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**Transition to where?  
Exploring the Transformative Potential  
of “Cosmolocal Technology”  
in Quest of Future Coexistence**

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**Declaration:**

Hereby I declare that this doctoral thesis, my original investigation and achievement, submitted for the doctoral degree at Tallinn University of Technology has not been submitted for doctoral or equivalent academic degree.

Asimina Kouvara



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**Üleminekud kuhu?  
“Kosmolokaalse tehnoloogia”  
transformatiivse potentsiaali uurimine  
tuleviku kooseksistentsi otsingul**

ASIMINA KOUVARA





# Contents

List of Publications .....	6
Author's Contribution to the Publications .....	7
Preface .....	8
Introduction .....	9
1. "Cosmolocal Technology" and the Commons.....	14
2. Methodological approach .....	16
2.1. Writing approach: In defence of writing (a bit) differently.....	17
3. Sustainability, technology and transitions/transformations.....	18
3.1. The narrow lens of traditional sustainability transition discourses .....	19
3.1.1. The problem with "sustainability" .....	19
3.1.2. The debatable role of modern technology .....	20
3.2. Transition to where? Seeking alternatives pathways .....	22
3.2.1. Another sustainability: Relationality, diversity and cooperation.....	23
3.2.2. Another way to thinking technology: Multiple "cosmo-technics" .....	25
4. The transformative potential of cosmolocal technology .....	28
4.1. Transcending artificial binaries .....	28
4.2. Addressing oppositions.....	29
4.2.1. Diversity vs Monoculture: Reappropriating techno-diversity.....	29
4.2.2. Engagement vs Alienation: Reappropriating technological autonomy.....	31
4.2.3. Hope vs Despair: Reappropriating techno-optimism.....	32
5. Conclusions .....	34
References .....	38
Acknowledgements.....	46
Abstract.....	47
Lühikokkuvõte.....	48
Appendix 1 .....	49
Appendix 2 .....	119
Curriculum vitae.....	157
Elulookirjeldus.....	158

## List of Publications

The list of author's publications, on the basis of which the thesis has been prepared:

- I. **Kouvara, A.**, Priavolou, C., Ott, D., Scherer, P., & van Zyl-Bulitta, V.H. (2023). Circular, Local, Open: A Recipe for Sustainable Building Construction. *Buildings*, 13(10), 2493. **ETIS 1.1.**
- II. **Kouvara, A.** (2024). Beyond fraudulent hopes versus despair: The potential of commons-based technological futures. *Journal of Futures Studies*, 29(2), 59–72. **ETIS 1.1.**
- III. Kostakis, V., Parker, M., & **Kouvara, A.** (2025). A tunnel to the other side of the world: What sort of writing can contribute to social change? *Culture & Organization*. **ETIS 1.1.**
- IV. Kostakis, V., Lemos, L., & **Kouvara, A.** (2024). Another scalability is possible! From non-scalability to cosmological scalability. *tripleC*, 22(2), 620–629. **ETIS 1.1.**
- V. Pisith, S, & **Kouvara, A.** (forthcoming). A Look at the Commons through the Lens of Buddhist Ethics. In: Stefan Partelow (Ed.). *Ethics and the Commons: Navigating the Normative and Applied Issues of Governance*. Center for Life Ethics at the University of Bonn Series. Springer. **ETIS 3.1.**
- VI. Sklavounos, I., Kostoulas, P., Koutropoulos, G., **Kouvara, M.**, & Theocharis, C. (2020). Kalderimi X2, Tzoumerka, Epirus: Paving the way for a new generation of craftspeople. *Journal of Traditional Building Architecture and Urbanism*, 1, 100–111. **ETIS 1.2.**

## **Author's Contribution to the Publications**

Contribution to the papers in this thesis are:

- I. The author of this thesis established the theoretical framework in collaboration with the paper's second author. The thesis author was also responsible for conducting interviews, gathering and analysing qualitative data from the case study, and was involved in the conceptualisation, visualisation, writing, and editing the original manuscript. As the first author, she managed primary correspondence and revisions of the manuscript.
- II. The thesis author developed the conceptual framework, conducted and documented the case study, and gathered and analysed qualitative field data. As the sole author, she prepared the manuscript, made revisions, and handled all correspondence.
- III. The author of the thesis contributed to the revision of the original manuscript by proposing a new conceptual framework and conducting a literature review concerning cross-writing approaches for communicating academic research to diverse audiences. The thesis author was involved in writing and editing throughout the peer-review process.
- IV. The thesis author conducted a targeted literature review to enrich the argument of the reflection paper and contributed to editing the original manuscript.
- V. The thesis author contributed to the sections regarding the theory of the commons and to the chapter's structure. The author was also involved in writing, editing, and revising the manuscript.
- VI. The author of this thesis contributed to documenting the project outlined in the paper, participated in fieldwork, and carried out hands-on research as a co-founder, participant, and researcher in the initiative presented in the manuscript.

## Preface

One morning this summer, I woke up to the news that fish experience side effects from Prozac (antidepressants) due to urban waterways being contaminated by the increasing consumption of such pharmaceuticals<sup>1</sup>. At first, I found it hard to process, yet I was not surprised. We are now living in 2025, and “They live” too, as John Carpenter accurately predicted in his 1988 sci-fi film. Similarly, Orwell foresaw that “Big Brother is watching you” in his book “1984,” written in 1949, and so forth. Art continues to prove how much more effectively it can predict the future than complex, data-informed models. Yet, for some reason, we forget the power of imagination, and the power of greed, confining our efforts exclusively to numbers.

Despite many years of schooling, I have an inherent inability to comprehend this established “common sense” and to rationalise what is deemed rational. However, this issue is certainly not only a problem of mine. My ongoing frustration of “not understanding” has driven me towards a journey to explore technologies and practices of the past, aiming to uncover what else exists and why the tacit knowledge and ingenuity, the vernacular wisdom, reflected in pre-industrial technologies, has been forsaken or replaced, often regarded as a sign of backwardness. Could this wisdom be restored, reclaimed, recuperated, reappropriated, or reinvented?

Initially, I was keen to learn about traditional architecture and building techniques. Throughout this journey, my interests expanded to include textile making, agriculture, and traditional Chinese health practices<sup>2</sup>. I have been exploring these fields as a practitioner, researcher, and participant in various initiatives, workshops, and training. However, when I later joined the “COSMOLOCALISM” research project<sup>3</sup>, my investigation widened to encompass a broader inquiry into technology. I then began to wonder whether a contemporary technological trajectory that evolves in pace and rhythm, within the limits of the physical world and in harmony with multiple perceptions of nature and the cosmos, might be possible.

This is what this thesis aims to explore.

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1 <https://www.theguardian.com/environment/article/2024/aug/27/australia-prozac-waterways-fish-behaviour>

2 I practice/study Wudang martial arts, Guqin (the ancient Chinese zither), and traditional Chinese medicine.

3 <https://www.cosmolocalism.eu/>



## Introduction

Despite abundant information about the damage caused by the dominant techno-economic trajectory, why is not enough change happening (Paulson, 2017)? And why, despite global sustainability efforts launched nearly four decades ago, does the “developed” world still adhere to loops of unsustainable choices (Sabau, 2020)? Have people become so accustomed to the belief that transformative change is impossible, or is there something else that provokes social stagnation amidst the destruction? Will technology save us all in the end?

The detrimental effects of the current trajectory-driven by relentless economic growth, industrial-scale production, unprecedented technological acceleration, and the assumed hegemony of the Western mind-exist, persist, and intensify despite being veiled, ignored, or denied. This trajectory is underpinned by an unfounded techno-optimism – a belief that modern technology can save humanity from looming catastrophes, avert the damage itself creates, and even liberate us from the constraints of human finitude. This belief holds some truth but not the whole truth. Even a simple children’s story can illustrate the grim reality of perpetuating social injustices and environmental degradation inherent in the current predicament (III). Yet there is considerable resistance against looking straight into the trouble, let alone staying with it (Haraway, 2016).

Part of the answer to why not enough change is happening lies in dominant institutions determining which worldview, and what morals and motives drive change, who is included or excluded from decision-making, what information is widely disseminated or withheld, how knowledge is produced, and which methods, narratives and pathways forward are prioritised (Saltelli et al., 2020; Silva & Stocker, 2018; Voci & Karmasin, 2024; I; II; III; IV). It also involves reflecting on the mechanisms available to society to confront unsettling realities or to envision and pursue alternative possibilities (II; III). I assume another dimension of the answer resides in the philosophical and psychological spheres, questioning what it means to be human and how we relate to “this strange being called the cosmos” (Hui, 2022b)<sup>4</sup>.

My aim is not to provide definitive answers to such questions but to inspire debate about the role of technology in driving transitions and transformations towards sustainable futures, challenging its current entanglement with reductionist and corporate-favoured ideas. I am troubled by the fact that much “uncomfortable knowledge” (Rayner, 2012) remains absent from discussions on sustainability, despite the growing recognition of the dark side of modern technology.

I view “technology” as integral to the human condition, a materialisation of worldviews (Hui, 2017a), and as an ambivalent (Feenberg, 1990) transformative force-capable of either leading to deepening crises and human domination or aiding the pursuit of healthier, just, *truly* sustainable futures for all. In this light, “modern technology” here represents a specific perception of “technology” based on Western modern ideals and dualist thought. Additionally, I consider the concepts of “sustainability” and

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<sup>4</sup> “*Cosmos* is a Greek word for the order of the universe. It is, in a way, the opposite of *Chaos*. It implies the deep interconnectedness of all things. [...] We seek a connection with the *Cosmos*. We want to count in the grand scale of things. And it turns out we *are* connected not in the personal, small scale unimaginative fashion that the astrologers pretend, but in the deepest ways, involving the origin of matter, the habitability of the Earth, the evolution and destiny of the human species, themes to which we will return.” (Sagan, 1980).

“sustainability transitions” to involve a double hermeneutic (Audet, 2014) and view them as open to various interpretations.

Like many others, I find it difficult to understand how further efforts along the current path could lead to the second (hopefully) desired future scenario, which, for now, remains both elusive and contested. If I were to describe it in a few words, this future would be guided by *planetary thinking* – an understanding that our current situation extends beyond the configuration of modern nation-states, anthropocentrism, and a Eurocentric view of history (Hui, 2024; 2021; 2019). It would be founded on *relationality*, where relationships among humans and non-humans are perceived as inherent and reciprocal – mutually interdependent and framed by the broader cosmic order; where living, social, technical, spiritual, and knowledge realms encompass one another, a quality reflected in the tangible outcomes of these relationships – *technics* (e.g., governance, tools) (Hui, 2017a; 2022a). Their interrelations would be presupposed rather than externally imposed to manage their interaction. “Nothing preexists the relations that constitute it” (Escobar et al., 2024, p. 8). This understanding of relationality contrasts with the reductionist techno-managerial perspectives on sustainability, which commence from an assumed division between humans and “nature” (a particular interpretation of nature) and then attempt to control how one affects the other, already implying an inherent conflict. Furthermore, it would be a future of *coexistence*, where diversity is embraced rather than merely tolerated (Hui, 2024), allowing different peoples and species to thrive on the same planet without depleting it, with each having a fair share and voice in fostering their prosperity (Bollier, 2024).

Such a future may seem distant, if not entirely unattainable, and is hard to imagine when confronted with the violent history of “civilisation” – scarred by genocides, ecocides, and apartheid of sorts. Its pursuit likely becomes more complicated due to our inherently limited or dispossessed ability to grapple with our subconscious awareness of mortality and the vulnerability of our earthly condition (Simpson, 2024).

The ways in which the Western mind conceives of human existence and coexistence are reflected in its cultural, social, political, economic, and technological systems – which, in their most extreme manifestations, render even metaphors seemingly redundant to describe. It is a world where ideals defining what it is to be human are lowered so much that the “highest” are reduced to material wealth, power, and virtual recognition, the relentless becoming of a self-absorbed, successful individual. It is a rootless culture, where the fear of dying (or living) is diverted into becoming a consumer and a commodity, always striving to be consistently happy, productive, and optimistic – while veiling hopelessness (Žižek, 2018); ultimately failing to “beat death in life” (Bukowski, 1996). It is a society of isolated atoms (Hui & Halpin, 2013), superficially connected through transactional networks yet disconnected from one another and the planet we depend upon (Escobar et al., 2024); a status quo of authoritarian “democracies” and state-corporation alliances (Klein, 2007) exploiting others’ struggle for survival under the guise of progress (Barca, 2020); whilst building walls and sophisticated systems to “protect nature” from us, and secure us from natural disasters, and invisible threats – free-riders, terrorists, refugees, or “the woke virus” of the mind<sup>5</sup>. Yet, who genuinely feels secure or content in such a world?

Nevertheless, another facet of human civilisation exists, primarily linked to the past yet carrying the seeds to a desired future (Kallis & March, 2015). It is reflected in a vast

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5 <https://www.theguardian.com/us-news/2022/dec/20/anti-woke-race-america-history>

array of ancient texts, indigenous mythologies, and more recent imaginaries and practices through which human vulnerability is rationalised and materialised in *vernacular*<sup>6</sup> ways of being, living, creating, and knowing that significantly differ from the established ones (Illich, 1980). This variety encompasses a range of common senses (Muñoz-Sueiro & Kallis, 2024) and commoning practices (Bollier & Helfrich, 2019; Ostrom, 1990), epistemes and epistemologies (Santos, 2015), systems of governance and public administration (Chafik & Drechsler, 2022; Drechsler, 2015; Shakya & Drechsler, 2023; **V**), and technologies (Hui, 2022a; **VI**), some of which remain relatable and relevant across cultures, localities, and time, or (re-)emerging.

The flattening forces of modernity and capitalist expansion, though, have overshadowed this diversity, with a determining role played by technological globalisation (Hui, 2024; Tsing, 2012; 2015; **IV**) rooted in a perception of technology as anthropologically universal (Hui, 2017b).

The growing awareness of various pressing issues associated with industrial capitalism and modern technology (e.g., environmental degradation, global wealth inequality, and cultural homogenisation), highlighted by the emergence of contested concepts like the Anthropocene, Plantationocene, or Capitalocene (Haraway, 2015), signals a transition beyond the so-called unconsciousness of modernity (Hui, 2022a). However, to leverage this shift towards a desired future requires more than mere recognition or critique. One of the most urgent imperatives is an in-depth inquiry into technology (Hui, 2017a).

First, this inquiry is essential to illuminate the overshadowed implications of modern technology and challenge its dominant role in shaping current sustainability discourses and courses of action (Takkinen & Heikkurinen, 2024). Second, it is crucial to explore alternative pathways for technology that could enable the flourishing of different imaginaries (Hui, 2024).

Proponents of the dominant politico-economic arrangements may acknowledge the evident problems but still argue that solutions lie in technological advancement (Hickel & Kallis, 2020; **II**; **III**). They typically focus on decoupling economic growth from environmental impacts while suggesting techno-managerial interventions to mitigate the disruptions caused by emerging technologies (Biely & Chakori, 2024). These perspectives bypass profound implications of modern technology (particularly affecting communities in the Global South) (Sovacool et al., 2020), simplify the “wicked” nature of sustainability challenges (Brown et al., 2010), and certainly do not question the very onto-political foundations of their strategies.

Conversely, proponents of alternative imaginaries and configurations critique the hegemony of Western modern, growth-oriented, and excessively technocratic approaches to prosperity, progress, and sustainability (e.g., Escobar, 2015). They highlight issues of

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<sup>6</sup> I employ the term “vernacular” as defined by Ivan Illich (1980) to describe autonomous, non-market-related practices that inherently evade bureaucratic control and through which people satisfy needs. These practices promote conditions of sufficiency and subsistence, founded on symbiotic relationships with natural ecosystems. Such reciprocal practices extend beyond monetary value, resisting the commodification, enclosure, and exploitation of shared resources and spirituality, while nurturing cooperative, convivial, grassroots forms of organisation, governance, and production (Galan et al., 2020; Illich, 1973; 1980; Schroyer, 2009). Illich transcends the mere association of these practices with the past, suggesting that the vernacular mode of being, doing, and making can once again expand in every aspect of life within a desirable (sustainable) future society (Illich, 1980). In this regard, it could encompass both pre-modern practices and digital cooperative networks equally.

power politics and justice that remain largely unaddressed or disturbingly silenced, and envision different pathways forward. However, they tend to avoid the question of technology, which is, nonetheless, unavoidable in the face of the contemporary planetary condition (Hui, 2024).

In this context, I explore an emerging mode of production and technology development rooted in the commons, namely “cosmolocal production” – referred to here as “cosmolocal technology”. My aim is to enrich our understanding of this phenomenon and investigate its transformative potential amid ongoing crises. I view cosmological technology as a holistic (though not perfect) practical response to the overlooked question of technology, one that aligns with several alternative transition discourses. Through a cosmo/onto-logical reading, I examine critical but under-explored dimensions that could enhance its potential for meaningful change. To support this analysis, I employ “cosmotronics” as a philosophical framework, expanding the inquiry beyond political, economic, and ecological considerations.

In this regard, my central question is: What is, or what could be, the transformative potential of cosmological technology in pursuing sustainable futures? Additionally, I explore secondary questions to uncover various dimensions of the main inquiry, including: What aspects of mainstream approaches (e.g., narratives, methods) to sustainability and technology hinder effective transitions, and how does cosmological technology address these limitations (I; II; III; IV)? How does cosmological technology challenge the “scale-at-all-costs” mentality and the “one-size-fits-all” solutions (II; IV)? How do commons-based institutions foster collective, transformative action, and how can this mobilising potential be communicated effectively beyond academia (II; III)?

The thesis draws on insights from four original publications and prior research on cosmological production, utilising additional key theoretical elements to present a new threefold contribution in its own right: First, it bridges grounded research on cosmological production to a broader horizon of inquiry in the context of planetary challenges. Second, it strengthens the connection of the cosmological framework with pertinent alternative discourses on transitions and transformations. Third, it positions cosmological technology as a framework that could facilitate collective action towards a common vision for a future rooted in alternative socio-political formations but also in the “relational dimension of life” (Escobar, 2018, p. 8).

The exploration unfolds gradually through a theoretical overview that elucidates critical aspects of the current techno-economic predicament and highlights how alternative perspectives challenge prevailing understandings of sustainability and technology, advocating for different future pathways. Anchored on these perspectives, the thesis ultimately discusses distinct aspects that underscore the transformative potential of cosmological technology. Some findings are supported by empirical evidence, while others embody theoretical ideas that aim to open new avenues for research and dialogue.

In essence, I maintain that the potential of cosmological technology resides in providing the infrastructure for grassroots re-appropriation of modern technology for collective benefit; in transcending stagnating dichotomies that dominate debates on technology and transitions, paving the way for the re-emergence of techno-diversity and grassroots technological autonomy; and in fostering cross-pollination and exchange between alternative discourse empowering the possibility of substantial changes towards a future of planetary coexistence.

The remainder of the thesis is organised as follows: the next section provides an overview of cosmological technology and the commons. Section 2 details the methodological approach. Section 3 outlines the theoretical background, and foregrounds critical observations. Section 4 presents the key findings of this exploration, addressing the principal research question. Finally, Section 5 offers concluding remarks, discusses limitations, and suggests avenues for future research.

# 1 “Cosmolocal Technology” and the Commons

“Cosmolocal technology” arises within the innovative structural framework known as “cosmolocalism” or “cosmolocal production.” This framework is based on the commons and combines global knowledge exchange with localised manufacturing, facilitated by digital communication networks (Kostakis et al., 2023a; Schismenos et al., 2020; II; III; IV).

The commons, as defined here, are not merely resources or resource management schemes, as suggested by capitalist-aligned and mechanistic approaches (Bollier, 2024). Instead, they represent a mode of social organisation that empowers communities to collaboratively manage shared resources and produce goods while prioritising socio-ecological well-being, placing an emphasis on access, transparency, and fairness (Bollier, 2014; Bollier & Helfrich, 2019). As such, the commons encompasses a rich diversity of examples throughout history and across localities and cultures, from community forests and fisheries to digital communities and emerging cosmolocal initiatives (Bauwens et al., 2019; Bollier, 2024; Ostrom, 1990; 2009). Nevertheless, there are no universal models or blueprints to define exactly how such commons-based ventures should be created and operated. Each example is unique (Bollier & Helfrich, 2019). In this way, the commons can be seen as a universal language unbounded by universalist ideologies (Gibson-Graham, 2002).

Viewing the commons as a social system highlights the dynamic complexities and symbiotic relationships among commoners, akin to all living systems (Bollier, 2024). Contrary to the orthodox economics’ assumption that people are inherently driven by individualistic self-interest – necessitating private or state ownership and regulatory frameworks to prevent resource depletion (Hardin, 1968) – commoners align their self-interest with the collective (V). They operate with a non-competitive mindset, asserting a degree of self-determination in fulfilling their needs directly and independently of markets and centralised state control (Bollier, 2024; Feola & Jaworska, 2019). Though the commons often operate as a “shadow culture” barely acknowledged by official institutions (Bartels, 2024; Bollier, 2024) and largely neglected by numerous disciplines (including sustainability sciences, and sustainability transitions) (Swilling, 2019; III) – continue to challenge the dominant trajectory beyond critique, illustrating how alternative forms of living, making, and making sense can navigate and shape sustainability transitions.

Commoners embrace interdependence with one another, with natural systems, and with non-human beings, not as a constraint but as the foundation for fostering prosperity. Their reciprocal relationships are rooted in ethics of care, mutual trust, and a sense of togetherness (Mandalaki & Fotaki, 2020). In this light, communing – the act of contributing to and benefiting from the commons – can be understood as “relationality in practice” (Swilling, 2019).

In the context of cosmolocal technology, commoners are empowered to utilise a globally shared pool of knowledge resources, including design files, skills, good practices, and know-how, openly available as digital commons to produce technologies; and contribute new solutions or refine existing ones. Physical production occurs locally, utilising shared infrastructures like makerspaces and fab labs, and is informed by demand and regional biophysical conditions, ideally aligning with the value systems defined by participants (Kostakis et al., 2018).

At present, several initiatives, primarily from the Global North, utilise the cosmolocal framework to develop a range of open-source solutions, including agricultural technologies

(e.g., L'Atelier Paysan, Tzoumakers) (II), prosthetics (e.g., OpenBionics), renewable energy systems (e.g., Wind Empowerment), buildings (WikiHouse), and even space technologies (e.g., Libre Space Foundation). Such initiatives can also be regarded as part of a distinct category of social movements, which Hess (2005) describes as technology- and product-oriented (II). Instead of merely critiquing or opposing the status quo of industrial production, these movements illustrate alternatives in practice (Giotitsas, 2019).

Cosmolocal technology promotes design-embedded sustainability, transparency and openness, countering planned obsolescence and enabling well-informed life-cycle sustainability assessments (Kostakis et al., 2018; 2023a). It also fosters *conviviality*<sup>7</sup> as an alternative to industrialism, emphasising the importance of social autonomy in technology production (Illich, 1973; Kostakis & Tsiouris, 2024). Additionally, it embraces the concept of “mid-tech” to achieve a balanced synthesis of high and low technologies (Kostakis et al., 2023b). The mid-tech approach combines high-tech efficiency with the autonomy and resilience of low-tech alternatives, utilising advanced digital design and knowledge-sharing tools while incorporating local expertise and simple techniques (Kostakis et al., 2023b). Lastly, cosmolocal technology offers a different perspective on scalability, where projects grow through global knowledge networks of small-scale, locally-oriented communities, challenging the idea of up-scaling at any cost (IV).

Consequently, local communities are empowered to design and produce durable, repairable, affordable, and contextually appropriate technologies that are tailored – or adaptable – to regional needs, capacities, available resources, and cultural specificities, while being supported by and contributing to a global knowledge community (Kostakis & Tsiouris, 2024).

In these ways, cosmolocal technology seeks to minimise material and energy footprints, reduce dependence on global value chains and proprietary technologies, and foster local autonomy, subsistence, and bio-cultural diversity. Nevertheless, several challenges remain, including reliance on energy-intensive digital infrastructures, limitations in the licensing and standardisation of open-source solutions, and insufficient institutional support (Costanza-Chock, 2020; Kostakis, 2019).

In spite of these obstacles, cosmolocal technology offers a promising alternative to the dominant model of centralised, proprietary technological development. Rooted in a cooperative and relational ethos, the continuous emergence of technology-oriented commons-based ventures demonstrates in practice how technology could be understood, developed and deployed differently, prefiguring an alternative vision of the future.

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<sup>7</sup> Conviviality is associated with a vision of a society where tools and institutions serve users rather than create dependency. It represents an intrinsic ethical value of production modes that allow people to meet their needs autonomously through social solidarity, friendship, and mutual exchange (see Illich, 1973; Vetter, 2018).

## 2 Methodological approach

This thesis presents the findings of an exploration into the transformative potential of cosmological technology in sustainability transitions. Adopting an exploratory and interpretivist approach to understanding this emerging phenomenon (Stebbins, 2001), the investigation is informed by the perspectives of communities engaged in cosmological technology and by my positionality as a hands-on researcher, practitioner, and participant in relevant projects.

The thesis builds on three original peer-reviewed articles and one reflection article (ETIS 1.1) (I; II; III; IV) (Appendix 1), alongside prior research on cosmologicalism conducted within the “COSMOLOCALISM” research project. It also incorporates insights from a book chapter (ETIS 3.1) (V) and another journal article (ETIS 1.2) (VI), although these are not central to the thesis (Appendix 2). In this final manuscript, I further integrate new theoretical perspectives to comprehensively address the research question. The overarching theme of the publications is to identify areas of critique and limitations within established notions, practices, and discourses regarding technology and sustainable futures, while tracing key attributes of cosmological technology that emerge as essential to its transformative potential for sustainability transitions.

The publications utilise qualitative methods and theoretical/conceptual analyses to elucidate various aspects of the inquiry. Publications I and II include illustrative case studies that provide real-world insights. The first case details an initiative developing an eco-friendly building construction system, adhering to a more conventional business approach to sustainable production, which reveals key points of both convergence and divergence with the cosmological approach (I). The second case discusses a grassroots initiative that develops open-source agricultural technologies, which also served as a pilot case for the “COSMOLOCALISM” research project, offering insights into cosmological technology development studied in its original setting (II). Publications III and IV present analyses from distinct theoretical perspectives, addressing more specific aspects of the thesis’s inquiry, such as communicating alternative trajectories like cosmologicalism (III) and employing a different approach to scalability (IV).

Furthermore, Publication I employs a quantitative Life-Cycle Assessment (LCA) method to evaluate the environmental sustainability of the building system developed by the initiative. This method was used to assess the building system’s footprint, but within the context of this publication, it serves as an opportunity to engage in a critical discussion about the assessment method itself.

The data were gathered from various sources, comprising semi-structured interviews (I), field research and participant observation (II), desk research of online internal documentation, and outreach related to the cases examined (I; II), outcomes of the LCA analysis (I), and the authors’ personal experience (II; III). A literature review, conceptual analysis, and critical reflections from the authors’ grounded perspectives guided the more theoretical pieces (II; III; IV).

The thesis draws from a diverse range of fields – including Transition Studies, Futures Studies, Science, Technology and Society (STS), Philosophy of Technology, and Sustainability Studies – interweaving theoretical frameworks that converge around a critique of the dominant paradigm and advocate for the development of new concepts, frameworks, institutions, and methods to rethink, develop, and communicate alternative trajectories as a holistic response to sustainability challenges. Additionally, the thesis is inspired by approaches to conducting and writing research that emphasise the inclusion



of diverse epistemologies, such as indigenous knowledge and non-Western thought, as well as subjective viewpoints which challenge the narrow lens of traditional sustainability transition studies (Escobar et al., 2024; Hui, 2024; Santos, 2015) and prevailing academic research/writing conventions (Gilmore et al., 2019; Weatherall, 2023). This theoretical diversity has enabled a multifaceted exploration of the research question, enhancing my understanding of cosmological technology while also allowing me to introduce cosmologicalism into various emerging discourses, thereby laying the foundation for future research and action.

## **1.2 Writing approach: In defence of writing (a bit) differently**

My thesis occasionally adopts an evocative, graphic, and personal writing tone in an effort to write (a bit) differently and subjectively while acknowledging the inherent biases present in my work. This personal and creative approach feels more intrinsically aligned with the nature and scope of my research. Such a writing style may seem unfamiliar compared to traditional academic approaches, yet it resonates more with the scholarship engaging with alternative visions for the future. The latter is where I stand.

The aim of “writing differently” (Gilmore et al., 2019) here is to communicate directly with the person behind the reader, to establish a genuine connection, and to spark dialogue and imagination about alternative future possibilities. Direct communication inherently involves emotions and subjectivity, and within the context of this thesis, it requires a clear positioning within the current power struggles to enable a fruitful and honest dialogue.

Academic norms often disregard personal knowledge, embodied experience, self-exposure, and creative writing styles are often disregarded by academic norms, which predominantly privilege expert knowledge and impersonal writing conventions, seemingly guided by objectivity (Wall, 2006; I; III). However, this perspective is evolving as scholars seek to transcend constraints that frequently exclude alternative ways of being and knowing in favour of abstraction and cognition (O’Shea, 2019; Pullen et al., 2020; III). Further, scholars increasingly explore how scientific research can become more heterogeneous, reflexive, and socially accountable (Rau et al., 2018). In this direction, they investigate “how a different, more inclusive politics and ethics could be developed and shared through academic writing” (Weatherall, 2023, p. 515) and seek ways to communicate beyond academic circles, journal paywalls, and the void of digital repositories. Such a shift is particularly crucial for emerging transformative phenomena like cosmologicalism, and is deeply relevant to critical debates on enhancing the integrity and social relevance of research on sustainability, technology, and transition (Audet, 2014; Feola & Jaworska, 2019; Rau et al., 2018; Takkinen & Heikkurinen, 2024; III).

Therefore, my choice to write differently – interweaving personal expression with works that have significantly influenced my thinking – represents a modest act of creative resistance against established conventions. Most importantly, it hints at an attempt to reclaim academic writing as a living, breathing medium that can inspire collective action toward a brighter future.

### 3 Sustainability, technology and transitions/transformations

The expanding body of work known as “transition studies” includes a range of theories and discourses that, within the context of sustainability, uncover two distinct schools of thought (Swilling, 2019). The principal difference between them lies in how they engage with the politics and ontologies underpinning sustainability, transitions, and transformations, and how they envision a desired future.

The concepts of “transition” and “transformation” have become buzzwords in political, scientific, and social movements (Audet, 2014), often used interchangeably and metaphorically (Hölscher et al., 2018). Despite the varied interpretations among different actors, the primary message conveys a desire to transcend the current (unsustainable) state of affairs and to identify pathways and solutions that would facilitate change in the pursuit of a renewed (sustainable) society, in harmony with the natural environment (Silva & Stocker, 2018).

Nonetheless, these concepts are value-laden, reflecting the perceptions, worldviews, and cognition of the relevant actors. Therefore, the context of change depends on whose agency is included or excluded from discussions and decisions (Patterson et al., 2016). Consequently, the processes that shape transitions and transformations are inherently political (Hölscher et al., 2018). Furthermore, despite all actors aspiring for a collective shift towards sustainability, the nature of this shift and the envisioned future remain debatable and contested. As Audet (2014) argues, these concepts embody a double hermeneutic. In the case of social movements that question the politics at play, the loose conceptualisations may offer a broad foundation for agreement and inspiration (Audet, 2014). However, the conceptual ambiguity, particularly surrounding transformational change, may undermine the contributions of these movements in challenging the status quo (Hölscher et al., 2018).

The first school examines transitions through the lens of sustainability transitions theory, developed in academia, exploring transformative changes through multiple dimensions (e.g., socio-technical, socio-ecological, and socio-institutional) (Grin et al., 2010; Loorbach et al., 2017). This approach primarily encompasses technical and managerial solutions, while failing (or avoiding) to address the power dynamics and ontological assumptions that fundamentally shape transformation processes (Biely & Chakori, 2024). These techno-managerial approaches predominantly operate within the framework of “greening” the growth economy, positioning advanced technologies as key enablers of sustainability (Hickel & Kallis, 2020). Consequently, sustainability is reduced to a technical issue, with techno-scientific controllability viewed as crucial for addressing mounting environmental challenges (Stirling, 2023, as cited in Takkinen & Heikkurinen 2024).

The second school encompasses discourses that primarily arise from social movements and activist action, concentrating on the political and cultural/ontological dimensions of transitions/transformations. These discourses advocate for radical transformations of dominant institutions and practices (Escobar, 2015). This perspective largely critiques the model of neoliberal globalisation and envisions futures beyond growth, development, and extractivism (Swilling, 2019). However, these alternative visions frequently encounter criticism for lacking concrete pathways to implement fundamental changes, including questions of agency in driving such transformations (Swilling, 2019).

As a researcher and practitioner committed to such an alternative vision, I partially acknowledge this critique – and it is precisely what this thesis aims to explore: a practical

and potentially transformative response in the making. However, I question the validity of this critique when it arises from standpoints that overlook or disregard two fundamental barriers: namely, the formidable resistance posed by dominant institutions and the epistemological hegemony of Western techno-science (Hui, 2024; Santos, 2015). These systemic constraints actively and systematically undermine the potential for alternative possibilities. I emphasise, however, Hui's (2024) argument that such alternative proposals risk fading into obscurity or being co-opted by existing power structures if the question of technology is not rigorously and strategically addressed.

Following, I will first provide an overview of how sustainability and modern technology are predominantly framed and assessed. This overview aims to highlight critical issues that traditional transition discourses overlook or, conversely, that underpin critiques. Subsequently, I will examine alternative approaches to thinking sustainability, technology, and transitions/transformations.

### **3.1 The narrow lens of traditional sustainability transition discourses**

#### **3.1.1 The problem with “sustainability”**

Awareness of environmental degradation caused by human activity and its impact on societal well-being has deep historical roots that trace back to ancient times (Du Pisani, 2006). How this awareness is addressed represents a major distinction between the two distinct transition discourses.

The contemporary concept of sustainability originates in pre-industrial Europe, initially introduced within German forestry circles that were alarmed by excessive timber consumption and the danger of resource depletion (Du Pisani, 2006). Their proposals sought to preserve the forests' regenerative capacity by regulating extraction to satisfy the demands of trade, mining, and warfare. Later, attention shifted to coal and oil to accommodate growing populations and industrialisation (Du Pisani, 2006). The escalating threat of resource depletion heightened awareness about sustainable resource use and “stimulated a mode of thinking” that would later influence the discourses shaping global sustainability agendas (Du Pisani, 2006, p. 87).

Notably, the shift in the perception of “sustainability” from subsistence practices to satisfying the demands of competitive markets and technological advancement denotes a distinctly utilitarian approach to nature, regarding it primarily as a “standing reserve” (Heidegger, 1977, as cited in Hui, 2017a, p. 4) – and serves as the foundation of the contemporary sustainability concept. This critical observation is essential to consider when engaging with alternative transition discourses.

Sustainability gained prominence through the strategic reframing of post-war development ideas into “sustainable development” (Sabau, 2020) – yet another rather overused buzzword (Du Pisani, 2006). Within this framework, sustainability represented a moral imperative for ensuring global and intergenerational equity in the distribution of resources and welfare (WCED, 1987). Nevertheless, it also asserted that deviating from the existing socio-economic order and modernisation schemes or halting economic growth was unnecessary (Blühdorn, 2017). Conversely, it emphasised that global economic growth should be accelerated, supported by advancements in technology and science, improvements in efficiency for monitoring and management, and the integration of social and environmental costs into market systems (Blühdorn, 2017).

Consequently, sustainability is presented as a seemingly positive concept, defined in objective and unambiguous terms. However, this perspective obscures its subjective and

normative dimensions (Troullaki et al., 2021). Ultimately, sustainability is reduced to a purely technical issue, thus necessitating technical solutions primarily aimed at achieving environmental-economic win-win scenarios (Blühdorn, 2017; Kovacic et al., 2024). This mindset has failed to address the pressing challenges effectively. Instead, it has provided a series of “palliative” measures (Reinert, 2006). And, frankly, it remains unclear not only *how* sustainability can be achieved but also *what* it aims to achieve and for *whom* (Illich, 1999).

This obscurity extends to the methods by which sustainability is assessed, with a typical, widely used example being the Life Cycle Assessment (LCA) method and its variants. Many applications lack transparency and clarity regarding the assumptions that guide both the process and its results (Troullaki et al., 2021; Wulf et al., 2019). Each assessment tool incorporates underlying values that define its criteria, processes, and ultimately the outcomes. The findings determine what is regarded as “sustainable”, which in turn may inform political decisions on policies, extending beyond individual products to entire systems, regions, or sectors of the economy (I).

The general ambiguity surrounding sustainability is not incidental but rather a necessary condition to maintain the status quo (Saltelli et al., 2020). Consequently, many inconvenient truths are ignored in sustainability discussions and communication (Voci & Karmasin, 2024; III), as the techniques (e.g., narratives, assessment tools) are neither objective nor neutral (Saltelli et al., 2020; Gasparatos & Scolobig, 2012). The deeper issue with “sustainability”, however, lies not in the ambiguity itself but in the failure to acknowledge it (Kouvara et al., 2024).

Moreover, the global unilateral character of sustainability agendas, wherein centralised, top-down strategies dictate the “correct” path for all societies to follow, has systematically overlooked the rich, diverse heritage of subsistence, commoning practices to managing shared resources or producing goods for collective benefit (Nightingale, 2019; Ostrom, 1990). Such practices resonated with local communities’ values and needs and were grounded in relational understandings of human-nature interrelations. However, with the gradual spread of the Western worldview as a single truth through colonisation and modernisation, these practices were often dismissed as primitive, or destructive, and were marginalised (Nightingale, 2019). Consequently, the lens through which human-nature relationships, and history, are perceived by dominant approaches is too narrow, which in turn limits our ability to envision alternative options to a sustainable future.

Overall, sustainability is a politically charged and contested concept that currently serves more as a rhetorical device than a genuinely transformative framework (Blühdorn, 2017). Meaningful change cannot be realised if the perceptions, biases and interests that currently shape problems and objectives and dictate the direction and pace of transitions remain unchallenged (Martin et al., 2024).

### **3.1.2 The debatable role of modern technology**

In the technical reasoning of sustainability, modern technology plays a pivotal role, serving as a means to a somewhat vague aspiration. Despite the apparent lack of progress in addressing, or at least halting, the escalating crisis, mainstream narratives – such as “green growth” (Perez, 2019) and “ecomodernism” (Asafu-Adjaye et al., 2022) – continue to assume that sustainability challenges can be solved through advancing technologies. These narratives suggest that economic growth can be decoupled from environmental degradation, despite the persistent failures in this regard (Vadén et al.,

2020) (II; III). Their assumptions not only oversimplify the complexities of sustainability issues but also ignore inherent pitfalls associated with modern technology.

Modern technology represents the transcription of modernity's ontology and epistemology into technics. This ontology is premised on the fundamental separation between humans and nature, which perceives the conquest of nature and the "othering" of diverse ways of thinking, knowing, and being as essential elements of progress for human civilisation (Barca, 2020; Plumwood, 1993). While this worldview presents itself as universal and deterministic in its assertions about how things are and ought to be, the claimed supremacy of its rationality and tools (e.g., science, technology) rests upon very thin soil.

As a result, modern technology is intertwined with discriminatory systems (e.g., colonial, racial, and gender systems) (Irwin & White, 2019; Paulson, 2024; II) and maintains strong ties to the dogma of growth. This reflects the fixation on the notion that growth is a prerequisite for societal well-being and can be achieved only through technological advancement and globalisation (Pansera & Fressoli, 2021; II).

The assumed imperative of technological globalisation has driven the spread of standardised homogeneous technologies, marginalising the rich technological diversity (technodiversity) that once flourished across cultures. This technodiversity emerged from distinct epistemological, ontological, and cosmological worldviews, through which societies developed locally embedded and culturally interwoven technologies to meet their needs while maintaining the balance of natural ecosystems (Calisto Friant et al., 2023; Hui, 2022a).

The deep interconnections between relational knowledge systems and technology production are largely disregarded today, leaving little opportunity for diverse technological trajectories to flourish. This decline extends beyond endangered cultural diversity, to biodiversity. For instance, modern pesticides, although designed to universally target specific biological and chemical traits in insects, exhibit effects that vary significantly by location, ranging from beneficial to disastrous (Hui, 2024), often leading to a "pesticide treadmill" where the use of one agrochemical necessitates the application of another (Argüelles & March, 2023). Likewise, genetically modified and standardised seeds, while potentially enhancing yields under shifting climate conditions and facilitating market integration, can severely harm local agrobiodiversity (Mazé et al., 2021).

Furthermore, by prioritising economic interests to drive growth, technology has significantly lost its social purpose, exacerbating the various forms of alienation that characterise neoliberal society and industrial production (Beinsteiner, 2020; Brownhill et al., 2012; Irwin & White, 2019). The ongoing destruction of traditional ways of living, the simultaneous intrusion of expertise and professionalisation (Illich, 1973), along with the centralised development of technology by corporations and government bureaucracies (Huesemann & Huesemann, 2011), has systematically detached people from the knowledge and means of subsistence and production.

This detachment cultivates a dependency on artificial systems and expert knowledge, undermining human agency and autonomy to engage with technology and understand how it mediates, shapes, and interferes with our lives and experiences of the world (Drechsler, 2020; Giambastiani, 2021; II). It also indicates an inability to grasp or assess the broader implications, origins, and biases of technology – a condition that Hui (2022a) describes as "technological unconsciousness." This state of unconsciousness, endemic to "homo industrialis," is a critical factor in why modern technology plays such a pivotal role

in the destruction of the biosphere and humanity's future, positioning it as a distinctly political issue (Hui, 2022a).

Thus, modern technology carries profound and often detrimental implications throughout its entire lifecycle – from design and production through distribution and usage to the disposal of artefacts. These repercussions include, among other issues, excessive material flows and energy consumption, toxic waste, loss of biodiversity, exploitation of labour, planned obsolescence, and opaque patent systems that hinder maintenance, repair, and transparent sustainability assessments. These challenges disproportionately impact various communities and ecosystems around the world (Jambadu et al., 2024; Kostakis et al., 2023b; Krebs & Weber, 2021).

Ultimately, the techno-optimist perspective, which views modern technology as a panacea and takes its dominance for granted, is both highly questionable and misleading (Hornborg, 2024; II) – nearly verging on belief. Rather than offering a comprehensive response to the complex demands of sustainability (e.g., social justice, ecological stability, cultural resilience), such promises, rather reflect a top-down imposition of hope (Drahos, 2004). These strategies of enforced hope, orchestrated by states, corporations, and scientists, aim to convince the public that this trajectory is the sole viable option; when, in reality, it serves to maintain the status quo and delays social action (Drahos, 2004; Blühdorn, 2017; II).

Despite hegemonic narratives continuing to shape sustainability transitions, the increasing recognition of modern technology's implications and contradictions regarding sustainability presents an opportunity to rethink technology in its entirety and diversity (Hui, 2021). This opportunity prompts a questioning of the ontological and political foundations upon which technology unfolds and materialises. Therefore, instead of adopting modern technology uncritically or rejecting it entirely, we could further investigate the possibility of reappropriating it.

### **3.2 Transition to where? Seeking alternatives pathways**

Whether the sustainability paradigm is approaching exhaustion, indicating the arrival of a post-sustainability era as Blühdorn (2017) suggests, or whether heightened awareness of the current predicament signifies the true beginning of the "Sustainability Age" for all (Swilling, 2019), it is undeniably a time of simultaneous stagnation and noticeable, experienced transition. But, transition to where?

Pathways that prioritise technocratic solutions designed to remedy planetary systems and protect ecosystems "without in any way reducing the powers and wealth of the rich and super-rich" (Swilling, 2019, p.5) and while overlooking the prevailing "monoculture of the mind" (Shiva, 1993), portend many bleak futures ahead. If the aim is to genuinely pursue sustainability as a vision of planetary harmonious coexistence for generations to come, the inquiry must be fundamentally reframed.

The complexity, depth, magnitude, and urgency of sustainability issues indicate that continuing on the current path undoubtedly leads straight downhill, head-down, unless someone is willing to jump on a spacecraft to Mars. Even then, I personally would prefer to skip the companionship of Musk and the like; *if* I had any choice (pun intended). The combination of growing mistrust, or even distrust in the supposedly "good" intentions of democratic institutions (Merkel & Lührmann, 2021; Van Prooijen et al., 2022; II) and the evident lack of effective solutions so far, presents numerous reasons to feel hopeless, frightened, and immobilized – if not choosing to remain "comfortably numb" (Waters & Gilmour, 1979).

In response to this stagnation and widespread anxiety, alternative discourses have emerged over recent decades, suggesting that new pathways are not only feasible but already present. These discourses first and foremost engage with *thinking* sustainability issues from varied perspectives— where thinking, in this context, “means to provide a new reading that has transformative power,” reflecting on our “actual situation and go beyond it to imagine radical openings” (Hui, 2021, p. 57). This serves as the emphasis of the subsequent sections.

### **3.2.1 Another sustainability: Relationality, diversity and cooperation**

Several studies within the broader context of sustainability transitions diverge from the prevailing “neutral” and reductionist approaches, foregrounding critical questions of politics, power, and agency in shaping narratives and potential pathways. These perspectives acknowledge that transitions often lead to uneven social impacts and an inequitable distribution of benefits, which can vary across different contexts. They therefore advocate for more democratic and inclusive processes, emphasising pressing issues of justice (e.g., socio-environmental, labour, energy justice, and indigenous rights) (e.g., Cain, 2024; Doyon et al., 2021; Fischer et al., 2024; Healy & Barry, 2017; Köhler et al., 2019; Sovacool, 2021; Scoones et al., 2020; Velicu & Barca, 2020).

However, more radical perspectives that fall within a broader category of transition/transformation discourses advocate for “significant paradigmatic or civilisational transformations” to achieve meaningful change (Escobar, 2015) or, more ambitiously, to “transition to an altogether different world” (Escobar, 2011, p. 138) – and, more importantly, to “a world where many worlds fit” (Zapatista quote, as cited in Escobar et al., 2024). These discourses incorporate various grassroots perspectives from social movements in both the Global North and the Global South, utilising the concepts of transition and transformation irrespective of traditional academic theories (Feola & Jaworska, 2019).

Although these discourses emerge from diverse intellectual foundations and operate through distinct epistemic and political practices, they find common ground in envisaging life beyond neoliberal globalisation, widely regarded as the root cause of multiple contemporary crises (Beling et al., 2018; Escobar, 2015; Feola & Jaworska, 2019). Consequently, they challenge dominant institutions, power structures, and epistemological barriers that currently exclude alternative understandings of social well-being and the interrelationships between humans and the natural world. Therefore, these discourses engage with politics in transformative processes, including also crucial ontological dimensions, which remain largely absent from traditional discourses.

Despite their diverse backgrounds, distinct similarities exist in how they envision the future, which appear to have naturally emerged from within each social movement (Feola & Jaworska, 2019). Consequently, these varied visions interweave with one another. Their similarities can be identified through three fundamental characteristics: a future composed of relational, communal, and plural worlds (Escobar, 2015). In doing so, they aim to dismantle the dominant Western (Eurocentric, Euro-American, modern) dualist ontology (which maintains separations between nature/culture, human/non-human, body/mind, and so forth. This ontology currently shapes scientific and technical thought, influencing socio-ecological relationships and recognising how these constraints limit possibilities for future coexistence (Beling et al., 2018; Bollier, 2024; Escobar, 2015).

Within these diverse imaginaries, “degrowth” emerges as a critical framework proposing radical and egalitarian socio-ecological transformation towards a future society liberated from the relentless pursuit of growth (Demaria et al., 2013; Kallis & March, 2015). Others suggest varied perceptions of what a desirable world could entail, moving beyond traditional narratives of sustainable development. A pertinent example is “Buen Vivir” – an evolving framework that integrates indigenous (Andean-Amazonian) and critical Western thought to envision new ways of living that prioritise ecological harmony, human dignity, and social justice over economic objectives (Beling et al., 2018; 2021).

Furthermore, the “Commons Transition” discourse presents a pathway to an egalitarian and environmentally sustainable society, and a cooperative political economy that surpasses market competition and bureaucratic demands (Bollier, 2024; Feola & Jaworska, 2019). This discourse originated from Ecuador’s “Free/Libre Open Knowledge” initiative, which sought to develop a strategy for an open “social knowledge economy” aligned with the vision of “Buen Vivir” (Feola & Jaworska, 2019). It has since evolved into a global framework that promotes policies generating collective value through open, participatory processes (Feola & Jaworska, 2019). It aims to realign and reimagine traditional commoning practices and cooperative thinking into new institutional forms, framing sustainability transitions as a subversive alternative to the capitalist order, including its more recent iterations, such as netarchical capitalism (Bauwens et al., 2019; Feola & Jaworska, 2019).

Simultaneously, these alternative perspectives seem to converge into the vision of a “pluriverse,” which represents an interconnected tapestry of relational, communal worlds, where the collective precedes the individual, and there is an inherent continuity between the biophysical, human, and supernatural realms (Escobar, 2015; 2018). This perspective sharply contrasts with modern dualist thought, which not only posits a strict separation between entities but also leaves the supernatural/spiritual dimension out of the equation (Escobar et al., 2024; Schroyer, 2009). In this vein, rather than endorsing globalisation’s “One-World world” doctrine – a singular unified reality propagated through colonialism and development schemes – this concept reframes the “global” as an opportunity to preserve diverse ontologies and ways of being (Escobar, 2015). In doing so, it counters the spatial division of the life-world into binaries such as global/local, Global North/Global South, East/West (and potentially planet Earth/outer space). In this way, the vision of a pluriverse also opens possibilities for reimagining “the plurality of European worlds” beyond Euro-modernity, including the potential for “degrowing into a pluriverse” that transcends capitalism, liberalism, secularism, and the State (Escobar, 2015, p. 460).

The convergence of these various storylines and pathways for change can foster strategic exchange among social movements in sustainability transitions, thereby establishing the foundations for other possible worlds (Beling et al., 2018; Escobar, 2015; Feola & Jaworska, 2019). However, the technology question is neither adequately nor jointly addressed within these discourses (Hui, 2024). This hinders the development of implementation pathways amid the planetary technological condition, as tensions between technological enthusiasm and scepticism remain unresolved (Kerschner et al., 2018; March, 2018). This is why I propose a way to encourage such an inquiry.



### 3.2.2 Another way to thinking technology: Multiple “cosmo-technics”

The appropriate role of modern technology in sustainability transitions remains a subject of debate (Heikkurinen & Ruuska, 2021). The fundamental challenge is how to reappropriate it – harnessing its potential to foster a healthy future for all while neither overlooking its drawbacks nor romanticising a return to the pre-digital or pre-industrial era.

Responses to the question of technology related to or emerging from the aforementioned alternative discourses on transitions – such as pluriversal technologies (Calisto Friant et al., 2023) or appropriate, convivial technologies (particularly in the context of degrowth) (Kerschner et al., 2018; Vetter, 2018) – exist; however, they fall short in addressing technology “in its totality and in its diversity” (Hui, 2021, p. 112). Firstly, they do not thoroughly consider the multiple dimensions of technology – political, material, ontological, epistemological, and cosmological – while there is a notable lack of critical exchange on this topic across movements. Secondly, they fail to situate technology within our contemporary planetary reality of unprecedented technological acceleration (Hui, 2024).

Drawing on these insights, I propose “cosmotechnics” (Hui, 2017a; 2017b) as a foundational framework for reconceptualising technology in the service of collective transformative change. This framing synthesises critical elements from diverse alternative perspectives and extends the inquiry beyond the prevailing focus on political economy and political ecology – crucial to engage with the question of technology holistically. It has also been catalysing for my exploration of cosmological technology, revealing crucial yet unexplored cultural dimensions that demand further research.

Cosmotechnics leverages the “ontological turn in anthropology, which aims to tackle the problem of modernity by proposing an ontological pluralism” (Hui, 2017b, p.2), and suggests delving into the culture-specific assumptions inherent to technology (Hui, 2017a). Thus, it illuminates critical interrelations between the epistemological and ontological dimensions in technology development that dominant discourses tend to overlook.

Cosmotechnics seeks to expand our critical thinking on technology beyond its exclusive association with Greek *technē* and the Promethean myth, irrelevant to cultures not influenced by Greek philosophy, as did Western European thought (Hui, 2022a). In this light, it “raises the question of technics not as a universal techno-logy,” but as a question of multiple locality-specific technics (Hui, 2022a, p.289). Put differently, cosmotechnics holds the thesis that technology is not anthropologically universal but rather “enabled and constrained by particular cosmologies which go beyond mere functionality or utility,” grounded in the diverse local/cultural contexts (Hui, 2017b, p. 2).

In this light, cosmotechnics invites an exploration of how non-Western and indigenous ontologies, along with their associated ways of being and knowing, could engage in meaningful dialogue with modern technology and Western metaphysics, to potentially reshape the future development of global technologies (Hui, 2017a; 2022a).

Cosmotechnics is described as “the unification of the cosmos and the moral through technical activities, whether craft-making or art-making” (Hui, 2017b, p. 7). Unification here means more than putting these two entities together; it refers to their dynamic, reciprocal relationship, constantly enforcing each other to acquire new meanings over time (Hui, 2021).

Seen from the lens of cosmotechnics, technology emerges as an ontological category embedded within a larger order of existence – a cosmology deeply connected to its culture

of origin, reflecting both geographic specificities and collective imagination (Hui, 2022a; 2021). Here, cosmologies refer not to scientific theories of outer space, as in astrophysics, or obsolete beliefs, but to localities and their diverse, context-specific ways of knowing and being and understanding morality (Hui, 2021). These distinct cosmological relations concretise in technical activities, including the invention and use of tools, or social and political systems (Hui, 2017a; 2021; 2022b). Thus, just as different localities embody distinct cosmologies, they also give rise to multiple cosmo-technics.

While a universal technical tendency exists – akin to natural laws, where certain technologies like fire-starting with flint or the wheel emerge across civilisations – historically, the diffusion of similar technologies across cultures was filtered and shaped by the constraints of each internal milieu (Hui, 2020). This process of local adaptation differs fundamentally from globalisation and its resulting technological homogenisation.

The concept of cosmotechnics is vividly illustrated by traditional Chinese medicine, which contrasts with the utility and functionality of modern Western medicine; yet it is no less medical (Ekbia, 2023). Chinese medicine operates through the language of Chinese cosmology, employing concepts like ch'i (vital breath), Yin and Yang, and the five movements (metal, wood, water, fire, earth) – principles that cannot be physically demonstrated in anatomy (Hui, 2024). It views the body as a microcosm reflecting the macrocosm, and intrinsically connected with the mind and the spirit (or soul); and heals by restoring internal harmony (Hui, 2022b; 2024; Ng, 2018). Western medicine approaches healing through mechanical scientific application, based on fundamentally different understandings of diagnosis, therapy, and bodily function (Hui, 2022b; Ng, 2018). Notably, despite Chinese medicine's effective continuous practice over thousands of years, its legitimacy is often validated only through confirmation by Western medical standards (Hui, 2022b; 2024).

An important insight from this example, which extends to many vernacular practices, is that Chinese medicine is not an ethnocentric form of technics. Rather, it represents “knowledge that is in principle accessible to everyone and could be practised by everyone” (Hui, 2022b, p.1411). This demonstrates how practices deeply rooted in specific cultural contexts can be shared and adapted across diverse communities without requiring forced adjustments.

Today, certain Chinese medicine practices, like acupuncture, are gaining recognition in Western medicine, largely due to documented patient successes in areas such as pain relief – even when Western scientific methods cannot yet provide their standard quantitative evidence. Similarly, Western methods have been incorporated into Chinese medicine education and practice. This mutual influence, despite differing cosmological frameworks, suggests potential for advancing medicine in a more holistic direction for the common good.

In the process of modernisation and globalisation, the rich variety of cosmotechnics – that is, technodiversity – and the embedded local and indigenous knowledge has been largely lost or diminished to mere historical reflection (Hui, 2024; Santos, 2015). This erosion has conditioned us to think in terms of a singular, universal technological lineage (Hui, 2017a). However, just as there is no singular form of living or thinking, there is no single technology (Hui, 2017b).

In light of environmental catastrophes and the growing risk of losing control over increasingly autonomous technologies, a fundamental reassessment of our approach to technology is essential. This critical inquiry into technology should extend beyond developing more advanced or eco-efficient solutions, beyond retroactively imposing

ethics on Artificial Intelligence and biotechnology (Hui, 2019; 2020), and beyond pursuing yet another unified global solution. These narrow approaches merely perpetuate the current corporate-driven technological monoculture, accumulating ethical constraints until an inevitable breaking point (Hui, 2019; 2021). Meanwhile, international technological competition, driven by economic and military interests, threatens to perpetuate cycles of war, fascism, and nationalism (Hui, 2024). Moreover, restoring locally-rooted traditional technics, while valuable for various reasons (VI), is insufficient to pave a collective way out of the planetary technological condition and mounting crises.

Fundamentally, transitioning to sustainable futures goes far beyond mere technical considerations. A transformative shift towards a future of planetary coexistence cannot occur neither by developing a specific technology anew nor by restoring old practices; as the rotting root of our predicament extends beyond the “machine” itself – rather lies in the “machine heart,” the “calculative mind” (Hui, 2022a)<sup>8</sup>.

Instead, a promising path lies in envisioning different technological futures, inspired by diverse systems of technological thought (Hui, 2022a; 2024). This approach moves beyond the current trajectory of modern technology – confined by modernity, capitalism, and the Promethean myth – to exploring how multiple contemporary cosmotechnics could re-emerge (Hui, 2017a). Cosmotechnics, as a lens to thinking technology, opens new possibilities for reappropriating modern technology by investigating how non-Western perspectives and metaphysical categories can contribute to its transformation rather than its rejection (Hui, 2024; Hui, 2022a). This could foster “a new geopolitics that is not based on an apocalyptic singularity, but on technodiversity; this is also why cosmotechnics is a political concept” (Hui, 2019, p. 277).

Building on this understanding of cosmotechnics, I next examine how cosmological technology can facilitate such an exploration, serving as infrastructure for transformative visions to potentially move from imagination into practice.

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<sup>8</sup> In an ancient story associated with Zhuangzi (late 4th century BC, pivotal figure in Daoism), a man named Zigong meets an old farmer who is manually drawing water from a well. Zigong, observes that the old man “used up a great deal of energy but produced very little result” (Hui, 2022). So he says to him, as would someone chanting the mantra of efficiency today, “There is a machine for this job.” The old man responds, “I’ve heard my teacher say, where there are machines, there are bound to be machine worries; where there are machine worries, there are bound to be machine hearts. With a machine heart in your breast, you’ve spoiled what was pure and simple, and without pure and simple, the life of the spirit knows no rest [...] It’s not that I don’t know about your machine—I would be ashamed to use it!” (Zhuangzi story, as cited in Hui, 2022a, p. 106). A more precise translation for “machine heart” (*ji xin*) would be “calculative mind” (Hui, 2022a). Zhuangzi probably means that “one should avoid developing such reasoning about life, so as not to lose the way [Dao], and along with it, one’s freedom; if one always thinks in terms of machines, one will develop a machinic form of reasoning” (Hui, 2022a, p.106).

## 4 The transformative potential of cosmological technology

The prevailing story that we have inherited from the West has become “a dysfunctional cosmology” that functioned, at least for some, for a long time, but “it is no longer the story of the Earth. Nor is it the integral story of the human community. It is a sectarian story.” (Berry, 1988 in Escobar et al., 2024, p. 2). These words, which I attempted but could not transcribe any other way, capture the simple yet fundamental truth that global sustainability agendas and traditional transition discourses seem to ignore.

The current predicament stems from this dysfunctional cosmology manifesting in modern technology and its implications. Modern technology thus emerges as the “contemporary cosmotechnics that dominate the planet” (Hui, 2022a, p. 299), founded on reasoning that is “fundamentally against the conditions of subsistence and existence” (Hui, 2019, p. 275). Against this backdrop, cosmological technology may present itself as a countering cosmotechnics of a future to come, where prosperity ceases to be a sectarian story and becomes a planetary one.

In what follows, I examine why and how cosmological technology holds this potential, and what makes this potential transformative. My analysis rests on the premise that cosmological technology addresses the material, political, and ontological dimensions of technology simultaneously, while embracing a broader vision of planetary coexistence – transcending artificial binaries (Table 1) to tackle more substantive oppositions (Table 2) that currently remain unaddressed.

### 4.1 Transcending artificial binaries

A series of binaries currently dominate debates surrounding technology, production, and sustainable futures – global versus local, high-tech versus low-tech, modern versus traditional, scalability versus “non-scalability” (Tsing, 2012; 2015). While these dichotomies can provide fertile ground for dialogue and critique, they often create unnecessary confusion when proposing practical solutions. This confusion is unnecessary for two reasons. First, these binaries distract from the real challenges at hand; debates about the superiority of one approach over another obscure underlying biases and assumptions. Second, the resolution to these apparent dilemmas may lie in their creative integration. Cosmological technology offers precisely this possibility: a reframing of technology beyond such binaries to address more fundamental challenges.

Challenging dominant narratives, one end of the spectrum consists of proposals that oppose the dominance of techno-optimism and its faith in modern technology’s universal solutions. These proposals combine different elements in multiple ways. Some advocate for “low-tech” solutions – simple, frugal technologies that demand fewer resources and less energy. Others emphasise “local” approaches through decentralised and localised production, respecting bio-physical limits while leveraging local knowledge. The notion of “local,” however, can span various scales, from specific ecosystems to state boundaries, depending on context and challenges. “Traditional” is typically approached in terms of reviving or adapting indigenous techniques rooted in local knowledge. The idea of “non-scalability” (Tsing, 2012) promotes solutions that remain grounded in specific local conditions, contrasting with those intended for global uniformity.

While these proposals offer important critiques of the current trajectory, they alone cannot provide sufficient practical responses to global challenges. Cosmological technology, however, offers a different approach – one that resolves such binaries by demonstrating how their elements can be reinterpreted and integrated (section 1).

First, through its organisational structure, cosmological technology blends global connectivity with localised practices. This simultaneous local-global orientation empowers local autonomy and sufficiency while fostering a sense of shared global benefit (Schismenos et al., 2020). In contrast to capitalist interpretations, the cosmological framework views the global as a network of interrelated, diverse small-scale, locally-oriented communities (Kostakis et al., 2023a). Here, locality exists in dynamic exchange with the global while remaining grounded in its integral specificities. Second, adopting a mid-tech approach bridges the gap between low- and high-tech, or modern and traditional, enabling the integration of situated knowledge into new technologies without privileging one over the other. Third, by proposing an alternative approach to scalability, it challenges the unsustainable imperative of upscaling at all costs driven by uniform industrial technologies. Instead, it embraces “scaling wide” or “scaling out” enabled by collaborative networks of commoners – thus suggesting a new politics of scale (Kostakis et al., 2023a; IV).

The transformative potential of cosmological technology lies partly in its capacity to transcend these binaries through their unification in practice. However, more fundamental oppositions – arising from ontological and political struggles inherent to transitions – also demand attention, and here too, cosmological technology takes a clear stance.

**Table 1.** Artificial binaries and how cosmological technology addresses them – as a configuration for technology development/production, and approached through the cosmotechnics lens.

binaries		cosmological technology	cosmotechnics
global Global North	local Global South	global-local orientation global exchange local production	local culture cosmic dimension planetary condition
high-tech modern	low-tech traditional	middle-tech	technodiversity, multiple cosmotechnis
scalability (scale up)	non-scalability	scale-wide via commons- based networking	planetary thinking beyond nation-states and ethnocentrism

## 4.2 Addressing oppositions

### 4.2.1 Diversity vs Monoculture: Reappropriating techno-diversity

Although the commons is mainly discussed from an organisational perspective (Mandalaki & Fotaki, 2020), as a social system, its significance extends beyond economics, public policy, or politics. At its core, it represents a distinct mode of human existence (ontology) and knowledge (epistemology) that differs fundamentally from the established Western worldview (Bollier, 2014; V). The essence of this distinction lies in the relational and communal understanding of the world, where all aspects of life are mutually interconnected, and personhood is intrinsically interwoven with the web of life (Escobar, 2015). This ontology of the commons manifests in how communities of commoners organise and operate within and beyond their locality, as well as in their technological creations.

In this light, commons-based technology development incorporates both ethical principles and moral values that prioritise the collective over individual benefit – where the collective encompasses not only community members but extends to society, to the natural world – to “life-world” as a whole. This ontological, ethical-moral foundation guides the production and application of commons-based technologies.

Hence, the distinct characteristic of commons-based technology, as opposed to modern technology, is that while it retains a shared ontological/ethical-moral core it manifests in diverse ways within different localities and cultures (section 1). In traditional contexts, this foundation is more visibly intertwined with the various cosmologies rooted in each locality. This culturally embedded diversity has largely eroded through modernisation processes (sections 3.1.1, 3.1.2), but the commons, despite being marginalised in contemporary life, have not ceased to exist (Bollier & Helfrich, 2019) (section 1).

Cosmolocal technology is one such contemporary manifestation of the commons. It provides a framework that can be adapted to different contexts (geographical, cultural, cosmological) and a template for harnessing the benefits of the digital epoch for collective benefit, without compromising its inherent commons values. Thus, cosmological technology does not propose an ideal model of a single universal technology, but a universal trajectory that integrates diversity, opposing the “universalisation of homogeneity”, which is currently the case (Hui, 2024, p.242). In this sense, cosmological technology establishes the groundwork for a practical response to the pressing issue of technology – and particularly the pursuit of technodiversity – potentially fostering the re-emergence of multiple contemporary cosmotechnics.

Seen through the lens of cosmotechnics, cosmological technology is positioned within the ontological struggles, offering the opportunity to investigate the possibility of technodiversity – a quest into how non-Western perspectives rooted in different cultures and cosmological understandings could influence the development of future technologies. More specifically, it denotes the possibility of commons-based technodiversity.

While exploring such a possibility might not work well in urban settings, which remain detached from natural life, it makes more sense for rural settings, which are in more direct connection to the natural world, and where rituals, traditions and practices reflecting these associations remain alive, or struggling to. That is also why the example of “Tzoumakers” (the pilot cosmological initiative that we studied and which I have been engaged with), located in a remote mountain village, turns out to be fruitful ground to initiate such an effort (II). In this light, while the cosmological framework is argued to provide the tools and structures for cross-spatial organising for change (Kostakis et al., 2023a), it also provides the infrastructure for a systematic cross-cultural exploration of technology under the scope of reappropriating technodiversity beyond homogeneity.

Furthermore, this deeper understanding of the ontology of the commons, is essential to distinct cosmological communities that adhere the relational ontology of the commons, from other communities who just follow the same organisational arrangement (i.e. open global knowledge exchange, combined with localised production), but ignore the rest. Could a community that exchanges designs for 3D printed weapons in the dark web<sup>9</sup> be considered a cosmological one? Simply no. There are fundamental qualitative differences lying in these deeper ontological elements, indicating how cosmological technology

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<sup>9</sup> <https://www.wired.com/story/3d-printed-guns-blueprints/>

interrelates with the larger cosmic reality and how it envisions a desirable future. Yet this dimension remains largely under-explored.

In short, cosmological technology holds the potential to facilitate the investigation and possibly the formation of an altogether different trajectory for technology stemming from the grassroots and premised on technodiversity and the relational ontology of the commons.

#### **4.2.2 Engagement vs Alienation: Reappropriating technological autonomy**

From a more socio-political perspective, cosmological technology emerges as a response to the growing alienation and disengagement from technology, over-dependence on proprietary, “one-size-fits-all” solutions, opaque systems and expertise. By extension, it also responds to the limited opportunities civil society has to comprehend the complexity of sustainability challenges, let alone to meaningfully contribute to addressing them.

Against this alienation and disengagement, the cosmological framework offers numerous ways to restore some extent of social technological autonomy – grassroots technological sovereignty (Giotitsas, 2019) – through cooperative, convivial, and democratic processes. Communities are provided access to shared infrastructures, equipment and tools, knowledge resources, and support networks/systems, to produce adaptable, repairable, open-source solutions to meet needs (not greed), leverage and enrich digital commons, and ensure transparent sustainability assessments. Cosmological technology fosters a mindset around technology as to primarily serve a social purpose, which in this case extends beyond the locality and a specific local community.

By fostering hands-on engagement with technology, commoners have many opportunities to cultivate skills (e.g., use of tools, digital literacy, etc.), collective ingenuity and grassroots innovation (Troullaki & Rozakis, 2024); skills that enhance their abilities to comprehend, develop and use technology. They are also empowered to cultivate a broader understanding of technology (technological consciousness), getting a hands-on experience of the whole spectrum of processes that encompass the production of technology, and its potential implications. In this sense, commoners are enabled to become more conscious of modern technology and the current predicament.

This, in turn, holds the potential to foster active and more conscious citizenship, where through collective action, communities can resist or inform policy decisions or suggest alternative directions (II). In this sense, direct engagement with technology could foster the much-needed “transdisciplinary” approach to sustainability research and policy making, which requires the contribution of multiple actors, disciplines and real-world perspectives – pluralistic expertise (Rau et al., 2018) – to define problems and develop solutions to sustainability challenges holistically (Troullaki et al., 2021).

This “democratisation” potential is further leveraged by the ways cosmological networks utilise digital connectivity. Namely, by facilitating open knowledge exchange, while fostering global collective action in the re-making of a future society – beyond “smart citizens” and data providers (Kovacic et al., 2024; March, 2018), beyond “governance by numbers” (Saltelli et al., 2024), beyond the “industrialisation of social relations” (Hui & Halpin, 2013).

Nevertheless, given that heterogeneous interpretations of already contested and elusive concepts, such as sustainability and technology, persist even within the same local contexts (Berglund & Kohtala, 2020; Vetter, 2018), commoners are constantly met

with the necessity of being conscious and alert to each concept's underpinnings. This presents a challenging task. However, by engaging in inclusive processes, they are also empowered to actively participate in reappropriating and co-defining the meaning of certain buzzwords – which is vital to ensure that their creations remain aligned with their vision, and that diverse perspectives are equitably accounted for.

Abandoning or attaching new meaning to concepts, or introducing new vocabulary – i.e. new vernacular language, accessible, relatable, inclusive and “homegrown” (Illich, 1980) – is in fact, crucial for the current prefigurative stage. It is also fundamental to enable transformative change (Loring, 2020; 2023).

Technological autonomy, in the context of cosmological technology, simultaneously demands and fosters a conscious engagement with technology and the broader complexities of sustainability challenges. Ultimately, this need, which naturally emerges from the non-hegemonic, democratic character of cosmological technology, necessitates a dynamic reinvention of a vernacular language that will accompany not just transformative but *meaning-full* change.

#### **4.2.3 Hope vs Despair: Reappropriating techno-optimism**

Empowering hands-on engagement in the making and making sense of technology and impacts of modern technology, is directly linked to enhancing people's ability to discern fraudulent techno-optimist hopes from actual possibilities (II). This, in turn, not only promotes democratic, responsible, heterogeneous and reflexive decision-making to serve the collective (instead of corporate) interest in sustainability transitions; but may also encourage the practice of collective hope (Braithwaite, 2004) (II).

In the face of ineffective solutions and feelings of despair and anxiety against a future of impending doom of environmental collapse and uncontrollable superintelligent systems, collective hope – intertwined with collective action – empowers social mobilisation against dogmatic narratives that presuppose a unified high-tech future as the only path forward. Such assumptions are largely debunked and somewhat exhausted; even illusionary (Hornborg, 2024).

Cosmological technology already demonstrates that another technological trajectory is in the making, able to host many alternative visions for a future of planetary coexistence. In this light, techno-optimism may acquire a new meaning, reflecting the potential of society-driven and culture-embedded technology – countering the rather pessimistic belief that the current regime is the best we can do.



**Table 2.** *Oppositions that cosmological technology raises and aims to address.*

<b>oppositions</b>		<b>refer to</b>	<b>affect</b>
monoculture	diversity	ways of living, thinking, knowing, relating, making	inclusion, justice, fairness, biodiversity
alienation/ dependence	autonomy/ engagement	means of production (design, manufacturing), possession of know-how, inclusion in decisions	subsistence, democracy
despair	hope	collective/social action or stagnation	active citizenship, social imaginary and emancipation
ignorance	awareness	critical reflection/ understanding of impacts, origins, biases and how technology influences thinking and actions	informed assessments, decisions, policy, action

## 5 Conclusions

Transitioning to a future of planetary coexistence may be determined by which worldview prevails (Escobar et al., 2024). But even so, there may not be enough time to “transition” after all. Humanity, as a whole, may have long since lost the chance to be active participant in any meaningful change, and either Nature or Artificial Intelligence will ultimately take full control. Or, there may be a twist (this is a point where you can unleash your imagination).

If the present story unfolds without a twist, we may as well continue as colonisers of other planets or as lonely hitchhikers in the galaxy (Adams, 1979). Yet, the truth is that neither predictive models nor theoretical contemplations can grasp how many other countless possibilities may be.

We are somewhat forced to deal with the uncertainty of a future made of this, for many reasons dark, present, and while this confrontation may provoke stagnating feelings, it also presents a great opportunity to continue trying, not to predict, but to mobilise. This present stage of uncertainty is what this thesis is actually about – our current earthly condition and collective action taking place (or could be) against all odds at this moment of deep perplexing crises.

In this vein, I focus on exploring the potential of cosmological technology – a contemporary reflection of the commons in technology – to initiate transformative change: meaningful change against the prevalence of eschatological thinking – a technological apocalypse looms – currently diminishing our imagination regarding technological advancement (Hui, 2024, p. 242). This potential change also counters the hegemony of an ignorant, corporate-driven techno-scientific regime that consistently contradicts itself on the path to a sustainable future. Nevertheless, this sharp critique does not target modern technology and science as neutral, solitary material and intellectual entities; nor us, the people who appraise and utilise them and are consciously or unconsciously influenced and shaped by them. It is also not a critique aimed at the nation-border-defined states of the West, since the planetary condition recognises no such boundaries (Hui, 2024). Instead, it is a call to challenge and reconsider the very ontopolitical foundations that currently drive technological thought and how technology is predominantly perceived and developed. Thus this critique addresses the assumptions that drive modernisation, globalisation, economic and power competition, arrogantly marginalising, undermining, and oppressing alternative ways of being and knowing from which there is much to learn. This mindset narrows rather than expands future possibilities.

As a result of personal hands-on experiences and this research work, I am drawn to the idea that a complete civilisational shift towards an “altogether different world” (Escobar, 2011, p. 138) is essential. While this may sound implausible, it effectively underscores the depth and complexity of the transformations necessary for meaningful transitions.

While traditional discourses remain attached to the current power structures, alternative discourses cannot rely solely on counter-political action toward justice or different socio-economic and socio-technical configurations to maintain the effect of change in the long run. Neither can rely solely on action from one specific movement or the other, nor can they rely solely on critique.

There is pretty much a tacit consensus amongst advocates of radical change, that pathways to meaningful transformations need to be relevant to the planetary condition,

and to the vision of an inclusive pluriversal world, beyond geopolitics and politics of scale founded on global-local, Global North-Global South, West-East dichotomies. Yet considering the catalytic role technology plays in exacerbating or potentially addressing the crises, and the pivotal role modern technology currently plays in driving research, policies and transformative action, alternative imaginaries urgently need to jointly engage with the lingering, contentious question: what technology exemplifies a different world?

Fixation on homogenising modern technology (which constitutes the canon of Western thought and capitalist expansion) has constrained our understanding of different future possibilities for technology (Hui, 2024) and, thus, the development of alternative options for sustainability transitions. Within the context of alternative discourses, that converge through their critique of the status quo and position their imaginaries upon relationality and diversity, a response to the question of technology cannot be found in one single unified model, intended to be universally adopted. Instead, it should come from a trajectory that embraces technodiversity – not only in the sense of fostering the production of solutions that can *adapt to* local contexts to meet social needs and account for ecological stability. But also in the deeper sense, of allowing different technologies (e.g., tools, practices) to *emerge from* the diverse cultural contexts, incorporating the diverse cosmologies and context-specific values of each locality. The question of technodiversity (beyond ethnocentrism) is pivotal in exploring and substantiating “alternatives to the current impasse of innovation and development” (Hui, 2024, p.221).

From this point of stagnation, where the dominant narratives appear to have reached their limits, stuck in unsustainable loops, I propose that cosmological technology has the potential to de-stabilise prevailing notions and practices, and mobilise collective transformative action toward technodiversity. Though visionary, this understanding of cosmological technology indicates a technological future that is as much possible as it is *impossible*.

The transformative potential of cosmological technology lies in two critical attributes. First, it refers to the capability of cosmological technology to reside within the dominant systems, functioning as a transformative force in its own right – enabling further collective/social action, challenging existing power dynamics, and provoking systemic/structural change. It encompasses a viable technological alternative that, despite facing significant limitations, is evidently evolving among grassroots communities worldwide, representing a contemporary manifestation of traditional commons-based practices. Second, its potential pertains to the capacity of cosmological technology to empower alternative visions to flourish, providing a practical response to the question of what technology could facilitate their proposed transitions. It constitutes an adaptable *infrastructure*, rather than a unilateral technology, to be utilised within diverse localities, both in terms of geography (e.g., urban, rural) and culture – thus also addressing the question of technodiversity beyond nation-states and beyond the substantiation of tradition.

The dual potential of cosmological technology is evident in its fundamental characteristic of leveraging modern technology, albeit on a significantly different basis than dominant transition approaches: it does not reject but rather repurposes its advantages for collective benefit while aiming to mitigate its drawbacks. In doing so, cosmological technology transcends artificial binaries (e.g., global/local, high-/low-tech, etc.) (Table 1) that lead to dead ends in the quest to collectively address planetary

challenges. Instead, it suggests the creative integration of the constitutive elements of these binaries: through a simultaneous global-local orientation and a mid-tech approach, it overcomes the constraints of locality and global homogeneity, harnesses digital connectivity for collective benefit, and incorporates local knowledge along with the autonomy of low technologies to produce tailored, low-impact solutions.

Furthermore, it addresses more critical oppositions (Table 2) that hinder the ability of diverse social actors to drive change. Cosmolocal technology embraces diversity on various levels, considering different cultural specificities, individual perspectives, social needs, and local ecosystems. It offers tools not only to create adaptable, tailored technological solutions but also to develop new inclusive and appropriate language. This latter quality facilitates the resolution of tensions and inconsistencies arising from different interpretations of ambiguous concepts (e.g., sustainability, technology, transitions). Finally, by enabling the reappropriation of technological autonomy, it nurtures collective ingenuity, technological consciousness, and the practice of collective hope, catalysing action towards meaningful transformations stemming from the grassroots up (II; III; IV).

In summary, cosmolocal technology is presented here as an alternative technological pathway already in practice, providing both the conceptual and technical framework to serve alternative imaginaries that are disproportionately present in the current socio-political and ontological struggles. Thus, it demonstrates that prefigurative change is already occurring, and if substantially supported, rather than left to operate in the shadow of institutional support, public recognition, and academic research (Bartels, 2024; Bollier, 2024; III), it could expand the possibility of a desired twist in *our* story.

Despite cosmolocal technology being far from a perfect and mature trajectory, further grounded research could help leverage its full potential. Adopting a cosmo-logical approach to cosmolocal technology, enabled by the framework of cosmotechnics, underscores the importance of technological diversity (akin to bio-cultural diversity) and suggests another way to investigate its transformative potential beyond the discourse of political economy/ecology (Table 3). This area of research is integral to the core of the commons (governance, organisation, ontology, epistemology) and equally crucial in deepening our understanding of the emerging cosmolocal phenomenon. However, this aspect has not been thoroughly investigated.

So far, grounded research on cosmology technology has been primarily informed by initiatives in the Global North within similar socio-political and cultural contexts. However, while there are various cosmolocal cases in different contexts (in the Global South), research has not yet substantially examined what non-Western perspectives (including different cultures, spiritualities, religions, and local traditions) can contribute to both the substantiation of the cosmolocal trajectory and its potential to pave the way towards technodiversity.

As our understanding of how cosmolocal technology integrates with and promotes (techno)diversity remains uncertain, future research should concentrate on a more systematic study of this potential, initially based on the various cosmolocal initiatives currently active worldwide. To this end, it is essential to create new conceptual frameworks and employ relatable forms of communication to ensure inclusive, transdisciplinary, cross-cultural investigation.

The outcome of any creative endeavour that does not sit well with dominant institutions and *their* story cannot be predicted, and there is always the risk of being co-opted by powerful interests (Feenberg, 1999). However, it is by embracing this

uncertainty that change can take place. If the full potential of any transformative effort were evident from the outset, it might have been suppressed in its very early formation. It is the capacity to adapt to change that sustains life, after all. Exploring the ontological, cultural, and cosmological/spiritual dimensions of cosmological technology is not only valuable for broadening the scope of theoretical contemplation for its own sake. It also serves as a political act that questions and challenges established norms of rationalisation, aspiring to inspire and foster more inclusive and resilient technological practices. This is why, above all, I approach technology primarily as a question of *living* (Hui, 2022a), and cosmological technology as a potential response in the pursuit of sustaining life, envisioning a future of planetary coexistence.

**Table 3.** How the frameworks of cosmologicalism and cosmotechnics can integrate to open new research areas for further exploration of the transformative potential of cosmological technology.

Framework	cosmo-localism		cosmo-technics	
Description	configuration for technology development/production		philosophical lens to thinking technology	
	global knowledge exchange localised production based-on the commons		unification of cosmic and moral dimensions manifesting in technical activity	
What is about?	making	socio-political aspects, materiality	making sense	ontological, cosmological, spiritual aspect
Why useful?	practical/empirical tool		theoretical tool	
Approach to technology?	conviviality, relationality, autonomy, openness, democratisation		cultural embeddedness, technodiversity	

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## **Abstract**

### **Transitions to where? Exploring the transformative potential of “cosmolocal technology” in quest of future coexistence**

While techno-optimist narratives depict the current technological trajectory as inevitable and adequate, critical perspectives emphasise how this narrow view constrains our collective ability to imagine alternative future possibilities. In contrast to misplaced hopes that modern technology alone will resolve escalating planetary crises, this thesis explores the transformative potential of “cosmolocal technology” – an emerging approach to technology development that combines global knowledge exchange with localised production – as a foundation for alternative technological pathways.

Drawing upon four original publications, prior research on the cosmolocal phenomenon, and theoretical perspectives from various transition discourses associated with social movements challenging the dominant regime, I investigate how technology could foster plural ways of being, knowing, and creating, countering the detrimental universalisation of homogeneity driven by technological globalisation. The research employs “cosmotronics” as a philosophical framework to engage with technology’s cultural embeddedness and ontological dimensions – elements often neglected in conventional sustainability approaches yet essential for paving pathways to meaningful change.

The thesis presents three key contributions: it links empirical research on cosmolocal technology with broader inquiries into sustainability challenges; reinforces connections between the cosmolocal framework and alternative transition imaginaries that contest techno-managerial perspectives; and conceptualises cosmolocal technology as an infrastructure for collective action towards futures rooted in relational communal worldviews.

I argue that the transformative potential of cosmolocal technology arises from its capacity to enable grassroots reappropriation of modern technology for the collective benefit. The cosmolocal configuration transcends conventional dichotomies (global/local, high-tech/low-tech) while addressing fundamental tensions related to diversity, agency, and hope. Crucially, it offers a practical means for exploring technodiversity – how diverse cultural and cosmological perspectives could expand our understanding of technology beyond the assumptions of Western modernity.

While cosmolocal technology remains an evolving phenomenon, its emergence demonstrates that prefigurative change is already taking place. This thesis positions it within broader socio-political and ontological struggles and suggests new research directions on how non-Western perspectives could enhance its transformative potential and inform the development of future technologies in the quest for planetary coexistence.

## Lühikokkuvõte

# Üleminekud kuhu? “Kosmoloakaalse tehnoloogia” transformatiivse potentsiaali uurimine tuleviku kooseksistentsi otsingul

Kuigi tehno-optimistlikud narratiivid kujutavad praegust tehnoloogilist trajektoori vältimatuna ja piisavana, rõhutavad kriitilised vaatenurgad, kuidas see kitsas vaade piirab meie kollektiivset võimet kujutleda alternatiivseid tulevikuvõimalusi. Vastandina ekslikele lootustele, et tänapäeva tehnoloogia üksi lahendab kasvavaid planeedi kriise, uurib see väitekiri “kosmoloakaalse tehnoloogia” transformatiivset potentsiaali – tekkivat lähenemist tehnoloogia arendamisele, mis ühendab globaalse teadmiste vahetuse lokaalse tootmisega – kui alust alternatiivsetele tehnoloogilistele radadele.

Toetudes neljale originaalpublikatsioonile, varasematele uuringutele kosmoloakaalse nähtuse kohta ja teoreetilistele perspektiividele erinevatest ülemineku diskursustest, mis on seotud domineerivat režiimi väljakutsuvate sotsiaalsete liikumistega, uurin, kuidas tehnoloogia võiks soodustada pluralistlikke olemise, teadmise ja loomise viise, vastandudes tehnoloogilise globaliseerumise poolt juhitud kahjulikule homogeensuse universaliseerimisele. Uurimus kasutab “kosmotehnikat” filosoofilise raamistikuna, et tegeleda tehnoloogia kultuurilise juurdumise ja ontoloogiliste dimensioonidega – elementidega, mis on tavapärastes jätkusuutlikkuse lähenemisviisides sageli tähelepanuta jäetud, kuid on olulised tähenduslike muutuste teede sillutamiseks.

Väitekiri esitab kolm peamist panust: see seob empiirilised uuringud kosmoloakaalse tehnoloogia kohta laiemate jätkusuutlikkuse väljakutsete uuringutega; tugevdab seoseid kosmoloakaalse raamistiku ja alternatiivsete ülemineku kujutluste vahel, mis vaidlustavad tehno-juhtimislikke perspektiive; ja kontseptualiseerib kosmoloakaalset tehnoloogiat kui infrastruktuuri kollektiivseks tegevuseks tuleviku suunas, mis põhineb relatsioonilistel kogukondlikel maailmavaadetel.

Väidan, et kosmoloakaalse tehnoloogia transformatiivne potentsiaal tuleneb selle võimest võimaldada rohujuure tasandi kaasaegse tehnoloogia taasomastamist kollektiivse kasu nimel. Kosmoloakaalne konfiguratsioon ületab tavapärased dihhotoomiad (globaalne/lokaalne, kõrgtehnoloogiline/madaltehnoloogiline), tegeledes samal ajal põhiliste pingetega, mis on seotud mitmekesisuse, tegutsemisvõime ja lootusega. Mis eriti oluline, see pakub praktilist vahendit tehnomitmekesisuse uurimiseks – kuidas erinevad kultuurilised ja kosmoloogilised vaatenurgad võiksid laiendada meie arusaama tehnoloogiast väljapoole lääne modernismi eeldusi.

Kuigi kosmoloakaalne tehnoloogia on endiselt arenev nähtus, näitab selle esilekerkimine, et prefiguratiivne muutus juba toimub. See väitekiri positsioneerib selle laiemate sotsiaal-poliitiliste ja ontoloogiliste võitluste konteksti ning pakub välja uusi uurimissuundi selle kohta, kuidas mitte-läänelikud perspektiivid võiksid tugevdada selle transformatiivset potentsiaali ja informeerida tuleviku tehnoloogiate arendamist planeetaarse kooseksistentsi otsingul.



# Appendix 1

## Publication I

**Kouvara, A.**, Priovolou, C., Ott, D., Scherer, P., & van Zyl-Bulitta, V.H. (2023). Circular, Local, Open: A Recipe for Sustainable Building Construction. *Buildings*, 13(10), 2493. **ETIS 1.1.**

**Publication II**

**Kouvara, A.** (2024). Beyond fraudulent hopes versus despair: The potential of commons-based technological futures. *Journal of Futures Studies*, 29(2), 59–72. **ETIS 1.1.**

**Publication III**

Kostakis, V., Parker, M., & Kouvara, A. (2025). A tunnel to the other side of the world: What sort of writing can contribute to social change? *Culture & Organization*. **ETIS 1.1.**

#### **Publication IV**

Kostakis, V., Lemos, L., & **Kouvra, A.** (2024). Another scalability is possible! From non-scalability to cosmological scalability. *tripleC*, 22(2), 620–629. **ETIS 1.1.**

## Appendix 2

### **Publication V**

Pisith, S, & **Kouvara, A.** (forthcoming). A Look at the Commons through the Lens of Buddhist Ethics. In: Stefan Partelow (Ed.). *Ethics and the Commons: Navigating the Normative and Applied Issues of Governance*. Center for Life Ethics at the University of Bonn Series. Springer. **ETIS 3.1.**

**Publication VI**

Sklavounos, I., Kostoulas, P., Koutropoulos, G., **Kouvara, M.**, & Theocharis, C. (2020). Kalderimi X2, Tzoumerka, Epirus: Paving the way for a new generation of craftspeople. *Journal of Traditional Building Architecture and Urbanism*, 1, 100–111. **ETIS 1.2.**

# Curriculum vitae

## Personal data

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2016–2019 National Technical University of Athens (NTUA), MSC Environment and Development of Mountain Regions  
2004–2013 Technical University of Crete (TUC), Integrated MSC in Architecture

## Language competence

Greek Native Speaker  
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## Professional employment

2021–Present Tallinn University of Technology, Junior Research Fellow  
2018–2020 Boulouki NGO (GR), Co-founder, Researcher, Architect/Practitioner  
2019–2020 Technical Dept. Levadia Municipality (GR), Architect  
2015–2016/2017–2018 We Design (GR), Architectural Assistant  
2014–2015 Benedict O’Looney Architects (UK), Architectural Assistant  
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2016–2019 Ateena Riiklik Tehnikaülikool (NTUA), MSc mägiipiirkondade keskkond ja areng  
2004–2013 Kreeta Tehnikaülikool (TUC), integreeritud MSc arhitektuuris

### Keelteoskus

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