DESIGNING OUT A DEPENDENCY ON WASTE

AEB: “for a clean society, now and in the future”

RESEARCH PLAN

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Waste To Energy (WTE), overcapacity, transformation, closed-loop, waste management, circular economy, doughnut economy, Amsterdam Westpoort

Problem Statement

The Netherlands is considered a world leader in waste management, largely because of their **Waste-To-Energy (WTE)** infrastructures. These WTE plants convert non-recyclable materials into electricity and heat. This recovers around 50% of energy content, and represents one of the least effective **R-strategies** set out within a circular economy: recovery (Minguez et al, 2021). The country is home to 12 waste incineration plants, and these infrastructures represent the last part of the **"make-use-lose"** linear economic model.

Together, these plants have a capacity of over 8 megatons, and produce roughly 10% of the country's "renewable" energy. These plants need to run at near full capacity to be financially viable, but the Netherlands only produces 5.7 megatons of waste each year. To remediate this **overcapacity**, the incineration plants import about 1.5 megatones of combustible residual waste from other EU countries annually (van Santen & Kooiman, 2019). This means that we have a **dependency on waste**.

This dependency is becoming increasingly problematic. International goals to tackle climate change mean the trade of waste is becoming more heavily taxed, making it too expensive to continue to import. Although the Dutch population is expected to grow, domestic waste production is projected to decline (Houtkamer, 2019). National goals to half raw material use by 2030 and have a completely **circular economy by 2050** mean that the stream of combustible waste is expected to dwindle in coming years.

Population growth, urbanisation trends and a scarcity of space mean there is increasing pressure on areas surrounding cities to become liveable and accommodate a mixed program of functions. Industrial areas - where most WTE plants are located - are among these. Populations are concentrating in cities, and as a result, so are resources and waste (Cohen, 2015).

Amsterdam has more citizens than any other Dutch city, and it has chosen to respond to these increasing pressures by expanding the city towards the port, home to the country's largest WTE plant: **AEB Amsterdam**. The city has also been one of the first to incorporate circular economic principles into its policies, by incorporating Kate Raworth's *Doughnut model* into its municipal vision (Nugent, 2021). This model outlines a social foundation, as well as an environmental ceiling, and proposes that a thriving society will function in the "sweet spot" between these two boundaries (Raworth, 2017).

Although decentralization is often a tactic employed within circular economic models, the AEB is connected to a city-wide heat and energy network. Its role in heating and powering 35,000 homes within the city adds a layer of complication to its potential adaptation (AEB, 2021). These factors combined make it an ideal focal point for this project, with many scales of impact and potential intervention.

Objective

This project strives to create an exemplary approach to waste management infrastructures for the transition from linear to circular economic models in the Netherlands. It explores the role of architecture in maintaining and adding value in a transitioning system.

Within this transition, the concept of **waste** itself is likely to change. A circular economy strives to close loops - meaning waste is seen as a new starting point, rather than an end: as a **resource**. The design should take this into consideration, and place itself strategically within this context: ideally helping to redefine the concept of waste.

Programmatically the priority will remain waste (or end-of-life material resource) management. However it is likely that the process of future proofing and closing loops at the site will introduce new functions.

There is potential within this project to explore several research routes. Namely:

1. the transformation potential of the physical structure
2. the spatial and programmatic opportunities of the processes happening within the structure
3. the structure's energetic and thermal role within the city

Time limitations mean that priority will be placed on the second route. This is because it offers exploration within specific and realistic boundaries, while maintaining relevance at a larger scale. The other topics will be considered, but not as extensively.

Ultimately the project examines the potential of working within a real world time frame up to 2050 to transform an industrial icon of the old economy, into a future-proof, closed-loop city space that meets a new set of urban demands for the growing and evolving city of Amsterdam. This will mean the new structure should respond spatially and programmatically to its physical, social and temporal contexts, and perform within the *sweet spot* of the doughnut model.

The research itself should create guidelines for the design, and identify potential areas of intervention.

Overall design question

Which architectural interventions can facilitate the transformation of AEB Amsterdam into a future-proof closed-loop waste management facility that helps Amsterdam achieve it's doughnut economy municipal vision by 2050?

Sub-questions:

1. What does it mean to future-proof an industrial complex, and what is the role of architecture within this?
2. What does a closed-loop waste management facility look like, and what is the role of architecture within this?
3. How can we fit this transformation temporally into the specified timeframe?

Thematic Research Question

Which processes within AEB Amsterdam are most suitable for architectural adaptation to create a future-proof closed-loop waste management facility that helps Amsterdam achieve it's doughnut economy municipal vision by 2050?

Sub-questions:

1. What significance does AEB have for Amsterdam's *doughnut model*?
2. Can we develop an AEB specific *doughnut model*?
3. What are the processes taking place inside the WTE plant, how are they organised spatially, and what are their respective contributions to the *doughnut model*?
4. How are these processes expected to change in a closed-loop system?

Hypothesis

I expect the thematic research to reveal that AEB makes a significant negative contribution to the city's air pollution, ozone layer depletion, chemical pollution and climate change. As well as a positive contribution to energy, income & work and networks. I also expect it to reveal that the substitution of particular processes will push these indicators closer to the *sweet spot* in the doughnut. Although calculations will be somewhat speculative due to lack of data, use of the doughnut model and established indicators should make results measurable. I expect the design research to produce 3 separate design phases, each with a progressively mixed use program.

Methodologies

Material Flow Analysis (MFA) is an approach to study and quantify the flows of resources within an ecosystem. This will help gain an understanding of the processes in and around the

site, and their scale, by identifying and quantifying waste, heat and energy flows, which will be the centre of the design.

Literature review analysis of published literature will place the project within relevant academic context and recognise the state of the art.

Case study analysis will act as real-world referential points for the project. Exploring relevant existing examples will inform the project by acting as inspiration or warning against pitfalls. Case studies will not be limited to WTE plants, but also include adaptation of similar industrial infrastructures, such as coal power plants.

Mapping on various scales and topics allows an understanding of the site within a larger context. By highlighting particular aspects one at a time site specific qualities can be identified.

SWOT analysis will help to unveil potentials for the site by revealing strengths, weaknesses, opportunities and threats. This type of analysis can be combined with mapping for a spatial understanding of these aspects. This can help identify entry-points for intervention.

Site visits can inform the research and design processes by allowing a more intuitive understanding of the site, its zeitgeist, character and phenomenology. It is an important way to explore the human experience of the space, and can be combined with *sketching, writing* and *photography* to record and explore these qualities.

Interviews provide an important human aspect to the research. This is valuable as it can offer more down-to-earth, current and unexpected information than academic literature, and lead to gateways to intervention.

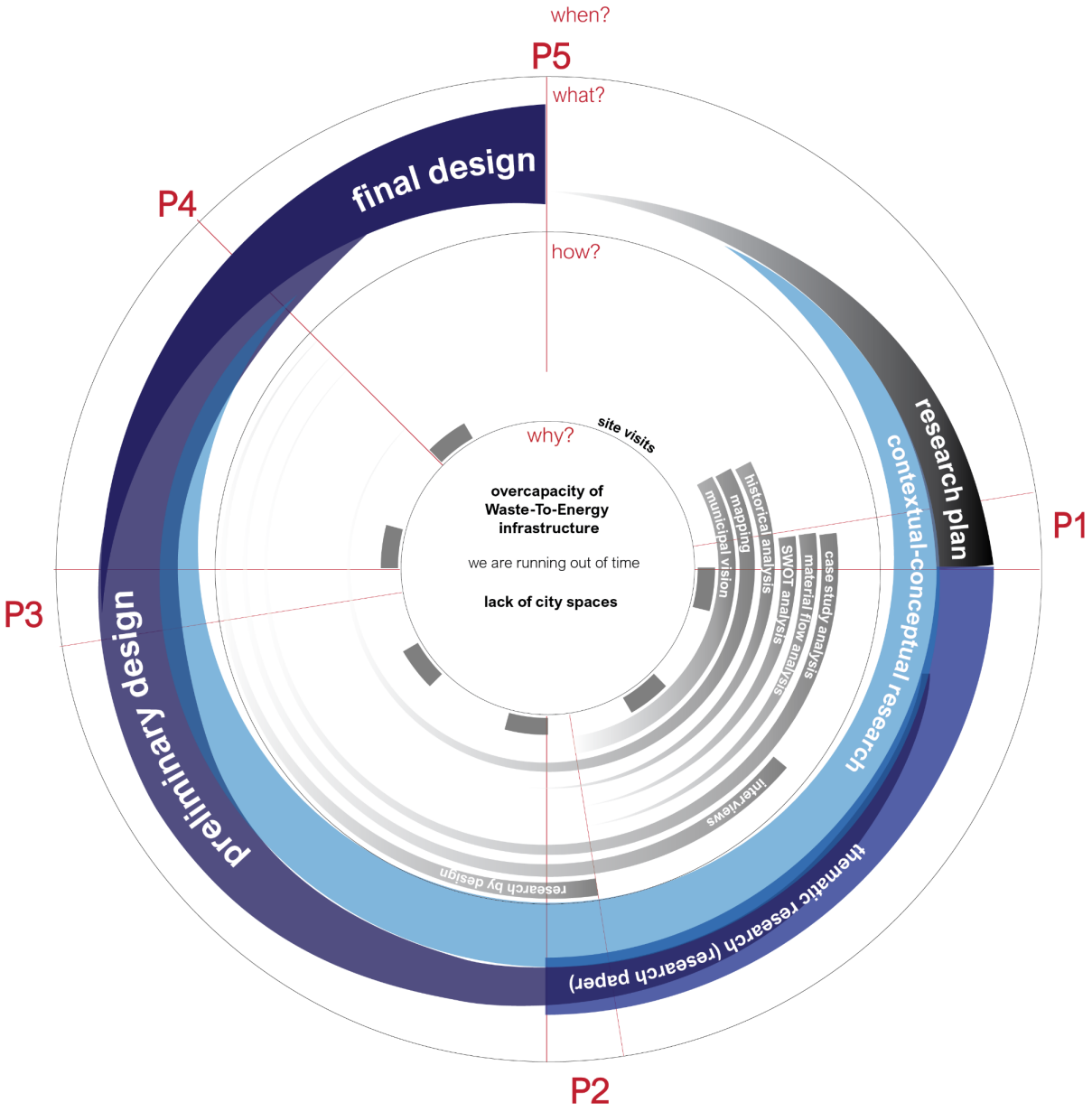
Historical analysis includes understanding the intentions and background of the site. This can help to form a narrative, which can inform design decisions and will be critical in identifying the monumental values of the site.

Municipal vision research enables the project to align or challenge larger external goals and visions for the area and city. Thereby creating opportunities to spark meaningful discussions with stakeholders.

Research by design includes exploring potential design options through conceptualization, drawings, maps, models and renders

	question	methodology	resources/references	pitfalls
Conceptual contextual research	*What does it mean to future-proof an industrial complex, and what is the role of architecture within this?*	Case study analysis, site visits, literature review, Research by design	Rotterdam former waste incinerator (Attractiepark Rotterdam), other	All of the built examples exist within the current linear economy
	What does a closed-loop waste/resource management system look like, and what is the role of architecture within this?	Case study analysis, site visits, literature review, research by design	Buiksloterham, Havenstad Amsterdam, other	All of the built examples exist within the current linear economy.
	How can we fit this transformation temporally into the specified timeframe?	Case study analysis, historical analysis, interviews, municipal vision	Previous student work: Darshik Parejiya, Tslil Strauss other	Financial and political complexities
Thematic research	*What significance does AEB have for Amsterdam's doughnut model?*	Literature review: municipal vision	Municipal documents (strategy, monitor, vision) National statistics	Subjectivity and immeasurability. oversimplification
	Can we develop an AEB specific doughnut model?	Literature review, interviews, SWOT analysis	Design for climate change Doughnut economics Municipal vision	Oversimplification and determinism: choosing to focus on specific aspects can skew the model
	What are the processes taking place inside the WTE plant, how are they organised spatially, and what are their contributions to the doughnut model?	**Material Flow Analysis (MFA),** site visits, Interviews, literature review	Contact persons at AEB: archives, site drawings? Online resources: AEB website, national statistics, Reference projects: Thermen Westpoort, Jeroen Atteveld Social media	Potentially biased sources: political agendas. ***Determinism: I need the end result to be an architectural intervention***
	How are these processes expected to change in a closed-loop system?	Literature review, interviews	municipal vision, doughnut economics,	Potentially biased sources, oversimplification, speculation

Planning



Relevance

The issue of overcapacity with regard to waste management is not isolated to the Netherlands. Other wealthy Western countries such as Sweden face similar problems, and WTE plants represent only a fraction of our industrial heritage (Bergman, 2019). The spatial legacy left behind by the industrial revolution offers a playground of opportunity. There are many industrial infrastructures which now face redundancy, such as coal power plants. The approach laid out within this project can be applied to a multitude of structures.

Architecture, as an intersectional and diverse discipline, is a field with great potential to tackle the complex problems associated with the transition to a circular economy. This is because

systems thinking is a central part of the new economic model, and architecture has the capacity to combine and create dialogue between many scales and disciplines simultaneously.

This project strives to be exemplary. The coming decades will be critical in determining how we respond to the threat of climate change and resource depletion. Transformative, innovative and regenerative architecture projects can offer inspiration for systemic transformation and pathways to a thriving planet and society. Overcoming the cultural, political and economic inertia which keep us in the old, linear way of doing things, will take many approaches from many angles. We are the last generation that still has the power to alter the course of climate change, and we are running out of time.

Positioning

Because this project strives to be exemplary, the role I am taking on as architect is that of a visionary and storyteller. Through this project I hope to inform and inspire industry leaders, policy-makers, and other members of society. Grounding my project within research and aligning it with regional and national goals will be critical in creating a convincing and relevant narrative.

Communication and audience will play significant roles in this process, which is why I have already contacted AEB Amsterdam and other relevant parties. Their inclusion in the process will not only be meaningful for the project, but critical in my understanding of my role as an architect.

This work positions itself within ongoing climate concerns, and embraces the circular and doughnut models as appropriate approaches to address these concerns. These models are in high acclaim, but have never been put into effect at such large scales, and unintended consequences are always a risk in these situations. In dealing with these approaches, I will need to be aware and cautious of pitfalls such as determinism and oversimplification in particular.

More specifically, the doughnut model already presents two dilemmas which will need to be navigated:

1. **Measuring the unmeasurable:** The doughnut model includes many subjective parameters, such as social equity and justice. How can we say we have succeeded in these areas, and who has the authority to say that?
2. **Apples and oranges:** with this model, stakeholder's set their own benchmarks and indicators. There are no universal units assigned to it, so no two doughnut models will be the same, or comparable to each other. Further, it includes all aspects into one convenient and simple model, but how can we give equal weight to subjective and objective aspects? It makes the system a question of priorities, that is easy to skew towards different agendas.

In this project, a lot of assumptions will need to be made in order to make design decisions. These assumptions can border on the utopian, but provide a framework to provoke further discussion. Many questions remain. Does our physical infrastructure really need to adapt to our economic systems? Do we consider this a new beginning or account for the immense carbon debt we have been building for decades? And the wealthy West's disproportionate contribution to resource depletion? What considerations can we make for the human condition: greed, competitiveness? Would a collection of perfectly circular economies no longer benefit from the unifying political complexities of economic interdependence?

Like many of today's designers, my priorities will be in line with global concerns for climate change. With growing awareness of our impact on our planet, we all have "skin in the game". We do not know if these approaches will work. All we do know is that the way we are doing things now will not be able to work for much longer.

Literature

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