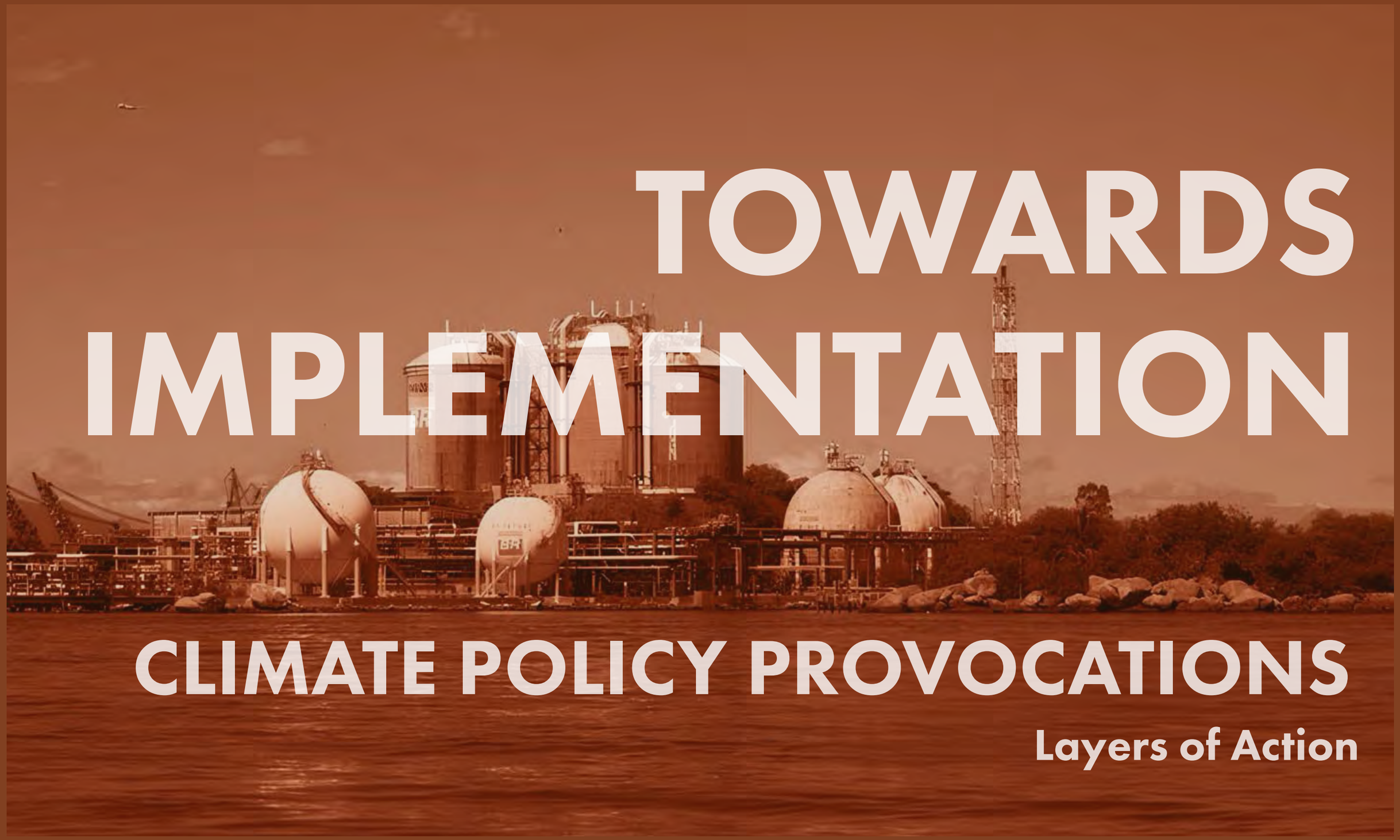

TOWARDS IMPLEMENTATION

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 OR 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 Maracan 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., Maracan 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 Maracan 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 Maracan Village and dedicate 1% of the education budget to expand the university, securing its campus and training 500+ Indigenous climate mediators annually.

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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 OR 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 Ind stria 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

GLOBAL

- 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 Piau).
- Advance implementation of the Ecological Transformation Plan and Nova Ind stria 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.

LOCAL

- 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 Sol rio 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 Concei o, 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 OR 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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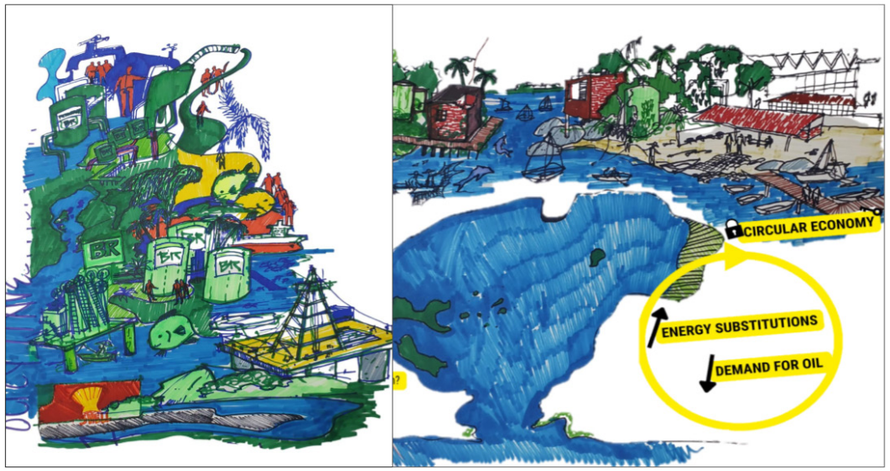
TATIANNA SITOUNIS

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 OR 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

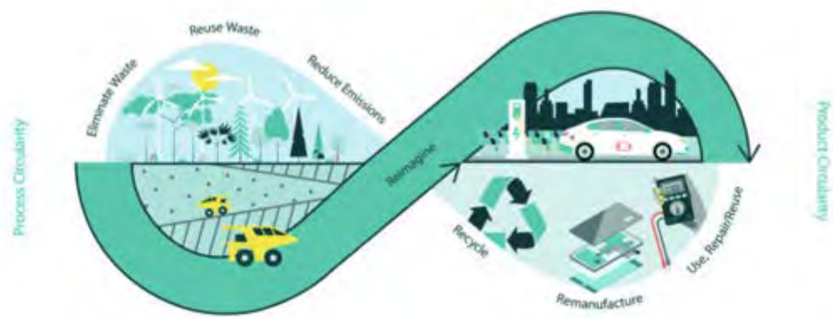

Figure 1: **Process and product circularity**
Source: ICMM 2023.[1]

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 OR 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 Concei o, 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 Concei o.

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 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 Concei o, 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 22 C with a mean relative humidity of 79%, which already created dangerous wet-bulb conditions. Since 2023, though, temperatures have reached over 40 C 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 Maracan 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 Maracan 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 Maracan 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.

Rerhythm: Learning to Question the Recipe

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 Concei o, 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 Mau in Niter i, 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 Concei o, a small fishing village in the city of Niter i. 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.

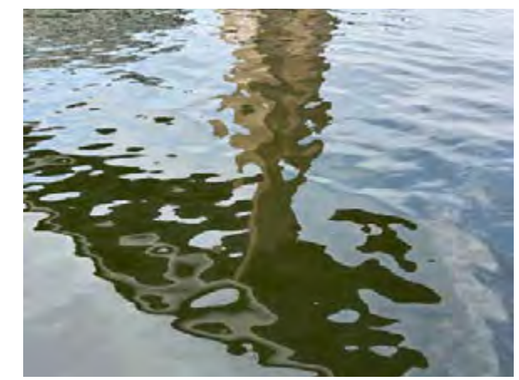
Led by such a prompt I visited the Tekohaw Marakana, Maracana Village, situated in land which was formerly not only grey infrastructure but also a remnant of the colonial mentality which had separated nature from humanity. Here questions about the future of oil extraction in the Guanabara Bay, about 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.

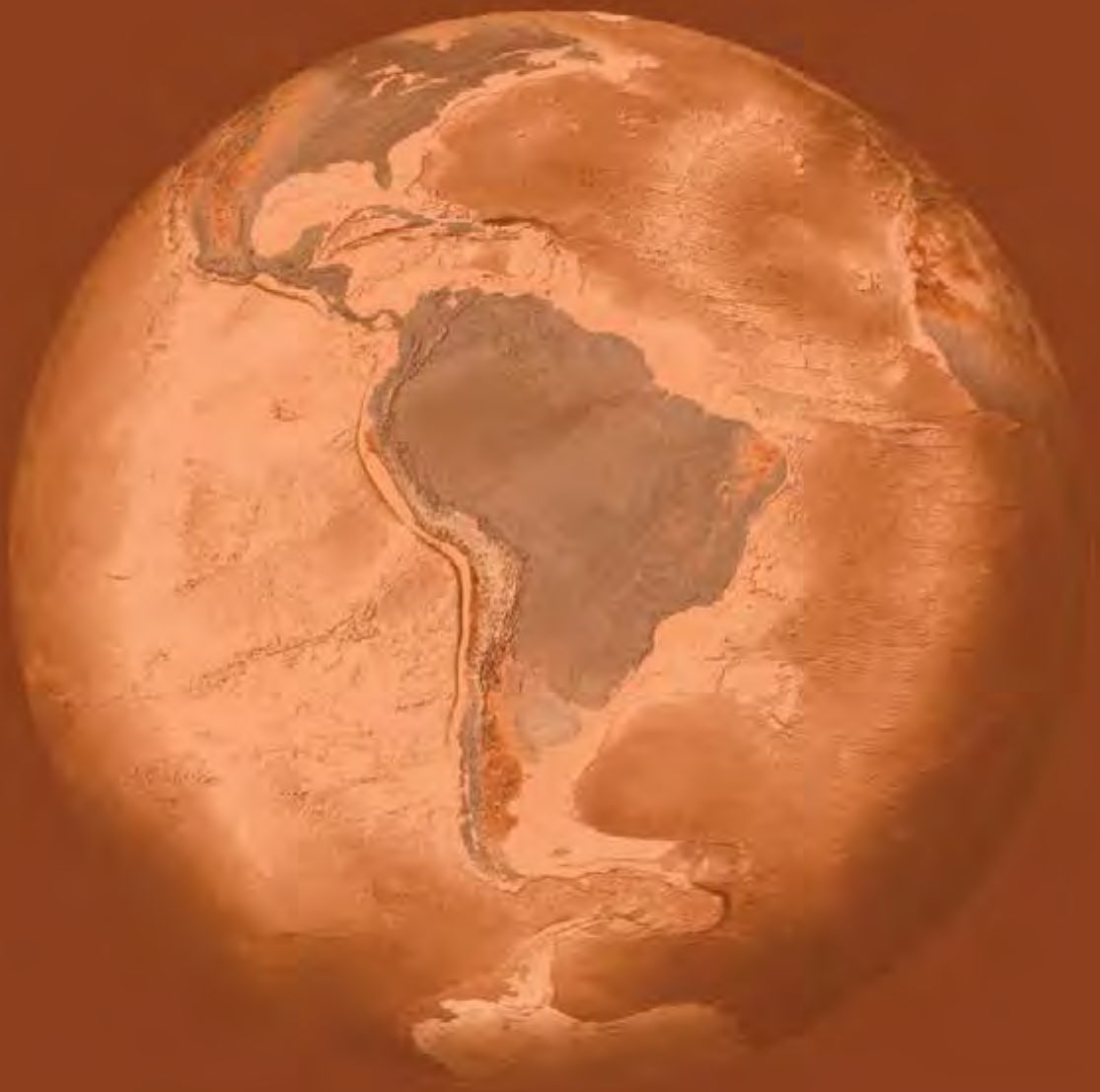
What did you learn about risk? About resilience? What did you learn about the relationship between policy and the built environment? How did you get from grounding and context setting to your final recommendations?

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.



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