The green transition in a hybrid totality

Heterodox views on the zero-emission prospect

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Produksjonen og reproduksjonen av produksjonens vilkår var betinget min mor og far.

0.1. Abstract

The thesis takes as research objective the prospect of a pathway to a zero-emission economy in the climate transition literature, coined the Transition Question. It is posited that the prescriptive politics for the climate transition within the orthodox approaches is inadequate. *Part I* displays a historical survey of the fields Marxism and ecological economics that supports the notion that a heterodox alternative can be found in combination of these approaches. Taking on the heterodox counterpart to the literature that guides current policies, the thesis undertakes a systematic literature search which inquiries to the prospect of transitioning. Severe deficits in literature that try to ground the discrepancy between trajectory and destination are identified. Analytics that account for global dynamics are similarly missing. Most sampled literature rejects the project of green growth and tendentially defers to the alternative transition project of degrowth. Advancing from a width study to a depth study in *Part II*, the thesis analyses the sampled literature through the methods of immanent critique and systematic dialectic. This approach critiques and reconstructs the arguments in the literature in a double movement. It is found that heterodox literature fails to falsify green growth, but the current paradigm remains a low-confidence prospect. The Transition Question is then expressed in the theoretical hypothesis of a hybrid totality. The hybrid totality emerges as the conclusion of the systematic dialectic grounding the research objective and completing the literature analysis. The act of planting seeds for climate imaginations that compliments the present critique is lastly undertaken.

Keywords: climate debate, systematic literature search, ecological Marxism, ecological economics, systematic dialectic, world-ecology, metabolic rift

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I

Encounter

1. Research in a time of change

The Leviathan is coming. The current mitigation effort appears increasingly lacking with the passing of each day. In this thesis we shall explore alternative ways of thinking about the climate crisis and the prospect of commandeering a path to the zero-emission economy. I shall attempt to explain why the current project of green transition is failing. The thesis will further argue reasons the theoretical research program supporting climate governance is faulty. I pose that the literature concerning the green transition follows two major modes. Orthodox literature following the methods premised on the marginalist revolution guides the theoretical-political research program and political paradigm of green growth. A heterodox mode of materialist analyses is reserved for wayside critics. We shall voyage the heterodox literature in the hope that it can guide new ways of approaching the problem of the great green climate transition.

The current paradigm is supported by research identifying present and future decoupling between emissions and economic growth on national and spatially restricted scales. This approach fundamentally does not account for the problem that emissions are embedded in global production networks. Nor is it attuned to the objection that the trajectory of decoupling might not point to a decarbonized economy, but to a green optimum in the consolidated fossil-industrial Technosphere. Imbued with a distrust of the hegemonic mode of apprehending the green agenda, this thesis seeks to establish the prospect of undertaking the green transition by the perspectives of alternative sources. This road takes us to literature studies in width and depth. This path provides the present effort with a prognosis of the current state of the transition and its supporting research efforts. The analytic design following the literature research will then undertake the dual movement of assessing the strength of the literature while developing a theoretical hypothesis of the climate crisis from which solutions to the green transition predicament can sprout.

1.1. Transition Question

This is an effort undertaken in a program of geographies of sustainable development. I will swiftly identify development with the current trajectory of the economy and the perpetuation of the climate crisis. The present thesis is firmly grounded in the critique of development. I am one of "those malcontent with development (Cowen & Shenton, 1996, p. 423)." However, in accepting the presently cited champions of development, the aim of this thesis is not to take

stand in a one-sided rejection of development but to desire the term reinterpreted in service of the climate transition objective. While post-development in geography tend to concern critique of the paradigmatic models of development for societies outside the heartlands of the industrial revolution (Dunlap et al., 2021, p. 8), the thesis is rather interested in an alternative mode of development that might produce a pathway to the zero-emission economy. The rejection of the development term is not of importance here, but I do share criticisms of the traditional models of development throughout the thesis. The determinism of productive force development in Marxism is thusly assessed. The critique that traditional sociology of environmental modernization failed in favor of red-green perspectives is therefore also followed (White et al., 2016, p. 110).

The question of a green development that will produce a zero-emission economy is one of the great problems of our times. Following the Marxist tradition, I propose that this research theme should be coined akin to the great research problems in formative social theory. The climate transition problem is the 'Transition Question' (TQ). The research objective of this thesis *is* the Transition Question. This is not pursued as the development of an alternative economic system with claims to a decarbonized future. It is rather the inquiry whether this green development indeed is tenable in current literature on the green transition. From the present effort it is hoped that a refoundation of green development can begin to grow.

The criticism of the current green growth project comes from empirical assessments of its trajectory. The project hinges on the concept of a decoupling of emissions from the metrics of economic growth. However, current research indicates that emission-economy decoupling is not a robust theory (Haberl et al., 2020; Hickel & Kallis, 2020; Parriqué et al., 2019; Vadén et al., 2020). The debate operates with a distinction between the terms relative- and absolute decoupling. The former points to a divergence between linear metrics. The latter points to the real decrease of greenhouse gas (GHG) emissions while the economy grows. As the context is a growth economy and the objective reaching zero-emissions, only absolute decoupling is adequate. While the present literature observes plenty of cases of relative decoupling, cases of absolute decoupling are more contentious. There are countries where absolute decoupling trajectories are found. However, a scope restricted to national emissions data is not adequate when emissions are a global concern. The problem with decoupling is most pressing on heightened geographical scales. On a planetary level the green growth prospect is highly discredited. The current volume of research that targets absolute decoupling on national or

regional scales thus faces the problem of reconciling the planetary assessments (Vezzoni, 2023). Red-green perspectives are thus important to integrate in the conversation over the green pathway. Radical critics find the preoccupation with glacial reforms supported by macroeconomic prognosis a feature of post-politicized normative imagination or a 'fetishistic disavowal' of the potentially gargantuan embedded materiality that constitutes the problem (Swyngedouw, 2024).

It is further seen that the decoupling literature face problems even internal to the conceptual flaw of spatial scale. Macroeconomics supporting green growth tendentially have one-sided demand-driven models (Jacques et al., 2023). This clashes with alternative perspectives where the supply-side is the economic motor. The presently cited review article even reveals that the major studies fail to account for roughly half the factors the authors consider important. Moreover, only three out of those 20 studies account for planetary dynamics. As of 2019, only "a couple studies" accounts for global dynamics (Distelkamp & Meyer, 2019). This problem compels a theoretical investigation into the climate transition literature. The current political consensus of green growth rests on a technical feasibility literature, a blue literature that relies on national accounts for decoupling. These approaches generally correspond to the methodological paradigm following marginalist economics. It is in the divergent approaches outside this research approach and policy paradigm, in Lakatos' meaning of the term (Lakatos, 1976), that this thesis turns.

1.2. Objective

By investigating the heterodox literature that engages with the problem of the precise pathway to a zero-emission economy, this thesis inquires if we can reach decarbonization under the current paradigm of green growth. The literature relevant to this research question conjoins this problem with various perspectives on the requirements to reach the zero-emission benchmark. As such, the research of this thesis is about the prospect of green capitalism, but this is read in critical perspectives where requirements to the transition are found inside or outside this paradigm and grounded through different theories of the crisis. Theoretical positions underpinning any opinion on the TQ thus become crucial to research in this context. The thesis will therefore ground the climate theory in pursuit of the research question. This objective then advances to a dual movement of critique and reconstruction of the theory of the climate crisis. Therein is the prospect and possibility of the green transition firmly grounded.

The thesis project follows the above reasoning to investigate specifically the heterodox literature. This literature research is designed as a study in width and in depth. The former is a systematic literature search with a corresponding analysis. For the latter, a research design is implemented to abstract a sample from the recent literature which produces an assessment of the TQ that should complement the current orthodox literature in the total sum of the research prescribing the climate transition.

We will find that heterodox literature generates emergent properties that bypass the concrete research question (RQ). These dynamics are a generative moment that comes though the inductive element in the research design. Evaluating these dynamics contributes to the research in the sense that overstepping the RQ helps to assess the RQ itself. This research follows a tradition that does not shy away from the Hegelian adage that concrete knowledge is the unity of identity and non-identity. The depth study takes the sample to a literature analysis that develops a precise assessment of the TQ through the development of a novel theory of the climate crisis. This is an effort consistent with the emergent properties of the literature search. It is indeed the search that constitutes the theory. A presentation of the theoretical effort undertaken follows.

1.3. Positioning

The green imperative is shaping geography (Zimmerer, 2017), where interdisciplinary efforts have long been called for (Barnes & Sheppard, 2009; Matthews & Herbert, 2008, p. 260). By widening the lens across disciplines, I aim to gather insights with which to develop this project. Whereas macroeconomic prognoses of the climate transition are stuck with the abovementioned dilemmas, classical ecological economics have reshaped into a new current of social critique that prescribes a radically different pathway to the green economy. This is the current of degrowth, a community that rejects the green growth paradigm chiefly through planetary emission data (Kallis et al., 2018). However, should such data change, the prescriptive foundation of degrowth is challenged. Grasping a theory that inquires why we face the climate problem, rather than remarking that we indeed incur global warming, is thus necessary. The tradition that offers robust explanations of the logic of the emission-system comes to the fore. Thus, the ecologically attuned strain of Marxism is of great importance for our research theme. On one hand, scholars in the Marxist tradition tended to stay preoccupied with the Marxological theory of metabolism. This approach is based on philological

excavations of the subliminal ecological theory within Karl Marx' mature framework (Foster, 2000). Such theories have produced a discourse through the idea of ecological degradation taking form as a rift between capitalist processes and biospheric processes. Moreover, this approach might be too limited to help progress the climate transition research because further engagements have tended to shift into other traditions of metabolism (Newell & Cousins, 2015). On the other hand, there is a broad usage of social metabolism and degrowth where the oeuvre of Joan Martinez-Alier is influential (Engler et al., 2024). The problem here is translating applied studies and empirically grounded assessments of the TQ to a framework that can *explain* the climate crisis. An objective then emerges of finding an approach that is open-ended and enables dynamism that can progress the field. The heterogeneous red-green research literature is not situated at an adequate level of abstraction. Further, rather than following philological excavations of Marx' metabolic theory, a generative approach to developing an adequate climate theory must look elsewhere.

In the age of the end of history (Fukuyama, 1989), at the eclipse of Marxism as a relevant research program, an effort was made to reinvigorate Marxian social theory for this new age (O'Kane, 2018). Moishe Postone, with *Time labor and social domination* (Postone, 1993) endeavored to propose a new reading of Marx' mature critical theory. For Postone, Marx' analysis, with polarized classes under increasing industrialized production, has become inadequate to grasp the essence of society in the new age. A more adequate critical theory in this context seeks to capture what is implied as the key constituent moment of this age, the shifting experiences of social time. Akin to that which David Harvey sees as postmodernity's production of fractured, kaleidoscopic, and disorienting spatio-temporalities (Castree, 1992), the objective became a reinterpretation of Marx that could consistently ground the perception of temporal fragmentation that Harvey dubs the 'annihilation of space by time.' The time of publishing was in the decades succeeding the ecopolitical revolution of the western societies which circumscribes Postone's argument. This was also concurrent with a renaissance of ecologically engaged Marxist theory (Heron, 2021). However, instead of integrating green themes in the effort, Postone developed a theory of abstract, social times, ultimately implying a normative call to abolish abstract times.

While not following the distance of Postone, the turn toward spatial phenomenology would become a key debate in geography. David Harvey and Neil Smith would pivot to the idea of produced space drawing from Henry Lefebvre and Marx. A theme in radical geography

developed from this to consider geographical concepts as produced by social processes. I will mention this during the survey in the next chapter. Here emerged a mainstay in geography where the earth-system is understood as reshaped or produced by capital. A global analysis of the planetary emissions networks thus continues a current of radical geography that mediates between spatial concepts and social processes. While the development of the concepts in eco-Marxism could be understood as environmental sociology, the processes and spatial scopes that are the key concern in this thesis is buoyantly geographical.

The theoretical shifts in geography and the reconstruction based on new readings of Marx attempted to reinvigorate critical perspectives in a time of radically changing objectives, but the present day demands a climate theory adequate for our problems. This must be one which centers the climate crisis rather than following Postone's lofty abstractions in temporality. However, following Postone's project with a green lens could have similarly generative results. Such an approach is based on a reinterpretation and restructuring of Marx' presentation in *Capital,* containing a critique of political economy analyzed as a dialectical totality. Such a totality is the sum of the conceptual system we use when thinking in a specific context. This intellectual horizon is furthermore dialectic because we highlight the processual nature and inter-relatedness of our concepts, continuing the abovementioned principles in radical geography. For the present purpose, a totality must be restructured to be grounded in our planetary ecology. Thus, the conceptual apparatus at work is one which looks at the whole earth-system and the social dynamics therein, and how this multitude is connected by the dynamics between it all. Such an effort is shaped for the factual requirements of grasping a GHG emission problem that is equal to the whole earth-system. The scope is not daunting, it is the needed one. Through these premises we can fashion a generative critique adequate for a society attempting to produce a sustainable transition towards zero GHG emissions.

1.4. Problems

Mine is a thesis of width. My statement is that width begets depth, and I contend that I demonstrate this in the concluding chapters. Climate transition science is one of brevity and so it needs to be. Multicausal emission reduction forecasting alone does not cover all dynamics surrounding GHG emissions. We should therefore investigate other perspectives too. It does appear that the thesis makes a great leap backwards in its affinity for mid-century Marxism and ecological thinking. Against this I will translate a point from Ståle Holgerson:

“ecological crises are High modernist (Holgersen, 2022, p. 285).” Even the most scholastically profane positivism is more instructive for the normative prescriptions of a drowning island community than the immanent meta-observations in the cultural turn. Additionally, the depth study rests on the premise that the abstraction from the heterodox literature to our sample is valid. If this assumption fails then the depth analysis amounts to one interpretation of the climate crisis which, if strictly non-representational, will hopefully prove gainful on its own accord.

The final point is this section is a mere note on the writing. I tend to italicize key points in text. “We” signals the reader where to think. The textual development is in present tense, while summaries of what we cover is in past tense. However, the latter might mix with references to ideas which are mentioned in present tense as I don’t like to signal outdatedness on behalf of the authors engaged with. This contributes to certain pages having a feeling of grammatical slide, but such is the presentation I find most apt. Readers may also notice uses of references from geography course literature. The low-confidence references (Dunlap et al., 2021) and (Purdy 2015) are emblematic of this character. I use these references in a deliberate design implemented to show that the present research, while far flung from geographic convention, remain with the major themes and valuable lessons from the discipline, and to display that these can integrate organically into interdisciplinary efforts such as the present, which climate research and as we have established, geography, should undertake.

1.5. Layout

Chapter two surveys the inherited literature the thesis works with. It is found that ecological economics and Marxism share deep research commitments and overlapping research throughout history. The commonalities therein compel us to speak of one heterodox literature community in the context of climate transition literature. Chapter three applies this red-green literature to a systematic literature search and analysis in width. *Part II Immanence* thus begins. A shortened sketch for the methodology to that end is displayed before the results are disclosed. Chapter four explains the methodology and strategy for presentation of the literature analysis in depth. The presentation of this literature analysis and the theoretical reconstruction unfolds across the succeeding chapters. Chapter five presents a bundle of literature that orients to our RQ by affirming green growth. A bundle that prescribes managerial visions for a societal transformation is shown in chapter six, before chapter seven

takes on approaches to systemic change that are coupled with normative visions for societal change. The lingering problems in defining the RQ develop in chapter eight. The theoretical hypothesis that concludes the analytic endeavor of this thesis is proposed in chapter nine. This leads to the thesis retrospective in chapter 10. Lastly stands appendix I with the discussion of literature search methodology in its required brevity and appendix II documenting the literature sample.

2. History of heterodox materialism

The present chapter constitutes our research engagement by establishing the links between the present research and the scholarly traditions from which my perspectives draw. The chapter traces the development of critical social science that takes interest in the material world from the early developments of materialism through Marx and towards newer subfields. We will see reasons for bracketing ecological economics and Marxism as one bundle of heterodox natural- and social sciences, a red-green heterodox literature that this thesis posits as the basis for a forward analysis of the climate crisis.

2.1. Marxian genesis

We begin with the early attempts to grasp social and physical processes that situated the early intellectual milieu of Marx. Marxism refers to Marx, but it should also be understood as a movement of intellectual affinity that grew out of the philosophy of the young Hegelians, chiefly Ludwig Feuerbach, and the contemporaneous thought in political economy and utopian socialism as these developed at the turn of the 19th century. Marx' own crystallization of a cohesive position can be dated 1843-1848, while early works of Friedrich Engels (Engels, 1843), influenced and partook in this development while Joseph Dietzgen (Dietzgen, 2010[1869]) independently conceived tenets of the Marxism as understood after Marx, influencing the broader movement. Marxism as a tradition beyond Marx himself can tentatively be periodized with the first independent study adapting the methodology, August Bebel's (Bebel, 1964[1879]). Marx' method as commonly understood, and the core feature of historical Marxism, was the method of historical materialism. It entails the identification of determinate material relations, the causal drivers for historical change, and an analysis of their historical emergence and conditions for existence. Materialism understood here is the development of thought that conceives society with entirely secular concepts. Montesquieu

(de Secondat Montesquieu, 1977[1748]) can be understood as a popularizing breakthrough (Clarke, 1991, p. 18), while natural sciences a century later with figures like Darwin consummated its position in the sciences to Marx' approval (Foster, 2000).

From political economy came theories of society's constitution, the early full account of all the elements of a society and its interactions (Clarke, 1991, p. 12). Political economy conceived society as composed of classes, each belonging to an economic function in the total social product. Marx and Marxists took this societal analysis for their own political ends and would critique these theorists which resulted in a refinement of their models, and a critique stressing the historical conditions, the contingency of society's *constitution*. This foundational critique stands in tension with a Ricardian socialism that can also be found in the thinkers. This latter position is rather a moral or political critique that aims to redefine the rightful distribution of the product among the classes, rather than critiquing their conditions of existence and thus imply the possibility for transformative change.

The legacy of the left Hegelians is evident in the historical materialist outlook and the philosophy undergirding Marxism. This became a theory of history in which the subject-object antinomy of Kant was attempted overcome with Hegel's identical subject-object unfolding through history. For Hegel this was Geist. For Marx and the Marxist this idea would rather be grafted onto entirely secular and material terrain. It was fashionable to see this movement in the forces and relations of production, which implied that socio-economic history had a trajectory towards communism. This philosophical legacy also brought the concepts dialectics and totality. These concepts express the mutual interrelations of all things, requiring knowledge to be sought as constituent part of a greater whole, thereafter the need to find which relations are determinate in an analysis, relations Marx saw in commodities, labour, and capital in the context of capitalism.

2.2. Classical Marxism

The scope of the application of this philosophy was never clarified, and the difference between Marx and Engels on the matter remains debated (Saitō, 2023). What is certain is that Engels undertook a project to establish a system that was at least latent in Marx, dialectics of nature (Foster, 2022). This unfinished work of Engels developed a system in which all of nature existed in dialectical relationships. This system, like with Dietzgen, came to be

dialectical materialism, and percolated through Georgi Plekhanov and Lenin to become a Marxist orthodoxy. On the other hand, views remained which rejected this system and saw instead dialectics in a yet Hegelian manner. Chiefly with György Lukács (Lukács, 1971), the dialectic was not in nature, but the unfolding of proletariat as historical subject. Lukács would influence the emergence of Western Marxism and the emergent split between camps in which the role of nature and ecology emerged in contested ways. Before this, however, ecology was largely confined to economic analysis. In the posthumously published *Capital vol. 3* (Marx, 1993), the section on ground rents opens for Marx' treatment of soils and nutrient depletion. The first systematic treatment was Karl Kautsky's 1899 *Agrarian Question* (Banaji, 1976), in which the socio-economic trajectory of smallholder farming was contested. Marx' unfinished work suggested an eventual real subsumption under agrobusiness, which Vladimir Lenin supported in contemporaneous theorizing (Lenin, 2019[1899]). Kautsky suggested that natural conditions, family labour and other factors contributed to a resilient longevity for smallholders, capital being disinterested in subsuming it (Rogers et al., 2013). Here was already a basis for valuable ecological thinking. With the term subsumption, Marx would describe the development in capitalism in integrating production in its circuits, formal subsumption, before transforming the production relations so that they conform with the standard of a capitalist economy, the real subsumption (Fuchs, 2021). This made palpable an analysis of relations to nature taking a two-step movement towards servicing capitalism and becoming fully integrated in capitalism. Ecological degradation saw thereafter its first theorization with Rosa Luxemburg's *Accumulation of Capital* (Luxemburg, 2015[1913]). The theory posited capital as necessarily expanding spatially, which means it requires external space to parasitize upon to continue accumulating. This work remains a central reference on externalities of capital. The framework in *Tektologia* (Bogdanov, 1922), became a precursor to systems theory (Gare, 2000). Nikolai Bukharin attempted to understand how an ecologically inflected totality develops (Bukharin, 1979). Externalities and degradation could henceforth be spun into multiscalar system perspectives and account for the capital-nature dynamics on the world scale.

Engels' system, popularized already with Anti-Dühring (Engels, 2020[1878]), merged with Darwinism to form a generation of "red scientists" in the natural sciences of Britain emanating further through figures like E. Ray Lankester and William Morris, and internationally with J.D. Bernal and others (Foster, 2023; Zhang, 2023). This same framework labored under the crop of soviet natural sciences, the ecological works of which were leading

the field and remaining influential until High Stalinism and Lysenkoism bankrupted the scholarly community. Here we had the "ecological-economics of Sergei Podolinsky and the earth-science of Vladimir Vernadsky", Vladimir Stanchinsky's ecological thermodynamics and Sukachev's geobotanics (Boxley, 2022). Vernadsky was fundamental in developing the concept biosphere and recognizing the earth-system as dependent on socio-ecological factors. Podolinsky proposed an early union of biophysical factors and the Marxist idea of economic planning based on use value, which he saw as quantifiable in energy embodiment (Foster & Burkett, 2004). Stanchinsky championed nature reserves to integrate empirical ecosystems analysis with planning. They all reaped the fruits of Marxism's before modern academic specialization integrated these inventions in more specific frameworks successively detached from Marxism proper.

2.3. Western Marxism

The other trajectory to this history was that of Lukács' following. His critique of dialectics of nature morphed with Freudian psychology to form the research platform of the Frankfurt School. Here the principal concern was studying the instrumental reasoning of industrial modernity and its subjugation of nature. Nature thus gained thematic preeminence, but ecological analyses were few, and nature came to be seen as a passive, empty object onto which society acts (Smith, 2010, p. 46). Texts like Theodor Adorno's *Theses on need* (Shuster & Macdonald, 2017), critique the consumers subjective drive to consume commodities, preceding the predominance of consumerism in green thought. Alfred Schmidt, his student, produced *The Concept of Nature in Marx,* a foundation for critical theory of nature (Schmidt, 2014). Herbert Marcuse's later works introduced a normative ecology (Boxley, 2022). Rejection of natural dialectics made this tradition less concerned in exploring symbiotic nature-human relations, diminishing its relevance for ecological Marxists but inspiring the emergence of ecological themes in Critical Theory.

2.4. Modern green thought

The new left after 1968 and the emergent green movement tended to think ecology against or as unrelated to Marxism. This was the emergence of modern green thought as politico-normative and interdisciplinary concern with the environment. A figure in both is André Gorz, who extended Marcuse's influence, as his friend, on new ecosocialist thinking throughout the 70s and 80s. Gorz (1997) popularized Ivan Illich's concept of conviviality, a normative politic

of wellbeing against productivist state socialism and capitalism particularly influential for degrowth. The link to Marxist methodologies, however, remains weak. This period saw one of the earliest Marxists working with modern green thought in George Caffentzis. He hypothesized ecological collapse and was an early participant in the debate over the Peak Oil theory. Connecting the latter thesis to class struggle, contending it to be the only the struggle that can circumscribe the limits to capital, was an early contribution to directly link Marxism and modern green thought (Caffentzis, 1973). Modern green thought would at this point convalesce with the emergent field of ecological economics. The foundation of this field is surveyed in the following.

2.5. Ecological economics

Eugene Odum developed ecology toward systemic analyses of the earth-system, a conception of ecology that is both a social and natural science (Odum & Barrett, 1971). It is this interdisciplinary understanding of ecology that this thesis consistently refers to. The son, Howard Odum, developed this field further as a biophysical systems theory which would be crucial for the first generation of ecological economics. A foundation for ecological economics was laid with his energy theory of value (Odum, 1988). Odum developed the concept of emergy, or energy memory, which would denote the real value of commodities in trade corresponding to energy use in its production. Robert Costanza (1980) held such a notion and worked to account for the relationship between market price and energy embodied in production (Hornborg, 2011, p. 104). Another foundation was that of Ilya Prigogine's synthesis of thermodynamic principles with system dynamics (Prigogine & Lefever, 1973), which would enable a systems-theory perspective on energy flows.

The central contribution in the field's emergence, however, was Nicholas Georgescu-Roegen's. He provided the first systematic synthesis of thermodynamic principles with political economy. The 1971 book *The Entropy Law and the Economic Process* posed that the earth-system inevitably trends toward declining and extinguishing of resource- and energy use (Georgesçu-Roegen, 1971). This involved the application of the concept entropy to material resources, an argument that the resources we can use in our economies will diminish over time. This led to a controversial proposition for a fourth thermodynamic law that holds that all recycling degrades (Burkett, 2006, p. 155). A student of Georgescu-Roegen, Herman Daly, is the final seminal theorist in classical ecological economics. Daly proposed the steady-state

economy, a model of a socio-economic system in which material use can be recycled and kept in use at a fixed aggregate indefinitely (Burkett, 2006, p. 146). This proposal and the subsequent critique and alternative from Georgescu-Roegen were both concerned with hypothesizing a means for an advanced civilization to survive in the long term. Compelling this problematic was the entropic theory breakthrough which compelled the sciences to reckon with the theoretically robust argument of an inevitably fatality in a growth-oriented economic system.

It is striking the degree to which this literature parallels that of the community of ecological soviet- and red scientists in the interwar period we encountered earlier. The objectives, methods and results of these scientists and the formative ecological economists indicate shared orientations, while the key differences are in their sophistication, which is an obvious effect of time, in addition to their view of Marxist methodologies. Emblematic of this is Georgescu-Roegen's self-identification as Machian and apparent disapproval of Marx (Georgescu-Roegen, 1999), which equates to a clear dissociation with eco-Marxism. This, however, seems puzzling considering his seeming scholarly kinship to Podolinsky and Stanchinsky. Perhaps it indicates that these traditions can be bracketed as one bundle, a heterodox literature that is eco-social or red-green, wherein methodologies are superseded by research subjects.

A similar throughline is identified in the next generation. The 70s saw the emergence of the Vienna school of metabolism as an early evolution of ecological economics. The Vienna school developed the concept of metabolic flows and developed the tools to make a first analysis of the material throughput of the economy (Fischer-Kowalski & Haberl, 1993). Central to research here was the influence of Georgescu-Roegen. This community would refine the Material Flow Analysis to account for the material flows in global trade and their national accounts (Hornborg, 2011, p. 19). This enabled the development of a field that parallels economics, which has the capacity to analyze trade in its physical dimension as opposed to the economist's preoccupation with the monetary and valuative in trade.

The concept of metabolism has two different lineages which both concern themes that have great similarities. Just as with the two ecological economic communities, the communities of metabolism points to one Marxist and one other heterodox school with shared objectives. The latter metabolic school is a Marxist metabolism that grew in prominence later, but its

foundation is traceable to the 70s. Alfred Schmidt developed metabolism for Critical Theory (Schmidt, 2014). István Meszaros' *Marx theory of alienation* (Mészáros, 2006) also did recover Marx' idea of metabolism. Fused with Marx' early theory of alienation, Meszaros systematized a theory of metabolism in which human-nature relations are mediated by human labour. While the labour process alienates under capitalism, this made for a capitalistically alienated metabolism. This leaves a conceptual apparatus which renders a triad of humanity, its social metabolism, and the universal metabolism of nature (Foster & Clark, 2016). Where the Viennese developed quantified metrics of material throughput in the economy, Meszaros tried to understand how this logic of throughput was constituted in human society. The Marxian metabolic theory did not cast significant influence until the full blossoming of second wave eco-Marxism where John-Bellamy Foster popularized his theory and familiar literature on throughput quantification emerged. Here again do we see ecological economics and Marxism parallel in themes while their correspondence remained underdeveloped.

2.6. First wave eco-Marxism

Beside Meszaros' metabolism, theorists who recuperated Marx' thinking for ecological problems emerged in the 80s in what is retroactively termed a first wave eco-Marxism. The concept "treadmill of production" following Allan Schnaiberg (Schnaiberg, 1980), drew from an array of postwar Marxist thinking. Here capitalism was seen as conflicting with ecology by an expansionary drive from competition, which sets in path dependency against the environment (Clark & Longo, 2017). Ted Benton (1989) was also among the first wave of modern ecological Marxism and perhaps the thinker periodized as starting the first wave. This first wave as periodized in this fashion was critical of Marx and Marxism (Heron, 2021), and suggested areas in which the frameworks fell short in handling the environment (Grundmann, 1991). Bunton critiqued the linear production model and claimed that production systems in which humans take on a passive regulatory role must be accounted for, and that Marx' neglected thermodynamic, physical limits (Camilla, 2020). James O'Connor (1991) coined the second contradiction thesis. Capitalism for O'Connor has two contradictions. The first is internal to capitalism, between forces and relations. The second is among the conditions for capital itself, the environment undermined by capital itself being the core focus. The influence of this thesis was stunted, as commentators tended to interpret it as proposing a doubled crisis theory, a crisis in labour and nature (Camilla, 2020). Consider to this effect also note 39 in Holgersen (2022, p. 328). However, the key with O'Connor is opening a second domain of

inquiry, the dynamics related to the conditions for production and reproduction (Rudy, 2019). O'Connor's thesis was another attempt to rectify the assumed ecological neglect in Marx.

2.7. Applications and hybridization

2.7.1. Political ecology and geography

Concurrent, but before preceding the influence of ecological Marxism, developed the subfield political ecology. The field started as a research platform for applied studies of land management and -conflict with a critical perspective. Piers Blaikie and Harold Brookfield inaugurated a Marxist model of soil degradation produced by state and capitalist pressures on the agrarian land with the core textbooks Blaikie (1985) and Blaikie and Brookfield (1987). Externality following Luxembourg becomes a central theme. The field soon took a cultural turn, shifting to discourse analysis and hybrid approaches from non-Marxist poststructuralism (Jones, 2008). The field would see great uptake of the Production of Nature thesis (Robbins, 2012).

Posed by Neil Smith (Smith, 2010), here a repurposing of Lefebvre's (Lefebvre, 1991) spatial phenomenology made for a theory of capitalism as subsuming the world under the value-form, including all market exchange and its relationship to land and nature. The value-form in Marxist thought has different expressions. A formal tradition of value-form theory considers capitalism to develop social reality expressed in fetishized forms. Using negative dialectics, such theorists always see an incongruence between an object and the subject's conceptualization of the object, producing the latent 'violence of abstractions.' We will dwell on this idea throughout the methodology. With Smith we speak instead of the application of Marx' value system. Smith posited that society is governed by socio-economic rules that correspond to the abstract quality of economic value as it exists in capitalism. Instead of interactions with nature being governed by the concrete utility we see in a piece of nature, interactions are governed by the economic logic of value. As such a second nature, a value-form nature, becomes a social reality and takes on social preeminence over the 'natural, first nature' under capitalism. As the system develops the line between the two becomes blurred and we can now only speak of a capitalistically produced nature. Smith's advisor Harvey would take up the same principles in later writing, and this Marxist-based hybridist approach is one of several that entered Marxist geographies from the 80s and 90s onward.

The conceptual hybridity that emerged here, however, entered the post-structural paradigm in the sciences and crosspollinated in outside domains. The hybridists were concerned with the inter-relatedness of social and environmental realities, and developed ways to conceptualize and analyze these worlds in more and more complex ways. In political ecology this would produce the polar position of radical constructionism where everything is constructed (Escobar, 1996), so that we have no handles with which to grasp what other viewpoints considers objective reality. More common were themes of mutability between the human and non-human (Haraway, 1987), and this conceptual turn toward analytic opacity and empirical complexity will prove crucial to our debates on the definite prospects of a green transition.

Harvey himself drew from dialectical materialism and integrated environmental relations in his space economy of capitalism, a lifelong project of grafting Marx onto a spatial materiality that became successively deepened and engaged with ecology (Harvey, 1982, 2006). Along these lines is the emergence of a broad social science which studies the inter-relationship with environmental and social factors in an ever-expanding variety of ways. Some of those that remain within the research program of the red-green bundle are shown below.

2.7.2. Interdisciplinary uses

The new environmental sciences interacted with the themes of development studies and postcolonialism early on. Vienna metabolism would develop to an ecological Prebisch thesis (Hornborg, 2011, p. 19). The world-system analysis approach was combined with material throughput analysis to produce the ecological unequal exchange theory. This approach was independently made by Steven Bunker and Alf Hornborg (Bunker, 1988; Hornborg, 1998). While Bunker's approach built on Odum's energy value, Hornborg was committed to interpreting the economy through material flows and a marginalist conception of value. He used the concept 'ghost acreages' to denote the unity of land and energy in material footprint as a spatial equivalent and drew from Prigogine's thermodynamics. In Hornborg's project the crucial ecological problem with the current economy was the time-space appropriation of its process, where a "global analysis reveals the extent to which this is achieved at the expense of (arguably 'underpaid') human time and natural space elsewhere in the world system. (Hornborg, 1992, 1998, p. 19)." Such a scope of analysis resembles Bukharin's pioneering global analysis. The systemic viewpoint of Hornborg's methodology was refurbished for an individual analysis, where each person's interaction with ecology was in focus. This was the

ecological footprint analysis and the later embodied land approach (Hornborg, 1998, p. 15). These then represent a methodology that has undergone two rightward steps from the red-green theory. These literatures highlight the tensions between analytic scales in ecological thought. They also reveal an ambivalence toward Marxist value theory or its energy value offspring while residing in a common sphere of research affinity.

2.7.3. Feminism

The emergence of green thought and the new social theory of the 68'-ers also preceded new Feminist theory. Some feminist communities would develop ecofeminism where the gendered and ecological reproduction of society in relation to nature was studied (Pineault, 2023, p. 20). The link to Marxism is so apparent that its estrangement was described as a missed rendezvous (Otto Wolf, 2007). The economistic theme of reproduction as a social domain related to the economic system would develop into modern social reproduction theory (Bhattacharya, 2017). Reproduction approaches were subsequently expended into the domain of the environmental, where various ways of conceiving ecology were analyzed as part of the reproduction of the economy, or the conditions for production and reproduction recalling O'Connor's two contradictions (Fraser, 2022). Here again are communities with theoretical divergences which yet can be considered associated in research objectives.

2.8. Second wave eco-Marxism

A second wave of eco-Marxism is distinctly periodized for its rejection of the earlier criticism of Marx (Heron, 2021). Newer research on Marx' own thoughts resulted in newer readings which argued that Marx' developed an ecological theory which previously was ignored. Chief proponents Foster and Paul Burkett thus developed a Marxological theory of metabolism and drew from Meszaros' works and Marx' research on agronomy (Burkett, 2014; Foster, 2000). The thesis of a metabolic rift commenced, which posed that capitalist reproduction circuits and environmental reproduction after capitalist processes have entrenched on it develop asynchronously, leading to increasing environmental destruction by the logic of the economy. Concurrently, Martinez-Alier and the Catalan milieu would engage typical environmental politics with arguments drawn from Marxism, trying to develop an eco-Marxism this way (Hornborg, 2011, p. 18). The latter combined with thinkers like Serge Latouche were fundamental in influencing the degrowth movement in the 2000s (Kallis et al., 2018).

2.9. Contemporary green thought

2.9.1. Managerial approaches

We have seen hints at green approaches conceived on more right-wing terrain. With the individualization of systemic analyses came also green theory preoccupied with management of current systems. The concept of resilience formed a discourse around adaptability through the climate crisis, substituting the concern of eco-crisis identification and elimination. Alongside this came calls for a new pastoral traditionalism, arguing that food systems in non-industrial societies must be adapted (Folke & Berkes, 1998; Levin et al., 1998, cited in Hornborg, 2011, p. 21). In review of the above literature, Hornborg explained that this inaugurated resource management science, which he criticized as a mystification of the techno-social arrangements that displaced such societies in the first place and as an ideology that has strong colonial connections. Further institutionalization of green thought saw the imperative of ecological mitigation and adaptation throughout the green crises becoming hegemonic discourses of the green transition and crucial to that current project. The throughline to post-politicized climate discourse and the fetishistic disavowal of foundational causes are evident. This highlights the tension in this field. It is clearly required to sort out the heterodox parts of ecological economics to develop a heterodox red-green category of research literature.

2.9.2. Macroeconomics

Along this ecological management was a new wave of ecological theory which oriented towards management in the form of measuring ecological performance in governance. This was the 2010s wave of ecological economics wherein was developed macroeconomic models. This is the highly current field of ecological macroeconomics (Hardt & O'Neill, 2017). Models in this community are conceptually linked with neo-Keynesian economics, where the former differs and is more relevant because it seeks environmental outcomes para economic outcomes. These models then account for the ecological, environmental, and social factors that have reached conventionality from the previous heritage of green thought. The current evaluations and future projections of climate transitioning that the hegemonic green transition uses rests on the models currently developing.

2.10. Third wave eco-Marxism

The most recent trends in the Marxist legacy on red-green thought is periodized as a third eco-Marxist wave (Heron, 2021). A tendency in this literature is the buoyant heterogeneity of approaches and concerns an overcoming of the narrow Marxological approach of the earlier generation. Scholars apply the legacies of Marx and Marxists in different ways. Andreas Malm's *Fossil Capital* (2016) and Jason Moore's (2015) world-ecology gains preeminence as a trifecta with the metabolic rift approach. Moore synthesized the themes in the earlier literature on world-system approaches and hybridism in his approach. Malm popularized the analytic focus of economic power as the prime characteristic of capitalism, thus reintegrating key motifs of the value-form approach in Critical Theory with current Marxism. Robert Biel covered ground with the attempted systemic application of the concept entropy to social systems (Biel, 2013). Biel both tokenized the abridgement between ecological economics and provided new theoretical reasons to develop the agroecological tropes common in the degrowth climate movement.

There is also a contemporary development of ecological themes in Critical Theory which continues the discussions that the eco-conscious participants of the Frankfurt School started. Among these is the value-form approach to Critical Theory, which derives from Marx but little of any orthodox Marxism. Carl Cassegård's attempted Critical Theory of nature was one such effort that aimed to sublate the eco-Marxist debates by reference to Critical Theory, there as a form-matter dialectic against the Marxists' nature dialectics (Cassegård, 2022). In this tendency scholarship ranges from philosophical reconceptualization of ecology and crises to novel frameworks used in applied studies. Important is also socio-ecological hybridity, which we have seen above, that currently expands the brevity of this research community and engenders themes like the Transition Question with important, destabilizing arguments.

2.11. Summary

The literature overview of this thesis aimed to present the development of literature that seeks to understand the environment, the human society, the way these are united in destiny and how the contributors before us have left us tools to solve the problems of today. We observed only half of the debate, and this was the half that corresponds to our quest to revitalize the heterodox approaches, the arguments and debates that consider the climate crisis in alternative ways. Ecological research communities with less interaction between the red and the green

was not considered here. Loiseau et al (2016) highlights that the general notion of a 'green economy' has a very long history, with proponents as early as 1920. Therein is a plethora of semantic distinctions, geographical and theoretical multitudes, but a common theme is the attempt at valuating externalities of the economic system. This marks off a fundamental distinction from our themes with its integration into the economic analytic scope the material quality of the economy. Green growth is furthermore understood to concern literature on 'weak sustainability,' that is, concepts which fail to establish the pathway to zero-emissions, typically by an orientation toward relative decoupling and –mitigation (ibid.). The term green economy accordingly failed to be a research concept in this thesis.

The perspective I gained from my acquaintance with these histories is that various research which considered ecological realities and critically grasped human society all had a shared destination. These thinkers all searched for ways to cohesively understand humanity and nature as constitutive of a unity sharing this earth, a unity which we could, and probably should, struggle to change for the better. This compels me to bracket these literatures as one bundle of red-green theory, a heterodox materialism. Crucial also is the understanding that volumes of this literature were constituted in traditions founded on the earlier modern attempts to integrate natural and social science. Central in this respect was Marxism, which spawned its own ecological subfields that independent ecological fields would come to mirror, parallel and overlap, unite, dissolve, and re-emerge with. In that red-green history, however, fidelity to research interest superseded fidelity to ontology or method. In light us this literature survey, new Marxist approaches should feel no need to follow dialectical ontology. In this spirit the intent henceforth is free inquiry into heterodox materialism with its prospective assessment of the Transition Question at heart.

3. Sampling heterodox materialism

A systematic search is performed in this thesis. The search aims to gather heterodox materialist texts published in recent years, and which all grapple with the core criteria of the present research objective. These include articles that imply reflection of the research question, that overcome national accounting as measurement, and that attempts to ground trajectory with destination. The following is a sketch of the methodology supporting that search, *fig. 1*. The full walkthrough of this process is presented at the end of this thesis, see

appendix I. That walkthrough includes a reflexive evaluation of the design and execution of the literature search in addition to deliberations on details. The sample is displayed in appendix II.

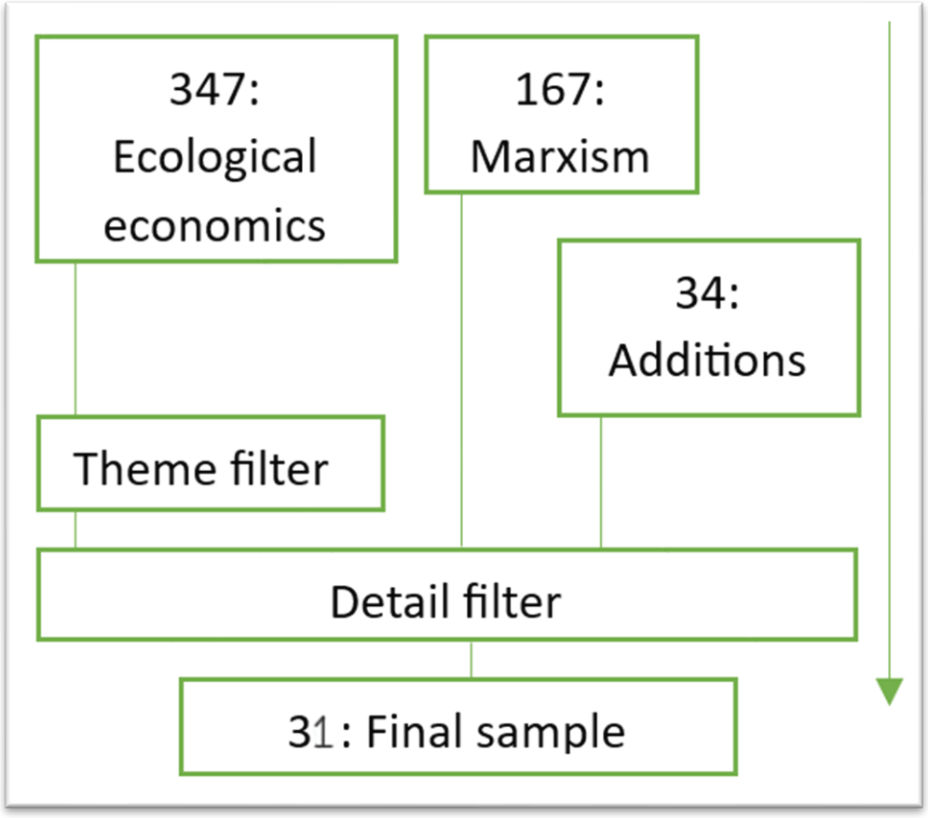

Fig. 1. Summary of systematic literature search design.

What now follows are only its results, a set of results which are carried over to *Part II*. In that part this thesis pursues a critical engagement with the research question through the material offered in this literature sample.

3.1. Results

The results are what is left after over 700 hits in literature searches, including duplicates, became 31 filtered samples. The relative brevity of the search design, while attempting to catch all the literature, concluded on a dire sample size. This highlights the critical deficit of literature, both of those using red-green macroeconomic modelling and those using properly heterodox methodologies, in grasping the prospect of planetary dynamics and the problem of defending the presumed arrival at the zero-emission state. These are both qualifications that are extremely crucial to ground in a watertight argument for any transition research to be

prescriptively sound. Before my interpretive efforts begin, I stress that this is the most crucial insights emergent from this thesis. *The scholarship should immediately shift scope to that of zero-emissions and that of global emission dynamics*. The disproportionality between search results and final samples also strengthens the claims emergent in this thesis. The literature grappling with the present research problems in the proper parameters are slim. The resulting claim from this thesis is thus a more valuable contribution to the climate transition science than assumed prior to this literature search. Furthermore, the aim of defining a sample does not require brevity for a deeper analysis. An analysis is width provides a typology of arguments, and it is the next research efforts that must convert a typology to a definite answer to the RQ. For the thesis purpose, the sample size is this phase of the research is not important.

Presently is presented the answers to our research question of whether the current project of green transition is tenable. Seven samples affirm the RQ while 16 negates it. Seven samples remain unclear on the problem to the degree that an implied position identified through my interpretation is not found. Of these five are pessimistic on the issue, while two seem more optimistic (Lei et al., 2023; Loiseau et al, 2016). One outlying text negates the research question while arguing to collapse the binary of the question (Leonardi, 2021). This perspective and others that destabilize the research design is analysed further into this thesis.

The topics contained in these texts is presented in the following. The first cluster is literature that sees the green transition in the green growth paradigm. These texts orient the problem around technical feasibility for policy-technology implementation, and analysis of current transitioning which conforms to green growth. Here we encounter arguments in favour of BECCS implementation as a pivotal breakthrough for decarbonization under green growth (Sadhukhan, 2022). We also encounter different modelling arguments that uses macroeconomic models that computes with various social and environmental factors. These texts argue for a green transition using model projections with parameters that conforms to feasible policies under green growth. Some texts go further in offering theoretical defence. We encounter Schumpeterian economics where it is argued that the transition's required technological change must revolutionize the socio-technical fabric of the economy (Bosch & Schmidt 2019). A perspective attunes us to the consequences of better socio-economic indices when implementing policies (Brand-Correa & Steinberger, 2017). Additionally, an argument

is made that a transformed corporate structure can synchronize capitalism with a degrowth program (Tokic, 2018).

The second cluster is managerial literature argues for radical changes in the policies, social structure, and technological composition of the present state through an ambiguous relationship to the green growth paradigm. Common among this literature is the position that great change is needed, and that the discussion of this change is framed around transitional feasibility and the management of the envisioned transition. The texts imply that the transition is most meaningfully addressed as a matter of political operations that can be grasped from the present standpoint. Herein are calls for transforming the economy into a new, bioeconomic system (Giampietro, 2019). There emerge arguments that a steady-state economy must be constructed (Washington, 2021), or that various articulations of a-growth economies must be developed, who have in common politically reconfigured systems of material throughput which are shaped to conform to the green transition. Authors herein tend to concede to illiberal governance as means to the TQ ends (ibid.; Jacques et al., 2023).

The rest of our sampled literatures imply that the green transition is untenable. The following texts orients the green transition in discussions that aims to transcend or break with the current system. This literature takes on normative visions of systems change. These texts have in common the evaluation that a fundamental change is necessary, and that the discussion of what is the alternative is framed by what the authors' finds to be the most compelling proposition of a future system. Several articles adapt the position of degrowth. It is present here both the technical arguments for systems change and the normative promotion of the degrowth supporters preferred system. Other arguments in this cluster are that the systems change is an opportunity to construct socialism (Gunderson et al., 2018). Socialism can mean a variety of socio-economic systems, and in this literature the discussion opens for ideological normativity. Sharing the normative approach of these texts are two outlying perspectives. These are correspondingly anti-systemic and share some of the politics as the rest, especially with the term degrowth. However, these frame the transition problem as predominantly a question of cultural change (Hornborg et al., 2019). One of those perspectives argue that the degrowth solution is premised on a fundamental shift, a cultural revolution that would require us to transform our desired lifestyles to reach the objective (Trainer, 2020, 2022).

The following section takes on research results that contributes to the present research while failing to conform to the research question. While this thesis is oriented toward feasibility of zero-emissions as opposed to realistic prognoses of our trajectory, adding width to the research that can transgress the above distinction strengthens the analysis. It is furthermore a crucial quality of the heterodox perspectives. Where the thesis is constructed to synthesize the alternative views to the hegemonic green transition theory, presenting this heterodox corpus in brevity against and over the RQ is an important part of making this contribution impactful. In practice, this concern mean that I aim to include in the research emergent perspectives that can illuminate the research topic. Such an emergent property identified is the quality of *dynamics* discussed in the literature. These are dynamics that does relate, if not answer, the RQ.

The reason this cluster of literature is studied will presently be argued. The RQ implies a present in metastasis and a definite gap between the present and the future. This can be seen when we ask what can change. Doing so takes for granted that forces and relations subject to change are posed as open to interaction, as opposed to being predetermined. Such a predisposition is inadequate in the time of a polycrisis. Tipping points in climate science is handedly acknowledged. Non-equilibrium approaches in thermodynamics and ecology compels us to research emergent dynamics and predetermined changes in a world undergoing seismic shifts. Indeed, negative feedback mechanisms from the economy outside the problem of emissions produces changes to ecologies which reverberates through the analytics of ecological crisis and the abovementioned tipping points. Any implication that we, or the changemakers, have a real political manoeuvrability that is an identity between the capability to create change with the real execution of this change errors. These assumptions result in a discursive naiveté that takes for granted that the question of feasibility have an impact on the real effort to solve the TQ. On a higher abstraction, this objection recalls the debate over the cartesian dualism in early science (Smith, 2010, p. 10). We must think in a way that overcomes that tendency to imagine nature as a terrain that the mind aptly perceives and changes at will.

Against the problem presented by the above two assumptions of metastasis and changemaking, the dynamics argue that changes and transformations are already occurring or is even predetermined to emerge. This means that several of the articles studied argues around the question of a green transition without directly or indirectly contributing to illuminate the

question of whether the transition is tenable. These dynamics are still judged to be crucial to the present research. The topics brought by these texts contributes by engendering our research with perspectives on our future that makes our inquiry to the green transition more meaningful. By this I mean that without adding onto the textual mass that aims to approximate the precise answer to how we can transition, the dynamics imagined or identified helps to gauge the stakes of the topic. Additionally, they contribute to generate new perspectives on our prospective futures or to reinterpret the present.

One of the dynamics takes on a classically Marxist problematic of a future in dual determination, either as revolution or barbarism. This article contents that the logic of capitalism brings about a trajectory towards geopolitical conflicts, or 'inter-imperialist rivalries,' which the author implies as prospect of world war (Yu, 2020). A similar framework attunes us to the argument that the class conflict in capitalism inevitably points to a proletarian revolution, implying that socialism is already set to become the green transition (Chambers, 2020). Further articles use models of environmental systems to theorize that the linear throughput structure of today is approaching a breaking point with either the social pressured enacted or the land and material uses in the economy (Hornborg et al., 2019; Moore, 2021). These theories points toward a looming catastrophic breakdown of the economic and ecological system or that unknown modal transformations of the relation between land, energy and human use in production will happen. A last contribution demands us to accept the inconclusiveness of the research topic and to shift objectives to what we find important going into the unknown of before-or-after a green transition (Leonardi, 2021).

3.2. Summary

The search result implies a strong deficit in both research that grounds the claim of a zero-emission destination and those that account for global dynamics. The present research, then, contributes to an underexplored junction of research problems. The following research is correspondingly a valuable contribution to the debate. These results are the perspective of width that complements the successive analysis of depth. The width analysis claims that the abstraction from the entire heterodox literature provides a result that is representative of the field. Here, then, we find that the TQ is inconclusive. However, a strong tendency is a negation of the RQ, a rejection of the current project of a green transition. This result is therefore a low-confidence assessment of current sustainable development. This result must

thereafter be mediated with the other part of the climate transition debate, that of the feasibility literature which is outside our scope. The following presents the depth analysis. We will find this process resulting in an amplification of the low-confidence assessment of the green transition.

II

Immanence

4. Critique and reconstruction

We established the objective of pursuing our RQ in both width and depth. The previous chapter produced the heterodox transition literature's assessment of the TQ in its width. This became a typology of positions of inconclusive status identified through a standard literature search. No deeper qualification of the merit of the different positions would unfold from such a search. In the present chapter we prepare the effort of producing the equivalent in depth. In other words, to convert the typology into a definite conclusion. To this end a methodology for the qualitative analysis of the literature sample must be established. A first point is that the method used should be consistent with the disciplines under study, that of ecological economics and Marxism. Ecological economics is strongly committed to empiricism, as shown in the previous survey. This presents us with a problem since a deep scepsis to naked empiricism is foundational to this thesis. This concern is illustrated with the parallel between our objection to arguments for decoupled emissions, and a dialectician's criticism of empiricism: "dialectical development has nothing in common with a vulgar evolutionism predicated on extrapolating an existent tendency (Arthur, 2003, p. 67)." It is indeed the use and misuse of empirical analyses that compels an analysis of heterodox literatures. It is in Marxism, then, the method resides. Marxist methods revolve around the terms immanent critique and dialectics. The various meanings and implications following the Marxist usage of these terms must condition our present objective.

Cassegård (2022) and Dybedahl (2014) systematize the varied Marxist uses of dialectics. Cassegård distinguishes three lineages of different uses of the term dialectics. These are "dialectics as causal interaction", historical dialectics that repurpose Hegel's Geist where the notion of historically constituted relations are important, and systematic dialectic (Cassegård, 2022, p. 45). Dybedahl sees the uses in either an ontology, which we can see used in Engels' dialectics of nature, Ollman's internal relations and various Maoists reinterpretations which feature dualisms and Manicheanism. Dybedahl also posits dialectics as the name of a historical trajectory and as a method of investigation. Lastly there is again systematic dialectic posited as I translate it: "As a method for rigorous and systematic *presentation* of a totality (Dybedahl, 2014, p. 16)." The crucial aspect of this version, the author says, is that it is conceptual rather than historical and empirical. Such dialectical research is not an empiricist analysis of the economy but a rigorous analysis of the conceptual coherence in political economy through the use of its own conceptual apparatus. This means that it is at the same

time a critique that reconstructs to correct the prior literature and a critique that generates social normativity.

This notion of systematic dialectics recalls the seminal contribution to Marxian theory from Postone. His position on *Capital* (Marx, 1990a) is that Marx' approach successfully grasped the determinate relations of social reality, so that a logical analysis became a real historical analysis (Postone, 1993, p. 285). Marx' conceptual relations there corresponded to the social reality these concepts express, and this was not a coincidence but the real purpose of the design. This seems to correspond to the concept of a systematic dialectic even if Postone precedes its coinage in (Arthur, 2003). The centrality of Postone's project is that there is an acute need to update Marx through the same method. Postone tries this but concludes with an extremely abstract analysis of the socially constructed temporalities in the capitalist totality rather than orienting towards the climate crisis. Contributing with a corrective that accounts for the climate science thus becomes our prospect. With *Capital* as a reinvigorated reference point following thinkers in the new reading of Marx, the present research can be developed akin Marx' original presentation of the totality of capitalism's social reality.

Considering the reading of Marx and the survey of the term dialectics, other uses of dialectics are not favored here, and I will not have the opportunity to explain this in depth. What is crucial is that committing either to an ontological construction or a meta-theory of history inherently limits our range of inquiry. This seems counterproductive. Systematic dialectics, on the other hand, faces us with ideas about the immanence of capitalism without such rigidities. Here, then, a dialectical presentation of a planetary totality where the ecological relations are centered becomes the objective. This, in turn, requires that we apprehend the problem with the orthodox climate literature that we don't engage with, and that we apply this method to the sample literature correctly.

To the first problem, we must proceed strictly on the presumption that this work represents an abstraction from the heterodox half of the literature the RQ assesses. In the dialectical analysis there are thus two options, either to concede that the reconstruction is inherently one-sided, or make the claim that we access knowledge that supersedes the orthodox literature. Only the first position is tenable and this thesis positions accordingly. However, it does so with the view that we access arguments that have strong consequences for the climate literature in general, and that our system becomes a valuable conclusion to the transition

debate. To the second problem, the systematic dialectical method requires a technique for grasping the granular of a sample text. This will be the method of immanent critique applied to our research object, the analysis of the real interiority of our sample texts. It is thereafter required to reconstruct a totality on the principles of systematic dialectics.

Immanent critique is the method of application that follows systematic dialectics as the method of conceptuality. Cassegård bundles the two together as a 'critical materialism,' one of the three modes of Marxist inquiry we saw earlier. Immanent critique formally means "the assessment of the rationality or worth of conventional understandings and standards by somehow drawing on resources internal to the society or culture of which they are a part (Sabia, 2010)." However, in the current discipline this also entail some kind of generative moment, or transcendence, which Cassegård sees in the usage of the foundational Adorno (Cassegård, 2022, p. 39). When Cassegård argues that "[…] in critical materialism the task of dialectics is not to conceptualize historical change but to undermine reified conceptual constructions (ibid. p. 122)", we are faced with a mode of analysis that aims to destabilize current objects to break reification of social forms as understood in value-form theory.

Reification is a Marxian concept denoting the social processes that makes an observer separate an object from the ulterior causes that create the semblance of the object, a wider application of Marx' fetishism of commodities (Lukács, 1971). Reification is a central concept among these approaches because it signals the need to separate an analysis of the apparent or the socially real, and the important processes that constitute the apparent. In other words, to recuperate objective reality hidden by social reality. The equivalent to Cassegård's point in our project is to apply immanent critique to our literature sample to destabilize their assumptions. In both respects, this follows toward a reconstruction of knowledge attuned to that which is behind the reified forms. Similarly, the new Marxian approaches of Simon Clarke and Postone analyze capitalism immanently. With Clarke that analysis is a notion of historical constitutionality of capitalist social reality (Clarke, 1991), with Postone the same inside a systematic totality (Postone, 1993). The immanent critique proposed presently is not simply cultural relativism, it is an analysis that examines the interiority of an object, its internal consistency, and then generates a moment with which to reconstruct the totality back on our terms.

Present is the development of systematic dialectics. In the work that coins the term, Chris Arthur explains: “It is the logical development of a system of categories, or forms of being, from the most elementary and indeterminate to the richest and most concrete (Arthur p 83).” Arthur elaborates that “The presentation ends when all the conditions of existence needing to be addressed are comprehended by the entire system of categories developed.” The key trait of dialectics here is that the system of categories provides new meaning to lower-order categories by the unfolding of higher categories. We are thus quite far removed from the triadic ontology often associated with Marxist dialectics. What is instead important is that in building a long argument, we gain fundamentally new insights because of the logical unfolding of the arguments. Recall that the term totality in this context refers to a thinker’s conceptual horizon. This methodology is a manner of systematizing thought on a given subject which at the same time unfolds to new, novel insights. In this conception, which equals that of Cassegård’s, the totality gains explanatory power only when it is self-circumscribed, and its application can only be internal to itself. This approach therefore faces the problem of relating to the outside. Postone, on the other hand, is more concerned with discussing the historical constitution of capitalist relations, mirroring the other Marxian approach preceding Arthur’s (Clarke, 1991). Indeed, an idea of certain transhistorical relations, chiefly transhistorical labour, is taken up to solve the problem of relating to the outside. If the totality posits labour as transhistorical, this relation becomes a tether connecting the conceptual construction to the unfolding of history. However, this solution does not follow from Postone to the two above proponents of systematic dialectics. This tension is discussed in what follows.

One novelty in my thesis design is that systematic dialectics is reorientated as a method of textual analysis. Previously it was mostly used as the design of a specific kind of totalizing social analysis. Here this totalizing social analysis is not brought from a reasoning on the general level that Marx accesses for *Capital*. It is brought from a literature sample. In this thesis, then, the sample is ordered by categories which logically unfold a theoretical system. Regarding this novel approach I would like to disclose that this method as the way to order, structure, present, and guide my reasoning through this work have come about as an outgrowth of my process of adapting concepts like dialectics and immanent critique. A first rejection of dialectical ontology led to a novel adaptation of a combined categorial critique (Clarke, 1991), with the immanent critique of the text samples. This corresponds to practical materialism in Cassegård’s topology. A more cohesive approach that unites the sweeping and

the granular scopes of the above would be found in systematic dialectics. Moreover, this reinterpretation of a concept is not unfounded. Marx' development of *Capital* was a long process of engaging with the political economic literature of the times (Marx, 1993). The totalizing social analysis of Capital was built on thousands of pages of manuscripts directly absorbing the literature of the times. Even studies of the then emerging natural science works have been identified in Marx' paper trail (Saitō, 2017). The differences in application of systematic dialectics might not be impactful after all.

4.1. The Cassegård problem

One crucial text must be discussed before our analysis can be presented. Cassegård's *Towards a Critical Theory of Nature* (Cassegård, 2022) is a highly relevant text that covers a lot of ground near this thesis. Cassegård is an important discussant because the book presents the methodological confluences of the new readings of Marx and its relation to nature. This discussion revolves around non-identity. This concept means the incongruency between the subject as mind conceives it, and the real object. Positive thought posits that the two are identical, this being an ontology that negative dialectics negate. We will see that the present thesis processes a range of red-green climate literature as systematic dialectics. This presentation is at the same time a claim over methodological consistency. Cassegård poses that the method of systematic dialectics is only logically mediated with the perspective of non-identity, the negative dialectics of Adorno. However, I do not adhere to negative dialectics. The influence of this approach is the unlabeled systematic dialectics of Postone's critical theory (Postone, 1993), before Chris Arthur presented his (Arthur, 2003). For Postone, the objective of inquiring to a totality as the current horizon of knowledge requires that the determinate relations must be constituted in the identification of this totality. Thus, Postone is preoccupied with the constitution of the relations of capital and labour in the totality of current capitalism. This is a systematic dialectic, but there is not an imperative adherence to non-identity in that project. In my view, Cassegård's schema is thus not instructive (Cassegård, 2022, p. 45). The schema rather orders the methods in a way that logically would unfold toward his novel theory. The present rejection of the prescriptive system of logic Cassegård claims for the methodology we both use is inherent to my aim. Our divergences are indeed inherent to my overall thesis. This is because my goal is to assess the Transition Question through the resources of the collective, not through the erudite advancement of one node of theory, be it even Adorno's.

The stake of this discussion is that Postone has a 'real' connection to the totality's outside through transhistorical labour. Cassegård have avoided the same solution, and I infer this to be because of a principled adversity to identity-thinking. The main difference between this thesis and him is that Cassegård's engagement with hitherto positive theory, eco-Marxism of different varieties included, bring forth the conclusion that these approaches all inhibit the precarity of instrumental reason's social domination. He is very concerned with stressing the need for a non-oppressive determination of the object. My current project, however, is not committed to a rigorous adherence to non-identical thought forms, that is, to negative dialectics. We both share the concern against instrumental reason and see a problem in ecological theory that advances views of socio-natures that reifies relations. However, my work emerges from the traditions materialism that are identical thought-forms. The work herein is the pursuit of an increasing refinement of theory that mitigates the problem of reification. This approach supersedes Cassegård's because it does not reject forms. Apprehending forms as influential in the same grasp as their underlying constitutions implies the possibility for a more nuanced analysis.

We should hold onto the goal of developing positive science that is non-dominating. And in this track, I do conclude on positions that show a strong capacity to make progress to that end. Indeed, the question is rather whether the difference to the negative dialectic approach is that great. Cassegård's pursuits conclude on the construct of constellations around the object. This constellation is a sphere of multitudes that inquiries about the object in different ways, in a non-identical fashion. For Cassegård this should also include perspectives from natural sciences. In this way the knowledge-confidence from natural sciences can be reconciled with the methodological rigor of an anti-reifying approach (Cassegård, 2022, p. 126). In the development of the present theory, we find socio-natural hybridism more and more crucial. This can be seen as a concession to external theory, an abridgment with 'contemplative theory' that is logically consistent with determinist dialectics only, not the practical materialism or the systematic dialectics currently discussed and employed (ibid. p. 43). However, the resemblance between the construct of constellations and the hypothesis of form-hybridity is very strong. The latter is not committed to non-identity, but through its development in the contradictions inhibited in identical thought, it has itself become a concept that covers the multidimensional contradictions that are non-identical, but unitarily bracketed in the same fashion as constellations.

Conclusively, I will also argue that Cassegård's text implies that the stakes with non-identity in ecology, beyond its reason for existing as anti-domination, is to not flatten the "capacity of nature to resist (Cassegård, 2022, p. 19)." What does eco-Marxism aim to do in its advancement of Marxism? O'Connor attunes us to the problem of the conditions of the reproduction of capital (O'Connor, 1991). This includes the ways nature strikes discordance with capital's logic, the way it outright disrupts it and imbues it with a potentially terminal trajectory. The tradition already has several decades of theorizing that covers the Adornoian objections. It is specifically the analytic of 'shock' and 'pain' that comes with the non-identical encounters that Cassegård stresses as crucial (Cassegård, 2022, p. 112), that is not in high regard in this thesis. Shall we go as far as to announce that non-identity in ecological theory *is* socio-natural hybridism? No. But there is certainly great correspondence across perspectives, a correspondence that might be gainful for further development of contemporary Marxist debate (Dinerstein & Bonefeld, 2020).

4.2. Summary

In short, we found the depth analysis should be borne with a Marxian methodology. The methods therein center around the term dialectics. Of the various uses of the term, systematic dialectics suit our endeavor and worldview the best. This approach combines an immanent critique of the sample literature with a movement of reconstruction from the sample contents. This reconstruction takes the form of a systematic totality and is the theoretical conclusion to the TQ inquiry. The rigor of this approach comes into question in Cassegård's work. However, Cassegård's is an imposition into the research program with the Adornoian theory of negative dialectics whereas this thesis is an approximate to critical theory that develops as an immanent engagement of the heterodox literature. It embodies, and therefore is seen as a trajectory of, successively elaborate methodological reads of Marxian theory in the applied science sense. The background literature taken on is traditionally Marxist, but the method in use is a modern divergence. The critique of instrumental reason and the Frankfurt School research program is not foregrounding to the present. Value-form theory enters my context because of this convergence in recent climate crisis theorizing. The zero-emission instrumentality is, as I see it, unavoidable even if I share the concern of instrumental reasoning.

Does this mean that the thesis will present a structure of all the literature from our sample, where the critically excavated immanence in each author points toward an unfolding argumentative structure? No. The following part of the thesis is a presentation of the studying and reasoning undertaken under the presently discussed principles. The interiority of the literature sample is presented in a way that provides throughlines between the themes and the logical premises of the text. As we approach the ending of this presentation, however, it will become evident how the argumentative structure coheres. Neither is every text taken on in equal measure. Certain articles would be of less interest to a reader and to the propulsion of our inquiry. Some texts duplicate an argument or are grounded to such a weak degree that there is little gain in dwelling on it. As this is the depth-analysis, that which compels us deeper gains preeminence. Lastly, it would be absurd to claim that a line of reasoning such as a thesis is borne exclusively with the material inside this structure. When I later reference critique of the labour theory of value, this is an insight gathered from outside. It is instead the throughline developed that takes on the inconclusiveness of empirical positions, into which this exterior insight is brought in as a complementing argument. The method develops the forms, but it is the applicant that must provide one's own views. This last point recalls the proposition I started from, that I am not using dialectics as causal drivers but to structure and in so doing enable the proponent to generate further knowledge.

5. Green development

The following progression of *Part II* of the thesis presents the literature analysis. The first chapter takes on texts that affirm the RQ, that is, affirms the current project of green growth. Some texts present theoretical arguments in defense of this pathway, although the bulk literature argues this pathway based on macroeconomic modelling. These are covered presently.

5.1. Modelling

Yannis Dafermos and Maria Nikolaidi (2022) points to a green transition through the implementation of carbon tax and policy mixes. The model used assumes that factor weightings are fixed, which leaves no political space to evaluate the importance of the ecological or social vis a vis the financial. This is in the author's opinion best left to policymakers. Martin Distelkamp and Mark Meyer (2019) finds that a set of efficiency

regulations and global abatement policies could steer us to zero-emissions, including upstream taxation in extraction industries and emission caps in production sectors. The modelling avoids accounting for the exogenous effects of trade, and uses a series of parameters including ore prices, financial stability, and fossil fuel prices from IEA assessments. Lei et al. (2023) supports a green growth pathway accompanied with a policy package. In its prescriptive context of south – and southeast Asia, the article argues the emission problem can be overcome with a double process of technological development and rationalization of statecraft. Development of energy-related technologies and technologies of effectivization is wanted from the private sector, enhanced by tax breaks, and democratization of state and the public sphere. The scenario requires that "the energy 'rebound effect' is negated through the implementation of credible measures." We are not led to gather what these are, is dubious if such even exist. The emission outsourcing concern is accounted for, but the authors seem to reach the opposite conclusion than what is soundly established: "it has also been argued that technological spillovers from foreign direct investments can induce greater use of cleaner energy (ibid.)." In the regional context of this article, the opposite can be the case. The concept of fossil outsourcing is well known (Malm, 2012), and the fact that EU-emission trends are reducing while the global trend increases speak to this being empirically correct on the planetary level (Ritchie et al., 2020). The regional endogeneity of the argument is thinly supported, being bolstered only by an off-hand reference to a required closure of FDI from unclean sources and nations.

Marquetti et al. (2019) also offers an endorsement of green growth through a more systematic and empirical model, taking the GDP-emission relations in eighty-four countries from 1980 to 2014. It finds broad causes of relative and select examples of absolute decoupling. The article finds that among the countries not seeing absolute decoupling, most are in the global south, including China, Brazil, Indonesia, and Korea, some of the most populous countries in the world. Given that these are newly industrialized or emerging countries, they imply two points that complicate the decoupling scenario. They themselves fail to decouple as the emerging centers of pollution globally, being a problem for the decoupling thesis. Further, their relative emission decoupling could be underpinned by technical shifts as either endogenous economic upgrading or a symptom of further outsourcing. Especially China's Belt and Road project do imply further outsourcing to central Asian and African resource economies.

Djasmine Sadhukhan (2022) affirms green growth through a modelling of energy performance. It aims to avoid counting on speculative, unproven technologies such as BECCS: “While there are integrated biorefinery with carbon capture and storage (BECCS) technologies, this study is solely considering natural SOC for neutralizing GHG resulting from electricity generation systems (ibid.).” Thus, the projection modelling that their green growth support is founded on avoids BECCS but when this argument is extended to the zero-emission question, BECCS is brought into the conclusion post facto: “The most powerful strategy for NZE is BECCS providing energy storage, hydrogen, fuels, electricity, and CO2 sinks such as forestation, soil, and biodiversity. (ibid.).” It is here even highlighted as the most important technology in this argument. While we avoid BECCS debates here, a text that relies on the insertion of unsupported, indeterminate assumptions fails to affirm the TQ.

Present literature further weakens in instances where the economic concept of factor-equivalence prevails. This term means that economic modelling can substitute between different processes after the optimal weighing of such factors is reckoned. Contrary to such methodological abstraction, accounting for biophysical processes embedded in human social systems cannot be reduced to anything but what they are. The climate cannot be substituted for money. More strongly is the problem with scenario projections in such literature. It is almost unanimously the method to identify trends in the economy and extend those into the future. For our research objective the trendline is not resultant criteria, only the establishment of a zero-emission state. These arguments then fail in identifying trendlines with the qualitative shift from a decarbonizing economy to one that is carbon-free. It could be argued, against the general macroeconomic approach, that these projections only target the optimum of a fossil-industrial system or Technosphere, that represents a substantial but incomplete decarbonization. Such a fossilized backbone could be the result of processes outside the scope of economic projection. Furthermore, even through a filter that is intended to identify the articles attuned to global dynamics to be assessed prior to establishing global decarbonization prospects, the literature is prone to weakness on this account.

At the same time, it is not suggested that these concerns aim to falsify the green growth literature’s claims to the TQ. The contributions from these models are something of which I make no claim to competency. This encounter with technical macroeconomic literature shows the problem with a diffuse boundary between classical ecological economics and the modern marginalist subfield. I reiterate that the design of this thesis is intended to establish an account

of the other half of this climate transition literature, that of the heterodox approaches outside such marginalist economics. I will thus defer to scholars in such fields. What remains from the above, however, is a concrete excursion that supports my claims that methodological and conceptual contributions, in the heterodox direction, are direly needed in concluding the TQ.

A further sample literature shows what I find to be further evidence to the same proposition, in this instance in the shape of research instrumentalization (Loiseau et al., 2016). This article is a literature analysis of the term 'green economy.' It identifies the capacity of its uses to support "transitioning towards sustainability." The policy-friendly ecumenism of the article does not help in establishing an argument for a managerial green growth pathway. The possibility of a failure to realize global decoupling is noted by not pursued. The article proceeds to abandon the problem entirely:

> "How strong a movement is required to safe-guard planetary boundaries is a question of socio-ecological knowledge and the potential for innovation. It may, however, require the political imposition of some boundaries for resource consumption in order to unlock the full innovative potential of a green economy."

It is ultimately such socio-ecological knowledge that must be applied before prescribing politics to the green transition, contrary to what this article does. Such discursive deference to authorities is or can be presented as a display of instrumentalized research or signify post-politicization and fetishistic disavowal. The article encounters hard counterarguments to its green growth modality but abandons the rigorous pursuit of its logical outcome. Such green growth literature offers but a vague directionality based on faulty research even if posing as prescriptively authoritative. We should rather advance to consider the green growth proponents that defend their positions with the rigor of theoretical arguments.

5.2. Interpreting

Sampled development literature that engages with theory includes (Bosch & Schmidt, 2019), (Tokic, 2018) and (Brand-Correa & Steinberger, 2017). The former uses Schumpeterian economics as the framework while the second article offers a novel perspective on the transition question wherein the presumed necessity of a degrowth transition is posited not as a break with core features of capitalism but as a reconfiguration of the relation between corporate and physical indices. The latter text presents an eclecticism that needs further

treatment. In the affirmative literature Schumpeter's economic theory is taken up in support for a capitalist growth solution to the zero-emission economy with the term 'creative destruction,' describing the tendency for capital to innovate. Capital will revolutionize its own production process by means of destroying the existing process (Holgersen, 2022, p. 64). In this way Schumpeterians can view a process of improved economic infrastructure where old infrastructure continues to be destroyed by new, more efficient outlay of capital. The destructive/creative process of new energy capital brings about an end to the fossil economy because of new energy competitiveness. In this sense, supporting the development of creative capital using zero-emission technology emerges as a TQ solution. Doing so implies fostering innovative, green entrepreneurialism in the capitalist growth economy.

Damir Tokic' vision of degrowth concedes to a slightly greater need to transform core features of the current system. Here is a proposal to bifurcate corporate earnings and biophysical throughput, such that the stock market can retain its growth mechanism while the physical economy declines (Tokic, 2018). Rather than arguing to decouple emissions from the economy, Tokic aims to untangle the growth-sensitive financial system from the production system of the economy. His departure from other degrowth proponents center on the problem of insurmountable turmoil with a systemic culling of job opportunities, and of a likely macroeconomic death-spiral brought about by a recession. Both problems are present in the literature and are scarcely fended off except in the prize example of Parriqué's (2019) proposal to chain currency and savings schemes with job realignments in one coherent systemic cycle of reforms. Void of such reforming zeal is Tokic's pro-systemic argument, who sees that "the planned degrowth can only be sustainable within the capitalistic system because capitalism is likely irreversible." Identifying what it takes to arrive at the zero-emission economy is our current objective, this perspective does not help. Neither does Tokic' scheme. By aiming at the corporate sector Tokic falls into a long line of thinkers who err in assuming an independency between the financial and the physical spheres of the economy, at least from Proudhon's time and to the present, something Marx painstakingly tried to rid economics of (Marx, 1990b).

The Schumpeterian argument is slightly more compelling. However, the prediction that creative destruction leads to greener economic infrastructure is ungrounded. According to the argument itself, the creative forces in play only function to improve the economy in its own valuation system. This means that an existing fossil economy will only see Schumpeterian

destruction by value improvements in the economy as is, this only leading the argument into further upscaling for infrastructures regardless of emission criteria. To twist this perspective around to reach the conclusion that only zero-carbon infrastructure will emerge from this mechanism requires a much more confused mix of behavioral- or value theoretical distortions into the argument. By this I mean the text would produce reasons that only zero-emission infrastructure would be decided on, regardless of market logic, or find reasons why the valuations that underpin this market logic would transform into something that accounts for ecology unlike today. Schumpeterian theory sees a terrain for green capitalist development that more empirically sound approaches posit as deepening the metabolic rift between capitalist value circuits and the sustainable reproduction of the biosphere (Foster, 1999). Creative destruction only tells of the furthered refinement of these same value circuits that continues to wedge the metabolic rift apart.

The final text is both stranger due to its eclecticism, and more compelling than the above arguments. Lina Brand-Correa & Julia Steinberger (2017) enters the debate with an optimistic rejoinder to the emergent focus on ecological limits. The thesis offered thusly posits that "[if societies' energy systems] would be focused on the satisfaction of human needs, it might well be possible to achieve universal well-being within planetary boundaries." The article pursues a conceptual framework which would optimize resource use and social gains and thus represents a positive contribution to the project of green transition without an agenda of systemic change. To develop this framework, the authors aim to optimize the relationship between energy and human wellbeing. Following this is redefining wellbeing to suit. The eudemonic mode of understanding satisfaction is argued favorably to that of the hedonistic. Thereafter is a redefinition of energy use metrics to the same end, from energy throughput as used in ecological economics to energy-services. The key proposition emerging from these steps is that a double decoupling is tenable with this analytical framework, implying an effectivization in both energy production-circulation and in its consumption. Energy is the bulk of the emission problem. The present thesis is therefore at the cusp of providing a partial solution to our Transition Question before problems emerge.

The antique concepts of satisfaction used in the article leaves us a curious question. The hedonistic mode is based on sensory inputs, while the eudemonic mode which the authors favor is based on the provision of needs and the cerebral meaning-making supported thereon. In both these parallels of utility and consumer, the specificity of the capitalist system is

present. In the former, the authors point out that the hedonistic concept became popularized with classical political economy where it was seen as complementing the principle of utility as guiding economic behavior. Correspondingly, the hedonistic concept parallels the commodity economy in which the social being is constantly presented with commodities in the pattern of buy-use-waste. Here the commodity can be understood as such a sensory input or quantum of utility. The contrary concept of this, which the article supports, could then be argued indicating a categorically dissimilar economic pattern. In other words, the authors' eudemonic mode of satisfaction could correspond to a non-capitalist system, but this is not considered in the text. A reason for this might be that the indices that follow this mode, which the article covers, are not used on a systems-optimal level. It is rather used to measure human development and deprivation in aid agencies at the frayed margins of the capitalist polity. Even so, this text runs contrary to its normative orientation vis a vis our research question.

In what follows I argue that even the article's main proposition counteracts its stance on the Transition Question. The text contextualizes its contribution in relation to the works of IEA, OECD, and UNEP. This indicates that it seeks to contribute to optimize the possibilities for the green transition project. This leaves the question whether it is assumed here that capitalism is managed, and through metrics, and that these are inefficient. It is hard to envisage the hypothesis that the economy is thusly controlled and thus susceptible to improvement, except in the provisioning of resources to poverty alleviation schemes that share the author's eudemonic indices. I find this contribution rather more compelling to prospective economic planning-management. The authors do not conclude to that end, but this potential is already identified:

> "[…] the description of alternatives through technologies or markets only is overly simplistic, since the appropriate unit of analysis is not the single actor using the technology, but instead the community or other larger unit making the decisions which enable individuals within it to use more or less energy to satisfy their needs."

The contribution of this article is inverse the normative prescription it contains in relation to our RQ. Such insights are an argument increasing in power by the distance to a model of transition that relies on the free individual and market as unit of analysis. Indeed, the objective of this article, that is the optimization of models that can direct a life-economy through the green transition, is most useful when coupled with a political system that

contradicts the liberal-democratic form. This insight would then do well if used with a proposal to reinstate the closed, managed capitalism system of the interwar era, as understood by critical theory (Postone, 1993, p. 110). Alternatively, it would be fertile for a reformulation of a planned economy, that is, socialism.

5.3. Summary

With both the investigation of satisfaction concepts and the critical view of the text's political implication, Brand-Correa & Steinberger (2017) ended up a more compelling reason to consider anti-systemic literature than contributing to the green growth project. The Schumpeterian perspective failed in its own immanence while Tokic' anti-finance was wrong. It is curious that green growth proponents that presents theoretical defense seem to fail at doing so. The tendency to draw from eclectic resources may speak to a lack of rigor, a failure to grasp the determinate factors that constitute capitalism in the climate crisis. Against such argumentative strategy, I find the macroeconomic modelling to present a much stronger argument in affirming the RQ. The critique of such methods remains. The projection non-identity was furthermore troublesome and unaccounted for in the literature. The partial usage of factor-equivalence in the models was thereafter troubling, because we research toward a salvaged socio-climate as the real thing, not something that has been expressed in another factor such as money. Lastly, the models were never convincingly able to account for the network of planetary GHG emissions. Decoupling in one scope seldom translates to definite arguments for a planetary decoupling. We do not have the opportunity to pursue the green development literature further. We retain the plausibility of affirming the RQ, that is, finding the TQ to be solved in a carefully managed capitalism. However, the theoretical defense to that effect was lacking. We thus progress to the negative literatures with little present conviction.

6. Managerial transition

The sampled managerial literature blurs the line between the question of exiting capitalism and prescribing the solutions we need to reach zero-emissions both in presentation and arguments. It can be seen as intrinsic to such literature, in that it posits directional control in the hands of decision-makers, that these questions are uninteresting compared to evaluating what needs to be done. This presumption is already problematized against the reality of

existing processes. We touched upon the problem of assuming political controllability in the face of seismic changes in chapter three. That perspective mounts a challenge to managerial visions, but we will not repeat that argument in this chapter. What follows is an engagement with this literature's conceptual bundling of the RQ with the requirements of transitioning on its own terms.

A throughline in this literature is concessions to illiberal means to the TQ's ends. The first article that opens the discussion for such illiberalism is that of Jacques et al. (2023), where the brand of modelling we have covered resurfaces. Topher McDougal (2022) provides a tangent on both accounts. Rather than a macroeconomic model, McDougal touches on the same themes from a novel interdisciplinary synthesis. The illiberal prescriptions that follow are more pronounced. The text (Washington, 2021), however, concludes towards the kind of Malthusian themes we should expect to encounter somewhere on the range of green thought. Washington's is a theoretical engagement that critiques current discourses and the immanence of such scholarship. The first article, however, enters these themes as a candid discussion of the policy pathway that follows their modelling's findings.

The context of (Jacques et al., 2023) is the critique of an argued gap in the literature on the transition question: "Current models are only partially able to assess robust transition pathways as they lack an accurate representation of the interactions between the energy production sector with its inherent biophysical constraints, the real economy, and the financial sphere." Interestingly, the model finds that production factors see an exogenous evolution through the convergence point in this simulation, which is 2060. The authors indicate that these unresolved variables will limit the possibility of economic growth in that timeframe. The study presents an argument for a managed transition through the growth economy but indicates that the growth system indeed will have to end. Another point is that the scenarios indicate a supply firmly outstretched by the larger demand. This they argue "can only be handled thanks to a strong supervision of the economy by the government. We assume that the latter limits consumption of workers and capitalists through forced savings, in order to leave enough room for investment into renewable infrastructure." This further indicates a need for an illiberal management program to see the transition through.

While in a planetary model, this hypothetical will demand management strongly outstripping empirical examples. The Dengist era of China is a largest example we have of suppressed

consumer demand, there used to accumulate means to expand fossil industrial infrastructure (Harvey, 2007). Used contrarily, the practicalities and the ethics of such management is a challenge equally met with the tendential Jevons paradox. This concept would rather indicate a funnel of surplus into further profitable avenues regardless of emission criteria. The authors candidly identify an investment share for the transition needed equal to the WW2 war economy of the United States (Jacques et al., 2023). The conclusion both strengthens an a-growth alternative and indicates that an end to growth economies will happen after the transition. The transition management needed is equal to extreme war economies, and this applies to the planetary fossil industrial economy. Such a strongly suppressed consumer economy is simply unfeasible. The author's views bears similarities to a repressive management scenario that inevitably leads to a future round of restructuring as the pressures of capitalism will meet a growth-death after 2060 according to this article, which then precipitates further transformations. Supporting a capitalist green transition under these terms is a bleak prospect.

In a more transformative view, McDougal (2022) draws a bioenergetic evolution model which looks at human energy use and the prospect of a green transition through a species-level evolution theory. The text concerns the transition prospect of the human species and its extra-human relationships by using evolutionary concepts like predation and mutualism. It posits an evolution of three steps: predation; competition; and mutualism. Coupled with bioeconomics, the evolution to a species-level of mutualism corresponds to a stage of reduced environmental impact of energy consumption. McDougal's is a growth-skeptic call to progress to a system in which inter-species dependency is recognized and human predation on non-human resources is ended by ecological peacekeeping. The call is shepherded by a mix of market incentives and governmental coercion. McDougal concedes to state violence as plausibly necessity to his ends. This text is further alienating in the analytical effort undergirding this conclusion, by its premise of species-level evolutionary steps through which we must pass through.

McDougal's forecasting calls forth an economic system akin to a-growth positions. It is specifically the governance he sees leading to this destination that is divergent. A critical read of Jacques et al. (2023) favors the same perspective on the TQ as the governance proposed here. A pivot to an immediate a-growth program outside market mechanisms emerges here as the sounder and more conscientious policy. If proponents of green growth must concede that growth-death must happen at some point, why not support a change now? Is there not

sufficient literature that provides human and ecological reasons to support such change sooner rather than later? The pursuit of technicality in such transition literature seems to obscure what is important. When the argument must be stretched beyond the limits of credulity to prescribe a pathway, here as a historically unique war economy, I reiterate the worth of critical literature in the climate transition discussion. McDougal's is an effort to this end, but rather than drawing from established critical traditions, he conforms to the pattern we have seen of eclectic novel frameworks. By contrasting his analysis with the various frameworks we encounter in our thesis, such as the explanations given in classical ecological economics, we come to see this stage-based evolutionary conjecture as absurd. This ultimately underscores the precarity of transition proposals in the managerial outlook. It also reanimates the curious identity of managerial solutions and tenuous models of society. A last sample text goes even further in illiberal visions.

Haydn Washington (2021) makes a theoretical intervention in the growth debate. The article targets ecomodernist and neoclassical scholars who, in Washington's mind, present denialism of physical limits in the earth-systems that the politics of the green transition must grabble with. It also discusses a steady-state economic proposal, although with a remarkable Malthusian interpretation. Drawing from a range of metrices like material footprints and planetary overshoots, the transition question comes with a twist: "Clearly, endless physical growth on a finite planet is unsustainable, especially when one has exceeded ecological limits. The question thus becomes: 'but can the economy continue to grow if we do not grow physically?'"

Reorientating the growth problem to the human population size is a macabre specificity. The proposed TQ solution is a steady state economics the author defines with three points, the first being a 'sustainable population', shortly after the author states that population growth is the other half of resource consumption growth as the two sick 'addictions' discharging the climate problem. "A continually rising human population is not sustainable when society is way past ecological limits (Ceballos et al., 2017; Crist et al., 2017; Ripple et al., 2017; Washington, 2019)," says Washington, marshalling a handful scholars who speaks to the 'centrality' of population control against the presumed mass of scholars who are in denial of this factor. The author goes so far as to list population as among the 'endlessly growing' factors. The absurdity of ignoring the basics of demography, the demographic transition model (Kirk, 1996), and the current empirics regarding a global declining growth rate, leads one to question

if there are nebulous ulterior motives to the argument. The question of economic growth fades in relevance as Washington harps about human and material growth. The conclusion ultimately rejects this growth factor too but focuses more on the need to change the worldview of anthropocentric modernism to an eco-centric modernism within which a steady-state economy remains the proper transition solution.

Considering the above arguments, we can entertain the notion that the population size can be a complete non-factor. If we consider material and carbon throughput as a function of the economic system, it is clear this increases because the economy does. The latter's root cause is what Marx famously identified as capital valorization-for-self (Marx, 1990a). Later followers Wood (2002) and Malm (2013) expand on his insight to theorize this self-valorization as a strong system, that at once formed will continue to increase and strengthen itself. This is outside a demographic factor. An increased population is in this light simply an outlet for *expanding* the consumer base, the buyers of commodity production, which if stops growing will turn towards an *intensified* outlet, a consumer base that buys more. Where it to both stop growing and stop purchasing the fruits of the self-valorization, the system would indeed break down or be forced to change, but the responsibility for the consumption relation is not on the population. It is rather due to the capital mechanism, as Marx (1990a, p. 873) and followers documents in primitive accumulation (Harvey, 1981; Malm, 2013). This can be explained as an omni-temporal structuring of the population as dependent consumers alienated from a subsistence outside the wage-commodity relation in capitalism. Even more firmly negating are value-form perspectives that see capital as apprehending the whole world for its accumulation (Burkett, 2014, p. 98). The consumer and the demographic factor become utterly irrelevant under such structural logics, the inner workings of which we return to later.

Articles such as Washington's serve as a reminder that green thought has a tendentially strong history of supporting eugenics as part of green politics (Beirich et al., 2010; Purdy, 2015). Such greens saw the superficial transgressions on the environment in the increasing mass of human activity without identifying a root cause more compelling than to point to the population increase. This applies to the level of governance. Early environmental politics, such as the American national parks, were produced in unity with repression of indigenous peoples. Contempt in nature reservation politics for traditional users is perpetuated today in the fortress conservation model (Holmes & Cavanagh, 2016). Perhaps such ideological remnants are what remains with Washington.

More interesting with Washington is the presented hypothesis that seeks to explain the resistance to changing the growth system and resistance to a consensus that shifts away from pro-growth thinking. The climate problem is ideologically denied "owing to neoliberal hatred of any regulations that could restrict activities of business." The natural-ideological denialism presented doesn't suffice to explain a general resistance to growthism. Neither does it seem robust as a theory. I would be gravely cautious to assign natural traits to humans, especially on a species-level as in this article. Further, neoliberalism as a polemical object is increasingly trite (Dunn, 2017; Venugopal, 2015). Environmental apathy implicates almost every governing political program or socio-governmental composition there is, Washington should not restrict this to neoliberalism. Neoliberalism as object is largely a fetishization of financial pressures in an analysis that instead should see this as corresponding to the production factor. The object criticized in this context should remain capitalism in general. In the context of assessing the TQ, it makes little sense to be restricted to a neoliberal epoch, which the turbulences of 2020 and 2022 arguably signaled and end of (Kılıç, 2021; Saad-Filho, 2021). Washington's effort remains instructive only as polemics in this academic debate, and even here I miss an effort to engage with the progressively more robust models used to argue for a pro-growth pathway to the green transition.

Washington's ecological economics and ecological ethics research embodies a failure to note statistics on the human stratification of the ecocide perpetrators (Hickel, 2020). It is also a failure in mediating between his Malthusian bias and the contrary of the demographic model theory, the latter supported by global empirical data (Roser & Ritchie, 2023). Note that this criticism is directed at analyses that posit demography as a strong factor. Neo-Malthusianism properly reckons with more factors (Meadows & Club of Rome, 1972). The point is to relativize demography when compared with structural critique and see the precarity of the prescriptions that emerge from Washington's mistake. It is further troubling that this article is published as a special issue of financial scholarship, thus placing eugenics on the green agenda to the financial community and positing it as equally valid to material abatement schemes. Perhaps this remains a case study of the earlier problematized prospect of instrumentalization of climate science. In his context we should rather explain the critical perspectives that point to innate dynamics in capitalism as a part of the problem.

6.1. Summary

Washington's example further illustrated the precarity of posing a managerial pathway as the TQ solution. This article, along with (McDougal, 2022) and (Jacques et al., 2023), advanced the conclusions we found for the green development literature sample. The calamitous ecological ethics of Washington signified the need for a critical intervention in the debate. Malthusian misanthropy warned us to consider deeper problems in the transition debate than the problem of fetishistic disavowal. Green growth defense in theoretical form implied novel approaches and a deficit in rigor. Here the similar traits emerged in literature that approach the TQ in the same policy context as above, that is as operationalizable governance in current political structures. It is yet again the empirical modelling which was most robust, but prescriptions thusly nestled encounter social and ethical dilemmas that were unresolved. The latter was more strongly pronounced in the managerial approaches. It is with the remaining samples that we must now look for a resolution to the problems we faced in the transition literature thus far. These have in common normative visions for a pathway to a zero-emission system that is transformative against the current system.

7. Normative transition

The function of the governing, top-down viewpoint of inquiry made for an ethical concern and a latency for violence in the managerial literature. This problem is innately negated in normative visions of social change. The function of mediating existing constraints with utopian intent sets an agenda which can produce resolutions to the above problems. Such literature is analyzed in the following.

Throughout the normative literature sample, we encounter identification of the crisis with various theoretical propositions. These are often marshalled in union with empirical data for planetary emissions to support the envisioned pathways in these articles. Throughout this chapter we analyze the way the RQ is grounded, that is, the reasons this literature gives for calling for systems change to reach zero-emissions. Such reasons take the form of attempts to explain the climate crisis at the locus of a socio-ecological theory. Throughout our journey, this thesis aims to critique these attempts and in so doing reconstruct the environmental crisis theory from which the definite explanation of the crisis unfolds, and from which a green pathway can be grounded.

7.1. Empirical explanation

Typical among the empirical arguments are the kind of global GHG trends that tend to underscore the basis of literature in the degrowth current. Emblematic of this is a first sample from the towering degrowth figures Jason Hickel and Giorgios Kallis.

This article, (Hickel & Kallis, 2020), is a review paper that analyses policy literature using the heading green growth. It takes an interest in finding how the premise of absolute decoupling of material throughput against economic growth measures to empirical evidence. A key finding in the article is that numerous studies and indicators compromise the empirical argument for decoupling on the global level. They ultimately state that "it is empirically feasible to achieve green growth within a carbon budget for 2°C with the most aggressive possible mitigation policies if the growth rate is very close to zero and if mitigation starts immediately", that neither the theory nor the critique of degrowth is conclusively settled, but that the only course that makes political sense is to reject green growth. Similar positions on the RQ, the question of reaching zero-emission in the current paradigm, have already been identified numerous times.

Such an analysis is a step forward for the TQ assessment based on empirical trends. The current analysis has a stronger grasp of the planetary logic of emissions, a logic which is crucial to properly assess the trend of the global economy. The historical-empiricist method is the same between this and the previous modelling articles, but it is important to avoid the spatially restricted scope from which decoupling is supported. A problem with the present article's argument, however, is that the models reviewed are less sophisticated than those we find in ecological macroeconomics which support growth. Kallis and Hickel rely on modelling in articles published in years like 2015 and 2016. In some of our sample literature it is shown that macroecological models are a rapidly evolving field where strong gains in the modelling sophistication is noted as recent as in 2023 (Jacques et al., 2023). It is thus poorly attuned to possible trends toward stronger decoupling in recent futures, while at the same time providing stronger command of emissions at the planetary scope than in such typical articles.

Ultimately, the dueling of statisticians that appears as subject of the debate across these papers is inconclusive and unsatisfying as proof upon which to roadmap our future. The prime issue I have with this way of handling the TQ is that this is a game of statistics without the

complement of robust theory. Arguments over skewed parameters and maladjusted priors fail to show a firm grasp of the underlying problem with the emission economy. The authors have a focused critique of the materiality of the growth economy, but they seem to avoid theorizing the essence of the problem. Among Marxists, in contrast, a conclusive determination of the climate crisis tends to be posed in the interiority of the matter-economic value relation. That perspective will surface in our later effort. A convincing theory is needed in combination with the statistical game to offer a better answer to the Transition Question.

7.2. Economic explanation

The above contention spoke to a lack of rigor in establishing the normative basis for a TQ assessment. We will therefore apply the normative transition articles from our sample theory for their explanations of the crisis.

A first encounter with theoretical explanations for the climate crisis is those that posits economic factors as the causal perpetrator. Predominance for economics in explaining macroscopic development is a recurrent trait in heterodox literature. Marxism is especially prone to this, here we have the legacy of orthodox Marxism that established the conventional wisdom that the economy is determinate in the final instance, an 'economic determinism.' The following sample texts follow suit in positing economic forces as the relevant factors to consider when we look at the prospective futures of the TQ. As a logical consequence, we also become attuned to arguments over peculiar dynamics that destabilize our RQs. Not only is the question of achieving zero-emissions relevant following this, but also if the determinate economic forces in our society already propel us to a trajectory into different futures.

The paper of (Yu, 2020) offers a theory model that posits two propositions that invoke emergent dynamics that interact with our thesis objectives. First, it poses that we are approaching grave risk of a world war. It then posits that we are approaching the end to the final stage of the capitalist system, that it is inherently on the cusp of breakdown. Collin Chambers (2021) offers the prospect of a revolutionary rupture with the system by the agency of the proletariat. When determinism of the proletariat as subject is described, we recall the Marxist Hegelianism listed among Cassegård's and Dybedahl's dialectics. The argument posits that Hegel's Geist inverts to materialism, thus having the teleology of a subject of history which must be in the material world. Lukács famously reasoned that the proletariat is

this subject (Lukács, 1971). We have already seen the different ways subject is posed, which shows that Lukács is not authoritative. The theory can also be questioned empirically. Neither should we forget tendencies where the validity of the category ‘proletariat’ is contested. There is in short no reason to hold onto the present position.

Bin Yu follows instead the causal dialectics we see in Cassegård’s overview. The argument draws from Lenin’s imperialism thesis that posits imperialism as a developmental stage of the capitalist system that comes about with the emergent monopolization Lenin observed at the turn of the 20th century (Lenin, 2017). The thesis extrapolates this observed tendency to explain the general development of capitalism. This argument rests on the version of dialectics that Lenin applied. This type of causal dialectics was inherited from Plekhanov’s mechanical materialism (White, 2015), that read Engels, and Marx through Kautsky’s interpretation (Kautsky, 1909). These posit an ontology in which matter moves through certain laws (Engels, 2020), such as that of the transmutation of opposites. The schema in the inherited theory assumes that these dialectical laws can be observed if the correct elements are grasped, that is, the properly determinate relations in the material world. Drawing from Marx, the determinate relations are the causal drivers of the world, including the class structure and production capacity distribution. A cogent continuation of this was to see the macrostructure of the economy as the causal drivers in the time of Lenin’s writing, and he could thus posit the transmutation of opposites within the structure of the economy-as-imperialism as an ontological premise. We can thus arrive at the argument that Lenin’s theory presented the change from competition to monopoly, mediated through observations and the above theory, as an unfalsifiable position. This sequence seems problematic as a philosophical system.

Yu anyhow reasons thusly to deem the imperialism thesis relevant to an ‘old’ imperialism, but that the postwar restructuring demands an update on the theory. The crucial element of the new phase is identified with the currency arrangements in place with the collapse of the Bretton Wood-system, where petroleum transactions started to default to USD usage. This was a position that privileged the US economy. This article detracts from typical commentary on the ‘petrodollar’ to focus of the institutionalization of US-issued IOU’s. Currency floating and the world financialization in the 70s, here in fact periodized strictly as 1973, is defined as beginning the ‘neo-imperialist era.’

The other trajectorial dynamic Yu attunes us to is the argument that capitalism is inherently near its systemic death. To this end Yu uses Lenin's theory of capitalism as a stage-structural model. First it was predicted imperialism in the Hobsonian sense (Etherington, 1982), was its ending. Doomsday prophesies do indeed abound, but there remains the argument that we are approaching certain biophysical constraints that demand something change. The strange aspect of the argument is that ecology is not considered accordingly. In the ecological sphere Yu only extends the argument to value-capture of nature. This is a strictly economically determined theory. The perspectives at face value are worth considering. Geopolitics remains an important concern, and we can apprehend its influence in the case of war or extreme great power competition that will restrict the public sphere for the sake of national competitiveness such as with interwar fascism and the cold war system. However, the argument of a systemic end depends on its theoretical underpinning to a much stronger degree than the prediction of war. As we investigated the tenuous anchorage of the Leninist ontology in the section above, and as we contextualized it in the broader history of various uses of dialectics, we should be prepared to discard this thesis.

In this section, then, we have seen two versions of economic determinism that recalls one-sided theory and different uses of dialectics in the Marxist tradition. The emergent perspectives have attuned us to dynamics destabilizing the RQ, and in so doing help to expand the scope of the heterodox transition discussion. On the other hand, these arguments are poorly supported. The themes of revolution and war might be current, but this is not the case because of the theory advanced. A theory constituted one-sided in economic factors is not adequate. More curious is it that Yu sees the seigneurialism of 'neo-imperialism' in the green financial sector, and that this is a key part of the conflictual dynamic. Here Yu is consonant with contemporary trends in political ecology that sees climate mitigation policies as new avenues of profit capture (Fairhead et al., 2012), some which even argue it presents a struggle to capture rent on carbon regulations that prey on and undermine the ecological purpose of such policy (Andreucci et al., 2017; Felli, 2014). To close this section, it should be mentioned that the emergent perspective of value-capture in political ecology, which Yu incidentally encounters, is one that could contribute to the transition research. We will indeed find this moment pivotal to our analysis.

7.3. Socio-economic explanation

Unimodal explanations that privilege economic factors are not sufficient in developing a climate crisis theory. The next attempt is to integrate social dynamics into the previous model. This section draws from the conventional heterodox ecological terms that speak to the climate crisis. An article from our sample literature approaches accordingly.

The article (Gunderson et al., 2018) presents a theoretical intervention in the debate over energy technologies for the green transition, specifically the aspects of the energy boomerang effect. This is a term denoting various unwanted side-effects of energy technologies. Importantly here is the paradox in which the development of green energy technologies tends to increase total energy usage rather than limiting polluting energy usage. The authors argue that a more proactive attitude to techno-fixes can make the degrowth project more feasible as a solution to the TQ. The authors enter these debates with the methodological principle of intersecting what is with what is possible. To borrow this perspective to our overarching goal, as the problem remains to solve the TQ, this implies drawing from different existent social contexts in use of current technologies to argue that the green transition is completely tangible and politically approachable without having to bet on unproven technologies such as BECCS and fusion energy. Writing of a degrowth scenario, the implementation of community-owned renewable energy is taken up. This ultimately represents a view in favor of Elinor Ostrom (1990) in the debate over commons, contrary to the immiseration thesis of Garrett Hardin (1968). Economic commons can be regulated sustainably among its users without collapsing because of self-interest and competition. The argument is that:

> "[…] economic degrowth and the collective ownership of energy systems would provide conditions conducive to mitigating this paradox, or, to better realize the potential environmental gains of alternative energy converters. A degrowth society with a collectively-owned energy system would allow for a reduction in total energy use (including non-fossil fuel-based energy use) as well as a lower ratio of fossil fuel energy to alternative energy."

This argument presumes that there is such an energy paradox that hinders immediate savings in energy usage and/or emissions. It presumes that to common the energy sector leads to changing social relations where this effective reduction takes place. Discussing counterforces to emission-savings interests us here. Through this interest we encounter various observations of such counterforces, be it the Jevons paradox or the energy savings paradox described in the

article. This point is not in contention. The argument that energy commoning negates this counterforce, however, seems more dubious. The argument goes that energy savings are trapped by the pressures of the market contra the commons, therefore that we need to be "moving away from energy as a market-based entity to energy as a commons." The problem here is that commoning as a solution implies that the problem is in exchange. If energy as production for the market were to be production for the non-market, the problem of growth in market-competition is solved as non-growth in commons-mutualism. The problem arises if we look behind energy production. Is changing the social relations for the recipient of energy production enough to change the energy production, or is energy production determined elsewhere? Among scholarship interested in both the growth impetus of energy and the social relations that emerge as a problem in this text is the environmental sociology of Political Marxism, the school of Marxist analysis centering relations and agents over forces and structures. Drawing from a reconstruction of Marx' theory from the perspectives in *Grundrisse* (Marx, 2005) cf. (Murray , 2013; Vik et al., 2022), the proponent Mau writes that the mature capitalist system contains a production- and a consumption logic that is mutually reinforcing, that is existing in the present time or in the mature phase of capitalism will reach a circularity (Mau, 2021). Researching the coal-industrial breakthrough in Britain, Malm identifies the same structure as empirically history (Malm, 2013), thus lifting this argument from scholasticism to a highly current diagnosis of the tenacity of capitalism and its continuing identity with GHG emission increases.

This perspective seen in light of the energy-commoning question means that the previous schema is incomplete. It doesn't make sense alone to alter the output. The determination of energy production as something that is locked in a growth impetus is ultimately bound in both ends, both in the producer and in the market. To break this circularity the production system itself must change, and this would mean to shuffle among the factors of ownership and funding structure, the owner and labour relations, and the production objective of energy-commodities to non-commodity production. This requires a shuffling of the system until it is something else, something that breaks with capitalism's circularity. The authors clarify that their degrowth politics inevitably is a form of socialism. Through the above contention, the case is instead made that this idea of degrowth socialism must imply greater changes than tweaking ownership and market outlets in energy production. It implies a strong form of social transformation which only parts of degrowth proponents argue for (Saitō, 2023). The transition must be strong because it is now the pivotal logic of commodity production and the

foundational division of labour that is the focus of transitioning, not ownership structure or type of produced goods that tend to be the themes in degrowth (Islar et al., 2024). Social relations cannot remain while the economic factors change. The social relations must change, and this will in turn condition the economic factors. Indeed, this perspective leads to the proposition that our theory must be constituted in both economic factors and social relations.

7.4. Integrated ecological explanation

The previous argument established that an account of the crisis needs to grapple with both the economic factors and social relations in our society. We first argued that lopsided outcomes follow from an account that considers the economic forces to supersede other elements in a theory. This is important to underscore because of the historical legacy of such economic determinism in critical thought. It is now time to consider economic forces and environmental factors as mutually determinate, as co-constitutive to our theory. Analytic scopes that try to integrate environmental and economic elements develop the kind of hybridism we encountered in the survey. The fleeting hints of the need to consider such environmental hybridism develop fully in this section. An expression of this is to consider society and nature as co-constituents, which Jason Moore's oeuvre attempts to do (Moore, 2021).

Of the many topically current articles published by Moore in our timeframe, only an unpublished paper, drafted on the author's website, made our literature search. It is moreover a highly emblematic text of Moore's scholarship in the period of his research where the world-historical analysis of the ecological crisis was taken on. Moore advanced his world-historical thesis in several texts in this timeframe, the present unpublished text included. These are all presented most thoroughly and systematically in the book *Capitalism in the Web of Life* (Moore, 2015). To uphold the rigor of peer-reviewed material, the following presentation is in correspondence between this unpublished essay and Moore's corollary offerings.

The article presents an essay on the world-history thesis of Moore. This is chiefly scaffolded on Fernand Braudel's world-history (Braudel, 1992). Braudel developed the theory of a world-economy, denoting a bundle of production, circulation, and consumption networks that could be analyzed as a cohesive system, not covering a whole world, but being at a 'worldly' scale. Giovanni Arrighi attempted to refine Braudel's work by systemizing an economic logic

immanent in Braudel's history (Arrighi, 1994). More updates this framework to account for the way nature, the environment and material factors corroborate this world-economy. In so doing Moore identifies peculiar ways that the physical world is subsumed under capitalism in historical perspective. From this can be drawn new insights about the constitution of the climate crisis.

In the current sample we encounter the term Cheap Frontier, denoting a barrier separating the current network of economic circuits with a zone of resources, which if inhibited will fundamentally generate an upswing in this economic circuit, typically by providing cheaper inputs in resources and acreage (Moore, 2000). The chief example is the Colombian encounter with its dispossession and appropriation of hemispheric resources for an existing Eurocentric economic circuit. Moore sees the centuries long economy following this encounter meeting a downswing as the frontier closes, the annexation of 'unnaturally cheap' economic factors is coming to an end with the modern economic integration of the western hemisphere. What will follow from this is a return to a hitherto unseen 'real economic baseline.' Moore argues that the above history represents capitalism as a geological force and that its macroscopic conditions will fundamentally worsen, leading to secular decline and/or opportunities for systems change (Moore, 2021). Moore uses the term epochal inversion to describe the specificity of the capitalist system in this current phase. This is what Moore premises for this epochal inversion:

> "[…] entails not only a transition away from the web of life as profit-making opportunity but a transition towards an epochal resistance to capitalism's Promethean drive. The "taming cycle" through which capital, empire and science realized control over limited spheres of life is coming to an end. Superweeds, superpests, super-diseases are altering the geographies of capitalism and everyday life in ways that are frustrating the disciplines of capital. This is destabilizing the profit calculus of world accumulation as we have known it for five centuries (ibid.)."

Here the text points to a contradiction internal to the economic circuits of the system, the aforementioned closure of systemically underpriced inputs due to the great frontier. It also points to a contradiction external to this circuit, or something enmeshed in the economic circuit with the ecological. This can be understood as unvaluated nature that conditions economic circuits. The current crisis represents the economic downturn mentioned before, and

the consequences of the unmitigated deficit in the reproduction of the conditions of production both ecological and social, and the deteriorating planetary ecology in total.

This exposition points to two avenues of interest. A general contribution to the assessment of the TQ is evident in positing an economic normality that has been distorted by the Columbian encounter and thus hidden for centuries. This also recurs a discussion with the previously established problem of dynamics adjacent to our RQ. In the following, however, we look at the constitutive relations to Moore's theory that is implied thus far.

When the above theory conceived of conditions behind the reproduction of the economy, that is, Moore's view of something external to the circuits from the above, it follows O'Connor's thesis of the second contradiction (O'Connor, 1991). For Moore and O'Connor before him, the second contradiction denotes the eco-Marxist scope of analysis. While the progenitors analyzed the relation between worker and production, they systematically missed the problem of ecology's interaction with capital's production and circulation. Ecology conditions capital but is not reproduced like capital and must thus be integrated into the analytic scope on the same level. A second-generation intervention into this thesis is to integrate feminist reproduction theory (Federici, 2019), which sees human sociality also being produced outside capital's valuation and thus reproduction, and outside eco-Marxist theory. Nancy Fraser would reconstruct O'Connor's theory with such insights addressed (Fraser, 2022). It is here, too, that Moore's theory domains. Other thinkers who make the effort to pursue the effects of the conditions behind production and reproduction tend to present these dynamics as auxiliaries to the capital relation. Moore differs in taking the step to consider capital and nature as mutually co-constituent all the way through. This is expressed in the 'double internality' of capitalism-in-nature, and nature-in-capitalism. The stake from this reconceptualization is evident in the rift-or-shift debate in eco-Marxism.

Earlier contributions to this project developed Moore's conceptual shift from the metabolic rift perspective towards a new 'metabolic shift' perspective (Moore, 2011). Here Moore updated Foster's Rift to consider nature and economy as co-constituents, which reframes the climate crisis to *shifts* in the metabolic relations, rather than a collapse through the *rift* perspective. Because of this, the question over society-nature determination is the essence of the rift-or-shift debate in eco-Marxism. Proponents of the metabolic rift theory have strongly criticized Moore for engaging in conceptual hybridism (Malm, 2019). Society and nature as

separate scopes, they claim, has a normative orientation that correctly grasps the stakes of the climate crisis. This perspective finds that hybridism muddles the analytics of the climate crisis and is thus an irresponsible position. Underpinning this is Foster's ecological teleology, that sees capitalism collapsing through this rift. For our concern with the RQ, it is to the contrary more beneficial to retain the plausibility that this is not the case, that the climate crisis rather morphs the socio-economic system in unexpected ways. Thus, Moore's article prepares us to consider the superiority of grounding the ecological and economic as mutually constituting.

The second avenue of interest Moore attunes us to is through another instance of *dynamics* that upsets our thesis' premises by offering novel perspectives around the research question's premise. The following presents the pursuit of this point. During this presentation, the question of social relation vis a vis the double internality comes to the fore. This deepens the theoretical work that we are undertaking in this chapter.

The dynamic is Moore's view of a macroscopic trajectory of the capitalist system moving without an equivocation to the agency of us concerned with the green transition. If capitalism is dependent on a relative fixed matrix of environmental factors in accumulation, and these factors are pointing to an impending environmental catastrophe, Moore can predict a massive upset in the system. Moore do not reject the ecological rift, the point is rather that a co-constitutive view provides the analytic tool to pursue both a collapse narrative and a narrative of an ecological fix that implies a massive transmutation of capital's relation with nature, the *shift*. Indeed, what for rift-proponents is a social cataclysm, Moore has entertained as a potential triumphant rupture against the system (Moore, 2014). His text connects the climate crisis with the Late feudal crisis, for Moore like Silvia Federici a golden age for underclass living standards (Federici, 2021, p. 51). The hypothesis then develops that the coming climate crisis can be welcomed as a restructured social system which enables liberation. This working hypothesis clearly posits social relations as determined by the 'double internality' and not as an active factor with its own causal determination with other factors inside the development of this hypothesis. Moore is certainly concerned with the social relations in the problem and thus terms like 'biotariat' are produced. But such agents are presented as resistance to the secular logic of the double internality of economy and environment. Therefore, Moore sees the present dynamic inverting in a political counterforce, revealing the adherence to Cassegård's causal dialectics in this work.

The theory for a reckoning with the trajectory of a greening capitalism is valuable. It is, moreover, something with the same tenor as in established nodes of inquiry from ecological economics. The scholars in these fields who, like Hornborg, theorize around the ghost acreages of resource- and land use that can be expressed as capital, work around the same fundamental insight. The socio-ecologic composition of our world that the economic logic works through, is built on the fundamental assumption that energy use can be drawn from compressed sources, that is, fossils. A change away from fossil energy thus requires unimaginable changes in the entire socio-ecological makeup of this planet. The specificity of Moore is to ground this perspective in a cohesive historical analysis, and to point to the economic consequences of the concept of a green transition. This is the epochal inversion and the Great Implosion of capital-nature. It is with the logical throughline from Moore to the prescriptions for a crisis that reveals the limits of the theory as it stands.

The ambiguous assessment of a crisis with Moore's view rests on the supposition that social relations are determined by the ecology-economy determination, the 'double internality.' If social relations and economic forces are rather mutually determined, the opportunities in the shift-sans-collapse that is presented as plausibly generative above, would rather be unambiguously negative. An ecological shift-sans-collapse will not dissolve the social composition of class society, because these existent relations already co-constitute the other factors. The whole point of the article in our context, that is, as a perspective of something against capitalism as crisis perpetrator, will as such fail on its own premise. The climate crisis can only be negative for social relations, something the rift-proponents correctly grasp. The analysis has instead helped to develop the argument that the 'double internality' must be socially co-constituted.

7.5. Summary

This chapter presented the normative transition literature and analyzed the theoretical underpinnings such normative prescriptions emerge from. I presented these explanations in a successively complex order and argued that each conceptualization is lacking. This led us to reconstitute the theory from the strongest position available, in our literature sample this being Jason Moore's. With Moore we overcame the unimodal explanations of economic determinism and co-constituted the environmental factor in the climate theory. Moore's thesis does not, however, appropriately balance the determination between the economic forces and

social relations, his theory is too deeply indebted in the classical Marxist determinism of productive forces to achieve this. In Moore's works this is expressed as a determinism of productive forces that are mutually economic and environmental.

We will apply the insights here to a synthesis with perspectives that negate this determinism and instead aim to co-constitute the social relations and economic forces. We encountered one perspective that considers such socio-economic co-constitution and engages environmental analysis on that foundation. This was an analysis that gathered from the new readings of Marx, the theories of Political Marxism and value-form theory, which revolve around the concept of a mute compulsion of economic relations (Mau, 2021). Here it is not the economic that determines the social, but the social is equally enmeshed with the economic to produce the socio-economic interiority of capitalism. In my mind, an integration of this perspective with the boons of Moore's theory can be a higher synthesis of the heterodox theory that tries to locate the essence of the problem, an identification that enables a better basis from which to produce a solution to the TQ.

8. Transition Question

We hitherto approximated a theory of the climate crisis that can contribute to determine the TQ. This chapter takes on the typology of theoretical positions that emerged as the most valid arguments in the literature discussion. It is identified that these positions are constituted by a specific set of fundamental assumptions, and these will be resolved in this chapter. Inquiring about the base veracity of the constitutive assumptions allows us to approximate the definite answer to the RQ in these literatures. Three samples from our literature analysis engender this exact perspective and are thus treated in accordance with this present endeavor.

8.1. Empirical commitments

The first of these articles is that of Pearse & Bryant (2022), a use of the value-form theory we have encountered and mediated throughout this thesis. The authors dance around the concrete TQ but write a clear implication to their position. The article draws from environmental geographies that poses that fossil fuels condenses and enables a society based on a highly specific condensation of spatial, material, energy -throughput and social capacity, et cetera. We can call this bundle of materiality world-use. A carbon transition will thus decondense the

web of life built atop the fossil fuel use, thus increasing this world-use enormously and bring with it severe impacts. Moreover, it does not follow that a transition is systemically improbable. This deference to factor-equivalence in a socio-ecological transition mirrors that of ecological economics which sees the crux of the problem in that fossil fuels condenses the spatial-material resources needed to emit usable energy, such as Hornborg's ghost acreages (Hornborg, 2006), a fundamental insight we have seen sharing tenor with Moore's world-ecology. The position that only an empirical account of the transition can ground the TQ remains with us.

8.1.1. Ecological economics

In the ecological economics we engaged, a green transition is a matter of expanding the spatial-material resources for energy use and the ballooning socio-ecological ramifications that follows. Hornborg (et al., 2019) likewise demands that the analysis takes on a multicausality that is seen as missing in Marxist and 'mainstream assumptions.' The authors in the present article, and Hornborg throughout his career, stress that an account of flows in the earth-system must be valuated as people really do valuate things. The distinction between the concept of value and market pricing is seen as obscuring the real stakes of their research, that is, quantifying the wealth in real material flows. Such concept of wealth follows from early marginalist critiques of Marx and Ricardo, where labour is substituted for the monetary realization for a commodity in its exchange based on utility (Clarke, 1991, p. 185). The marginalist economic breakthrough contained the axiom that only the act of realization revealed what traders were willing to valuate. In what we can call the Hornborgian metabolic approach, value is thus on marginalist foundations, marking a divergence from energy valuation or labour valuation in what we have hitherto seen. Here is instead a framework of wealth measured in market prices.

If nature is appropriately monetized and global trade eco-regulated to account for climate impacts, this perspective makes compatible the prospect of a capitalist decarbonization. If people 'just decide' to realize or determine value in mitigated climate impacts, the market trends toward less emissions. This is evident because capital conforms to value, either as labour abstraction or as a unit of what we just discussed, marginalist wealth. We thus arrive at the point where Hornborgians who have no value theory leave open the possibility for a capitalist green transition. This perspective circles back to the problem of naked empiricism.

If our models can detect a decarbonizing trajectory, the TQ is solved. However, we already established contrary positions to such empiricism. This position on the TQ thus seems precarious. The twist is that the same holds for the Marxist approaches.

8.1.2. Marxist value

In the Marxist approaches, the labour theory of value is central. However, the application of this theory to macroeconomics tend to recur a problem of establishing exactly this labour-value firmament, which leaves Marxist economics as a proper methodology uncompetitive (Heinrich, 2013; Steedman, 1977; von Böhm-Bawerk, 1949). Indeed, the leading means to recuperate value-labour is a method of infinite-bracketed successive approximations between price and value (Shaikh, 1984, p. 79), the distinction between which is classically called the Transformation Problem in Marxism (Clarke, 1991, p. 139). This is hugely impractical and functionally avoids the problem by offering a solution that amounts to a bad infinity. Such an unresolved theoretical problem is inadequate as the frame from which to assess our common destiny.

If we now relate the above to the evaluation of this thesis' RQ, that is if society can succeed with this green transition paradigm, we see that there are several lines that point to negation. With Hornborg there is a predominance of empiricism by way of marginalist quantifications to falsify the current projections at the planetary scope (Hornborg, 2011). With Marxists there is an inherent logic that concludes in the negative. In both respects, money-as-it-is or money-as-theoretically-something, the problem is negated, but done so only in part, a part which will be elaborated shortly. The affirmative opposite, however, remains unfalsified and will return to us later. To the present point, while the labour-value problem remains, the rigorous position is to locate the RQ negation outside this value theory. We can therefore say that theoretically-empirically, the RQ is negated, but in a fashion that advances the flaws in this heterodox literature. An attempt to overcome these flaws to then strengthen this conclusion follows. This attempt takes on a foundation that has recurred with our thesis, and we return to it now.

8.2. Value-form approach

A theory immanent to our established discussion that eschews the limits of empirically affirming value-labour on the one hand and empirically the trajectory of capitalism on the other, is that of the value-form theory in the later Marxian tradition. We have seen how Pearse

& Bryant (2022) uses this tradition with an ambivalent attitude towards metabolism. Their divergence from pioneering proponent Burkett underlines the heterogeneity in this community too. With Burkett value is rather the eco-crisis *tout court*. Burkett explains that the core argument in the value concept to ecology is that a green capitalism, and thus an affirmative to the RQ is categorially impossible:

> ”the value-nature contradiction cannot be resolved by private rents or by grafting “green” tax and subsidy schemes onto an economic system shaped and driven by money and capital. Ecoregulation using monetary and market-based techniques is the pursuit of an “optimum” on capital’s terms. Value, with all its anti-ecological features, remains “the active factor” disrupting the co-evolution of society and nature due to its treatment of people and nature as merely “disguised modes” of value itself (Burkett, 2014, p. 98).”

Here we can draw an understanding of the climate crisis as a world in itself abstracted to the production of value by capital, the “modes of value itself.” There are no means to reconcile value with the climate because climate and the problem therein has become nothing but a function of capital. The atmosphere has undergone real subsumption, becoming the produced nature theorized from Neil Smith onwards. However, this perspective hinges on the strength of the value concept used. Burkett sees value as “the substance of wealth in its specifically capitalist form” and “the abstract social labor time objectified in commodities (Burkett, 2014, p. 79).” If Burkett’s value is economically grounded in individual commodities, as with Marxists, the issue with the above theory of climate crisis remains. We have seen that value as an economic measure is problematic.

8.2.1. Non-valued value

Certain value-form proponents, however, reconstruct a Marxian social theory where value is rather a social-theoretical anchorage, a part of a method of determinate abstraction that researched not economic units but the social constitution of the appearance of our world by reference to its underlying dynamics (Clarke, 1991, p. 139). It is not something that should be subjected to econometric scrutiny. If we apply the value-form theory as a diagnosis of capitalism, we can pose that it hitherto has formed a systemic logic where environmental protection and emission reductions is categorially irrelevant. For the question of quantifying environmental dynamics this perspective leaves open to the ecological economists’ methods

in favor over the value-labour commitment in Marxist economics. Such ambivalent perspectives are discussed in what follows.

8.3. Hybridity

Lastly, we return to the nodes where a green transition is unfalsified. Here we have constructionist thinking that problematizes the hard boundaries between nature and environment, making the establishment of limits and their overshooting difficult.

8.3.1. Constructionism

Hybridism in the form of radical constructionism is arguably incommensurable with our objectives. This mode of thinking contributed with a discursive rejection of the 'hard limits' in the climate debate. Proponents are right in contesting the simple category of measured 2 degrees heating as the axial on which we argue our futures, but when this becomes an orientation that ignores the robust counterarguments we have covered, it's hard not to see it as overtheorizing towards the wrong conclusions. Especially Escobar's (1996) radical constructionism posits an analytic where it becomes virtually impossible to prescribe climate politics. We are rather interested in socio-natural interlinkages that speak to our political interpretations of biophysical evidence, not ones that cast earth-systems science into the doldrums of epistemic relativization. We might, however, see such approaches diminish in light of the new climate debates. Commentary on Latour is instructive in this respect. The commentary points out that he undertook a theoretical moderation in later works by conceding the following:

> "some modern processes are characterized by relatively stable networks, which allow them to be analyzed by conventional sociological categories. In contrast, he has suggested that his own approach is best used for dealing with unstable and/or emergent socionatural processes that are thrown into crisis (White et al., 2016, p. 135)."

8.3.2. Hybrid materialism

Outside the applications in the post-structural discursive paradigm is hybridism as frameworks in which to explore the material word, hybrid materialism. This resembles more the stable categories in the above. The self-identification of these proponents is: "Hybrid materialists find the preoccupation with external limits to be less compelling (White et al.,

2016, p. 152).” For these scholars it is inquiring how society and nature co-constitute one another in varied ways that is pressing, indeed to research “how they both instantiate and reflect capitalism in varied ways.” Neil Smith, which we saw together with Harvey was instrumental in developing political ecologies that began decomposing the cartesian binary of society-nature, is formative to these viewpoints. With Smith we should speak of a category of nature produced by capitalism, which follows after a natural first nature was subsumed by nature as apprehended by capital, until only the constructed capital-nature is left in our analytic scope. The proximity to constructionists is evident, but it is important to realize the hard root of social critique that points to Marxian theories of capitalism as Smith’s point of departure. In the context of the Leviathan where we need hard material evidence and, following, robust political directionality, this legacy is expressed in a much more ‘responsible’ formulation with Jason Moore. With Moore we saw the ‘double internality’ that co-constitutes the economic and environmental, and I have argued that this is the proper depth our theory requires, in addition to a corollary in social relations. From the previous chapters it should be no surprise that the category of hybrid materialism emerges as central to our dialectic.

8.3.3. Hybrid value

In the pathway undertaken in the parent heading are also socio-ecological conceptualizations that resort to empirically conclude the problem. One final sample from our analysis offers a novel perspective of a capitalism mutating towards a developmental logic that bypasses our critique to leave the emission-relation ungrounded and thus completely free to empirical interpretation. This perspective applies the hybridism we just covered. Recall Yu’s article striking consonance with half-recent trends in political ecology. Here we have an emergent movement for capital to integrate ecology deeper in its reproduction system. This is softly recognized in Cassegård's work too: “[...] geo-engineering threatens to become capitalism's next large-scale step toward integrating itself fully into the circuits of nature (Cassegård, 2022, p. 199).” This theme is taken up in the final article we have sampled in our literature analysis. Leonardi (2021) has the objective to incubate an encounter between two currents deemed increasingly influential in the debate over and through the Transition Question, the theoretical-normative position of autonomism, or workerism from *operaismo*, and world-ecology. This strongly recalls the interlinkages this thesis worked with in the higher-order meditations of our systematic dialectics from the previous chapter.

To the present, Leonardi finds in Autonomous Marxism the analytic of social constitution in its primacy of relations of production, and in world-ecology an environmental theory that is socially and ecologically constituted. With this commonality the author seeks to make a synthesis that grapples with respectively the prospective collapse and adaptability of capitalism in crisis perspective. Leonardi finds that world-ecology has a society-nature dualism in its value theory. Note that this this is distinct from its nature-society integralism that it draws Marxist attacks for (Foster et al., 2011, p. 73). Leonardi reckons this to be a theoretical failure in the face of contemporary political ecologies which sees a new hybridization in capital's value production: "post-dualistic indeterminacy that characterizes both geo-engineering and bio-technologies does not represent an obstacle to the deployment of capital; rather, it acts as the premise of a "new mastery of nature" (Leonardi, 2021)." This identifies a tendency in capitalism to overcome its current contradiction between valorization and green abatement, that is, the need to mindlessly grow or reduce growth to save the environment. While the idea of capital increasingly gaining control of nature is an old theme, we are presently faced with the hypothesis of capital that is in the process of changing its value function because of this increasing integration with nature. Instead of a Marxian value that is purely immaterial, perhaps the movement to deepen eco-regulation changes the terms of capitalism to such a degree that the Marxian value concept must correct for an increasing integration of nature. If this integration covers carbon trading and climate rent, it influences the emission factor. This changing concept of value implies a changing conclusion in analyses of capital's GHG performance in rift-metabolism and other value-centered Marxist approaches. Leonardi makes a striking contribution by opening for speculation on a *real* valuative hybridism which the theory of climate rent and ecological valuation implies that capitalism is *superficially trying to move towards*.

The counterpoint to this is that this hybridized solution itself is inconclusive (Leonardi, 2021). We do not have sufficient grounds to conclude that an emerging adaptation to the thesis of a socio-natural hybrid valuation of and for capital is possible, but neither can we discard it. We should then follow Leonardi in being attuned to this development while concluding ambivalently. That recognition leads Leonardi to pivot the discussion away from the TQ, our thesis objective, to work on more concrete concerns that transpose the TQ divide between prospective green transition or non-transition. This is a shift to mitigation, adaptation, and social struggles before and/or after a green capitalism proof itself. Such inconclusiveness mirrors our prior assessments of the modes of engaging the TQ where empiricism was

unresolved. The objective forward must be to conserve the problem of inconclusiveness in the systematic dialectic.

8.4. Summary

This chapter was a pursuit of the TQ through the typologies of theoretical approaches from the sample. Leonardi's point corresponded to a higher-order determination in the systematic dialectic and was thus presented in a commanding placement. This is synchronous with the co-constitution between social, environmental, and economic factors. The plausibility of a changing valuation logic *is* a possibility emerging from this latest determination. Indeed, we saw how the empiricist objection colors the final answer to the TQ. We furthermore found that hybrid materialism and the value-form principles constitute the most adequate expression of the climate problem as I see it in the present literature. We then sublated the final contradictions that emerged from the above heterogeneity, to prepare us to conclude in an expression that locks the systematic dialectic. This is the hybrid totality we approach. The following chapter coheres this concept into what becomes the theoretical conclusion of this thesis.

9. Hybrid totality hypothesis

We exhausted the possibilities of predicting green transitions in its various modalities. Evidence for a green capitalism was not indefinitely falsified. Supporting the arguments therein in light of the contrary evidence and perspectives, however, brings the question so closely toward the ultimate divider of ontological incommensurability that pursuing a standpoint therein is inadequate. Most rigorous text point toward some kind of societal transformation that breaks with the encasing bonds of the current system. The ways forward therein can remain contested for now. Against this grouping are important reminders to respect the ambivalences toward transitioning-non-transitioning, and rather orient normatively and scholarly toward the pulsating, vibrant life-web of an unknown and unknowing world speeding through seismic changes.

The question of adaptation is a question of capital's invention of ecological valuation that makes accumulation and GDP growth switching track into an economy that balances for the environment and thus jets towards zero-emissions, (Ekers & Prudham, 2015) compare

(Chambers, 2021). Either the socio-economy collapses or transmutes into new forms, recalling the rift-or-shift debate in eco-Marxism. As long as the question remains inconclusive, I find the coherent reading of Marxian value theory to be the one that rejects value-determination of individual economic units, instead posing labour as instrumental to make sense of the aggregate pricings in the economy at its macroscope (Clarke, 1991, p. 139; Heinrich, 2013). Value may or may not be accurately transformed into price, but capitalism is built, and markets coordinated on the essence of proletarian labour. Marginalism, economics proper with its commodity-utility, can provide instructive explanations for present interactions but never ground the theory to the same robust anchorage. The approach highlighted above allows us to put to rest the Transformation Problem and the laborious project of reorienting a Marxist economic science after each new marginalist attack (Clarke, 1991, p. 308; von Böhm-Bawerk, 1949). At the same time, we maintain the source of normativity, that labour brings forth the wealth of our societies and can credibly lay claims to more of its fruits than our society is ever capable of returning. Thirdly, this perspective leaves the business of working through the issues of a socio-critical environmental research program with those heterodox approaches that after Hornborg finds it perfectly reasonable to stick with marginalist pricing as measurement, this being the mainstay of the ecological economics community we have surveyed. Indeed, this compels our system to reject a ‘strong’ labour theory of value.

In the previous section we exhausted the TQ by reference to value. The ambivalence in that conclusion mirrors precisely the themes that emerged as central from the discussion on the constitution of the climate crisis. We concluded that Moore’s framework ought to integrate non-determinism in its view on economic forces. An according socio-economic co-constitution was found in value-form theory. Taking these together fulfills our systematic dialectic system. Thus, the present conceptualizes a conclusive theory of the climate crisis. The last determination is therefore that the societal logic that commands our climatic destiny is a synthesis of the value-form and socio-ecological hybridization. The premise is simple. Value-form theory in its present, limited use, considers ‘our current society’ to be reified by capital and thus a green dimension outside or against capital is impossible. Hybridist theories contend that society-nature distinctions become more and more muddled. If capitalism is in the process of mutating in green ways that allows it to internalize emission abatement mechanisms, *the reference point for the value totality changes*. The world is no longer capital’s anti-ecological abstraction, but *capital’s concurrent eco-mutating, and thus plausibly RQ-compatible, abstraction*. I call this conclusive position, this hypothesis emergent through

our analytic design, a *hybrid totality*. With this concept we see a world that is trapped in self-reinforcing mechanisms based on capitalism's specificity. We also see the world as increasingly integrated in processes that blurs the line between nature and society. Capital is subsuming the world in a hybrid form, and this frontier of development constitutes the question of a green transition. It looks like the prospect is failing, but the logic of hybridity coupled with a critique of the labour-value that Marxist ecology rests on, makes the prospect valid and in demand of new nodes of research and political strategizing.

Ecological economics was right to seek biophysical knowledge outside the Marxian categories. The intercommunal discipline that emerged here, political ecology, offered the proper tools to realize the capital-nature relationship's specificity, and the implications following. Marxism proper constituted the climate problem in its correct scope, identified the stakes and provided the prescriptive legwork to the Transition Question. It is moreover in the contemporary eco-Marxist debates the TQ is most strongly tackled. While most of this literature relies on causal dialectics or practical materialism, I here produced a conceptuality of the climate problem that overcomes the limitation with several of the prominent works. Tensions between Malm's and Moore's theories revolve around the problem of agency under the mute compulsion, that is, the socio-economic co-constitution with Malm and the one-sided 'double internality' as we saw with Moore. The rift-or-shift debate similarly revolves around the question of environmental relations as unconstituted or co-constituted. In addition to these, the lingering empiricist objection, which is strengthened through a common critique of the consistency of classical Marxist theory, was taken up in our systematic dialectic. The result was a sublation of all these perspectives that developed as a consistent unfolding of the systematic dialectic that was based on the literature sample in this thesis. This was a sample which itself was a necessary abstraction from the heterodox literatures, a half of the scientific debate over the Transition Question.

9.1. Transition Question

We reached a conclusive system that commands claim as the strongest assessment of the heterodox view of the TQ. This must be mediated by the orthodox literature outside our scope, but we developed a critique that goes a long, if incomplete, way to supersede the feasibility literature and the green transition program. A key point with the hybrid totality is to see the inconclusiveness of green capitalism in the process of a transforming world. We

cannot know for certain if capitalist transmutability is real and strong enough to negate the present evidence to the contrary. Leonardi reminds us to bracket transition-non-transition, and pivot toward meaning-making in this conception of future. What we learned, however, is that the brevity of the heterodox half of the transition sciences makes a clear statement that green capitalism is a low-confidence future, and that a theoretical-political research program thusly anchored is purely irresponsible. Thus, the research question is closed. What conclusion this leaves when welded together with the first half of the sciences, that of the blue feasibility literature, is for the scholars thusly well versed to establish.

The present conclusion, however, points toward systemic change. The policy pathway to that end must correspond to the changing factors and relations we covered. At the same time, the political requirements are gated by the prescription of the hybrid totality which grounds the problem and must be the locus for unfolding transition politics. It is such inquiries of future paths that we should spend our remaining time on. The following section begins this conversation.

9.2. Transition seeds

The term ‘hatchet and seed’ denotes a typical principle in political ecology (Robbins, 2012, p. 98). Critique is followed by generative hypotheses where the latent political normativity of the field develops freely. As this thesis has acquired kinship with Critical Theory, it is only proper that I conclude in a form that corresponds to Cassegård’s prescriptions, that of generative utopian thinking (Cassegård, 2022, p. 187). Thus, the act of planting seeds follows from both the above sources of the thesis perspective. The conclusion to our RQ posits that the systemic road is highly improbable. The TQ therefore shifts categorically to the alternative of capitalist management, to acquiring power outside power to enact a transformation on categorially different terms. The critique culminated in the hybrid totality hypothesis. In striking difference to standard Marxist political worldviews, working class politics, just like any politics is here considered system-immanent:

> “[the fundamental problem is] that capital rests ultimately on proletarian labor – hence, overcoming capital cannot be based on the self-assertion of the working class. … that would require overcoming the value form of the surplus and the capital-determined form of the labor process (Postone, 1993, p. 371).”

This is what value-form thinkers see as capitalism's great specificity, it is the only social structure that has formed a quasi-autonomously operating and self-reinforcing system, totalitarian in its only precise usage. The problem of 'omni-temporal' pressures is most accurately grasped by this theory. Such theory sees everything as so strongly entwined that the only progress is through escape, either as a millenarian collective phenomenon of communization (Endnotes, 2010), or by leakage into the outside of the totality. In the context of planting seed for generative climate politics based on our thesis conclusion, the motif of rupture is a complete capitulation because it leaves the problem so deep that it is impossible to prescribe a solution. The notion of a systemic hemorrhage to the outside of the totality recalls anarchist preoccupation with autonomous zones and utopian socialist thinking around self-reliance and agrarianism. While an agrarian retreat capitulates against the fossil-industrial economy, we can entertain hypotheses in this direction. Note that the hybrid totality implies hybrid possibilities (Moore, 2014), not unidirectional reification.

The social science systems theory outline of Robert Biel can be surprisingly instructive to this end. Through Biel's analysis, both the ecology-economy materiality and the social conditions become important factors. With Biel the entropy of capitalism in a social and climate crisis sense can be overcome by building provisioning outside the capital circuits. This is also socially generative for reconstituting sociality that degrades under capitalism because sociality is the unvaluated conditions behind production, as seen in eco-Marxist and feminist theory. Using 'entropy' to social systems, Biel offers a robust prescription of urban gardening as a real counter-systemic mode of resistance (Biel, 2013, p. 51). Urban food production is indeed highly central to the degrowth movement (Guerrero Lara et al., 2023). This leaves the impression that degrowth, a vital green movement, already pivots on activities that have counter-systemic qualities. Seen in this light, a pathway to a real political formation that escapes the critique of system-immanence is already evident in the climate political movement.

In a different direction, we can speculate that there are possibilities in socio-economic systems that are not subject to real subsumption. Here economic provisioning outside the wage relation contrasts with the principles supporting the theory of mute compulsion. This idea could become a speculative argument that the value-form holds in mature capitalism, in the industrial heartland, but that mixed economic systems in parts of the global south can be politically maneuvered, free of the social laws of capital. If we then recuperate the empirical

arguments for spatially restricted absolute decoupling, in Europe in particular, we can argue that absolute decoupling is valid for such economies in the global north and that the categorial problem is the issue of outsourced emissions. We can then pose that the political structure of key emissions outsources in the global south are outside the mute compulsion. The causes for uptake of outsourced emissions can then be addressed through open politics in postcolonial states. The question then is what happens when a closing of outsourced emissions in the south impacts the emission-economy logic of northern fossil capitalism.

These positions leave us to an inconclusiveness that can only reconcile the urgency of climate action through magical thinking around a rupture, or through the ethical nuclear bomb of shifting the political burden to societies outside real subsumption. We must entertain the notion that the hybrid opportunities of the dialectic do not fully negate formal politics. In the seminal theory *Fossil Capital* (Malm, 2016) we are told of a workerist agency that could punctuate the mute compulsion. Later Malm marked himself as proponent of a new wave of 'climate Leninism' among others (Heron & Dean, 2022; Malm, 2020). For such perspectives it has always been the pragmatism and the result-oriented prestige of the Bolshevik method that provides ethos. Against this argument should be noted the recent historians who contextualize the Bolsheviks as a contextual variance of classical social-democracy (Blanc, 2021; Lih, 2005; Nimtz, 2014). That movement, in the second international, developed mass movements with the aim to achieve a democratic mandate for systems change. The Leninist tradition recurrently sees theoretical self-negations that points back towards the parent strategy (Gorz, 1968; Miliband, 1978, p. 172; Poulantzas, 2014, p. 262). Social-democracy also carried the greatest approximation to a system change from an international movement (Broué, 2004, p. xi). The organizational mode of theory clearly circles round to the revolutionary democratic mass party position. A strategy in this mode should be considered relevant.

Such prospects must again meet the counterargument of spontaneity implied in a critique of formal politics as system-immanent to the totality. However, a contemporary systematization of the logic behind spontaneous and horizontal strategies finds that its differences to party politics is overstated (Nunes, 2021). Rodrigo Nunes rather prescribes an assemblage of tactics that have a shared anti-systemic directionality, in which organization and spontaneity harmonize. If degrowth is a real movement with valid anti-systemic credentials, then we can already see this full-spectrum radicalism in the process of growing. The perspectives can be

reconciled at that. If this fails to convincingly address system-immanence, then one must concede the aptitude of ‘revolutionary melancholy’ as a trendy disposition in our field. However, we should not foreclose an imaginative pragmatism that challenges the fatalism of system-immanence on empirical and theoretical grounds. It must have aims to reconstruct near-successful histories with their criticisms adjusted for. A prime example of this is a revisit to the strategy of social-democracy, this time with the critique accounted for, which I find in non-determinist ontology and mechanisms to prevent the formation of a conservative stratum of professionals that have a material incentive to balk at the critical moment that Wilhelmshaven should have been (Broué, 2004, p. 129). Perhaps a multitude of approaches that are attuned to the critique we cover in this thesis is the best bet to developing the capacity to resolve the TQ. These are the loose ideas, the convention of casting seeds, that compliments the critique developed in this thesis.

10. Retrospective

This chapter sums up the insights found throughout the thesis and the problems prescribed to further research. These points are coupled with a few words of reflection around the research process. First and foremost, everything developed in this thesis was distinctly declared to represent the heterodox counterpart to the blue, orthodox literature on the green transition. What is summed up presently is a one-sided view of the climate debate. I deferred authority to those competent on the technical feasibility literature, specifically the ecological macroeconomic modelling. A critical comment was inserted in which I said that the heterodox literature supersedes the parameters of the orthodox literature. This can naturally never be defended. The point was rather that the heterodox literature tries to overcome the limitations it claims to find in the orthodox literature. As such, it is claimed that these critical perspectives count more in the final sum of the climate debate. What followed in the red-green analysis were discussions and conclusions that are incomplete, but which represent an approach that tries and claims to be the prescriptive view.

The course of *part II* led us to a two-fold conclusion. We found both a constituent climate theory and the concrete answer to the research question of the TQ expressed in a novel thesis of the climate crisis, namely the hybrid totality. This insight was developed on the premises developed in *part I*. There we found that the histories of Marxism and ecological economics

parallel to a degree so strong that we can research through a bracketed rubric, the heterodox materialism of the red-green traditions. In systematizing the literature, we found that there is a critical deficit in research that properly apprehends the global dynamics and the full trajectory of a transformation that becomes a zero-emission economy. This is a hugely important point to emphasize, as these qualities foreground the rigor of climate politics. The literature is moreover divided on the prospect of a transition under the current paradigm of greening capitalism, although a majority tend to reject this with a tendential affinity toward a degrowth alternative. The different perspectives imply incongruent approaches which require a deeper analysis to sublate and thus arrive at a definite assessment. Undertaking such an effort followed. On one hand we saw how an adequate climate theory must be co-constituted between more factors than present in most of the literature. Such an approach resembles an integration of the sensibility of the unique economic power in capitalism that we find highlighted in newer readings of Marx, and the socio-natural hybridism that is developed strongest with Moore. On the other hand, we lastly found that the pursuit of the TQ assessment leads to an expression that conforms to the above theory. The hybrid totality is as such the circumference of the climate problem, an expression of the most precise answer to the question of a current green capitalist development towards a decarbonized world, and the medium through which we must develop a pathway to the zero-emission economy.

The journey to these insights was a strange one. The theme and the RQ were fixed from the start. The design of combining a systematic analysis with an interpretive theoretical effort was a product of my contradictions. I was happy to discover a literature gap in such an enormously important juncture. On the other hand, I am left with a feeling that neither part of the thesis developed into the full brevity I wanted to reach. Influenced by currents engaged in a process of recuperating the research of early Marxist natural science, it made sense to me to compare those efforts to midcentury ecologists. Such did the red-green reading of intellectual history come about. I figured early on that the perspectives of Moore and Hornborg offered me more tools to understand the climate predicament than what I found in the reads of Marxologists. More than this I am happy that I decided to integrate the toolkit from Critical Theory and the lineage of new readings of Marx. I would have liked to make a more rigorous and deeply fixed abridgment between these perspectives. The pursuit of syncretic macroeconomic literature had to be given up. I should also have liked to research the veracity in the very recently developed macroeconomic models in this thesis. These are certainly aspects I hope the interdisciplinary encounters will develop in future research. While recalling

the methodology, the systematic dialectic as applicable method also came about through an immanent engagement with these themes. Recall that I disclosed this in the abovementioned chapter.

The full development of a prescriptive politics in the hybrid totality perspective could not be undertaken. I followed political ecology in tossing out seeds for the future discussion. It is among those sparse lines I oriented the reader to a future agenda. The hypothetical hybridization of value calls attention to research potential differentiation and metamorphosis in the social system as these theories see it. The emergent hypothesis of a changing reference point for the value totality is certainly worth discussing. Such theoretical encounters are a first step in recuperating social content after the paradigm of form-analysis in Marxian theory. This is a worthwhile prospect in dialogue with the radical voices claiming value theory abandoned content after discovering the merits of a reinterpretation of Marx preoccupied with forms (Dybedahl, 2024). Through the present framework there remains speculation that the uneven level of subsumption under capitalism implies certain hotspots for political counterforces, such as communities with life-provisioning outside the wage-relation like certain indigenous agrarian communities. In this thesis I mentioned the potential contradiction between decoupling in industrial societies of real subsumption, versus resistances to outsources emissions in the global south, specifically in societies outside the complete subsumption. Of course, scholars like Fraser see all this as a differentiated but unitary relation of value production. The question in this context is rather what different political opportunities are present therein, as against the problem of system-immanence. This rumination points to the need for applied research using the hybrid totality or using a general unity of the value-form and hybridism. Beyond prescriptivism for the pragmatic politics of climate liberation and the research program thusly needed, such a theoretical syncretism is what I hope the future attends to.

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12. Appendix I - Literature search

A geographical researcher that inquires to the prospective TQ have two options to take in its methodological fundament. It can either rely on thick descriptions and empirical assessment of all current and plausible sources of carbon emissions or have faith in abstractions to remain approximate with truth. The former is inherently designed to have a stronger claim to empirical correct data, and the scope of this method for a planetary reckoning might not be impossible given the width and volume output on scope-specific research. For a thesis, however, it is given that some degree of abstraction is needed to approach our topic. Abstractions are the means we must apply to make sense of voluminous data (Holgersen, 2022, p. 122).

12.1. Introduction

The thesis approaches the literature review with a first structured and a second systematic literature search and -analysis. This approach was chosen to highlight the exterior conditions of the scholarly community I engage with before pursuing my research. I have taken it upon me to review a community of literature with a purpose to form a critique. The approach should thus offer a quasi-objective overview of said field. This will anchor my inquiry and offer verifiability subsequent research in the field can work from (Linares-Espinós et al.,

2018). The systematic literature review is not comprehensive. The insights gained here will succeed from the above typical literature review section in which I present a historicist systematization of the relevant literature. This is thus a two-pronged approach. The literature search provides a methodological anchorage for the theoretical pursuits of this thesis, and the standard section of a literature review offers the overview and insights of the field as required for any thesis. In the search we look at heterodox approaches including Marxism and ecological economics assessing green transition through capitalism.

12.2. Search structure

The first stage is the search itself. See *Fig. 1*. for a visualization of the process. A systematized schema for searching and narrowing data is employed, following the mold of (Clifford et al., 2016, p. 48; Wiedenhofer et al., 2020). The search is performed in the *Web of Science* core collections database. The search queries are structured after two subjects identified in the literature overview of the thesis. These were 'ecological economics' and 'Marxism.' These were in turn coupled with a set of objects: 'green transition,' 'energy transition,' 'emission,' 'zero-emission,' 'net-zero,' 'decouple,' 'decarbonize,' and after the fact 'carbon neutrality.' Changes on the root 'Marx' is checked for but searches for 'Marxian' or 'eco-Marxism' yielded nothing unique. Marx itself cannot be a search term as the name is too great a reference to enable manageable sample size, and it is the derivative theoretical positions following Marx that is the object here. Those are gathered in the search matrix. Case sensitivity, variations on the word roots and variations on hyphenated terms are checked for. This yielded result changes between decoupling and 'decouple,' 'emission,' and 'emissions' et cetera. This set of interrelated search terms are chosen corresponding to the thesis objective of finding what the heterodox literature concludes on the prospect of transitioning to an emission-free lifeworld in the system's current parameters. Searches were time gated between 1.1.16-13.9.23, in turn corresponding to the periodization of this literature observed in prior, and complimenting the imperative of working with current, up-to-date scholarship. The search was set in one query without Boolean operators, as attempts to search with operators yielded severely weaker yields. Examples of a search is thus: 'Marxism carbon neutrality,' or 'ecological economics net-zero.' UIB's Oria database are assessed and discarded for its weaker results.

The searches yielded 743 hits. Checked for duplicates left 167 items under Marxism, 347 items for ecological economics and 34 *a posteriori* on subject 'carbon neutrality.' The latter yielded two texts to the final sum. The main filtering process took on two parts, narrowing down the two subject libraries. The 347 items were scanned at title and if needed abstract for relevance. Varied literatures flagged for these terms, demanding a great reduction in the sample size. Ecologist literature used 'decoupling' in rhizomic contexts, innovation studies using 'sustainable' broadly, case studies in environmental history, articles modelling and arguing for 'some' emission reduction, were all cut. A result of 99 items were evaluated in a detailed reading of abstracts and whole texts if needed. Admission was set following a strict adherence to all select criteria: 1. Items must have an approach in the Marxisant and heterodox ecological economics sphere. 2. Items must answer or strongly imply answers to the research question. 3. Items must supersede an analytic seclusion to one country or economically cohesive region, thus ASEAN para EU. The yield was 23 texts. A parallel process filtered the 167-item library down to 8 texts. The same method and criteria are applied. The rough and fine filters are processed simultaneously, as this library had a stronger distortion in search results making a faultless filter of a large sample tenable. The occurrence thus was a yield of over 100 articles of China's scholarship which tendentially researched national or prefectural emissions and which articles tended to flag for the 'Marxism' term regardless of methodological approach, which tended to be econometric. A grand total of 31 texts, all articles but one book chapter, succeeded to content analysis.

12.3. Discussion

As the scope of the thesis is an examination of heterodox ecological economics accompanying and including the third generation of eco-Marxist literature, all literature prior to 2016 is rejected. This decision rests on my claim that the defining feature of this periodization is the development of a 'world-ecology' approach, and the popularization of the concept 'fossil capital', often as a triadic debate between these two approaches and the framework of metabolic rift. This corresponds with the world-ecology breakthrough of *Capitalism in the web of life*, published 2015 (Moore, 2015). *Fossil Capital* (Malm, 2016) was released for Verso in 2016, although the titulary thesis is from 2013, and the concept through Elmar Altvater is older. The parameter thus remains the popularization of world-ecology throughout 2015, which is assumed would leave an impact in encyclopedic texts from

2016 onwards. The periodization proposed here is also supported by one of the object articles (Leonardi & Torre, 2022).

Another important note is that the query ‘ecosocialism’ is omitted. Ecosocialism has a weaker connection to Marxism. As a theory it is rather an offshoot of anarchist strands such as through the great legacy of Murray Bookchin. The omission loses material for political prescriptions, but as a community of inquiry in the context I work on here, I look for Marxisms, and they tend to be labelled accordingly. One exception showing the predicament of this methodology is *Karl Marx’s ecosocialism* (Saitō, 2017), although this text is very firmly connected to the label ‘eco-Marxism’ otherwise and appears several times in this literature search.

The imperative has been selecting texts that answers RQ. An article (Bovari et al., 2020) model explicitly for a 2.5°C warming scenario instead of modelling for zero-emissions in the current parameters. I decided this to be irrelevant since 2.5*C is unacceptable normatively, and the ‘current parameters’ that I have circled on conventionally write for a 1-5°-1,99°C frame. Such an article can be of interest, but that is a line drawn.

The subject sphere demarcated as that which is relevant here, the heterodox materialism was developed for the precise category ‘Marxisant-heterodox.’ Marxisant simply means Marxian and/or Marxist. The key with this category is to restrict literature to that which shows a very firm adherence to the socio-material and socio-political. The literature overview shows a strong overlap with ecological economics and Marxism. Figures like the two Odums of systems ecology, Georgescu-Roegen and Vienna metabolism Martinez-Alier and Catalan ecological economics, Hornborg and Marxism “adjacent” ecologies can all be sought. *Social ecology of Capital* (Pineault, 2023) is such a synthesis of “weak” Marxism with other ecological sciences. My approach posited that it is scholarly counterproductive to identify a theoretical approach that is endogenously Marxist, but to instead see, as the historical view of the literature shows, the interrelatedness and transdisciplinary the research with inspirations in Marx and nature has been. There is thus a need to develop a sound category to catch this research objective in the literature screening process. This can be done by looking at negative definitions, and positive definitions.

A negative definition stresses the rejection of one quite common typology in the literature. This is monetary-technocratic approaches. These approaches discuss emission pathways as economic factors isolated in abstraction from the materiality and relationality of the actual system. This presents data as quasi-objective trends that policymakers can enact upon. Perhaps the most fundamental insight of the Marxist method is what Clarke apprehends as the critique of the categories employed in such technocratic-managerial methods (Clarke, 1991, p. 325). Rejecting this point towards analyses that sees the relations and the politics as relationally embedded in historical lines and conditionalities. This difference is what Marxists traditionally call their methodology 'dialectical', cf. (Burkett, 2014, p. x). Dialectical approaches see categories under study as conditioned on specific relations, embedded in historical conditionalities and as being processual. For instance, where econometric approaches assume a quantitative pathway towards net zero emissions if their models are statistically validated, which they often are as showing secular trends towards decoupling emissions, dialectical analysis objects to the inference from trend to result. The corollary to these negative criteria is the positive traits demanded. Instead of heterodox or Marxist, the category 'critical-material' can represent the positive traits for my sample selections that holds claims on the analytical needs of this research project. Thus, the thesis researches a category 'heterodox' which is negatively defined 'Marxisant-heterodox' and positively defined 'critical-material.'

The article *Is green growth possible?* (Hickel & Kallis, 2020), reveals no direct commitment to a critical-material approach. This content is gathered from the research question in its title. A scholar in this domain would know the tradition these two authors write in and include the article on those grounds, but as is, the sample selection is ambiguous. The goal is to study the select literature, the above subtext thus concludes with the tipping of scales. Similarly, Pearse and Bryant (2022) handle the electricity transition with a value-form approach. This approach as a Marxian legacy and one approach that we will engage throughout this thesis. Here, it signals an implication for the prospective transition through its theoretical outlook, without addressing the TQ directly. This is because of a position vis a vis labour value and the materiality of capital accumulation. This does not mean that every value-form text should be included, beside hits to the search parameters, this article also meets the criteria because of its assessment of transition socio-spatiality.

Regarding degrowth, I disclose that articles with the degrowth approach automatically fulfilled the methodological criterion. The position such articles have on the research question, that is, the forecast of zero emission under the current parameters, is already implied with the term degrowth. *Research on degrowth* (Kallis et al., 2018) is therefore admitted. Further, the tradition stems from the critical side of ecological economics, indebted to scholars like Martinez-Alier who reasons in part with materialist and Marxist frameworks. Objections could be raised here, as degrowth may skew the final data. I would, however, counter this with the point that *the goal here is to codify a typology of RQ conclusions which have incongruent assumptions, therefore rendering each type equalized in the results*. Moreover, it must be recognized the great plurality in degrowth, a highly ecumenical term which is best understood as a signal term to an open conversation. Works therein such as Parriqué's thesis (Parriqué, 2019), posits degrowth as a program where one cornerstone is institutionally managed transformation of currency systems, a far cry from the ecosocialist normativity of scholars like Kallis. In addition, *A study of degrowth paths based on the von Neumann equilibrium model* (Heikkinen, 2020) was rejected from the search, as this degrowth-oriented article uses a purely marginalist model, thus being a negative arbitration balancing the above positive arbitration. In finality, this omission shows the capability of the search process to identify the relevance in degrowth's interiority.

Trainer's *A technical critique of the Green New Deal* (Trainer, 2022) is an example of the qualitative aspect of the filtering. Here I see the abstract discuss rejecting claims of green growth and affirm the term degrowth. This signifies both a RQ implication, with degrowth, and an approach that is critical-material because it aims to discuss entire social systems. Vezzoni's *Green growth for whom, how and why? The REPowerEU Plan and the inconsistencies of European Union energy policy* is similar (Vezzoni, 2023). It is about the EU, but the abstract shows an analysis integrating extra-spatial relations with global extractivism and Chinese manufacture, which, while being a think analytical scope compared to a planetary analysis, shows an attempt to supersede the national fix. As discussed, squarely marginalist approaches are rejected. This applies to traditional methodologies in ecological economics that for instance computes on the KAYA identity, such as (Du et al., 2022). These approaches couple the fetishized abstractions of marginalist economics with energy and other material values, and as such contribute to a mere refinement of the same problematic methodology. An extreme dilemma in the process that strained the subjectivity of the process was the article *Environmental innovations, energy innovations, governance, and*

environmental sustainability: Evidence from South and Southeast Asian countries (Lei et al., 2023). The article uses the STIRPAT model, a highly integrated set of factors that nevertheless rests on marginalism. The model was developed by Richard York, Foster's collaborators and one of the core scholars in the rift school of ecological Marxism. Such a case shows further the dilemmas of researching through a fixed schism between fields. This article shows an understanding of the limits of marginalist approaches and a spirit of its supersession and is thusly included. It remains, however, the most ambiguous of all the samples.

The granular scan is a key step in the process. The article *Growth in the ecological transition: green, zero or de-growth?* (Priewe, 2022) would succeed the filter, however, the detailed scan revealed that the analytic criterion ineligible. In the full text it is seen the approach is monetary-technocratic and uses as ad hoc computation of fossil capital stocks. *Simulation and verification in high-performance computing for cluster distributed doubly fed induction generators in the horizon of Ecological Marxism* (Xue, 2021) was also filtered out, where a full-text scan revealed a lack of methodological discourse and literature review making it difficult to understand what is being undertaken, what exactly the "Marxism" referred to contains. One was not identified.

12.4. Coding

This part takes on the select texts and processes them through coding analysis that aims to identify the characteristics aftersought. Textual coding is employed for this. An invariable scheme for coding the data is rejected, as the coding process can never be fully rid of the subjectivities of the researcher and the contexts (Clifford et al., 2016, p. 651). The methodology employed is rather a generalized schema of descriptive, thematic, and abstracted categorization of the texts studied, per (ibid. p. 653). The literature analysis employs an initial hypothetico-deductive scan, and a subsequent inductive analysis using grounded theory. The former is a standard method of science, and allows verifiable results with given parameters (Lawson, 2000). The result of this hypothetico-deductive scan was a series of categories displayed in the literature search results. It was also the categories forming the first-order determinations in the systematic dialectic. The deductive phase formed the below scheme which forms the prime address to the RQ of this thesis. The second phase of this second stage is the inductive grounded theory analysis. In this part the key was being receptive to new research questions and new perspectives emerging during the literature coding (Sbaraini et al.,

2011). While the deduction led to answers of a set of questions, the grounded theory led to new reflections summarized after the literature study and -coding. The sets of steps in this methodology form a cohesive methodology to literature reviews and have been used in very closely related subjects (Cosme et al., 2017). This inductive phase of the literature analysis opened for, and succeeded in, generating new perspectives labelled ‘dynamics’ to the RQ during the coding process. Questioning the scientific interest of pursuing the RQ commenced, and this methodology thus crystallized a new perspective in seeing the literature producing a line of argumentation defying RQ, and instead looking at open-ended dynamics that should be researched rather than single-mindedly focusing on the teleology of greenhouse gas emissions. Taken together, the coding process was structured as a dual movement where the strengths of both deduction and induction joined in solidifying the rigor of the approach.

13. Appendix II - Literature sample

Table 1. Sample literature from systematic literature search.

Akbulut et al. (2019)	Bosch & Schmidt (2019)
Brand-Correa & Steinberger (2017)	Chambers (2020)
Dafermos & Nikolaidi (2022)	Distelkamp & Meyer (2019)
Giampietro (2019)	Gundersen et al. (2018)
Hardt et al. (2021)	Hickel & Kallis (2020)
Hornborg, Cederlöf & Roos (2019)	Jacques et al. (2023)
Kallis et al. (2018)	Koch & Buch-Hansen (2021)
Lei et al. (2023)	Leonardi (2023)
Leonardi & Torre (2022)	Loiseau et al. (2016)
Marquetti, Pichardo & de Oliveira (2019)	Mastini, Kallis & Hickel (2021)
McDougal (2022)	Moore (2021)
Nieto, Carpintero & Miguel (2018)	Pearse & Bryant (2022)
Sadhukhan (2022)	Tokic (2018)
Trainer (2020)	Trainer (2022)
Vezzoni (2023)	Washington (2021)
Yu (2020)	