



# The Metabolic Periphery

*towards socially, economically and ecologically productive operational  
landscapes in the periphery of Madrid*

*periphery - urban metabolism - unequal exchange - wasting practices - operational landscapes - capitalocene*

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*Natures were appropriated. Capital was accumulated.  
Wastes were dumped overboard.*

- Jason W. Moore



**Image**

Deviant Art. (2020)  
*A gravel pit hovers  
over a field of trees,  
symbolising the en-  
croachment of opera-  
tional landscapes into  
peripheral areas.*

# Problem Statement

Cities in the **Capitalocene** are defined by a globalised urban metabolism in which centralised urban areas, or zones of agglomeration and accumulation are reliant on peripheral zones of production, supply and disposal, covering the entire globe (Ibañez & Katsikis, 2014). These zones of production, supply and disposal, which facilitate the metabolic processes of urban settlements can be defined as **operational landscapes**. Although urban centres are intrinsically tied with such landscapes, they are often intangible in the mind of the average consumer of the city. That is because on a planetary scale they are scattered in the **global hinterland**, covering even the most remote locations imaginable, out of sight and detached from urban centres. On a regional scale; within the city and its surrounding territory, operational landscapes are typically located on the **periphery**, a zone in-between the centre and the hinterland, where materials and energy are stored and organised, and where operational practices take place on a smaller scale.

This linear metabolic arrangement and its spatial relations are evident in Madrid, where the operational components of the city's metabolism - those zones of production, supply and disposal - are relegated to its vast periphery, particularly in the southeastern region of the city. The location of operational landscapes in the southeast is not accidental, but it is rooted in the socio-economic landscape of the city. An invisible, but very real line can be drawn from the northwest to the southeast of Madrid, defining its social and economic inequality, underdevelopment and contamination. This line is tangible and recognised by Madrileños. Formed due to the historic, geographic, social, economic and political development of the city, the line has been termed the **diagonal de la segragacion**, or the 'diagonal of segregation' (Club de Debates Urbanos, 2018). The role of the southeastern periphery as Madrid's back-end operational landscape, supplying the city's metabolism, has contributed to its underdevelopment, and while the financially driven centre benefits from the operative performance of its periphery, the periphery suffers socially, economically and ecologically. This creates an **unequal exchange** in the city, where the wealthy, financialised centre benefits from a metabolic process that relies on systems of degradation in its periphery.

## Capitalocene

The Capitalocene challenges the generalised view of man vs. nature offered by the Anthropocene in climate politics, instead defining capitalism as the central force behind humanity's organisation of nature and its associated negative implications.

## *diagonal de la segragacion*

a non-physical diagonal line can be drawn from the northwest to the southeast of Madrid along which people are organised in terms of wealth and opportunity, with the southeast being the poorest region of the city.

## unequal exchange

places of supply, production and disposal in the periphery perform an unequal social, ecological and economic exchange between the centre.



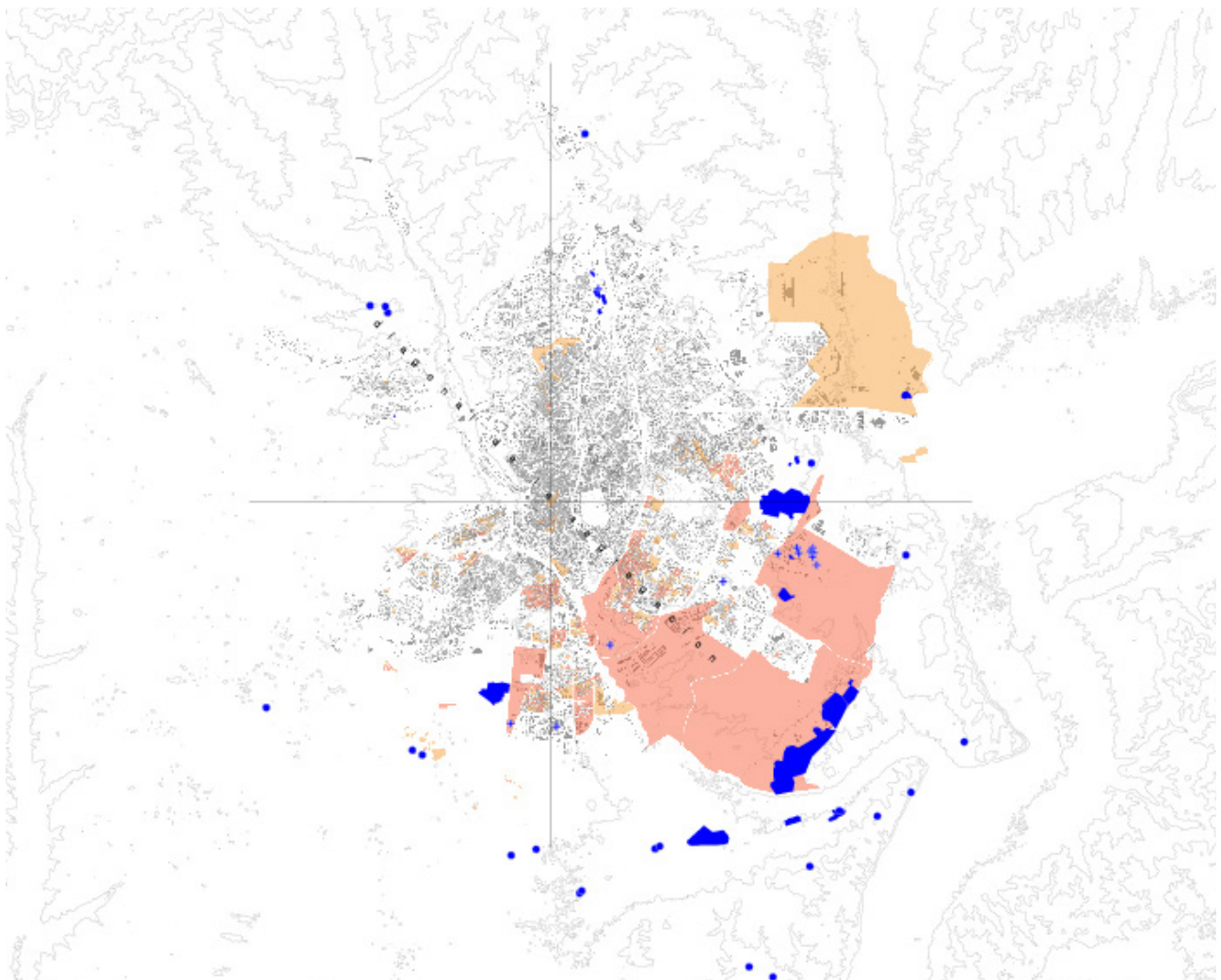
### Drosscapes

Vast, wasteful and wasting landscapes produced by urban areas.

### Image

Map of Madrid overlapping the lowest income neighborhoods in the city (red and orange) with operational landscapes (blue). The north-south and east-west axis intersect at the Puerta del Sol.

The re-evaluation of the city's metabolism, and its entrenched systems of unequal exchange is critical in the face of the massive urban transformation that will take place in the periphery in the near future. These projects include the Nuevo Norte project, the Madrid Metropolitan Forest and the suburban expansion project in the south. This region is therefore an opportunity zone, where a change in the metabolic processes associated with continued urban growth can be instated, moving away from wasteful practices of growth. The wasteful practices associated with the city's metabolism has created an assembly of **drosscapes** in the periphery. Coined by Alan Berger, drosscapes are wasteful and wasting landscapes which contribute towards and are created from the ecologically unsustainable metabolic model of the city (Berger, 2006). If the urban expansion of Madrid continues using the same metabolic model, the city will continue creating more drosscapes, unequal exchanges and degradation in peripheral areas.



The image below depicts a former concrete factory in Vicálvaro (a district in the southeast of Madrid) being torn down, to be replaced by housing blocks similar to those in the foreground. In the image one can observe several wasteful practices associated with Madrid's urban growth, and its embedded systems of unequal social, economic and ecological exchange:

1. The contamination the factory caused to its surrounding residential areas during its operation, for the benefit of places of accumulation in the centre.
2. The demolished material, which was sent to a landfill or recycled, the process of which requires further infrastructure and operational landscapes.
3. The continued reliance on peripheral places of supply and production needed to construct its replacement from scratch, which will contribute towards further reliance on contaminating processes in the new periphery and the hinterland.
4. The new construction itself, composed of commodified housing blocks, built to generate capital, but socially and ecologically unproductive for the community.

**Image**

Demolition of a concrete factory in Vicálvaro, replaced by housing. Robert Royal (1998-2001)



Unless the city's metabolism and the methods of its urban expansion are reconsidered, these wasteful and unequal practices will continue to take place, leading to the continuation of systems of contamination in the expanding periphery and hinterland. This problematisation led me to formulate my primary research question, which asks:

**What if the existing metabolic processes of supply, production and disposal in Madrid's periphery could be rethought, and a socially, economically and ecologically productive process could be instated for peripheral communities?**

Research Question

Several operational and sub-operational questions emerged from this research question:

- What communities are most negatively affected by unequal metabolic exchanges in the city?  
*How do operational landscapes negatively affect the quality of life of communities that live in proximity to them?*  
*Where are the places of greatest social, ecological and economic inequality?*
- How does the metabolic system in Madrid's periphery work in terms of the flow of goods, people, energy, waste, food and water?  
*What are the wasted by-products of operational landscapes in Madrid's periphery?*  
*What are the systems of contamination produced by operational landscapes?*
- What strategies may be implemented to 'scape' (metaphorically resurface) the dross (wasteful and wasting zones) to prevent further wasteful practices?  
*What strategies may be implemented to rethink the periphery's metabolism?*  
*How can operative landscapes become socially, economically and ecologically productive?*
- How has Madrid's urban metabolism shaped the urban development of its periphery?  
*How have operational and accumulative landscapes transformed over time and in relation to each other?*



# Theoretical Framework

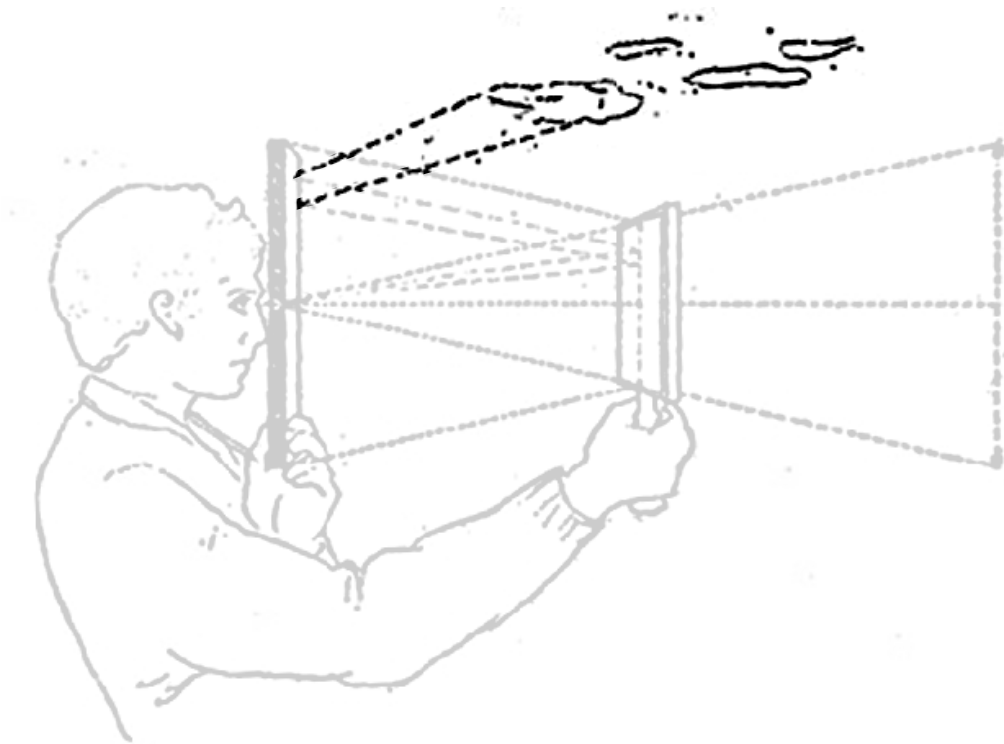
The metabolic process of the city, defined by central consumption and enabled by zones of supply, production and disposal extends far beyond the urban centre, into peripheral areas on a regional scale, and to the most remote locations in the hinterland on a global scale. In the **Capitalocene**, this global metabolic system is defined by an era in which the earth itself is commodified, and in which nature is organised by capitalist processes (Moore, 2015). Peripheral operational landscapes supply urban centres through a complex network of infrastructure and human labour. Cities are reliant on these operational landscapes, located in the global hinterland to supply them with the material that creates urban agglomerations of capital. As natural landscapes are transformed into raw materials, which become commodified products, the rift between the consumer and the process of production widens. However, materials should not be viewed as fixed commodities, but as objects continuous from the landscapes they originate from, and although these landscapes may seem distant, urban centres and peripheral operational landscapes are intrinsically linked territories socially, ecologically, economically and politically (Ibañez & Katsikis, 2014).

However, these two territories do not mutually benefit from their exchange of resources, creating an unequal exchange. Jane Hutton emphasises this point in *'Reciprocal Landscapes: Stories of Material Movement'*, where she discusses the relationship between urban centres and the distant territories that feed them (Hutton, 2019). While cities benefit from the accumulation of capital, operational landscapes often suffer from contamination and systemic **underdevelopment**. Furthermore, these areas also suffer on the market, as produced, finished products tend to be priced disproportionately higher than the raw material, and extractive economies decrease in power over time, while core industrial economies increase in power (Hutton, 2019). In *'Unless: The Seagram Building Construction Ecology'*, Kiel Moe discusses similar issues of unequal exchange, where he draws resonant examples of the unequal exchanges between urban accumulative centres and operative landscapes by describing the construction ecology of the Seagram Building. He frames the Seagram building as a manifestation of capitalist ideals; a representation of wealth and

## Stephen Bunker's Theory of Underdevelopment

Extractive peripheral areas are structurally underdeveloped over time through the processes of extraction and unequal exchange. They typically become poorer over time, and they do not have the means to rehabilitate their environment, while wealth is concentrated in central urban agglomerations. (Bunker, 1985)

power, sited in the centre of Midtown Manhattan; “a trophy”. This description is then juxtaposed with the “atrophy” it causes in the operational landscapes that supplied it, such as the Chuquicamata copper mine in Chile, and a glass factory in the small town of Butler, Pennsylvania that went out of business shortly after the Seagram Building’s construction, leading to social, ecological and economic degradation which disproportionately affected vulnerable members of society (Moe, 2021).



#### Image

An edited illustration of Brunelleschi's perspective experiment. While the sky and clouds above the human figure supply the light for the scene, they are out of sight in an orthographic perspective. Similarly, operational landscapes that supply resources for the city, they are out of sight in the object-oriented viewing of the city.

In Madrid, a social, economic and ecologically unequal exchange in the city's metabolism may be observed particularly in the southeastern periphery of the city, where the contaminating metabolic processes of the city tend to be located.

*The southern districts are defined as isolated spaces, functionally specialised in housing heavy, harmful, unhealthy or dangerous industry, with severe environmental deficiencies, deficits in facilities of all kinds (transport, schools, health centres, green areas, cultural facilities...) and with the presence of large infrastructures that fracture it and degrade the living conditions of its inhabitants. The southern districts socially exemplify discrimination and an absolute dependence on centrality. (Club de Debates Urbanos, 2018)*



Polluting infrastructure is not located in low-income neighbourhoods accidentally, but strategically. In '**Discard Studies** : Wasting, Systems and Power' Lepawsky and Liboiron argue for a framework where material waste is not the main object of study, instead investigating broader systems of waste and wasting.

*The broad and systematic approach to how some materials, practices, regions and people are valued and devalued, become disposable or dominant, is at the heart of discard studies.*  
(Liboiron & Lepawsky, 2022)

#### **Discard Studies**

A framework for the analysis of wasting and wasteful practices as social, economic and political issues pertaining to systems of power.

Through the process of the city's development, Madrid's periphery has been systematically devalued and discarded by the powers of the city. The southeastern periphery especially may be described as a patchwork of **drosscapes** (Berger, 2006). The region is filled with such sites, including operational landscapes, unused land, socially and ecologically unproductive developments, and areas which promote wasteful lifestyles. However, the term 'drosscapes' may also be interpreted to carry with it certain positive implications for the future of these sites, as it suggests that landscapes of dross may be 'scaped' or resurfaced to become productive. This research aims to conceptually resurface the dross in Madrid's periphery. As a place in flux, the periphery offers an opportunity area where a systematic change to the city's metabolism can take place, turning wasteful, contaminating landscapes at the less favourable end of an unequal exchange into socially and ecologically productive places.



# Methodological Framework

A speculative research question led to the formulation of several operational questions, which attempt to gather information on the three main themes of my research: **urban metabolism, unequal exchange and wasting practices**. Several methods will be applied to each of the operational questions which include a combination of quantitative, qualitative and mixed methods. The combination of such methods will allow for the triangulation and verification of findings, thus improving the accuracy of my research. The methods used may be organised into four sections, due to their similarity and overlap:

## *Primary and Secondary Literature*

Primary literature was used to channel my initial fascination presented at the start of the graduation studio into the current problem statement and research questions. Primary literature will continuously be referred to throughout the research to ground it within contemporary discourse, while secondary sources such as scientific articles, blogs and news articles will be used to situate these issues in Madrid, informing an understanding of the symptoms that emerge from the problematisation. Although news articles and other secondary sources may have certain biases, I aim to mitigate the limitations of such biases by covering a variety of sources, thus diversifying the information gathered.

## *Mapping and Historical Analysis*

By mapping issues in the city, I would like to spatialise them, defining critical areas to investigate further, eventually landing on a strategic location to intervene on for the design project. A historical analysis of the city's development will be important in projecting its development into the future, and in informing potential strategies which may be taken to prevent the proliferation of issues. The use of geographic information system (GIS) data will be critical in spatialising these issues. Government data sources such as those from the Community of Madrid and the National Statistics Office (INE) will be especially useful in mapping.

### Substance Flow Analysis

A quantitative method used to analyse the flow and stock of materials within a system.

### Actor Network Theory

A framework developed by Bruno Latour used to analyse social associations or networks. (Latour, 2005)

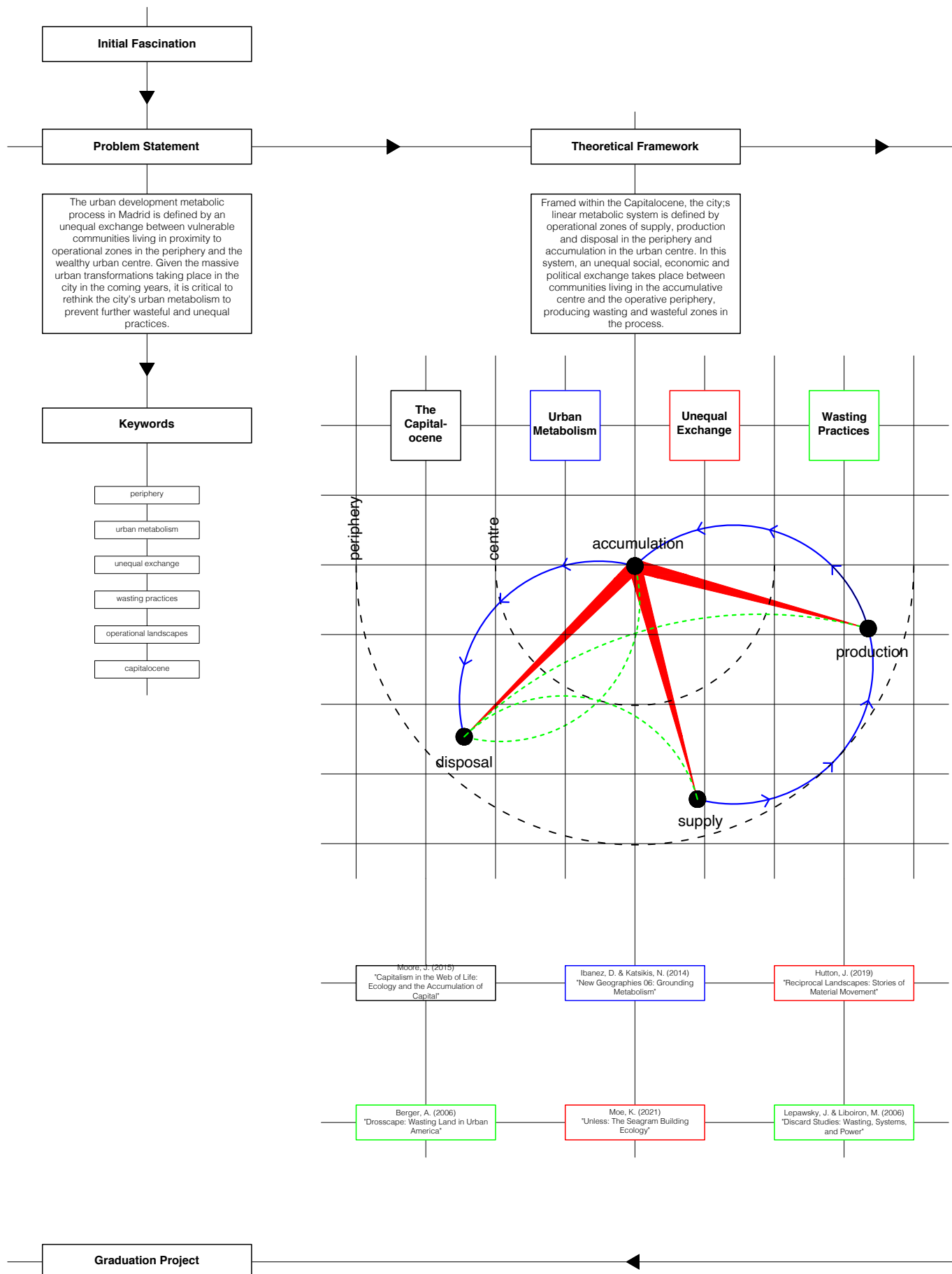
## *Substance Flow Analysis and Actor Network Analysis*

To analyse the urban metabolism in Madrid's periphery I will employ **substance flow analysis** (SFA) to quantify the material inputs and outputs of operational landscapes and gain an understanding of the untapped byproducts created by the industry in the region. By analysing the flows of goods, people, energy, waste, food and water I would like to gain an overview of the urban metabolism of the region. Although some degree of assumptions may need to be made for this type of analysis, I hope to maintain accuracy by referring to typical values using secondary sources.

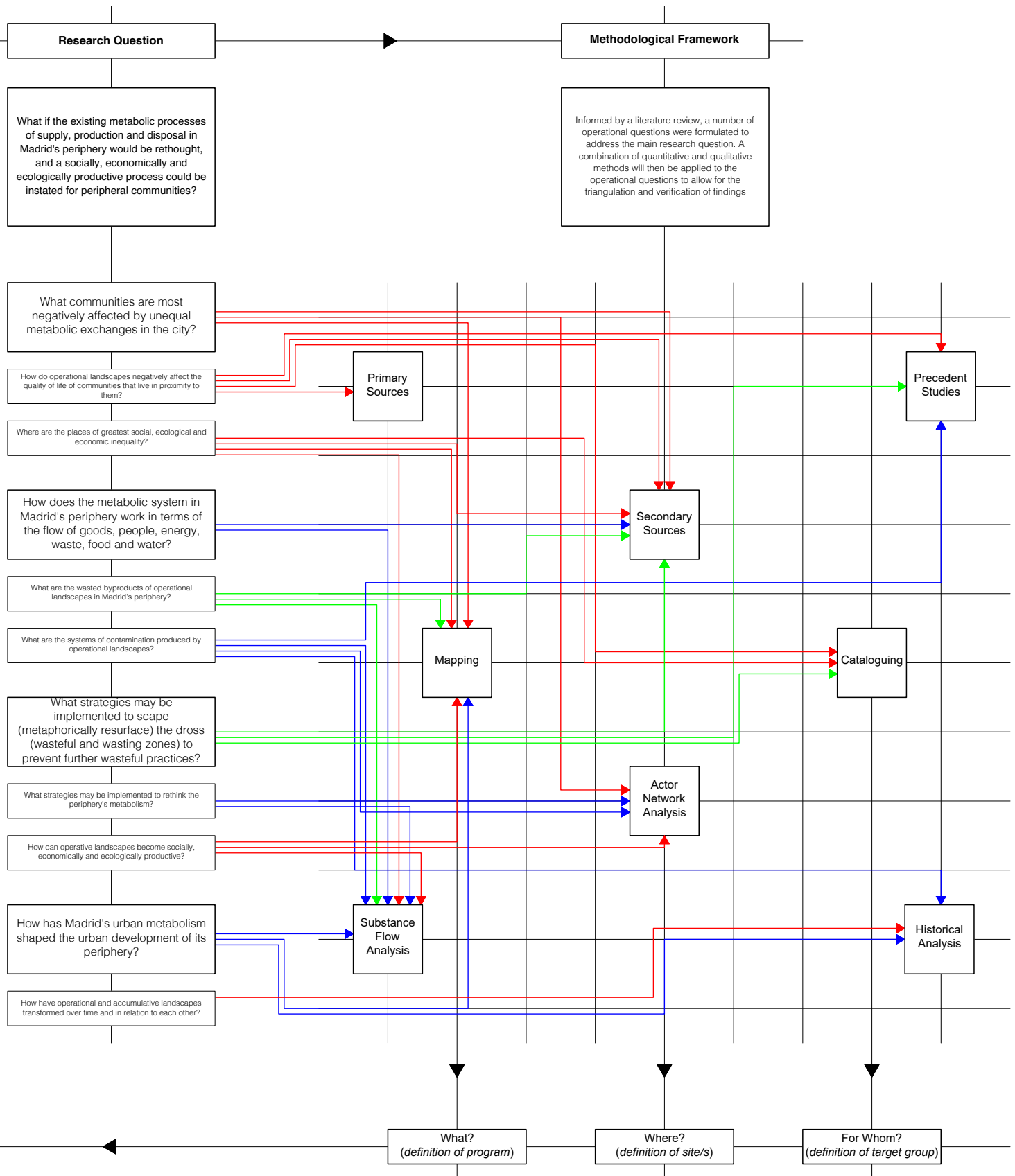
**Actor network theory** (ANT) will then be used to understand the relation between the metabolism of the region and the actors and agents who may enact a change within it.

## *Cataloguing and Precedent Studies*

Cataloguing methods will be applied to findings made during the fieldwork, where critical neighbourhoods identified through mapping and secondary sources will be visited. By making a catalogue of drosscapes, operational landscapes and the systems of contamination and unequal exchange in the periphery, I will understand how issues of unequal exchange and wasteful practices issues manifest physically. For example, to understand how operational landscapes create socially unproductive spaces, I would like to document the ways these places create conditions of inaccessibility, contamination and noise for surrounding communities. Precedent studies which address the themes of urban metabolism, unequal exchange and wasting practices will then be used to inform strategies that I may take in approaching the design project.







## Argument on Relevance

Madrid's urban growth has been defined by a metabolic rift between the urban centre and its peripheral territories, resulting in an unequal social, economic and ecological exchange between these two reciprocal landscapes. While Madrid's urban centre is a place of accumulation, with an ambition to define itself as a financial hub in the country, and where operational landscapes are obscured, peripheral communities suffer from living in proximity to contaminating industries such as the landfills, where methane leaks have been seen drifting over surrounding residential areas (The European Space Agency, 2021). In the face of the massive urban transformations planned to take place in Madrid, it is critical to study the city's metabolism to improve the way that it consumes the resources which drive its growth. The periphery emerges as a key opportunity area where a systematic change may be enacted. Unlike the centre, the periphery is unencumbered by a dense and historic urban fabric, and its vast infrastructures and industries have the potential to be tapped into. By harnessing the byproducts of peripheral industries to generate something productive for their surrounding communities, waste generation may be mitigated and social, economic and ecological inequalities between the centre and the periphery may be reduced.

Research into urban metabolism, unequal exchanges and wasting practices holds significant relevance in the contemporary field of architecture. By engaging with the metabolic processes that underpin the profession, architects can redefine the scope of the practice, particularly in addressing the unequal exchange between centres of accumulation and the peripheral areas that supply them. Pre-Columbian settlements in the Amazon provide an inspiring example of how human habitation can integrate seamlessly with its surrounding metabolic processes, as these settlements left no visible traces of human impact and were only identified in the 1980s when a geographer observed geometric cuts into the earth from a flight over the Amazon (Tavares, 2016).

Contemporary architects such as Kiel Moe and Gilles Perraudin are rethinking the processes of extraction that feed their projects, designing socially and ecologically productive processes that

counteract the typical patterns of unequal exchange. For instance, Kiel Moe, who uses timber in many of his projects due to the location of his practice, aims to design extraction processes that enhance the biodiversity of the forests he sources timber from rather than wrecking it. Similarly, Gilles Perraudin, who makes extensive use of stone in his work, develops parks in towns adjacent to the quarries he uses, thus offering a socially and ecologically productive place for that community (Moe, *The Berlage Sessions: "On Ecology"* by Kiel Moe, 2022). A striking example of ecologically productive extraction may also be seen in the image below, where timber was extracted by cutting trees in different shapes, as part of an experiment to test which shape allows for optimal sunlight penetration into the forest floor, thus attempting to enhance the peripheral landscape through an operational process (Manaugh, 2017).

#### Image

Satellite image of an experiment which involved cutting trees in a forest on the Arkansas/Missouri border in various shapes to study which one had the most effective exposure to sunlight. This is a sensitive example of an extractive process that may actually stimulate forest recovery. (Manaugh, 2017)

By conducting this research, I hope to gain an understanding of the strategies that can be employed in the city to mitigate unequal social, economic and ecological exchanges between centres and peripheries, offering a productive process for all actors involved. I hope that this will inform the way that I practice as an architect in the future, in whatever way possible. A change in the way materials are specified in a built project, for instance, can have an impact on whether it contributes to the continuation of unequal practices.



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