Undoing Oil:
Regenerative Disassembly for Copenhagen's Petrol Island

by
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Author's Declaration

I hereby declare that I am the sole author of this thesis. This is a true copy of the thesis, including any required final revisions, as accepted by my examiners. I understand that my thesis may be made electronically available to the public.

Abstract

Copenhagen aims to become the first carbon neutral capital by 2025. Climate and energy crises are a concern for both the governing and the governed among Denmark's six million people. Compared to its Nordic neighbours, the country is second only to Finland with the most ambitious climate targets.[1] To curb global emissions and forward the green transition, Denmark is ending its public financing of fossil fuels abroad as well as phasing out oil and gas in the North Sea and encouraging others to follow suit.[2] While the country promises to stop using fossil fuels by 2050, energy humanities scholars suggest the transition is less a challenge of technology or public policy than a matter of society and culture on a global scale.[3] Yet oil companies worldwide go to great lengths to keep the spatial networks of oil invisible on the periphery of urban settlements.[4] In Copenhagen, *Prøvestenen* or 'Petrol Island' is a highly secured coastal landscape for the country's largest storage of fossil fuels.[5] The vast majority of the Island is not accessible to the public. Both globally and in the soon-to-be carbon neutral city, oil is hidden in plain sight. Denmark has a tradition of public engagement with energy infrastructure, suggesting a need for greater citizen agency in the climate and energy crises.[6] But oil infrastructure appears exempt from this sentiment. A societal shift toward green energy must better engage its individual actors: starting with visibility at the human scale. With two hundred and fifty oil tanks banished to the urban fringe, Petrol Island is a key space in Denmark's petrocultural transition. This thesis asks, how might spatial access to infrastructure that promotes public engagement with energy industries spur a societal and cultural shift toward life after oil?

Undoing Oil: Regenerative Disassembly for Copenhagen's Petrol Island is a speculative architectural vision for the Island's (re)growth. I use a method of 'regenerative disassembly', or growth through the unbuilding of things. Through this approach, I focus on infrastructural deconstruction, re-composition, and the reuse of material as methods of environmental repair. To degrade petrochemical leakages and reduce carbon emissions, I plan ecological restoration while making the landscape safe for human encounters. The combined process reveals Petrol Island to be an accessible landscape for public engagement with energy infrastructures for a collective cultural shift beyond oil.

Regenerative disassembly involves three thematic phases: breaking, growing, and taking. These phases give their names to the chapters below. In ***Breaking***, I illustrate the disassembly of oil infrastructure as a method of rethinking repair. This phase learns from the decommissioning of offshore oil platforms as well as relevant post-industrial projects like Landschaftspark in Germany. In ***Growing*** I propose to counter the ecological contamination from petrochemicals using phytoremediation while paying homage to existing spontaneous vegetation. This phase is propelled by the local tradition of nature education and pedagogic landscapes for play. ***Taking*** is an exploration of community engagement efforts in the Danish welfare model. I examine historical examples of spatial appropriation and urban regeneration in Copenhagen and suggest that Petrol Island is an important stage for socio-cultural change. Each chapter addresses spatial elements and major stakeholders and the thesis culminates with a design proposal for the Island's transition. Over three seasons on foot I documented subtle growth and the mutating topography of a working energy landscape. Using analogue photographs, sketching, and theoretical research this thesis works to uncover an invisible landscape for its remedial regenerative potential. My findings illuminate that for societal energy transition, a crucial ingredient is collaboration between human and non-human communities. However, long term change is still a slow-moving machine of many parts. I capture just a moment in oil space - the blink of an eye in fossil time.

Acknowledgements

There are many people to whom I am endlessly grateful, first and foremost being my supervisor, Jane Mah Hutton. In our first studio class in TRD1, you asked why each of us were here to undertake the Master's program. I blurted out clumsily that I was disillusioned with the world of architectural practice. What I really meant was that I had lost my faith in learning more generally. Thank you for really listening to me, not just for hearing my words. Thank you for your patience, encouragement and unwavering confidence in my own ability to complete the project when I doubted it very much myself. Thank you for your time, commitment, and critical feedback. Thank you for your non-judgmental yet well-informed approach. Your way of educating has been groundbreaking for me. Thank you for (re)teaching me how to learn.

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To my big sister Emma, thank you for reading my wordy drafts and for giving me your talented critique. Thank you Madeleine for your brilliant thoughts, weekly tea&thesis chats and for becoming my friend along the way. And thank you mentors and friends, especially Paul and Alessia, for beckoning me into the world of architecture and believing in me even when I'm a real stick in the mud.

Thank you to my partner Søren for your local knowledge, thrifty ideas, and for repeatedly visiting the trash island with me (or in place of me). Thank you for cooking your lasagnas and for making me the most-needed cups of tea. Thank you for telling me everything is okay even when it really is not. Thank you for getting me up in the morning and making this strange country into my home.

Dedication

To Copenhagen, the city that took me in.

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1 "Who Leads the Way When it Comes to the Climate?," Nordregio Magazine, accessed January 4, 2023, https://nordregio.org/nordregio-magazine/issues/state-of-the-nordic-region-2020/who-leads-the-way-when-it-comes-to-the-climate/.

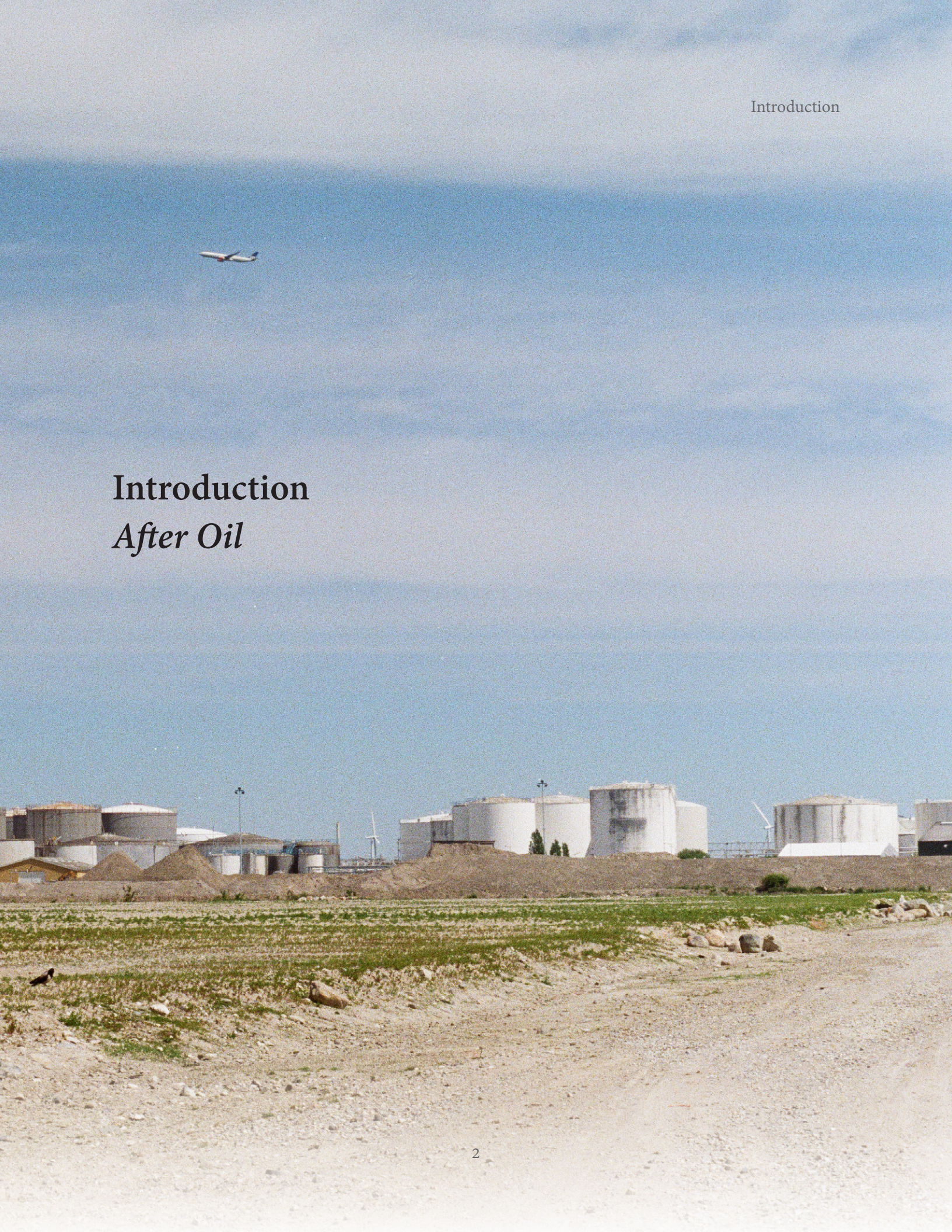
2 "Denmark to become first country to end public financing of fossil fuels abroad," CPH Post, accessed January 26, 2023, https://cphpost.dk/2021-11-03/news/denmark-to-become-first-country-to-end-public-financing-of-fossil-fuels-abroad/.

3 From energy humanities scholars, the Petrocultures Research Group, in their introduction to *Petrocultures: Oil, Politics, Culture.* Sheena Wilson, Adam Carlson and Imre Szeman, eds., *Petrocultures: Oil, Politics, Culture* (McGill-Queen's University Press, 2017), 5.

4 Rania Ghosn, "Energy as a Spatial Project," *New Geographies 2: Landscapes of Energy*, no. 2 (2009): 8.

5 Martin Eriksson, *Prøvestenen: A terrain vague of future becoming* (Master Thesis in Landscape Architecture, University of Copenhagen, 2021), 25.

6 Julie MacArthur, "Challenging Public Engagement: Participation, Deliberation and Power in Renewable Energy Policy," *Journal of Environmental Studies and Sciences,* no.6 (2016): 636, https://doi.org/10.1007/s13412-015-0328-7.



Introduction
After Oil

Fig. 1.1 An image from the Copenhagen Post of the North Stream Pipeline explosion, September 2022. (Source: https://cphpost.dk/?p=139021)

On New Year's Eve 2023, Queen Margrethe II of Denmark named the climate crisis among the gravest issues facing society in her annual public speech. In September 2022, Denmark was home to history's largest single human-caused methane emission[1]–an entirely preventable climate catastrophe. Natural gas billowed to the surface of coastal waters, wasting the equivalent of a shocking eight months of Denmark's total CO2 emissions.[2] While Danish Prime Minister Mette Frederiksen attended the ceremonial opening of the Baltic Pipe, a new route carrying Norwegian gas to Denmark and Poland symbolizing a slash in the European Union's dependency on Russian fossil fuels, explosions rang out amidst the Baltic Sea. Half a million tonnes of natural gas began pouring out of two existing Russia-to-Germany pipelines in what Frederiksen has deemed "deliberate actions", and what Polish Prime Minister called "an act of sabotage" toward Europe by Vladimir Putin. Being what The Danish Energy Agency describes as "not a small crack, […] but a really big hole", the explosions are taken as retaliation for Western sanctions over Russia's war in Ukraine.[3]

The event raised political tensions while heightening worry over climate change and the energy crisis in our collective conscience. Wasting nearly a year of CO2 emissions underlines how despite efforts to reduce emissions and move towards greener energies, Denmark has a continued relationship

with fossil fuels. Moreover, it reveals vulnerabilities in the region's energy infrastructure. Undeniably, the event reflects that among the nation's mere six million people, climate and energy crises are a concern for both the governing and the governed.

Days before from the explosions in September, the Danish government agreed to energy-saving measures including lowering the heat to 19 degrees Celsius in all public sector offices.[4] Since Russia has not reopened the exploded pipelines, independence from this energy source affects heating, lighting, and broader consumption of electricity and gas in Europe. With just 30% of domestic gas consumption in Denmark covered by local biogas and potentially huge pressure on the electricity supply in a "cold and windless winter", the risk of power outages increases. Along with the public sector, "all Danes are encouraged to save energy".[5] This thesis attempts to illustrate how the social value of care for the environment might be instrumental in an infrastructural, spatial shift beyond oil in the face of planetary climate crisis. The Danish government appears to be taking the crisis seriously with ambitious climate targets and by promoting citizen responsibility. But even in Copenhagen, oil is still very present albeit hidden in plain sight. Regarding fossil fuels, there appears a hush in public discourse surrounding different energy sources and a lack of transparency about their future use. The point is: we must move beyond oil. This thesis examines oil infrastructure in a society that is pretending it already has.

Fig. 1.2 "Only turn the heat to 19 degrees, turn off the heat when you open windows, limit hot water usage, use power when it is cheapest" are a few of the reccomendations from the Danish Energy Agency's campaign to save energy. (Source: https://www.tekniq.dk/nyheder/installatoerer-har-noeglerolle-i-spareindsats/)

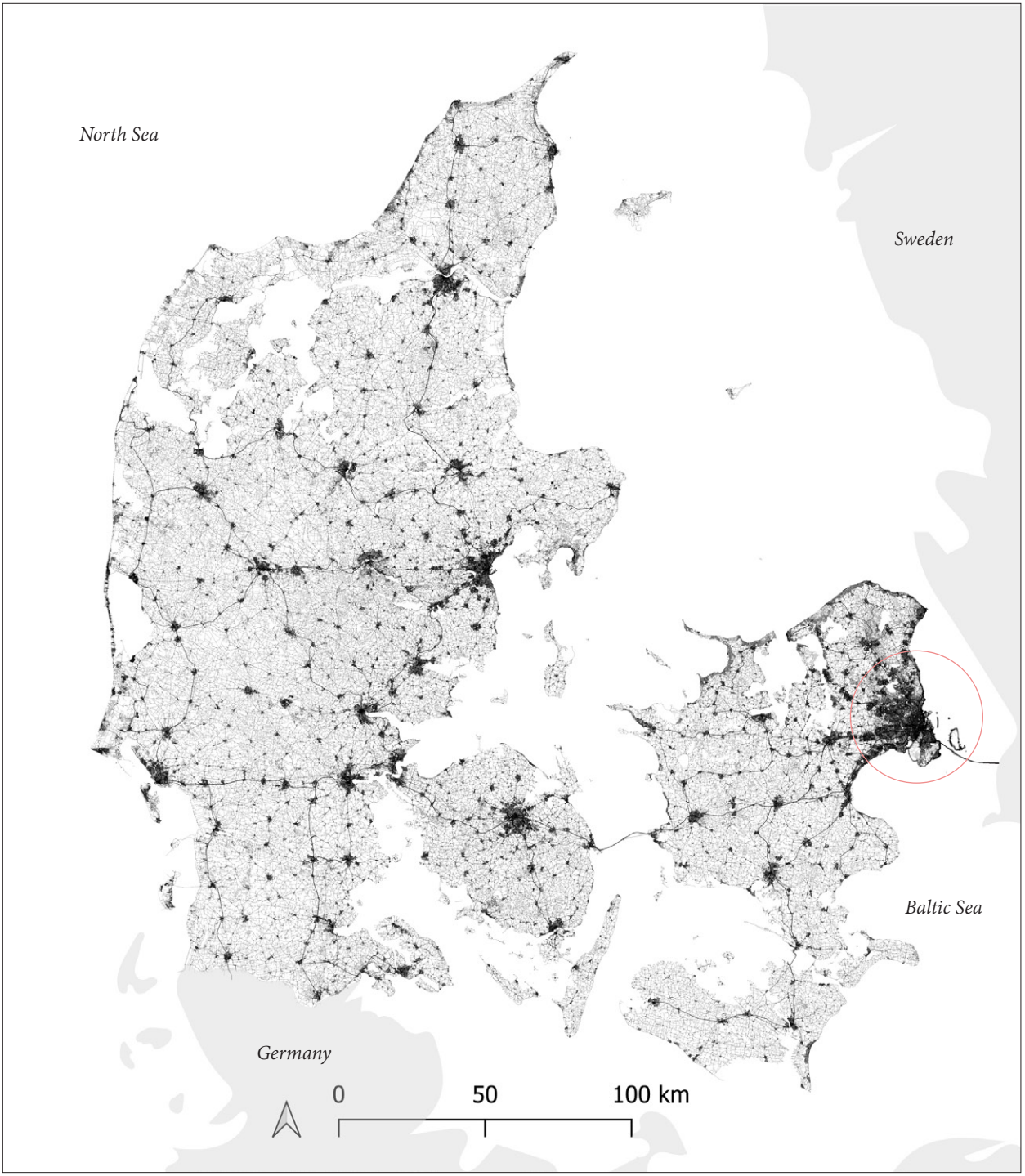

North Sea
Sweden
Baltic Sea
Germany
0
50
100 km

Fig. 1.3 (Opposite Page) Map of Denmark. Black points indicate major cities and urban settlements. Copenhagen is circled. Drawing by author.

Fig. 1.4 A bridge with bicycles, Copenhagen 1936. (Source: 'By og Havn' City of Copenhagen Port Authority archives, accessed with permission, November 2022).

Community Energy

Roughly 200 kilometers west of the exploded North Stream pipeline lies the historic port of Copenhagen, the capital city of Denmark and an urban fabric intricately woven with the sea. Steel sheet piling and stony breakwaters dovetail into the Øresund, a 118km long strait between Denmark and Sweden. In 1974 the International Energy Agency (IEA) formed in response to the international oil crisis with Denmark among its founding member countries.[6] According to the IEA in 2013, carbon-dioxide from energy-related activities made the largest contribution to greenhouse gas emissions, with fossil fuels still accounting for over 80% of the world's energy supply.[7] Despite the clear connection between fossil fuels and environmental degradation, global society has been taking such risks for a long time. However, between the 1990's and 2011 Denmark decreased emissions by nearly 20%, while Canada *increased* emissions by over 20% in the same period. Likewise, New Zealand saw an increase by over 40% and Australia by nearly 50%.[8]

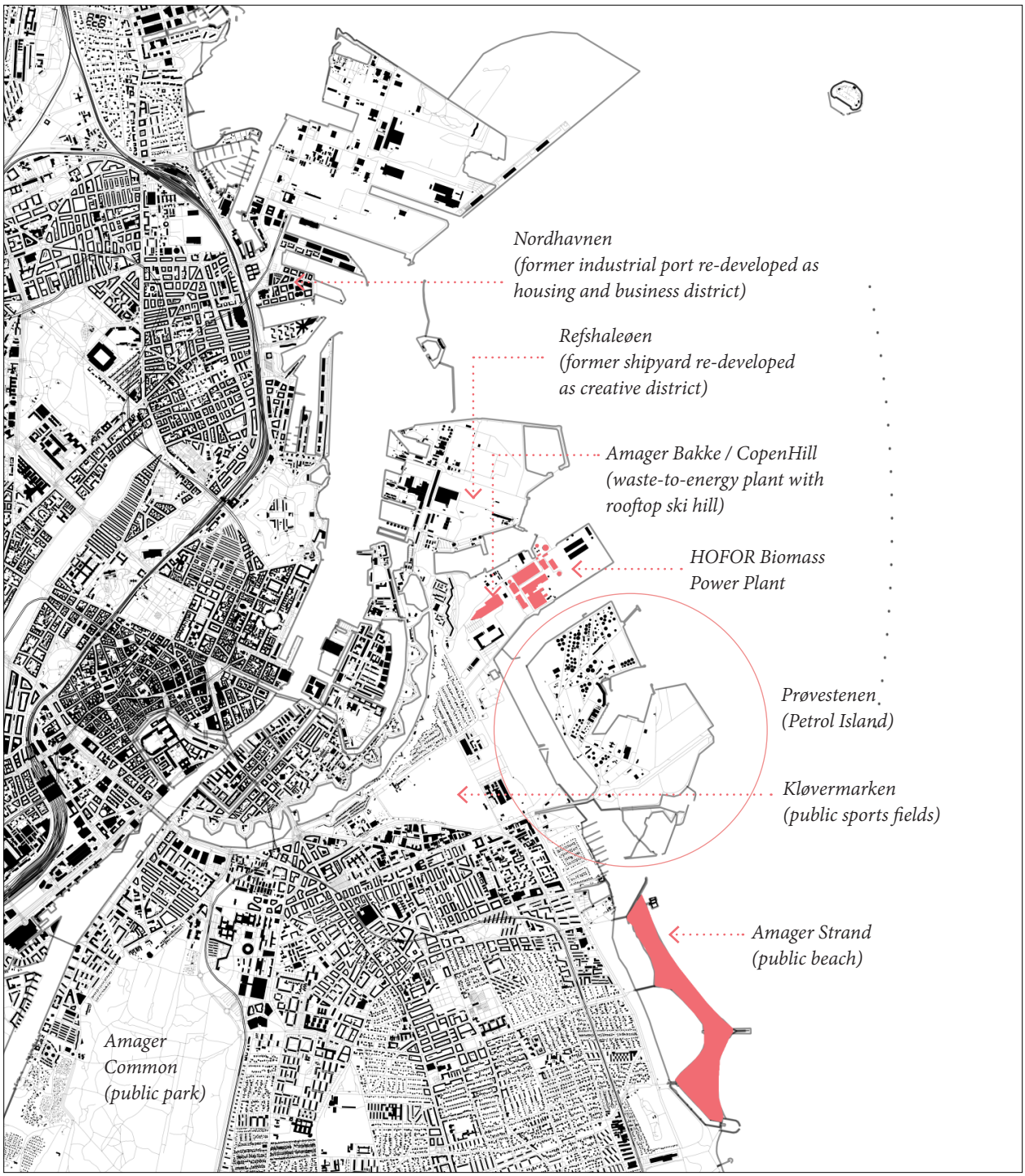

Øresund
Amager
Common
(park)
Copenhagen
Airport

Finland leads the Nordic region with its ambitious target to be carbon neutral by 2030 and carbon negative shorty thereafter. Not far behind, Denmark passed legislation to reduce emissions from 1990 levels by 70% by 2030. Iceland plans to be carbon neutral by 2040 (although their emissions have *increased* since 1990), Sweden plans for net-zero emissions by 2045, and Norway plans to reduce emissions by 80-95% by 2050. Norway's much less ambitious target of reduced emissions by 40% by 2030 pales in comparison to Finland and Denmark, and much more worrisome is Norway's actual projected reduction by only 7% by then.[9]

Fig. 1.5 (Opposite Page) Map of Copenhagen. Circle indicates the approximate urban center. Drawing by author.

Within its plan, Denmark committed to achieving total independence from fossil fuels by 2050, and Copenhagen aims to be the first carbon-neutral capital city by 2025 under the *CPH 2025 Climate Plan*.[10] With a phased approach, the CPH 2025 Climate Plan focuses on energy consumption, energy production, mobility, and city administration initiatives. By 2019, Copenhagen looked hopefully on track by reportedly having reduced CO2 emissions (including traffic, electricity, and district heating) by 54% since 2005 when the plan was implemented.[11]

Fig. 1.6 Graffiti on a bike lane in Copenhagen, 2022. Photograph by author.


Nordhavnen
(former industrial port re-developed as housing and business district)
Refshaleøen
(former shipyard re-developed as creative district)
Amager Bakke / CopenHill
(waste-to-energy plant with rooftop ski hill)
HOFOR Biomass Power Plant
Prøvestenen
(Petrol Island)
Kløvermarken
(public sports fields)
Amager Strand
(public beach)
Amager Common
(public park)

How is Denmark doing it? It seems to have all began with the nation's collective reaction to the 1970's oil crisis. Integral to their success in reducing carbon emissions is public engagement in energy systems involving community ownership and service provision.[12] Following the 1970's oil crisis the Danish government implemented a policy to improve economic and environmental outcomes in the country, part of which delegated community ownership of wind turbines and the development of combined heat and power and district heating.[13] Organized cooperatives for large power plants with electricity distributors as owners as well as tax free income investments on some wind farm projects are some examples. These public engagement features resulting from Danish energy policy are often deemed responsible for the country's large wind uptake and district energy systems.[14] While not necessarily unique, Denmark's ownership-engagement approach represents a highly developed and overarching application of citizen agency in the energy sector.[15]

Fig. 1.7 (Opposite Page) Central Copenhagen. Noteworthy industrial and public infrastructures highlighted. Petrol Island is circled. Drawing by author.

Petrol Island

Oil infrastructure appears to be excepted from the ownership-engagement approach. Despite its pungent presence in hand-held pumps at the gas station, oil en masse seems to flow wrapped in an invisibility cloak in the eyes of the public, kept on the outskirts of town and largely unseen by passers-by. But it is hard to ignore on the island of Prøvestenen. From above, Prøvestenen is a large and oddly shaped landform linked to Copenhagen's south-east water frontier. *Prøvestenen*, meaning 'touchstone' also goes by the nickname *Benzinøen,* literally translating to 'petrol island' in English.[16]

Fig. 1.8 Archival photograph of Petrol Island, 1930's, from the By og Havn archives.

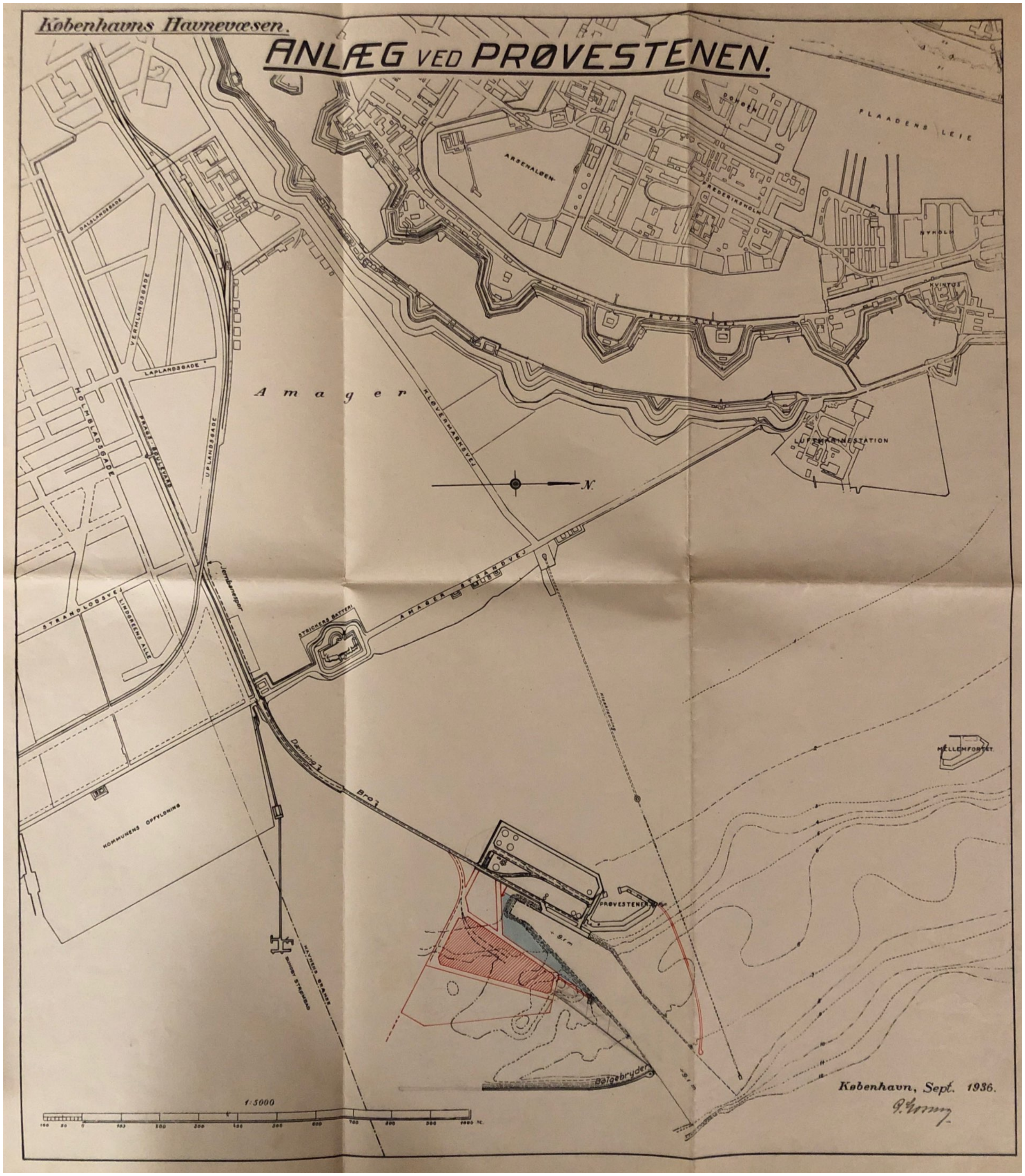

Københavns Havnevæsen.
ANLÆG VED PRØVESTENEN.
FLAADENS LEIE
ARSENALØEN
NYHOLM
LUFTMARINESTATION
Amager
N.
AMAGER STRANDVEJ
STRICKERS BATTERI
KOMMUNENS OPFYLDNING
Dæmning 7
Bro 7
PRØVESTENEN
MELLEMFORTET
Bølgebryder
1:5000
København, Sept. 1936.

Fig. 1.9 Archival photograph of Petrol Island, 1930's, from the By og Havn archives.

Fig. 1.10 (Opposite Page) 1936 plan for the construction of Petrol Island from the By og Havn archives.

For the last century the artificial island has been growing, its landscape being put to work; Petrol Island is the country's largest fossil fuel farm with 250 tanks[17] storing various substances in their last stage before distribution – an oil space. Beginning as a minor sea fortification in 1713, the 1920's through 1930's saw first the Navy and then the City of Copenhagen acquire the island to store oil and gasoline, later expanding the landscape with infill to generate a larger complex of oil tank farms.[18] Today, the vast public Amager Beach Park sits to the south of the Island while both the HOFOR Biomass Power Station and Amager Bakke waste-to-energy plant hover directly north, placing it in a broader network of public, industrial and energy infrastructures. Expansion of the artificial island's landmass using local surplus construction soils continued until the early 2000's. As part of the city's carbon neutrality efforts in 2010, three wind turbines were then constructed on Petrol Island.[19]

Fig. 1.11 1700's historic 'Prøvestenen' fortification with new surrounding soil infill in progress in the 1930's. Archival photograph of the construction of Petrol Island, from the By og Havn archives.

Fig. 1.12 Soil infill process. Archival photograph of the construction of Petrol Island, 1930's, from the By og Havn archives.

Fig. 1.13 1930's oil tanks on Petrol Island. Archival photograph from the 1930's, from the By og Havn archives.

By og Havn, the Copenhagen City and Port Development, owns and operates the area today. Scattered amongst the field of oil tanks and wind turbines, the bustling 2.3 square kilometre landscape hosts a miniature mountain range of perpetually shifting dry bulk aggregate and post-consumer material. Additionally, the newest and southern portion contrasts the Island's industrial chaos with an 8m tall noise barrier ridge and a rugged public park. Since 2000, By og Havn planned for the southern part, *Petrol Island South,* to become a large recreational area complete with boat storage, camping facilities, vegetation, and paths for public use. However, the following decade's financial crisis forced this plan to be put on hold leaving the area abandoned until 2020 before being opened in its existing condition as a park. Currently, there are no official plans for the redevelopment of southern Petrol Island, but it remains an area for "possible establishment of business activity for recreational purposes".[20]

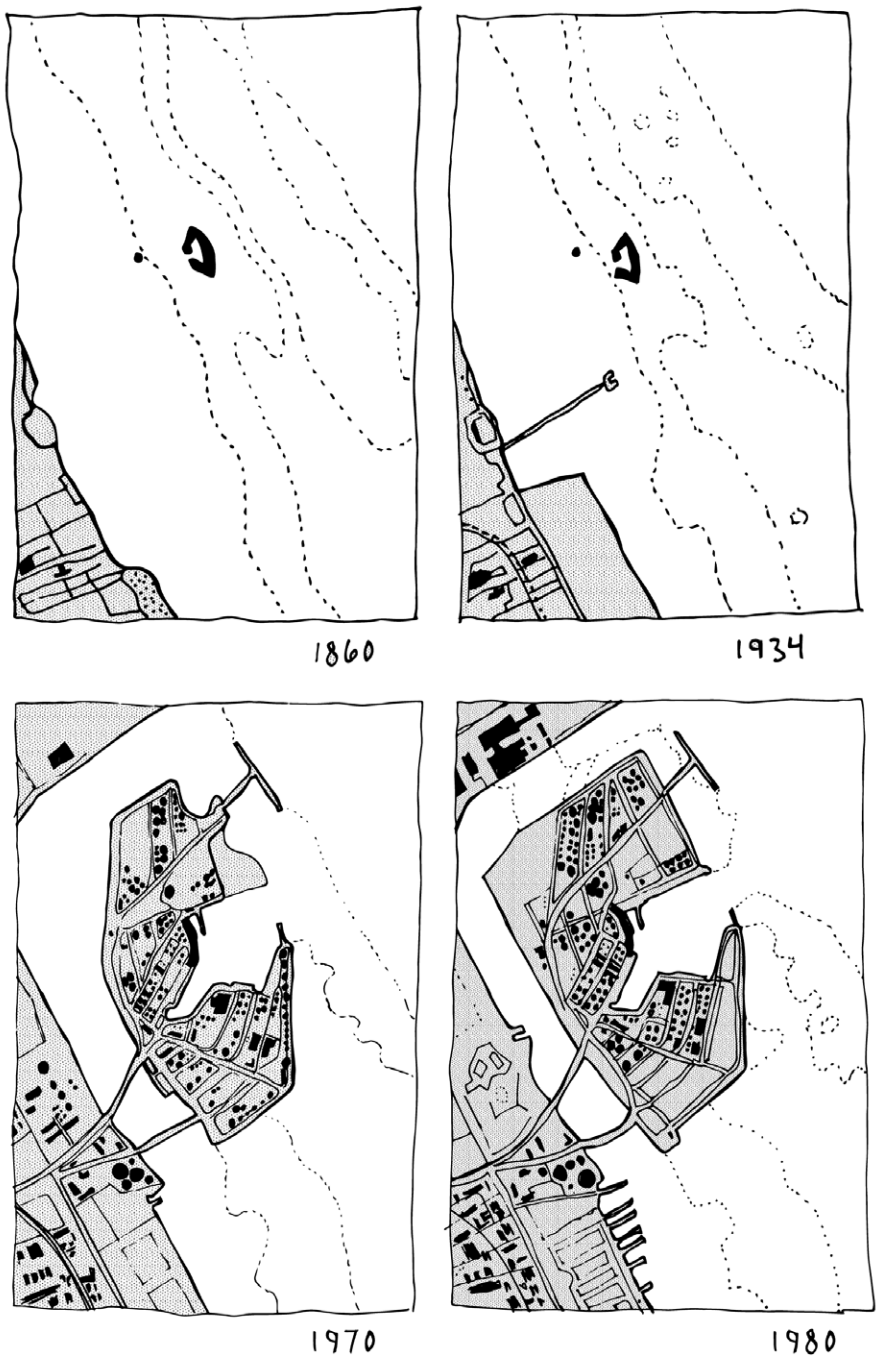


Fig. 1.14 The growth of Petrol Island, 1860-2008. Sketch by author.

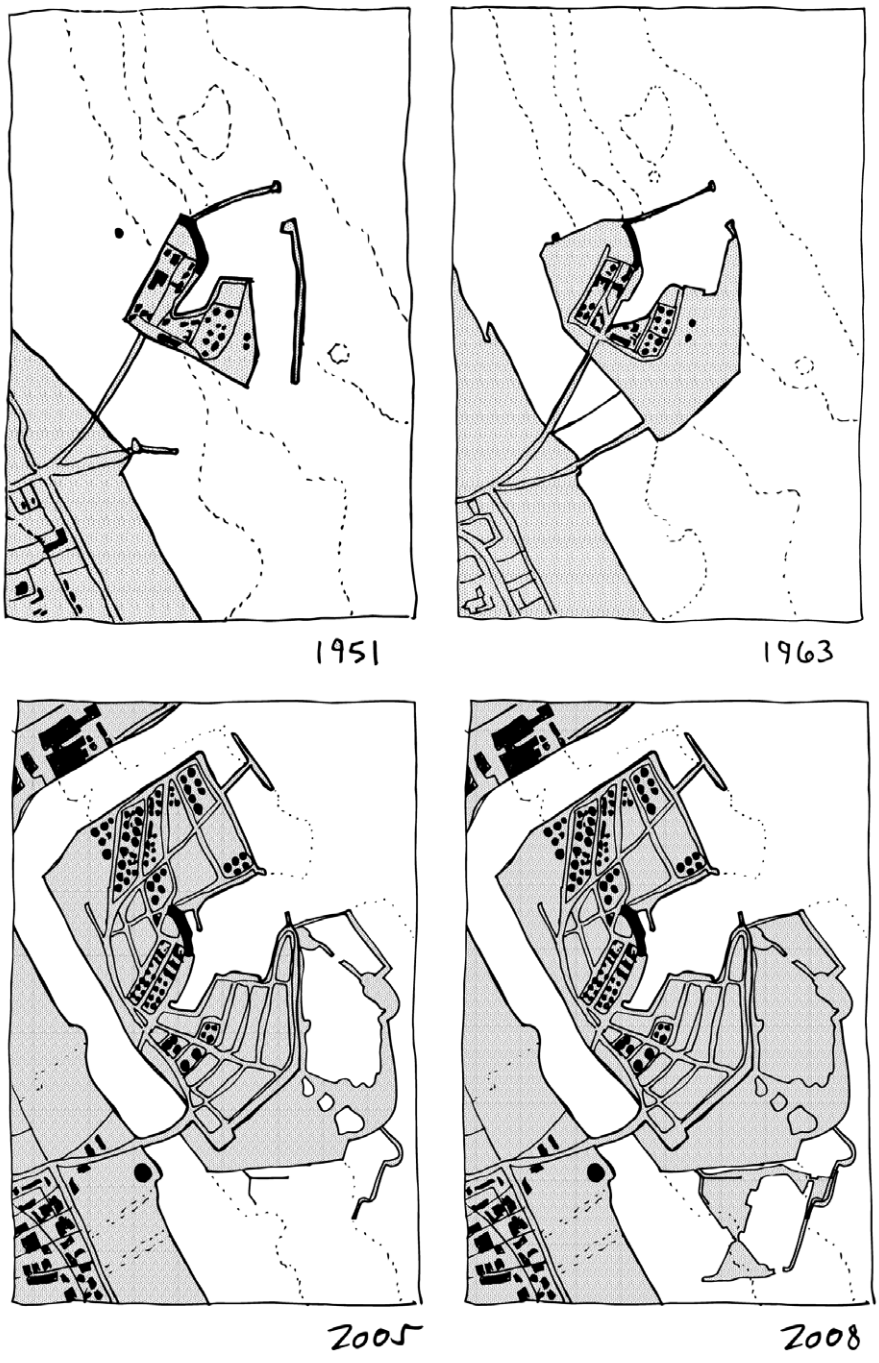

1951
1963
2005
2008

Fig. 1.15 Recent aerial image of 'Petrol Island South'. White dashed line indicates walking path. (Source: https://byoghavn.dk/offentlig-adgang-til-proevestenen-syd-forlaenges-frem-til-sommeren-2021/)

Fig. 1.16 Recent aerial image of Petrol Island. (Source: https://byoghavn.dk/offentlig-adgang-til-proevestenen-syd-forlaenges-frem-til-sommeren-2021/)

Fig. 1.17 (Opposite Page) Existing plan of Petrol Island as it appeared in 2022. Drawing by author.

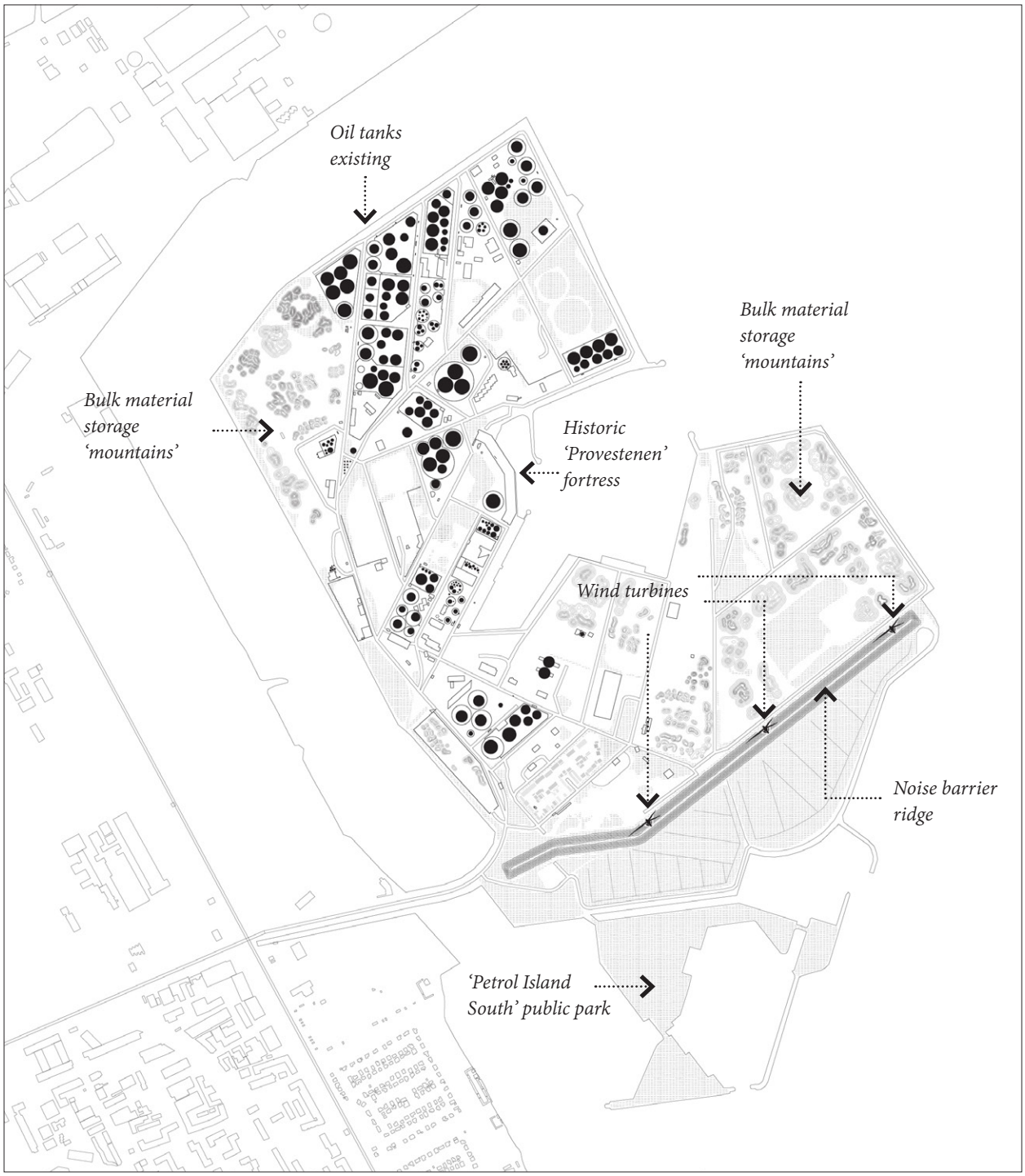

Oil tanks
existing
Bulk material
storage
'mountains'
Historic
'Provestenen'
fortress
Bulk material
storage
'mountains'
Wind turbines
Noise barrier
ridge
'Petrol Island
South' public park

Fig. 1.18 Standing on top of the noise barrier ridge facing east. To the right is Petrol Island South public park. To the left are the industrial yards. Built into the ridge are three wind turbines - the turbines in the background are in the water of the channel. In the far background across the Øresund lies the coast of Sweden. Photograph by author.

Directly adjacent to Petrol Island on the mainland appears an undeveloped section of coastal plots along with Kløvermarken, a large sports field. Not surprisingly amid a housing shortage, these plots are marked for potential residential development.[21] But what about the elephant in the room? What is planned for Petrol Island's (leaky) time-bomb: oil? Layers of chain-link fence keep curious park dwellers hundreds of meters away from the oil tanks, along with all other industrial goings-on. The only glimpse one can get into the mysteries of Petrol Island's gas station for giants is perhaps from a kayak on the sea, on top of the ridge beneath thundering windmills or by climbing up *CopenHill*, Bjarke Ingles' famous ski hill next door. How might spatial access to Petrol Island promoting public engagement with energy infrastructures spur a societal and cultural shift toward life after oil?

Fig. 1.19 Wind turbines and noise barrier ridge separating 'Petrol Island South' park, 2022. Photograph by author.

Fig. 1.20 Dry bulk mounds with the oil tank farm in the distance on Petrol Island, 2022. HOFOR power station and Amager Bakke in background. Photograph by author.

Fig. 1.21 Standing on top of the ridge, one can see Petrol Island's bulk construction material storage in foreground. Oil storage tanks in background. Photograph by author.

Fig. 1.22 "Danish Iron and Metal" material mound as seen from the top of the noise barrier ridge, Petrol Island, 2022. Photograph by author.

Invisible Landscapes

Petrol Island is hidden, but not quite alone. Just meters away are neighbours Amager Bakke, a combined waste-to-energy plant with rooftop nature park and HOFOR, a retired coal-fired power station now burning biomass. On the horizon of the city's peripheral vision, Petrol Island is an energy space in the neighbourhood powerhouse. In the essay *Energy as a Spatial Project* in the *New Geographies* journal, architectural critic Rania Ghosn reflects on the spatial conditions of oil, noting how energy, or "the ability to make nature do work" needs and exploits space as a resource to construct geographies of power. [22] The exploitation of nature requires a power imbalance in which publics are disengaged from energy production through spatial separation. Energy, or 'nature doing work' is the essence of Copenhagen's Petrol Island. It is an artificial landscape built to store extracted oil with wind energy as an afterthought; a 'working' landscape closed to the public and banished to the city's edge.

Ghosn highlights that the creation of value in energy regimes has been internalized in urban centres while the costs have been externalized out of sight to the periphery. While energy spaces are extensively connected across trade routes, territories, and environments, "their spatial networks are unevenly visible in their operations"[23], with great lengths taken by oil companies to "render most of their operations invisible and outside of political controversy".[24] Regardless of their invisibility, Ghosn concludes that whether to meet the shifts in production or to move toward a green energy transition, oil infrastructures are being abandoned, demolished, and adapted in response to the changing energy market.[25] "Making visible the infrastructure", *New Geographies* asks "what are the social, political, and spatial implications of the next mode of energy, and how can design practices partake in shaping a more just urbanization?".[26]

This thesis moves to make Petrol Island visible as an energy space. The site is externalized to the urban periphery and thus out-of-sight to a public that generally wants to cease using fossil fuels. The public in this case if disengaged. For this reason, I suggest citizen engagement with Petrol Island through increased access to promote visibility. Using design practices to shape a more just urbanization during the energy transition, I propose public spatial agency in an oil space.

Petrocultures

The internationally emerging field of the energy humanities has looked to the *Petrocultures Research Group* since 2011 as a leading force in researching the social and cultural implications of oil and energy.[27] In 2017, founders Sheena Wilson and Imre Szeman together with Adam Carlson published the book *Petrocultures*, an essay compilation to feed scholarly discussion positioning "oil and energy as the fulcrum around which many of today's most pressing social, economic, and political issues must be analyzed and understood".[28] *Petrocultures* acknowledges that although oil transformed everyday life in the twentieth century, it has taken until the twenty-first century for us finally realize the degree to which it has shaped our existence. With newfound awareness of oil's importance comes a recognition of the fact that going forward "we will need to extract ourselves from our dependency on oil and make the transition to new energy sources and new ways of living," propelling us toward a social transformation like none other in history, affecting the entire planet's beings and infrastructures.[29] In their words, the looming threat of its absence means oil will again transform us from "people who exist comfortably in petrocultures" to people who will adapt to fit "contexts and landscapes we can barely imagine - and quickly".[30]

The transition to move away from fossil fuels is less a challenge of technology or public policy than a matter of society and culture. Not only a question of what kinds of energy should replace oil, be it wind, solar or otherwise, it is also the purposes to which we put energy, "the *why* and the *how*". The transition therefore involves not just a shift to green energy but also that in the values and practices stemming from our fossil-heavy lives. In effect, fossil fuels have been "hidden in plain sight", their importance in defining modernity standing in inverse relationship to their presence in our social and cultural imaginaries.[31]

In August of this year, I attended the annual *Petrocultures 2022* conference themed *Transformations* in Stavanger, a small city known as the energy capital of Norway. I presented my in-progress thesis paper alongside thinkers in the energy humanities and became engulfed in oil discourse for a weekend. I heard Adam Carlson of *Petrocultures* speak about Canadian oil, the 2022 Trucker Convoy as an expression of Western petromodernity

Fig. 1.23 Secure entrance to Petrol Island's industrial grounds, 2022. The sign reads "Enter with PASS". All was quiet, as it was Sunday. Photograph by author.

Fig. 1.24 Walking along the top of the noise barrier ridge in Petrol Island South. Photograph by author.

and a "radically-symbolic resolution of neoliberalism's contradictions". Sheena Wilson also discussed the trucker convoy, analyzing it through "an intersectional, feminist, decolonial lens" speaking particularly to extractivist logics. Keynote speaker Oxana Timofeeva, a Russian professor at the Stasis Center for Practical Philosophy, spoke about oil and war and attempting to deconstruct Russia's petroimperialism as both a political formation and a state of mind. A cross-disciplinary arts and science workshop by Ernst Logar of the University of Applied Arts in Vienna offered hands-on experiments with crude oil as a catalyst for discussion surrounding the transition to clean energy.[32]

Oil has nearly always been both a strong political and technological instrument. However, from critical conference presentations I learned that the topic of oil is much more nuanced and complex than I had originally understood; it is neither easy nor simple for a society to cut ties with oil. Perhaps most importantly, moving beyond oil is not a rapid process. Whole settlements, livelihoods, and traditions have grown from it. The conference was held in the Norwegian Petroleum Museum which itself showcases Norway's oil infrastructures and seems to celebrate the extractive tradition. Stavanger is the 'oil capital' of a country named by the research group to be a 'petroculture', along with Canada, Nigeria, and Russia among others. A friend who grew up in Stavanger told me: "my dad used to take us to that museum when I was a child." After the conference I flew over the North Sea oil rigs in a small, fossil fuel-powered aeroplane back home to Copenhagen. I left with the impression that oil runs deep in our collective conscience, but not always due to its environmentally destructive nature. I applied this new understanding of the complex nature of petrocultures to my design proposal going forward by implementing a layered approach that prioritizes the consideration of diverse societal groups, histories, and voices.

Island as Stage

In the Danish context, Petrol Island is a key space in which the transition from oil to greener energy can take place. The Island is an example of Ghosn's invisible infrastructure overlooked in urban Copenhagen's new carbon neutral identity. It holds the potential to be a stage for cultural and societal transition beyond our fossil fuel-heavy lives. Informed by Danish

traditions of community ownership-engagement within the energy sector, social welfarism, spatial appropriation and closeness with the natural world, the thesis illustrates an idea for Petrol Island's transitional phase. The proposal incorporates three themes which I elaborate in the ***Breaking, Growing,*** and ***Taking*** chapters. Each theme leans on key theories which inform my schematic design choices to follow. Given that the transition itself is temporal, the phases are not exclusive nor separate but very much interwoven and often happening simultaneously in time.

I take the position that to transition to a time after oil both culturally and structurally, adjacent communities must engage more directly with the landscapes where nature is put to work. To promote public discourse and energy visibility, we need to see the consequences of our climate actions up close. For these interactions to take place, I propose the disassembly of Petrol Island's oil tank farm in ***Breaking***. The deconstruction process offers an opportunity for stakeholder groups to see the insides, outsides, and scale of oil infrastructure. It also offers an important opportunity to salvage materials and experiment with material reuse. Because deconstruction can be a long and complex process, if visible to the public there arise opportunities for citizen engagement and learning throughout the process itself. The ***Growing*** phase illustrates the planting and nurturing of spontaneous vegetation and deliberate phytoremediation species to degrade toxic petrochemicals on site. Furthermore, plants are relatable at the human scale. Coexistence with non-human species helps to bridge the gap in scale between humans and infrastructures. The fact that encounters with nature is a common form of education in Denmark supports the idea that to interact with the oil infrastructure of Petrol Island, we humans must let plants lead the way. The ***Taking*** phase promotes the visibility of energy infrastructures through public access to the oil space. I suggest public programming of both the infrastructure in various states of material disassembly as well as the phytoremediation vegetation landscape. Spatial encounters with infrastructure create greater discourse and social visibility when people are allowed to walk, climb, inhabit, and play with oil tanks, likely for the first time.

Fig. 1.25 The few human-scaled objects on Petrol Island are railings, steps and fences. Shown here is the entrance at the base of one of the windmills. The door was locked. Photograph by author.

Endnotes

1 The event was estimated the largest human caused methane emission by Manfred Caltagirone of the United Nations Environment Program. Louise Wendt Jensen, "Nord Stream Gas Leak Is Pure 'Climate Catastrophe,'" *Energy Watch*, September 30, 2022, https://energywatch.com/EnergyNews/Policy___Trading/article14451393.ece.

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Method
lens & time

Fig. 2.1 Photograph by Edward Burtynsky from the series "Oil" entitled "SOCAR Oil Fields #3, Baku, Azerbaijan, 2006". (Source: https://www.edwardburtynsky.com/projects/photographs/oil)

Burtynsky's Oil

Canadian photographer and artist Edward Burtynsky documents industrial landscapes. The content and style of his work inspired the beginning of this thesis. The power of Burtynsky's photographs "lies in their ability to make visible the otherwise hidden and geographically distant destructiveness of the global cycle of extraction, manufacture, and disposal that characterizes contemporary capitalism."[1]

His body of work is debated as an act of environmental justice, with supporters claiming the fact "that he chooses to pay attention to these places is already a form of engagement."[2] However, it is worth noting that critics argue Burtynsky's "making environmental destruction visually beautiful runs the risk of desensitizing audiences from the subject's horror, aestheticizing—thus even making desirable—the scale of toxicity he portrays. (…) this seductive toxic sublime [helping] viewers to become comfortable with what might otherwise be a difficult landscape."[3]

With this in mind, I proceeded to take photographs of Petrol Island while considering the risk of aestheticizing, desensitizing, or celebrating it. After the fact I noted a major departure from Burtynsky in my own work: I document from a human-scale perspective. I am often on an intuitive quest to personify objects and places through portrait-like orientation and depth of field. Burtynsky communicates the vast sublime using wide perspectives and an omnipresent eye over landscapes. Therefore, although his evocative industrial imagery originally inspired my research method, we did not look through the same lens. I only attempted to use photographs to make visible the otherwise hidden landscape of Petrol Island with a similar objective in mind.

Fig. 2.2 Photograph by Edward Burtynsky from the series "Shipbreaking" entitled "Shipbreaking #49, Chittagong, Bangladesh, 2001". (Source: https://www.edwardburtynsky.com/projects/photographs/shipbreaking)

Fig. 2.3 The archives of 'By og Havn', The Copenhagen City and Port Development, 2022. Accessed with permission, photograph by author.

Fig. 2.4 The archives of 'By og Havn', The Copenhagen City and Port Development, 2022. Accessed with permission, photograph by author.

The Attic

In November 2022, By og Havn, the Copenhagen City and Port Development, opened their doors to the public exhibiting their archives for the first time. I attended in the hopes of finding some information about the City's plans for Petrol Island. This kind of information was not included. Regardless I arrived to find a precious attic of paper records of Copenhagen's past and ongoing development projects, not yet digitized. I sifted through multiple binders of loose papers about Petrol Island – containing telegrams, permits and letters between engineers, authorities, and architects. I found printed photographs of the Island's construction from the 1930's and some original architectural plans from the same period. Even considering the gap in information for future plans for the space, the visit was fruitful to clarify the Island's past. I include some photographs and drawings here, with permission of the archives.

Fig. 2.5 Sketches of possible interventions over site photographs. Drawings and photographs by author.

Field Work

Exploring the publicly accessible portion of Petrol Island by bicycle, run, swim, and on foot repeatedly over a half-year period, I used a combination of analogue film photography and sketching to observe and comprehend a post-oil future for this energy space. Documenting by the archaic method of colour film, I sketched observations by hand to gain a rapid and overarching understanding of emergent patterns. Over time I witnessed seasonal growth and decay, human marks such as unscripted walking paths and bonfire debris, changing winds, tides, and birds; I found fences, danger signs, security cameras, abandoned boats and active construction sites; I found layers of bushy overgrowth and life rings, sea rescue ladders and rust, graffitied signs and thriving patches of shrub, marsh, and trees. Looking out at the horizon of oil cisterns, humming wind turbines, dust-billowing gravel mounds and windy grasses, on Petrol Island I felt deeply out-of-place. Such visits prompted the identification of three thematic stakeholders present on Petrol Island. This catalyzed my proposal for an alternate future to the Island's use as an inaccessible landscape for oil.

Approach

My research began as a quest to explore and represent an out-of-sight landscape. Historical research was supported by the City of Copenhagen Port Authority's non-digitized archival material. Theoretical research accompanied my journey throughout. In essence, photography and on-foot human-scaled site visits were both an entry point into the research content and a method of gathering information first-hand that propelled later design decisions in the proposal.

This thesis illustrates three thematic engagements with the disassembly of infrastructure toward a more restorative future. The themes, Breaking, Growing, and Taking can be considered temporal phases which occur in a somewhat overlapping, entangled manner. Each 'phase' observes a different stakeholder in the holistic ecosystem that is Petrol Island. Stakeholders refer to living beings (human and non-human species) as well as material objects and infrastructures, positing that to orchestrate a restorative future there must emerge a closer, reconciliatory understanding between coexistent inanimate objects and extractive materials, ecological lifeworlds and societal human populations. Each phase features a different group of stakeholders who can be seen to have conflicting interests playing out on the stage that is Petrol Island; phases motion to prioritize the histories, needs, and right to remain of each stakeholder by acknowledging their existence and potential as equal entities.

Stakeholders make up three general groups: 1) state-led, privately operated, 2) state-led, community operated and 3) community-led, citizen operated. Each phase focuses on a stakeholder group. Breaking deals with the state-led privately operated, involving government policy makers, designers, and landowner-operators like the City of Copenhagen Port Authority as well as contractors and skilled construction personnel. Growing considers the state-led community operated, referring to government and public sector employees, skilled construction personnel, designers, and organized education and community leaders. Taking activates the community-led citizen operated, including individual volunteers and groups or members of local society at large.

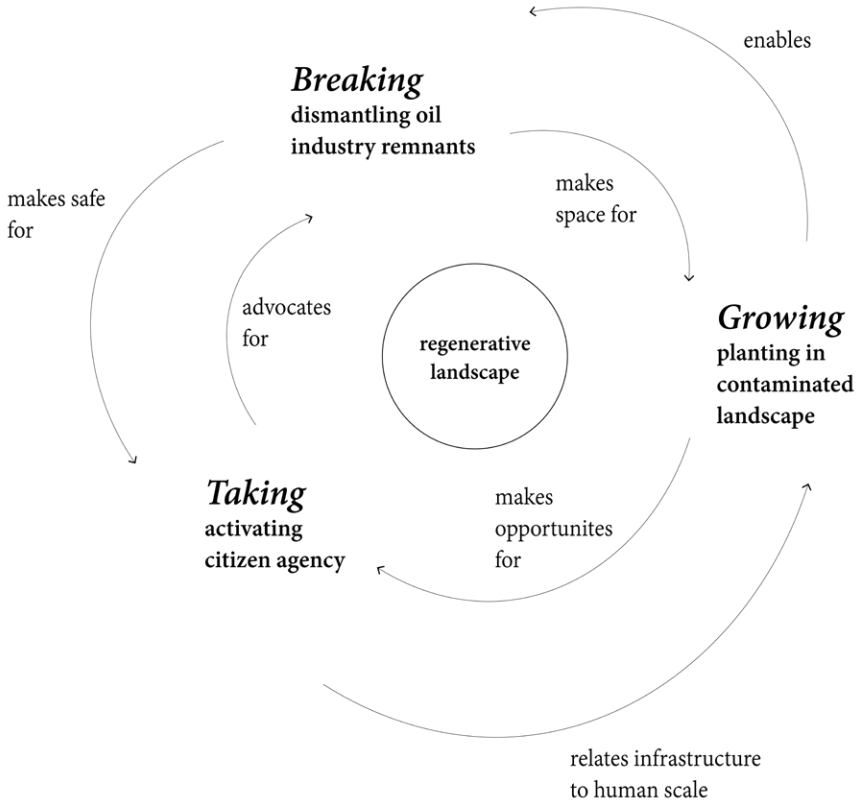
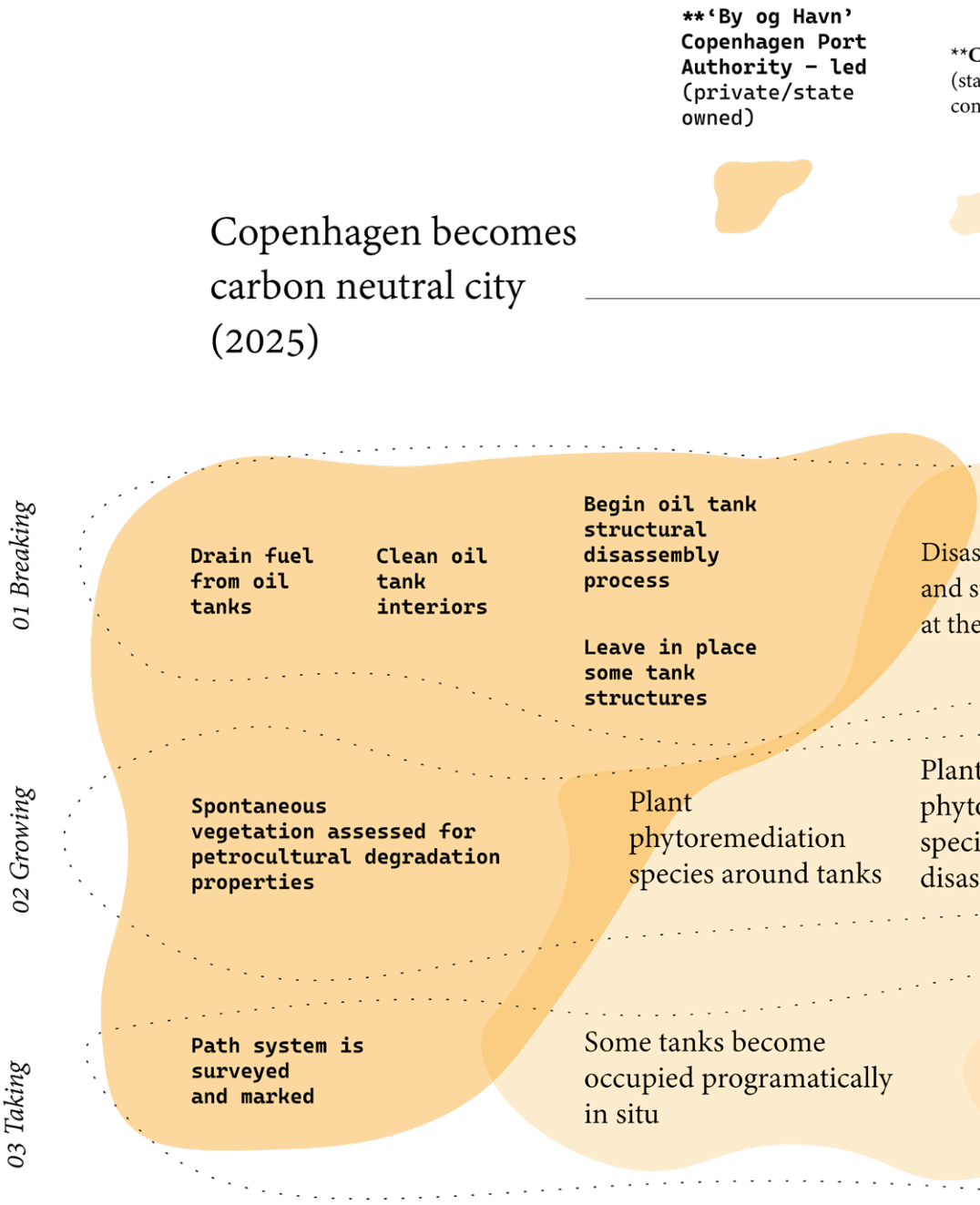
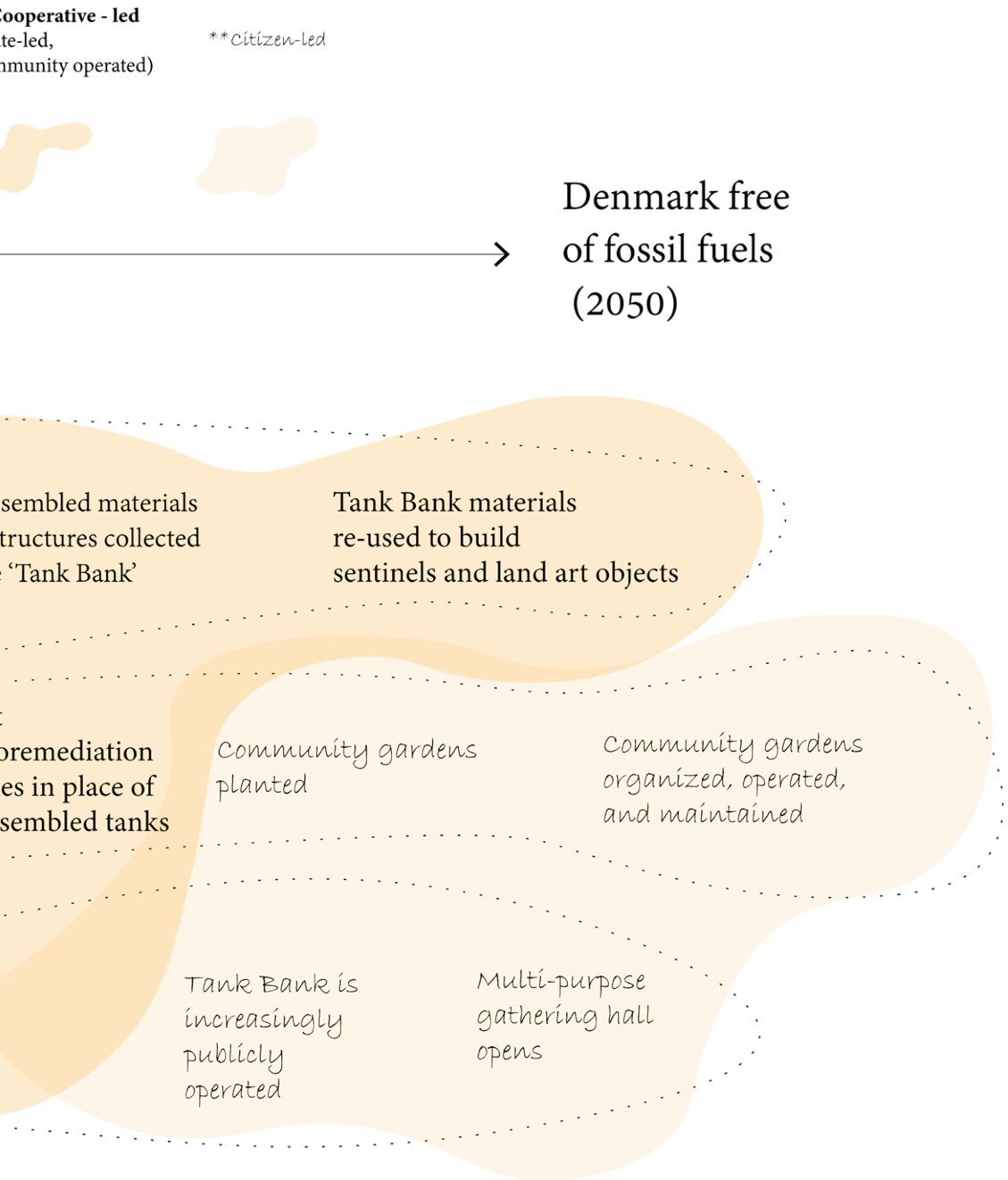


Fig. 2.6 Diagram showing the relationship between the three phases.

I call this approach regenerative disassembly. I define this as a notion of growth through the unbuilding of things. The method uses infrastructural deconstruction, re-composition, and the reuse of material as methods of environmental repair. To degrade petrochemical leakages and reduce carbon emissions, I plan ecological restoration while making the landscape safe for human encounters. The combined process works to reveal Petrol Island to be an accessible landscape for public engagement with energy infrastructures for a collective cultural shift beyond oil.

Fig. 2.7 Timeline of three phases and their temporal relationship.

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Tank Bank materials
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sentinels and land art objects
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Community gardens
planted
Community gardens
organized, operated,
and maintained
Tank Bank is
increasingly
publicly
operated
Multi-purpose
gathering hall
opens

Fig. 2.8 Early concept sketch of key stakeholders. Skilled construction personnel, as well as private, state, and community actors are considered. Drawing by author.

government

policy makers

-politicians

-law makers

land owners

-Copenhagen Port Authority

designers

-engineers

-landscape architects
-architects

skilled

construction

-Copenhagen Port Authority employees

-contractors

public safety keepers

-police

-emergency responders

community

leaders

-non profit entities

-environmental activists

educational

leaders

-school principals organizers and teachers

-university faculty members and researchers

sport and recreation

leaders

-scouts

-sports organizations

citizen

volunteers

-nature enthusiasts

-seniors

-park dwellers


Bulk material storage 'mountains'
Wind turbines
'Petrol Island South' public park
Bulk material storage 'mountains'

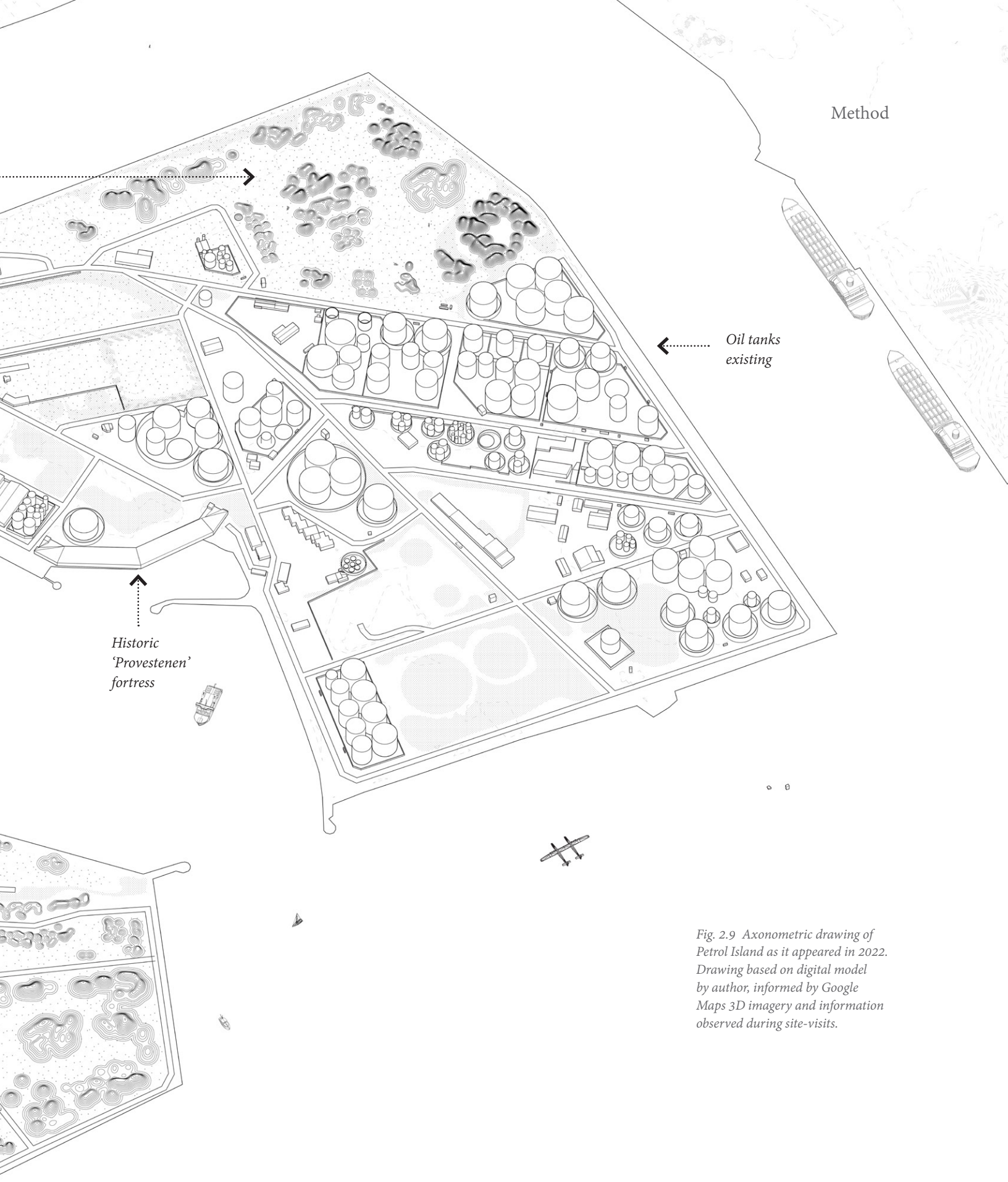

Fig. 2.9 Axonometric drawing of Petrol Island as it appeared in 2022. Drawing based on digital model by author, informed by Google Maps 3D imagery and information observed during site-visits.

Endnotes

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Breaking

Fig. 3.1 "The Brent oil field, off the Scottish coast, is scheduled for decomissioning." (Source: https://e360.yale.edu/features/as-north-sea-oil-wanes-removing-abandoned-rigs-stirs-controversy)

The country of Denmark forms a small landmass in northern Europe, the North Sea looking over its western shoulder and the Baltic Sea rising from the east. While masses of oil exploded out of the Baltic Sea's North Stream pipelines from Russia in September 2022, the North Sea's oil wells are beginning to run dry as its hydrocarbon reserves are depleting, requiring the disposal of hundreds of soon-to-be obsolete offshore oil and gas platforms. The task of decommission involves "twin-hulled megaships, underwater lasers, robot submarines and diamond saws"[1] among other complex technological and engineering feats. The massive infrastructures must be returned to shore for dismantlement and recycling, a particularly challenging job for engineers. The same will be true for offshore turbines in the now about 3000 wind farms in the North Sea, as "someday they too will reach their end of their service lifetime and need recycling" says Richard Nielsen, a physicist and offshore technology specialist of the University of Aberdeen.[2] The task of decommissioning energy infrastructures as they become obsolete is not a simple one. It also poses several questions about waste, repair, and the life cycles of materials.

The magnitude, scale and dominating oil infrastructure on Petrol Island suggests a sense of eery magnificence edging toward the sublime. Looming high in the landscape, the 250 oil storage tanks demand attention. They are not neutral inanimate objects. They hold the physical substance of oil to embody international energy politics, planetary climate crisis, pollution, and environmental disturbance. I propose a future that opposes the oil industry, dismantling physical oil remnants while addressing their symbolic architectural identity through an integrated, 'broken world thinking' approach.

Fig. 3.2 Approaching Petrol Island from the mainland, the view across the shallow channel shows a skyline of oil tanks, mostly painted white. Photograph by author.

Fig. 3.3 Standing as close as one can get to the oil facilities on Petrol Island, outside the secured entrance gate. Amager Bakke, the waste-to-energy plant with rooftop 'CopenHill' can be seen in the bottom left background as the sloped roof with steam chimney. Photograph by author.


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PRØV STENEN

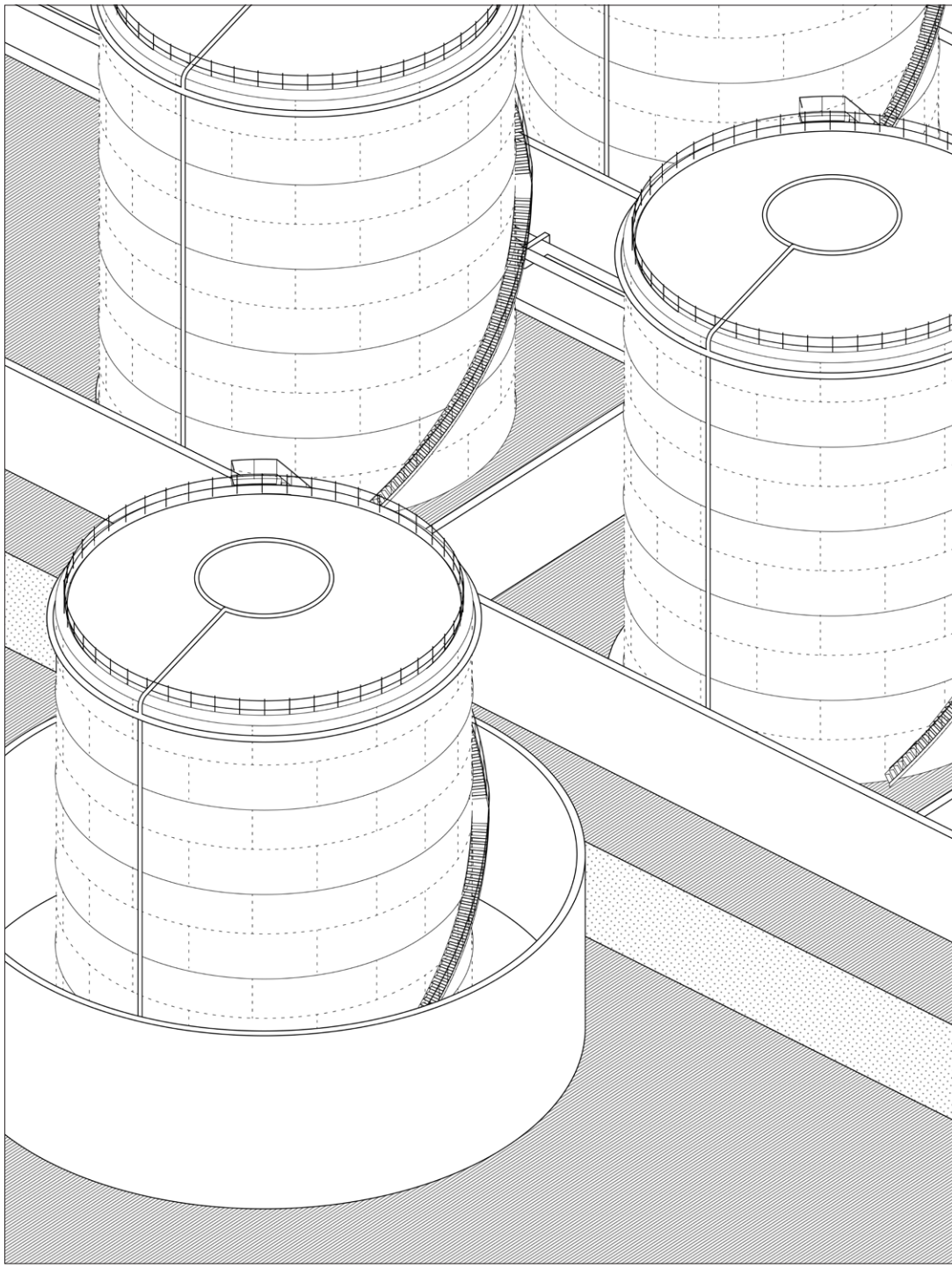


Fig. 3.4 Axonometric view of a typical portion of the oil facility on Petrol Island. Estimates were made about the height and structure based on Google Maps imagery. Note features such as concrete barrier walls surrounging tanks, piping, and exterior access stairs. Drawing by author.

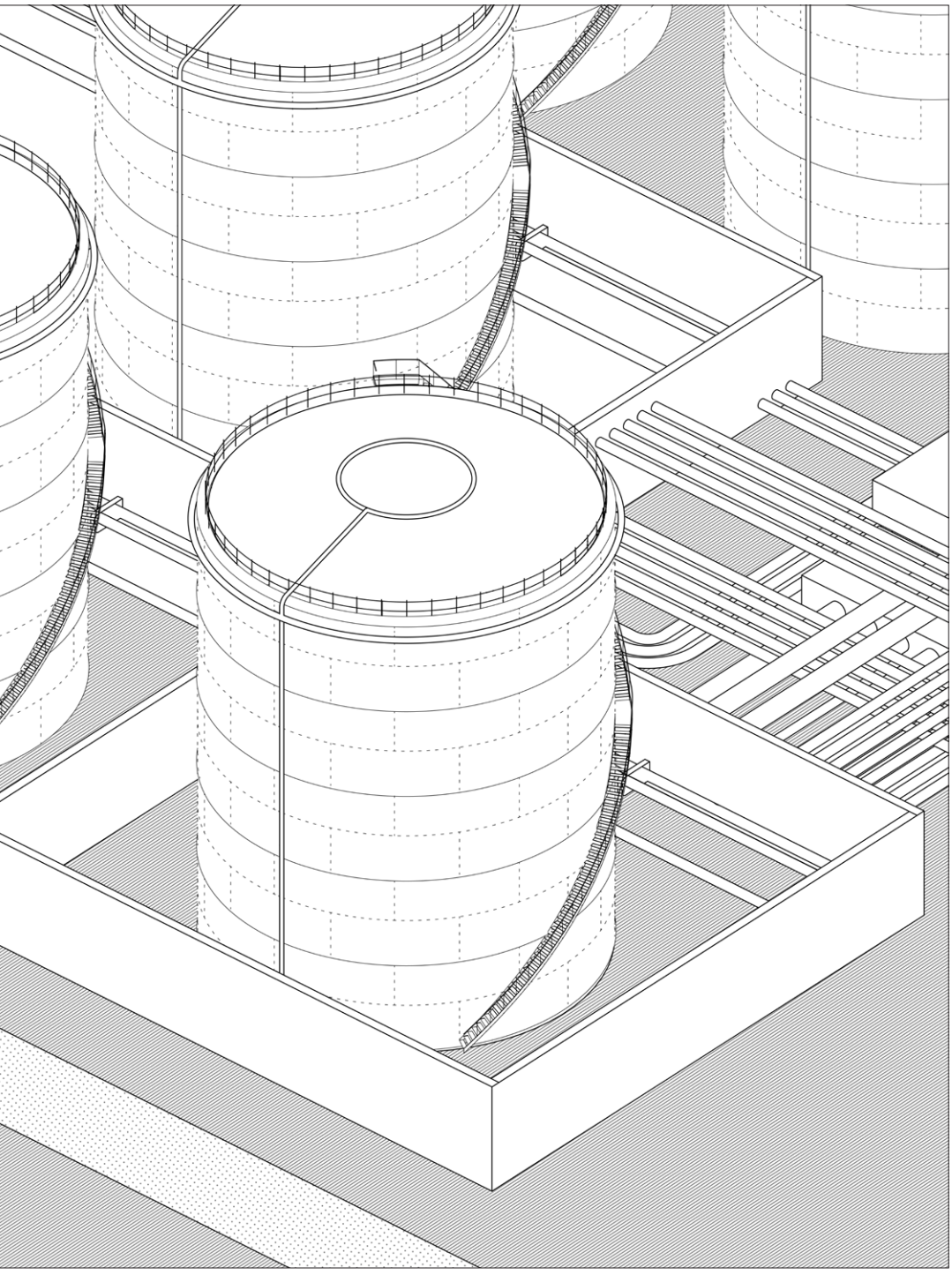


Fig. 3.5 Standing at the base of Petrol Island's wind turbines, which are on the public park side of the fence. Retaining wall shows weathering. Photograph by author.

Disassembly as repair

In the 2014 article entitled *Rethinking Repair* published in *Media Technologies: Essays on Communication, Materiality, and Society* from the MIT Press, Steven J. Jackson describes the exercise of 'broken world thinking'. Asking "what happens when we take erosion, breakdown, and decay, rather than novelty, growth and progress as our starting points"[3], the exercise involves two components: first an appreciation of the limits and fragility of the natural, social, and technological worlds we inhabit followed by a recognition that many of the stories and orders of modernity are in a process of decay. As the modern infrastructural ideal is threatened, Jackson argues for an approach to renewal based on "the subtle arts of repair".[4] He defines *repair* as "acts of care by which order and meaning in complex sociotechnical systems are maintained and transformed, human value is preserved and extended and the complicated work of fitting to the varied circumstances of organizations, systems, and lives is accomplished".[5] What is an act of care that preserves human value within the complexities of modernity in an industrial oil storage facility? As the modern petrocultural ideal is threatened, what might illustrate this notion of repair in a broken world in the heat of energy crisis?

Breaking, the first thematic phase of this thesis, considers Jackson's approach for the future of Petrol Island's oil infrastructure. The oil tanks both symbolize the use of fossil fuels in a society that aims to cease their use, and pose a threat to surrounding ecologies and human communities through their toxic leakage. Therefore, as a method of repair I propose infrastructural disassembly, in-situ occupation, and material reuse. In essence: take them down. In this sense, deconstruction of the oil tanks is seen as process of care. To preserve human value, repair takes place here through a closer interaction between people (owners and operators of the oil tanks as well as the workforce required to physically (de)construct them) and the physical elements on the site.

Learning from offshore

Based on a systematic review from leading scientific databases, the *CREATION Research Group on Renewable Energy* from the University of Rio Grande do Norte in Brazil proposes a conceptual framework for the

decommissioning process of offshore oil and gas platforms. Published in the *Marine Structures* journal in 2022, the article describes five major dimensions involved in the process.[6] This framework provided a basis for understanding the path to disassembly of Petrol Island's existing oil infrastructure. Though an onshore oil storage facility such as Petrol Island is entirely different than that of an offshore oil and gas platform, the stakeholders and societal contexts for decommissioning are likely similar. For this project, I view both offshore platforms and Petrol Island's oil storage facility as two important infrastructural landscapes on the wider spectrum of oil space.

Resulting from the *CREATION* group's comprehensive literature analysis, *decommissioning* is widely defined as "the final phase in the life cycle of a structure […], the process by which industrial facilities begin to shut down, […] the reverse process of installation, […] recovery of the site to leave the energy it had before, […] [and] justice to restore the damage done to people, society, and nature".[7] Most decommissioning projects start with planning and engineering followed by technological steps specific to the infrastructure such as "plug and abandon" and the removal of substructures. Final steps include "site cleaning and remediation" and "site monitoring and inspection". Various stages mention the potential reuse of substructures and material components for another function through recycling to change their usefulness.[8] The entire process is lengthy, expensive, and complex. It involves "multiple stakeholders such as operators, reverse supply chain, government, environmental groups, and other users [of the ecological landscape]".[9] Authors note that in the case of the UK which has a robust decommissioning framework, planning is presented as only a process for operators and neglects to specify the participating stakeholders and their functions. These multiple stakeholders have diverging interests plus the complexities of time, cost, and technologies for decommissioning which literature generally overlooks.

Most plans for decommission aim for a site-specific outcome. Strategies can abandon structures in place, opt for total or fragmented removal leaving some facilities in situ. In summary, **1) total removal** is the most expensive and complex option, with direct environmental impacts such as death and loss of immediate flora and fauna; **2) partial removal** is less intensive,

Fig. 3.6 A bulldozer named Anders. Looking into Petrol Island's industrial grounds from the public park, a view from somewhere walking along the ridge. Photograph by author.

Fig. 3.7 Initial sketch for how to dismantle an oil tank structure after it has been emptied of contents. Considering the containment walls, which are estimated between 4-8m tall (average) surrounding Petrol Island's various tanks. Drawing by author.

expensive and can produce less pollution comparatively, yet must consider the environmental impacts of leaving some organism communities and materials intact. The **3) 'abandon in place'** option appears in the literature "with little evidence about its impact on the environment". The most important aspect of this option is to secure an acceptable level of stability for all structures. Analytically, some sources claim "in terms of energy consumption and landfill material, [leaving in situ] generates less waste and energy consumption" than its alternatives. In the context of offshore oil platforms, some conservationists claim the leave in situ option to be favourable, though other groups are concerned about environmental safety in this case. Consensus only exists in that "each decommissioning option for offshore platforms will generate a different ecological impact […] requiring a case-by-case strategy."[10]

Either directly or indirectly, the decommissioning process affects society, with much of the costs allocated to the public. High process costs "will hit the population, as part of these costs will be passed on to them through tax concessions given to the oil and gas industries". The article concludes that regulatory bodies in charge of environmental, social, economic, and technical aspects of the process must develop resolutions together, and that the process "should be seen […] as a sum of all parts, involving stakeholders who have conflicting objectives, technological solutions, and options that can generate different impacts in social, environmental, financial and security spheres".[11]

General plans for decommissioning oil platforms set a precedent for how to decommission Petrol Island's oil tank farm. Options for the decommissioning outcome greatly informed the design the *Breaking* phase. I employ total removal, partial removal, and abandon-in-place strategies in different zones around Petrol Island's oil tanks. I also operate on the notion that with multiple stakeholders involved, the decommissioning process is necessarily collaborative. Thus, ***Breaking*** deals with what I categorize as the 'state-led privately operated' group of stakeholders. This involves government policy makers, designers, and landowner-operators like the City of Copenhagen Port Authority as well as contractors and skilled construction personnel. High-level organizers and skilled labour personnel are needed for processes like draining fuel from the oil tanks and the safe handling of large structures, machinery, and materials. Policy makers and designers are also crucial here for the planning, permit, and safety side of deconstruction.

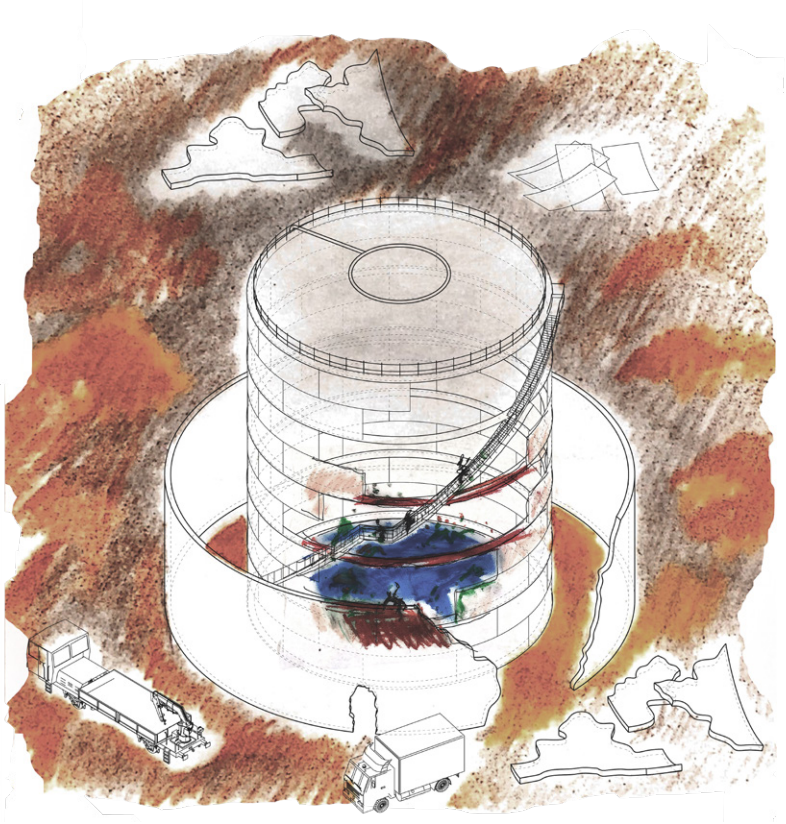


Fig. 3.8 Initial sketch for how to dismantle an oil tank structure after it has been emptied of contents. Considering the surrounding soil textures and human scale labour involved in the decommissioning process. Drawing by author.

Fig. 3.9 'P.O.R.T & Rock Chapel Marine' by Landing Studio, Chelsea, Massachusetts. (Source: http://www.landing-studio.com/projects#/the-port/)

Neither landscape, park, nor tank farm

American group Landing Studio has worked directly with oil infrastructure demolition. Their project Tank Farm Demolition from 2012 in Chelsea, Massachusetts orchestrated "the demolition of a 13-million-gallon asphalt and jet fuel terminal" on the waterfront.[12] The work included full abatement, clean-out and the tactical salvage of the 18-meter-tall storage tanks, piping and some large aluminium geodesic domes covering the tanks. They moved salvaged structures and implemented lay-down zones during all phases of the demolition and construction process.[13] Lay-down zones generally refer to spaces used for temporary material storage and/or the assembly of construction equipment needed for the demolition process. The project developed to become the P.O.R.T & Rock Chapel Marine, (Publicly Organized Recreation Territory) in essence "the conversion of an oil tank farm into shared-use waterfront road-salt terminal public recreation area, and wildlife habitat landscape."[14] Landing Studio's phased approach to elemental structure movement and material salvation was greatly informative for the Petrol Island oil storage tanks. Acknowledging that the demolition process requires great coordination and planning for material storage during the disassembly process led to the conception of Petrol Island's Tank Bank.

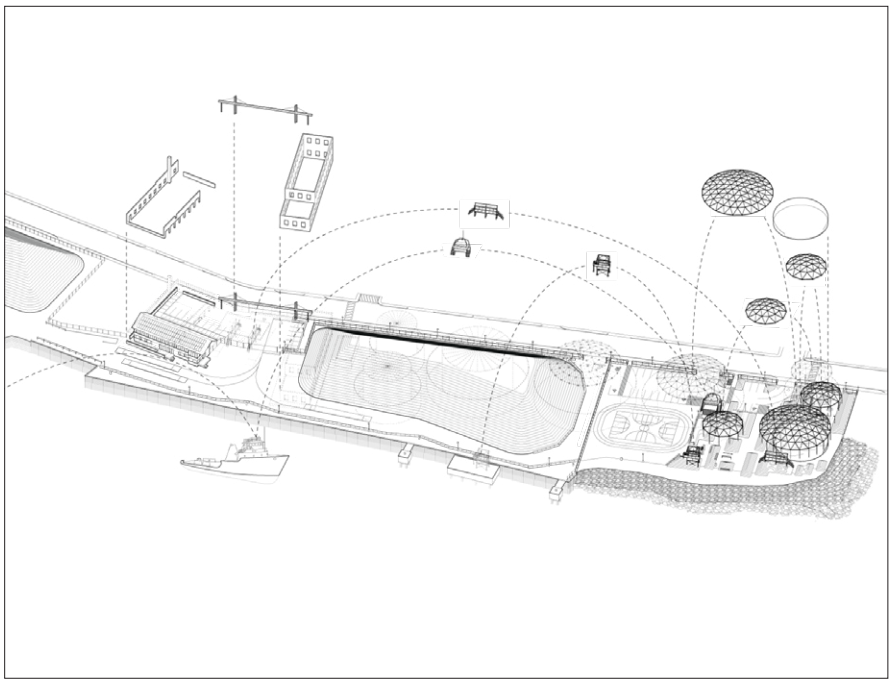


Fig. 3.10 'P.O.R.T & Rock Chapel Marine' by Landing Studio, Chelsea, Massachusetts. (Source: http://www.landing-studio.com/projects#/the-port/)

Fig. 3.11 'Tank Farm Demolition' by Landing Studio, Chelsea, Massachusetts. (Source: http://www.landing-studio.com/projects#/tank-farm-demolition/)

Fig. 3.12 'Tank Farm Demolition' by Landing Studio, Chelsea, Massachusetts. (Source: http://www.landing-studio.com/projects#/tank-farm-demolition/)

Fig. 3.13 'P.O.R.T & Rock Chapel Marine' by Landing Studio, Chelsea, Massachusetts. (Source: http://www.landing-studio.com/projects#/the-port/)

Fig. 3.14 Landschaftspark Duisburg Nord, Germany.(Source: https://www.flickr.com/photos/jschiemann/8927363072)

One cannot discuss post-industrial redevelopment for public use without looking at Germany's Duisburg Nord Landschaftspark, 'Duisburg North Landscape Park'. This project greatly motivated a pragmatic approach for Petrol Island's future. Latz+Partners 1990's plan for the former steelworks is described by Alan Tate in *Great City Parks* as "neither landscape nor a park".[15] It is often compared to Bernard Tschumi's Parc de la Villette for its prototypical scheme as urban park of the century. But where Parc de la Villette rests on deconstruction principles, Landschaftspark uses "decomposition and recomposition"[16], foregrounding minimal design intervention through processes of "new interpretation […] [and] metamorphosis of existing structures without destroying them".[17] Rather than simple deconstruction, the project instead "retained and adapted the majority of the industrial structures, landforms and naturalized vegetation".[18] The plan was intended to demonstrate social, cultural and ecological measures toward economic transition in a former industrial region. Instead of removing existing overgrowth, or "volunteer vegetation", Latz+Partners embraced the natural ecological processes already occurring while adapting the existing infrastructure to be "safe for public access".[19] Bridges, walkways, gathering spaces, and gardens of found materials have been orchestrated around the site in a multi-layered effort to engage the public with the place in its post-industrial state.[20]

Fig. 3.15 Landschaftspark Duisburg Nord, Germany.(Source: https://www.flickr.com/photos/vm1909/51298587663)

Designer Peter Latz himself claimed that today "there is no such thing as a park for all" referring to when park users were a collective. "Nowadays everyone goes alone; the dog owner, the diver, the cyclist", said Latz, justifying his design incorporating four separate, individual park concepts layered over one another. The four concepts include a water park, rail park, promenade par, and fields and gardens. Above all, Latz was adamantly "allergic to the idea that nature should reconquer something for itself", instead illustrating a design that seeks to balance the natural and artifactual.[21]

Breaking Petrol Island

Through design exercises, I illustrate not the total erasure of the infrastructure nor the total preservation of it, but a slow, multifaceted orchestration of taking down the cisterns, and an in-situ programmatic use of them in the process. Once empty of their contents, the decommissioned tanks can be disassembled into various sub-structures and material collections. Disassembly in this case is an opportunity to 1) physically dismantle remnants of the oil industry and 2) illustrate in-situ, on-site use of the infrastructure during the disassembly process creating new life for the place beyond its entangled identity as an oil space. In-situ use of the infrastructure promotes new ways for communities to critically interact with remnants of the oil industry for pedagogical, historical, and societal engagement. Detailed drawings of the tank are followed by sketches of possible ways to disassemble it, and ways to use the architectural object in various stages of deconstruction. In essence, to repair Petrol Island means to orchestrate a web of deconstruction operations, material reuse interventions, and through this a blossoming of critical interactions between humans, non-humans, and infrastructures stakeholders.

The *Breaking* phase is an exercise in schematic disassembly, material shifting and replacement. The plan shows the site-wide scheme of interventions. The majority of the oil tanks are to be deconstructed in this scheme, except a few chosen specifically to remain, later to be converted as programmatic 'hubs'. This process is detailed in the final *Taking* phase. Before any disassembly could begin, the tanks must be emptied of their contents. Once this has been orchestrated, the disassembly process begins. While parts of the tanks are deconstructed, they require a large amount of space for

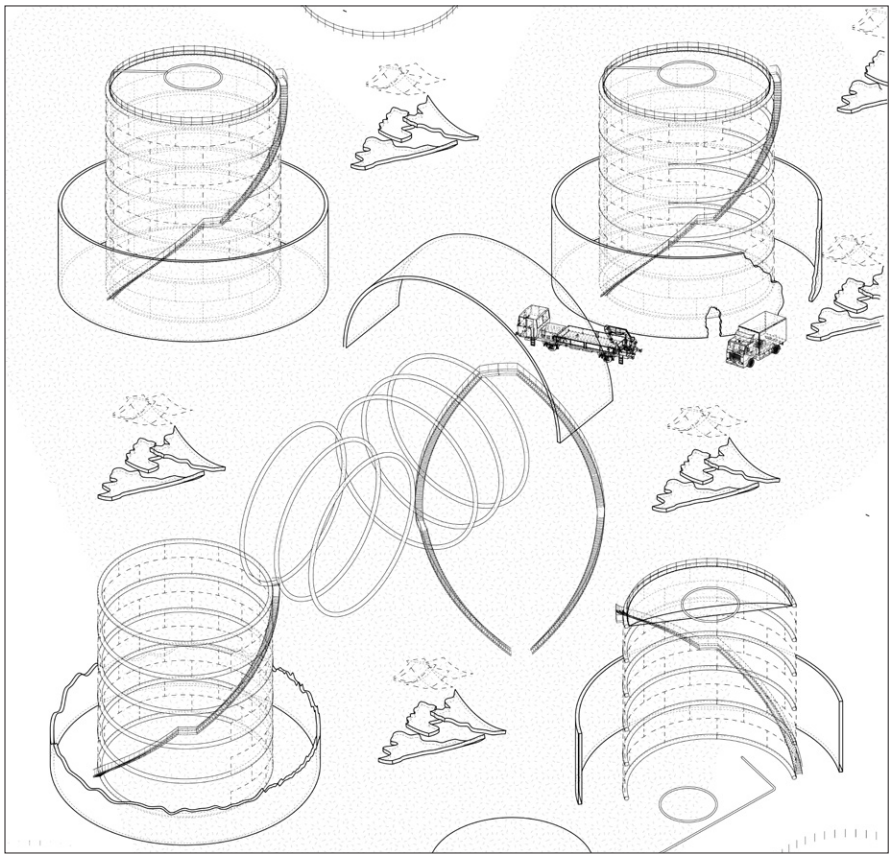


Fig. 3.16 Sketch of infrastructural parts and elements, imagining how they might come apart. Drawing by author.

storage and sorting. Space for this is allocated in the open area adjacent to the most concentrated number of tanks. The idea is that this space for material storage becomes the 'Tank Bank', where objects and materials from the disassembled oil tanks can be recycled and reused around the site or exchanged within the community.

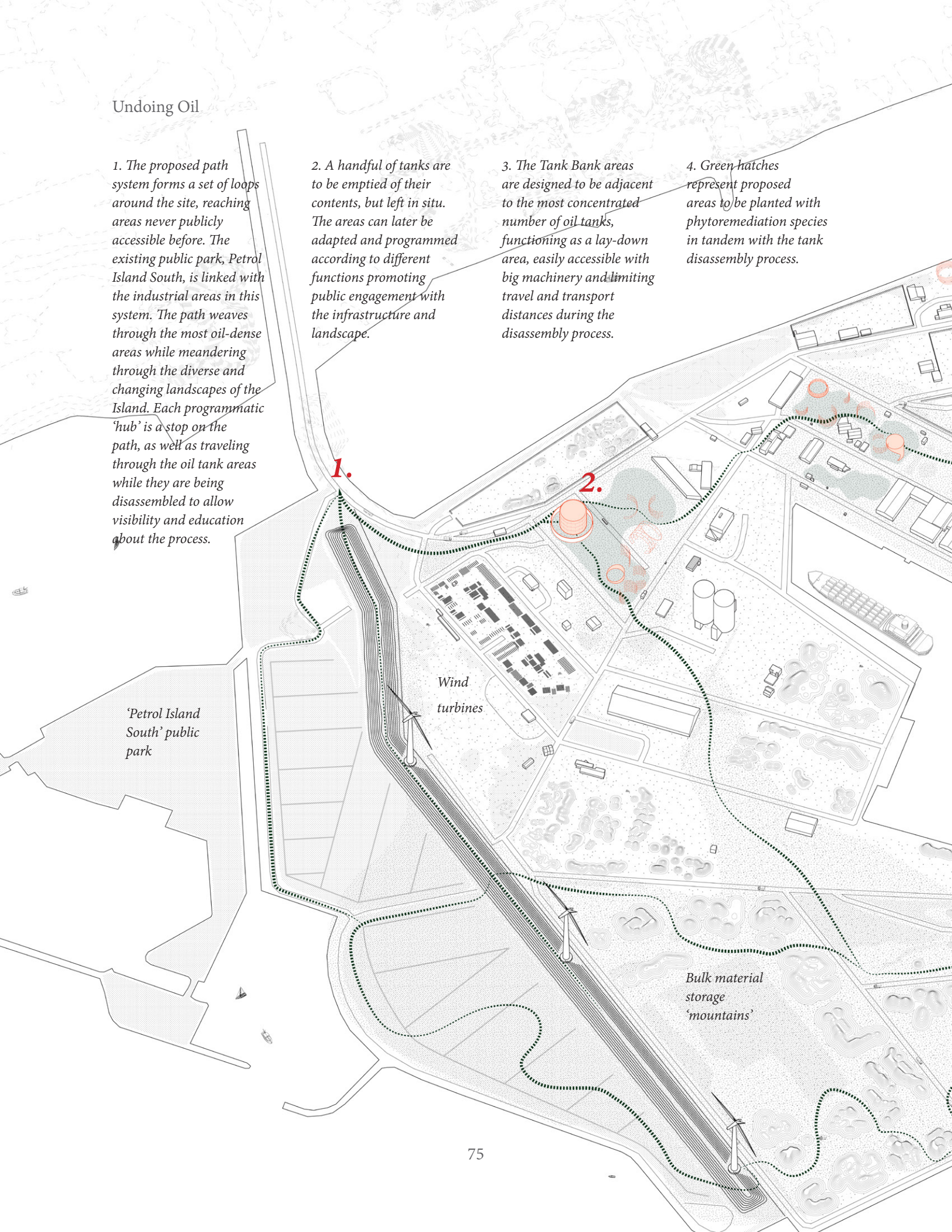
During the disassembly process, phytoremediation of contaminated soils beneath the tanks should begin as soon as the areas are uncovered given that plant growth will take many years. Therefore, this phase also involves the initial planting of remediation species in the most concentrated oil tank zones. At the same time, a basic path system to connect areas of the site is begun. This is seen as the first step towards access and the planned engagement with community members and infrastructure, as well as transparency in both the disassembly and remediation processes.

1. The proposed path system forms a set of loops around the site, reaching areas never publicly accessible before. The existing public park, Petrol Island South, is linked with the industrial areas in this system. The path weaves through the most oil-dense areas while meandering through the diverse and changing landscapes of the Island. Each programmatic 'hub' is a stop on the path, as well as traveling through the oil tank areas while they are being disassembled to allow visibility and education about the process.

2. A handful of tanks are to be emptied of their contents, but left in situ. The areas can later be adapted and programmed according to different functions promoting public engagement with the infrastructure and landscape.

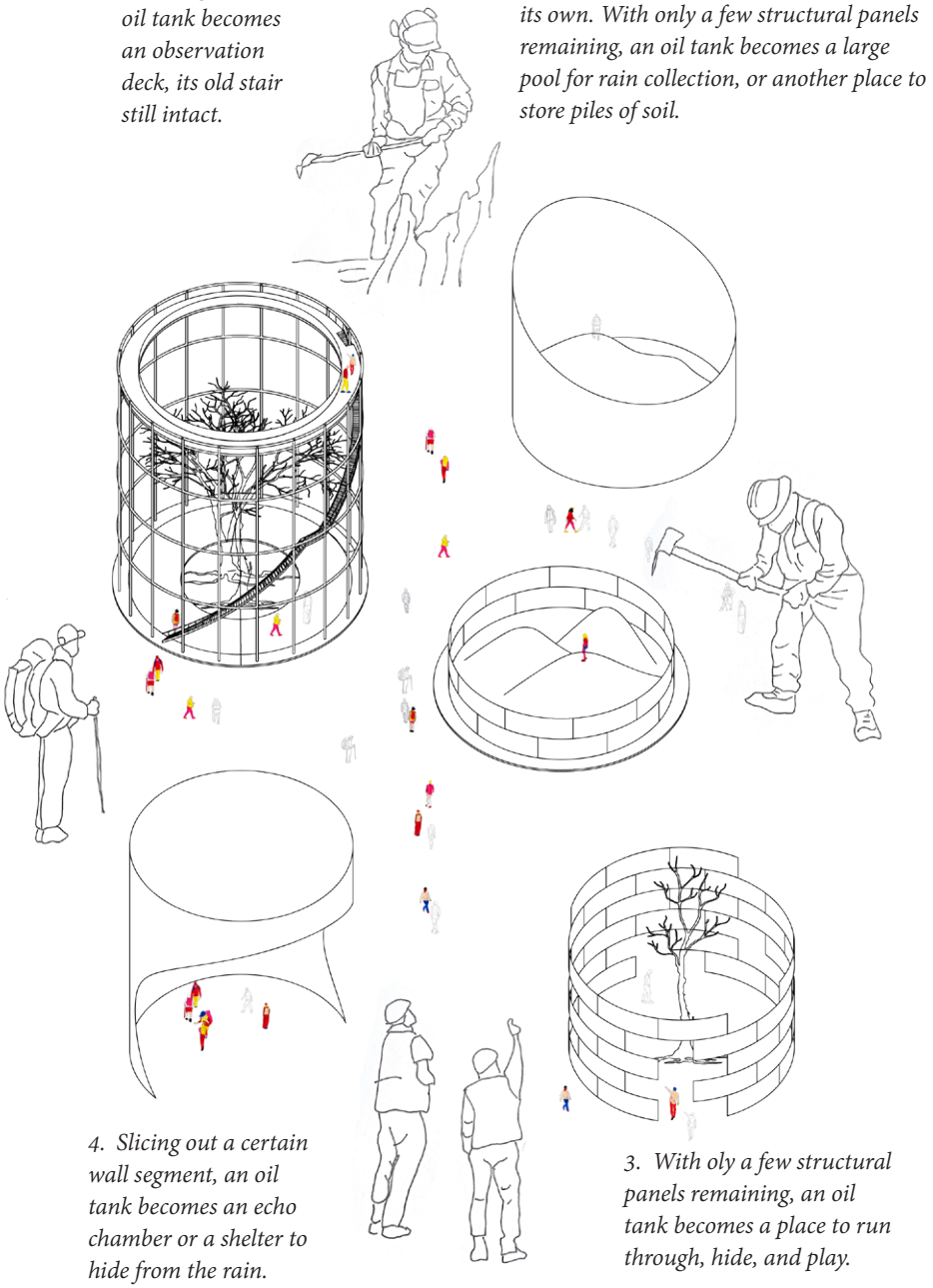
3. The Tank Bank areas are designed to be adjacent to the most concentrated number of oil tanks, functioning as a lay-down area, easily accessible with big machinery and limiting travel and transport distances during the disassembly process.

4. Green hatches represent proposed areas to be planted with phytoremediation species in tandem with the tank disassembly process.




Breaking
Bulk material storage 'mountains'
3.
2.
2.
2.
3.
4.
2.
Historic 'Provestenen' fortress
structures in stages of disassembly (total removal)
structures remaining (partial removal/abandon in place)
remediation planting
path network

Fig. 3.17 Typological ideas for occupying oil tanks in-situ during the disassembly process. Drawing by author.



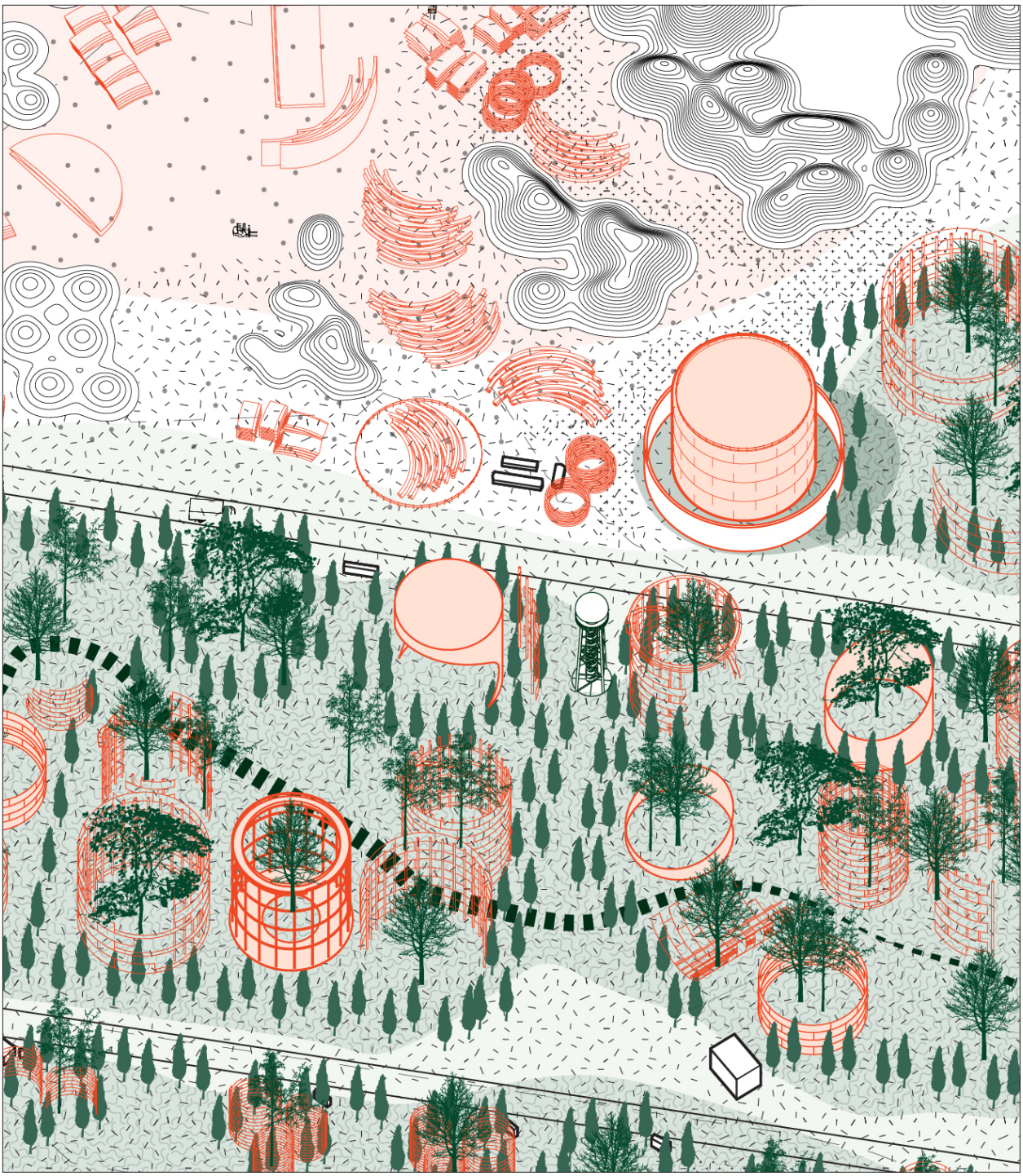
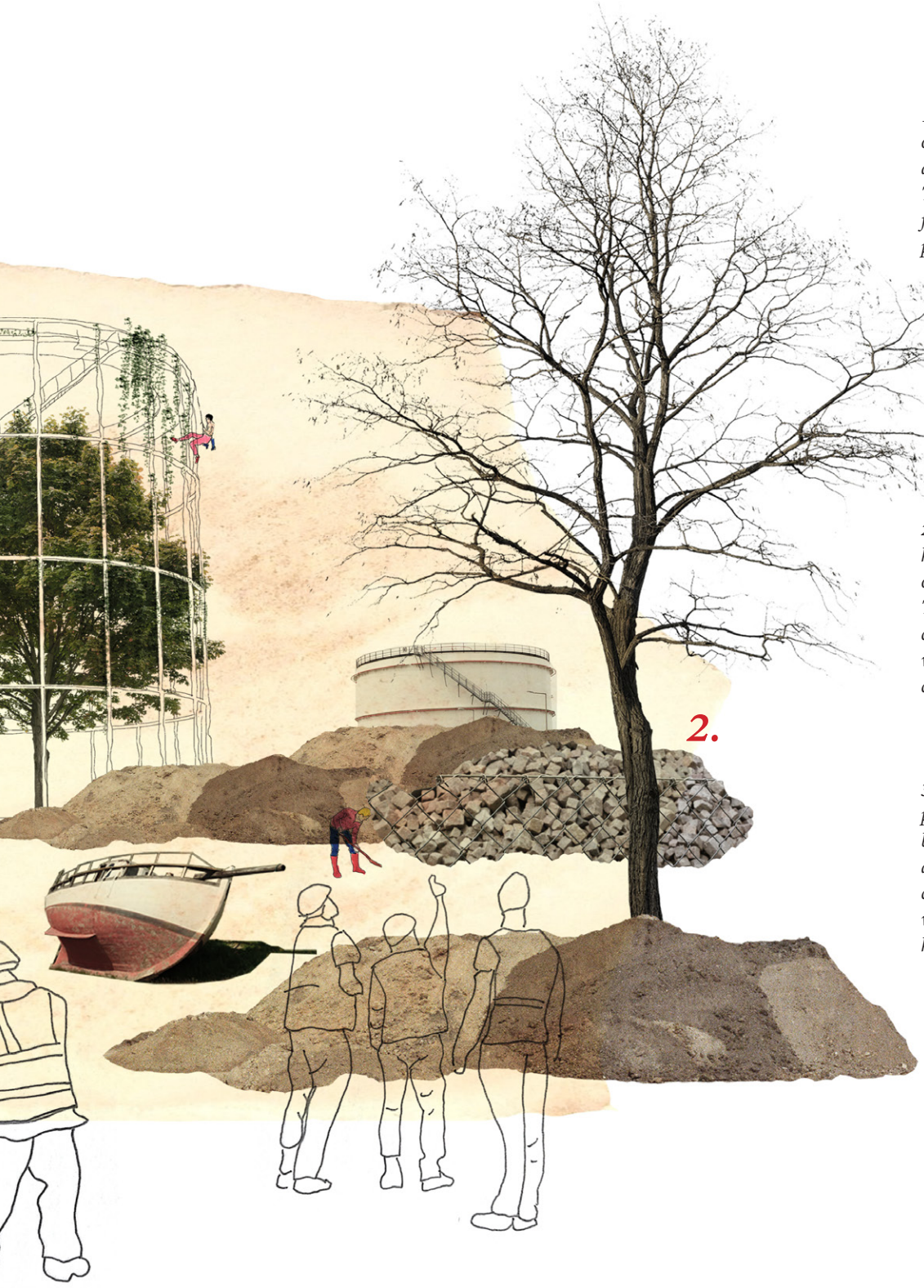


Fig. 3.18 Collage rendering of the landscape with some oil structures left in situ in the Breaking phase.



1. The frame outlining an old oil tank becomes an observation deck, its old stair still intact. The structure can become a new frame for climbing plants, or people.

2. Surrounding soils will likely have an unknown amount of petrochemicial leakage. This phase is therefore mostly carried out by skilled personel who know how to work with contamination.

3. With only a few structural panels remaining, an oil tank becomes an apportunity for a new micro-ecosystem that can begin to be inhabited even while deconstruction is still happening all around it.

Endnotes

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4 Steven Jackson, "Rethinking Repair," in *Media Technologies: Essays on Communication, Materiality, and Society*, edited by Tarleton Gillespie, et al. (Cambridge: MIT Press, 2014), 222.

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Growing

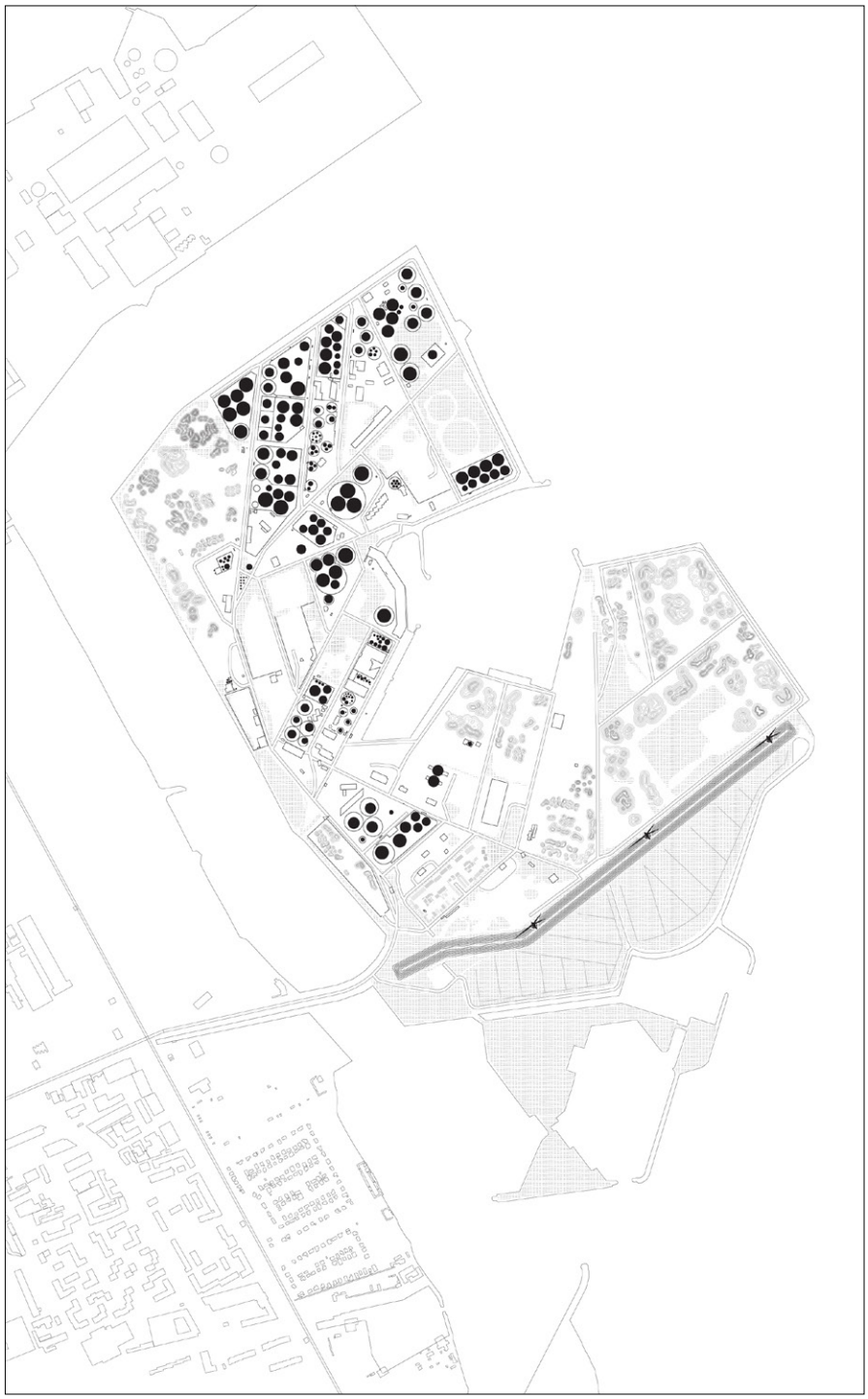


Fig. 4.1 Plan drawing of existing conditions on Petrol Island. Black fill indicates oil tanks remaining. Drawing by author.

Beneath Petrol Island's oil tanks is likely substrate steeped in a cocktail of 'petrochemicals', including BTEX (Benzene, Toluene, Ethyl benzene, and Xylene: VOCs found in gasoline), MTBE (Methyl Tertiary Butyl Ether –a gasoline additive) and PAHs (Polycyclic Aromatic Hydrocarbons).[1] Since oil tanks occupy roughly three quarters of the Island's surface area and a narrow, shallow sea channel separates it from the mainland, the entire area is likely subject to widespread contamination through "leaking under storage tanks (LUSTs)".[2] The western channel water appears barely waist-deep, while the eastern coast is deep enough for large tanker ships to dock and refuel. Therefore, it is also estimated that LUSTs have seeped down to the groundwater table, posing a multidimensional issue for human and nonhuman species alike.

In this chapter I strategize to remediate the harm of leaked petrochemicals in Petrol Island's ecosystem to both reduce carbon emissions through ecological growth and make the landscape safe for human interaction. This phase represents the 'regenerative' aspect of *regenerative disassembly*. It also embodies 'disassembly' in reference to the notion of breaking down toxic environmental contaminants. *Growing* considers the state-led community operated stakeholder group, referring to government and public sector employees, skilled construction personnel, designers, and organized education and community leaders. With this combination of state-led skilled personnel and community members, the *Growing* phase begins to (slowly and carefully) bring the public onto Petrol Island. The following theoretical research describes a cultural Danish pedagogical approach to nature an infrastructure, the concept of vilified spontaneous vegetation in ruderal landscapes, and the process of phytoremediation. The resulting design exercise proposes a plan to acknowledge vilified species in an invisible landscape through engaged ecological care, social interaction, and landscapes for play.

Fig. 4.2 The view at the base of a wind turbine after climbing down the industrial side of the ridge. It is noisy here both from the turbine spinning above in combination with the industrial grounds over the fence. There is no path through waist-high vegetation to climb down here, enforcing the feeling of being a trespasser. Railings are the only suggestion that humans are present. In the full bloom of July, all of the greenery appears unmaintained. Photograph by author.

Fig. 4.3 Walking deep into the Petrol Island South park, there are a few abandoned or disused boats floating tied to the docks. Grasses, shrubs and small trees grow flush with the sheet piling and water's edge making any sense of a path invisible. It truly feels as if no one is watching this area - and it's tempting to climb aboard. Photograph by author.

Plant/play pedagogy

Margaret Birney Vickery wrote *Pedagogic Landscapes: Recreation, Play, and Danish Infrastructure Design*, published earlier this year in *The Routledge Handbook of Infrastructure Design* by Joseph Heathcott. Vickery argues that despite the general history of infrastructure being isolated and out of sight, in Denmark there is a "broader tradition of popular education where recreation, outdoor activity, and play lead to deeper connections with nature", with Danish designers coming to regard infrastructure as having both a functional and pedagogical role necessary to "the provision of public goods and the building of a healthy society".[3] Fundamentally, the line between urban 'infrastructure' and 'nature' is beginning to blur. Locally there has been a long cultural emphasis on outdoor learning to develop creativity in individuals and cultivate respect for the natural world.[4] Vickery illustrates this concept in multiple architectural infrastructural projects after tracing the history of outdoor recreation as a pedagogical means to connect humans with nature. Carl Sorensen's concept of the junk playground from the 1930's as well as recent examples such as Bjarke Ingels' Amager Bakke, the waste to energy plant "Copenhill" (which neighbours Petrol Island), demonstrate how and why Denmark's "model of government and public participation […] has been so successful at promoting green infrastructure and power".[5] Vickery explains that "recreation in the outdoors introduced construction techniques, hydrology, and natural systems to the public, while forging human connections, […] [and that] the preservation and development of green spaces within an urban fabric has been an integral part of the development of Copenhagen". Highlighting nature in Danish cultural identity, the work examines attitudes in Demark toward education, recreation and play that contextualize how new hybrid energy infrastructures offer both organized experiential learning and spontaneous encounters with the natural world.[6]

Junk Playground

Denmark has a long history with social cohesion through "egalitarian education and community engagement." Integral to this history is the pedagogical exposure of youth to the natural world through the education system. This began in part with the 'folk high school', often organized through

Fig. 4.4 Junk playground in Freetown Christiania, Copenhagen 1970. (Source:https://jyllands-posten.dk/indland/ECE8970919/starten-paa-en-fristad/)

community efforts. Since the early twentieth century, folk high schools have been "firmly attached to the soil, […] offering education, for and through one's own nature". This manifests in national educational objectives today in the 'outdoor classroom' which prioritizes regular experiences with nature.[7] Soon after the folk high school movement began, influential Danish landscape architect Carl Theodor Sørensen designed the 'junk playground' in the post-war period. Instead of a traditional playground involving permanent structures, they gave children "old cars, remnants of construction equipment, packing crates, and branches" resulting in complete freedom to explore and discover capabilities of materials, their imaginations, and "how to make and care for spaces".[8] Continuing to develop in Denmark, junk playgrounds (by the 1980's called 'adventure playgrounds') encouraged children to engage directly with dirt, water, and the growing of plants and animals. Essentially Vickery illuminates how interactions with 'junk' space and materials were used "to teach children about the world around them, and to care for it through play".[9]

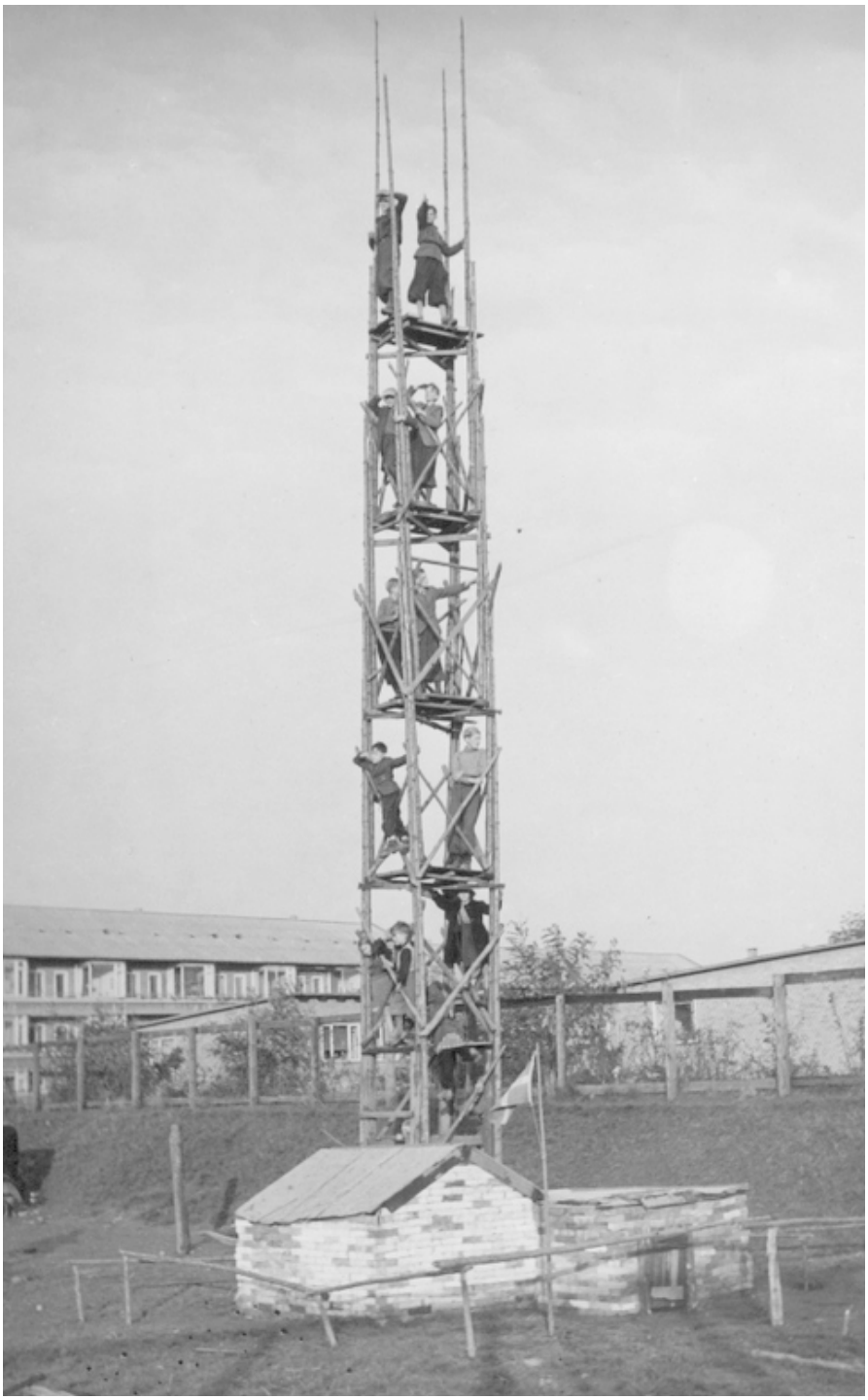


Fig. 4.5 Sorenensen's junk playground in Emdrup, Denmark, circa 1943. (Source: https://cphpost.dk/2017-03-19/history/the-junk-playground-denmarks-eco-contribution-to-outdoor-school-education/)

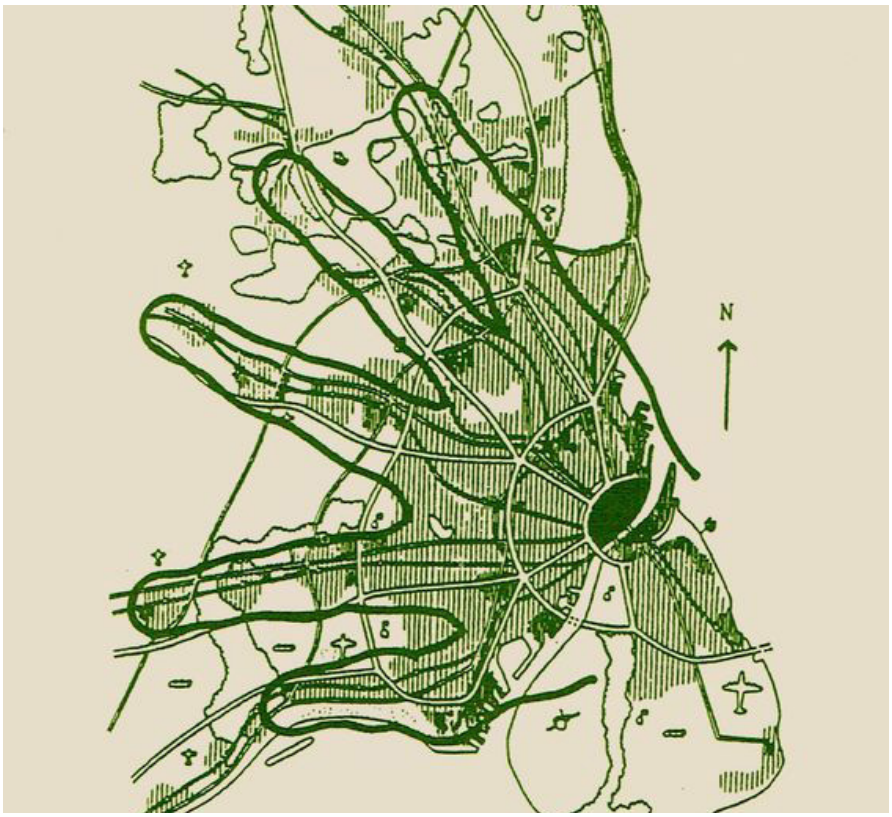


Fig. 4.6 The Five Finger urban regeneration plan for post-war Copenhagen. (Source: https://www.pinterest.ca/pin/274297433535315143/)

Urban green

On an urban scale, Copenhagen's "Five Finger Plan" of the mid-twentieth century also illustrates Denmark's cultural value of the natural world. The 'fingers' spread throughout the city formed green corridors, highlighting "the importance of reserving a regional coherent network of green space areas to provide easy […] access to recreational experiences for the urban population". Local architect Jan Gehl, advocate for the 'human scaled city', and credited with Copenhagen's transition from cars to bicycles and public transportation, said in 2013 that "the best thing you can do in city planning is to invite people to perform some natural activities every day". These activities involve both intentional and accidental encounters with the natural world, and demonstrate what Vickery argues to be "a common belief in the importance of time spent in nature for the health and well-being of Danish citizens".[10]

Nature/infrastructure

While both twentieth century Danish education and urban planning instigate everyday encounters with the natural world, this does not historically include interaction with energy infrastructure to witness nature being 'put to work'. Large sale infrastructures such as power plants and waste treatment plants, Vickery writes, have generally been isolated and out of sight, "ignored and forgotten". This invisibility is necessary to sustain our indoor artificial environments resulting in "the neglect of ambient nature, urbanity, and infrastructure itself".[11] However, some notable architectural projects have materialised in Denmark which begin to address this neglect, suggesting reconciliation in the silent tension between infrastructure and the natural world. Echoing the junk playground philosophy, Bjarke Ingels' *Amager Bakke* waste-to-energy plant, also called *CopenHill*, is "truly three things at once: combustion plant, architectural fixing point, and a playground for all of us" says Brigitte Kleis in the Danish architecture magazine *Arkitekten* in 2020.[12] The plant is a year-round attraction with its artificial turf ski slope together with hiking trails, trees, and pastoral wildflowers and grasses on the roof. When approaching the highest peak, depending on the wind direction, one gets blasted with a steamy reminder of burning waste from the plant below. The same peak boasts a panorama of the city and a refreshing green oasis, however manufactured its elements may be. Overall, these connections encourage individuals to contemplate and "care for both infrastructure and the natural world".

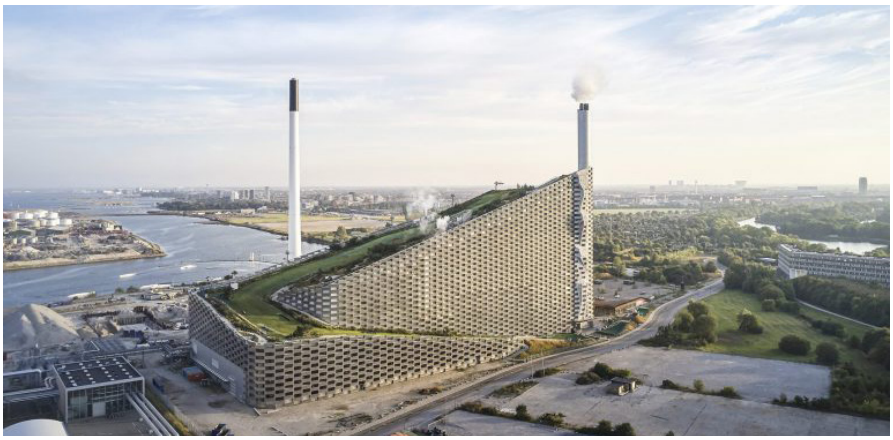


Fig. 4.7 Amager Bakke and Bjarke Ingels' CopenHill ski slope on roof. Note Petrol Island in middle left background.(Source: https://a-r-c.dk/amager-bakke/)

Fig. 4.8 Amager Bakke and Bjarke Ingels' CopenHill ski slope on roof. Note that Petrol Island's oil tanks can be seen in the background. (Source: https://www.dezeen.com/2019/02/18/copenhill-amager-bakke-big-ski-slope-copenhagen-energy-plant/)

Rather than learning passively through indoor traditional educational methods, instances such as these inform the Danish public through experience; the culturally embedded goal of an educated citizenry serves to actively engage the public in experiential learning about both nature and infrastructure.[13]

The vilification of spontaneous vegetation

Turning your back for a moment on the breathtaking city panorama at the top of CopenHill through the cloud of steaming waste from the plant below, you are confronted with the looming oil tanks and humming windmills of Petrol Island. The contrast between the white painted tanks, open sea of the Oresund and seemingly lifeless soil below is striking. Look closer, however, and emerging atop piles, along roadsides, and through cracks on Petrol Island is a wild mix of creeping green. It is clearly an unscripted takeover by weeds.

Despite the Danish pedagogical embrace of the natural world, human values still seem to trump biological factors in urban areas. While simultaneously encouraging some organisms that make our environment more "livable", "attractive", and "profitable", we vilify others. When they flourish in contradistinction to our goals, we denounce many adaptable and resilient organisms as weeds and pests.[14] These are the words of horticulture and botanist Peter Del Tredici in *Spontaneous Urban Vegetation: Reflections of Change in a Globalized World* when discussing how volunteer urban vegetation promotes the growth of stress-tolerant species on unmaintained land. The article explains how "spontaneous vegetation is a cosmopolitan mix of species that grows and reproduces without human care or intent, […] appearing in marginal or degraded urban land that receives little or no maintenance".[15] The management of spontaneous vegetation to increase its ecological and social values is more sustainable than simply restoring the historical ecosystems that existed before the urban disturbance. [16] This is curious in the case of Petrol Island, given that there was no 'before' time in terms of its vegetation; the entire landscape was artificially constructed using surplus soils from construction sites being dumped into the water.

Fig. 4.9 Vegetation observed on Petrol Island. Photograph by author.

Fig. 4.10 On the side of the noise barrier ridge, diverse and established vegetation that is visibly unmaintained. Photograph by author.

Nevertheless, the ability of spontaneous vegetation to promote the growth of other stress tolerant species, namely those used in phytoremediation, propels the decision in this project to incorporate both. Therefore, in proposing a strategy to address the leaked petrochemicals, I apply Del Tredici's theory of spontaneous urban vegetation to embrace the visible growth of plants on Petrol Island for their own stress-tolerant, empowered properties.

Ruderal landscape

Patchworks like that of Petrol Island are both spontaneous native and exotic species on a mix of disturbed, compacted, and loose soils, subsoils, and construction rubble. Considering Del Tredici's classification framework, the entirety of Petrol Island can be categorized as 'abandoned ruderal landscape', based on its past land-use history, vegetation types, soil characteristics, and level of maintenance required to preserve its integrity. Ruderal landscapes are also the least studied type of urban landscape, "associated with margins of transportation infrastructure, abandoned or vacant industrial property, and the interstitial spaces that separate one land-use function from another". Given their marginal presence ruderal landscapes are often referred to as 'wastelands', yet the spontaneous urban vegetation they support can effectively achieve much of the ecological restoration and remediation with less financial investment and a greater chance of long-term success.[17] Under its subjection to work as an oil space with transportation infrastructure, industrial property, interstitial spaces, and itself being a transitional area between urban fabric and coastline, Petrol Island appears a ruderal landscape rife with silent conflict between infrastructure and nature.

With this knowledge I employ a two-step approach to Petrol Island's ecological restoration: 1) a classification of the area as a *ruderal landscape* as per Del Tredici's definition, requiring study, value and attention, and a recognition of emergent and established spontaneous urban vegetation as critical indicators of the natural attenuation process of petrochemicals and 2) the implementation of a phytoremediation strategy, both in planting typologies and species selection, that embraces, builds upon and supports the remediation work of spontaneous vegetation already taking place.

Fig. 4.11 Quick sketch on tracing paper over top of existing site conditions. Focus in this case is on the material mound storage area for gravel. The area was chosen for its particular appearance of well-established and thriving vegetation. Observations gathered from site visits were aided by Google Maps aerial views for parts of the site inaccessible on foot. Focus placed on textures, materials and spontanous vegetation patterns. Drawing by author.

Fig. 4.12 Quick sketch on tracing paper over top of model showing existing site conditions, revealing growth particularly at roadsides. Drawing by author.

Fig. 4.13 Quick sketch on tracing paper over top of model showing existing site conditions near the Provestenen old fort area. Upon closer inspection there appeared to be planting efforts as shrubs appeared in deliberate rows here. Drawing by author.

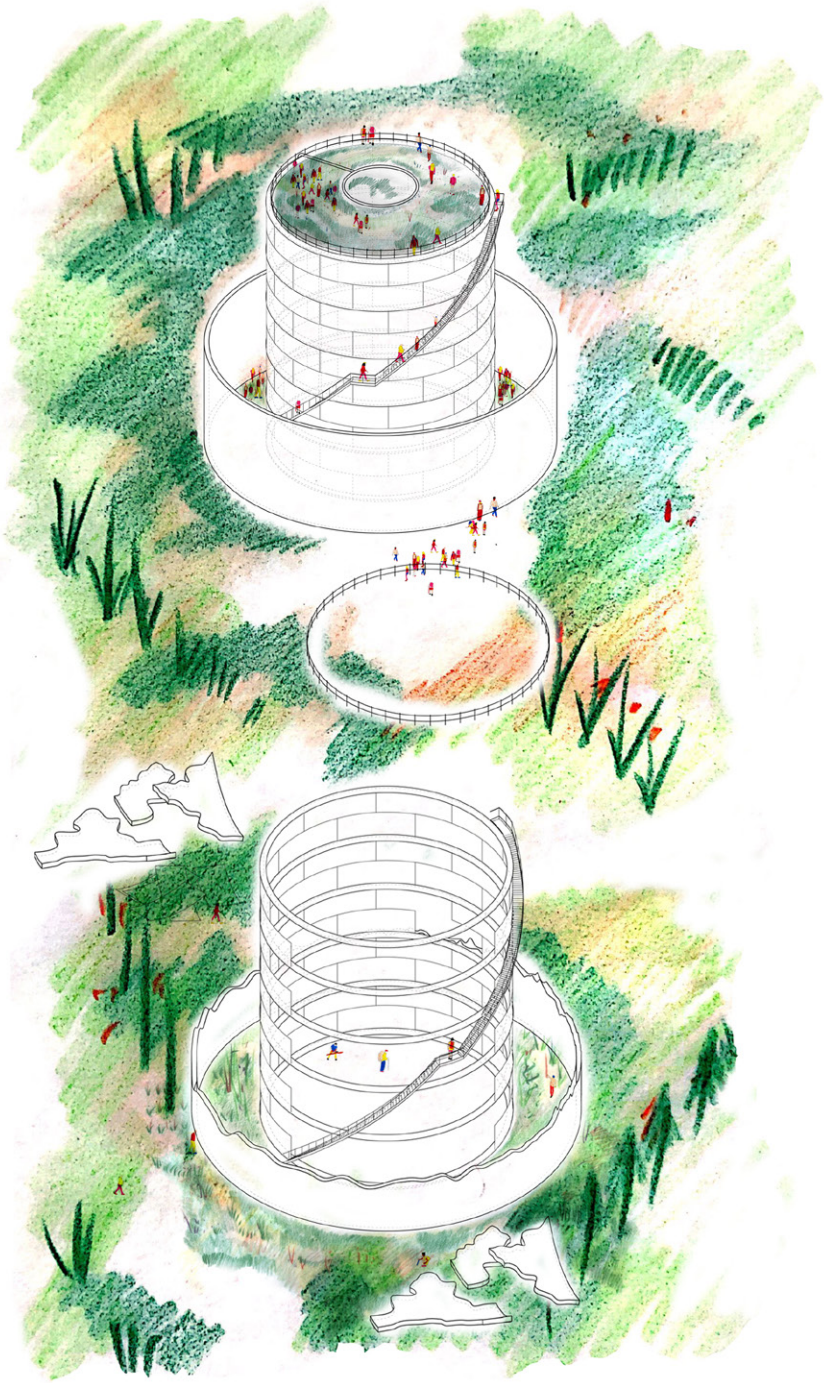


Fig. 4.14 Quick sketch on tracing paper over top of typical oil tanks. What if the tanks supported green roofs similar to CopenHill? Drawing by author.

Phytoremediation

As well as being some of the most common contaminants found in sediments and soils globally, 'petrochemicals', also called petroleum compounds or hydrocarbons, are known and suspected carcinogens.[18] Leaking petrochemicals from their controlled containment into any environment poses a threat to the health of species; where there are leakages, there are affected humans and non-humans with whom the ecosystem is shared. What can be done to cleanse these areas of petrochemicals so that they are inhabitable for naturally diverse species assemblages? What clues can be gathered by observing the vegetation already present?

As suggested by spontaneous urban vegetation, within a threshold there are species which can survive and thrive in these environs. In soil, some plant species have proven to survive in very high concentrations of petroleum, their roots penetrating to and even seeking out contaminated soils, even if they have begun in unpolluted soil. Examining Niall Kirkwood and Kate Kennan's comprehensive guide to phytotechnology from a design perspective, *Phyto: Principles and Resources for Site Remediation and Landscape Design,* I trace a theoretical plan for the phytoremediation of Petrol Island through which petrochemicals in both groundwater and soil can be removed by the long-term work of plants. Kirkwood and Kennan address the relative viability of using in-situ phytotechnologies for the removal of contaminants from soil and ground water. The 'Petroleum' contaminant group includes oil, gasoline, Benzene, Toluene, PAHs and additives such as MTBE, typically sourced from "fuel spills, petroleum extraction, leaky storage tanks, industrial uses and railway corridors".[19] From field tests Kirkwood and Kennan have categorized main organic petroleum compounds to show 'good' opportunity for application through processes of *phytovolatilization*, *phytodegradation*, and *rhizodegradation*. Comparatively, the removal process of Petroleum in soil and ground water through these phytotechnologies require what Kennan and Kirkwood categorize as 'less time', or approximately 10 years, which is short relative to other contaminant categories such as heavy metals.[20]

It is important to note that left alone without the deliberate implementation of phytoremediation, on-site hydrocarbons would likely volatize or degrade through natural attenuation processes such as soil microbial

activity, sun exposure, wind, and humidity. Therefore, introducing specific phytoremediation plants and planting typologies is simply a way to speed up the natural attenuation process in soil and to help contain and treat whatever fraction has mobilized into the groundwater.[21] Plants introduce oxygen, sugars and enzymes promoting soil biology in turn providing more degradation than soil alone. The most important factor in this case is to introduce plants that can tolerate the petrochemicals, which then grow fast and produce a large amount of biomass and grow in the contaminated soil. Masses of trees with deep roots are used to control, degrade, and volatilize light hydrocarbons in groundwater before their release. From the groundwater, the pollutant is pulled into the organism and degraded within it before being volatized into the air (air which scientists have collected over said tree canopies concluding that there is no resulting detriment to human health).[22]

Along with long-rooted trees for groundwater, fast growing, deep and fibrous rooted grass systems are favourable for soils.[23] Kennan and Kirkwood suggest a few planting typologies in soil such as degradation cover, interception hedgerow, and degradation bosque to allow the plants to thrive and do their work best. For the purposes of this project, I trace examples of each planting typology on Petrol Island, proposing a diverse collection of species native to Europe.[24]

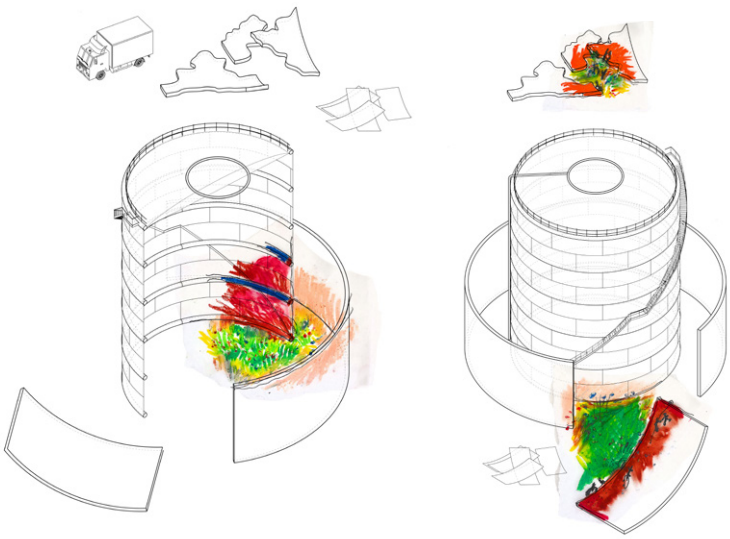


Fig. 4.15 Quick sketch on tracing paper over top of existing model of oil tanks, exploring concepts of vegetation including phytoremediation interacting with the infrastructure. Drawing by author.

Fig. 4.16 Quick sketch on tracing paper over top of existing model of oil tanks, exploring concepts of vegetation including phytoremediation interacting with the infrastructure. Drawing by author.

Growing Petrol Island

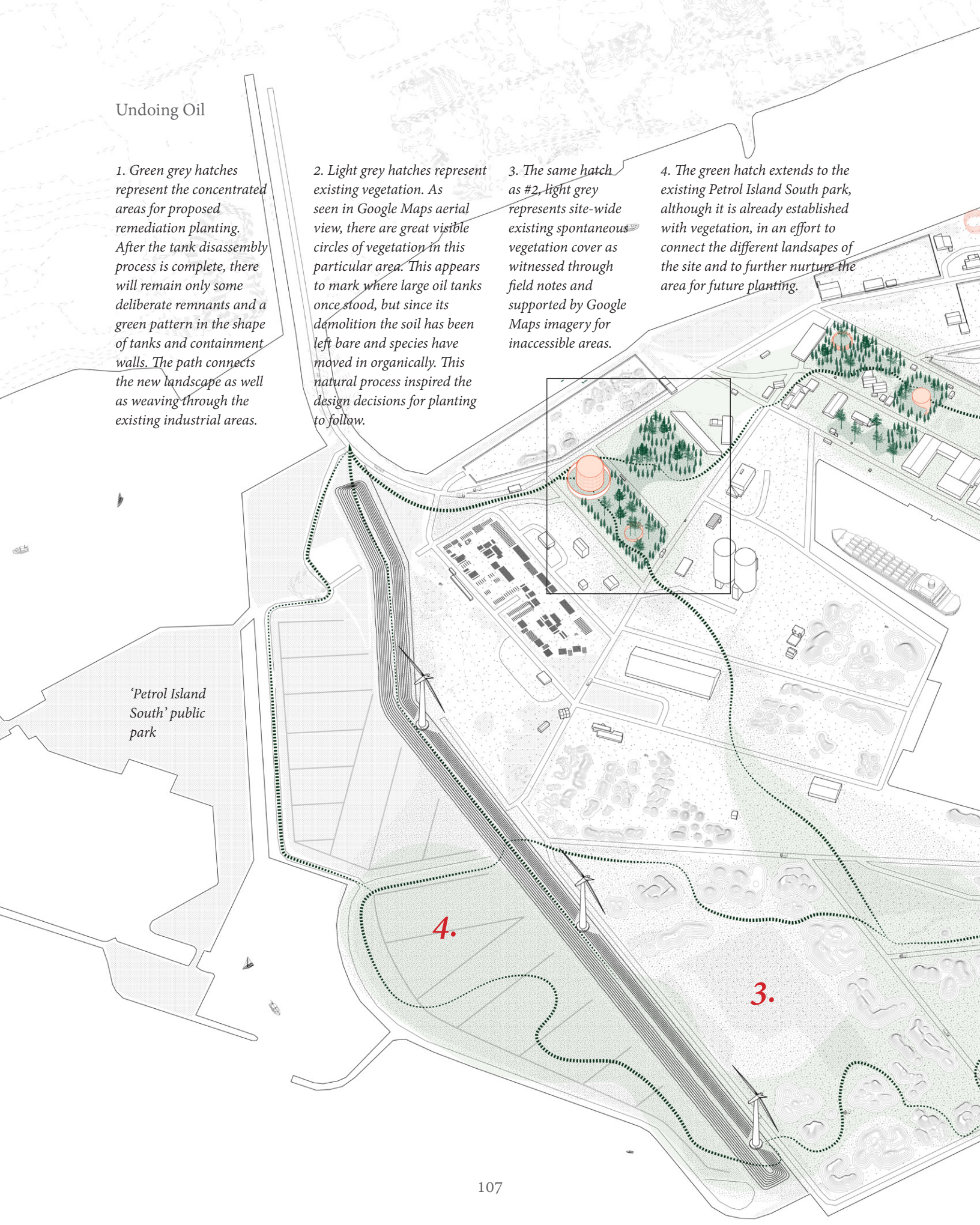
While acknowledging spontaneous vegetation species on Petrol Island, the *Growing* phase implements methods of phytoremediation around the site along with public engagement movements. *Growing* seeks to continue the Danish tradition of nature education by reinterpreting activities such as the junk playground on Petrol Island. The Tank Bank is intended as a sort of giant junk playground in this sense. At the same time, the idea of hybrid infrastructure involving nature can be applied to the oil tank disassembly zones. While the oil tanks are being deconstructed, plants are being introduced, and new ways to interact with the structures emerge. This offers an opportunity for direct human engagement with the infrastructures, as well as to see plant species doing their decontamination work. Three typologies of planting were chosen in reaction to site-specific conditions and their ability to add symbolic value to the landscape by marking the places where oil tanks once stood. Where there was a tank, there will be (at least one) tree; degradation bosques are established in soil nearest to the oil tanks to encourage deep and broad root access to the contaminant, while symbolizing the past presence of oil. Along with the bosque comes understory species, or degradation cover such as grasses that cover the shallowest soils and support the bosque. The interception hedgerow is then added, forming a deliberate 'wall' of trees where the concrete containment walls once stood. The idea is that this planting pattern demarcates the history of oil in a more positive way, while the plants do their work to heal the environment.

1. Green grey hatches represent the concentrated areas for proposed remediation planting. After the tank disassembly process is complete, there will remain only some deliberate remnants and a green pattern in the shape of tanks and containment walls. The path connects the new landscape as well as weaving through the existing industrial areas.

2. Light grey hatches represent existing vegetation. As seen in Google Maps aerial view, there are great visible circles of vegetation in this particular area. This appears to mark where large oil tanks once stood, but since its demolition the soil has been left bare and species have moved in organically. This natural process inspired the design decisions for planting to follow.

3. The same hatch as #2, light grey represents site-wide existing spontaneous vegetation cover as witnessed through field notes and supported by Google Maps imagery for inaccessible areas.

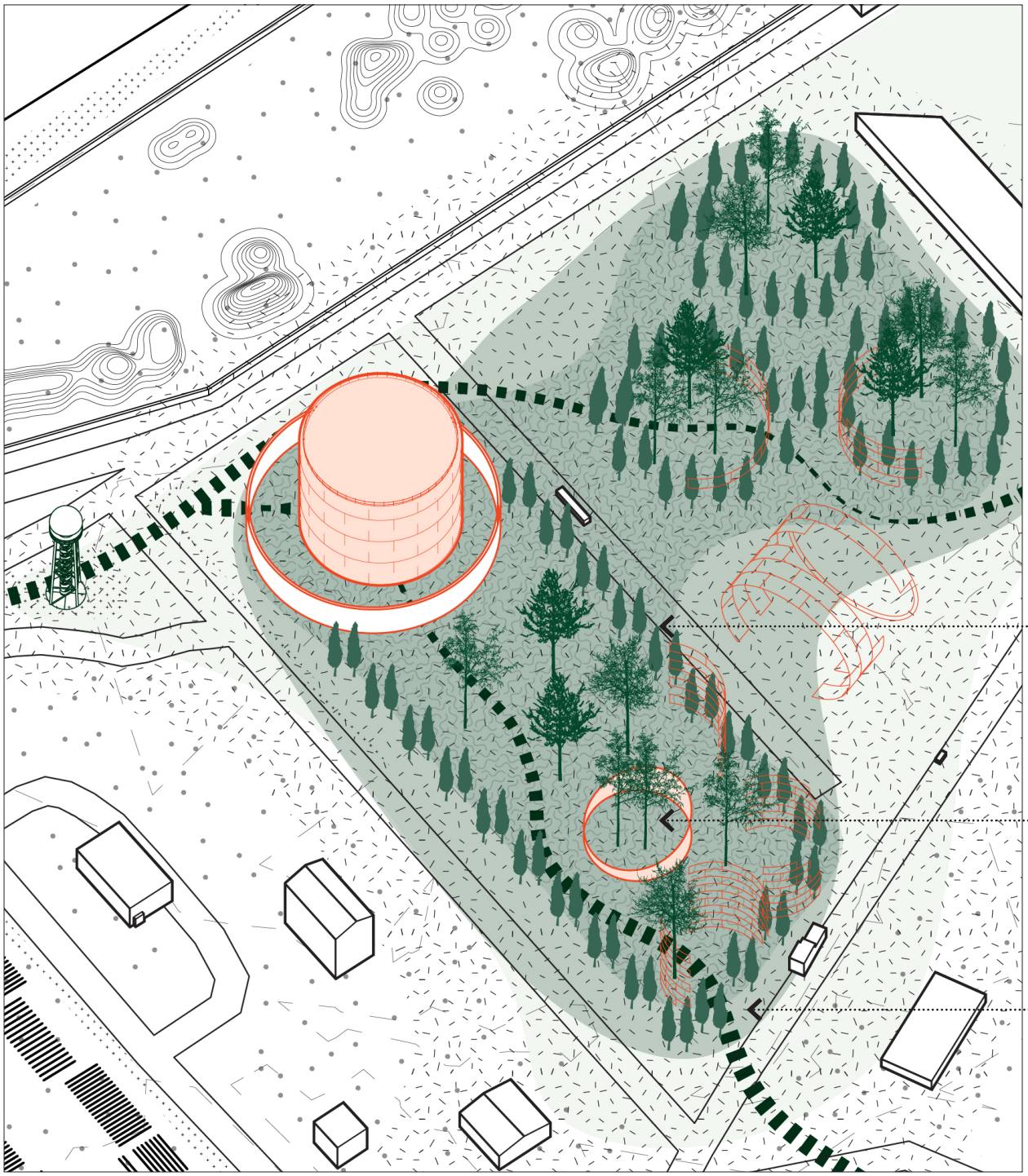
4. The green hatch extends to the existing Petrol Island South park, although it is already established with vegetation, in an effort to connect the different landsapes of the site and to further nurture the area for future planting.



degradation bosque
(large trees planted in place of former oil tanks)

interception hedgerow
(small trees planted along former containment walls)

degradation cover (low vegetation)

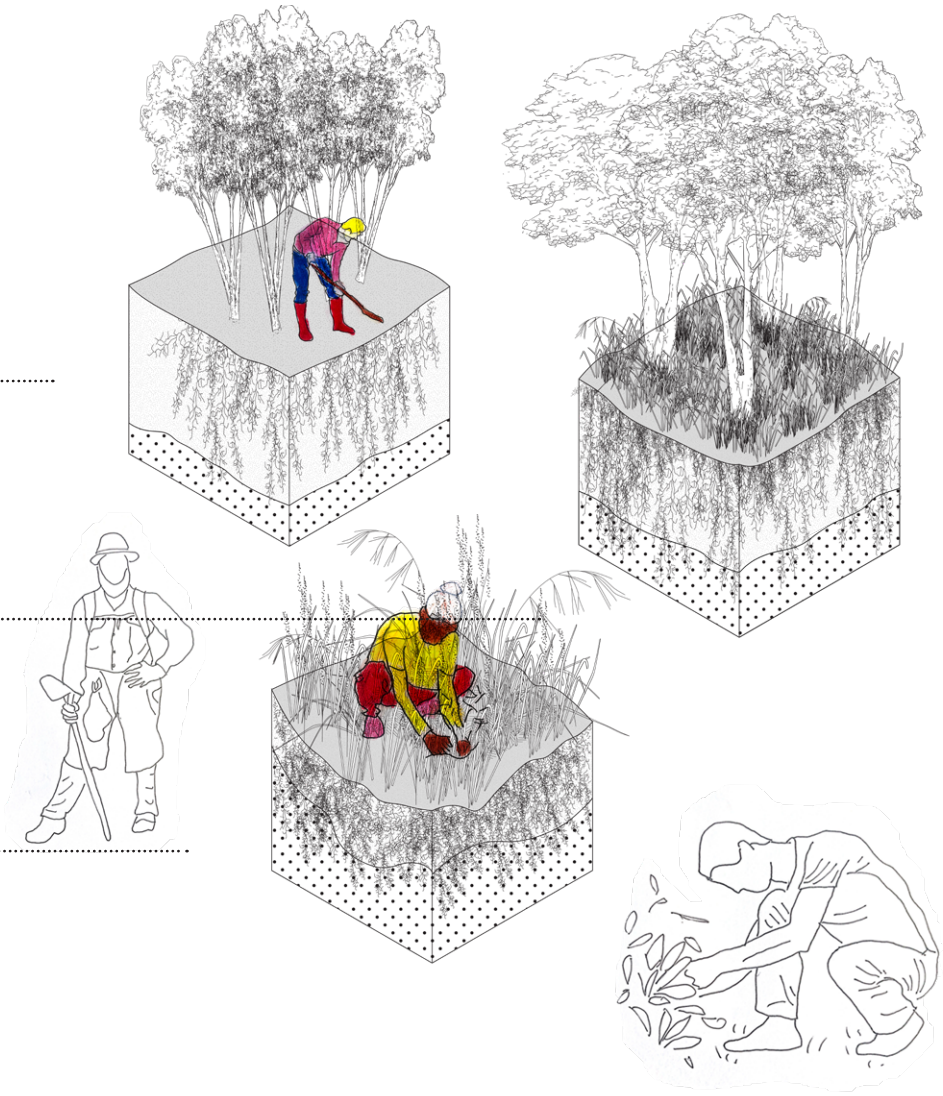


Interception Hedge Row

A single row of deep-rooted trees tap ground water and provide petrochemical degradation with some contaminant mitigation. This planting method is used to border previous oil tank zones, tracing the outline of the concrete containment walls to act as both a practical counteraction to contamination and symbolic delineation of the site's former purpose.

Degradation Bosque

Trees and understory species degrade petrochemicals with no harvesting necessary. This method is chosen for the inner circle with closest proximity to petrochemical contamination; directly beneath the oil tanks. Where there was a tank, there will be bosque. The large, fibrous root zone reaches 0-3 meters deep to the estimated contamination depth.



Degradation Cover

Herbaceous species degrade petrochemicals with no harvesting necessary. Grass roots reach contaminated surface soil from 0-1.5 meters below.

Fig. 4.17 Typological ideas for the phytoremediation process. Drawing by author.

Fig. 4.18 Collage rendering of the phytoremediation planting typologies at work together in the Growing phase.

1. Interception Hedge Row

A single row of deep-rooted trees tap ground water and provide petrochemical degradation with some contaminant mitigation. This planting method is used to border previous oil tank zones, tracing the outline of the concrete containment walls to act as both a practical counteraction to contamination and symbolic delineation of the site's former purpose.

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Endnotes

1 Kate Kennan and Niall Kirkwood, Phyto: Principles and Resources for Site Remediation and Landscape Design (New York: Routledge, 2017), 65.

2 Kate Kennan and Niall Kirkwood, Phyto: Principles and Resources for Site Remediation and Landscape Design (New York: Routledge, 2017), 65.

3 Margaret Birney Vickery, "Pedagogic Landscapes – Recreation, Play and Danish Infrastructure Design," in The Routledge Handbook of Infrastructure Design, ed. Joseph Heathcott (New York: Routledge, 2022), 108.

4 Margaret Birney Vickery, "Pedagogic Landscapes – Recreation, Play and Danish Infrastructure Design," in The Routledge Handbook of Infrastructure Design, ed. Joseph Heathcott (New York: Routledge, 2022), 109.

5 Margaret Birney Vickery, "Pedagogic Landscapes – Recreation, Play and Danish Infrastructure Design," in The Routledge Handbook of Infrastructure Design, ed. Joseph Heathcott (New York: Routledge, 2022), 109.

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14 Peter Del Tredici, "Spontaneous Urban Vegetation: Reflections of Change in a Globalized World," *Nature and Culture* 5, no. 3 (2010): 299, https://doi.org/10.3167/nc.2010.050305.

15 Peter Del Tredici, "Spontaneous Urban Vegetation: Reflections of Change in a Globalized World," *Nature and Culture* 5, no. 3 (2010): 301, https://doi.org/10.3167/nc.2010.050305.

16 Peter Del Tredici, "Spontaneous Urban Vegetation: Reflections of Change in a Globalized World," *Nature and Culture* 5, no. 3 (2010): 301, https://doi.org/10.3167/nc.2010.050305.

17 Peter Del Tredici, "Spontaneous Urban Vegetation: Reflections of Change in a Globalized World," *Nature and Culture* 5, no. 3 (2010): 300, https://doi.org/10.3167/nc.2010.050305.

18 Kate Kennan and Niall Kirkwood, Phyto: Principles and Resources for Site Remediation and Landscape Design (New York: Routledge, 2017), 66.

19 Kate Kennan and Niall Kirkwood, Phyto: Principles and Resources for Site Remediation

and Landscape Design (New York: Routledge, 2017), 64.
20 Kate Kennan and Niall Kirkwood, Phyto: Principles and Resources for Site Remediation and Landscape Design (New York: Routledge, 2017), 63.
21 Kate Kennan and Niall Kirkwood, Phyto: Principles and Resources for Site Remediation and Landscape Design (New York: Routledge, 2017), 67.
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Taking

Fig. 5.1 "Welcome to the Construction Site". Walking into the park at Petrol Island South, despite the vast expanse of unruly vegetation and lack of paths there are still clear indicators of the Port Authority's ownership and control. Deliberate signage appears around certain areas, indicating perhaps future development plans and definitely meant to keep public park-dwellers out. This fence segment was apparently moved and left open so part of the shoreline could be accessed. The sign indicates it is a construction zone with safety equipment required to enter. Photograph by author.

Barriers to physical access, and very limited visibility into the industrial portion of the Island were observed in my field notes and photographs. Though the Petrol Island South park is publicly accessed, it is quickly clear that the industrial portion is highly secured with the objective to keep the public out. By allowing, inviting, and designing for people to access the industrial portion, regardless of what programmatic activities are taking place, there is an opportunity for new engagement with and public agency over an energy space. This is crucial for citizen engagement with the transition to green energy. The final phase of this project considers Petrol Island through the eyes of the everyday citizens entangled with it.

Taking activates the community-led citizen operated stakeholder group, including individual volunteers and groups or members of local society at large. Regenerative disassembly in this case refers to a redistribution of power in terms of ownership and access to space. The idea is that new citizen agency in the energy crisis in terms of oil infrastructure blooms through a re-programming and new access to Petrol Island's oil space. This chapter interrogates the current ownership model that dictates Petrol Island. I summarize the Danish welfare system in and some noteworthy urban examples of spatial appropriation (or lack thereof) within it. Finally, I highlight some local examples of urban regeneration to learn from their ownership models and suggest the need for Petrol Island to become a deliberate public space.

Fig. 5.2 Many layers of fence. Standing by the entrance to Petrol Island's industrial grounds. Photograph by author.


4,3 m
KORT

Fig. 5.3 The multiple personalities of Petrol Island. Photograph by author.

Fig. 5.4 Climbing down by the other side of the noise barrier ridge. Photograph by author.

Fig. 5.5 In Petrol Island South park, there are just a few signs of humans. Emergency ladders from the water appear frequently along the canals. Such objects make swimming and fishing seem free and tempting. Tires as buoys for boats are also frequently hanging. But of the handful of boats tied up, most are vacant and sinking, rotting, or vandalized. Photograph by author.

Fig. 5.6 Calm, protected harbour water and a wooden piling in the park for tying up boats. Photograph by author.

Welfare Spaces

Beginning in 2017, the cross-disciplinary research project *Spaces of Danish Welfare* from the Royal Danish Academy was published in 2022 as the volume *Architectures of Dismantling and Restructuring Spaces of Danish Welfare, 1970-Present* by Kirsten Marie Raahauge, Katrine Lotz, Deane Simpson, and Martin Søberg. Investigating the intersection of space and welfare, the project hypothesized that "welfare spaces could be understood through their transformations concerning scale and distribution, and that nexus between citizens and welfare spaces was of major importance, […] [the project aiming] to bring into the field the entanglement with power relations between state, society and market on a large scale as well as in small-scale everyday life".[1] This thesis is informed by aspects of the book in its quest to better understand citizens' agency in a place like Petrol Island, in the context of evolving Danish welfare society.

While the Danish welfare state was formed between 1945-70 to base the tax system as a mechanism for redistribution, the 1970's marked a turning point for the reinterpretation of the welfare model. In combination with other economic, political, and social events, this shift was a result of "the 1970's oil crisis, inflation, deindustrialisation, and globalization". This reinterpretation meant a more complex system toward which provisions are delivered by an increasingly diverse range of actors and for specific groups. Since the post war period, spatial planning was a crucial element of welfare system construction and redistribution of responsibility between governmental bodies. The role of philanthropic and civic society actors has also changed, reflected in spatial transformation in which city and landscape planning are undoubtedly intertwined.[2]

Politically, the Danish welfare state was recently described as "the social democratic capitalist welfare state model" by sociologist Gøsta Esping-Anderson in which "public amenities are equally accessible to all citizens and that the state actively interacts with market forces through mitigation and limitation of market influence" through very high taxes for welfare provisions and by sustaining the market.[3] What exactly is included in "public amenities"? Is energy a public amenity? Is peripheral, industrial space a public amenity? Are temporary public parks an amenity?

A five-pillar structure by British economist William Beveridge in 1942 named "housing, education, social security, employment, and health" as the traditional basis for the welfare model. However, today the *Spaces of Danish Welfare* project posits that "non-human agents were part of the intermingling of space and welfare", and that the welfare condition has developed to be too complex for Beveridge's metaphor; that "climate change, infrastructure, tourism, security, pandemic effects, [and] virtualization" have come to figure prominently in welfare spaces emerging.[4] Moreover, Katrine Lodz writes in her book *Forming Welfare* that architecture is a determining factor in orchestrating citizens' meeting with the Danish State; that the evolution of public institutions can be seen as "the most obvious spatial and material manifestation of the burgeoning welfare state and its basic values".[5] Petrol Island, as infrastructure, a place charged with energy resources related to climate change, and a 'healthy' park, can be seen as a welfare space in which the intersection between governing bodies and citizens is staged.

The eternity machine

Petrol Island is a short 4 kilometers east of Amager Common, a sizeable park on Copenhagen's larger island of Amager. Jesper Pagh writes *On the Battle for Amager Common - A Power Play of Housing Politics in Copenhagen* analyzing urban policies in the city, demonstrating how the balance between green, growing and just planning in the city has evolved. Pagh illustrates the battles between citizen groups and municipalities, arguing that they display different kinds of acting communities and housing policy disputes. The Copenhagen City and Port Development, or *By og Havn*, currently owns the Island of Prøvestenen. By og Havn operates on a market dependent model, which according to Pagh, must be adjusted. By og Havn exemplifies the practical implications of the shift in urban planning relations and interactions between stakeholders in the Danish welfare model from the 1970's to present day "entrepreneurial" urban governance.[6]

After Copenhagen's economic decline due to deindustrialisation and depopulation in the 1970's and '80s, By og Havn (then called Ørestad Development Corporation) was formed as a publicly owned, privately run corporation by the Danish state and Copenhagen Municipality. This was a result of political planning for the resurrection of the city, with decisions to

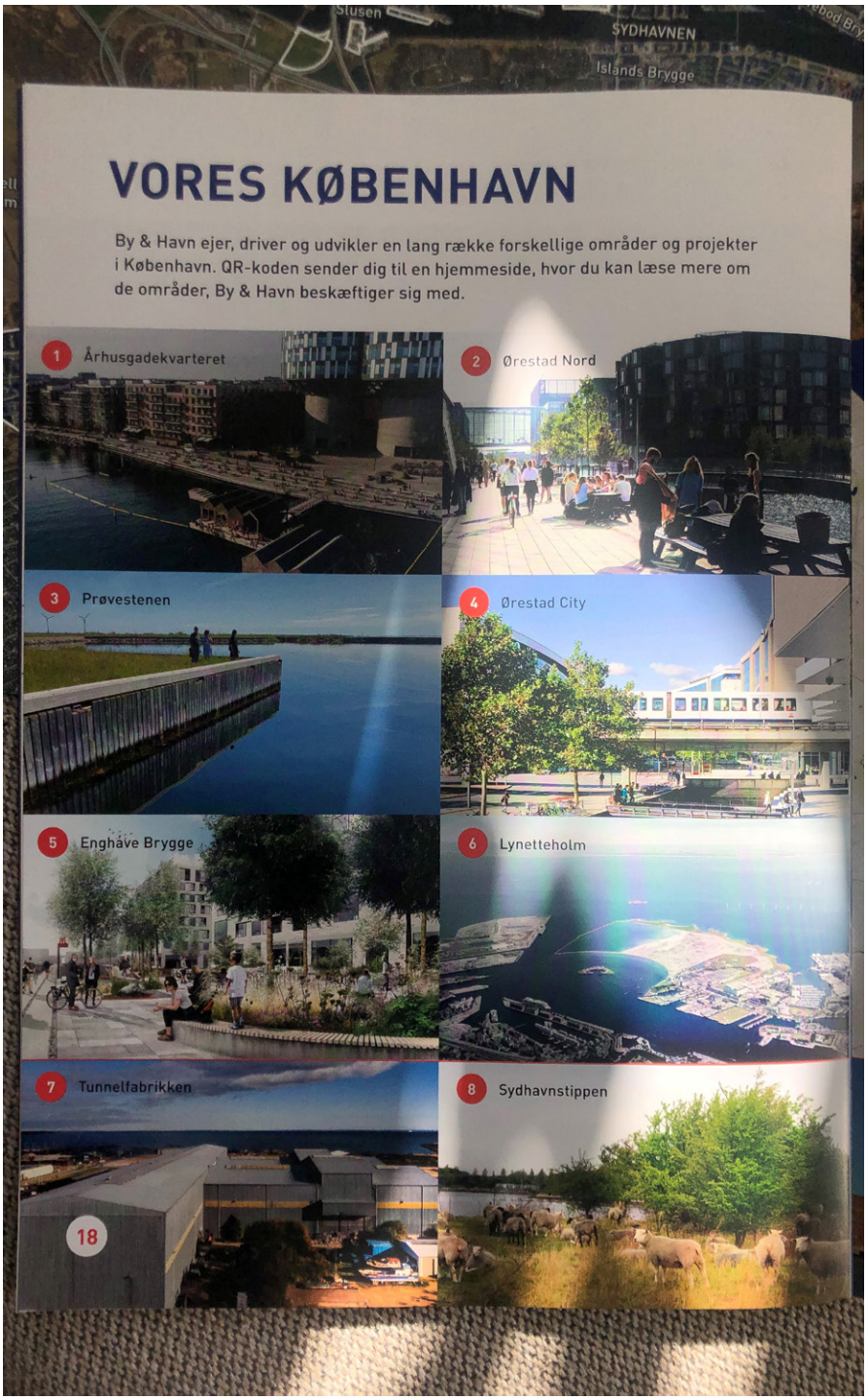


Fig. 5.7 A pamphlet collected from the By og Havn archival exhibition for the public, 2022, reading "Our Copenhagen". Eight projects are advertised here as development projects. Number 3 is Petrol Island. Note the image is from the park with no oil tanks in sight. Also note: Image 1 shows Nordhavnen, or 'North Harbour', a post industrial area developed into a creative and housing district; Image 6 shows the future plan for Lynetteholmen, which I will discuss in the essay to follow; Image 7 shows a cultural center in Nordhavnen converted from an industrial warehouse; Image 8 shows 'South Harbour Tip' which is an artifical landmass built with a surplus soil and trash infill, now turned into a park with sheep grazing. Pieces of plastic and other objects can still be seen protruding from the ground. Photograph by author.

"build a bridge between Copenhagen and Malmö, Sweden; to expand the airport; and to finance the construction of an underground metro through the development of publicly owned land".[7] National and local governments transferred land assets to the corporation, whose explicit goal was "to create revenue through asset management and development of the land, […] [using] this revenue to service the debt for the metro line, which in turn increased the value of the land", and to pay for the local infrastructure that enabled the development of the land.[8] In 2007, Ørestad Development Corporation was split into two separate corporations, *By og Havn* and *The Copenhagen Metro*. Since then, By og Havn's responsibility is for the continuous development of Copenhagen Harbour and its surrounding areas. Pagh describes the corporation now in practice to be "an eternity machine trusted with all major strategic urban development projects within the municipal borders of Copenhagen in the foreseeable future", with no other Danish municipality having a corporation like it.[9] To address issues put forward in the case of *The Battle for Amager Common*, Pagh suggests, among other things, to adjust the model of By og Havn to "public ownership of a development corporation that can act on market terms", and to "engage in a new political culture, […] inviting the citizenry to participate in an actual collaborative process about the future of the city".[10]

Spatial appropriation

As well as being at the whim of By og Havn, Petrol Island exists in a complex urban context within a stone's throw from many neighbouring noteworthy sites. Denmark, and particularly Copenhagen, reveal both a long and fresh history with spatial appropriation. On the 6th of September 1971, 'slum stormer' squatters penetrated the fence of an abandoned military barracks near the city centre to performatively declare their *Freetown Christiania*. Separated by only a large sports field, the easiest route south to Petrol Island by bike is through *Christiania*. Passing through the gates the overgrown streets instantly burst with colourful murals, puffs of smoke and signs saying, 'no photographs'. After 50 years and numerous challenges with politicians, urban planners, and drug-related crime, the "motley blend of reused old structures, new off-grid housing, un-domesticated urban nature and self-sustained infrastructure and institutions" still thrives, though its success and future is subject to constant debate. Regardless, "the flower children

Fig. 5.8 When the military vacated the barracks in 1971, individual activists moved into the empty buildings beginning what was later to be claimed "Freetown Christiania". (Source: https://jyllands-posten.dk/indland/ECE8970919/starten-paa-en-fristad/)

Fig. 5.9 There are a total of 325 buidings in Christiania, adding up to 66,000 square meters of floor area. By 2012, the Freetown still owned roughly 50,000 square meters. (Source: https://jyllands-posten.dk/indland/ECE8970919/starten-paa-en-fristad/)

Fig. 5.10 Christiania recently, as part of Hostel World's 'must-do' list when visiting the city. (Source: https://www.hostelworld.com/blog/christiania/)

created their own alternative society", an urban utopia that has survived against all odds in "the otherwise carefully regulated Copenhagen".[11]

As the slum stormers claimed their Freetown, in north-western Copenhagen architect Steen Eiler Rasmussen planned a tabula rasa New Town neighbourhood of Tingbjerg, an ideal city. Surprisingly, in his 1976 book *About Christiania*, Rasmussen later became a defender of Christiania. Rasmussen contrasted his more-rigid-than-intended Tingbjerg "where everything is quite heartlessly regulated and normalized and forced into the correct forms, […] to Christiania, where everything is free" and people organized their own urban society from the bottom up without a master plan.[12]

In 1973, the popular *Byggeren* or "junk playground" was established by residents in Copenhagen's north neighbourhood of Nørrebro. Just 6 years later the playground faced demolition in favour of a new municipal master

plan for social housing. This provoked a passionate public response and tense confrontations between civilians and police. Defenders of the junk playground barricaded it for nearly a month, preventing the start of demolition. The municipality responded with police deployment, resulting in battles for several weeks. Nearly 15,000 Copenhageners marched to City Hall demanding to save Byggeren but watched in vain as the junk playground was irreversibly bulldozed by the municipality days later. The area is now known as the Black Square and is said to be struggling with a host of social challenges.[13]

In the words of Arne Gaardmand in a 1995 seminar to the *Dansk Byplanlaboritorium,* the Danish city planning lab, the neighbourhood of Nørrebro today is a wonderful place to live. Yet it does still embody a heritage

Fig. 5.11 Byggeren, Norrebro's junk playground, being taken by police in 1980. (Source: https://cphpost.dk/2016-08-04/history/the-year-the-city-fought-the-kids-and-won/)

of unpleasant memories for locals of how the urban renewal materialized. Gaardman states that Nørrebro's recurrent tensions were probably caused "by a failed politics of relocation, housing and social issues". Furthermore, and in the extreme case of the Byggeren junk playground, "it is still vividly recollected in Nørrebro how the plans were forced through, what little influence the citizens had and the extent to which the politicians, public servants and 'the system' as a whole manifested governmental overreach and 'only we know' attitudes".[14] Walking through where I live in the neighbourhood of Nørrebro today in 2022 I see more people out walking on the streets than in any other part of the city; there are often 'Car-Free Sundays' occupying main streets with flea markets and community events, and walls are common canvases for opinionated graffiti.

Fig. 5.12 A sign seen posted outside the grocery store in Norrebro, inviting Copenhageners to join a demonstration to stop Lynetteholm in June 2022. Photograph by author.

Fig. 5.13 A rendering of the future Lynetteholm. (Source: https://minbaad.dk/nyhed/archive/2020/03/december/article/lynetteholmen-er-en-katastrofe-for-sejlsporten-i-hovedstaden-siger-dansk-sejlunion/)

One of the City of Copenhagen and By og Havn's most recent and heavily debated development projects, financed through the asset management and land development model, is *Lynetteholm*. According to By og Havn, the project "will create the foundation of Copenhagen's new peninsula and future storm surge protection plan," at the same time guaranteeing that the Municipality can deposit surplus soils from construction sites in a "climate-friendly manner". Part of the climate-friendly plan is a promise for a green coastal landscape of stone dams with new potential for plant and animal habitats underwater.[15]

Described by the citizen group *Byen for Borgerne*, 'City for the Citizens' in their public plea project *Stop Lynetteholm,* the peninsula project is the largest construction project in Danish history in its 2.8 square kilometer mass and 70-year timeline to completion. With its plan to house "35,000 inhabitants and [create] 35,000 jobs", the protest group claims the project is no longer possible to be funded by the land-sale model and must now be funded by taxpayers.[16] A central figure in the reinvention of Danish housing since the 1970's, architect and founding partner of the firm *Vandkunsten*, Thomas Arnfred, criticizes the Lynetteholm masterplan for its lack of flexibility and creativity.[17] In an excerpt from *The Welfare City in Transition,* Anne Romme and Morten Birk Jorgensen claim Lynetteholm to be a local example of how By og Havn together with the municipality "develop housing for the largest and strongest group of investors: an upper-middle-class family with a willingness for life-long indebtedness to get a share of the city's delights".[18]

Along with healthcare and education, housing in Denmark is a common public good. Housing is considered one of the welfare state's main services, even though it is not financed through the general tax system. Citizens must rent or buy dwelling spaces but do so in a market that is highly planned and regulated by public sector, state, and civil agents who share the responsibility of ensuring homes for all. Citizens are not simply allocated housing by the state, nor is it free. But the right to a dwelling is a pillar of national Danish housing policy, with some political scientists arguing it to be a social right in being a central concern for welfare state policies. Housing cooperatives and association-based social housing make up much of Denmark's dwellings along with collective ownership and active citizen communities.[19] Yet there is still a shortage of housing in Copenhagen.

Presented as a kind of "kinder egg", the Lynetteholm plan is meant to solve the city's housing shortage and prevent future sea-level rise in one quick fix.[20] However, the citizen protest group, "STOP Lynetteholm!" works against the new development based on the following principles: "We must not burden the climate and exploit nature when we develop our cities and infrastructure, […] there are other and better solutions than Lynetteholm, which can effectively secure Copenhagen against storm surges, […] Lynetteholm must not block the important inflow of salt water to the Baltic Sea, and the entire Øresund must be included in a future marine nature national park, […] the citizens must have an influence on Copenhagen's future, and they must have their right of appeal restored, […] we do not want to be part of By & Havn's [City and Port Development] debt circus and demand full openness about the overall finances of the project."[21] The perspective of the *STOP Lynetteholm!* group illustrates that within the welfare system's context, housing is not always of primary concern for the people. Or rather, housing does not always trump other concerns about environmental sustainability, democratic transparency, and citizen agency in the future development of the city. Lynetteholm further exemplifies a misalignment between public political priorities and state-driven urban planning solutions.

Fig. 5.14 Refshaloen public street market and creative district. Note in the background: Amager Bakke and CopenHill, as well as the oil tanks of Petrol Island in the distance. (Source: https://migogkbh.dk/reffen-og-broens-gadekoekken-aabner-i-naeste-uge/)

Freetown Christiania is the most radical and arguably the only successful long-term example of spatial appropriation in the city of Copenhagen. The Byggeren junk playground revealed citizens clashing with the state for their top-down planning approach, and ultimately losing. Lynetteholm is not an example of spatial appropriation at all but rather a more recent large-scale planning debate in the city where the public body appears divided and powerless against spatial decisions by the state.

Governing the Shipyard

This section argues for Petrol Island's urban regeneration into a community-led district to serve the public. I explore the qualities needed for a financially viable, sustainable urban district with a model of urban governance plausible in the local context. However, the following article examines successful urban regeneration projects in Copenhagen that have found new identities as specifically creative districts. This is where my proposal differs. Rather than a creative district which can be argued to promote gentrification, I propose public programming that harbours the Danish tradition of making nature a pillar of education and play.

Deindustrialisation of Copenhagen's harbourfront meant vacant areas for re-purposing. This provided opportunities to develop new cultural districts close to the city center. The article *Fostering and Planning Urban Regeneration: The Governance of Cultural Districts in Copenhagen* in a 2018 issue of *European Planning Studies* examines models of governance in these areas, arguing the need for "a mix of bottom-up and top-down approaches." In short, the 'top-down' approach refers to policy schemes funded and run by public agencies. 'Bottom-up' encompasses both profit and non-profit actors outside of the sphere of policy and is dependent on these actors' capabilities alone. Instead of either totally unregulated initiatives or purely real estate-driven developments, financial viability of new districts should come through a combined approach allowing "creative workers and companies to retain a certain control […] and in turn to counteract gentrification." Social science scholars of city governance identify *public-private involvement* and *the level of intervention* as two main dimensions of urban regeneration. Copenhagen is marked by examples with a variation in both dimensions therefore representing a good case in which to examine these principles.[22]

Fig. 5.15 Tracing over site photographs to imagine subtle interactions between people and the elements of Petrol Island. The characters in this sketch are planting and nurturing the vegetation. They could also just be enjoying a walk in the park. Drawing by author.

Long term sustainability of creative districts is often hindered by approaches surrounded by "alienation, misrepresentation and lack of community ownership." In terms of public-private involvement, the literature concludes that "allowing for temporary uses", with room for risks and experiments, has proven a successful way to support urban development. In terms of intervention, they advocate for "a shift from top-down approaches to community development in the decision-making processes in order to generate identity and a sense of belonging." [23] Informed by this discussion of ownership which looks to local examples like the Refshaløen shipyard, I propose a mixed bottom-up with top-down ownership approach for Petrol Island. This would allow for backing and funding through public policies as well as the agency and involvement of non-profit initiatives and community groups outside the realm of policy.

This thesis focuses on the transitional phase of Petrol Island. Therefore it fits well into the timeframe of "allowing for temporary uses" with room for risks and experiments. Also borrowing from *The Governance of Cultural Districts in Copenhagen's* findings, I advocate for community involvement in the decision-making process. The result? A large, temporary adventure-like landscape that embodies traditions of the Danish junk playground in its experimental nature while offering real opportunities to recycle materials, host experimental public events and educate the population about the energy and climate crises.

This is not just a park. Petrol Island is neighbours to Kløvermarken, the large sports field to the west and Amager Beach park to the south. Large parks in the immediate urban fabric such as Amager Fælled effectively serve the greater urban areas with nature-encounters. Freetown Christiania is also considered an alternative park by some. Instead, this proposal builds upon Bjarke Ingels' Amager Bakke waste-to-energy plant concept with public park integrated with the infrastructure. Petrol Island's situation within the energy infrastructure of the industrial coastline offers a unique opportunity for the public to interact with both infrastructure and park. Furthermore, it is not meant as only a neighborhood park. Rather, I advocate for Petrol Island's use as a city-wide landmark in environmental repair, renewed citizen agency and climate education.

Taking Petrol Island

The *Taking* phase focuses on the new life and identity of Petrol Island. In this phase, the goal is to enable new opportunities for community access and engagement with the space activating it as a valuable cultural district within the Danish social and cultural framework. I do this through a series of programmatic gestures suggesting the re-use and appropriation of former oil tanks while planning movement throughout the greater landscapes of the energy space. This process happens in tandem with the *Breaking* and *Growing* phases; however, *Taking* is the final 'phase' given that much of the spatial occupation by public groups requires both a landscape of safely decommissioned oil infrastructures and an environment cleansed of petrochemical contaminants first.

The oil tanks proposed to remain were chosen for their strategic locations around the site that might lend themselves to specific functions. While these structures are being re-occupied, it is intended that planted remediation species continue to grow and thrive beyond the green 'swath'. On some existing areas where spontaneous vegetation is especially developed, planned community gardens can begin.

The lack of visibility into the site is addressed by introducing a network of viewing tower structures, or 'sentinels'. These are proposed to be constructed using recycled materials from the Tank Bank. While the viewing towers offer interactive glimpses into the never-before-seen landscape, they take visitors to new heights above, around and throughout Petrol Island's history and ongoing operations. Sentinels serve as anchor points along the path, with the main structure climbing one of the existing wind turbines to engage directly with wind energy while observing the abrupt contrast between the existing public park and industrial areas. From this point climbers can fly to the next sentinel by zipline, providing a new way to physically experience the site without interfering with the ground plane still in industrial operation. Sentinels are concentrated in the 'material mound' area of the site for the greatest visibility. On the ground, parts from the Tank Bank are to be distributed as land art objects in this area. The intention is that while nodding to their history, the former oil objects shed their danger while symbolizing new life.

Fig. 5.16 Tracing over site photographs to imagine subtle interactions between people and the elements of Petrol Island. Characters in this sketch are climbing the wind turbine as an example of close physical interaction with infrastructures in a new way. Drawing by author.

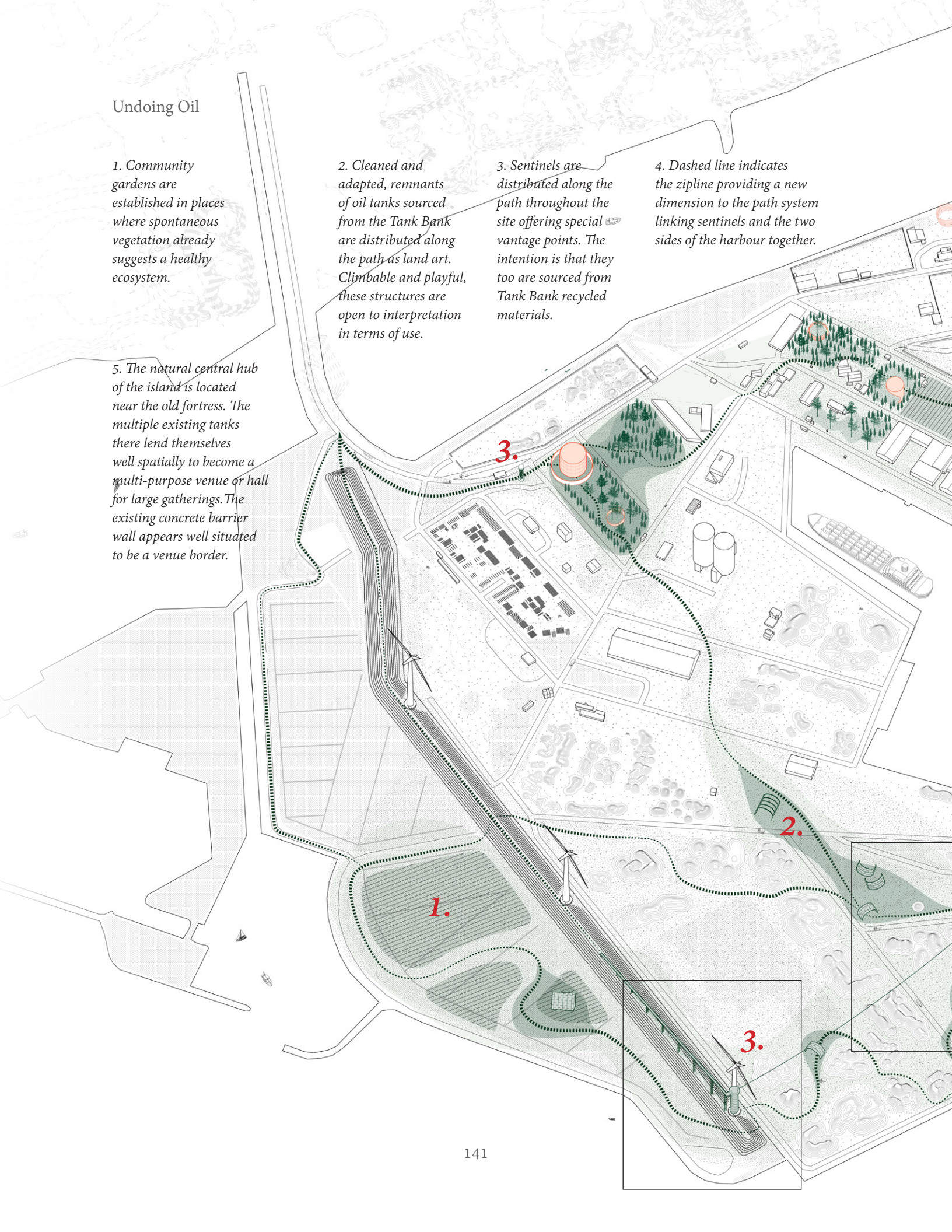
1. Community gardens are established in places where spontaneous vegetation already suggests a healthy ecosystem.

2. Cleaned and adapted, remnants of oil tanks sourced from the Tank Bank are distributed along the path as land art. Climbable and playful, these structures are open to interpretation in terms of use.

3. Sentinels are distributed along the path throughout the site offering special vantage points. The intention is that they too are sourced from Tank Bank recycled materials.

4. Dashed line indicates the zipline providing a new dimension to the path system linking sentinels and the two sides of the harbour together.

5. The natural central hub of the island is located near the old fortress. The multiple existing tanks there lend themselves well spatially to become a multi-purpose venue or hall for large gatherings. The existing concrete barrier wall appears well situated to be a venue border.



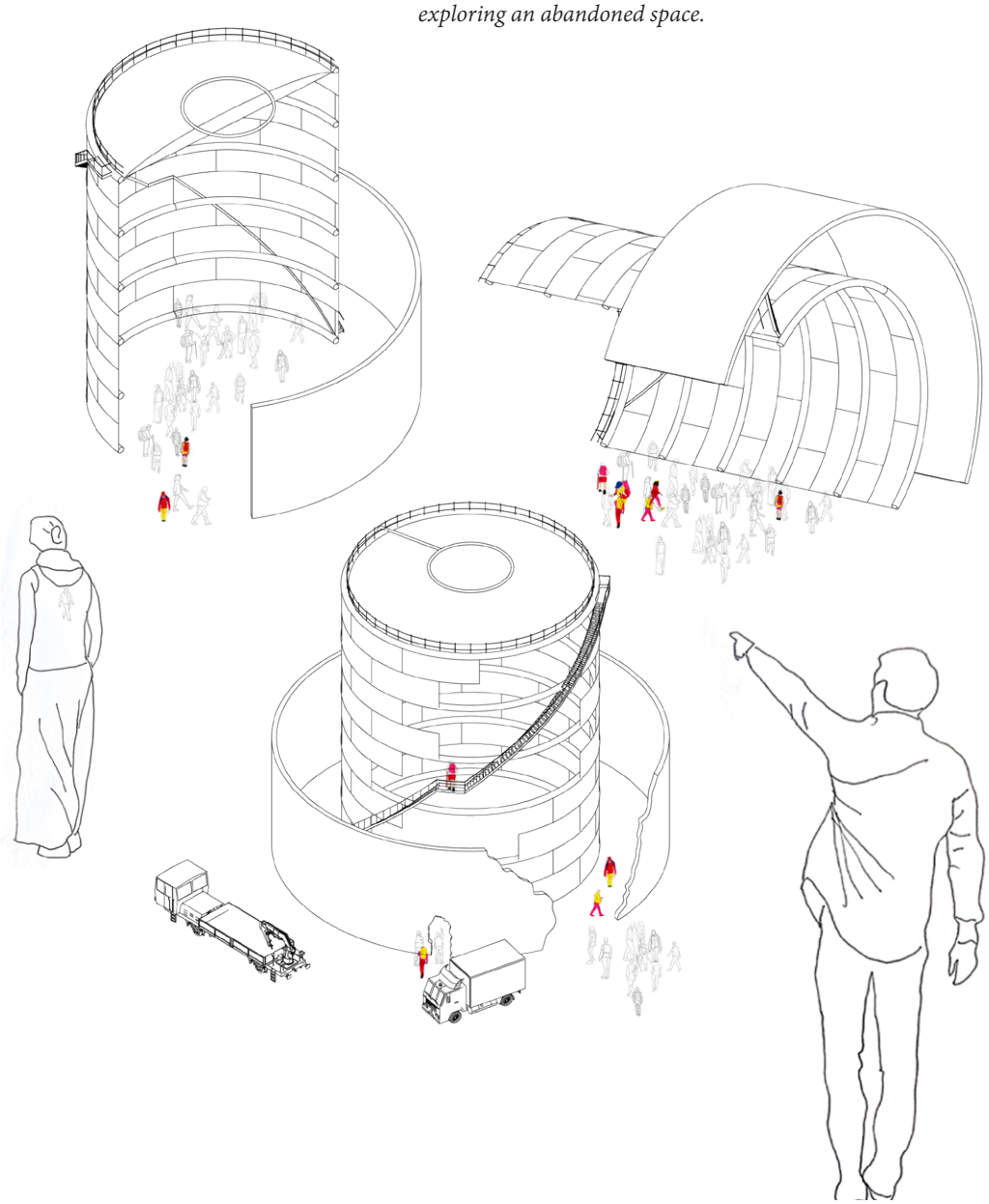
new structures sourced from Tank Bank materials distributed around the site

community gardens

focused program areas

Fig. 5.17 Typological ideas for occupying oil tanks as new public space. Drawing by author.

When certain elements are adapted or removed, the arrangement of four large tanks lends itself well to a large gathering space for many people. Multipurpose concert halls spring up in this location, with the acoustics of an empty oil drum and the irreplaceable feeling of exploring an abandoned space.



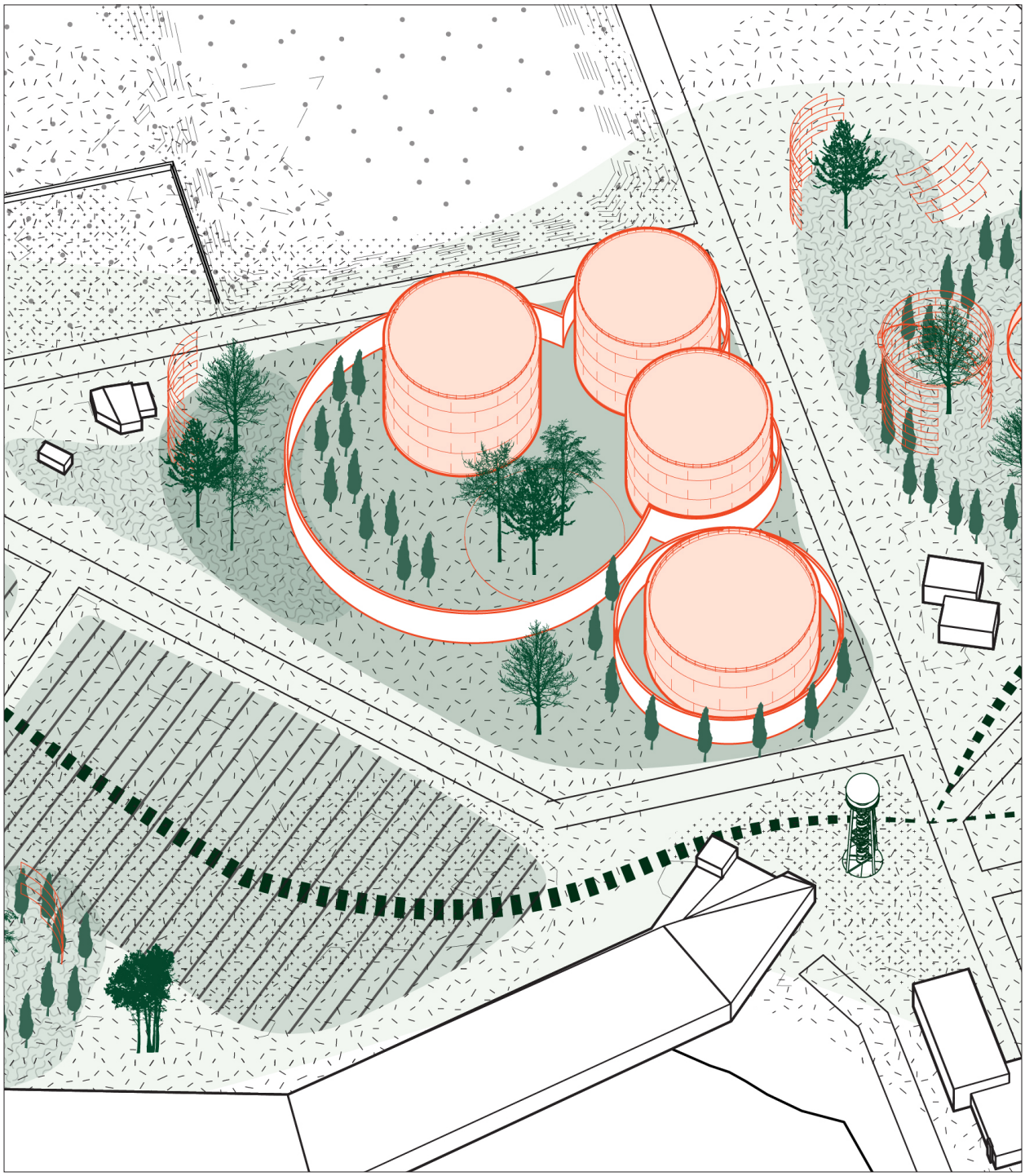
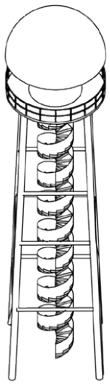
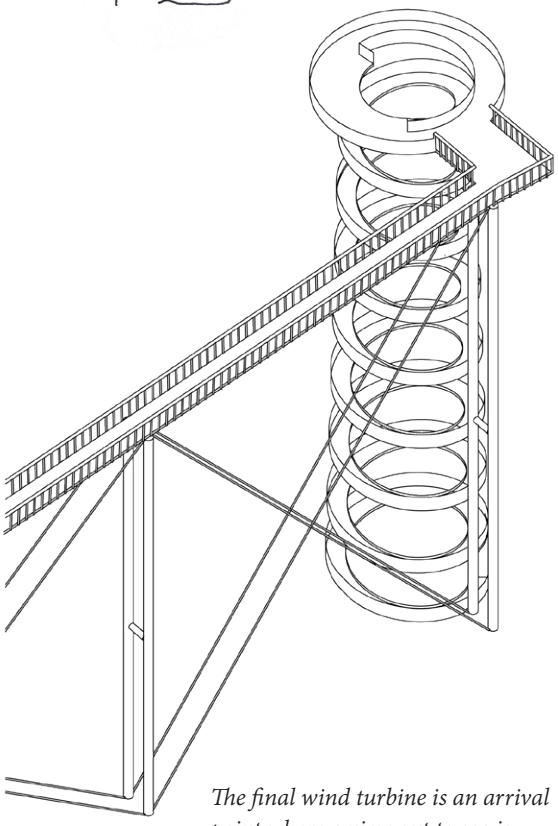


Fig. 5.18 Typological ideas for re-using oil tank materials in new construction on site. The new structures serve as arrival points along the path and lift people up for new vantage points over the topography. This promotes transparency of the disassembly processes, remediation growth patterns, and enables encounters with the nature/infrastructure landscape. Drawing by author.

Materials from the Tank Bank are a whole new resource for recycled construction. To bring visitors up in elevation for vantage points into the vast landscape, towers or 'sentinels' are constructed onsite and placed in strategic stopping places.



As part of the path system and the Sentinel network, a winding ramp climbs half-way (50m) up the mast of a wind turbine. This comes at the farthest point into the Petrol Island South park, marking the divide between industry and public green space.



The final wind turbine is an arrival point where a view out to sea is matched by a panorama of Petrol Island's oil tanks. Engaging the wind turbine directly promotes a close learning experience with wind energy also.

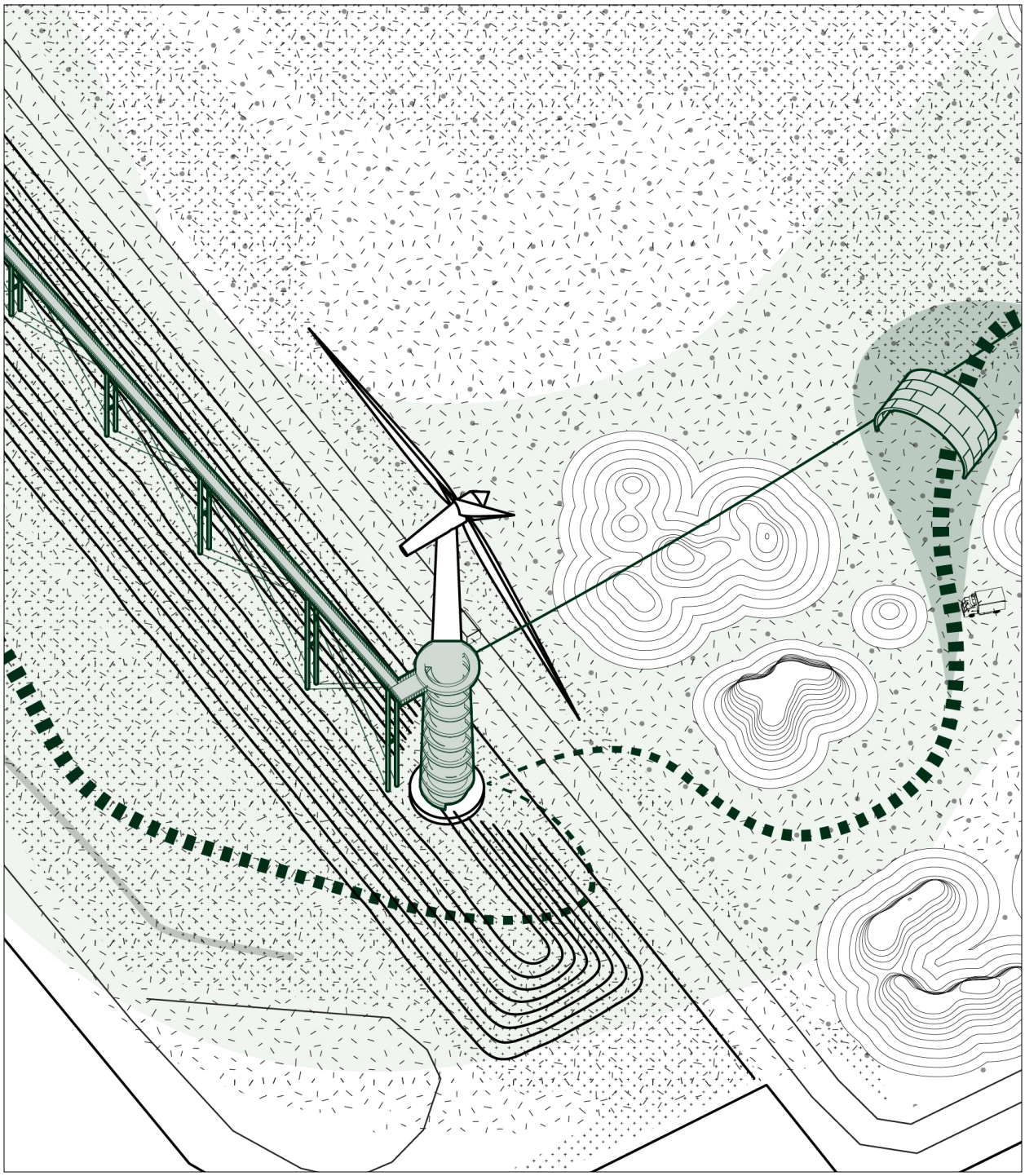
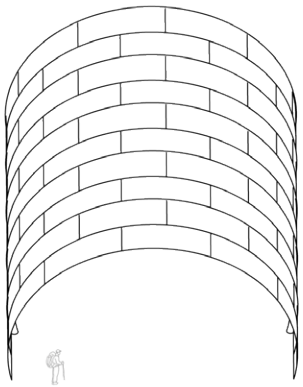
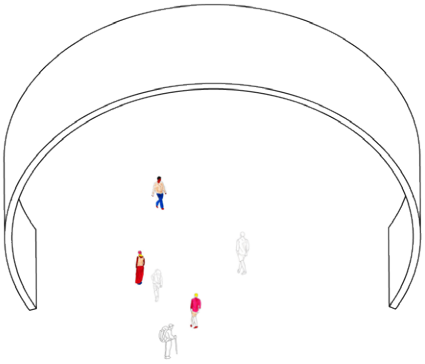


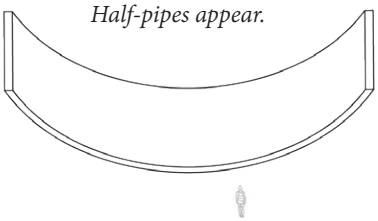
Fig. 5.19 Typological ideas for re-using oil tank materials in new construction on site. Objects are distributed along the path that winds its way through all of Petrol Island's different landscapes. Drawing by author.



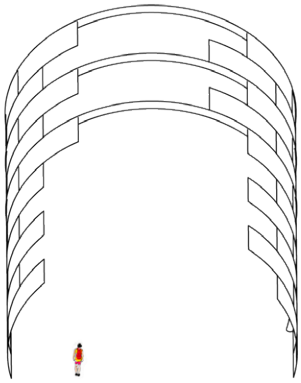
Tunnels appear.

Arches appear.





Half-pipes appear.



Curious structures appear.

While concentrated in the bulk storage yards, or 'mounds', these structures help to connect the multiple changing landscapes of the Island by promoting visibility and foot traffic. Using different angles and configurations, they offer new ways to experience the materials salvaged from Tank Bank deconstruction, and in this to contemplate materials leftover in the aftermath of oil.

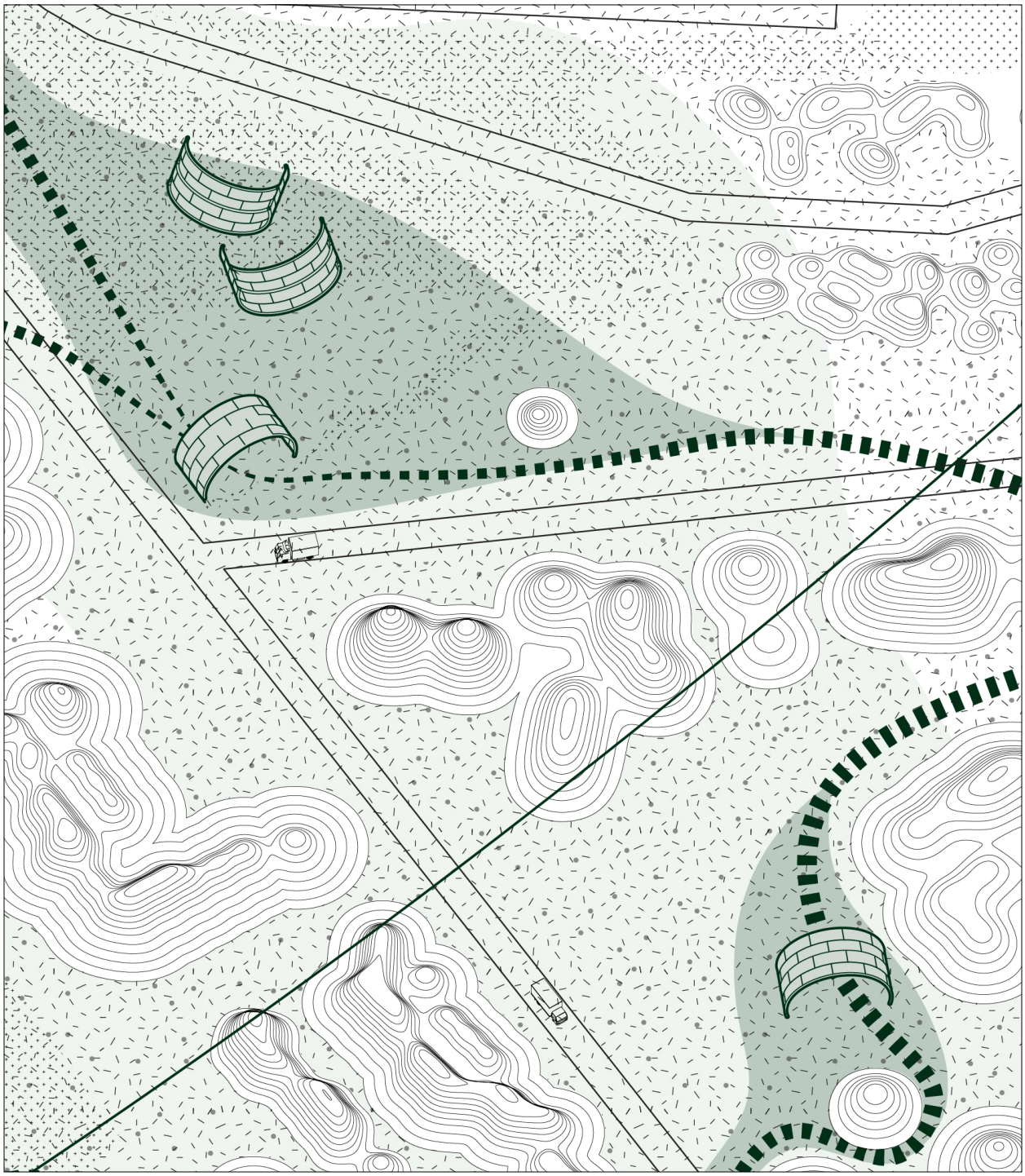


Fig. 5.20 Collage rendering of the gathering hall (a former half-tank) and some land art sourced from the Tank Bank.

1. The Gathering Hall

Using an oil tank cut sectionally, a new impomptu space emerges. It exudes potential to be used by gymnasts, musicicans and other public festivals.

2. The Half Pipe

Community outdoor activities that benefit from concrete structures can be inventive with the land art objects.

Endnotes

1 Kirsten Marie Raahuage, Deane Simpson, Martin Søberg and Katrine Lotz, eds., *Architectures of Dismantling and Restructuring: Spaces of Danish Welfare - 1970-Present* (Zurich: Lars Müller Publishers, 2022), 28.

2 Kirsten Marie Raahuage, Deane Simpson, Martin Søberg and Katrine Lotz, eds., *Architectures of Dismantling and Restructuring: Spaces of Danish Welfare - 1970-Present* (Zurich: Lars Müller Publishers, 2022), 32.

3 Kirsten Marie Raahuage, Deane Simpson, Martin Søberg and Katrine Lotz, eds., *Architectures of Dismantling and Restructuring: Spaces of Danish Welfare - 1970-Present* (Zurich: Lars Müller Publishers, 2022), 32.

4 Kirsten Marie Raahuage, Deane Simpson, Martin Søberg and Katrine Lotz, eds., *Architectures of Dismantling and Restructuring: Spaces of Danish Welfare - 1970-Present* (Zurich: Lars Müller Publishers, 2022), 28.

5 Katrine Lotz, Jesper Pagh, and Ellen Marie Braae, eds., *Forming Welfare* (Copenhagen: The Danish Architectural Press, 2017).

6 Kirsten Marie Raahuage, Deane Simpson, Martin Søberg and Katrine Lotz, eds., *Architectures of Dismantling and Restructuring: Spaces of Danish Welfare - 1970-Present* (Zurich: Lars Müller Publishers, 2022), 431.

7 Kirsten Marie Raahuage, Deane Simpson, Martin Søberg and Katrine Lotz, eds., *Architectures of Dismantling and Restructuring: Spaces of Danish Welfare - 1970-Present* (Zurich: Lars Müller Publishers, 2022), 431.

8 Kirsten Marie Raahuage, Deane Simpson, Martin Søberg and Katrine Lotz, eds., *Architectures of Dismantling and Restructuring: Spaces of Danish Welfare - 1970-Present* (Zurich: Lars Müller Publishers, 2022), 431.

9 Kirsten Marie Raahuage, Deane Simpson, Martin Søberg and Katrine Lotz, eds., *Architectures of Dismantling and Restructuring: Spaces of Danish Welfare - 1970-Present* (Zurich: Lars Müller Publishers, 2022), 431.

10 Kirsten Marie Raahuage, Deane Simpson, Martin Søberg and Katrine Lotz, eds., *Architectures of Dismantling and Restructuring: Spaces of Danish Welfare - 1970-Present* (Zurich: Lars Müller Publishers, 2022), 431.

11 Pernille Maria Bärnheim, Signe Sophie Bøggild, and Kristoffer Lindhardt Weiss, eds., *The Welfare City in Transition*: *a Compilation of Texts and Images 1923-2020* (Copenhagen: The Danish Architectural Press, 2020), 37.

12 Pernille Maria Bärnheim, Signe Sophie Bøggild, and Kristoffer Lindhardt Weiss, eds., *The Welfare City in Transition*: *a Compilation of Texts and Images 1923-2020* (Copenhagen: The Danish Architectural Press, 2020), 34.

13 Pernille Maria Bärnheim, Signe Sophie Bøggild, and Kristoffer Lindhardt Weiss, eds., *The Welfare City in Transition*: *a Compilation of Texts and Images 1923-2020* (Copenhagen: The Danish Architectural Press, 2020), 69.

14 Pernille Maria Bärnheim, Signe Sophie Bøggild, and Kristoffer Lindhardt Weiss, eds., *The Welfare City in Transition*: *a Compilation of Texts and Images 1923-2020* (Copenhagen: The Danish Architectural Press, 2020), 68.

15 "Lynetteholm: We recycle the earth locally to storm surge protection," By og Havn, accessed June 3, 2022, https://byoghavn.dk/lynetteholm/.

16 "What Is Lynetteholm?" Byen for Borgerne: Stop Lynetteholm!, accessed October 28, 2022, https://byenforborgerne.dk/.

17 Pernille Maria Bärnheim, Signe Sophie Bøggild, and Kristoffer Lindhardt Weiss, eds., *The Welfare City in Transition*: *a Compilation of Texts and Images 1923-2020* (Copenhagen: The Danish Architectural Press, 2020), 121-122.

18 Pernille Maria Bärnheim, Signe Sophie Bøggild, and Kristoffer Lindhardt Weiss, eds., *The Welfare City in Transition*: *a Compilation of Texts and Images 1923-2020* (Copenhagen: The Danish Architectural Press, 2020).

19 Kirsten Marie Raahuage, Deane Simpson, Martin Søberg and Katrine Lotz, eds., *Architectures of Dismantling and Restructuring: Spaces of Danish Welfare - 1970-Present* (Zurich: Lars Müller Publishers, 2022), 361.

20 Pernille Maria Bärnheim, Signe Sophie Bøggild, and Kristoffer Lindhardt Weiss, eds., *The Welfare City in Transition*: *a Compilation of Texts and Images 1923-2020* (Copenhagen: The Danish Architectural Press, 2020), 121.

21 "What Is Lynetteholm?" Byen for Borgerne: Stop Lynetteholm!, accessed October 28, 2022, https://byenforborgerne.dk/.

22 Christina Lidegaard et al., "Fostering and Planning Urban Regeneration: The Governance of Cultural Districts in Copenhagen," *European Planning Studies 26,* no. 1 (2018): 2. doi:10.1080/09654313.2017.1364352.

23 Christina Lidegaard et al., "Fostering and Planning Urban Regeneration: The Governance of Cultural Districts in Copenhagen," *European Planning Studies 26,* no. 1 (2018): 3. doi:10.1080/09654313.2017.1364352.

Reflection

With two hundred and fifty oil tanks hidden in plain sight, Petrol Island is potentially a key space in the local petrocultural transition. This thesis was a speculative architectural vision for its regrowth. In the context of both city and country-wide agendas for a transformation of the energy sector, the climate and energy crises are clearly a concern for both the governing and the governed. However, the social and cultural movement beyond oil is still itself peripheral and appears limited. But perhaps this was because my own research was itself peripheral and limited. I began to recognize some limitations in my own research methods as examples. For instance, I was never able to access the industrial oil tank farm on Petrol Island. My time at the Copenhagen City and Port Development (By og Havn) archive was as close as I got to entering. My findings were also hindered by the fact that I do not communicate in fluent Danish. This meant a limited ability to examine historical documentation, conduct interviews, or to connect with a network of real-life actors. The result? A critical vagueness to the research and missing the 'word on the street' in terms of the actual future for Petrol Island.

Through analogue photographs, sketching, and theoretical research this thesis aimed to illuminate an invisible landscape for its remedial regenerative potential. Being an outsider in the community regarding creativity also presented me with a unique vantage point. I saw Petrol Island's potential without limits. I was void of pre-conceived notions or stories of the neighbourhood. I could craft a simple narrative about the place without the blinders of a lifetime of local urban memories. I was naïve to much of the cultural context and knowledge that depends upon growing up in a place, attending school, and everyday language. In hindsight this was both a limitation and a unique opportunity. I was driven to seek knowledge on my own. I was driven to contemplate Petrol Island as a foreigner, alone.

Getting to know the place on foot through this lens was greatly influential for imagining its transition. As a subject in my own experiment, I gained insight into design for the human scale. Along with this came a new aspect of care for non-human species and the community at large. However upon reflection, I discuss some major overarching questions that this thesis raises.

Firstly, there are practical issues in the design proposal. For example, more specific soil testing and analysis would be crucial to understanding the real contamination levels. Results may impact the phytoremediation strategy and alter the entire scheme.

In terms of the oil tank disassembly and reuse, does it have to be the whole island? Could not one adapted oil tank suffice as a landmark in a park, to demarcate the past presence of fossil fuels? With space as a precious commodity in the urban fabric, arguments could be made to better redevelop the Island as a residential area in the context of a housing shortage.

This leads me to note that the public programming of Petrol Island is intentionally vague. Are the remaining structures best used as concert halls, education centers and land-art? Or could they become climate refugee emergency housing instead? Tank Bank materials might better be used to build storm surge mitigation for rising sea-levels during climate change. The thesis proposal stops short here.

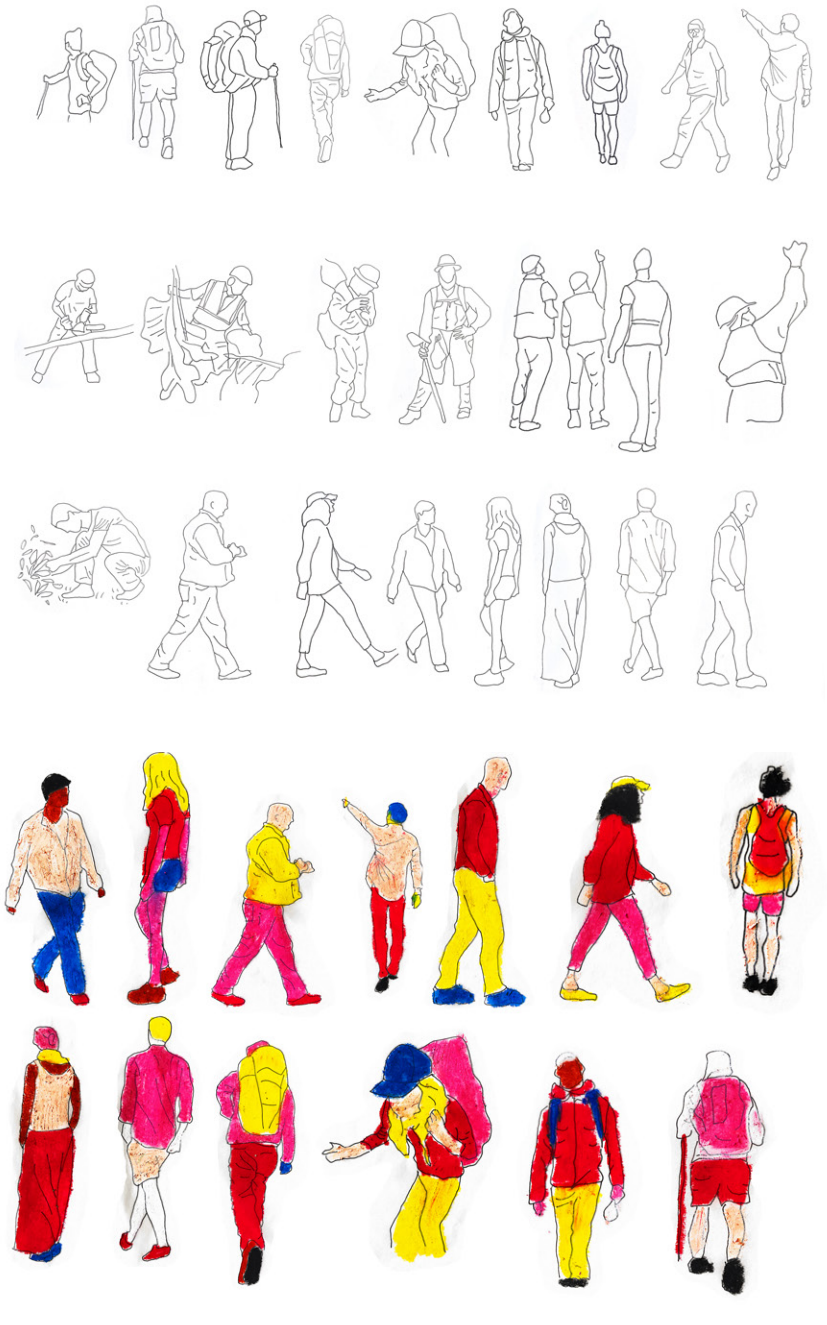
Other challenges arise in terms of societal implications. Would increased engagement with an oil space simply villainize one energy source while praising others? In this case, wind, solar and biomass etc. are implied to be 'good' energy. Villainizing oil may in fact contribute to the general alienation of energy spaces in the future, as each one turns from 'good' to 'bad' when technology evolves.

Furthermore, increased public interaction with an oil space might downplay the significance of environmental toxicity, desensitizing us to energy spaces and environmental disturbance. Could increased visibility of Petrol Island risk aestheticizing it by way of overcrowding, over-exposing, or trivializing its symbolic harm?

There is also a risk that exposing the shocking scale of energy spaces will push them further beyond the periphery of urban settlements. It should be noted that Petrol Island specifically may not be intentionally hidden; energy infrastructures are often out of sight at city edges, practically, to mitigate fire, explosion, and safety hazards for urban populations.

Finally, I return to the very first reason I began to study this landscape. I was seduced by the feeling of its wild, wide-open space. Feeling alone was the best part. Might the level of intervention I propose spoil the most desirable and authentic attraction of post-industrial spaces? Industrial urban outskirts often are, or feel abandoned, and crossing their barriers is precisely so seductive because it goes *against* authority, unscripted and unregulated.

All this being said, is it too little, too late? A slow, phased transition may be meek in the urgency of planetary climate crisis.



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