and intergenerational timeframes into account and striving for ancestral knowledge to be constantly included and interiorized in consultation processes for urban design projects
- Enabling regulations that both protect existing green cover from real estate pressure and incentivizes transformation of unsustainable infrastructure, creating Green Corridors.
- Promoting cost-effective research conducted by locally-led initiatives. In the case of Teto Verde Favela an experimentation with materials where plants could grow led to the widespread adoption of bidim, a polyester textile which can be sourced from recycling water bottles or vinyl .
- Partnering with UFRJ so that citizen-led research and scholars/students create enduring collaborative frameworks which unlock Rio's renowned creative potential.

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APPENDIX

REFLECTIONS ON EARTH STUDIO

Climate School Students

Salt, Soil, and Sovereignty
Learning Resilience from the Ground Up

Amina Diop





"The future of the climate space might look dire to some, but to me, I see resilience budding, quiet strategies rising to meet geopolitical, cultural, and economic obstacles."

This class was unlike any other - part studio, part fieldwork, part awakening. Traveling to Rio de Janeiro and zooming in on the ongoing transformation of the Maracanã Village, an Indigenous reclamation of a former museum into Brazil's first Indigenous university, reshaped how I understand resilience, justice, and repair.

My research started with salt as a metaphor and material: a site of extraction, a preservative, and a symbol of healing. Salt, in this sense, became more than a mineral—it became a lens through which to understand fractured landscapes and systems. When paired with the work of urban practitioner networks like the Maracanã community and NGOs engaging in land reclamation, salt's meaning deepened. It connected colonial extraction histories and today's ecological and cultural sovereignty struggles.

The most challenging moment came when attempting to map intersecting systems of harm and potential repair. The simulation on restructuring financial mechanisms like the Loss and Damage Fund and direct funding to community-led initiatives, such as the Maracanã University, was a breakthrough. It forced me to grapple with the geopolitics of climate finance: who controls resources, who sets the terms for repair, and who decides what counts as legitimate knowledge. I expanded my scenario to include redirecting Petrobras decommissioning funds toward Indigenous-led climate restoration.

Through this process, I explored the entanglement of race, geopolitics, and legal systems in shaping vulnerability. Favelas and Indigenous communities are systematically excluded from city-making processes; they are the most impacted and yet the agents of the most profound regenerative action. Policies at the municipal and federal levels often undermine community ownership, but grassroots legal strategies, from land tenure to cultural preservation, offer a blueprint for radical accountability.

My biggest takeaway is that resilience isn't a fixed outcome; it's a practice, grounded in relationships and power. Resilience must be felt locally while being supported globally. Climate justice isn't just about bending the curve or building green and grey infrastructures; it's about reclamation, about narrative, about abundance as a tool for repairing the ways of being that honor land, people, and future generations.

For future students and educators, immersive, community-embedded learning is essential. It humbles you. It sharpens your sense of responsibility. Education in the climate space must go beyond theories of risk, it must build frameworks for commonality and co-creation.

Critical Minerals, Critical Minds

Anar Amarjargal

This class has been one of the most impactful experiences in my academic journey. It was my first time engaging in such an applied and practicum-based course, and I appreciated the opportunity to go beyond theoretical learning – by literally traveling to Brazil! Researching Brazil's potential in the energy transition through the flows and forms of critical minerals, and then actually visiting the country to meet with stakeholders – from the oil and gas sector to university students – was incredibly powerful. Seeing all our hard work come together by thinking critically, asking difficult questions, and synthesizing everything into our final project was truly motivating.

One of the most challenging moments for me was navigating the complexity of the energy transition itself. As someone deeply rooted in the climate space, I've often seen the fossil fuel industry as the villain. But during this class, I was forced to reckon with the idea that things are not so black and white. The energy sector is deeply embedded in livelihoods, national economies, and geopolitical systems. We can't just make it disappear. This nuance was hard to accept at first, but through conversations with my peers and professors, I came to understand the importance of finding balance – where renewable energy and climate justice can grow alongside more responsible forms of extraction. So many ironies surfaced during our trip – like learning about a massive oil ship named after a famous Brazilian painter who ironically died from his oil paints. It's strange and poetic in a way – a perfect example of how our professor's mind works: practical, but always seeing the bigger picture with poetic precision.

A particularly impactful moment was speaking with a student from UFRJ who grew up in the favelas. I asked her what she thought Brazil needed most for a just energy transition. Her answer was simple but profound: education – not just in science and math, but in critical thinking beyond what people know. Her story of choosing education, then inspiring her friends and sister to follow, reminded me how transformational education is. It made me reflect on my own home country, Mongolia, and how – although geographically and culturally different – many of the challenges we face are interconnected. It reminded me that we are all part of one ecosystem – something we often forget in our siloed thinking. The interconnections are real, and understanding how our projects, ideas, and realities overlap is critical if we want to create real systems change.

Reimagine. Reimagining our systems, our solutions, and the way we think about resilience has been a major takeaway from this class, especially through our collaboration with urban design students. Climate justice isn't only about cutting emissions – it's about building systems that are equitable, resilient, and inclusive of the people most affected. The built environment plays a critical role in that – it's where policy becomes tangible. Imagina sem medo – imagine without fear – a phrase that continues to resonate with me. We must dare to dream of new futures, even when they feel far away or hard to define. As this wonderful class comes to an end, I believe it is just the beginning of our work. To my fellow students: be aware of the trade-offs. Not everything can be 100% sustainable, and that's okay. Our job is to find the leverage points where we can make a difference. As my brilliant friend and classmate Carissa put it so perfectly, this class allowed us to think about climate through society, rather than just climate and society. That framing – that clarity – truly changed how I think.

I've learned so much from the brilliant minds I worked with – each one of you has expanded how I view the world, and I'll cherish this experience forever.

Climate Solutions rest at the bottom of Pandora's Box

Carissa O'Donnell





Climate is one of the many spaces in which we cannot think in a binary. As those who have attempted to unravel it know, it's a tightly bound knot of externalities, trade-offs, and benefits where pulling on one thread only tightens another. Decision-makers assessing this entanglement know that it is growing: action just as much as inaction are consequential.

Yet at the surface, climate change mitigation appears to offer binary choices: reduce emissions or don't; reduce emissions or grow the economy; reduce emissions or allow the prosperity of industrialization. Remaining at the surface risks pulling the obvious strings without considering counter-narratives and externalities that turn binary choices into parasitic relationships. Climate mitigation cannot succeed if the immediate needs of people are in competition with the longevity of the planet.

The narrative must switch, and as a global society we must realize that the planet is more resilient than us: it will survive through the strain we place on its systems. Humankind will not fare the same. Our social systems, the things we take for granted, and the things we need to survive will slowly dissipate and reconcentrate into the hands of those most privileged to possess them; the same hands that are tugging at the surface of the climate crisis knot.

The novel Abundance by Ezra Klein and Derek Thompson defines the two pathways currently presented to governments. Pathway one requires leveraging industrial policy and multilateral agreements to ensure the planet remains habitable and its resources accessible. The other path is not unlike a power grab; countries entrench themselves in extractive, linear supply chains, compete over diminishing resources, consolidate power, and, in doing so, limit the progression of innovation and human evolution.

This moment demands a deviation from the status quo.

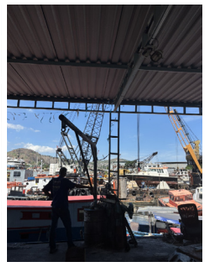
In a time where action is as powerful as inaction, we must act intentionally. We must re-evaluate what we value; recognize that the things we rely on to survive take precedence over luxury goods; we must structure economies that reflect the same. If the climate crisis is to be adequately addressed, it must be through society, not alongside it. Major change, rapid mobilization, and ultimately human evolution is sparked by a shock to a system and the necessity to respond.

We know the climate crisis will deliver events that shock systems: whose plans will already be on the table when it is time to respond? Hopefully the ones visualizing the multidimensions of policy and the imbalances of impact– the ones who see the climate crisis as a human crisis.

Caroline Sacher







This class offered something rare: a space to slow down and think abstractly. To sit with contradictions, discomforts, and big questions that don't have quick answers. It was a speculative space, but also a deeply material one, where we traced how climate risk is not just atmospheric, but structural, cultural, and temporal. A space to think deeply about how complex systems in our society often work to undermine the very climate solutions they claim to support. It invited me to stop thinking of policy as a fix and start understanding it as a form of pattern one embedded in ecosystems, memory, and power. Climate risk isn't only physical it's systemic, temporal, and epistemic. It's constructed through supply chains, labor policies, construction timelines, and colonial governance structures that erase ecological intelligence. It taught me to see infrastructure not just as material, but as a cultural rhythm one that can either dominate or regenerate.

One of the first themes that struck me during this class was Dr. Lesley-Ann Noel's analogy of design thinking as curry. Where some people follow recipes, while others experiment with ingredients. The more we understand the components, the less we rely on rigid frameworks. The challenge and opportunity is to design solutions that shift power and center equity. Instead of forcing bold ideas into flawed systems, we must question whether those systems should be preserved or radically transformed. The more I studied infrastructure, policy, and power, the more I realized how few people question the recipe. In Rio de Janeiro, for example, the city is trying to build climate-resilient infrastructure, but it's doing so by extracting sand from its own degraded shorelines. It's a recipe for collapse, disguised as progress. My instinct was to find a technical fix. But this class taught me that true repair isn't about tweaking the system, it's about questioning the system entirely. It's about refusal.

That's how I arrived at rerhythm: a lens I developed to reimagine infrastructure as cyclical, participatory, and alive. It came from listening, especially to stories like that of Nadia, a fisherwoman in Ilha de Conceição, who reads the tides like a clock and knows when the land is ready. Her expertise isn't written into policy, but it should be. That shifted everything for me: who gets to be seen as an expert? Whose rhythms are we building for?
Throughout the semester, I saw this same dynamic across scales: repair deployed to preserve industry, not transform it. Restoration weaponized to sustain extraction. Climate action co-opted by corporate timelines. That's when it hit me: narrative control is a form of infrastructure. It shapes what gets funded, what gets framed, and what futures we're allowed to imagine. We can't fix broken systems with the same tools that broke them. We need policy that's porous to ecology. Infrastructure that doesn't dominate the landscape, but listens to it. We need resilience that regenerates, not just resists.

We need to move from fixing broken systems to metabolizing new ones. I learned that policy must be porous to ecology, that decision-making should follow ecological and social tempo, not fiscal deadlines or political cycles. Risk, I've learned, is not neutral. It's shaped by whose timelines dominate. And resilience isn't a universal good, it can be used to preserve extractive systems. What we need is regenerative resilience, grounded in community agency, ecological timing, and infrastructure that restores as it protects.

To future students and educators: education must be a site of refusal and reimagination. It should offer not just answers, but alternate tempos to slow down, listen to community memory, and reframe expertise. The most powerful thing a classroom can offer is a new way of seeing and a new pace for responding. That is the space Johanna created for our class and I truly will be forever grateful for this. A space to question the recipe. A kitchen full of strange ingredients. A chance to imagine something wildly better. Together.

Be comfortable with the murky unknown because those are the spaces in which true creativity can thrive, and inform new ways of seeing futures that can help to solve some of our biggest climate change challenges. Don't just ask what we should build; ask when, why, and for whom. That's what Johanna gave us in this class. A space to question the recipe. A kitchen full of strange ingredients. A chance to imagine something wildly better. Together.

I wanted to take one last moment to thank Johanna, our GSAPP collaborators, UFRJ and all other contributors in Rio de Janeiro, for the overwhelming amount of work and care that was put into this partnership. All of their work made this a truly once in a lifetime opportunity that I truly think will be brewing in my head for a long time to come.

Preconceptions of Repair

Jarrod Sims



Photo: URFJ and Columbia University Collaboration



Photo: Rocinha, The Forest, Highrise, and Favela

This class centered on envisioning the opportunities for repair and climate justice against the backdrop of an energy transition. The added context in Rio and Brazil presented a broader perspective, highlighting the need to think from an abundance mindset instead of a mindset of lack. While there is a lack of financial resources dedicated to funding the energy transition or inclusive economic practices within cities, there isn't a lack of opportunities. This shift in perspective modified my thoughts on resilience and what it can look like. As communities face risks from climate change, unequal access to infrastructure, and socioeconomic conditions, there is a realization that many solutions have been ruminating in the minds already. Communities have attempted to enact these strategies, but the projections of increased mineral reliance and worsening climate hazards threaten to outpace a community's bandwidth to adapt. In addition, communities are not often seen as having equal footing as large corporations that aim to profit off the land they inhabit. These compounding pressures complicate an energy transition, cementing the need for a just transition.

While researching Rio's context in advance helped to set the stage, being grounded in place introduced the key actors. Observing the petrochemical presence immediately upon arrival, engaging in conversations with URFJ students and local stakeholders, and visiting Rocinha aided in understanding how some of the actors manifest their presence and the evident power imbalances. These power imbalances influenced and challenged my approach to repair. Sometimes, local agents just require a platform or equal footing to enact change, so one approach is to leverage tools to ensure communities have the privilege to decide and advocate. Of course, not all strategies of repair have been found, but residents have generated solutions for themselves just by naturally interacting with their current environment. Current power imbalances have disincentivized communities from being formally involved in the planning and in how they want to interact with their space. I've seen that abundance is present within these communities; their ideas deserve a platform to be heard formally, and communities deserve autonomy in decisions involving their future.

Resistance, Resilience, and Resolution: Imaginaries of Climate Justice and Abundance in Rio de Janeiro

Julia Goldsamt







At Estaleiro Mauá in Niterói, Rio de Janeiro, Ana Asti, State Secretary of Water Resources and Sustainability, shared that "Rio has enough water that people feel comfortable polluting it." Surrounded by leisure, industry, and livelihoods reliant on water, she spoke to Rio's proximity to natural resources, viewing this abundance as both a gift and a given. The next night, it rained for 12 hours straight, rendering many confined to the hotel lobby and others drenched, wading in ankle-high water through flooded Ipanema streets. A group of us had just gotten back from favela Rocinha, where hours earlier, as we passed multiple retaining walls against a backdrop of narrow staircases and back alleys, we had seen the water drainage system at capacity from the first thunderstorm of the evening. As I lay in bed later that night, I saw Rio's water as not just abundant, but foreboding. Across the city, as water rushed down cobblestone streets into overflowing sewers, life kept moving; bartenders continued mixing drinks; bikers delivered food; people ran up and down the stairs when the elevators stopped working. For Rio, it seemed, water was both a lifeline and a death wish. Abundance does not always imply resilience.

I thought of Nadia Coelho, an environmental activist and resident of Ilha da Conceição, a small fishing village in the city of Niterói. I wondered what she would have said about the rain, if the tides would still come in strong enough for her to fish on the Bay once every 12 days. I thought about the UFRJ students, many of whom were still mid-commute from the day's activities. I thought about home, where the summer before, heavy rains had shut down half of the NYC subway system. We had traveled almost 5,000 miles away to confront a reality that exists in our own backyards, understanding Rio not just as a result of the climate crisis, but as an urban microcosm of a climate-altered future. In Rio, we saw both the causes of this crisis and its immense effects: petrochemical architecture dominating a landscape riddled with extreme weather events, failing infrastructure, and vast contrasts in resilience and vulnerability. Extractive industries existing on a landscape scale, and imaginaries of climate justice that must match them.

I started this course with a study of the mineral extraction of clay and its role in Brazilian Quilombos, mapping it as culture, heritage, and resistance to climate change and the unjust systems that have caused it. I examined this materiality of decolonial resistance, questioning the desire for physical abundance at the root of the climate crisis. My experience in Rio paradoxically confirmed these theories while defying them through new imaginaries of abundance as joy, hope, and will.

This course challenged me to apply 2d theories of climate justice to 3d policy and design that is inclusive of communities that may be left out on paper. It taught me how to apply theory to practice, and that resilience is an alignment of the two. It left me revitalized and in awe, at times lost or devastated, and overwhelmingly exhausted. It left me with a breathtaking sense of hope within a like-minded, wildly creative community of students and faculty from the Climate School, UFRJ, and GSAPP. In this alignment, it made me resilient.

To peers, educators, and the Columbia University community: The climate crisis is a crisis of community. It is a crisis of imagination and a crisis of optimism. It does not exist in a bubble, nor can it be solved in one. It is a crisis demanding a solution that begins in the classroom and ends laughing in flooded city streets, playing volleyball on Ipanema Beach, and dancing Samba well into the night. In the face of most crises, community is the solution. As of May 2025 at Columbia and in the world, this lesson is more important than ever.

“Progress is Giving Power Back to Nature”

Pablo Yanez Mena



Earth Studio: Towards Climate Justice and Resilience is better understood as an experience, not a mere for-credit course. The name in itself has been a provocation. It conjures images of urban and climate policy arising not in intragovernmental bureaus nor in labs, but rather as growing out from the earth, and all the materials that exist in nature: rocks, wood, coral and of course all the elements that shape both the renewable and non-renewable families of energy supply.
There’s also a reason for justice and resilience to be grouped together. The materials I’ve just mentioned have shaped our livelihoods and there’s ample evidence to ascertain that the multi-pronged crisis which we inhabit stems from an unsustainable, unhealthy, cycle of usage affecting those materials. Evidence is even stronger in regards to showing how those who have made decisions about how the earth is re-shaped and profited from it are also those best equipped to withstand the inherent risks of separating industry and nature. Those who have contributed the least to, and profited the least from, transforming our planet into a landscape of extraction are bearing the brunt of its most nefarious consequences. This has been conceptualized as climate justice. In our Earth Studio, thus, sites of practice are where we must imagine a more just design of space, melding the tenets of urbanism with the imperatives of climate action.

Brazil, particularly Rio, substituted scholarly articles as our reference base. We studied its history of mineral extraction and visited the main nodes of oil pumping. We listened to stakeholders; academics, public officers and, most relevantly, local communities and brilliant UFRJ students. I will never forget what this group of students taught me about how they imagined Rio moving forward, acknowledging their amazonian and mata atlantica inheritance and, thus, the stewardship of knowledge holders: those whose livelihood has been always inextricably intertwined with their surrounding landscape.

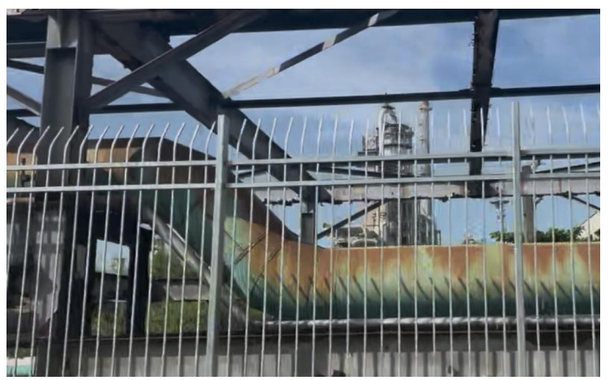
Led by such a prompt I visited the Tekohaw Marakana, Maracana Village, situated in land which was formerly not only grey infrastructure but also a remnant of the colonial mentality which had separated nature from humanity. Here questions about the future of oil extraction in the Guanabara Bay, about what role Petrobras would have in a potential net-zero scenario took a backseat to clear-cut definitions about the right to language and culture, the rights of nature and the
struggle for land and housing.

This doesn’t mean in any sense that policy definitions about equity in the decisions of cleaning up oil pollution or decommissioning infrastructure should be set aside. One of the most beautiful takeaways to spring forward from the Earth Studio is that just as nature and all its component parts are linked by a rhizomatic process of growth, so did we as a cohort. Everyone came in with a distinct worldview, concerns and research priorities, but due to the methodology put in place all of us could add up to conclusions which would be more than the sum of its parts. While being witness to language classes performed in the Tekohaw Marakana I understood what could be my contribution: Taking away the possibility to use native names for nature also takes away much of its capacity to nurture landscapes of resilience, as colonial naming practices strips away the role of nature-human connectedness.

A future of justice and resilience requires policy to stem from different roots than those of colonial frameworks. UFRJ students also exposed me to the work of Ailton Krenak, seminal indigenous brazilian thinker. “The future lies in the pursuit of ancestral knowledge”, he warns us. In the context of understanding Planet Earth as transitioning from landscapes of extraction into landscapes of repair these words will ring forever true in my mind.

Design the “Real World”

Samantha Dady





The climate crisis is a crisis of our collective ability to think beyond, and not be limited by, the way things have always been done, by the extractive industries that have dominated our lives for the past century, by business as usual. As such, the climate crisis is a crisis of our collective imagination.

In visiting Rio de Janeiro and witnessing its immense fossil-fuel fingerprints—its pipelines emerging from the murky, greenish-blue waters of the Guanabara Bay and stretching miles-upon-miles to its refineries and its hundreds of internal-combustion-engine tankers lining up to receive their petrochemical communion and disseminate it across the city and around the planet—it is nearly impossible to imagine it differently. But, there was a Rio before this extractive infrastructure—and a Rio before the previously extractive infrastructures (i.e., coffee, sugar, labor), when the bay’s primary extractive export was silver anchovies—and there will be a Rio after it. It is this “after” that we owe special attention.

Collaborating with GSAPP’s M.S. in Architecture and Urban Design cohort revealed to me that to thrive in this “after,” we must actively design it. In reshaping the hard edges of Rio’s Governor’s Island into soft ones, reworking the use cases for miles-up-on-miles of pipelines, and remodeling public transportation points into lines and lines into planes, design is a powerful tool for challenging, for reimagining, historically extractive narratives. As we design the world, the world, in turn, designs us. So, through design, we have a profound opportunity to redesign our landscapes outside of, unbound by, and beyond the paradigms which created them. As a climate policy practitioner, I want to get a lot more comfortable thinking unbound by extractive paradigms.
I want to relish more in imagining a 2050 world that feels, currently, entirely politically impractical. What if fossil fuel subsidies ended in the United States? What if we set a global carbon price? What if progress was measured by well-being and world-wide equity instead of GDP? There are, of course, bad and better ideas, but the ideas bound by business as usual have not gotten us anywhere closer to meeting our climate goals, so let’s welcome the big, the bold, the abundant ideas.

The “real world” is the world we design it to be.

Centering Abundance, Coexisting with Contradiction

Tatianna Sitounis



Traveling up Sugar Loaf Mountain.



On one of the Transpetro Islands.

It remains difficult for me to articulate how much this course has touched my heart. Earth Studio: Landscapes of Repair 2025 tackled some of the most deeply complicated and interrelated issues that Rio de Janeiro is facing as it concerns climate change and the energy transition. While there were many highlights of this course, the most personally impactful moment was the privilege of traveling to the city of Rio itself, where we got to meet our fellow peers and colleagues at UFRJ in person. The depth to which the students, faculty, and stakeholders in Rio opened their hearts to us, welcomed us into their lives for that week, and shared their brilliance is a gift I will cherish forever. Being able to situate ourselves in the landscape that had been the topic of discussion all semester was extremely grounding, as I finally got to locate myself within the context of the place I had been studying, and gain firsthand experience (as much as one can get in a week) on interacting with the systems, the structures, and the challenges myself.

Rio is a wonderfully complicated setting with a wildly diverse and bountiful environment. The two images attached here reflect some of these elements, and their contradictions. The picture on the right was taken at one of the Transpetro Islands in the Guanabara Bay, where I was part of a site visit to some of the islands in the Bay that store and ship oil. The picture on the left was taken in one of the cable cars traveling up to Sugar Loaf Mountain. To me, the landscape picture of Rio reflects the landscape level problem facing this setting, and all settings globally, relating to the need for the just energy transition. On the right, the picture emphasizes the juxtaposition between beauty and environmental cost, as the harm caused by fossil fuels is and has been well known yet continues to persist. As well, it highlights the conflicts surrounding this harmful resource, as it has also been, for better or worse, the catalyst for social and economic benefits. In this way, the two pictures are inherently connected, as the landscape photo looks as it does because of the other, colorfully piped setting.

Through these dynamics, and this course, I walk away with a further understanding of existing within a conflicting space. Seemingly contradictory things can coexist. This tension is where growth, creativity, and imagination thrive. It has been at this intersection where this class has largely situated itself, and where I have been pushed to expand my own thinking, truly exploring beyond the confines of the status quo. In this class I found deep abundance, transformational thought, and infinite inspiration on a better future for everyone. It is an honor to say that I was part of it.

Here, I would like to close with another infinite thank you to my peers, colleagues, and mentors who guided such a life changing experience. You all make the future so bright.

From the Margins of Extraction to Reimagination

Chesang Rotich

Figure 1 A view of Guanabara Bay from The Sugarloaf Mountain (Left) & Tour of CTDUT Facility (Right)

Describe your experience in the class. What was most impactful? What was a challenging learning moment you had and how did you overcome it?

"Maybe this is one of those rare experiences that truly make sense when you look back on them", is something I told my peers as we headed back to the hotel after a full day of activities during our time in Rio. On the final day of class, I realized just how true that was- I felt both challenged and fulfilled! The Earth Studio class with Johanna Lovecchio is the most transformative class I have had in Climate School. Every assignment, every guest speaker presentation, every site visit to every one of my peers reminded me that climate change is not just a scientific crisis, it spans geographical boundaries, it is political and deeply human.

Before this class, I thought of climate-justice mostly in terms of policy and technology, almost as something abstract. We were pushed to think beyond existing frameworks and solutions, instead we sought to center justice as something tangible and lived. The challenge was learning to hold space for contradiction. We moved through this by letting go of the urge to resolve every challenge that exists globally and instead focused on the granular issues. We observed, we listened, took notes, wrote down quotes, doodled and even examined the little things that make up the Kent Hall building that our class was held to at taking walks in our neighborhoods and observing the infrastructure. All this made up for the wholesome and insightful discussions we had throughout the 5 months.

What was a story of a person or community you learned about? How did it shift your thinking or perspective?

Learning of the Quilombos, the Afro-Brazilian communities descended from those who fled slavery, reframed what resilience truly means. These communities continue to resist centuries of dispossession, navigating threats of land grabs and invisibility in urban planning. Their existence isn't just symbolic; it is a blueprint for climate justice. They reminded me that resistance is not always loud, it is often quiet, intergenerational and rooted in place. This encounter shifted my perspective on what it means to "adapt". For the Quilombolas, adaptation is not about accepting loss but about defending what matters most, even at its core, is about the remains, to belong and to shape one's own destiny. Their experience challenged my assumptions about who gets to be an expert and reminded me that the most important knowledge often resides in those granular margins, at the edges of power, but at the heart of justice.

What is a key learning from your research and design work? What did you learn about the complexities of climate justice and resilience-building? What of these lessons and practices will you take with you?

Traveling to Rio de Janeiro, I witnessed how extractive infrastructures, ports, refineries, and research centers are often hailed as symbols of progress. Yet, these spaces are rarely designed with justice in mind. While touring CTDUT, and R&D facility, I was struck by the absence of future-facing thinking. Their focus was on efficiency and expansion, not repair or redress. It was this moment that challenged me: What is innovation if it ignores the communities and ecologies it impacts.

Our group's design work began with great optimism: what if we could transform Brazil's heartlands into engine of green innovation? But the more we learnt, the more we explored Rio's Guanabara Bay, the more we saw how "green" transitions risk repeating old patterns of extraction and exclusion if they are not rooted in justice. We encountered the complexity of overlapping interests: global investors, local governments, workers and communities all with different stakes and vulnerabilities. One key lesson was that resilience isn't a universal blueprint- it is highly contextual. What works in one place can deepen harm in another. We learnt to ask key questions: Who defines the problem? Who benefits from the solution? And who is left out? The process taught me that real climate justice work is slow, iterative, and must be co-created with those at the margins.

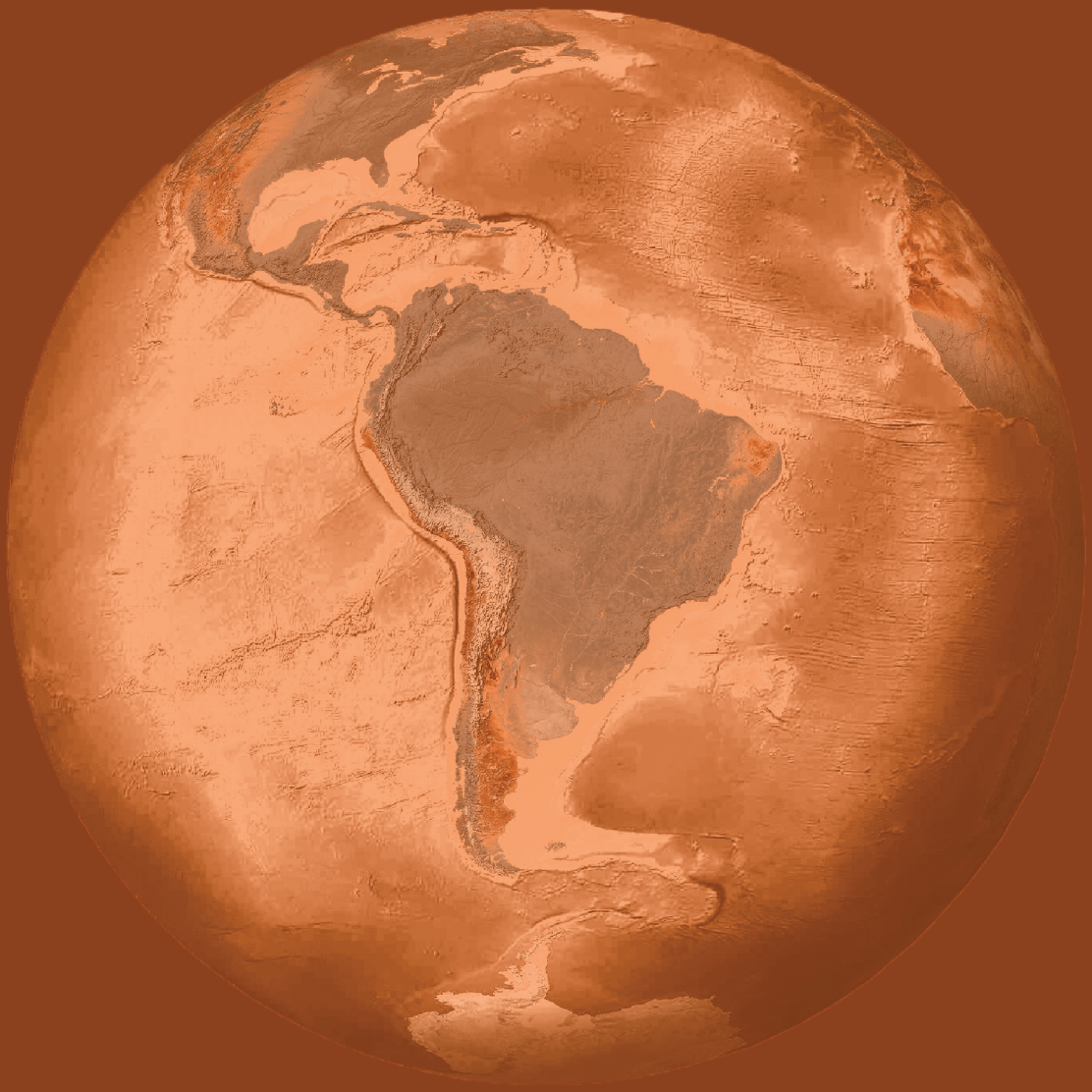
What did you learn about risk? About resilience? What did you learn about the relationship between policy and the built environment? How did you get from grounding and context setting to your final recommendations?

Risk, I learned, is not evenly distributed; it accumulates in the cracks- those granular margins, where social and environmental vulnerabilities meet. And how we define vulnerability keeps changing. Risk and resilience are shaped by policy, power and place. Taking a tour of Rio's Guanabara Bay and walking through neighborhoods adjacent to industrial sites, I saw how the built environment can both reflect and reinforce inequality. Policies that look neutral on paper often have unequal impacts on ground.

Our process moved from mapping these lived realities-through interviews, site visits, and historical research- to crafting recommendations that prioritized repair over replacement and inclusion over efficiency. One key recommendation was ensuring adaptive reuse of industrial infrastructure that line up roads leaning to the bay or big refineries around REDUC. We learnt that resilience means more than bouncing back, it means reimagining what's possible together.

What recommendations or advice do you have for students, peers, and educators at Columbia or more generally? How are and is education a key element of climate justice and action?

My advice: embrace the discomfort of not knowing. Get comfortable with working with lots of ambiguity. Let the field unsettle your assumptions. Seek out the granular margins and do not be afraid to slow down and listen. The most important thing I am taking away from this class is not a set of defined answers, but a renewed sense of commitment to keep asking better questions, and to do them in community. Earth studio has taught me that climate justice is not a destination, but a practice, a way of seeing, relating and acting that is always unfinished.



COLUMBIA GSAPP URBAN DESIGN

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