THESIS FOR THE DEGREE OF DOCTOR OF PHILOSOPHY

Knowing one's place in transformation

Power geometries and subjectivities of innovation in the making of African energy futures

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Gothenburg, Sweden 2026

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Cover image: This image is an illustration of the themes of this thesis by my oldest friend, Edmund English. In a sense, it simply depicts my work. It shows energy technologies and symbols commonly associated with knowledge and capital, as well as Rwandan landscapes and artistic traditions. The volcanoes shown were an ever-present backdrop to my time at IPRC Tumba in 2023. They also provide heat-retaining volcanic rock for local cookstove technologies, becoming symbolic of locally-grounded energy transformations. However the image is also Edmund's interpretative framing of what my work means to him. Here, it contrasts with the front cover of my 2023 midterm licentiate thesis, which I developed using a then-novel generative AI. At the time I critiqued the strangely de-situated perspective of the image, owing to the algorithm's opaque decisions to foreground certain technologies and landscapes. Whilst both images illustrate the idea of framing which is central to my thesis, I prefer this one: as a reflection of my work, as embodying Ed's perspective and as the recognised labour of a human.

Edmund Francis English is a poet and illustrator. He is the author of Women of the Tender Night (Kulvert, 2026) and Fatima of the Hills (Kulvert, 2024). He has designed book covers, posters, band logos and T-shirts. He is co-editor of Kulvert and lives in Bristol, where he runs the Selah! Underground River Poetry Nights. See more of his work at kulvertbooks.com.

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Abstract

Transformations of energy systems, for example through innovation, could in principle be shaped by almost anyone or anything. However, in practice, the processes understood to drive such transformations are often associated with particular kinds of people, places, priorities and activities. These associations have material implications for who shapes, and who benefits from, energy system transformation. Given the prevalence of innovation and transformation within contemporary discussions of desirable energy futures, it is necessary to investigate the assumptions bound up in how transformations are understood and enacted, in particular those related to geography.

This thesis explores how diverse actors shape and are shaped by power-laden flows related to innovation and oriented towards transformation. These flows encompass knowledge, finance, technology, and materials. To investigate how actors make sense of and enact innovation and transformation, I draw on the concepts of interpretative framing, agency, spatial relations, power geometries, subjectivities, and coloniality. The analysis is grounded in human geography and engages with scholarship including sustainability transitions, science and technology studies, and post-structuralist theory. Empirically, the thesis focuses on energy system transformation in Africa, particularly Rwanda. I examine academic knowledge production about innovation and transformation, geographically distributed actors engaged in Rwanda's energy transition, an innovation-oriented institution in rural Rwanda, and flows of capital for technological innovation from Europe through Rwanda to sites across Africa. In the thesis, I conceptualise Africa less as a fixed location and more as a shared and perceived identity, as well as a designated target of transformation efforts. I do not claim to discuss African energy futures in totality.

Across the thesis, innovation and transformation emerge through multiple and overlapping power geometries. These are sets of spatial relations between actors and locations that are stabilised through flows of knowledge, technology, capital, and materials. Different geometries recognise particular forms of value and expertise, and confer legitimacy in ways that make some actors and locations appear more central to transformation than others. Stabilised to varying extents through actors' articulations and practices, these geometries produce subjectivities as actors come to know their place within transformation. At the same time, agency emerges relationally through the practices by which actors inhabit and negotiate these positions, as well occasionally reshaping them.

A persistent tension runs through the empirical material between more universalist and more situated power geometries, and the framings, flows, and subjectivities associated with each. Universalist geometries, organised around globally recognised technological frontiers, remain dominant. These concentrate legitimacy, visibility, and resources among actors possessing the requisite mobility, capital, and proximity to knowledge networks centred outside Africa. In doing so, they reproduce spatial hierarchies that echo longer histories of coloniality. However, practices including local fabrication, repair, and collaborative design simultaneously stabilise more situated geometries and subjectivities, positioning actors who might otherwise appear peripheral as catalysts of transformation. Transformation therefore emerges as a multilayered and contested process with ambivalent effects, involving both the continual reproduction of dominant spatial hierarchies of legitimacy and the ongoing emergence of alternatives.

Through this analysis, I contribute a spatially grounded theorization of participation in transformation and an empirical account of engagements with innovation and transformation related to Rwanda, showing how unequal opportunities to participate are both reproduced and challenged. I further demonstrate how academic knowledge production participates in shaping what counts as innovation and where it is understood to occur. Ultimately, this thesis argues that transformations towards African energy futures are made through subjective spatial relations between people and places, even as these transformations simultaneously remake those relations.

Keywords

Innovation, transformation, agency, geography, energy

Articles appended to the thesis

A1. Unsworth, Sam, Helene Ahlborg, and Sofie Hellberg. "Agency, Directionality, Location and the Geographic Situatedness of Knowledge Making: The Politics of Framing in Innovation Research on Energy." *Environmental Innovation and Societal Transitions* 49 (December 2023): 100780. https://doi.org/10.1016/j.eist.2023.100780.

A2. Unsworth, Sam, Helene Ahlborg, and Sofie Hellberg. "'We Don't Have Time': How Imaginaries of Urgent Energy System Change Marginalise Locally Driven Pathways." *Energy Research & Social Science* 120 (February 2025): 103888. https://doi.org/10.1016/j.erss.2024.103888

A3. Unsworth, Sam, Alex Muhirwa, Helene Ahlborg, and Sofie Hellberg. "Innovating here or imitating there? Spatial subjectivities of innovation related to a Rwandan technical college". Manuscript. Earlier version submitted to the International Sustainability Transitions conference 2024.

A4. Unsworth, Sam. "'We Don't Want to Be Colonialism 2.0': Emerging Frontiers of Climate Finance for Technology Innovation." *Finance and Space* 2, no. 1 (May 2025): 116-39. https://doi.org/10.1080/2833115X.2025.2483766.

A5. Ali, Muez, Lilia Caiado Couto, Sam Unsworth, and Ramit Debnath. "Bridging the Divide in Energy Policy Research: Empirical Evidence from Global Collaborative Networks." *Energy Policy* 173 (February 2023): 113380. https://doi.org/10.1016/j.enpol.2022.113380

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Acknowledgements

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Foreword

It is 2010. I find myself in the University of York library late at night, staring up at the moon through the window. It is autumn term of my second year studying history. The moon I am looking at is the same one that Galileo looked at four hundred years ago and I feel a profound sense of knowledge resonating within me. I am writing about the relationship between telescope makers and astronomers on the one hand and religion and astronomical theory on the other. Through a history of science lens, I am beginning to understand that the story I am telling is not one of definitively correct science, a genius inventor or an unstoppable technology. Rather it is a mix of material circumstances, knowledge politics, technologies and events shaped by power relations. Galileo is an active participant in this story. Looking at the moon and imagining his radical departure from dominant interpretative frameworks by claiming it was not a heavenly sphere, but merely an imperfect lump of rock, the world begins to make slightly more sense to me.

It is 2012. I find myself in the office of the charity Renewable World in Brighton, UK. I read their tagline on the wall: "Tackling poverty through renewable energy". I look at the images of smiling people with the technologies they have received. Having just finished my history degree, I feel thrilled to be in my second week as a Projects Officer liaising between our funders and countries across Africa, South Asia and South America. The logic is philanthropic; UK-based energy companies and philanthropic groups fund the distribution of energy technologies. However, this morning I am on the phone to my colleague in Kenya, feeling out of my depth as we face a problem. A few months ago, finances were transferred to build a solar-powered health centre. A building has been erected and is now in use. But upon visiting, our team discovered that a church had been built instead, with power used for a keyboard rather than refrigerating medical supplies. The building has been consecrated and is in use, but we must report to our funders with smiling faces and accounts of healthier citizens. Instinctively this news makes me smile, but this quickly fades as I learn that the upstream funders will be unimpressed about this misuse of their funds. Something does not feel right to me about this situation manifesting as a problem. Somehow, it relates to Galileo and his telescope.

It is 2017. I find myself in the offices of the Rwandan Ministry of Environment. I am three years into my career as a Sustainability & Climate Change Consultant at PwC. After a Masters in Governance and Development, I feel somewhat hopeful that private sector sustainability work might avoid the paternalism of the charity sector which I experienced. I am here to secure government buy-in for a Green Climate Fund project for my UN client, funded by the IKEA Foundation. Spanning Rwanda, Tanzania, Cameroon and Niger, I am shaping activities to reduce emissions and build resilience in informal settlements. On one level, I feel like I have "made it". On another, I again feel out of my depth. I know that my analysis is anchored far more in what has seemingly worked elsewhere, derived from internationally-focused publications and discussions with "global experts" in London, than the actual situation and priorities of people in these settlements. I nonetheless perform the role expected of me, positioning myself as an authority on Rwanda's green transition. I suspect the civil servant across the table can see through this, but the ruse holds. We are brought together by the promise of fifty million dollars of climate finance. But as we leave, the ruse breaks. My colleague sanctimoniously promises the

civil servant that we will deliver this money to help the people of Rwanda. I naively nod along and immediately feel simultaneously complicit and moronic as we are met by a justifiably cynical expression. I should know better.

It is 2019. I find myself in an office with Sir Nicholas Stern at the London School of Economics (LSE). Having moved from PwC to the Grantham Research Institute, LSE to do policy research on decarbonisation, I hope to pursue a career oriented towards impact with fewer of these troubling undertones. We are meeting to discuss a new programme of research focused on the role of innovation in achieving net zero emissions. At this point, I understand innovation as one of those amorphous words loved by consultants which you can use to pad out conversation or cover uncertainty whilst being hard to disagree with; "we need more innovation!" But here, Sir Nick is referring to something very specific and economics-oriented, a language I quickly need to learn to remain credible. This innovation can be measured, analysed, induced and directed towards sustainability. And based on the conversations in the room, there seems to be an unspoken consensus that it requires finance, is practised by the private sector and creates economic growth. Our conversation isn't anchored to any particular geography: are we saying that innovation is the pathway to net zero emissions and sustainable growth everywhere? Once more, that feeling of being slightly out of place and depth sets in. This may not be a disciplinary world in which I will be of much use. Galileo and his telescope come to mind once more. This time, I am certain: I need to do a PhD so I can try to figure all of this out.

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It feels fitting to introduce my thesis with these vignettes. Returning to academia for this PhD has been as much a journey of reflection about my life and career as it has a research project. More than anything, this PhD has been the arena within which I have worked through uncertainties and at times guilt about my implied and enacted role in global processes of transformation. Does this put this thesis in the category of a "problematic attempt to reconcile settler guilt and complicity" (Tuck & Yang, 2012)? At times over the past six years this accusation could perhaps be levelled at me fairly, but today I feel less insecure about my place in the world.

I began this PhD and moved from the UK to Sweden with my partner Dalia in 2020. The world was in the midst of a crippling pandemic, yet on a personal level it felt like a profoundly exciting time for us. My experiences over the past six years have vindicated this excitement. I have been lucky enough to spend extended periods of time living in both Sweden and Rwanda, as a result of my PhD funding relating to transitions in Rwanda. These are both countries I have fallen in love with, whilst coming to recognise their faults. I have been lucky enough to be paid to read, think and write about things I care deeply about, a novelty which still hasn't worn off. In working on my papers, I have moved around Rwanda extensively; from the upmarket hotel bars of Kigali to the open road south to Huye, the terraced fields of Kayonza and the perpetually curious and welcoming communities of Tumba. These memories will serve me a lifetime.

Alongside producing the articles which make up this PhD, over the past five years I have also been involved in a collaboration between my employer (Chalmers University) and the University of Rwanda's

African Centre of Excellence in Energy for Sustainable Development. Through my PhD I have acted as an advisor to an innovation hub hosted by the Centre and helped to establish what is now the University of Rwanda's annual Innovation Week. Since then, I have remained intermittently involved with the hub as it has evolved and become more established. It has been immensely rewarding, albeit challenging at times. The collaboration has provided me with both a context to reflect on and test out ideas - ideas which have consequently crystallised in this thesis – as well as a welcome escape from my studies.

The year 2025 was one of major change in the context of this PhD. Within the first three months of the year, my partner Dalia and I became parents to our first child Ash and I unexpectedly accepted a lectureship at UCL. Becoming a parent has been joyful, as has being reunited with family and friends in the UK. But this has also undeniably been a chaotic period of relocation and new responsibilities during which I needed to pause my PhD for an extended period. Life back in the UK can feel a world away from my times swimming in Swedish lakes or watching mousebirds climb vines in Rwanda. But amidst this chaos, returning to finish this PhD in January 2026 has been a strange joy. It feels bittersweet to close this chapter yet rewarding to see it span such a transformative period of my life. Looking over the past six years, I can say they have been amongst the best I've experienced. Beyond any hopes for recognition or impact, this simply makes the contents of this PhD deeply personal to me.

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Before progressing, one final piece of scene-setting is required regarding how the global political climate has shifted over time. The outset of my PhD in 2020 now appears close to a high-water mark of consensus regarding two movements with notable connections to this thesis: sustainable development on the one hand and Diversity, Equity and Inclusion (DEI) on the other. In 2020, powerful actors across governments, business and culture where I was living in Europe as well as elsewhere were mobilising in support of both. Companies were claiming to go green (Climate Action 100+, 2020; PwC, 2021), governments were adopting net zero targets (UNFCCC, 2020) and climate finance was growing (Watson, 2021). Likewise, in the wake of the murder of George Floyd, DEI was being endorsed as a moral imperative by some of the most powerful economic actors in the world. In both domains, I observed levels of consensus across groups of actors which now appear historically exceptional (Harper, 2022).

I agreed with the fundamental emphasis placed by these movements on reducing reliance on fossil fuels, redressing environmental damage and tackling inequalities and the exclusion of marginalised groups. My career to date however, as the vignettes above evidence, had exposed me to some of the limitations and contradictions in mainstream approaches to tackling these challenges, particularly when administered through transnational North-South collaborations lacking cognisance of the power relations at work. I observed these at-the-time powerful agendas mobilising resources in support of politicised visions of change. It felt timely to use my PhD to critique this emergent paradigm of mainstream sustainability and inclusion in a context in which I had experienced these limitations first-hand; efforts to drive energy transitions in Sub-Sahara Africa.

A lot can change in six years. Whilst the seeds were sown earlier, between 2020 and 2026 there has been an acceleration towards political polarisation, populism and post-truth. Simultaneously, we live in a disturbing era of increasing geopolitical conflict alongside the targeting and displacement of civilian populations. In this context, I have perceived a notable downward shift in sentiment towards sustainable development and DEI (Sherman, 2026). Whilst these agendas are not entirely abandoned, many of the powerful business owners, politicians and financiers who in 2020 advocated for net zero and DEI have fallen silent or actively turned against these priorities (Bhuiyan & Kerr, 2025; Makortoff, 2025; Moriarty, 2026). For some this seems ideological; for others there seem to be simply other issues considered more pressing. In my respective homes of Sweden and the UK, this has meant reduced capital and a partial dismantling of consensus. European funding for research collaboration, technology transfer and innovation towards sustainable development outside Europe has declined (Ahmed, 2025; McKie, 2026), affecting my own work with the University of Rwanda. At the same time, alleging coloniality in contemporary projects risks sounding naïve in a new era of brazenly imperialist behaviour (Borger, 2026). Through this, a question emerges. Should we continue critiquing agendas of sustainable development and inclusion and risk providing ammunition to those who attack them, or instead seek to defend these agendas? Put differently, what is the place of this thesis in this emerging world?

I would argue that this question is a provocative false binary. Seen through the lens of this thesis, the issue highlighted is not what to do when global sustainability agendas expand or contract, although I welcome research on this necessary topic. Rather the issue highlighted is how to grapple with a political economy of transformation in which patterns of expansion and contraction in transnational flows of capital, knowledge and technology have socio-material consequences in the places where flows of capital land (or fail to). When funding surges, certain projects fitting with these financing logics proliferate and take shape. When it recedes, these projects often unravel. I saw this starkly when I encountered KOKO Networks in my fieldwork, a cooking-as-a-service business who at the time were expanding rapidly across East Africa. Their model depended on high carbon prices to subsidise fuel and infrastructure. Whilst their set-up was impressive, stalling approvals related to carbon accounting complexities recently led to the company's collapse (Rattenbury & Peters-Stanley, 2026). I encountered similar dynamics elsewhere: for example I heard how a UK-headquartered solar home system provider operating in a Rwandan refugee camp had recently withdrawn entirely when its time-limited and climate change-oriented funding package ended.

These are not simply stories of failure. These projects, both while operational and after their eventual failure, likely produced ambiguous effects (Ahlborg, 2018). However they nevertheless emphasise the fragility of intended transformation pathways contingent on fickle political and financial sentiment formed far from those intended to benefit. If there is a lesson in the current retreat of sustainable development capital, I believe it is that we must not simply defend these agendas but reimagine them, particularly the spatial relations of power through which they are enacted. Set in this context, I believe this thesis maintains relevance in the increasingly uncertain world that we are moving into.

"The basis of the conversation about Africa was that it was a recipient of science, technology, and innovation, not a maker of them."

- Mavhunga, 2017

"There is a joke: if you get two chairs, wooden and plastic, we African guests will sit on the plastic chair first because it comes from outside. Even if the wooden chair is more costly, the African will pick the plastic chair. We like what others make, rather than what we make ourselves."

- Interlocuter from A3

1 Introduction

1.1 Background

"I'm in HQ, the global team. I don't just work on Rwanda". It was February 2022, and I found myself sat opposite a member of the executive team of one of the leading distributors of Pay-As-You-Go (PAYG) Solar Home Systems (SHS) in Rwanda and across Africa more broadly. Our meeting took place in the context of a broader encounter between the Rwandan Government's urgent effort to achieve universal electricity access by 2024 (MINECOFIN, 2022), and those actors who positioned themselves as able to deliver this transformation. My PhD's interest in who was understood to drive energy sector transformation in Rwanda had led me to be sat facing one of those actors. This particular combination of SHS technology and a PAYG business model has been hailed in both academic literature and policy discourse as a key innovation for the transformation of energy systems across Africa (Barrie & Cruickshank, 2017; Kizilcec & Parikh, 2020; Perros et al., 2024; World Bank, 2024). My interlocutor[1] had requested to meet at Java House, an upmarket coffee shop in the Kigali Heights development overlooking the capital city below. As I recall this particular exchange, I can hear the genial chitchat of Kigali's internationally networked socioeconomic elite unfolding around us.

My interlocutor took a bite of his lunch then continued articulating Rwanda's place in his company's geographic footprint. "I work with the head of operations and the marketing manager in every country like Rwanda". He went on to describe this wider footprint chronologically. Their journey started with himself and a few others developing their core technology proposition whilst studying together at a European university. Over time, facilitated by networks which they had developed through volunteering in Sub-Saharan Africa (SSA), their fledgling venture gradually expanded to several countries. These places were designated as markets, with Rwanda one of their first. Markets played a role primarily in providing customers, alongside local agents who shared market intelligence with the hardware teams in Europe. As manufacture grew in scale, they recruited staff in China. Likewise, staff in India came to manage back-end software elements of the business. Finally, the global team, which my interlocutor was part of, was headquartered in Europe. They split both their staff and time mainly between Africa and Europe, with the design team and most of the company's investors located in the latter (predominantly impact-focused private equity). My interlocutor had an obvious commitment to understanding and helping his company's prospective customers. For him, the most effective way of serving these customers was to harness knowledge, technology and finance in one place in service of transformation in another.

I share this vignette neither to valorise nor demonise my interlocutor, who is anonymised by the number of other similar exchanges with people of different nationalities I have had. What my interlocutor

[1] This is the term I use to refer to the many people I engaged with through the research process culminating in this thesis, primarily through semi-structured interviews and observation as well as more informal exchanges. In the articles appended to the thesis, my co-authors and I more commonly refer to respondents. However I use the term interlocutor here to reflect my theoretical interest in subject formation, placing emphasis on my own role as a researcher in co-producing narratives of innovation and transformation.

provided is on one level an unremarkable case of globalisation and geographic specialisation in value chains (Gereffi et al., 2001). Through multiple exchanges with this interlocutor and others I nevertheless sensed that these actors were framing the transformation in a certain way which rendered Rwanda and its citizens primarily as a market to be served by others. This was not simply rhetoric; given his connectedness to transnational flows of knowledge, materials and apparent legitimacy in the eyes of the Rwandan energy sector, this frame made a specific set of positions in transformation available. At the same time, it was evident that opportunities for people within Rwanda were mediated by material circumstances. My Rwandan friends subsequently explained to me just how desirable the high-paying office jobs with my interlocutor's organisation and others like it were, available only to members of the Kigali-based elite. By contrast, the role of customer-facing sales agents was fundamentally different and much lower paid, although still highly desirable and available to a relatively narrow demographic. Other jobs in the international value chain were unquestionably out of reach. Put simply, most citizens of the country slated for transformation were effectively excluded from a role in this particular configuration save for selling and using devices. As my interlocutor had explained to me, this company like several others had an innovation team in Europe serving their markets in Africa. Whilst he described efforts to engage the Indian software team in technological development processes, with regard to involving people in Rwanda he simply explained that "obviously you don't do much research here".

This exchange functions as a provocative entry point to what this thesis seeks to make sense of. This act of interpretative framing gives transformation a perceptible spatial logic, the articulation of which made my interlocutor inhabit a position as a self-proclaimed provider of innovative technologies to places where such innovation did not occur. In doing so he also ascribed roles within this geographic configuration, such as the Rwandan citizen as willing technology adopter. This particular interpretative frame and the positions it constitutes forms only part of the continually unfolding patchwork of framings (Wolsink, 2020), subjectivities (Foucault, 1982; Butler, 2014) and spatial geometries of power (Massey, 1993) which relate to wider practices and processes of transformation in and for Africa.

I engage with a small fragment of this patchwork by examining how roles in contemporary transformations towards African energy futures are spatially produced, with a particular focus on those related to Rwanda. This thesis is anchored in human geography and seeks to make a contribution towards the sustainability transitions literature. In doing so, I also draw upon diverse interdisciplinary fields including Science and Technology Studies (STS), post-structuralist feminist theory, economic geography, political ecology and scholarship of modernity and coloniality.

The sustainability transitions literature provides a valuable departure point for this thesis through its insistence that participation in transformation is unevenly distributed across space (Smith et al., 2005; Loorbach et al., 2017). Nonetheless, I seek to unsettle some of the assumptions embedded within this framing. I differentiate this thesis from strands of the sustainability transitions literature that define categories of actors (see Kivimaa et al., 2019), in pursuit of increasingly "comprehensive" typologies of actors and roles in transformation (Fischer & Newig, 2016, p.16), often with limited reflexive engagement regarding how such categories are produced and stabilised (Stirling, 2019; Poelsma et al.,

2025). Instead, I focus on the discursive practices and performative enactments through which positions are constituted and access to them mediated.

For this reason, I use the language of actor "positions" rather than "roles" throughout this thesis. This terminology foregrounds participation in transformation as relationally, spatially, and discursively constituted, rather than being reducible to fixed categories. Innovators, financiers, or researchers, for example, are understood not as defined roles but as contested positions produced through particular spatial, institutional, and discursive relations, and invoked in relation to other actors and locations. In this sense, the positions occupied by different actors - including researchers themselves - are constituted through and implicated in the ongoing enactment and reproduction of spatial relations through which transformation takes shape. By tracing how flows of technology, finance, and knowledge are mobilised across space in support of contrasting framings of transformation, this thesis examines how actors may be positioned differently across multiple and overlapping spatial relations of power. They may be rendered marginal or passive in some contexts, while simultaneously constituted as authoritative agents of change in others.

1.2 Reading the thesis

This is a compilation thesis formed of five journal articles, appended here, and summarised in this "kappa"[2]. The primary purposes of this kappa are to synthesise the findings of each article, to situate them in context and to outline a spatial theorisation of positions in transformation informed by the articles as a collective body of work. In Section 1, I begin by outlining the research aim, questions and scope of the work, as well as the gaps I address and contributions I make. In Section 2, I situate the work theoretically by describing my onto-epistemological perspective, setting out the literatures I engage with and finally outline the theoretical framework I use to make sense of my empirical material. In Section 3, I establish a broader context of transformation in Africa, including historic, current and forward-looking perspectives. In Section 4, I outline the thesis methodology, including its rationale, research methods and reflections on my positionality.

In Sections 5 and 6, I outline the results of this thesis. I do this in two ways. First in Section 5, I provide a summary of the results of each article. In Section 6, I then present the results in synthesis by answering each of the three research questions in turn. In Section 7, I discuss some key themes emerging from the thesis, before offering concluding thoughts in Section 8.

Following the thesis kappa, I append the five articles of the thesis. I focused on producing standalone articles which I could publish during my PhD journey, noting the pressures of contemporary academia to build a publication record early. Article 1 (A1) investigates processes of framing in how innovation is put to work in academic research on energy, with a particular focus on scholarship about or originating from Africa. Article 2 (A2) investigates who is positioned as driving change in relation to desired energy sector transformations in Rwanda, using the concept of socio-technical imaginaries to characterise

[2] Kappa is a Swedish word meaning a comprehensive summary.

contrasting shared perspectives on how this transformation might come about. Article 3 (A3) focuses on a technical college in rural Rwanda described as generative of transformation by certain actors in A2. The article investigates how people subjectively position what happens at the college in relation to broader processes of transformation. Article 4 (A4), rather than focusing on a specific location, instead traces flows of climate finance for technological innovation which pass through Rwanda from upstream investors in Europe to entrepreneurs and envisioned beneficiaries across Africa. Finally A5 applies an even wider spatial lens to reflect on geographic patterns of academic research focused on policy-induced energy transformations in lower income countries (including those in Africa, such as Rwanda), asking whereabouts in the world are those scholars who are cited and win research funding .

1.3 Conceptual groundwork

In this sub-section I briefly operationalise the key concepts used in this thesis, which I elaborate further in Section 2.6. The concepts are mutually constitutive and should therefore be understood in relation to each other.

I begin with **interpretative framing**, which I use to refer to the ways actors foreground particular aspects of desirable processes of change, such as certain actors, practices, knowledges, and futures. These frames shape how transformation is understood and enacted, while backgrounding alternative possibilities. In doing so, interpretative framing both makes sense of the world and participates in producing it.

I conceptualise **agency** not as an inherent property which actors possess or lack but as a relational and emergent capacity to act. Agency is both ascribed - through interpretative framings that designate who can act and how - and performed through situated practices. It is thus constituted through, and productive of, ongoing processes of subject formation. Building on this, I characterise certain ways of exercising agency as reproducing relations of **coloniality**, understood as relations oriented around extraction, exploitation or dependence.

These processes unfold through **spatial relations**, understood as continually produced through interactions between people, places, technologies, and ideas. Space is relational and dynamic, shaped through the same interpretative framings and practices that organise life. Across these spatial relations, **power geometries** describe how actors are unevenly connected to socio-material flows such as knowledge, capital and technology. The latter concept helps to explain how some locations come to be associated with the passive receipt of technologies and others with innovation activities, whilst still recognising such configurations as always plural and emergent.

Through these intersecting dynamics, **subjectivities** emerge as actors inhabit subject positions in transformation through articulations and practices. These positions are shaped by interpretative framings and related to each other by power geometries. These subjectivities have material effects as they are enacted in practice.

I conceptualise **transformation** as the ongoing, normatively oriented socio-material reconfiguration of relations from one state to another. I understand transformation to be plural, emergent, and articulated differently by actors through their interpretative frames, having the potential to encompass both larger and smaller scale change. In this thesis, I am particularly interested in transformation processes related to energy systems, whilst noting that what I study often spills over into other sectors and domains.

Finally, I treat **innovation** as a situated claim about how and why certain practices and processes oriented towards transformation matter. Rather than defining innovation based on a certain set of characteristics, I analyse how actors frame certain activities as innovation, and how these claims relate to broader processes of transformation; shaping agency, subjectivities, and power-laden spatial relations.

1.4 Research gaps

Each of the articles appended to this thesis articulates specific research gaps which they address as standalone scholarship. In this section, I therefore characterise the three broader gaps which this kappa and the appended articles as a collected body of work seek to address.

The first gap I seek to address is theoretical, relating to how participation in transformation is theorised spatially. A central line of enquiry in the field of sustainability transitions relates to how power relations shape who plays an active role in socio-technical change, and how participation in processes or benefits of transformation comes to be unequally distributed (Smith et al., 2005; Fischer & Newig, 2016). I assert that this enquiry could be strengthened by attending more closely to the precise dynamics through which positions in transformation are claimed or ascribed, and how conceptions of place and space matter in who can inhabit different positions.

There is some promising work in this regard, investigating how combinations of actor roles form relational constellations (Wittmayer et al., 2017) or how certain actors empower or disempower others through ascribing roles. A commonly discussed example of the latter in transition studies is how market-oriented actors commonly construct ordinary citizens as “users” or “consumers” in ways which constrain their active participation (Avelino & Wittmayer, 2016; Smith & Stirling, 2018). I nonetheless argue this line of inquiry can be furthered in two regards. First, I would argue that this analysis can be extended to relationally interrogate how an array of actors come to find their place in transformation. Why and how for example do these market-oriented actors position themselves as able to designate “consumers”? Scholars have relatedly noted that the sustainability transitions literature is yet to fully utilise post-structuralist analyses of subject formation in transformation (Hopkins et al., 2020), although contributions spanning sustainability transitions and political ecology point towards the potential for this (Ahlborg & Nightingale, 2018). Second, I would argue that applying a power lens to participation in transformations (a lens often demonstrated to be missing by Ahlborg et al., 2024) requires attending more closely to how different actors conceptualise space and their own position within it. This includes their material circumstances, particularly where actors are located and their

ability to move between and access different locations. However it also includes the interpretative frameworks and geographies of knowledge production through which actors perceive their own locatedness in relation to others. I would argue that these perspectives, long discussed in human geography (Tuan, 1975; Agnew, 2014; Jöns et al., 2017), so far remain comparatively marginal in the sustainability transitions literature (Bridge, 2018; Coenen et al., 2024).

The second gap I seek to address is empirical and relates to understanding Rwanda's role as a nation in processes of transformation. Over the past 20 years research interrogating processes of transformation in Rwanda has bloomed, reflecting broader patterns of rapidly increasing academic output[3]. However, a closer look at this body of research indicates that much of this work falls into three broad categories. The first positions the country as a site of transformation via technology diffusion, with empirical enquiry focused on the prospects and impacts of different technologies such as biogas or solar home systems (see for example Mugisha et al., 2021; Roopnarain & Adeleke, 2017; Lenz et al., 2017; Jagger & Das, 2018). The second category sits broadly within the innovation and development studies literatures and examines the role of innovation, education and industrialisation in pathways of socioeconomic development, including the building of knowledge-based economies (see for example Murenzi & Hughes, 2007; Yongabo & Göransson, 2022; Nsengimana, 2021; Van Dijk, 2025). The third applies a more critical lens to Rwanda's politics, democratic processes and wider governmental apparatus. This includes interrogating how the country has become securitised and marketed as a development project to external actors (Goodfellow & Smith, 2013) as well as detailing a transition towards authoritarian government rule since the 1994 genocide (Reyntjens, 2004; Longman, 2011; Lyons, 2016; Mann & Berry, 2016).

Across these works linking Rwanda to transformations there is thus a tendency to position the country in empirical research primarily as either a value-neutral geographic container (Massey, 2005) within which technologies are diffused and developmental outcomes achieved; or as the host of a national government wielding highly concentrated political power. Some examples can be identified which make empirical contributions sitting somewhere between or aside these contrasting orientations. For example there are geographers who interrogate the politics of Rwanda's emergent positioning as a hub of digital innovation where platform technologies encounter globalised capital flows and local circumstances (Cirolia et al., 2023). Likewise, whilst inverting the relative emphasis on technology and social relations, some innovation and transitions scholars analyse how user practices, behaviours and local traditions interact with patterns of technological innovation and diffusion (Dawson et al., 2016; Bisaga & Parikh, 2018; Kabwete et al., 2019).

These latter examples are insightful veins of literature which I seek to contribute towards, but they nonetheless remain comparatively marginal in the wider context of research about transformations and Rwanda. Limited attention has been paid to how the country is situated within transnational networks of actors, capital, technology and knowledges oriented towards energy systems transformation, or to

[3] Searching Scopus in March 2026 with the Boolean search string *"Rwanda" AND "transformations" OR "transitions" OR "innovation" OR "energy"* revealed 815 academic publications since 1981 in the fields of social science, energy and environmental science, of which 773 were published since 2006.

how competing interpretations of innovation and desirable transformations are articulated and negotiated within and in relation to the country. This gap is particularly stark in comparison to European countries such as the UK and the Netherlands which are subject to countless studies across these themes.

The third gap I seek to address is methodological. Academic knowledge - particularly in research traditions rooted in natural science, engineering, and management studies - often maintains a distinction between academic literature as knowledge or theory and empirical phenomena as data or evidence (Law, 2008). Academic publications are typically treated as repositories of established knowledge to build upon, contest, or use to interpret empirical findings, a pattern observable in much of the sustainability transitions literature. Conversely, empirical data are often approached as traces of an external reality, providing the material from which academic knowledge is assumed to be derived (Cetina, 1999).

While widely used, this methodological convention can sit uneasily with influential perspectives on ontology and epistemology across the social sciences. Relational thinking in STS (Haraway, 1988; Jasanoff, 2004) and scholarship on the coloniality of knowledge (Fanon, 2001; Grosfuguel, 2007; Mignolo, 2010) have long argued that scientific knowledge is produced through situated socio-material practices and power relations, rather than simply reflecting an external reality. Social and systems theorists have developed related critiques. Giddens' notion of "double hermeneutic circles" highlights how academic inquiry co-constitutes the world it seeks to explain (Giddens, 1983; 1986). Scholars of "second-order cybernetics," including Margaret Mead and Heinz von Foerster, similarly examine feedback loops between systems and their observers (Mead, 1968; von Foerster cited in Scott, 2004). More recent work in critical systems thinking builds on these insights to identify a constructed dualism between knowledge-generating systems (e.g. universities or research networks) and knowledge about the world (Midgley, 2023). In methodological terms, this distinction is often reflected in research design through the separation of literature review and empirical analysis. Maintaining this dualism without reflection can risk obscuring how knowledge-generating systems are themselves embedded within, and actively shape, the world they describe.

These strands of critique can be brought together under the concept of co-production (Jasanoff, 2004), which recognises that academic research not only shapes how phenomena such as transformations are interpreted but also participates in shaping the conditions under which they unfold. This may occur, for example, through influences on funding priorities, policy agendas, institutional collaborations, or the spatial organisation of expertise. At the same time, academic practice is itself shaped by power relations, including the geographic distribution of research institutions, the priorities of funding bodies, and hierarchies that influence whose knowledge is recognised as legitimate.

Within the social sciences, and particularly in fields such as sustainability transitions that explicitly engage with processes of transformation, the importance of co-production is widely acknowledged. Academic knowledge is understood to have the potential to shape transformations by framing problems, legitimising certain actors and technologies, and directing attention and resources towards particular

pathways (Stirling, 2019). However, there remains scope for more explicit engagement with how these dynamics operate within academic publication in ways that extend beyond authors' intentions.

1.5 Research aim and questions

My research aim has evolved from an initial interest in interrogating the implicit assumptions often made about the people and places associated with innovation towards a wider exploration of participation in transformation across space. My research aim is as follows:

To investigate how diverse actors across the world shape and are shaped by power-laden socio-material flows of knowledge, finance, technology, and materials oriented towards transformations within Africa, with a particular focus on innovation as a concept, energy as a system and Rwanda as a site of transformation.

This aim can be addressed in multiple ways. In this thesis, I seek to shed light on it through a relational and critical geographic analysis. I therefore investigate the following research questions in order to address the overarching aim described above:

1. *In what different ways do actors make sense of what is involved in energy-related innovation and transformation?*

2. *How do relations between different locations and positions for actors come to be stabilised through flows of finance, technology, knowledge and materials for innovation and transformation?*

3. *How are different actors' capacities to inhabit these positions shaped by, while also reshaping, their socio-material circumstances?*

These research questions apply contrasting analytical lenses to the articles appended to this thesis and engage with them in different ways. Rather than synthesising findings around themes already elaborated within the individual articles, this kappa uses the articles collectively to develop a contribution that extends beyond what can be found in any one of them. The questions are therefore structured cumulatively and linked chronologically: each response builds a body of knowledge that informs the subsequent question.

Although I answer the research questions primarily by drawing on the theory, empirical material, and analysis developed across the five articles, the synthesis also introduces several additional conceptual and empirical elements. Most notably, I draw upon Massey's (1993) concept of power geometries, which does not appear explicitly in the articles themselves and although the concept of subjectivities only arises in A3 (the final article I have written), I utilise the concept to make sense of all of my articles. I also foreground dimensions of the empirical material that receive less emphasis in the individual papers, including interlocutors' perceptions of the gendered and racialised aspects of innovation and transformation.

1.6 Scope

These questions inform the thesis' scope and empirical focus. An overview of the thematic, sectoral, technological and geographic scope for each article is outlined in Table 1. Across the articles, the scope is anchored to practices and processes oriented towards transformation in Africa, understood as some kind of change for people who live there (as opposed to, for example altering lives in Europe). These people may be interlocutors I have engaged with directly, or people described or imagined by others. For example, I interacted directly with rural Rwandan users of cookstoves, but I also heard European finance providers describe this kind of individual hypothetically as who their finance aims to support; both fit within my scope. Furthermore, the scope includes many other actors who come to be related to these transformations and who are situated unevenly across the region and outside it, as the final column in Table 1 illustrates.

Thematically, whilst A1, A3 and A4 focus explicitly on how different actors engage with innovation as a concept, A2 and A5 are oriented towards wider processes of transformation, although innovation is still invoked by the actors I study in both articles. Likewise, whilst only A3 and A4 are focused explicitly on technology by research design, all of the articles place a strong emphasis on the role of technologies in transformation through acts of interpretative framing by actors. Table 1 elaborates these scoping aspects in further detail.

Table 1: Overview of scope by article

Article		Scope and rationale		
	Thematic scope	**Sectoral scope**	**Technological scope**	**Geographic scope**
A1. Agency, directionality, location and the geographic situatedness of knowledge-making: The politics of framing in innovation research on energy	• **Innovation** within broader processes of **transformation** - all articles included in sample discuss innovation in various ways (e.g. frugal, technological, social) • Scope sets out how innovation is framed in different ways by scholars from different disciplines, institutions and geographies	• **Energy sector** (with exception of small number of articles focused on characterising innovation discourse as multiple). Scope reflects PhD description at the outset, focused on the energy sector	• No specified technological scope: Various **energy technologies** as well as **non-technological** approaches to energy-related innovation	• Part of literature sample undefined (i.e. authors and study counties anywhere), part articles authored from **African institutions**, part articles focused on **African countries**, and a subset of these articles specifically focused on **Rwanda** • Scope captures a broad range of innovation theorising from diverse perspectives whilst being attentive to how innovation is theorised and applied in relation to Africa
A1. "We don't have time": How imaginaries of urgent energy system change marginalise locally driven pathways	• **Transformations** more broadly; **innovation** a recurring concept, but several respondents do not use this language in describing how they drive change • Scope enables those who position themselves as delivering transformation to articulate this in their own terms	• **Energy sector**, albeit with connections to other sectors (e.g. **water, buildings, agriculture, education**) and cross-sectoral priorities (e.g. climate change, poverty reduction) • Scope enables focus on how actors relate to policy efforts to transform the energy sector	• No technological scope • Interlocutor orientation towards **cooking and off-grid electricity generation** leads to focus on technologies in these areas, as well as applications of Artificial Intelligence (AI) and Internet of Things (IoT) e.g. PAYG solar	• **Rwanda**, although many of the actors who position themselves or are ascribed by others as driving energy sector transformation in Rwanda are located **outside Rwanda** at least to some extent • Scope enables a focus on the specific context of the Rwandan Government's policy agenda to rapidly transform the energy sector, whilst linking to transnational financing schemes and market dynamics

A3. Innovating here or imitating there? Spatial subjectivities of innovation related to a Rwandan technical college	• **Innovation** within broader processes of **transformation**, with majority of interlocutors directly discussing innovation • A small number of respondents such as members of surrounding communities do not use this language • Scope reflects the fact that the college has an explicit mandate to teach and practice innovation: therefore explores how it is understood and who practices it	• **Energy sector** is primary focus, particularly technologies for cooking, albeit initiatives in practice are often cross-sectoral, linking with **water, buildings, agriculture, education**. Also links to cross-sectoral priorities (e.g. climate change, poverty reduction) • Scope reflects the disciplinary foci of innovation and education efforts at the college: renewable energy is the main specialism of the college alongside agriculture, mechatronics and telecom	• Technology-focused scope given the mandate of the college to focus on technological innovation • Strong focus on technologies for cooking, water heating and electricity generation alongside others tackling cross-sectoral challenges faced locally, with AI and IoT often playing a role.	• **Rwanda;** more specifically a technical college in **Bushoki Sector** and the communities which surround it and actors elsewhere who engage with it • Nonetheless, many of the broader processes of innovation and transformation which interlocutors relate themselves to happen elsewhere in the country or even **outside Rwanda,** such as technical advances perceived as cutting edge • Scope enables a deep dive into how innovation is understood and put to work in a specific location understood by some to be generative of transformation, whilst setting this in a broader geographic context
A4. 'We don't want to be colonialism 2.0': emerging frontiers of climate finance for	• **Innovation** within broader processes of transformation • Scope based on the financial flow which is at the centre of analysis: it is specifically to support entrepreneurs	• **Cross-sectoral** focus on tackling **climate change** through either mitigation or adaptation • Entrepreneurs focused on **energy, agriculture,**	• Technology-focused scope given the finance flow studied is available for "climate tech" • Focus on software and platform innovations	• **Northern Europe** as location of headquarters of most upstream investors and the intermediary • **Rwanda** for intermediary's "Africa" office and one upstream investor

technology innovation	understood to be doing innovation	**water and health** – often in combination	• Many rely on AI and IoT-powered solutions.	• **Across Africa** for downstream entrepreneurs receiving investment • Scope based on the intermediary's financing
A5. Bridging the divide in energy policy research: Empirical evidence from global collaborative networks	• Broader processes of **transformation** • Whilst innovation is not specified in the search terms, the bibliometric word clouds (Figure 9) shows that many recurring terms in the sample are often associated with some form of innovation, such as economic growth, sustainable development and rural electrification • Scope was set with co-authors	• **Energy sector,** more specifically energy policy • Scope investigates the dynamics of how research about energy policy in lower income countries is funded and cited	• No technological scope • The bibliometric word clouds (Figure 9) nonetheless indicate a strong focus on energy technologies	• All **lower income countries** (classified as low income or lower middle income by the World Bank) are included as locations which are subject to academic study • However authors writing about them or institutions funding them based **anywhere in the world** • Part of the analysis focused on lower income countries in **Africa (including Rwanda)** within the sample

I feel some discomfort in setting the geographic scope for this thesis as Africa-wide. Such a broad geographic scope risks an inexcusable act of homogenisation from afar, as has so often been the case (Said, 1978; Mudimbe, 1988; Ferguson; 2006). The geographic scope is however necessary due to the Africa-wide scope demarcated by many of the actors I study, such as CF Investments[4] in A4. This resonates with postcolonial scholarship which, while critiquing the vagaries of discussing Africa on a continental scale, nonetheless acknowledges that Africa is a commonly used designation i.e. "you are African" or "we operate in African countries" as well as a claimed identity (Ba & Cury, 2022). The second reason is simply that all of the research which makes up this thesis can be situated as relating to locations broadly recognised to be situated within the Africa continent[5]. This does not mean I claim to summarise the full extent of transformations across Africa. Rather that my research design applies a spotlight to a few specific locations from my own external vantage point (see section 4.7 on my positionality). I thus conceptualise Africa less as a fixed location and more as a shared and perceived identity, as well as a designated target of transformation efforts. To make this broad scope workable, I narrow the geographic scope for each article by focusing on specific cases of transformation as outlined in Table 1.

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At the outset of this research process, the scope focused on the role of innovation in "sustainable energy transitions" in Rwanda. The focus on Rwanda has remained, although both the empirical processes and literatures I have studied have consequently extended to geographies beyond Rwanda, as described in Table 1 above. The focus on energy has likewise remained throughout the thesis journey, and each of the appended articles speaks to the energy sector in some way, as shown in Table 1. Some of my interlocutors, such as those identifying as government energy policy staff, fit within rigid sectoral boundaries and reproduced them through their stated roles. However, far more of my interlocutors across A2, A3 and A4 moved freely between sectors or did not acknowledge sectoral boundaries at all. Many described ideas spanning energy, agriculture and telecommunications, while others simply framed what they did as everyday life. Some also explained explicitly how the sectors and priorities they worked in shifted according to where and when financial resources became available.

I am more reticent to link the thesis as a whole to sustainability. Although some interlocutors spoke explicitly about sustainability, particularly those connected to international finance flows in A2 and A4, I neither asked directly about sustainability nor defined it myself. Instead, I approached questions of where transformation might lead broadly, rather than treating sustainability as a predetermined goal. For example, while A2 was designed around Rwanda's ambitions to expand renewable energy and electricity access, I did not frame these as inherently "sustainable", noting that such language was used primarily by internationally headquartered NGOs and private sector partners (see, for example, SE4ALL, 2024). Across the empirical material, more consistent aspirations concerned transforming (often understood as modernising) how people lived, improving living standards and creating

[4] As I do in the full article, I use the invented name "CF Investments" here to refer to the venture capital intermediary which the case study focuses on. I use this name to protect the organisation's anonymity.
[5] I formulate the geographic scope in this way to recognise that the notion of Africa as a singular continent has itself been critiqued as constructed from an external vantage point, see Mudimbe, 1988.

socioeconomic opportunity. Sustainability therefore falls outside the formal scope of the thesis. It nevertheless surfaces across A1 - A4 through certain interpretative frames, while remaining notably absent from others.

1.7 Contributions

As described in Section 1.4 on research gaps, each article appended to the thesis describes the specific contributions made by each. Here, I summarise the core contributions made across the thesis in response to the three gaps identified above. These gaps are theoretical, empirical and methodological.

This thesis addresses the theoretical gap identified above by developing a spatial and power-oriented theorisation of participation in transformations. I demonstrate how interpretative frames constitute subject positions, as well as how material circumstances, and spatially organised socio-material flows combine to shape who can legitimately inhabit different positions in processes of transformation. In doing so, I contribute towards debates within Sustainability Transitions on participation and power by showing how actors come to claim, occupy, or be ascribed positions in transformation, and how spatial relations shape these processes. The thesis does this in three main ways.

First, I theorise subject positions of transformation as discursively constituted through spatial interpretative framing. While prior work in Sustainability Transitions has examined how actors perform or are assigned roles within transitions, I pivot away from discussing roles to instead demonstrate how spatial positions emerge through framing practices that specify which actors, places, and practices are understood to drive transformation. Across the articles, interpretative framing brings about a series of recurring subject positions -including universalist innovators, technology recipients and knowledge gatekeepers - which are reliant on particular understandings of innovation, knowledge, and spatial relations. This shows how actors become intelligible as participants in transformation through discursive processes rather than pre-existing categories. I demonstrate how these frameworks have complex spatial footprints related to much more than simply the location where a transformation takes place (for example Rwanda). Many different aspects of how transformation processes are framed, such as the actors, knowledges and temporalities considered necessary or useful, carry spatially coded assumptions regarding where in the world these things reside or are deliverable from.

Second, the thesis relatedly applies the concept of power geometries (Massey, 1993) to transformation to explain how subject positions of innovation and transformation become stabilised through their relations to other positions and the socio-material flows of knowledges, technology and capital which link subjects and places together differently. These subject positions and flows organise transformation into several recurring configurations which are anchored to contrasting interpretative frameworks - most notably a universalist technology-oriented geometry connected to transcontinental resource flows, alongside locationally embedded and situationally embedded geometries. Noting that subject positions in different geometries can be occupied simultaneously by a single actor, this theorisation accounts for the messiness, ambivalence and multiplicity in how actors relate themselves to transformation in different ways over time, as well as the tensions and contradictions which they perceive about

themselves. Likewise, it also highlights relations of dominance between these geometries in terms of the materials, capital and perceived legitimacy which circulate with them.

Finally, the thesis demonstrates that participation in transformation ultimately emerges through the interaction between subjectivities and actors' material circumstances. Differences in wealth, mobility, education, and geographic location shape actors' ability to claim or be ascribed to particular subject positions. By linking discursive subject formation with spatial inequalities in access to resources and mobility, I show how uneven participation in transformation is accomplished.

Next, the thesis addresses the empirical gap described above by examining Rwanda not merely as a location where transformation initiatives occur, but as a power-laden relational space which is constituted differently through processes of transformation. Rwanda is variously analysed across articles A2, A3 and A4 as a node within transnational networks of innovation and finance which receives capital and disburses it across the continent; as a site where multiple imaginaries of energy systems transformation interact; and as a country riven by urban-rural divides which are reproduced by, whilst constraining participation in, Rwanda's capital-infused innovation system centred on Kigali. In doing so, this thesis contributes an empirically grounded account of how Rwanda as a location constitutes and is constituted by the visions and practices of actors seeking to induce transformation.

Finally, I claim a modest methodological contribution by treating academic knowledge production as part of the socio-material flows through which transformations are constituted. In A1, I approach academic texts and scholarly practices as "actants" that shape how transformations are understood and pursued, bringing methodological practice in the sustainability transitions literature closer to relational traditions in Science and Technology Studies (STS) (Jasanoff, 2004; Bellacasa, 2011). This allows the sustainability transitions literature itself to be analysed as empirical material, revealing the interpretative frames through which innovation, transformation, and associated actors and places are constituted. Through this approach, spatially coded assumptions about where innovation occurs and how it circulates become visible in A1.

Relatedly, A5 examines the spatial organisation of academic knowledge production itself, analysing where institutions producing knowledge about lower-income countries are located and how citation and funding patterns associate legitimacy with expertise in particular places. In doing so, I bring the systems that generate scholarly knowledge into the same analytical frame as the transformations they describe (Midgley, 2023). This helps illuminate how academic research participates in shaping problem definitions, directing attention and resources, and reproducing or contesting wider power geometries.

I do not suggest that such reflexivity is absent from existing scholarship, nor deny the analytical value of distinguishing between literature review and empirical analysis. Rather, the contribution of this thesis, particularly A1, lies in offering concrete examples of how reflexivity can be placed in the analytical foreground of academic work related to innovation and transformation. In this sense, I approach scholarship simultaneously as a knowledge product and as a participant in processes of transformation, highlighting the value of attending more explicitly to the power relations and political effects of academic research.

2 Theory

In this section, I outline the different ways in which I engage with theory across this thesis. I begin by describing my own onto-epistemological perspective, to make sense of the literatures I draw upon and concepts I work with. I follow this by theoretically situating the thesis as interdisciplinary. While this PhD project at the outset was anchored in the sustainability transitions literature, this thesis in its final form has an explicit spatial lens, meaning I position this thesis primarily within human geography. Nonetheless, whilst each article can be situated at least partially within geography, they each engage with different interdisciplinary fields grounded partly in human geography but extending beyond it. Each field provides a different lens which allows me to approach innovation and transformation from different perspectives and contribute towards the theoretical framework which follows. These fields are:

- Sustainability transitions
- Science and Technology Studies (STS)
- Post-structuralist feminist theory
- Economic geography
- Political ecology
- Modernity and coloniality

I subsequently describe how I draw upon each of these fields to provide empirical entry points, conceptual and analytical tools and interpretative lens. I then conclude the theory section by drawing together these perspectives into my theoretical framework, based around the interrelated set of concepts which I operationalise in the thesis.

2.1 My onto-epistemological perspective

In this thesis, I adopt a relational onto-epistemological perspective. Ontologically, I understand the world to be emergent and constituted on an ongoing basis through continual interactions between social and material elements. This means that rather than knowing structures, actors or places as distinct or out there permanently, I know temporary iterations of the world continually produced through situated relations and practices (Bouzarovski & Haarstad, 2019; Yıldız, 2026). Epistemologically, knowledge is therefore not a representation of an external world, but part of the ongoing processes through which the world is continually interpreted, enacted and provisionally stabilised. Ways of knowing the world are therefore inseparable from the conditions under which they are produced and from the relations that shape what can be known, by whom and with what effects. I would tentatively claim that this resonates with how I understand the philosophy of Ubuntu, which I have come into contact with through the development of this thesis. Ubuntu is associated with the pan-African Bantu language family which refers to human beings as both Muntu (singular) and Ubuntu (plural). Whilst Ubuntu as an ethics system and ontology is complex and multifaceted, one of its central aspects is its insistence that the self can only be known in relation to its community: as Mbiti explains, “I am because we are and since we are therefore I am” (Ntibagirirwa, 2018).

My onto-epistemological perspective therefore recognises the coexistence of multiple situated ways of knowing and engaging with the world which are each embedded within uneven relations of power, resources, and social and material connections. At the same time, I recognise the unequal but shared experience of material circumstances; for example, the concentration of things in certain locations and not others, such as the natural distribution of volcanic rock with heat retention qualities or unequal access to electricity infrastructures. This means I sympathise with, but do not align myself with, the "ontological turn" in scholarship asserting fully separate or incommensurable realities (Zúñiga, 2025, Querejazu, 2026). Nonetheless, in practice I align myself with many of the key tenets of this scholarship. I believe that the onto-epistemological processes through which actors make sense of material circumstances (i.e. how the volcanic rock might be distinguished from living things, how it comes to be understood as volcanic, how its heat retention qualities are known and why heat retention is considered desirable) are multiple, with these different sensemaking systems having worldmaking effects. Likewise I resist recognised pressures from universalist ontology that a totalising reality exists, with a singular past or possible future states considered the only alternatives to the present reality (Oliveira, 2021; Querejazu, 2026). I therefore make room for multiple co-existing life-worlds forming part of a shared but differently experienced reality (Ingold, 2011). My analytical focus is therefore on how actors' positions, practices, and interpretative frameworks intersect with flows of knowledge, material resources, and social relations, shaping which pathways, practices, and ways of acting on the world are legitimised, reproduced, or contested over time.

Building on this stance, this thesis adopts a deliberate practice of pluralising terms such as geography, knowledge or subjectivity. This practice is well-established in human geography (Kumar, 2022), post-structuralist scholarship (Butler, 2014) and STS (Haraway, 1988), but these concepts may be more conventionally treated as singular in others. I selectively pluralise concepts to reflect my understanding that these are not unified or internally coherent sets of phenomena but are constituted through multiple, situated, and sometimes competing relations and practices. For example, different actors may enact distinct geographies through how they relate places to one another or mobilise different knowledges in making sense of and intervening in the world. Similarly, subjectivities and power relations are understood as relationally produced, unevenly distributed and always multiple (even with regard to a single person). I nonetheless use plurals selectively to acknowledge how certain configurations come to dominate, stabilise, or marginalise others as well as how certain worldviews may assert that these things exist only in singular terms (e.g. a universalist view of knowledge as accumulating).

2.2 Situating the thesis in human geography

Human geography provides the backbone of this thesis by framing space as a temporary but continually reproduced assemblage of different related aspects (Massey, 2005; Cederlöf, 2024). For example, one person's interpretation of space and the places and scales which constitute it can be understood as a particular assemblage of components, including but not limited to people, technologies, knowledges, histories, futures and physical locations (Anderson et al., 2012). This helps to explain how locations and their inhabitants come to be situated differently within worlds according to different perspectives; for

example making some places traditional and others advanced according to different viewpoints (Ferguson, 1994; Ingold, 2011). Other spatiotemporal constellations occur simultaneously and space is always under production, making different futures possible (Massey, 2005). Approaching transformations through a human geography lens has profound implications for knowledge. People come to know worlds differently as they move through them in different ways (Ingold, 2011). This diversity may however be obscured by power relations which make certain conceptualisations of space associated with the interests of powerful actors appear universally relevant or most feasible (Lefebvre, 1991). It follows that central geographic concepts like scale (e.g. the "national" or "local" scale) can only be understood in relation to other perceived scales and the socio-spatial processes that frame them as legitimate or expected scales for some activities and not others (Bouzarovski & Haarstad, 2019).

Geographers have explained how actors and locations are produced through and situated within "power geometries" (Massey, 1993). These are networks of power-laden relations that shape what practices become possible, desirable or expected in different places, while themselves being continually reshaped through material activity (Holloway et al., 2019). As a result, actors' aspirations, including those related to innovation, are mediated by where they are located, while also informing the places and lives which they aspire towards (Crivello, 2015). Different ways of linking places across space give rise to multiple, coexisting geographies through which the world is understood and enacted. These geographies are reproduced unevenly through discourse, practice and resource flows, even as material conditions shape how they are interpreted and performed (Gregson & Rose, 2000; Holloway et al., 2019).

Like other relational approaches in social theory (Giddens, 1984), this perspective moves beyond a structure–agency divide. However, whereas structuration theory primarily explains the reproduction of social relations over time, Massey (2005) places spatial relations at the centre of how the world is organised. Structure and agency are understood as emerging from dynamic and spatially distributed relations in which power is unevenly allocated. Capacity to act is therefore shaped by an actor's position within these relations. Both physical location and how locations are understood in relation to other places help shape the opportunities and constraints actors encounter in processes of transformation.

2.3 Entry points for investigating the positions of actors in transformation

The interdisciplinary field of Sustainability Transitions sets out the empirical terrain which I investigate in this thesis; what different actors in diverse locations do within processes of transformation. In A1, A2 and A3 I draw upon the sustainability transitions literature for its focus upon the dynamics of socio-technical change within and between systems of varied functions (Köhler et al., 2019; Andersson et al., 2023). This literature, while multifaceted, commonly points to innovation as central to processes of change. It deploys innovation in more heterogeneous ways than mainstream innovation studies' primary focus on innovation related to products and processes (Kivimaa et al., 2019). It is most commonly understood either as an emergent outcome of systemic functions and interactions (Bergek et al., 2008) or as a practice contributing towards wider processes of change, for example by providing

alternative means of achieving societal functions (Geels, 2002; Smith et al., 2010), some of which may be oriented towards sustainability (Kivimaa & Kern, 2016). This literature also has a strong normative thrust, seeking to understand and potentially foster fundamental shifts in socio-technical systems (Kivimaa et al., 2019) often towards futures considered desirable (Smith et al., 2010; Andersson et al., 2021). This has given rise to the language of socio-technical transitions, with transitions meaning a process of change from one state to a perceptibly different alternative state and typically associated with normative efforts to foster sustainability (Silva & Stocker, 2018).

Critical sustainability transitions scholars have raised concerns about restrictive assumptions in how transitions are theorised, particularly which kinds of actors play a role, what is satisfactory as a "sustainable" end state and the extent to which unruly processes of socio-technical change can or should be controlled (Stirling, 2015; Stirling 2019). Whilst differences between terms like transition and transformation relate more to how they are operationalised by different academic and practitioner communities than to fundamental differences in definition (Hölscher et al., 2018), these concerns have led some sustainability transitions scholars to prefer the term transformation as connoting broader and open-ended processes of change (Stirling, 2015).

The phenomena I seek to investigate in this thesis are thus rooted in the sustainability transitions literature, pertaining to how different individuals, groups or theoretical perspectives interpretatively frame systemic interactions, particularly those between actors, places, technologies, institutions and capital, as constituting broader processes of transformation. More specifically, I draw upon and contribute towards a sub-field known as the Geography of Sustainability Transitions (GeoST). GeoST has emerged as a response to dominant approaches in sustainability transitions to viewing location as the principal dimension of geography which matters (Coenen et al., 2024; see for example Köhler et al., 2019). GeoST scholars have pointed out how the sustainability transitions literature has exhibited methodological nationalism through its privileging of certain empirical contexts (particularly those in Northern Europe and America) from which to theorise the dynamics of transitions (Coenen et al., 2024).

Related critiques of the broader "spatial turn" in energy research - culminating in the interdisciplinary field of Energy Geographies - have described the Eurocentric orientation of much of this literature (Bridge, 2018). Recent Energy Geographies scholarship has sought to rectify this by investigating how processes of transformation in East Africa alter power dynamics and produce relational dependencies and uneven development between places, for example energy-oriented financial flows which produce rural-urban divides (Hategekimana et al., 2025). Growing attention of the GeoST and Energy Geographies literatures to the spatial and scalar dimensions of knowledge has demonstrated how commonly articulated foci of transformation such as energy or sustainability are themselves linked to spatially situated knowledges (Bridge, 2018). These spatial and scalar tensions in knowledges of transformation lie at the heart of this thesis.

2.4 Tools for conceptualising how knowledge becomes materially performative

I draw upon a combination of Science and Technology Studies (STS) and post-structuralist feminist theory to conceptualise how different actors interpretatively frame certain things as being relevant to transformation and thus render other things in the background. Additionally, these fields help me to theorise how actors become subjects of transformation through the performative enactment of specific frames. I draw upon STS literature in A1, A2, A3 and A5 to reject the notion that knowledge-oriented concepts such as science, innovation and technology possess universal characteristics and are thus distinct from politics (Pinch, 1990; Collins, 1992). The STS literature highlights the geographic situatedness of science, technology and innovation, with contrasting imaginaries, logics and frames perceptible amongst actor groups (Haraway, 1988; Jasanoff & Kim, 2015; Wahome & Graham, 2020) and power relations between these. This lens helps to contextualise observations that research institutions all over the world are typically compared against metrics which originate in higher income countries, contributing towards an unbalanced landscape (Kraemer-Mbula et al., 2020). Likewise, it helps explain why knowledges accumulated by African peoples through living their daily lives come to be considered irrelevant to efforts to do innovation, whereas what is prized is the "scientific" knowledge often detached from lived realities which is learned at schools or universities (Mavhunga, 2023).

To be attentive to these dynamics, I situate this research within relational traditions in STS that emphasise the co-production of knowledge, institutions, and material arrangements. In this perspective, scientific and technological knowledge is both shaped by the socio-material conditions within which it is produced and actively participates in configuring those conditions (Jasanoff, 2004; Bellacasa, 2011). Applying this lens renders explicit the ways in which spatially coded knowledge about scientific and technological practice can act as a means of organising and reproducing divisions between actors (Lefebvre, 1991). For example, socio-technical imaginaries function as particular framings of transformation which may be shared, stabilised or contested between groups, with resources mobilised towards more dominant visions of change (Smith & Tidwell, 2016; Rudek, 2022; Kuchler & Stigson, 2024). However these analyses also recognise the importance of material circumstances in shaping how different actors produce and engage with knowledges. STS scholars have described for example how material and epistemological arrangements from Kenya's colonial era continue to exert an influence on the opportunities available to Kenyan actors within global technocapitalism (Coban, 2024).

In this thesis I am particularly interested in how individual actors find themselves in different positions related to transformation. Post-structuralism navigates long-standing structure-agency debates (Ahlborg & Nightingale, 2018) by asserting that societal structures are not pre-existing but performed through actors inhabiting subject positions linked to more dominant knowledge formations (Foucault, 1982; Butler, 2010; Carpenter, 2020). Repeated performances of subjectivities contribute towards the apparent stability of structure (Butler, 2014). Frames shared and stabilised between different actors, such as socio-technical imaginaries or the logics which govern finance flows, can be enacted through subjectivities.

Performativity can bring expected realities into being. For example, the citing of dominant economic knowledge formations through articulations and practice can stabilise the continual functioning of market economies, leading some to view the economy as an entrenched societal structure. However subjects may also seek to bring about new realities through the discursive formation of alternative subject positions and social forms (Butler, 2010), made material when actors resist inhabiting subject positions which dominant norms gesture them towards (Salih, 2007). This has led some sustainability-focused scholars to search for performative "potentialities" in which actors cite alternative norms and knowledge formations through their practices (Baker & Modell, 2019).

This lens of performativity relates to geography as well, an intersection I seek to foreground in this thesis. Post-structuralist geographers argue that subject positions are not inhabited in already existing locations, but rather that performativity brings these places and spaces into being. This focuses attention on how performances of different subject positions produce different articulations of space, with consensus and contestation emerging around which locations are marginal or central for example (Gregson & Rose, 2000).

Whilst a distinct academic field, complementary insights on how systems are framed from Critical Systems Thinking help to indicate how STS and post-structural perspectives might be applied to systemic transformations. Systems theorists have explained how system boundaries do not exist innately but are brought into being when actors make normative judgements about what counts, thus excluding some things and not others (Churchman, 1968; Ulrich & Reynolds 2020). This emphasises the need to account for a wide plurality of perspectives in what might constitute systems, of being attuned to power relations between these actors and the importance of reflexivity by those who performatively define systems (Midgley, 2023).

2.5 Tools for analysing how transformation-oriented activities are spatially distributed

I draw upon the fields of economic geography and political ecology as analytical tools to examine spatial distributions of transformation activities. Economic geography investigates how people, places and processes come to be materially and unevenly distributed across space (Mäki & Marchionni, 2011; Baker et al., 2025). The literature has shown for example how flows of digital technologies reproduce spatial relations of difference through emergent distinctions between locations within the "space of flows" (e.g. systemically connected locations possessing opportunity) and the "space of places" which by contrast are poorly connected, fixed, and isolated, a product of class, rural-urban and national divides (Ash, 2018).

I use economic geography to examine how transnational networks of actors are spatially arranged in two empirical cases: the geographies of finance in A4 (Van Meeteren & Bassens, 2024) and the uneven spatial organisation of academic knowledge production in A5 (Amarante et al., 2021; Backhouse, 2021). This lens helps explore how transformation efforts produce, reinforce and contest spatial hierarchies

such as cores, peripheries, leaders and laggards (Binz & Castaldi, 2024). Economic geographers also emphasise that community needs are always situationally contingent, despite tendencies to reduce them to broad categories such as "employment" or "healthcare" (Binz & Castaldi, 2024; Flanagan et al., 2023). This perspective encourages attention to how different innovation activities define particular problems as legitimate targets of intervention (Flanagan et al., 2023). I also engage with work at the intersection of economic geography and political economy to examine how interpretative frames and material conditions shape the transformation activities that become possible in different locations (Newell, 2019; Baker, 2023), including the political economies of energy systems change explored in A2 and A3.

In A4, I additionally draw on political ecology to examine the uneven effects of transformation processes. Political ecology highlights how access to resources, infrastructures and legitimacy is shaped by historically embedded and evolving power relations (Allan et al., 2022; Mirumachi, 2020; Deberdt & Le Billon, 2024). This helps situate place-based interventions within wider political and economic dynamics that influence where capital and other benefits ultimately accumulate (Dorn, 2022; Haag et al., 2024). The literature also examines how people navigate changing social, technological and environmental conditions that may create opportunities for some while reproducing inequalities for others (Li, 2014). I draw on these insights in A4 to analyse how sustainability-oriented capital flows create a landscape that downstream actors must navigate to access finance, and the ambivalent effects that result.

2.6 Lenses for interpreting hierarchical relations between people and places

The final interdisciplinary field I draw upon is scholarship which engages with modernities and coloniality. I use this scholarship as a lens to interpret relations between actors and places. I understand modernity as a broad logic and aspiration which emphasises human progress towards a rational and desirable state of being modern. Whilst seeking to hierarchically order and universalise, it manifests in multiple, unpredictable, and contextually specific ways (Linehan, 2009), hence me speaking of modernities. Coloniality is defined as a set of relations oriented around exploitation, extraction and dependency (Fanon, 2002; Quijano, 2007; Rodney, 2018). Some scholars thus see the two concepts as intimately linked. The emphasis often placed by modernist logics upon rationalisation and the reification of universal frontiers, typically located in higher income countries considered to be at the apex of development, is understood to engender the hierarchical organisation of people, places and knowledges in relation to this apex. Relations of coloniality play out as a result of the logics advanced by modernity which unequally order the world (Quijano, 2007; Oliveira, 2021).

Several actors from the African national independence movements of the mid-twentieth century provide foundational perspectives on postcolonialism and coloniality which continue to influence contemporary discussion of African futures (Adesina, 2022; Chipato, 2023). Their elaboration of distinctly African modernities also troubles the claim above that aspirations of modernity inevitably

engender homogenising desires to simply emulate other places. For example Julius Nyerere, the first president of Tanzania, articulates Ujamaa, an explicitly African socialist project oriented around economic self-reliance (Nyerere, 1977). Nyerere argues that precolonial communal values can ground a modernising African state, rejecting what he views as uncritical imitation of European models. Whilst Ujamaa as a political project of collective agriculture had mixed effects (Hunter, 2008; Keskïn & Abdalla, 2019), his emphasis upon both a cultural and epistemic reorientation away from dependency upon, and assumed inferiority to, former imperial powers (Nyerere, 1962) remains relevant today.

Kwame Nkrumah, the first president of Ghana, relatedly contends that formal independence can mask continuing economic domination by former colonial powers and capitalist systems (Nkrumah, 2004). His advocacy for pan-African continental unity and industrialisation positions decolonisation as an ongoing, state-led modernisation project resisting enforced economic dependency (Nkrumah, 2004). Léopold Sédar Senghor, the first president of Senegal, along with Aimé Césaire, develops the concept of Négritude, which advocates for African peoples and diaspora to reject self-identification as colonial subjects requiring guidance and instead to recognise the value of, and feel pride in, intellectual traditions and Black aesthetics rooted across Africa (Diagne, 2010; Mavhunga, 2023). Senghor nonetheless departs somewhat from Nkrumah and Nyerere by placing greater emphasis on synthesising values and knowledges he considers African with incoming flows from external knowledge systems that can be put to work in service of postcolonial state-building (Táíwò, 2022).

Across this small sample of visions for transformations led by and benefiting African peoples, there is nonetheless subtle heterogeneity both in the relative position of external actors and also in the character of the modernities implied by them. This makes them useful lenses through which to view my own empirical focus upon how positions in transformation come to be distributed across space. Noting the claims to link modernity with coloniality above, I utilise these perspectives to draw a distinction between two kinds of modernist framing. First are modernist framings of transformation in general; and second, specifically universalising modernist framings which orient transformations in one place towards a universally relevant knowledge frontier elsewhere. I would argue that the original visions of Nkrumah, Nyerere and Senghor fit the first category of modernities described above but not the second. Modernist logics of transformation may be profoundly emancipatory for those groups who conceive them, even if they draw upon knowledges from elsewhere. By contrast, I would argue that modernist framings which explicitly reify a universal frontier location elsewhere, whilst still producing diverse manifestations, are strongly oriented towards the reproduction of hierarchical and unequal relations in the manner described above (Quijano, 2007; Oliveira, 2021).

Postcolonial Africa remains deeply marked by representations of sex, body and gender from colonisation which shape the contemporary subordination of subjectivities of womanhood, Blackness and queerness (Bertolt, 2018). These dynamics can be understood through a lens of intersecting relations of power that hierarchically organise both people and places. The spread of modernist thought across the world has been accompanied by a racialised and gendered coding of the world's population: for example, hierarchically arranged categories such as Black, White and Asian on the one hand and locations such as Africa, Europe and Asia on the other (Bertold, 2018). These stratified knowledge

systems provided historical means to rationalise the subjugation of African peoples, and continue to structure contemporary inequalities (Tamale, 2020). Alongside race, gender operates as a key dimension of stratification. The continued depiction of African countries as harbouring "traditional" gender roles through which men exercise power to a greater extent, according to Oyěwùmí (1997) ought to be understood as a power-laden modernist discourse which obscures the role of colonisation in producing and stabilising these subjectivities. Scholars likewise note an enduring masculinist bias in academic research pertaining to Africa, which tends to deprioritise or ignore gender relations as entrenched, timeless and inevitable (Tamale, 2020).

Intersecting inequalities across race, gender and other dimensions such as class and educational attainment have been conceptualised as mutually constitutive (Collins, 2017). These overlapping hierarchies continue to exert coloniality through the exercise of power relations in contemporary society, with colonial-era systems of classification and domination enduring beyond formal colonial rule (Quijano, 2000). A central injustice within this is that those locations which experienced formal colonisation often harbour restrictive norms today around gender and race. In some instances, this leads to prejudice as well as actors internalising and constraining their own horizons of possibility. Concretely, this means that differentiated opportunities emerge across positionalities. A wealthy White European woman working in an African country is likely to encounter different opportunities compared with a White European man or a lower income Black woman in that same country, with historical relations playing a central role in structuring these differences.

These various perspectives help me to be cognisant of the historical context of relations between the places I investigate (Tarvainen, 2022), as well as to interrogate narratives of or claims towards modernity, such as modernist articulations designating people or places as traditional (Oliveira, 2021). I approach coloniality and modernity as relational patterns linked to certain interpretative frameworks which sometimes become visible in how innovation and wider transformations are articulated and enacted across space.

I acknowledge epistemological tension in discussing relations of coloniality in transformation whilst using frameworks such as STS and post-structuralism which have Eurocentric roots. The relationship between coloniality and the interdisciplinary fields I draw upon in this thesis is viewed differently by scholars. Some scholars connect these frameworks together, for example studying how socio-technical imaginaries of innovation and entrepreneurship, aspirations of modernity and coloniality of relations are mutually constitutive of each other (Wahome & Graham, 2020). Post-structuralist theory has been positioned by some as a complementary tool for anticolonial struggle, framing the works of Frantz Fanon for example as encouraging colonised people to reclaim and reconstitute their subjectivities and cease occupying restrictive subject positions of colonised victimhood (Jilani, 2023). Such perspectives focus attention on how people, knowledges and material conditions must transform alongside each other (Jilani, 2023), resonating with the claims of Senghor above (Diagne, 2010). Relatedly, others have asserted that a university being "African" is not about where it is located or who works there, but rather the extent to which it helps people understand African society and its contradictions and thus contributes towards alternative social forms (Ba & Cury, 2022).

Some scholars conversely critique an overreliance on the contributions of European and North American scholars of post-structuralism and STS as fundamentally limiting Afrocentric theorising of topics like innovation by overlooking onto-epistemologies rooted within the continent (Mavhunga, 2017), reproducing coloniality in knowledge production. Others instead raise concerns that overemphasising the imperative to decolonise knowledge and practice can itself limit possibilities for actors in places like Africa by reducing complex relations between places to reductive judgements of what counts as colonial, engendering the dismissal of promising possibilities (Táíwò, 2022).

I seek to navigate between these perspectives by framing this research as an exchange between theories and ideas from diverse geographies. I acknowledge that the thesis engages primarily with theoretical traditions developed in Europe and North America, while also drawing on scholarship and perspectives from Africa, as well as South Asia and South America to a lesser extent. I do not position my research as decolonial, but rather as work which describes how relations of extraction, dependency and epistemic hierarchy may continue to surface and shape contemporary transformation initiatives (Tuck & Wang, 2012). Likewise in the context of this thesis I seek to avoid moral or ethical judgement of my interlocutors' aspirations towards modernity. Instead, following the example of Ferguson (1994), I analyse these aspirations and relational practices as spatially situated, socio-materially productive and always occurring alongside enacted or potential alternatives. Finally, I try to be attentive to relations of coloniality (i.e. of extraction, exploitation or dependency - Mignolo, 2010) both in what I study and my own research process, elaborated further in Section 4.6.

2.7 Theoretical framework

In this sub-section, I draw together the various academic disciplines and interdisciplinary fields described above to operationalise the key concepts which shape this thesis. I operationalise these concepts as mutually constitutive, with each relating to the others to form an internally coherent toolbox which I use to make sense of my empirical material. These concepts are as follows:

- Interpretative framing
- Agency
- Coloniality
- Spatial relations
- Power geometries
- Subjectivities
- Transformation
- Innovation

Interpretative framing

I use the term "interpretative framing" to refer to the lenses through which actors envision desirable processes of change. Framing involves bringing particular constitutive elements - such as actors, locations, scales, temporalities, knowledges or future directions - into the foreground while leaving alternatives in the background. Through their continual articulation and performance, frames stabilise shared ways of interpreting the world. Across the thesis, I examine interpretative frames embedded in individual aspirations, socio-technical imaginaries, academic concepts, and the logics through which actors enact practices such as financial disbursement. I use the language of framing to emphasise that these processes do not simply interpret the world but help produce it by rendering some possibilities more visible and actionable than others. Frames are reproduced through diverse practices, including dialogue with interlocutors during fieldwork and the publication of academic research.

Interpretative framing organises claims about innovation and transformation by shaping who counts, which activities matter, and what is recognised as legitimate. In this sense, it relates to the post-structuralist concept of discursive formations (Foucault, 1982), which influence who is recognised as a subject and which practices are regarded as valid - for example, as innovation rather than imitation. The theoretical framework developed below is itself an act of interpretative framing, bringing certain concepts and understandings into focus while placing others in the background so that they can be analysed in relation to one another.

Agency

Whilst many definitions of agency exist, I find the following useful: "the capacity, condition, or state of acting or of exerting power" (Merriam-Webster, 2026). This definition focuses attention on agency as something enacted through practices and processes. However, rather than treating agency as an inherent attribute that actors either possess or lack, I hold the concept open in much the same way as I do innovation (Ahlborg & Nightingale, 2018). References to agency can be understood as claims regarding capacity to act or exert power. Consistent with my onto-epistemological perspective, I treat agency as relational (Burkitt, 2017). Agency emerges through interactions between actors, technologies, infrastructures and ideas rather than residing in any one of them (Anderson et al., 2012; Burkitt, 2017). I also distinguish agency from autonomy. While self-determination may be understood as one form of agency, actions can be agential without being self-determined (Foucault, 1982; Carpenter, 2020).

To move beyond a structure-agency binary, I draw on post-structuralist analyses of governmentality, which conceptualise agency as constituted through processes of subject formation rather than as an expression of freedom outside power relations. Agency emerges through the situated practices by which subjects engage with, negotiate and potentially rework the conditions of their own formation (Hansson & Hellberg, 2015). As power relations unfold, they are both shaped by and embedded within material and institutional arrangements that enable some forms of action while constraining others (Ahlborg & Nightingale, 2018).

This framing allows me to deploy agency in different ways across the thesis. In A1 and A2, I use agency as an analytical category to examine who is regarded as capable of driving transformation and by whom. Such attributions of agency - for example, when financiers or policymakers position the international private sector as a source of change - contribute to processes of subject formation. At the same time, agency can be understood as emerging through these processes, such as when private-sector actors internalise particular understandings of their role and act accordingly (Butler, 2014).

In A3, I engage with "performative agency", a concept derived from post-structuralist analyses of performativity (Foucault, 1982; Butler, 2014). Because dominant knowledge formations are continually reproduced through citation and performance, performative agency can be understood as moments in which subjects refuse to reproduce them (Butler, 2010). Such acts do not necessarily transform dominant formations, but they create the possibility for change by introducing what Salih (2007, p. 65) terms "moments of promising instability". I am particularly interested in instances where actors cite alternative knowledge formations and inhabit subject positions that challenge established power geometries and norms of transformation.

Coloniality

I use the term "coloniality" to describe relations oriented around extraction, exploitation and dependency (Quijano, 2007; Mignolo, 2010). Following Quijano (2007) and Oliveira (2021), I understand such relations as linked to universalising modernist framings which hierarchically organise people, places and knowledges around presumed frontiers of progress, legitimating subordination. Coloniality therefore does not refer to any presence or influence of external actors, influences or knowledge. Rather, drawing on Nkrumah's (2004) concern with enduring forms of subordination beyond formal colonial rule, I use the concept to identify particular relational patterns through which transformations become organised around unequal allocations of recognition, legitimacy or benefits. In this thesis, coloniality is thus treated as a relational quality that may emerge through how innovation and wider transformations are imagined and enacted between people and places.

Spatial relations

Spatial relations are central to this thesis. I am interested in how actors, locations, knowledges and technologies become socio-materially related to one another across the world. Following Massey (2005), I understand space not as a fixed container but as relational and continually produced through power. Common descriptions of the world, such as accounts of Africa exporting raw materials to higher-income countries (WITS, 2026), reflect sets of recursive spatial relations that have become stabilised and dominant rather than singular spatial realities. Space is therefore produced through ongoing encounters between people, places, technologies and ideas. I understand space and time as fundamentally entangled (Massey, 2005; Ingold, 2011), with spatial relations containing particular histories, presents and futures.

Seemingly singular spaces can be constituted through multiple coexisting spatiotemporal trajectories. The relation between two places, for example, may be understood through urban-rural distinctions, personal memories, or as part of a single shared location. Spatial relations frequently reproduce hierarchical modernist imaginaries that position some places as advanced cores and others as backward peripheries (Willett, 2020). Attending to how space is produced through relations - for instance, when technologies circulate between places - highlights that space is continually enacted. Geographies can thus be understood as temporary constellations of spatial relations, always open to alternative interpretations. Throughout the thesis, interpretative framings of transformation play a key role in constituting these relations from different vantage points.

Power geometries

Building on the operationalisation of spatial relations above, I conceptualise power as similarly relational, emergent and productive (Ahlborg, 2017; Ahlborg & Nightingale, 2018). This perspective on power emphasises situating and understanding power in a given context or encounter, encompassing both individual abilities to act as well as more systemic constraints (Nightingale, 2006; Ahlborg, 2017). This enables a focus on questions related to the different ways in which relations of power are reproduced or contested, and what consequences this has, for example upon inequalities between people and places. There is long-standing debate surrounding how power relates to space, in particular the geographical stretching out of social relations between places (Giddens, 1986) which has led to the unequal spread of interests, ideas and access in a globalised world. This state of spatial unevenness has been attributed to a compression of space by time under capitalism (Harvey, 1989) or colonial modernity (Oliveira, 2021). Massey (1993) however cautions against any generalising explanation of the myriad power relations at work in how we understand and experience space. Such an understanding avoids seeing power as residing within deep-lying societal structures, and instead as an ongoing process of performance which is produced in space and partly constitutes it (Nightingale, 2006). Through this, I operationalise a constitutive understanding of power as continually emerging from relations between humans and other living beings, things, environments, discourses and institutions (Ahlborg & Nightingale, 2018). Critically, technologies and knowledges are not simply passive tools but are actants which participate in the (re)production of power relations by mediating, enabling or constraining possibility (Ahlborg & Nightingale, 2018).

I focus particularly on "power geometries" (Massey, 1993), understood as the ways people are positioned in relation to socio-material flows and therefore come to constitute and experience space differently (Massey, 1993; Rogers et al., 2013). Power geometries shape who can initiate flows, who receives them, and who is constrained by them. Rather than treating capitalism, coloniality or other hierarchies as reified structures, this perspective highlights the spatial configurations through which stratified relations of class, capital, gender, ethnicity, modernity and coloniality are reproduced and contested (Massey, 2005; Kitchin, 2016). I combine this concept with subjectivity to examine how different subject positions are constituted within power-laden spatial relations. Socio-material flows,

material circumstances and interpretative frames together shape who can occupy particular positions within these geometries.

This focus aligns with Wahome and Graham's (2020, p. 1) concern with "the power geometry that leads to the identification of some geographies with the production of technological knowhow and others as sources of raw material and recipients of finished products". Such spatial hierarchies often appear neutral or meritocratic, obscuring the interpretative frames through which participation in transformation is legitimised. Actors with proximity to forms of techno-spatial legitimacy may come to view these arrangements as natural or desirable (Bourdieu & Wacquant, 1999; Wahome & Graham, 2020).

At the same time, power geometries are never singular or fixed. They are multiple, contested and continually in production (Massey, 1993; 2005). People occupying the same location may experience them differently, while individuals can simultaneously benefit from and be constrained by the same socio-material flows. I use the concept to examine how transformation initiatives focused on Africa participate in the ongoing spatial reconfiguration of power. Relatedly, I use the term "politics" as shorthand for contested relations within power geometries, including the knowledge politics through which actors and places are assigned particular positions. The production and circulation of academic knowledge can itself be understood as one such stabilising performance.

Subjectivities

I use the term "subjectivities" to refer to the multiple subject positions that are performatively enacted by or ascribed to different actors, with individuals potentially inhabiting several simultaneously (Foucault, 1982; Butler, 2014). I am particularly interested in how practices and processes related to innovation, energy policy and transformation produce such positions. While subject positions are discursive constructs - for example, designating someone as an innovator or technology recipient - they can have material effects when enacted in practice.

Subjects are constituted through language, practices and narratives, shaping how actors experience and understand the world. In this thesis, actors *becom*e subjects through accessing positions associated with transformation. These positions are identified in three ways. First, some are directly articulated by interlocutors who describe themselves as innovators, facilitators of change, financiers, or disconnected from innovation. Second, I infer subject positions from actors' practices, such as academics who act as gatekeepers for innovation as a concept through their scholarship. Third, I examine imposed subject positions through which others are categorised within innovation discourse, for example as users, beneficiaries or irrelevant to transformation, regardless of how they understand themselves.

This focus also highlights a limitation of the thesis. I concentrate on subjectivities related to innovation, energy and transformation rather than on how actors understand themselves more broadly. Whilst I recognize that all subjectivities are inherently intersectional, subjectivity emerged as an organising concept relatively late in the research process. This means that I paid comparatively limited explicit

attention in the research design to important dimensions of subjectivity such as gender and ethnicity, although they do nonetheless emerge to some extent through my empirical material (see sections 4.6 and 6.3).

Transformation

I use the term transformation to refer to ongoing socio-material reconfigurations of relations between things which have a normative orientation, understood as being motivated by situated evaluations, needs, or aspirations by one or more actors. This understanding of transformation as having an explicitly normative orientation is thus distinct from broader ongoing process of change. It may encompass processes as diverse as sectoral restructuring, social movements or adjustments to everyday life. Because these reconfigurations unfold across space and time, transformation is inherently plural and emergent (Feola, 2015). This broad framing creates an arena within which actors advance different interpretations of transformation, including those centred on innovation or sustainability (Scoones, 2020). While some transformations may be linked to identifiable interventions, such as policy-induced behavioural change, many involve complex shifts that remain beyond the control of any single actor or group (Stirling, 2015).

This definition avoids prescribing specific criteria for what counts as transformation, such as systemic change, altered actor positions or sustainability outcomes (Feola, 2015; Markard et al., 2012; Bennett et al., 2019). It also avoids drawing a rigid boundary between transformation and dynamic stability, recognising that such distinctions are often subjective (Midgley, 2023). This is particularly important given the thesis' focus on lower-income people in Africa, many of whom navigate conditions of inequality, scarcity and vulnerability. From this perspective, seemingly everyday adaptations - such as changing cooking practices to maintain health or care for others under conditions of precarity - can constitute transformation when they are normatively motivated. Such practices which might otherwise be dismissed as mundane or merely coping may therefore be understood as transformative. This broad understanding enables me to situate innovation, discussed below, as one particular articulation of transformation.

Innovation

In this thesis, I operationalise innovation as an intentional claim made about practices or processes that are oriented towards transformation. I do not propose this as a universal definition, but use it as an analytical tool. This differs from more common definitions that emphasise novelty (Merriam-Webster, 2023) or causal processes of change (Andersson & Törnberg, 2018). In practice, however, innovation means different things to different actors, often privileging particular people, places, knowledges and activities. Global innovation metrics, such as patents and R&D expenditure, tend to prioritise forms of technological novelty associated with research, publication and risk capital, routinely positioning Africa near the bottom of global rankings (WIPO, 2025). By contrast, scholarship on grassroots, frugal and

artisanal innovation foregrounds locally embedded experimentation, repair and adaptation aimed at addressing situated needs (Pansera, 2013; Radjou & Euchner, 2016; Kabwete et al., 2019).

This ambiguity is central to the thesis because it highlights both what innovation means to different actors and what the concept does. In particular, innovation's association with intentional action gives rise to claims about agency and who is capable of driving change. Rather than treating innovation as an event or outcome, I understand its use as a situated claim that a particular practice or process matters for transformation. The emphasis on orientation recognises that such claims may refer to transformations that are realised, anticipated, attempted or even judged to have failed. In all cases, innovation signals an expectation or desire that transformation should occur. Within this framework, innovation is one particular articulation of transformation.

3 Contextualising transformations in and of Africa

This section sets out a historic and contemporary context to this thesis. I acknowledge criticism that discussions of transformation are too often disconnected from history, in doing so reproducing coloniality of knowledge (Arora & Stirling, 2023). I undertake a conscious act of interpretative framing in choosing what to include to help readers make sense of my subsequent empirical work; many alternative histories could be provided. Here, I focus on long-run transformations of systems spanning social, technological and ecological elements (Ahlborg et al., 2019), with a particular interest in transformations which involve the reconfiguration of socio-material flows between places. This socio-material framing accounts for shifts in material resource flows over time and shifting perceptions of how Africa as a continent engenders or receives knowledge, as well as the relative positioning of African countries within the world. Given the particular orientation towards Rwanda in this thesis, I draw specific attention to the country's position in this wider history. I begin by outlining a historical perspective, followed by aspects of Africa's present context and transformation pathways lying ahead.

3.1 A historical perspective

For thousands of years communities across modern-day Africa have produced diverse technologies, artefacts, practices and associated knowledge systems which have enmeshed the social, technological and ecological (Mavhunga, 2017). Socio-materially, this has engendered diverse flows of materials, technologies and knowledges across Africa and sometimes beyond it. The continent has hosted diverse lifestyles, from nomadic hunter-gatherer communities to city states, empires and bureaucracies (Falola, 2024). Recognising this fundamental historical context dispels the corrosive myth that the history of technology and innovation within Africa begins with the colonial era (Mavhunga, 2017).

More specifically, trajectories of technological change and networks of technological knowledge have long unfolded across the continent in areas such as metalworking, pottery and botany. For example, there is extensive evidence of successive furnace designs for iron smelting, with evidence dating back to the first millennium CE in present-day Mali (Serneels et al., 2013). Archaeological and oral evidence testify to the experimental, improvisational and evolutionary nature of these technological practices, with breakthroughs in smelting taking place in present-day Nigeria, Democratic Republic of Congo and Malawi for example (Chirikure, 2017).

These transformations, particularly through the production and dissemination of tools and related knowledges, recast growing practices and subsequently peoples' relationship with the land. Technological breakthroughs and practices took place primarily in people's homes or in the open air and were steeped in ritual symbolism, with metallurgy for example often associated with fertility (Chirikure, 2017). Activities at these sites resulted in significant technological accomplishments, with the Haya people in Tanzania notably devising a means to produce carbon-grade steel 1,500 years ago

(Schmidt & Avery, 1978). Likewise, positioning the home as a kind of laboratory ought not to necessitate assumptions that such activities were artisanal in scale; there are historical examples of larger scale iron manufacturing amongst the Babungo people of Cameroon for example (Chirikure, 2017). These material accomplishments were accompanied by highly specialised knowledge systems, including an array of both oral and written traditions. Oral knowledge systems spanned a vast range of topics which can be interpreted as history, art, science, politics, ideas and practical knowhow (Oyeniyi, 2021). This included for example knowledge of the plants that people cared for, engaged with and used (Augusto, 2017) as well as the wider ecological systems which they relied upon.

In present-day Rwanda, the country's precolonial history culminated in the 19th century CE in a kingdom centred on the Nyiginya clan with the capital at Rubengera. The kingdom stabilised hierarchies of power to govern its subjects. It furthermore developed specialised agricultural practices, artistic culture and ritualised systems of organisation which enabled it to engage in multifaceted relations of trade, warfare, technology and knowledge exchange with its neighbours (Ntagwabira & Kusimba, 2021).

The extractivist logics and material violence administered by foreign powers in the eras of slavery, resource extraction and ultimately colonialism beginning from the 15th century CE (Eltis & Jennings, 1988) play an undeniable role in this history of transformation. Nonetheless, how it played out was highly heterogeneous both within and between modern-day nation states, with different social groups and places having a different experience of colonialism at different times, even on the same day (Tamale, 2020). Most pertinent to this thesis is the way the colonial era transformation of Africa reconfigured flows of technologies, knowledge, capital and materials. They did not entirely replace or start a new history separate to that outlined above: many of the socio-material flows described above continued during this period, and strands of these precolonial socio-techno-ecological systems, knowledges and practices endure (Mavhunga, 2017). The colonial era did however bring about transformations through additional transcontinental flows which continue to reverberate today (Oliveira, 2021). Most violently, European powers developed modalities and business models for the industrial extraction and outflow of raw materials and enslaved peoples for consequent exploitation elsewhere, wreaking devastating environmental and social harm (Inikori, 1992; Hicks, 2020). Ethiopia stood alone as the only country in Africa not to experience territorial colonialism by foreign powers (Hailu, 2020)[6], making it an important source of inspiration for colonised people across the continent during and after this period (Mariam, 2013).

Alongside this material extraction, the knowledge systems fostered by African peoples over thousands of years (for example the plant-related knowledge described above) were similarly transferred to Europe and put to work in service of the emergent global economy (Augusto, 2017). These knowledges now form a crucial yet typically unacknowledged foundation of today's universally positioned scientific and medical knowledge, a phenomenon which has been termed biopiracy (Alum, 2024). More broadly, this indicates how knowledge systems understood to be Eurocentric or "Western" are often described as a

[6] Liberia is the other country which has been deemed to have avoided territorial colonialism, although as a nation it traces its origins to the activities of various American societies which supported the migration of previously enslaved peoples from the USA to settle on the West African coast from 1822 onwards. For further details see Whyte, 2016.

monolithic entity originating purely from Europe and travelling to elsewhere but with little or no influence from these places (Graeber & Wengrow. 2021). Scholars have argued that this is a fundamental misreading, with foundational tenets of perceived-Eurocentric thought since the enlightenment being produced through encounters with people and knowledge systems outside Europe. This includes for example how indigenous peoples contributed towards widely recognised ideals of equality and justice by critiquing what they heard about contemporary living conditions in Europe (Graeber & Wengrow, 2021).

Whilst the provenance of these foundational European knowledge systems was geographically diverse, their character during and after the colonial period obscured this provenance and instead exported pervasive Eurocentrism around the world. Dominant interpretative frameworks circulating in Europe and North America began to construct Africa as a continent oriented around primitivism, victimhood or simply absence (Ferguson, 2006). This established an enduring racialised gaze which framed the continent as requiring inflows of technology, knowledge and other hallmarks of civilising modernity (Said, 1978; Purtschert, 2015). Likewise, recognised disciplines which endure today such as African Studies became established in Europe and North America with an explicit mandate to develop knowledge about African people and places which would be useful to the countries where these researchers were based (Mavhunga, 2023). I have encountered the legacy of these tendencies myself, both in my education and early career in the UK, where the continent was framed primarily either as a producer of enslaved peoples, a desperate place requiring help (often some form of capital flow), or as simply absent from discussion.

Alongside outflows from the continent were substantive inflows of people, knowledge systems and technologies to Africa. Colonies in Africa became consumers of the finished products of empire through a concerted effort by imperial powers to create a preference for and a reliance upon imported goods (Eltis & Jennings, 1988; Ocheni & Nwankwo, 2012; Britwum & Demont, 2021). Accompanying this was the transfer of knowledge systems such as schooling and higher education which spread across the continent. These were focused on European knowledge systems and racialised conceptions of science which framed Africa's populations as lacking knowledge and thus requiring European education (Fanon, 2002; Freire, 1996). The effects of this continue to be felt with many people leaving the continent to study in Europe and North America, constituting a "brain drain" effect (Dei & Asgharzadeh, 2002).

Scholars have argued that whilst gender relations in precolonial Africa were not uniformly superior (i.e. more balanced) than those observable today, they were nonetheless highly heterogeneous, with multiple examples of fluidity in gender roles (Oyěwùmí, 1997; Tamale, 2020). This heterogeneity was disrupted with the arrival of the European imperial project and the values entangled with it. Colonial interventions contributed to the confinement of women to the "private" or "domestic" sphere and the binarisation of gender roles (Oyěwùmí, 1997; Bertolt, 2018). At the same time, colonial expansion was accompanied by the global diffusion of racialised knowledge systems that categorised populations and places into hierarchical groupings (Bertolt, 2018). These classifications were central to the administration and

justification of empire, embedding ideas about gender, race and geography that persist into the present (Tamale, 2020).

Present-day Rwanda first became a German colony in 1897 followed by a Belgian colony in 1922 (Rwigema, 2025). During the Belgian colonial period various knowledge systems were imported, such as educational regimes following Belgian curricula (Duarte, 1994), as well as systems of ethnic classification. Regarding the latter, the Belgian colonial administration introduced an architecture to divide and rule the population in service of economic extraction. The ID cards introduced during this era stratifying the population by specifying "Hutu" or "Tutsi" identity are now recognised as one of the key antecedents of the 1994 genocide (Fussell, 2001; Rwigema, 2025).

There is no single date concluding the era of formal colonial rule in Africa, and scholars of coloniality may allege that no definitive conclusion has yet occurred (Pino Robles, 2002). An era from the mid-twentieth century up to the present day is nevertheless perceptible in which African nation states have taken various pathways away from colonial rule. Several influential actors in the independence movements of the mid-twentieth century provided foundational values and theories of postcolonialism which continue to inform the transformations which Africa might embark on now, including those referred to in Section 2.6. This generation of leaders strongly influenced the period immediately following formal decolonisation which was marked by several African countries instituting state-led industrialisation projects which sought to resist reliance upon the global economy, for example through tariffs and state ownership models which incentivised local industrial production (Mkandawire, 2001).

This period of postcolonial statehood was accompanied by the emergence of aid and international development discourse (Mkandawire, 2001), often administered by the same countries who previously undertook colonialism such as Britain, France and Germany (Nkrumah, 2004). Aid and development became established industries which created roles for "development" actors both within Africa and elsewhere to solve seemingly depoliticised problems (Ferguson, 1994). Relatedly, in the 1980s and 1990s, the World Bank-led "Washington Consensus" emphasising structural adjustment policies placed emphasis on integrating countries in Africa into the global economy by easing regulations, emphasising privatisation and encouraging international trade over industrial protection. The effects of this were far-reaching, with policies affecting most countries in Africa to at least some extent, with notable exceptions including Namibia, Sudan, Eritrea, Somalia, and Sierra Leone (Archibong et al., 2021). This era necessitated huge inflows of Overseas Development Assistance to Africa, rising from 1 billion USD (current) in 1964, to 19 billion USD in 1992 and 50 billion USD in 2018 (World Bank, 2026). Despite this, in material terms the Washington Consensus era was broadly viewed as a failure in improving socioeconomic conditions, with Africa being the only major lower income region globally with negative per capita growth between 1980 to 2000 and no major changes in poverty levels and debt (McCord et al., 2005). More recently, the aid and development industry in Africa has become vulnerable to socioeconomic and geopolitical shifts in those countries which contribute financial flows to sustain it. This has included the dismantling of the USA's development agency USAID (Faguy, 2025) significant reductions in bilateral funding by countries like the UK and Sweden in favour of defence funding (Brien

& Loft, 2025), as well as falling multilateral contributions to institutions like the United Nations (Davies & Foukes, 2026).

Rwanda implemented fiscal reforms under the Washington Consensus (Archibong et al., 2021). Like many other African countries, it has had a challenging road post-independence, negotiating factional politics, fraught relations with ex-colonial powers (most notably Belgium and France) and the unique tragedy of the 1994 genocide (Golooba-Mutebi, 2013; de Becker, 2016). Nonetheless in the period post-genocide, the country's rapid social and economic development under President Paul Kagame has been hailed by some as a "miracle" (Behuria, 2018) and the perfect example of a developmental state (Biedermann, 2016). Attention has been drawn to the apparently balanced path between collaboration with development partners and international investors on the one hand and becoming a knowledge economy which produces homegrown solutions on the other, leading to high levels of support for the government (Biedermann, 2016). Even so, the regime has many critics, with concerns about encroachment upon democratic freedoms, state-administered surveillance (Wrong, 2021) and military aggression (Levine-Spound, 2026).

Concurrently, three more recent shifts over the last twenty years provide relevant context to this thesis. The first is the gradual replacement of the Washington Consensus with what has been described as the "Wall Street Consensus", understood as the gradual pivot of development discourse and funding modalities towards private rather than public-administered finance. This broad logic emphasises the onboarding of people understood to be unbanked and existing within informal economies (including many in Africa) into globalised financial systems (Gabor, 2021).

The second is the rise of discourse in political, professional and cultural arenas both within Africa and elsewhere emphasising the necessity of no longer associating African peoples with outdated subaltern relations of dependence with other countries. There are several variants of this multifaceted discourse and bringing them together risks masking tensions and contradictions. On the one hand there are critical theory-informed calls to "decolonise" areas such as development spending (Mahlangu, 2025) and education (Adebisi, 2016), as well as criticism of such calls on the grounds that they perpetuate reductive myths about Africa's victimhood (Táíwò, 2022). At the same time, there is more economically-oriented rhetoric of "Africa Rising" (Gaillard & Mouton, 2022) with emphasis placed for example upon capital flows into and accumulation within Africa (Obeng-Odoom, 2014) as well as increased entrepreneurship and digital technology use within Africa (Gaillard & Mouton, 2022). Relatedly, Afrocentric articulations of modernities (Nwobodo, 2022) including Afrofuturism form part of this, crystallising in "Black Panther", the 2017 film that influentially depicted an independent, technologically advanced and proudly African nation of Wakanda to global audiences (Osei, 2020).

The third broad shift is the emergence of several other nations as major participants in flows of knowledges, technologies, finance and materials into and out of Africa besides the existing set of ex-imperial powers. The Chinese Government and private sector have become active across the continent, amongst other emerging economies such as India, Saudi Arabia and Brazil (LSE, 2013). China's role is notable firstly as a financier and architect of large infrastructure projects through the Belt and Road initiative, which is transforming connectivity on the continent (Huang, 2016). Secondly, it has become

an immensely powerful designer, manufacturer and importer of innumerable technologies which are integral to contemporary socio-techno-ecological transformations in Africa (Darko et al., 2021). These include low cost and widely available mobile devices, solar panels, grid transmission infrastructure, telecommunications infrastructure and surveillance technologies. Many of the ex-imperial powers remain interwoven with the continent through discussions of aid, development, innovation and wider economic cooperation, which arguably explains my own career trajectory culminating in this thesis. Nonetheless this cast of colonial powers is now joined by several other countries who participate in transformations in and of Africa. Scholars have observed that the new actors joining this landscape do not typically make claims of benevolence; the arrangement is explicitly economic (Lisimba & Parashar, 2020). In Rwanda, China has emerged as an alternative financing partner to European and North American nations, with a noted preference for directly financing infrastructure and real estate rather than transferring capital (Lisimba & Parashar, 2020).

3.2 Present context

This complex picture leads us to the material circumstances of Africa today. Material living conditions vary enormously, perhaps best illustrated by persistently high inequality of income both between and within countries across the region (Chancel et al., 2023). This also translates into extreme inequalities of opportunity. These opportunities are dependent on wealth as well as a complex intersection of factors including ethnicity, gender, birthplace, place of residence and parents' level of education (Brunori et al., 2019; Atamanov et al., 2024). Meanwhile, the population is expanding rapidly and is expected to double to two billion by 2050 (IMF, 2024). Whilst this creates potential opportunities to resite economic activity to Africa as the rest of the world ages in comparative terms, a central concern of many African governments today relates to how to create and sustain jobs for a population of this size, noting that about 85% of employment in Africa continues to be regarded as "informal" (Chipanda, 2025). Today, the majority of people across Africa are subsistence farmers, with most food consumed across the region produced on smallholder farms (Giller et al., 2021). The character of subsistence farming varies hugely between places, with growing conditions, food security, household income and access to land key variables determining the exact character of subsistence farming (Giller et al., 2021). Rwanda as one of the most densely populated countries in Africa and with around 80% of the population engaged in smallholder agriculture (AFDB, 2023) has instituted various land tenure reforms to bring individual plots together to boost productivity (Singirankabo, 2022).

The inequalities described above also play out in Rwanda, with proxy indicators illustrating significant divergence in material wealth. Private vehicle ownership is a conspicuous signal of wealth in Rwanda, with only 1.7% of households owning a vehicle in 2025 (Sabiiti, 2025). Vehicle ownership serves as a rough proxy for material wealth, ranging from no vehicle at all to basic estate cars and luxury Sports Utility Vehicles (SUVs). Scholars have observed how capital associated with globalised agendas such as tackling climate change is often used by recipient organisations operating in Su-Saharan Africa to purchase SUVs (Mavhunga, 2023). Given Rwanda's hilly and dispersed landscape, most people travel by private SUV if they can afford it. In Kigali, the car market is dominated by Toyota models (Severi,

2020) which form an implicit hierarchy signalling material wealth: Auris and Corolla models, followed by the larger RAV4 and finally Land Cruiser SUV models. The vast majority of citizens however rely either upon motorbike or cycle taxis, shared buses, minivans or walking.

With regard to material trade flows, there is likewise great heterogeneity between countries but Africa's combined economy remains strongly oriented towards the export of raw materials and the import of consumer goods and capital products (WITS, 2026). This dynamic frustrates many who see a missed opportunity to site value-adding activities within African countries, which continue to often be viewed as risky places to do business (Mavhunga, 2023). By contrast, Rwanda enjoys a reputation as one of the countries within Africa which is most welcoming to businesses, with stable governance structures (WB Doing Business Archive, 2026). This engenders substantial inflows of both international aid and foreign direct investment (Lisimba & Parashar, 2020). Nonetheless contemporary instability in the Great Lakes region and aforementioned concerns about authoritarian rule (as well the government's role in the conflict) threaten this reputation.

Ecologically, countries across Africa face compounding threats which are damaging and destabilising ecological systems, building on exploitative degradation from the colonial era (McKittrick, 2025). The impacts of climate change are already affecting the continent through more frequent and higher impact extreme weather events, particularly given large-scale reliance on rain-fed agriculture (Omotoso, 2023). Alongside this, other threats and damage unfolding across the region today include waste accumulation, air pollution, deforestation, forest fires, water pollution, water scarcity, overfishing and local environmental damage from mineral extraction (Sakariyahu et al., 2024).

Across the continent, a wider transformation is therefore unfolding as ecological systems destabilise and trigger potential cascade affects which may threaten food security across the region in the near future (Muli et al., 2018). This destabilisation of ecological systems is connected to contemporary socio-material flows to and from Africa. Africa is now recognised as bearing the environmental consequences of high consumption lifestyles in higher income countries. This is occurring both through inflows of waste directly from higher income countries (Sovacool et al., 2020) and increased temperatures resulting from greenhouse gas emissions elsewhere, as well as damage associated with outflows of minerals for in-demand technologies like batteries and semiconductors. Within Rwanda, one of the most acute pressures is deforestation, driven primarily by demand for firewood which remains the principal source of heat for cooking (MININFRA, 2018). Nonetheless, the specifics of how threats and damage are understood as well as how they manifest are highly locationally specific. Environmentally-focused initiatives are often framed as competing against priorities considered more important in a specific location (Damoah & Boglo, 2025). Relatedly, various instances of land dispossession in the name of environmental projects across the continent point to the risks associated with poorly designed projects which are out of step with the land's inhabitants (Fairhead et al., 2012; Lunstrum, 2016; Ashukem, 2023; Bülow et al., 2025).

3.3 Future transformation pathways

In the present moment and informed by the diverse histories briefly outlined above, both Africa broadly and Rwanda specifically are therefore connected to diverse articulations of forward-looking transformation. This is less of a metaphorical "crossroads" than a rambunctious intercity bus station. Enterprising actors tussle for attention and resources, ushering groups towards assorted vehicles of varying provenance which are oriented towards divergent pathways of transformation. Transformations tap into different histories, contemporary concerns and envisioned futures, serving different agendas and actors spanning states, donors, the private sector, multilateral agencies, communities and overseas diasporas.

In this final sub-section, I outline a series of future-oriented pathways which are commonly articulated in contemporary discourse regarding transformations in and of Africa. This provides a foundation for the empirical results which follow. These pathways form part of a discursive landscape within which my interactions with my interlocutors during fieldwork can be situated, with many interlocutors engaging with, referencing, or positioning themselves in relation to these pathways. For example, the scope of A2 is shaped by the Rwandan Government's stated ambition to transform its energy sector. The pathways presented here are therefore not intended as an exhaustive or definitive categorisation, nor as mutually exclusive trajectories. Rather, they reflect a set of recurring archetypal transformation pathways through which change is commonly understood, promoted, or contested by different actors. Broadly, these pathways centre on transformations of economic sectors and infrastructure, knowledge systems, environmental relations, and political and cultural life.

A first prominent strand is sectoral transformations of the economy, often with emphasis placed on technological and infrastructural changes, such as those related to energy, transport, food, water, sanitation and digital systems as well as urban planning. These pathways may tap into preexisting examples and configurations understood to have been implemented successfully elsewhere, for example relating to the expansion of electricity grids, telecommunications networks or road networks. In the energy sector, a core arena of activity is around how to provide reliable and high-quality energy services to citizens, with Sub-Saharan Africa described by the International Energy Agency as being "off track" towards Sustainable Development Goal 7 of affordable, reliable, sustainable, and modern energy for all by 2030 (IEA, 2025). Within this, ability to access electricity and heat for cooking are central areas of discussion. Noting that in 2023 around 53% of the SSA's population lived without electricity access (UNCTAD, 2023), many countries face decisions around whether to pursue more or less centralised electricity system architectures (Hojčková et al., 2018). Centralised grid expansion, like other large-scale infrastructure projects, frequently involves foreign contractors, financiers and consultants, embedding infrastructure within global circuits of knowledge, technology and capital (AFDB, 2025). In Rwanda, centralised visions of energy sectoral transformation via grid expansion are implemented by the government through state-owned enterprises such as Rwanda Energy Group. International firms play a substantial role by providing engineering services, technologies and finance (Nkurunziza, 2026; Construction Hub, 2026).

Nonetheless, grid expansion constraints make "off-grid" technologies such as PAYG-enabled SHS a key part of the electrification discussion in many African countries including Rwanda (Perros et al., 2024). In 2023, of the top 10 PAYG SHS companies by investment commitment, 9 were headquartered in Northern Europe or the USA (Baker, 2023). Relatedly, discussion of transformations in the cooking sector focus upon shifting both the practices and technologies through which people cook, with a "three stone fire" remaining the predominant means of cooking. Here, there is a burgeoning sector of alternative cookstove designs utilising different fuel sources (wood, briquette, pellet, gas, solar), processes (combustion, gasification) and desired outcomes (improved efficiency, reduced fumes, increased heat provision, convenience). Analyses of the cookstove sector in Uganda have indicated that dependency on external development capital and changing priorities have led to the stunted development of both technology designs and the sector more broadly (Nakyeyune, 2022).

A second strand concerns transformations which place emphasis on building knowledge-related capabilities, particularly through investment in education and higher learning as well as innovation system building. Reforms range from curriculum redesign, digital education, designated science parks, initiatives to broaden and strengthen Science, Technology, Engineering and Mathematics (STEM) participation and capabilities as well as establishing hubs and programmes to support innovation and entrepreneurship (Barakabitze et al., 2019; African Union, 2022). Such initiatives seek to cultivate knowledge economies of the sort which might produce jobs and locate a share of globally in-demand, knowledge-intensive service-sectors within Africa (African Union, 2022).

In academic research in such areas as engineering and physics, Africa is typically ranked well behind other regions worldwide (Gaillard & Mouton, 2022). Looking forward, scholars have questioned the validity of comparing academic output between countries against generalised criteria, citing for example a lack of attention paid to non-English language publications and a gatekeeping effect exerted by publishers in the Global North, as well as more structural barriers facing researchers based in lower income countries (Kraemer-Mbula et al., 2020). Likewise whilst Rwanda is highlighted as an "overperformer", most African countries depart on this particular transformation pathway from a position near the bottom of widely recognised innovation indices (WIPO, 2025). Rwanda has a stated ambition to become a knowledge economy and is orchestrating significant investment in its schools and universities, nurturing an emerging reputation as a hub of innovation and entrepreneurship within Africa (NCST, 2020; Yongabo & Göransson, 2022).

In this broader context of building knowledge-related capabilities, a key area of contemporary focus is how general purpose technologies like AI and IoT might be applied to sectors such as energy and agriculture in ways which help deliver sectoral transformation whilst also creating economic opportunities for both the users and designers of technology optimised-systems (GSMA, 2024; Olutumise, 2026; Mienye, 2024). There is a strong push for African countries to establish innovation ecosystems oriented towards these technologies (African Union, 2025), with digital platforms a central domain of innovation development (Cirolia et al., 2023). Despite this, concerns have been raised that the continent lacks enough skilled experts in these technology domains to take economic advantage of this opportunity and ensure context sensitivity (Ayim et al., 2022; Leal Filho & Gbaguidi, 2024). The

capital flows fostering these systems are also unequally distributed, with 83% of AI-related startup funding on the continent in the first quarter of 2025 going to Kenya, Nigeria, South Africa and Egypt alone (African Union, 2025).

A third strand of transformation encompasses environmental and climate-oriented transformations. Africa contributes a tiny share of historical greenhouse gas emissions yet faces acute exposure to climate-related impacts and other environmental threats, as described above. These threats produce demands from different actors for transformations oriented variously around climate change mitigation, adaptation and resilience. The energy sector is of central importance to this, due to the carbon emissions from fossil fuel energy systems and also the exposure of energy infrastructure to potential climate and environmental threats (Ayeta Mulyanyuma & Niringiyimana, 2024)

The concurrent sectoral and infrastructural transformations described above may exacerbate these environmental threats through further land degradation, biodiversity loss, resource extraction and pollution. At the same time, international concerns about climate change and the environment create opportunities for actors within Africa to access new or reoriented resource flows. For example, climate finance and technology transfer architectures, administered through multilateral funds and other actors, channel resources into projects envisioned as climate change mitigation or adaptation. However, such projects have also been argued to create new relations of dependence and contestations over accountability, access and distribution (Sial, 2024).

Finally, political and cultural transformations are continually unfolding across the region, tapping into the histories outlined above. Citizen-led regime changes and popular protests often connect to transformation pathways which emphasise democratic accountability and redistribution (Marks, 2024); Rukato & Okech, 2020), although such movements can also become blurred with more top-down authoritarian power grabs (Cheeseman, 2015). Alongside formal politics, cultural domains such as literature and music articulate imaginaries of preferable futures as well as critiques of power (Nyairo & Ogude, 2005; Mbembé & Nuttall, 2005; Okeke, 2019; Onyebadi, 2018; Jolaosho, 2019). Across these different articulations of transformation, Africa as a continent is a site where heterogeneous projects of change are imagined, negotiated and enacted.

4 Methodology

I begin this methodology section by describing the rationale for the methods used in this thesis. I follow this by describing the ways in which this research has been a collaborative effort. Next, I outline narrative analysis as my central research method, followed by describing the specific research methods I deploy in each article of the thesis. I then describe the circumstances of my interlocutors, including how and why I come to focus on certain dimensions of intersectional subjectivities above others. I then reflect more broadly on the influence my own positionality has had upon my research process before concluding with a brief statement on how I have approached research ethics in the thesis.

4.1 Rationale for thesis methodology

My research process can be understood as a series of methodological choices regarding theoretical perspective, research design, and specific methods, with theoretical framing (or deliberate choices to avoid it) crucial in setting research direction (Okoko et al., 2023). Theoretically, this thesis is grounded in critical theory from various disciplines and interdisciplinary fields (see Section 2) which together provide tools for identifying and critiquing spatial power relations of transformation. I did not, at the outset, begin with a specific theoretical framework to apply or a hypothesis to prove. Likewise, the thesis cannot be described as an example of grounded theory where I have been entirely led by my empirical material. This PhD has rather been shaped by a combination of my own interest in power relations between actors and places in transformation, rooted in personal experience, alongside the funded project which has supported my PhD oriented towards the role of users in innovation for sustainable energy transitions with a focus on Rwanda. It is noteworthy that the funding has been provided through the internal Chalmers initiative GENIE (Chalmers, 2023), meaning that I have received no substantive external pressure to keep my focus on the above topic or pursue other topics, besides ongoing conversations with my supervisors. Within the first few months of starting the PhD, I therefore developed a set of broad questions with which to query the literature I was reading for what would ultimately become my first article. These questions are:

- How are different actors associated with innovation?
- How are different locations associated with innovation?
- How are different processes and practices associated with innovation?
- How are different futures and societal directions associated with innovation?
- How are different knowledges associated with innovation?

These questions, informed by my early engagement with critical theory which encouraged me to think of innovation as political, have provided both a research direction and a lens through which I have viewed what I have encountered. These questions remain present in the first research question of this thesis, which feels appropriate given the research process and methodology has evolved over the course of the PhD as a means of addressing these questions.

This line of enquiry and orientation towards critical theory has led me towards research methods useful for documenting both the characteristics of these power relations and the sites of their reproduction or subversion (Cottrell, 2023): in this thesis, case studies. This choice was shaped by a combination of methods-oriented courses taken during my PhD, discussions with my supervisors and my academic background as a historian which has given me a strong conviction that multiple accounts of events coexist, and that perceptions and aspirations can be as consequential as events themselves. Following several years working on more formal and often quantitative analyses of sustainability-oriented transformations, I wanted this thesis to be grounded in a series of interlinked stories oriented around the aspirations and perceptions of different actors. I furthermore wanted to engage with the ambivalence and tensions within these stories rather than seeking to smooth over them. Qualitative case studies provided a way to capture this complexity and maintain richness in both data and explanation (Ndame, 2023).

All five articles appended to this thesis can be understood as case studies. Within human geography, case studies are typically defined as investigations of phenomena unfolding in specific locations, where the "case" is both locally grounded and understood as part of a wider phenomenon (Castree, 2005). They are often used to examine how seemingly similar processes play out differently across contexts. For example, studies of neoliberalism have shown that it is not a uniform entity applied across space but is instead geographically constituted through situated and contingent practices (Mansfield, 2004; Prudham, 2004). In this way, case studies can challenge homogenising accounts that assume concepts and processes operate consistently across the world.

However, this approach raises important methodological and ontological questions. As Castree (2005) argues, identifying a set of cases as belonging to the same phenomenon already involves assumptions about what they share, as well as about the scales at which they are compared (e.g. what counts as "local", "regional", or "global"). Without careful specification, this can lead to overly abstract or superficial claims about commonality - such as pointing to broad processes like privatisation or legitimacy - without adequately explaining how these operate in practice. More broadly, a case study often involves a tension between emphasising contextual specificity and making claims that travel beyond the immediate case (Castree, 2005).

In response, I define the case studies in this thesis as situated instances of how desirable forms of transformation are imagined, enacted, and evaluated through encounters between actors, places, and normative aspirations. In other words, the articles are not simply cases of "innovation" or "transformation" in general, but of the constitution of these concepts in practice. Each case examines a particular site in which such processes take shape, including a geographically distributed set of actors engaged in national sectoral transformation (A2), sites of academic knowledge production about transformation (A1 and A5), the allocation of financial resources for innovation (A4), and a specific institutional setting oriented towards innovation (A3).

These sites are analytically related not because they represent a single, uniform phenomenon, but because they each foreground encounters in which innovation and transformation are defined, negotiated, and performed. The aim is therefore not to derive generalisable claims about how

transformations occur universally, but to examine how they are constituted in specific contexts and what effects these processes produce. While certain patterns recur across the cases - particularly in terms of the subjectivities and positions that are enacted - I treat these as heuristic insights which might help academics and practitioners working in relation to innovation and transformation, rather than generalised theory about the characteristics of transformation. Taken together, the cases offer an account of a set of interrelated sites through which innovation as a concept is made meaningful. I seek to emphasise both the contextual specificity of these sites as well as the patterns which seem to echo between them, such as the recurrence of the universalist innovator subject position associated with globalised technological frontiers.

A2, A3 and A4 were conceived as case studies from the outset, focusing on empirical settings - national energy systems, climate finance flows, and innovation practices at a rural technical college - where desirable forms of transformation are pursued in contrasting ways, particularly through use of the concept innovation. By contrast A1 and A5 were not originally envisioned as case studies. A1 began as a literature review intended to synthesise knowledge on how innovation is framed, a methodology typically understood as distinct from case study research which produces empirical insights from specific settings (Eisenhart, 1989). However as described in Section 2, reading STS literature in parallel led me to interpret these texts as situated knowledge products which actively frame innovation, each reflecting particular positions and relations (Haraway, 1988). I therefore position the finished article as evidence of the different ways in which academic researchers and their scholarly work interpretatively frame innovation. Similarly, A5 was initially framed as a bibliometric study to explore geographic patterns in research on lower-income countries. Bibliometric approaches are typically understood as analysing the structure of academic knowledge rather than the phenomena themselves (Öztürk et al., 2024; Passas, 2024). To put it differently, in critical systems thinking terms bibliometric analysis is typically positioned as knowledge about knowledge-making systems rather than knowledge about the world, whereas case studies would count as the latter (Midgley, 2023). Through a critical theory lens, however, A5 too becomes a form of case study of how power geometries and subjectivities of transformation are materially performed through patterns of authorship, citations, and funding.

4.2 Collaborations across the thesis

This thesis is the result of several interlinked processes of academic collaboration. These collaborations have taken place across multiple levels. The high-level direction of this research has been shaped by a coalescing of many things. These include but are not limited to my research interests, my positionality and past experiences, my supervisors, my funding, my institutional setting and the many people and ideas I have engaged with along the journey. Likewise, many of my research methods such as semi-structured interview, observation and narrative analysis bring me into the picture as co-producer of data, both as a dialogic participant with my interlocutors and as an interpreter of our exchanges (Kutsyuruba & Stroud, 2023; Surawy-Stepney et al., 2023). I played a significant role in all of my interactions with my interlocutors through my physical presence, demeanour and interpersonal style. I furthermore exerted influence by framing questions in certain ways, discursively engaging with my

interlocutors' responses and leading the conversation in some directions and not others. I continued to play a significant role later during analysis by interpreting these exchanges, particularly when retrospective clarification was not possible.

I have also sought to collaborate with others through co-authorship across the thesis, in particular pursuing collaboration with scholars whose lived experience is more proximal to the geographic scope of my PhD than that of myself and my supervisors. I developed my academic networks during the first year of my PhD, culminating in an article which I co-wrote with a group of early career scholars identifying as being from the Global South. This included my friend Dr Muez Ali, a Sudanese citizen whose own PhD had a chapter focused on Rwanda and with whom I had extensive discussions regarding positionality and inequalities in academic knowledge production, which led to my involvement in the article (see Table 3 in A5) [7]. Later in my PhD through my fieldwork for A2, I developed a relationship with Dr Alexis Muhirwa, a staff member at Tumba Integrated Polytechnic Regional College (IPRC) Tumba who I subsequently co-authored A3 with alongside my PhD supervisors. I feel very lucky to have encountered somebody like Dr Alexis who shared my core research interests and had a real enthusiasm for collaboration. His involvement in certain interviews, our late night debriefs and his sharing of networks were all invaluable and he wrote key sections of the draft despite his other responsibilities and often short-notice requests for his time.

Through our collaboration, I began to more deeply recognise the pressures upon and sacrifices required by scholars based at many institutions across Sub-Saharan Africa to stay research-active. This led me to reflect over how my own desires for collaboration, as a time- and resource-rich European researcher, could themselves risk exerting extractive or tokenistic pressures upon others whose material circumstances were more constrained, including both my interlocutors and academic collaborators. My research assistant Pacifique Izera was invaluable in helping to bridge these shortfalls in Dr Alexis's availability, both his translation skills and his insights regarding the different perspectives that Rwandans have on technology and innovation. We briefly discussed Pacifique taking on a more involved role as a co-author but ultimately decided against this given Pacifique was due to start studying a Masters in an unrelated subject (and like many Rwandans, was already working multiple jobs). I sought to avoid tokenistic signalling of collaboration which did not reflect the work process. Likewise, I acknowledge that whilst Dr Alexis and I co-presented an earlier version of the work together at a conference in 2024, the time investment Dr Alexis has made in our collaboration is yet to result in publication. Thus I cannot yet claim to have distributed the opportunities of authorship engendered by this PhD, although it remains my hope.

A1 and A2 were co-authored with my PhD supervisors alone. This is because A1 was the first article I began work on, and when I began work on A2, I had not yet encountered any suitable collaborators. I likewise explored opportunities for co-authorship with other scholars for A4 but ultimately decided to be the sole author. This was because it was chronologically the last article that I began work on. My

[7] Whilst I generally avoid referring to the Global South in this thesis noting its construction of a binary, my co-authors on A5 together self-identify as scholars from the Global South so I use the designation here.

supervisors and I agreed that due to my interest in pursuing a career in academia, it would be advantageous for me to develop and author at least one of the thesis articles independently.

These conditions illustrate some of the practical challenges of seeking to implement deliberate collaboration in the context of a PhD. While I have managed to incorporate collaborative elements into both my data generation and analytical process, asymmetries in time, resources, and institutional positioning as well as expectations of academic career development influenced the form and extent of participation. My experiences highlight how efforts to pursue collaboration can generate additional demands on collaborators, particularly within resource-constrained institutional settings such as those at IPRC Tumba.

4.3 Narrative analysis as research method

To make sense of my empirical material, I utilise narrative analysis. Narrative analysis forms a fundamental pillar of social scientific practice across multiple disciplines. Whilst researchers have long been interested in the stories that people tell to make sense of their own lives, since the 1980s scholars have recognised a "narrative turn" away from treating narratives as simply empirical data and instead as constituted by the social contexts within which they are created (Pinnegar & Daynes, 2007; Earthy & Cronin, 2008). A narrative can mean different things across disciplines, ranging from full life histories composed through numerous interactions over time to shorter vignettes shared in response to specific questions (Riessman, 2005). What these forms share is a "storied" quality, in which events are selected, organised, and rendered meaningful for a particular audience (Riessman, 2005). Narratives are produced relationally, for instance through the interaction between narrator and audience (Earthy & Cronin, 2008) and serve as a key means through which people make sense of their experiences in engagement with others (Langellier, 2001; Kutsyuruba & Stroud, 2023). Whilst narrative analysis encompasses multiple strands, core areas of interest include structure, purpose, content, and modes of articulation (Parcell & Baker, 2017).

Narrative analysis aligns closely with my relational and emergent onto-epistemological stance. I understand narratives not as fixed, individual accounts but as situated and emergent articulations co-produced through interaction and context. Rather than treating narratives as coherent or internally consistent data to be "collected", I approach them as evolving sense-making practices performed in relation to particular audiences (including myself as researcher), settings, and moments in time. In line with relational and process-oriented approaches I treat narratives as inherently multiple, partial, and situated, resisting the assumption that they can be organised into singular, coherent accounts (Mol, 2002; Law, 2004). Instead, they may coexist in tension, reflecting different enactments of reality. In this sense, a "narrative" within my material is not simply a story told, but a relational configuration that may change over time (for example through retelling or subsequent interactions), revealing tensions, ambiguities, and reconfigurations in how interlocutors position themselves, others, and broader socio-technical dynamics. This makes narratives valuable source material from which to infer interpretative frames and subject positions, as I do in this thesis.

The narratives I engage with in this thesis are primarily shorter vignettes shared by interlocutors in response to open-ended questions such as "How do you engage with the concept of innovation?" or "Tell me about what your organisation does and how things have changed over time." However, I also encountered longer and more evolving narratives, particularly through sustained engagement in my fieldwork for A3. Unlike my fieldwork for A2 and A4, where data could often be neatly apportioned into interviews, many exchanges in A3 unfolded over several weeks across classrooms, canteens, transport, and walks around the college IPRC Tumba and surrounding area.

Here, narratives developed cumulatively and dialogically across encounters, shaped by our shifting interpersonal dynamics and contexts of interaction. For example, one respondent initially portrayed innovation at the college to me in a generally positive light in our first, relatively formal, interview. Weeks later, during a car journey to Kigali, he maintained aspects of this account but also articulated more critical perspectives regarding structural constraints, particularly relating to the mindsets of staff and students which frustrated him. I observed similar shifts across my fieldwork, recognising that narratives are not simply claims to truth but are infused with imagination, strategic interests and emotion (Riessman, 2005) and mediated by the relative positionalities of those actors involved in their constitution. Scholars have observed how foreigners in Rwanda are unlikely to receive fully candid responses to questions from individuals they do not know well, particularly if relating to sensitive or political topics, making long-term trust-building essential (Wrong, 2021). The 1994 genocide has been recognised to have fundamentally altered the ways in which people build trust; whilst the effect on individuals varies depending on their own relations with the genocide, it is recognised that overall levels of mistrust are higher (Ingelaere & Verpoorten, 2020). This dynamic was perceptible in my material, where initially positive accounts - for example regarding the role played by foreign companies - were sometimes followed by more critical reflections in subsequent interactions as actors became more familiar with (and possibly more trusting of) me. Following Law (2004) and Mol (2002), I interpret these not as inconsistencies to be resolved, nor that one account is truth and the other fiction. Rather they are co-existing versions of reality, with these shifts illustrating how meanings are negotiated and reworked through narratives over time.

The central form of narrative analysis I employed across A2-A4 was thematic analysis. This can be understood as a form of narrative analysis that focuses on identifying patterns across accounts by fragmenting narratives into themes, with comparatively less attention on aspects such as chronological structure or tone (Riessman, 2005). Thematic analysis enabled me to identify recurring patterns between actors, including shared framings and points of contestation (Braun & Clarke, 2006). I coded inductively using exploratory questions outlined in Section 4.1, such as what desirable forms of transformation involved, where they occurred, who was involved, and with what effects. NVivo software supported this process.

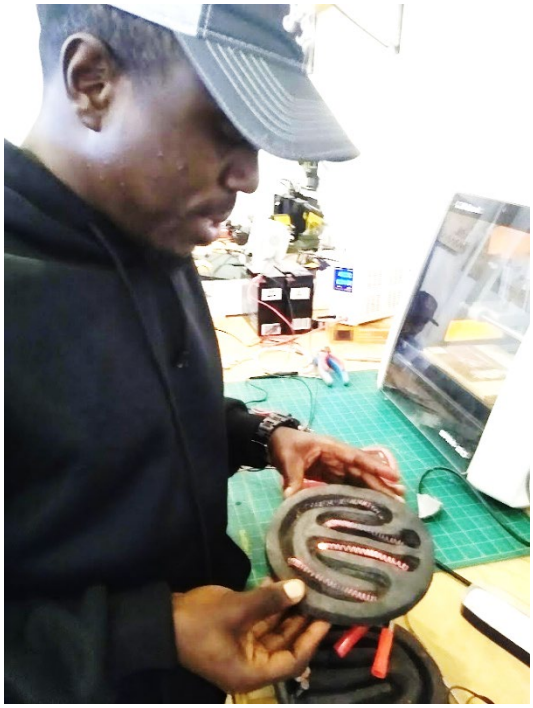
Alongside thematically-oriented narrative analysis, I also engaged in more structurally-oriented narrative analysis, attending to how stories were told including shifts in emphasis, tone, and temporality (Riessman, 2005). For instance, one interlocutor described her work in a rural pilot project with enthusiasm, highlighting collaborative, community-based innovation. However, when discussing an

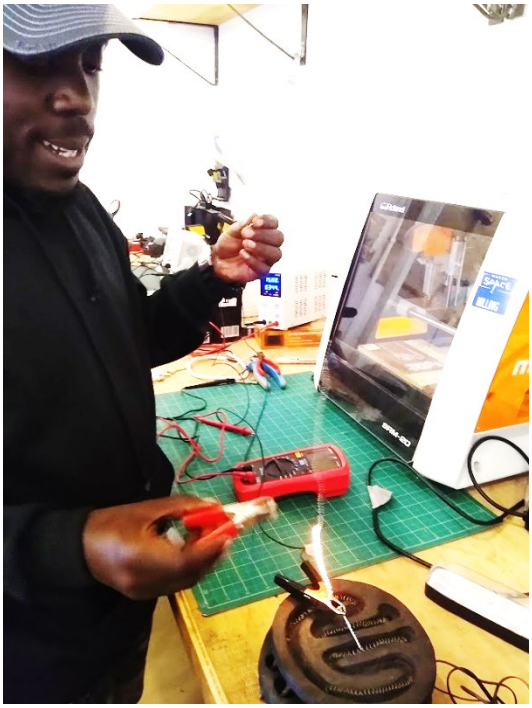
impending move to the city to support scaling efforts, her tone shifted, conveying ambivalence or sadness. My own research interests in the future trajectory of such work likely shaped this narrative articulation. This account became one of the empirical foundations through which I theorised temporal relations between the two socio-technical imaginaries discussed in A2, particularly the perceived necessity of transitioning towards less locally embedded forms of innovation to achieve necessary scale. Attending to such narrative shifts enabled me to trace how interlocutors reconfigured their positions across temporalities.

To co-produce narratives about innovation and broader transformation along with my interlocutors, I employed two primary research methods: semi-structured interviews and participant observation. Interviews served as the principal means through which interlocutors shared narratives, with flexibility allowing them to guide conversations and introduce analogies and examples (Berkovic, 2023). Participant observation, particularly in A2 and A3 (Tunison, 2023), enabled me to observe narratives as they emerged in interaction and to witness how previously encountered narratives were performed in different settings. At IPRC Tumba, for instance, I observed how similar projects could be framed as innovation by some actors and dismissed as imitation by others, as well as how respondents enacted practices they described, such as designing or using technologies.

During A2, I observed an engineer, Leandre Niyigaba, as he made a breakthrough in developing a low-voltage, high-current electric cooking system suited to capacity-constrained DC solar home systems. I captured this moment on camera (Figure 1), and the shared sense of excitement was palpable as he narrated his journey and future aspirations. In one instance, I also engaged in what Riessman (2005) terms “performative analysis,” using storytelling as a method to elicit reflection. At the conclusion of my fieldwork at IPRC Tumba, I facilitated a workshop in which I presented composite vignettes drawn from my observations to provoke discussion among staff, further contributing to the co-production and interpretation of narratives.

Figure 1: Photos of Leandre Niyigaba immediately after he developed an alternative means of configuring a DC-powered electric hotplate using available materials. Photos taken by Sam Unsworth, reproduced with permission.





4.4 Research methods by article

In this section, I describe the specific methodologies I have employed across the five articles both to gather data and to analyse it. This is summarised in Annex 1, which describes in more detail the approach to data collection and analysis across the thesis.

For A1, the primary research method is integrative literature review (Snyder, 2019). My co-authors and I purposively sampled a range of literatures known to engage with the concept of innovation, including scholarship from economics, sustainability transitions and decolonial thinking. To do this, we identified 88 articles which engage with the concept of innovation in the domain of energy. Our strategy for article selection used keyword searches, ranking searches by publication date and citations and reading of abstracts to check that an understanding of innovation plays a substantive role in the article. This sought to bring together a combination of seminal articles along with newer or niche perspectives, relating to a variety of theoretical approaches towards innovation as well as being a geographically broad sample. I analysed the literature sample using thematic analysis and the software Microsoft Excel, coding categories by which the articles differ: the actors, places and directions associated with innovation, as well as investigating how the articles are situated onto-epistemologically in terms of the locations they are written from and the locations and scales they speak towards, either explicitly or implicitly.

For A2, the primary research method is semi-structured interviews and participant observation. A total of 62 interviews were conducted, the majority of which took place in Rwanda in February-April 2022.

These interviews included actors from national government, local government, educational institutions, finance institutions, intergovernmental organisations, funds and programmes, private companies and non-profit organisations. These actors were selected via purposive sampling since they positioned themselves or were positioned by others as either facilitating or implementing energy sector transformation in Rwanda. Whilst the concentration of interlocutors within Kigali can be interpreted as a function of how the Rwandan energy sector is arranged, the influence of my own positionality upon this is also significant. I was based primarily in Kigali for the research and utilised my networks from my prior career developed as a London-based consultant working across multiple countries. The majority of my interviews took place in offices, cafes, restaurants, hotels or bars In Kigali. Article 2 should therefore not be considered an exhaustive account of everything happening in relation to energy sector transformation in Rwanda. I coded all of the data using the software NVivo using a combination of thematic and narrative analysis, aggregating first into broader codes followed by sub-codes. As differing perspectives regarding the characteristics of transformation began to emerge, I searched for theory to make sense of my observations and I found the STS / sustainability transitions concept of socio-technical imaginaries to be a good fit.

For A3, the primary research methods are semi-structured interviews and observation. The data includes 72 interviews, two focus groups, a workshop and extensive participant observation conducted between April and June 2023, whilst I was based at IPRC Tumba. Interviews were primarily conducted either within the campus of IPRC Tumba (with staff and students), in the communities surrounding Tumba (with local community members, local government officials and industry actors) or in Kigali (with national government officials and industry actors). I then observed actors enact certain interpretative framings through practices, for example during student-teacher interactions in the Student Pitching Session (SPS). This is the article with the greatest attentiveness to lifestyles lived by most Rwandan citizens - i.e. rurally located and engaged in subsistence farming (National Institute of Statistics of Rwanda, 2023). The college is situated in a rural area, and as part of the fieldwork process I spent much of my time walking through the surrounding villages, speaking with local farming communities about their relationship with the college. My co-author on this article is Dr Alexis Muhirwa, Head of Academics and Training at IPRC Tumba with strong networks within the college and its surroundings. We identified research participants by “snowballing” from the college and its surrounding communities, utilising my own networks and those of my co-author Dr Alexis. I thematically coded all of the data using the software NVivo, aggregating first into broader codes followed by sub-codes. As with A2, data collection was guided broadly by the initial set of questions described in Sub-Section 4.1 around places, actors, directions, processes and knowledges associated with innovation and broader transformation. Once I had coded the data I then sought to link my themes to specific literatures. Through this, I found that conceptualisations of space and placemaking from human geography, as well as post-structuralist analyses of subjectivities, helped me to theorise my coded data. Whilst I did not use the language of subjectivities in the other articles, through writing A3 I came to realise that much of what I describe across the other thesis articles pertains to the formation and performance of varied subjectivities. They therefore play an important role in how I conceptualise this thesis as a body of work.

For A4, the primary research methods are semi-structured interviews and thematic analysis. A total of 20 interviews were conducted with 23 individuals representing 12 organisations directly connected to climate finance for technology innovation flowing through CF Investments. All of these interviews were recorded. I met the director of CF Investments during fieldwork for A2, and he helped me to arrange a range of interviews with upstream finance providers and downstream entrepreneurs linked by capital flows to CF Investments, as well as interviews with several of his colleagues. Interlocutors were therefore identified in a different way to my other interview-based articles. Whereas A2 and A3 seek to snowball out in relation to a location in focus (Rwanda and IPRC Tumba, respectively), A4 instead focuses on a chain of actors involved in a specific transnational flow of finance: predominantly from Europe, through CF Investments in Rwanda and out to entrepreneurs in specific African locations innovating for beneficiaries across the continent. I coded the interview data using thematic analysis via NVivo. During coding, I responded to a call from the journal Finance and Space for a special issue on "Green Capital Landing", having noted that the data contained several relevant insights regarding the practices through which downstream actors access climate finance. This subsequently shaped the analysis to foreground how CF Investments and its partners both disburse and land climate finance and led me towards the literatures of economic geography and political ecology to conceptualise my findings.

For A5, the primary research methods are quantitative regression analysis (Figures 4, 5 and 6 of A5), network analysis (Figure 7 of A5), literature review (Section 2 of A5), and qualitative reflexive analysis of possible research processes and configurations implied by the quantitative analysis and based on the analysis and the authors' own experiences (Table 3 and Figure 10 of A5). The bibliometric data we work with includes over 6,000 published academic articles which relate somehow to energy in lower income countries. My involvement was primarily in the literature review and qualitative reflexive analysis described above, including developing Table 3 and Figure 10 of article A5, as well as analysing the quantitative results and framing the academic discussions which the analysis speaks towards. The core quantitative method was chosen prior to my involvement in the article, since two of my co-authors conducted an early version of this quantitative analysis independently. I also discussed some of the implications of our methodological decision to work with quantitative econometric methods and how this erases some of the nuances in the data (e.g. related to author positionality). Noting that I am not an economist by training, it has been a valuable learning experience to connect this kind of econometric research to my own interest in critical theory.

4.5 Intersectional subjectivities and analytical focus in studying transformation

This thesis uses the concept of subjectivities to make sense of the findings across the five articles appended to this thesis around how different actors come to be positioned in relation to transformation. However working with subjectivities requires careful consideration from a methodological standpoint, particularly in cases like my own where this theoretical frame has not guided my PhD from the start but

instead is one I have reached through my research process. Subjectivities of transformation, as with any form of subjectivity, are shaped through multiple, intersecting dimensions of difference, including gender, ethnicity, and race (Butler, 2014; Collins et al., 2021). All of these dimensions may influence how individuals gain access to and are positioned within the flows of knowledge, technology, and capital which I investigate. This sub-section therefore reflects on how these intersections were approached in this research and why I engage more with some than others in this thesis. The aim is not to exclude or devalue other forms of intersectional difference, but to clarify how and why I arrived at my particular analytical focus.

As described above, I designed this research to understand how actors come to participate in processes of innovation and transformation through a spatial lens, and how such participation is enabled or constrained in practice. Across my empirical material, those aspects most consistently cited by my interlocutors were differences in socioeconomic background and physical locatedness; their income level, their educational attainment, where they live and work, their relative ability to move between places and the type of organisations through which they are embedded (or not) in transnational networks. These factors therefore became the main ways in which I analysed participation in transformation and the principal evidence through which I characterise subjectivities.

This does not mean that other dimensions of difference such as gendered, racialised, and ethnicised forms of inequality are absent or irrelevant in shaping access and experience. They were rarely raised explicitly in fieldwork since my research design meant that I did not ask explicit questions about them, although I would argue they are present implicitly in the many discussions I had of spatial relations between locations (for example between Rwanda and European countries). Likewise, they would occasionally surface explicitly, as I discuss in Section 4.6 below. I encountered subjectivities of Whiteness in relation to Blackness, as well as gendered articulations. These accounts factor into my results section below, for example in A2, where some interlocutors described racialised hierarchies in professional settings.

The relatively limited number of explicit references to racialised and ethnicised categories of identity may also reflect the Rwandan context, where these identities are considered highly controversial and avoided in public discussion, in line with official government policy (Purdeková & Mwambari, 2022). More broadly, the 1994 genocide exerts a strong conditioning effect on everything that happens in the country. As Rwandan citizens became my colleagues and friends, I came to understand first-hand how everybody I engaged with had been directly affected by the genocide; whether themselves, their parents, their siblings or their neighbours. It came up regularly in conversation as a milestone in any history of a Rwandan company or institution. My interlocutors also made reference to government initiatives to distribute solar home systems to recognised genocide survivors. On a functional level, I learned to never organise any work-related activities during Kwibuka, the annual genocide commemoration period in April.

All of this then perhaps begs the question as to why the genocide is not foregrounded more explicitly in this thesis, particularly given my interest in subjectivities. This absence is not intended to diminish the significance of this profound societal trauma, which continues to shape social, political and institutional

life in Rwanda in complex and ongoing ways. Rather, it reflects the specific analytical focus of this thesis on how actors engage with and articulate processes of energy-related innovation and transformation in the present. However perhaps more importantly, it reflects the constraints upon my Rwandan interlocutors to speak without consequence about how ethnicised identities in Rwanda continue to shape change. In this sense, the genocide is not treated as an object of direct analysis, although it surfaces occasionally through the stories my interlocutors told and the practices I observed. To centre the genocide explicitly would require a different research design, ethical positioning, and empirical engagement than what I undertake here. Some of my Rwandan interlocutors who I became closer to over time did make reference to ethnicised subjectivities in our discussions of energy-related transformation. However, I choose not to draw upon this as empirical material since they shared these perspectives with me in confidence, noting the sensitivities described above.

Taking a step back to wider gendered, racialised and ethnicised identities, I recognise these as shaping access to the dimensions of education, mobility and economic opportunity which I foreground. I believe they influence the conditions under which individuals enter and move within transnational spaces, even when not directly articulated in the data. My own positionality as a White European male will also have shaped both access to interlocutors and the content of discussions. I treat these dimensions as present but not the primary analytical focus of this study. Nonetheless, I do draw in evidence related to other dimensions of intersectional subjectivity where my data allows it. For example I make several references to the gendered (A3) and class-coded (A4) settings associated with innovation which I engage with.

The following section builds on this framing by outlining the socio-material circumstances of my interlocutors, showing how differences in wealth, employment, mobility, and location shape access to and participation in processes of transformation.

4.6 The circumstances of my interlocutors

"The real Rwanda is outside Kigali"

- Interlocutor for A2

Across the fieldwork for this thesis, I engaged with a wide range of interlocutors living in widely varying circumstances, from farmers I spoke with whilst pounding cassava leaves by hand in Rwanda's Rulindo District to individuals in investment banks in Northern Europe. By circumstances, I refer in particular to how wealth, class position, place of residence, mobility, and organisational embeddedness are experienced differently across my interlocutors. Given my relational onto-epistemological stance, I avoid a hard boundary between social and material circumstances and instead consider them to be socio-material. Whilst I position these circumstances as descriptive context in this sub-section, I subsequently draw upon them in RQ3 as both shaping and being shaped by processes of transformation.

During my fieldwork, many of the more affluent individuals I encountered - particularly in A2 and A4 - had grown up or were primarily based outside Africa, while working towards transformations of the continent. The vast majority of interlocutors in A2 could be described as enjoying very comfortable

material circumstances relative to the wider Rwandan context. All, apart from two university students, were employed by formal organisations framed as contributing to Rwanda's energy transformation. This contrasts sharply with Rwanda's wider labour market, where 82.5% of employment is informal, primarily in smallholder agriculture (NISR, 2023).

Several interlocutors worked for smaller domestic firms and NGOs that reported financial precarity, including difficulties paying staff and, in one case, periods without pay during funding gaps. These organisations were often located outside Kigali's central districts. By contrast, those employed by internationally headquartered organisations gave no indication of financial insecurity and were concentrated in affluent Kigali neighbourhoods such as Kimihurura, Kiyovu and Nyarutarama. Most of those in internationally headquartered organisations arrived in Toyota vehicles, often luxury SUVs such as Land Cruisers, while a smaller number arrived by foot, bus, motorbike or cycle taxi - almost all Rwandan nationals.

In Kigali, many interlocutors formed part of overlapping social and professional networks of expatriate and Rwandan employees of internationally headquartered organisations. These networks converged at events on innovation, energy, and sustainability, as well as in informal social spaces across the city. A common feature among many in these networks - whether Rwandan or foreign-born - was education at globally top-ranked universities, particularly in Europe and the United States. Whilst most fieldwork for A2 took place in Kigali, visits to organisations outside the city and to upstream factories revealed actors (e.g. sales agents, factory workers, and subsistence farming communities) living in more precarious socioeconomic circumstances and with a perceptible separation from the social and professional networks described above.

My fieldwork for A3, for which I was based primarily at IPRC Tumba, contrasted sharply with A2 where I was primarily in Kigali. Most staff arrived at the college each day by foot, motorbike or cycle taxi, or minibus, while only a couple of senior staff owned SUVs. Students travelled almost entirely on foot or bicycle. My own fieldwork conditions also reflected this difference: travel between Kigali and the college involved two hours in a crowded minivan followed by a moto ride or a lengthy uphill walk, and living on site meant no running water or reliable internet. The surrounding communities lived in subsistence farming conditions, generally without grid electricity, though some used solar home systems for lighting and phone charging. I also visited alumni businesses in nearby towns and the outskirts of Kigali, which had broadly similar conditions, albeit with electricity access. A few wealthier farming households using biogas plants developed at IPRC Tumba lived in larger properties with herds of cattle (a significant marker of wealth in Rwanda), as did staff of a nearby tea factory using a solar water heater designed by the college. Overall, however, conditions in A3 contrasted sharply with the rooftop bars and cafés of Kigali encountered in A2. Many staff at IPRC also worked multiple jobs due to financial pressures, a practice both followed and endorsed by the college principal.

My fieldwork for A3 at IPRC Tumba also contrasted with my fieldwork experience for A2 in Kigali in terms of how I encountered relations of nationality, gender and ethnicity. My interlocutors for A2 were extremely diverse across dimensions of ethnicity, gender and nationality, whereas I would describe the vast majority of my respondents for A3 as male and Rwandan. With the notable exception of the college

principal, the head of student affairs and an employee of the business incubation hub, all other staff I engaged with were male. This included all of the staff I spoke with who were themselves working on innovations.

I cannot provide comparable detail regarding the socio-material circumstances of actors related to A1, A4, and A5. A1 and A5 were desk-based analyses of academic literature. Given broader barriers to entry to academia, including those shaped by intersecting forms of inequality (Rojo, 2021; Spiegel, 2025), one might argue that simply participating in academic publishing may indicate relative material and institutional privilege due to the time, resources, and training required to produce publishable work (a constraint observable amongst the staff of IPRC Tumba in A3). However, I am cautious not to overstate this since it risks obscuring variation in authors' circumstances. Likewise, while many of the studies in A1 focus on innovation in contexts of precarity, this does not necessarily reflect the material conditions of their authors.

My fieldwork for A4 was undertaken largely via Zoom, as my interlocutors were based across Europe and Africa. While their material circumstances were not directly observable, I gained the impression that most lived comfortably. Many worked in impact investment in wealthy Northern European countries, while others were based in CF Investments' Kigali office within a newly built innovation hub which I was familiar with through the elite networks I encountered in A2. My initial contact with CF Investments arose through its Africa director, whom I met at a social event in Kigali during fieldwork for A2. This overlap between the networks I engaged with in A2 and A4 was reinforced when I later visited their Kigali office to present findings from a report I prepared for CF Investments (see methodology section of A4 for further detail). The downstream investees receiving capital from CF Investments that I interviewed were spread across Sub-Saharan Africa but generally described themselves as materially comfortable and internationally connected, often referencing education at elite private schools or university studies in Europe or North America. Exceptions included one newly joined accelerator participant who was experiencing financial precarity, and an advisor to CF Investments who subsequently criticised their Kigali office in our interview.

In summary, my fieldwork took place across highly unequal circumstances. A2 and A4 primarily involved actors with high levels of mobility, educational attainment, organisational embedding in international institutions, and relatively comfortable material circumstances, alongside diversity of nationality, gender identity and ethnicity. A3 involved a comparatively lower diversity of nationality, gender identity and ethnicity alongside lower levels of material wealth, despite some variance between staff, students, and surrounding communities. While the circumstances of authors in A1 and A5 cannot be directly assessed, it is plausible that many occupy relatively privileged positions compared to the populations they study. To some extent these unequal circumstances are a product of my research design. Through my prior career, I had participated in and observed a transnational network of academics and practitioners working towards innovation and transformation, including what I perceived as a node of this network within Kigali. I wanted to study these networks (as I did in A2 and A4) but also look beyond them in order to observe contrasts. This led me to shape my field for A3 as

focused on a site which, whilst similarly focused upon innovation and transformation , was perceptibly distinct from these networks.

4.7 Reflections on positionality

"Given how zealous our decolonisers are when it comes to freeing the colonised from the continuing stranglehold of colonial hangovers, there is some irony in the fact that they may be guilty of condescension towards the colonised, refusing to take seriously the choices that some colonised make when exercising their subjectivity and the autonomy that comes with it."

- Táíwò, 2022

I have made repeated reference to positionality throughout this thesis, both as a methodological consideration and as a constitutive element of the knowledge production I engage in and analyse. In this sub-section, I reflect on how my positionality has shaped this thesis, and how my practice of reflexivity has evolved over time. Since the beginning of the PhD, I have maintained a diary (2020-2025; 28 entries) through which I have tracked these reflections. Read retrospectively, this diary functions less as a personal record than as a longitudinal dataset of my shifting epistemic positions, charting how I have engaged with ideas of and concerns about innovation, coloniality, and academic legitimacy. It documents my gradual recognition that positionality is not fixed or singular, but multiple and continuously reconfigured through practice (Soedirgo & Glas, 2023).

The reflections below draw on an auto-ethnographic synthesis of these diary entries. Rather than presenting a chronological account, I organise them under a series of themes to foreground the impact which my positionality has had upon this PhD thesis. I believe the quote by Táíwò (2022) above directly speaks to a core tension I have experienced through this PhD which I narrate below, around what it means as a citizen of a post-imperial nation to attempt research practice related to Africa which is cognisant of epistemic coloniality.

Positionality as situated identity

My engagement with reflexivity began as early concerns in my PhD journey, shaped by my prior experiences, that my positionality as a White British man might reproduce epistemic coloniality through unequal relations of academic knowledge production (Mignolo, 2009; Marchais et al., 2020; Rutazibwa, 2014). These concerns have been ever-present throughout the production of this PhD, although my understanding of and relationship with them have changed over time. Whilst I now recognise that positionality extends to much more than the identity one presents and the historical situatedness of this, my British identity has continually shaped how my interlocutors have engaged with me across this thesis. My interlocutors have almost always been aware of Britain's imperial history and have responded to this in different ways. Among my Rwandan interlocutors in particular, this has frequently manifested as a positive regard for Britain's colonial legacy and its contemporary global standing, particularly the

prestige of its academic institutions. I have experienced this as both enabling and uncomfortable, given how I benefit from this.

Likewise, my presented identity as a cisgender male has shaped my encounters. Most notably, in my fieldwork in Rwanda for both A2 and A3 I have built relationships with many of my male interlocutors through conversations which have perceptibly engaged masculine and heterosexual norms ascribing gendered roles for men and women. For example, over dinner, I would frequently encounter discussion of how men typically did not learn to cook in Rwandan culture and thus the importance of finding a female partner. My interlocutors would often find my position as an at-the-time unmarried and childless man intriguing and would ask why I had not yet married my partner Dalia. My maleness enabled me to access these conversations and build rapport through them (at least to the extent that I participated in them). Nonetheless, these gendered relations likely impeded my ability to build equivalent forms of trust with others. I do not suggest that such dynamics were uniform across all of my interlocutors; the majority of my exchanges did not cite these explicitly gendered norms. However, my positionality as a male researcher likely shaped the terms on which interaction was possible in ways that were not always visible to me. This may have influenced what was considered appropriate to share, the depth or direction of conversations, or the degree of familiarity that could be established over time, meaning that my access to certain perspectives was likely only partial. As such, while I was able to build meaningful relationships across a range of interlocutors, my gendered positionality inevitably structured both the opportunities and limits of my fieldwork in ways that I could not fully perceive or account for.

Whiteness also forms a central part of my identity as a researcher. My Whiteness became acutely perceptible to me in my fieldwork through my encountering of the term “Mzungu”, a Swahili word meaning “White person” or “foreigner” across East Africa (Kelly, 2019; Bunyan, 2021). I would commonly hear the term called out to me as I walked down the street, particularly in rural areas. I also heard a couple of my Rwandan interlocutors use the term, although they used it to refer to foreigners more generally rather than myself specifically. When I raised it in conversation with others, two of my Rwandan colleagues at the innovation hub at UR confirmed that Mzungu acts as a lens through which many Rwandans interpret people who do not appear to them to be of African heritage, even if they preferred not to use the term and considered it somewhat offensive. There is a clear racialised White/Black divide which shapes how people are engaged with in Rwanda, with Whiteness connoting one’s identity as a “foreigner”. As one of my interlocutors for A2 memorably explained in the context of advocating for their preferred solar technology of minigrids, smaller capacity solar home systems “are a White person's solution that they deem acceptable for Africans”.

Whiteness also strongly signals privilege. My Rwandan interlocutors would often assume I would expect or even demand a somewhat luxurious standard of living. I often had to insist that I was comfortable with accompanying my interlocutors in their own transport to field sites or staying in the staff accommodation at IPRC Tumba. Related to this, one particular exchange which struck me was with a Rwandan business owner I interviewed for A2. My interlocutor was shocked when I explained how in the UK, line workers (i.e. those responsible for maintaining electricity infrastructure, particularly

powerlines) were often White, which developed into a wider discussion of how many White people in the UK lived in conditions of poverty and held down comparatively low paid jobs or were even out of work; something my interlocutors found scarcely believable. These experiences indicate that in my fieldwork, my Whiteness (and that of others) acts as a racialised norm conveying privilege and material advantage (Busumtwi-Sam & Kashyap, 2025; Hermanussen, 2026).

More broadly, these encounters make clear that these different dimensions of my positionality are historically situated and have been actively interpreted by my interlocutors. My identity functioned as a signal, shaping expectations about my own preferences, interests, expertise, authority, and role within research encounters.

Positionality as shaping research design and epistemic expectations

My positionality has shaped the research design itself. Early in the PhD, I sought to orient the project towards decolonial agendas emphasising non-extractive academic co-production (Marchais et al., 2020), informed by debates on epistemic privilege and intersectional inequality (Collins, 2017; Hopkins et al., 2020). However, these ambitions encountered structural constraints of doing doctoral research, including limits of time, institutional positioning and the networks accessible to me. I therefore reoriented the project towards transnational actor networks connected to Rwanda, rather than the local end-user focus I had initially envisioned. This shift was pragmatic, but it also reflected how the research became shaped by the relationships available to me, rather than those I might have ideally sought to build.

A related tension emerged during early literature work (A1, A5), where I attempted to foreground African scholarship on innovation. I found that much of this literature mobilised frameworks structurally similar to those dominant in Euro-American innovation studies. This challenged my assumption that engaging geographically diverse sources would necessarily expose me to epistemic difference. In retrospect, this reflects how I initially assumed literature of diverse geographic provenance would naturally lead to diverse theory and ideas. These experiences highlight how my positionality operated ahead of my fieldwork, shaping not only interactions with my interlocutors but also the kinds of questions I asked, the materials I engaged with, and the assumptions I brought into the research process.

Positionality as enacted through research encounters

During fieldwork (from late 2021 onwards), my positionality became most visible through my interactions with my interlocutors. In Kigali, my participation in advisory work at the University of Rwanda's Grid Innovation and Incubation Hub placed me within institutional settings where innovation was predominantly articulated through commercialisation and investment logics. While I initially sought to open space for alternative framings of innovation, I often found it difficult to articulate these in ways that resonated with my interlocutors. Under the practical pressures of delivering the

University of Rwanda's inaugural Innovation Week, I reverted to a familiar "consultant" position - acting as an analyst, organiser, and facilitator in ways I sensed my interlocutors expected. Rather than challenging dominant framings, I found myself supporting them, in part because this aligned with the priorities of my interlocutors.

More broadly, my identity as a European researcher frequently led my interlocutors to position me as a holder of technical expertise. Many of my interlocutors sought guidance on technologies, funding, or innovation processes, and several invited me to participate in consultancy work, training sessions, or proposal development. These expectations actively structured the research process. I was not only observing processes of transformation but also being drawn into performing them. These dynamics became particularly visible during my fieldwork at IPRC Tumba (A3), where my interlocutors invited me to deliver training on technological innovation processes despite my limited expertise in the specific areas they were interested in.

Positionality as shifting subject positions

Over time, I began to theorise positionality less as a fixed identity and more as a shifting configuration of subject positions. This shift was particularly shaped by my engagement with research ethics training in 2022. I came to recognise that I moved between different subject positions depending on context and how my interlocutors positioned me (Soedirgo & Glas, 2020). At times, I performed a universalist subject position aligned with technical expertise and solution-oriented innovation; at other times, I attempted to engage more situationally embedded framings emphasising context and relationality. These shifts were not always deliberate but rather emerged through interaction. This dynamic extended beyond fieldwork into dissemination. For example, during a public media interview in Kigali in 2024, I found myself positioned as a high-tech innovation expert despite attempting to position my own specialism as distinct from, or even critical of, this kind of knowledge. In that moment, I nonetheless found myself responding within that framing, even as I felt the inappropriateness of it. Such moments illustrate how subject positions are not only negotiated in specific interactions but also reasserted through broader institutional and discursive settings.

Across the PhD, my approach to reflexivity thus shifted significantly. Early diary entries often framed positionality as a problem to be resolved, particularly in relation to concerns about extractive research practices:

"I am now starting to plan my first trip to Rwanda… I cannot shake the sense that I am ultimately still part of this problem. That I am asking for significant time and investment from others, into research which ultimately is likely to benefit me more."

- Diary entry, September 2021

Over time, I have moved towards understanding positionality not as something to be corrected, but as an analytic condition of research. This has involved moving away from binary framings (e.g. Western/non-Western, internal/external knowledge), and towards recognising how such distinctions

are continuously produced through practice. It has also involved shifting from treating coloniality as something to be identified and avoided, towards analysing how it is enacted, negotiated, and sometimes reproduced through my interactions with my interlocutors. My positionality shapes both what I am able to see, what benefits and constrains me and how others respond to me. Working from a European institutional context has enabled me to access particular networks and be granted authority in certain conversations related to the processes of innovation that I set out to study. At the same time, it has limited the kinds of relationships I have been able to build, the perspectives I could access, and the ways my work is interpreted by my interlocutors. My research is therefore unavoidably partial and situated. It reflects the spaces I could enter, the positions I was invited or compelled to inhabit and the forms of knowledge my interlocutors were willing to share with me. Recognising this does not resolve these tensions, but it allows me to be clearer about what this thesis can and cannot claim.

4.8 Research ethics

I conclude this methodology section with this sub-section briefly describing the research ethics I have upheld. I received informed consent from all my interlocutors prior to their involvement as research participants. For studies A2 and A3, consent was primarily secured via email or WhatsApp message, ensuring that participants were provided with clear information about the purpose of the research, their role, how and what data would be stored and used and their rights before agreeing to take part. For study A4, which was conducted via Zoom, written consent was obtained in advance through PDF letters distributed to participants.

In some cases within studies A2 and A3, where interaction occurred with individuals who had not been previously engaged (e.g. actors I encountered through my walking through neighbourhoods), verbal consent was obtained at the point of contact, following a clear explanation of the same points described above and confirmation of their willingness to participate. Likewise, I occasionally sought verbal consent when in conversation with somebody in a more informal setting (for example somebody with whom I previously held a more formal interview) if we strayed into topics highly relevant to my own research. However more typically I would seek to avoid this being necessary by making clear in our first interaction my position as a researcher; and that our subsequent interactions, unless specified otherwise, could be understood as potentially contributing data which I might draw upon subsequently, whilst abiding by our agreed terms of their involvement. In line with the Chalmers University of Technology policy on personal data processing (Chalmers University, 2025), all participation was voluntary, based on informed consent and participants were explicitly informed of their right to withdraw at any stage without consequence, as well as how their data would be used, stored, and reported in anonymised form. As described above, there are certain parts of my engagements with my interlocutors which I have left out of my analysis due to the sensitive and confidential nature of the perspectives shared.

All data has been handled in accordance with confidentiality and data protection requirements. Personal identifiers were removed through a coding system to anonymise respondents, ensuring that

no individual could be directly or indirectly identified, reflecting the principle of data minimisation and purpose limitation. The anonymised dataset has been stored on a secure, university-managed drive with restricted access, supported by appropriate technical and organisational safeguards such as access control and secure storage environments (Chalmers University, 2025). Consistent with Chalmers policy and General Data Protection Regulation (GDPR) principles, only data necessary for the research purpose were collected, retained only for as long as required, and protected against unauthorised access or disclosure.

I also made sure to have the necessary approvals required for the research. A key aspect of this was obtaining a research permit from Rwanda's National Council for Science and Technology. I was first awarded my research permit in 2021 (applicant number RP00000460) and extended my permit each year I conducted fieldwork in Rwanda through to 2024. The permit required me to include a description of my research plans, methodologies (including ethics for data collection) and also gain institutional support from a local university - in my case, the Africa Centre of Excellence in Renewable Energy and Sustainable Development, part of the University of Rwanda.

5 Results by article

This section describes the results produced by each of the articles appended to this thesis. I briefly summarise the research aim, theoretical framing and results of each article.

5.1 Results of A1

In A1 my co-authors and I aim to examine how innovation is framed within academic literature focused on energy by turning the analytical lens toward the knowledge-making process of scholarship. More specifically, we investigate the ways in which innovation is framed differently, with a particular focus on framings which either seek to apply innovation as a concept upon Africa (i.e. by scholars based at institutions elsewhere), or which is used by scholars based in Africa. By addressing the lack of critical interrogation regarding what innovation connotes in scholarship on sustainability transitions, we show how academic knowledge related to innovation shapes the actors, places and directions associated with transformations which come to be broadly viewed as legitimate.

Theoretically, we apply an STS lens to show how knowledge is always situated, even if modernist tendencies to separate knowledge from the locations they have been produced can make this situatedness difficult to recognise (Haraway, 1988). This leads to a focus upon the places each article claims relevance to and how this potentially relates to the institutions or disciplines within which the authors are located, for example investigating the geographic and theoretical situatedness of scholars claiming general geographic relevance. More broadly the grounding of this work in STS points towards the hierarchies encoded within innovation knowledges.

The results demonstrate how literature varies significantly in terms of how it engages with different potential characteristics of innovation. Most notably, there is a perceptible dominant current within the sample of articles whose scope and theoretical grounding lead them to take key characteristics of innovation for granted. This includes that it is firms who practice innovation, that innovation leads primarily to positive outcomes like economic growth or emissions reductions, that innovation mainly happens in higher income countries, and that what happens in higher income countries can also be generalised to other locations (i.e. that innovation can be theorised globally using data from Europe and the USA). These articles may not explicitly specify that these are the only actors, places or outcomes associated with innovation. However taken together, these articles implicitly stabilise a certain understanding of innovation. This assumed-archetypal innovation framing haunts the remainder of the thesis articles to varying degrees; in particular its spatial conflation of those places understood to typically practise innovation and produce innovation-related knowledge with those places which possess or can easily access capital and technologies considered to be frontier through globalised financial markets or neoliberal development logics.

Nonetheless, the sample also includes articles which do not fit the above trend, instead critiquing the assumptions made by the assumed-archetypal understanding of innovation described above. This framing process of bringing certain aspects into the foreground is also evident within this critical

literature, but this literature instead focuses on marginalised actors and locations such as indigenous peoples, as well as alternative outcomes (including those which may be undesirable) such as widening socioeconomic inequalities resulting from innovation. Whilst these alternative critical literatures are notably heterogeneous in what they associate innovation with, they much more commonly caveat the geographic relevance of their conclusions than in the assumed-archetypal understanding described above.

5.2 Results of A2

In A2 my co-authors and I seek to investigate the characteristics of energy sector transformation envisioned by the geographically disparate group of actors who position themselves as facilitating or implementing this change in Rwanda, with particular focus on how these imaginaries approach agency, location, temporality and directionality. My co-authors and I use the Rwandan Government's at-the-time urgent 2024 energy sector targets as a starting point from which to characterise imaginaries associated with delivering this change.

From a theoretical perspective, A2 is positioned between STS, sustainability transitions and human geography with a particular focus on the concept of socio-technical imaginaries as collectively stabilised visions pertaining to the role of science and technology in society (Jasanoff & Kim, 2015). I bridge STS with geography through a particular focus on how imaginaries arrange locations and construct scale within space, and with sustainability transitions through a focus on imaginaries specifically associated with energy transformation. I also seek to explore how competing imaginaries are stabilised, and the implications of this in terms of which actors are seen to drive processes of change.

The results identify two contrasting imaginaries for transforming Rwanda's electricity and cooking systems, each implying different actors, timelines, and geographies of change. Both are stabilised to some extent through their association with the Rwandan Government's targets, but they provide alternative pathways forwards and place differing emphasis on the importance of achieving them. The first imaginary promotes an urgent, import-led pathway dominated by transnational private actors, stabilising their legitimacy while positioning Rwandan users as largely passive recipients of externally developed technologies. This pathway's explicit motivation by government timelines prioritises speed and feasibility but reproduces dependencies and sidelines more situationally embedded activities. The second imaginary advances a slower, domestically co-produced pathway, collectively held by local firms, NGOs, and research institutions. Achievement of the government's target is a strong aspiration but less of an imperative above all else. It repositions these domestic actors as central drivers of energy transformation and aligns more with national ambitions for an innovation-led knowledge economy and home-grown solutions than with rapid sectoral change. Across the two imaginaries, the core finding is that collectively held imaginaries of change are stabilised to varying extents, with the first imaginary closer to material enactment and consequently shaping legitimacy and ability to access resources to drive change. Most notably, the first imaginary is enacted through the pre-eminent role played by transnational private sector actors in the dissemination of energy technologies to support sectoral

transformation, facilitated by finance provided by multilateral institutions like the World Bank which appears to favour larger and more established organisations.

5.3 Results of A3

In A3 my co-authors and I aim to analyse places within Africa understood to be engaged with innovation. We investigate whom, what or where actors in these places situate themselves in relation to, for example, the people or places they aspire towards. Furthermore, we look at the extent to which this reputation of innovativeness is broadly shared or contested. We investigate this using the case of IPRC Tumba, a technical college in rural Rwanda understood to be innovative by several interlocutors from A2. Like A4, described below, this article is interested in what is materially produced by framings of innovation which foreground certain locations and scales. However in A3, we are interested in a specific location and how different actors constitute its relations to other places, whereas in A4 I trace different actors along a flow of finance which spans continents.

Theoretically grounded in human geography, A3 applies a post-structuralist feminist lens to critically interrogate how different actors discursively frame the college in relation to other actors, places, scales, knowledges and temporalities. My co-authors and I investigate how actors become subjects of innovation by engaging with the concept in different ways, such as those actors who aspire towards being innovators who scale technologies across countries. In particular, I investigate how different subject positions are accessed through the citing of contrasting knowledge formations, with a particular interest in the tension between universalist knowledge formations which point towards globally-relevant technology frontiers and scaling alongside more locally situated alternatives.

The results demonstrate how a range of innovation subjectivities are claimed through divergent aspirations and perceptions of what actually happens at the college, as well as material practices such as teaching or technological experimentation. For those subjects who prioritise innovation knowledges rooted in Europe, North America or China, aspirations of what innovation could or should involve lead them to dismiss what happens at the college as imitation or failure. We argue that performance of these subjectivities, themselves stabilised by material circumstances such as performance contracts mandating technological innovation, may perpetuate observed disconnects with the communities surrounding the college (perceived as traditional) and pressures to focus on academic research for publication over tackling locally relevant issues. Nonetheless, as with A1 and A2, actors also claim alternative subjectivities through asserting that what happens at the college is legitimate innovation, producing alternative and situationally embedded criteria for what counts as success.

5.4 Results of A4

In A4 my research aim is to analyse how upstream climate finance is disbursed to downstream entrepreneurs across Africa working with "climate technologies" through CF Investments, an intermediary investment company that takes an equity stake in these startups. I seek to trace how the actors involved in this upstream-downstream flow of finance co-produce and navigate this form of venture capital climate finance and what is engendered by this aside from hoped-for impacts of profitable entrepreneurial ventures alongside climate change mitigation and adaptation.

A4 is theoretically positioned in the literature on economic geography with a particular focus on the role of finance flows in connecting places together and the futures produced by finance (Bryant & Webber, 2024). In particular, I am interested in how the expectations and assumptions embedded in upstream finance flows about what innovation of climate technologies involves, condition the practices of downstream actors (Ducastel & Van Veelen, 2026). I also draw on perspectives from political ecology and political economy to explore how sustainability-oriented transformation initiatives administered through incumbent economic and financial systems produce uneven benefits and costs (Franz & McNelly, 2024; Archer, 2024; Tarvainen, 2022).

The results demonstrate how CF Investments sit at the heart of a financial value chain and spatial configuration which is constituted by various actors within the organisation and upstream as a progressive step beyond typical financing configurations considered extractive and colonialist. This concern about context insensitivity and external value extraction shared by those upstream in the financial flow (mostly in Europe) constitutes what downstream actors do to land capital (mostly in Africa). I characterise a series of capital landing techniques deployed by these downstream actors. These are asserting legitimacy in both "local" contexts and global professional networks, using digital technologies which align with global trends and investor preferences, and locating activities in places which fit with venture capital demands for acceleration and scale up. I argue that these techniques may help to reallocate capital towards Africa to be accessed by entrepreneurs based within the continent (delivering on the aspiration described above). However I also assert that these upstream expectations concentrate innovation in certain African "hub" locations which excludes actors who lack the flexibility, capital and other privileges to access these places; as well as limiting possibilities for innovation to those which align with venture capital expectations for scale up. More specifically, the majority of locations on the continent come to be passive recipients of innovation by continent-spanning innovators who are nonetheless perceived as locally embedded by faraway investors.

5.5 Results of A5

A5 aims to analyse geographic patterns of academic knowledge production on energy policy in lower income countries. This responds to critiques that the situatedness of knowledge production is often obscured and that scholarship originating in higher income countries circulates more widely within mainstream academic networks (Backhouse et al., 2021; Müller et al., 2025). The article builds on A1's concern with the onto-epistemological situatedness of knowledge and A3's attention to aspirations

towards academic production. However rather than examining conceptual framings within a selection of literature, A5 takes a less granular view. We use article metadata to ask which places host and fund research on lower income countries that is recognised as legitimate within global academic discourse, as proxied by citations in ranked journals.

Theoretically, A5 is situated within economic geography and STS, treating geographic inequalities in academia not as background conditions but as actively constitutive of visibility and recognition. Academic knowledge production is conceptualised as a situated and power-laden process rather than neutral evidence. The article draws upon econometric methods to evidence this. The results demonstrate persistent geographic imbalances. Articles prescribing energy policy for lower income countries disproportionately originate from and are funded by institutions in higher income countries, and citation counts correlate with the GDP of the author's country.

While I consider this central finding to be robust, I wish to introduce two caveats and emphasise an aspect of the results for the purposes of this thesis. The first caveat is that the article demonstrates correlation rather than causation. Framed in the context of this thesis, GDP is a blunt explanatory tool. The observed association likely reflects complex processes including colonial histories, linguistic dominance, geopolitical positioning, and uneven integration into academic networks (Müller et al., 2025) more than simply how wealthy a country hosting research is. The article evidences an outcome of these processes - differential recognition in research practice and funding - rather than explaining their underlying mechanisms. This is why this article concludes the thesis as an example of the socio-material effects of how space configures positions in transformation. In this respect, the other articles in the thesis more directly interrogate the subjectivities and practices associated with these configurations. The preceding four articles shed light on some of the mechanisms which likely sustain the unbalanced landscape of academic networks characterised in A5, most notably subjectivities of transformation which valorise technologies and knowledges originating from outside the continent of Africa.

The second caveat is that I distance myself from the prescriptive claims directed at lower income country governments at the article's conclusion, noting that my co-authors self-identify as citizens of the Global South and write from this positionality. I support calls to legitimise more locally embedded and plural knowledges. Nonetheless, I do not position this article within my own thesis as a basis for prescribing what such governments ought to do.

Finally, I would like to draw attention to specific aspects of the results which demonstrate how material locatedness produces subjects, at the same time as subjects produce locations and scales in space. The "Africa dummy" in the regression analysis shows that research produced from Africa is cited less than research from other locations, even after controlling for GDP and journal quality. Conversely, research based in China is cited more than GDP alone would predict. Furthermore, journal ranking (SNIP) is a stronger predictor of citations than GDP, reinforcing concerns about gatekeeping effects associated with elite journals concentrated in Europe and North America (Müller et al., 2025). These findings are central to the thesis' argument about the uneven constitution of legitimate academic knowledge. Many other factors undoubtedly play a role in this. Nonetheless, I would argue that where in the world actors

are located plays a critical role in shaping how easy or difficult it is for them to legitimately position themselves as producers of transformation-relevant knowledge within mainstream academic networks.

6 Results by research question

The following sections address each research question in turn. RQ1 (Sections 6.1.1 and 6.1.2) is primarily exploratory, synthesising perspectives across the articles to examine how different actors envision innovation and broader processes of transformation. In doing so, I identify a series of interpretative frameworks through which actors make sense of transformation and allocate legitimacy. These frameworks form the conceptual foundation for the subsequent analysis.

Building on the framings described in answer to RQ1, RQ2 and RQ3 develop a more analytical focus by extending beyond the arguments advanced in the individual articles and introducing a material lens. In addressing RQ2 (Section 6.2), I combine the interpretative frameworks identified in RQ1 with Massey's concept of power geometries to examine how positions for actors and locations are constituted through processes of transformation. RQ3 (Section 6.3) then draws on the post-structuralist concept of subjectivities (Holloway et al., 2019) to explore how actors come to engage with transformation, while also building on the interpretative frameworks and power geometries developed in the preceding sections.

6.1 How actors make sense of energy-related innovation and transformation differently (RQ1)

Across the articles appended to this thesis, actors advance differing claims about what constitutes legitimate energy-related innovation and transformation. These claims relate to the practices, processes, actors and locations involved, as well as the temporalities, scales of change and future pathways engendered. As actors make sense of processes of transformation, they interpretatively frame some of these elements in the foreground, while others are simultaneously backgrounded. In this sub-section, I break down how actors make sense of innovation and transformation into two sequential parts. I first describe the dimensions by which actors frame energy-related transformation differently, which I have encountered across the articles of this thesis. I then draw these different dimensions together into a series of interpretative frameworks which offer contrasting sensemaking systems for actors engaging in transformation, bringing different kinds of actors into the foreground.

6.1.1 Dimensions of variation in how actors make sense of transformation

Foregrounded practices and processes

Across the five articles, a range of practices and processes are framed as central to desirable energy-related transformations. Three broad categories recurrently emerge which relate to transformations to innovation and technology differently. These are those processes and practices which 1) directly constitute technological innovation; 2) which support technological innovation and the roll-out of

innovative technologies; and 3) which are enabled by innovative technologies. The precise practices and processes which fall into these categories vary enormously across the articles. For the first category, this includes for example the development and scaling of technologies for cooking and powering electrical devices discussed in A1, A2, A3 and A4. For the second category, this includes the preparation and roll-out of policy and financing which supports technology development and scaling, such as Rwanda's Cooking Energy Business Growth Fund (CEBGF) discussed in A2. For the third category, this includes practices and processes typically understood as "benefits" from using technologies, including those discussed in A2 and A3 such as cooking with less polluting fuels or technologies or reading at night using electric lighting.

I do not consider these three categories of practices and processes to describe how reality is structured, noting their strongly technocentric orientation and passing resemblance to largely refuted linear models of innovation (Godin, 2006; Grubb et al., 2021). Rather, I introduce them as recurrent discursive arrangements engaged by different actors who see technological innovation as central to desirable transformations. For example in the case of CEBGF described above, the development of this financing mechanism could itself be understood as an innovation. However, in my empirical material for A2, my interlocutors instead framed this financial mechanism as supporting innovation related to cooking technologies, which they saw as critical for transformation. Whilst in practice the boundaries between these three categories are blurry and contentious, they are often framed in my empirical material as disaggregated, sequential and hierarchical. There is a relational hierarchy between each set of practices and processes which points to the undertaking of technological innovation as being particularly critical to transformation (above supporting innovation or using innovative technologies). However there is also an implicit hierarchy between processes and practices understood to fit these three categories and those which do not, which are consequently placed in the background. Whilst this backgrounding effect typically goes unacknowledged, some of the articles in the literature sample in A1 notably react against what they view as an excessive focus upon practices and processes recognised as innovation in relation to wider transformations. Overlooked alternatives which they point towards include ceasing damaging practices and processes; or practices and processes which care for, maintain or repair.

Foregrounded actors and knowledge systems

Across the articles, a range of different kinds of actor and associated knowledge systems are framed as central to innovation and transformation. Mirroring the demarcated categories of practices and processes described above, across A1-A4 innovation is often framed as being supported by one set of actors, undertaken by another, and subsequently delivered to a third set of beneficiaries. This implies that the capacity to shape pathways of transformation lies primarily with those actors understood to undertake or support innovation. Whilst myriad groups of actors are brought into frame across the thesis in vastly different ways, the groups which are most commonly framed as being involved somehow in innovation and transformation are the private sector, communities, staff and students of academic institutions, finance providers and government.

These groups of actors often span multiple practices and processes related to transformation, moving between supporting, practising and benefiting from innovation. Nonetheless, across these divergent framings there remains a recurrent association in A1, A2, A3 and A4 between innovation and formally structured firms and institutions, despite the fact that the majority of economic activity in Rwanda is regarded as "informal" (NISR, 2023). This foregrounds market-based logics of scalability and business viability, while marginalising the informal economy as a site where innovation might be practiced and transformation engendered, despite its recognised potential (Kaplinsky & Kraemer-Mbula, 2020).

Foregrounded locations

The kinds of actors which are discursively associated with transformation are closely tied to assumptions about where innovation occurs. The emphasis on formal private firms as innovators, alongside elite academic institutions as supporters and co-producers, leads many actors to associate innovation with locations characterised by strong business environments, technical expertise, and access to finance. As one interlocutor in A4 explains, it makes sense to undertake innovation in places "where you don't face a headache starting a business… with expertise that you can access and a lot of funding already crowded in." This is typically interpreted to mean capital cities such as Kigali, Lagos, Johannesburg, and Nairobi (A2-A4), as well as higher-income countries outside Africa. For example across A2, the first imaginary emphasising external technology adoption introduces a rural-urban divide through the association of Kigali with the actors and technologies understood to drive transformation, with the rest of the country framed as adopters. Certain locations and not others come to be associated with the knowledge and capacities required to practice innovation and engender transformation.

At the same time, alternative framings exist. In A1, scholars analyse innovation emerging from concerns rooted within communities, including informal settlements or gendered spaces such as kitchens, explicitly recognising these as marginal perspectives relative to where innovation is typically located. In A2, the second socio-technical imaginary emphasises technological change emanating from rural settings in Rwanda. In A3, some actors similarly frame innovation as emerging from engagement with surrounding communities. A further group of actors resists associating innovation with any particular location, framing innovation as potentially arising in diverse contexts depending on the issue at hand. As one interlocutor in A4 put it, "Only a fool should lock their mind to a locality."

Foregrounded temporalities, scale and future pathways

"If you invest in an entrepreneurial idea, if that idea succeeds, it's solving a social problem on the [African] continent, it's enabling access to jobs, it's potentially improving economic performance for that country"

- Interlocutor from A4

Across the articles, innovation is frequently associated with urgent, scalable and future-oriented transformation. In A2, desired temporalities are shaped by government targets for energy access by 2024, linked to aspirations to improve living standards and economic competitiveness in Rwanda (MINECOFIN, 2015). Across A2, A3 and A4, these aspirations towards more socioeconomically prosperous futures are not only articulated through policy agendas, but also by many interlocutors themselves. In A2 and A4, this urgency is reinforced by global sustainability agendas advocating rapid deployment of low-carbon technologies, alongside concerns embedded in carbon and climate finance regarding both carbon-intensive development and vulnerability to climate change. One interlocutor in A2 described being "hopeful about the general increase in urgency among populations across the globe for low carbon solutions", which they believed would facilitate their access to carbon finance in Rwanda.

Across A2-A4, rapid transformation is commonly linked to private sector innovation, business scalability and digital technologies such as IoT and AI. In A4, innovation is framed as helping the African continent both mitigate and adapt to climate change, while also aligning with expectations of financial return associated with global capital. Similarly, one interlocutor in A2 described his company as "a little bit neoliberal and we'd rather just economically outcompete [our rivals]." These framings associate desirable innovation with rapid, market-competitive scale-up and reinforce associations between innovation and those locations where advanced technological knowledge is perceived to reside. This is especially evident in A3 and A4, where innovation is repeatedly associated with explicitly modernist futures which emphasise IoT and AI.

However, A1, A2 and A3 also contain alternative framings which emphasise slower and more participatory pathways of transformation. In A2, this includes close collaboration with Rwandan agricultural communities, while in A3 some IPRC Tumba staff describe spending time embedded in communities discussing ideas and seeing where they would lead. Other staff, however, argue there is insufficient time for such engagement, reflecting additional temporal pressures associated with constrained innovation environments. Across these divergent framings, actors understood to catalyse transformation are often positioned separately from those expected to benefit from it. Nonetheless, alternative temporalities and scales open up different positions for communities and different locations associated with innovation.

6.1.2 Spatial interpretative frameworks through which actors make sense of transformation

The preceding sub-section raises a question: given the heterogeneity of transformation framings, how do the actors I encounter in this thesis actually make sense of valid innovation and desirable transformation? Drawing on the post-structuralist concept of discursive constitution (Foucault, 1982), this question can be approached by examining which framings recur and thereby stabilise particular ideas, assumptions, practices, and evaluative criteria. I describe these stabilised recurrent framings as interpretative frameworks. When actors articulate or enact what counts as innovation - for example, CF Investments financing innovation as a high-tech, resource-intensive process - they do so through such

frameworks. In turn, they both draw upon and reproduce them, rendering their actions intelligible while further stabilising the frameworks themselves.

Across the articles, I infer three sets of spatial interpretative frameworks which are at least partially stabilised across actors and actants. These frameworks attribute value and establish legitimacy differently, providing alternative starting points from which the same actor, location, or event can be understood as relating to transformation in divergent ways (or even be considered irrelevant).

Although these frameworks draw on all the dimensions outlined in the preceding sub-section, I describe them as spatial frameworks because spatial assumptions relate to each dimension, extending beyond the locations where transformation is understood to occur. Practices, processes, actors, knowledges, and imagined futures are all spatially coded in how transformation is understood. This includes for example assumptions about the locations where actors considered useful reside and where knowledge is produced, as well as the places associated with transformation pathways which are understood to act as models for other places to follow. Together, they constitute sensemaking systems that underpin the power geometries and subjectivities discussed in the following sections.

I refer to each set of spatial interpretative frameworks in the plural to emphasise that each set is not a unified structure governed by consistent rules. Rather, they comprise diverse situated articulations that nonetheless exhibit recurring patterns. Below, I outline three sets of spatial interpretative frameworks encountered across the articles, each offering different ways of making sense of transformation. As discussed in Section 2.6 on varieties of modernity, none exist outside modernist logics, and all entail means through which hierarchies of legitimacy are produced. However, they engage modernist logics differently. Universalist frameworks are oriented towards a singular frontier against which legitimate innovation is evaluated, whereas the other two diffuse how legitimacy is assessed across locations and situations.

Universalist interpretative frameworks

"All sectors [in Africa] I would say, are dependent on and driven by technology and innovation. If you look at this modern world that we're living in, where AI is dominating every aspect of our lives, there's no way you cannot have technology driving every sectoral development, unless you don't want to develop with the other parts of the world."

- Interlocutor from A4

Universalist interpretative frameworks are constituted across Articles 1-4. Actors drawing on these frameworks frame desirable transformation as driven primarily by private sector-led technological innovation that scales across nations or continents. Innovation is understood in relation to a universal technological frontier against which claims to innovativeness are assessed. Across A2-A4, actors frequently associate innovation with digital technologies perceived as cutting-edge such as AI and IoT. Places are positioned according to their proximity to this frontier. This engenders spatiotemporally hierarchical narratives of catch-up and leap-frogging, such as when an interlocutor in A3 explained that

“This kind of [innovation] culture isn’t quite here in Rwanda yet like in Europe”. Such framings also justify technological transfer from sites considered advanced to those framed as requiring transformation.

A key feature of these frameworks is the positioning of certain people and places as traditional, lacking knowledge, and therefore requiring modernising technologies alongside education and capacity-building. One of my interlocutors for A2, an internationally headquartered distributor of energy technologies in Rwanda, explained how “People in the rural areas still don't understand the benefits of using electric hot plates… So, it's mostly about educating these people.” The frameworks also emphasise urgency, positioning technology scaling across geographies as the most viable way of delivering rapid transformation. A central example across my empirical material is the first socio-technical imaginary in A2, which frames Rwanda’s energy transition through the rapid distribution of externally developed technologies.

This interpretative framework discursively constitutes a set of interrelated positions for actors associated with innovation. The first is a core or “inner” set of positions which together produce frontier technologies, relating to innovation, investment, knowledge production, technology distribution, and gatekeeping knowledge of innovation. The second is a peripheral or “outer” set of positions only able to receive rather than produce innovative technologies and knowledge. This includes technology users, knowledge recipients, imitators, failed innovators, and knowledge gatekeepers. These are associated with locations positioned as distant from the technological frontier.

Locationally embedded interpretative frameworks

Locationally embedded interpretative frameworks are constituted across A1, A2, and A4 through framings of transformation as rooted in specific places. Knowledge, technologies, and sustainability concepts derive legitimacy from their emergence within and accountability to particular localities. In A1, for example, certain scholars call for greater recognition of the traditional ecological knowledge held by forest-dwelling peoples. Desired transformations are thus understood to emerge from place-specific knowledges, materials, and priorities rather than being externally imposed.

At the same time, the “local” is itself discursively constituted. It may refer to a community in a specific location such as the villages surrounding IPRC Tumba in A3, or to broader categories of beneficiaries imagined from elsewhere, as in A4. Rwanda’s policy emphasis on “home-grown solutions” provides a clear example of these frameworks in practice, positioning Rwanda as a location both engendering and benefiting from transformation (Kayigire & Mutesi, 2017).

These interpretative frameworks discursively constitute positions for actors associated with locally embedded innovation efforts, such as locally embedded innovators, community-based knowledge holders, contextual intermediaries, and locally accountable gatekeepers of innovation.

Situationally embedded interpretative frameworks

"The innovation that's happening right now in the West, for example in Silicon Valley, is more consumerism…while if you look across Africa…I feel like we're solving real life problems."

- Interlocutor from A4

Situationally embedded interpretative frameworks are constituted across A1-A4 and prioritise knowledge and technologies considered useful in relation to specific problems at particular moments in time and space. Within this framing, legitimacy derives not only from proximity to a site of transformation (as emphasised by the locationally embedded framework), but from the usefulness of knowledge or technology in addressing a specific situational issue. It is this issue - understood as a unique configuration of time and space - that becomes the basis upon which transformation efforts are deemed more or less legitimate.

Although such frameworks may draw upon modernist principles - for example valuing technologies such as AI where they are perceived to be useful - they do not frame transformation as hierarchical transfer from more to less advanced sites or as catch-up. Equally, transformation involving no new technology may still be considered innovative if it solves a problem. Innovation is understood as situated problem solving, rendering adaptation, recombination, contextualisation or technology use as potentially legitimate forms of innovation. Actors likewise become legitimate through their engagement with and usefulness to a given situation. In this way, aspirations towards modernity exert less pressure to catch-up with other places and instead engender diverse futures emerging from situated encounters. In A3, for one of my interlocutors this meant joining up IoT technologies with a pressing need to ripen bananas during cloudy weather as well as locally available coding capabilities. Transformation, in this framing, is contingent upon situational fit rather than only location or proximity to a universal frontier.

These frameworks discursively constitute positions for actors as innovators (understood as a process of situated problem-solving), problem-holders and knowledge intermediaries, without hard boundaries between these positions.

6.2 How flows of capital, knowledge and technology stabilise positions in transformation (RQ2)

The interpretative spatial frameworks described in the prior sub-section have material effects. In this sub-section, I respond to RQ2 by showing how these frameworks shape flows of capital, knowledge and technology through which certain locations and actor positions become materially stabilised as relevant to transformation through relations with one another. For example, flows of capital for technological innovation in A2 and A4 enable actors in cities such as Kigali to access resources that support innovation activities, while other locations are positioned primarily as sites where externally developed technologies are used.

I describe these relations using the concept of power geometries (Massey, 1993). This concept helps me to describe how ideas about innovation and transformation are materially enacted across the thesis

through movements of finance, knowledge, and technology between actors and locations. Within these geometries, the positions discursively constituted by the interpretative frameworks described above, such as innovator, financier, or technology recipient, are stabilised to varying extents through these flows. Combining power geometries with post-structuralist analyses of subject formation helps explain how particular positions become associated with certain locations, shaping both who can inhabit them and what is expected in different locations.

Across my empirical material, multiple overlapping power geometries coexist, drawing on contrasting interpretative frameworks. The more such geometries are reproduced through socio-material flows - particularly large-scale circulations of capital - the more stabilised they appear and the greater the relational power exercised by those able to inhabit positions within them.

Table 2: The four co-existing power geometries characterised by this thesis and how they are stabilised by flows of capital, knowledge and technology

Power geometry	**Interpretative frameworks enacted by flows associated with the geometry**	**How positions for actors are stabilised by flows associated with the geometry**
The universalist inner geometry	Universalist frameworks which associate legitimacy with a perceived global technological frontier, located in higher-income countries and African cities such as Kigali, Nairobi, and Lagos. Across A2 and A3, interlocutors repeatedly locate innovation and transformation-relevant knowledge in Europe and North America, referencing universities s such as MIT, Cambridge and Yale.	Positions are stabilised through being connected to flows circulating within the inner geometry, as well as through engendering outflows to the outer geometry.
The universalist outer geometry	Universalist frameworks which associate locations considered peripheral to a global technological frontier with a lack of legitimacy to engage in innovation, other than to receive finished technologies.	Positions are stabilised either by receiving inflows from the inner geometry, or by being disconnected from (whilst desiring connections to) the inner geometry.
The locationally embedded geometry	Locationally embedded frameworks which associate legitimacy with rootedness in the places where transformation is intended to occur, for example through situated experience, physical presence, or understanding of place.	Positions are stabilised by flows which circulate within an intended location of transformation.
The situationally embedded geometry	Situationally embedded frameworks which associate legitimacy with contributions which are considered to be useful by actors concerned about a given situation.	Positions are stabilised by flows which engage with a situation in a particular location and moment in time.

Capital flows

Capital flows most prominently reproduce the universalist inner geometry, by stabilising positions for actors understood to be proximate to a technological frontier. Across my fieldwork, most large-scale investment circulates within this geometry. In A2, overseas contributors to the CEBGF for example channel large capital volumes into Rwanda's energy sector, while in A4 Northern European investors finance innovation through CF Investments. These capital flows stabilise positions for the financiers themselves, as well as innovators and knowledge producers in frontier locations able to access this capital and translate it into outward flows of technology and knowledge to those positioned in the outer geometry. These flows also stabilise intermediation and facilitation positions closer to intended sites of transformation. In A2 for example, Rwandan banks and green funds structure domestic subsidies using the World Bank to enable the rapid diffusion of primarily externally developed solar home systems, while in A4 CF Investments' Kigali office and African technical assistance providers translate investment priorities from Europe to Africa. In A5, capital for energy research related to lower income countries flows predominantly towards academic institutions in higher income countries.

These same flows simultaneously stabilise positions within the universalist outer geometry for actors who benefit from these capital flows but play no part in shaping them. For example the World Bank financing scheme for solar home systems in A2 creates positions for beneficiaries of externally designed and financed technologies. Constrained access to the forms of capital considered necessary for frontier innovation also constitutes positions for actors as imitators of - or failures relative to - legitimate innovators, for example those involved in battery innovation efforts at IPRC Tumba in A3. In A2 interlocutors identified limited finance and donor financing structures as barriers to innovation, with one private-sector interlocutor arguing that "Donor money tells you: "*You have funding for three years and you have two years to implement*". You will never experience the real innovation."

Capital also occasionally stabilises positions within the locationally embedded and situationally embedded geometries, although usually in ways entangled with the universalist geometry. In A4 for example, venture capital favours entrepreneurs who can demonstrate deep contextual understanding while simultaneously requiring that solutions scale to multiple locations in line with venture capital expectations. Direct financial support for transformation efforts within the situationally embedded geometry appears comparatively rare across my empirical material. The clearest example is the ten-year JICA funding programme at IPRC Tumba, which several staff described as creating time and space for iterative experimentation and innovation activities focused on situations experienced locally which are inspired by, but not understood as replicating, practices observed elsewhere.

Knowledge flows

Knowledge flows similarly stabilise positions across multiple geometries. Within the universalist inner geometry, they reproduce positions for knowledge production and gatekeeping in locations and academic institutions associated with the technological frontier. In A1, many scholars distant from the locations they analyse nonetheless prescribe how transformation should occur within them, while A5

demonstrates how academic funding and citation patterns favour higher-income-country institutions engendering knowledge flows intended for lower-income countries. These same flows stabilise positions within the universalist outer geometry for learners, implementers, facilitators, or recipients of externally generated knowledge. In A3, community outreach activities tend to (although not exclusively) stabilise positions for communities as passive recipients of externally generated expertise. This knowledge flow is mirrored by the capacity-building activities described by several private sector companies and NGOs in A2 whose main exchange of knowledge with Rwandan communities is one-way education about how to use novel technologies.

By contrast, the locationally embedded geometry circulates knowledge by amplifying expertise in a given location (for example by connecting it to capital), rather than substituting it with external inflows of knowledge. The investment model of CF Investments for example explicitly stabilises positions for innovators understood to possess local knowledge, with one interlocutor explaining how a "core characteristic [of the innovators we invest in] is that they really understand the space. Some of them have actually been involved". Relatedly in A2, one Rwandan energy company restructured its operations after Kigali-based sales agents became "lost" when engaging rural customers, requiring them to reallocate organisational resources towards actors embedded within those communities. In A1, similar framings emphasise the value of traditional ecological knowledge and to some degree stabilise positions for community-based knowledge holders as legitimate contributors to transformation.

Knowledge flows within situationally embedded geometries stabilise positions for actors involved in developing situational problems and solutions, as opposed to fixed locations of expertise. In A4, one interlocutor explained: "I went to Malaysia and Thailand to see rural farmers who are using the technologies [I work with]. I had to see the practicability of the technology among rural communities. Are there farmers similar to my farmers who are using it?". In this case, knowledge is valued not because it originates from a particular location, but because it appears useful to a particular situation. Similarly, in A3 staff and students at IPRC Tumba adapt globally circulating technological knowledge from freely accessible resources such as YouTube while also contributing knowledge back into these networks. In A2, farmers approach a domestically headquartered energy company with specific requests and business ideas, positioning problem-holders as initiators of knowledge flows rather than simply recipients.

Technology flows

Technology flows likewise stabilise positions in multiple geometries simultaneously. The most substantial flows I encountered across the thesis (in terms of units of technological devices moving between actors) stabilise positions primarily in the universalist geometry, with technology flows disseminating from recognised centres of innovation. In A2 for example, financing from various development finance institutions and international carbon financing mechanisms support the large-scale import and distribution of technologies from Europe, the US and East Asia into Rwanda, such as smart cookstoves and solar home systems. In A4, startups distribute software solutions across the

continent while remaining dependent on US-based software services. Such flows stabilise positions for innovators and technology distributors in frontier locations within the universalist inner geometry, alongside positions for recipients in the outer geometry. In A2, an internationally headquartered company distributes a bio-ethanol cooking solution in Rwanda using carbon finance originating within the inner geometry. Here, Rwanda becomes a market for the sale of a technology and business model which has already been decided. IoT-enabled cooking and refuelling systems are designed and manufactured in East Asia before being imported into Rwanda. This particular technology flow reinforces distinctions between sites of innovation and implementation. The flow stabilises positions for actors within Rwanda as users, recipients or distributors of technologies, but not developers of them.

Technology flows within locationally embedded geometries mirror knowledge flows, with technologies originating from and circulating within a given location. At IPRC Tumba, staff train communities to build cookstoves using locally available clay and bespoke designs. Knowledge, materials, and production are sourced locally, stabilising positions for designers and makers whose legitimacy derives from their embeddedness within the locations where technologies are developed and used. Within situationally embedded geometries, technologies circulate through ongoing experimentation, adaptation, use, modification, and repair in response to changing needs and engagement with specific problems. At IPRC Tumba, for example, a locally built solar water heater is repeatedly disassembled and reconfigured for pedagogical purposes while simultaneously serving local users, functioning both as a usable device and as an artefact addressing changing educational needs. The material components of the technology continually circulate, at a small but significant scale, within the college and its communities as it is taken apart, reassembled, modified and repaired.

Knowledge gatekeeping and the stabilisation of legitimacy

Across all four geometries, flows of capital, knowledge, and technology are accompanied by gatekeeping practices which maintain the boundaries of innovation for each geometry, stabilising positions both for the gatekeepers themselves as well as the other positions within the geometry. Within the universalist inner geometry, knowledge gatekeeping practices reify novelty, scalability, digitalisation, and formal research in association with frontier innovation. For example one seminal economics research article in A1 asserts that “new technologies, often first developed in advanced economies, in particular, the United States…will spread only slowly to other countries”. In A4 financiers and technical assistance providers require innovation to involve scalability and rapid deployment. Within the universalist outer geometry, similar forms of gatekeeping reproduce distinctions between “real” innovation, imitation, and failure. This occurs through educational practices at IPRC Tumba described in A3 where teachers judge whether student efforts ought to be considered innovation, often concluding they should not.

In locationally embedded geometries, gatekeeping positions are instead stabilised for actors who assess claims to local embeddedness. Across my empirical material, I do not see embeddedness as a fixed characteristic but rather actively claimed by actors seeking to access capital flows; in this case the VC flows I study in A4 which simultaneously stabilise the universalist and locationally embedded geometry.

Here, investors and technical assistance providers occupy influential positions as gatekeepers of embeddedness, determining which claims to locality are recognised as legitimate. This is not to say that such claims are purely discursive. My sense is that most if not all such claims to embeddedness have a material basis; investees of CF Investments often originate their ventures in industries or communities they are deeply familiar with, albeit whilst possessing certain privileges. It is however noticeable that it falls to the investors (whose geographic gaze is necessarily wide-ranging) to value and assess local embeddedness. It is this dynamic which encourages individual investees to claim to be local not only where they start out, but across the vast geographies which they seek to scale their technologies to.

Within situationally embedded geometries, legitimacy derives less from location or novelty than from whether contributions are judged useful by others involved in a given situation. Positions such as innovator, problem-holder, and intermediary are therefore stabilised through ongoing participation in problem-solving relations rather than through legitimacy in relation to particular places or technological frontiers.

6.3 How actors' capacities to inhabit positions in transformation are shaped by, whilst reshaping, their socio-material circumstances (RQ3)

In this sub-section, I respond to RQ3 by bringing together the preceding discussion of interpretative frameworks and power geometries with my interlocutors' circumstances outlined in Section 4.5. Taken together, these provide the basis for analysing how differential access to transnational flows of knowledge, technology, and capital unfolds in practice, and how this shapes the subjectivities associated with transformation and innovation that interlocutors inhabit, contest, or are excluded from. This includes moments when such positions are explicitly articulated and subjectivities claimed by actors themselves (i.e. "I am an innovator"), as well as when they are attributed, inferred, or negotiated through interaction with others.

I describe the varying ability of actors to access positions within each of the four geometries in turn. Through this, I show how wealth, gender, place of residence, mobility, and organisational embeddedness in particular both structure access to these positions and are in turn shaped through participation in them. The analysis traces how power relations across space are reproduced, stabilised or occasionally unsettled through the spatially coded subjectivities associated with processes of transformation. This is not intended as an exhaustive account of subjectivities of transformation but reflects those that emerged within the scope of the fieldwork conducted for this thesis.

The universalist inner geometry

> *"Outside Nigeria there is a way and manner of doing things so that the world of business and finance understands. And if you don't have that way and manner, then you are not seen as a credible person to back [financially]. That way and manner is what I learned at Yale."*

- Interlocutor from A4

While the universalist inner geometry configures flows across space, my fieldwork shows that actors' ability to inhabit the positions within it is uneven and closely tied to their material and spatial positioning. Access to capital, knowledge, and technology flows is shaped by combinations of wealth, class, educational attainment, place of residence, mobility, and organisational embeddedness.

Across A2 and A4, the position of universalist innovator is occupied by a relatively narrow group of actors. In A2, I observed that employees of internationally headquartered private companies claim positions in innovation ecosystems elsewhere, with innovation itself framed as occurring outside Rwanda. Their activities within Rwanda are therefore primarily those of innovation technology distributors, circulating externally produced technologies. These actors are embedded in Kigali-based networks composed of materially comfortable, highly educated, and often foreign-born individuals, with strong connections to transnational institutions.

In A4, some African entrepreneurs are able to inhabit the universalist innovator position and access capital. However, they are typically internationally educated, globally networked, and based in cities such as Kigali or Nairobi which are recognised within the geometry. As the quotation from A4 above demonstrates, familiarity with the norms and expectations of global finance - acquired through elite education - is a condition for credibility as a universalist innovator.

Positions for actors who distribute innovative technologies across geographies are more accessible but still unevenly distributed. Internationally headquartered firms and their employees dominate this position in A2, benefitting from established global networks and access to capital. This is illustrated through the account of an individual whose professional trajectory shifted significantly after entering the solar energy sector in Rwanda. Prior to this, he had worked in car hire sales in the UK with limited progression. Following a chance encounter, he was recruited into a company retailing solar technologies and quickly came to lead its Rwanda operations. He himself noted that he was not hired due to prior sector-specific expertise, but for the social and cultural capital associated with his education and professional experience in the UK. In describing this, I am not disputing his capabilities. Rather, it illustrates how recognition within the universalist geometry is structured through associations between expertise and particular locations, institutions, and histories. Actors with links to these locations appear to be more readily recognised as legitimate than those without such links.

Domestically headquartered firms by contrast attempt to occupy similar positions in transformation but often struggle to access funding and legitimacy. One CEO in A2 explained that while distributing technologies such as solar home systems can be lucrative, the structure of capital flows prioritises externally developed technologies, limiting opportunities for locally based firms with aspirations to develop technologies to engage. In this way, capital flows not only stabilise positions but also allocate differentiated responsibilities across actors, shaping who innovates and distributes.

Universalist positions for financiers, knowledge producers and knowledge facilitators are similarly shaped by unequal access to resources. These positions are predominantly occupied by actors based in higher-income countries or within well-connected regional offices. In A2, I observe how domestic

financial institutions act as intermediaries but remain dependent on external funding sources. In A4, transnational consultancies act as technical assistance providers to CF Investments, translating and structuring their innovation investment strategy. To do this, they draw on global expertise considered legitimate by universalist interpretative frameworks. Inhabiting these positions enables them to access capital and influence, reinforcing the material advantages of those who occupy them. In A5, one can infer from the trends in the bibliometric analysis that many of the academics based in higher income countries who write about energy in lower income countries effectively inhabit positions as universalist knowledge producers. Likewise, A5 also illustrates how academic funders may inhabit universalist financier positions by commissioning research intended to benefit locations far away whilst favouring scholars in the locations they are themselves based.

Knowledge gatekeeping about innovation is a key mechanism through which these inequalities are reproduced. Across A1-A4, various actors based either outside Africa or in cities such as Kigali successfully claim positions as universalist gatekeepers by defining what counts as innovation in ways that privilege certain forms of knowledge, technology, and organisational capacity. In A1, academics become gatekeepers who equate innovation with formal R&D or patentable outputs. In A2, the private sector and policymakers become gatekeepers, emphasising the urgency of energy-sector transformation to justify limiting participation by ordinary citizens. In A4, financiers become gatekeepers of innovation by enacting expectations of scalability, digitalisation, and rapid growth amongst their investees.

Participation in this geometry is also shaped by gendered dynamics. In A4, an advisor explained that many women disengage from elite entrepreneurship programmes due to the demands of balancing care responsibilities, household labour, and income generation. These constraints limit their ability to participate in these lucrative programmes that assume constant availability and mobility. While not always explicitly articulated as gendered, such dynamics shape who is able to access positions and therefore resources.

Engagement with this geometry, in turn, reshapes actors' circumstances. Across A2 and A4, those able to access capital flows - particularly those employed by internationally headquartered organisations or successful startups - often experience improvements in income, mobility, and professional opportunity. Participation becomes materially productive, reinforcing their position within the geometry. Conversely, those unable to access these remain positioned at a distance from capital and knowledge flows, limiting their ability to influence transformation efforts. A limitation of this thesis is that most interlocutors were engaged for only one to three months, limiting insight into change over time. However, sustained relationships with a smaller group from 2021-2024, including ongoing communication, suggest that many actors connected to the universalist inner geometry - particularly those employed by overseas-headquartered organisations - experienced substantial improvements in their material circumstances. For many, engagement in processes of transformation in Rwanda was economically advantageous and functioned as a career stepping stone. Several foreign nationals subsequently left Rwanda after temporary postings, using it as a site of professional advancement. Others progressed rapidly within expanding firms, including one interlocutor whose solar company grew from early-stage operations in Rwanda (describing it as an "ideal testbed") to multi-country

expansion in the period we knew each other. Others invested in land or developed commercial ventures in Rwanda, utilising the strength of their social networks gained through participating in transformation.

The universalist outer geometry

"We cannot call what we do in Rwanda innovation compared to what comes from elsewhere"

- Interlocutor from A3

Many of my interlocutors across A2 and A3 claim or are ascribed positions in the outer geometry, including several employees of domestically headquartered companies in A2. As one Rwandan CEO explained, "we cannot start with cutting edge technologies by ourselves; we don't have the resources, we don't have the expertise". Staff at IPRC Tumba in A3 inhabit positions of receivers of knowledge and innovation, as well as imitators or failures. Many members of the communities surrounding the college likewise position themselves as recipients of technological innovation, seeing even the college they live adjacent to as fundamentally separate and unknowable due to its rootedness in high-tech knowledge which they self-identify as lacking. One community member explained that "illiterate people like me cannot know what is happening in the college", instead focusing on the technologies they hoped to receive through government programmes.

Many of the innovation efforts I observed or heard about across my fieldwork lead to actors inhabiting positions in the outer geometry, which in turn stabilises the peripheral nature of these locations by denying them access to resources. Most notably in my fieldwork for A3, limited access to funding, materials, and institutional support at IPRC Tumba contributes to the abandonment of innovation projects deemed illegitimate within the universalist framework. This was particularly visible in the case of the solar water heater design developed at college. The tea factory's staff were enthusiastic users of the college's locally designed solar water heater for two years, and for a time were able to adjust and optimise their heater with help from the college staff who also used it as a learning opportunity (forming subjectivities associated with the situationally embedded geometry, discussed below).

However, after maintenance was abandoned by college staff and they faced technical issues, after attempting to repair it themselves multiple times they were forced to purchase an expensive imported alternative from Italy (to which attempts at repair or adjustment were impossible). The tea factory staff were saddened by this, lamenting that continued use of the college-designed heater was made impossible despite their best efforts. They shifted from being active co-innovators of a technology to innovation recipients, and the Tumba staff I spoke to about what happened self-identified as failed innovators. Material circumstances and events undoubtedly play a part in this story of technology failure and abandonment. There was a comparative lack of stable funding for materials, equipment and ongoing development of the design resulting from the college's peripheral location in the geometry. However, these cannot be disentangled from some of the college staff's related lack of confidence in the

technology as being a valid innovation. This particular chain of events both results from, whilst stabilising the reproduction of, the universalist geometry and its associated frameworks of legitimacy.

The actors who inhabit positions in the outer geometry are among the least wealthy and least privileged groups I engaged with. Actors lacking privileges across these intersectional dimensions come to be positioned as distant from the capital, knowledge, and technologies circulating through the inner geometry. In A3, one staff member of IPRC Tumba reflected that colonial education systems in Rwanda had historically prioritised rote learning over cultivating an innovative mindset. He saw this as contributing to the absence of an "entrepreneurial spirit" amongst Rwandan people compared to others. This points to how historically constituted knowledge systems continue to shape present-day capacities to inhabit innovation-related subject positions. One might debate this particular interpretation of educational history. However regardless of whether one regards it to be accurate, this internalised perception that those people who have been educated by legacy colonial era systems lack innovation capabilities stabilises the positioning of most Rwandan citizens (barring those able to attain specialised education) in the outer geometry.

Across my fieldwork, actors rarely framed their experiences in explicitly racialised or gendered terms. These themes typically either did not arise in conversation, were presented as problems to be tackled by transformation (such as the pervasive and gendered "time saving" argument for women to use improved cookstoves) or actors refuted these dynamics as concerns. For example one of my interlocutors, a downstream investee of CF Investments, explained "I've travelled half the world and I've never experienced racism as a founder." Nonetheless, this actor positions themselves as an innovator and has successfully received venture capital investment to scale their digital solution. In other words, they are able to legitimately inhabit a position within the inner universalist geometry.

I maintain that gendered and racialised dynamics play a role in how actors find positions in the universalist outer geometry. My emphasis on the relevance of these aspects is more my own inference and observation rather than my interlocutors actively expressing it, but there are exceptions to this. Regarding gender, the female CEO of a Rwandan energy company I spoke with in A2 explained how it would become a "man's world" when her team discussed technology innovation, giving the example of female Rwandan members of her team "stepping aside" and disengaging when an all-male team of academics focused on cookstove technologies from the UK engaged with her company. Another investee in A4 reflected that "There is the obvious stereotype that Africans and Black people face generally around funding that we are not as capable as our White counterparts. We don't typically attract funding at the scale that many of our colleagues do." Another of my interlocutors from A4 went into further detail about this:

"I'm an African female founder. We are bringing two things to the table, the gender aspect and the colour aspect. But we're not able to unleash the impact that we would like to. So many projects get funds easily because they're led by men… it's very rare for us to get funding, especially when we are speaking about technology like AI. Besides, most of our women are not tech-savvy. For men, you find many more have that interest in tech and the time to develop it. Unless you bring in someone to the organisation who is tech-savvy - often a man - it becomes a real challenge."

- Interlocutor from A4

For this individual, gendered and racialised dynamics intersect with interpretative framing of innovation as needing to be high-tech (coded as male domains) to make the position of innovator inaccessible to many. As investees of CF Investments these actors have managed to overcome these barriers. They nonetheless point towards more systemic constraints which position others who share certain characteristics in the outer geometry. More broadly, it would be remiss not to acknowledge that all of the actors I engaged with in-person who I characterise as inhabiting outer-geometry positions in my research were people I perceived as Black inhabitants of African countries. This stands in contrast to the other three geometries I describe, including the universalist inner geometry, which is inhabited by a group possessing a diversity of gendered and racialised identities based both within and outside Africa. This includes, but crucially is not limited to, Black inhabitants of African countries.

These recipient positions are not only claimed but also ascribed to actors through their relations with subjects in the inner geometry. In A2, I observed employees of internationally headquartered private sector organisations performatively ascribing innovation/knowledge recipient subjectivity to rural Rwandan communities through training and education formats premised on knowledge transfer rather than exchange. In A4, similar subject positions are inferred through financing models oriented towards scaling technologies to users across Africa, positioning users as becoming modern through technology receipt. One interlocutor explained that the role of community members was simply to adopt. Likewise the financial and knowledge flows analysed in A5 cast lower income countries writ large - including those in Africa - in a position as more recipients than producers of academic knowledge about their own circumstances (albeit with the caveats provided in Section 5.5). Here, one can link the trends observed in A5 with the accounts from A3 wherein staff at IPRC describe academic research on energy technologies as difficult to apply to their own contexts.

Gendered dynamics are also visible in practices of knowledge gatekeeping within the outer geometry. In A3, IPRC Tumba is markedly male-dominated, particularly among teaching staff. During the student innovation pitching sessions I observed, both judges and presenters were male, and ideas were frequently dismissed as insufficiently novel or derivative, reflecting the internalisation of universalist criteria. In separate mixed-gender discussions, some female students described their reluctance to voice their innovation ideas which they nonetheless believed could benefit their communities. They anticipated that these would not be recognised as innovation at the college. Here, knowledge gatekeeping - understood as the work of defining what counts as innovation - is not evenly distributed. Rather, it tends to be performed by those already positioned with greater authority within locations in the geometry (i.e. Rwandan men), reinforcing existing exclusions while appearing to uphold neutral standards of evaluation.

Whilst these dynamics might be expected to engender despondency, many who claim positions in the outer geometry nonetheless aspire towards positions within the inner geometry. In A2 and A3, I repeatedly encountered efforts to align with universalist definitions of innovation: a Rwandan company owner developing plans for transnational scaling; college staff investing significant time in producing academic publications about their innovation efforts; and students relocating to Kigali to access better-

resourced innovation ecosystems. These aspirations reflect how the inner geometry continues to structure imaginaries of success and direct activities, even for those systematically excluded from it who consequently claim positions in the outer geometry.

The locationally embedded geometry

"Local founders with experience on the ground will perform better than European founders with crazy tech expertise, but no actual experience of what's happening"

- Interlocutor from A4

In A2, I engaged with a Rwandan entrepreneur who positioned himself as a locationally embedded innovator through his work on an experimental cookstove. His claim rested on engagement with community knowledge, particularly around the heat retention properties of locally available volcanic rocks which he subsequently used. However, despite this strong claim to embeddedness, he struggled to access investment. One of my Rwandan interlocutors for A2 ascribed locational embeddedness to several Rwandan companies operating in the energy sector, describing them as "long-standing local players with a lot of market experience". Nonetheless this did not translate to their activities growing through links to capital or other benefits; my interlocutor explained how "Those guys have been struggling for a very long [time]" and that they needed more support.

Often by their nature, instances of locationally embedded innovation unfold without substantive flows of capital, such as IPRC Tumba's programme in A3 to co-design clay stoves with local communities using local materials. This is not to say that they do not have the potential to transform the lives of those involved. The Tumba clay stove programme engages with intersectional dimensions of identity in different ways to the universalist geometry, which is particularly striking given the strongly masculine environment of the college which codes technological innovation as a male domain. In the instance of the clay stove programme, IPRC Tumba staff described closely collaborating with Rwandan women in the design of the clay stoves. Their embeddedness in the desired site of transformation - the rural kitchens which are perceived as female-coded spaces - makes them active and valued participants in this process of transformation.

Whilst the impacts of these transformation processes might reshape the circumstances of those who participate in them, involvement in the geometry does not necessarily alter actors' circumstances by making them wealthier through the mediation and receipt of capital flows. The only instances of actors becoming locationally embedded innovators and receiving capital as a result are those entrepreneurs in A4 who occupy hybrid subject positions across the locationally embedded and universalist geometry. In this case, European investors, alongside CF Investments staff in Rwanda who share their concerns about coloniality in innovation finance, position themselves as financiers of locationally embedded innovators. One European employee of CF Investments explained how they are careful to avoid the impression that "the White people in Europe are there making decisions" whilst at the same time

recognising that "the CEO is a White European male, he owns the company and is funding it, so he needs to have a say".

In A4, CF Investments actively search for actors they perceive as legitimately embedded in place, drawing them into this subject position. In doing so, they also act as gatekeepers pushing for a more locationally diverse framing of innovation, positioning earlier Eurocentric financing modalities as having excluded African actors from technology innovation and their current approach as a corrective to this. However, in A4 the scale at which transformation is imagined extends across the African continent. As a result, entrepreneurs become subjects within this geometry by positioning themselves as locationally embedded at a continental scale. Becoming "local" in this sense, as recognised by overseas investors, simultaneously enables access to capital via the universalist geometry. Unlike the actors I described above from A2 and A3 who are largely disconnected from capital flows, these "locally embedded" actors in A4 also possess global networks, align with globalised sustainability agendas, and are able to scale rapidly via investment.

These dynamics reshape actors' circumstances. Where actors successfully inhabit these hybrid positions, they gain access to capital that enables them to expand operations and engage in broader transformation efforts. However, this often requires aligning with externally defined priorities, particularly expectations around scaling and technological form. Several CF Investments staff reflected on the tension this creates, noting the dissonance between supporting locally embedded innovation whilst requiring rapid expansion across the continent. In A2, similar tensions play out temporally. Some actors who initially engaged in locally embedded transformation processes, with active engagement by community members, described shifting towards models aligned with faster-paced and scalable transformation as they received external investment, reflecting the influence of capital flows linked to the universalist geometry. In this way, access to capital reshapes not only what actors do, but also the interpretative frameworks and subjectivities through which they make sense of the transformations they work towards.

The situationally embedded geometry

"If you look at many of the entrepreneurs that are going through innovation accelerator programmes in Africa, they will tend to be in the middle to upper-middle class. There's a lot of talent that we're missing in the lower economic groups who tend to be in technical schools. They're not in the university system where most of the accelerators tend to recruit from. They are creating the things which I think Africa needs more."

- Interlocutor from A4

Whilst the universalist geometry is more pervasive across the articles of my thesis, it is notable that the situationally embedded geometry is inhabited by a considerably wider range of actors across A1, A2, A3 and A4. Actors in varying circumstances inhabit positions as active participants in transformation who might otherwise become innovation recipients in the universalist geometry. Often this is precisely

because of the claimed relevance of their particular subjectivity(s) to a given transformation challenge or innovation process, across intersectional dimensions such as gender, ethnicity, educational attainment, socioeconomic circumstances and place of residence. This is evidenced by the quote above in which an investee from A4 actively appoints African people from constrained socioeconomic circumstances and more limited educational attainment into the position of situationally embedded innovator, precisely because their circumstances mean they understand the challenges facing the continent.

Some actors explicitly claim, or are attributed, the position of situational problem-solvers. Across A2, both domestically and internationally headquartered firms operating in Rwanda claim catalytic positions in transformation by explaining how they adapt technologies from elsewhere to fit local conditions. One local government official close to IPRC Tumba interviewed for A2 ascribes this subjectivity to staff and students at the college by explaining how "Innovation comes from the IPRCs. Their students who are trained to do improved cooking stoves… they are helpful in the district". Similarly, in A3, several staff and students of IPRC Tumba resist being positioned within the universalist outer geometry and instead claim legitimacy through their ability to carry out "small" innovations that respond to situational needs within their college and community. Whilst engagement with IPRC Tumba's solar water heater leads some actors to position themselves as failed innovators, others claim subjectivities of innovation by pointing to how they have developed something which really helps in a particular situation. The heater provides a much-needed example of a technology developed locally which might shift the mindsets of students. Even though its use remains limited and it has experienced breakdowns, it is narrated as an innovation because of its value in that moment and place.

Actors also inhabit positions as knowledge gatekeepers, working against those who police what counts as "real" innovation to instead expand such definitions. One staff member of IPRC Tumba in A3 explained that opening a bakery in a village could constitute innovation if it responds to a real need, a view echoed by a group of students who define innovation simply as helping their community solve problems. Similarly, in A1, several authors become gatekeepers by critiquing exclusionary framings of innovation and arguing for broader recognition of diverse practices.

A key feature of this geometry is that actors who might inhabit subjectivities of passive technology receipt in the universalist geometry are able to inhabit more active positions here. In A2 and A3, community members are sometimes positioned - and position themselves - as situational problem-solvers or collaborators. For instance, an employee of a Rwandan energy company I engaged with in A2 described how they work with users to co-develop solutions: "They [a user] have an idea for a business that they'd like to run. And then they'll come and say, "how can you help me with this?"". Relatedly, a Rwandan citizen living in the community surrounding the college in A3 insists he has ideas that could "really change" how he uses energy, even if these are not recognised within or demanded by the college. These claims do not always translate into recognition by others, pointing to ongoing power asymmetries even within the situationally embedded geometry, but they nonetheless demonstrate alternative subjectivities being asserted.

The material effects of the situationally embedded geometry's enactment are visible in a range of artefacts and practices. Across A3, a health centre in Bushoki uses hot water from a locally produced heater; students repeatedly assemble and disassemble this technology as part of their training; community members produce clay stoves and briquettes based on locally shared knowledge. In A2, Rwandan households use cooking technologies designed for their specific cooking practices using available materials and fuels. At the same time, moments of failure and breakdown - such as the difficulties experienced with the solar water heater or the inability to sustain maintenance of it - can interrupt these processes, sometimes pushing actors away from these positions or undermining their legitimacy over time.

The financial flows supporting this geometry afford the time and resources for actors in constrained material circumstances to claim positions as situationally relevant innovators, such as JICA's long term support of IPRC Tumba. This nonetheless highlights an important temporal dimension: the ability to remain engaged with a problem long enough to adapt and refine solutions. When finance is available as in the case of the JICA programme these opportunities exist and the power geometry is brought into action through these processes and practices. However when this finance ceases or is unavailable, the geometry weakens, with some actors such as those involved in the solar water heater drifting towards "failed innovator" subjectivities.

Many actors frame their engagement with external knowledge and capital through the JICA support programme to IPRC Tumba in A3 as empowering rather than fostering dependency. As one of my interlocutors explained to me, "JICA's main support related to innovation was to train teachers in how to think bigger and help students". Another explained to me how "We got [innovation] skills from the experts from Nepal [facilitated by the JICA programme]; based on this knowledge we started designing." While this could be read through the universalist outer geometry as passive knowledge receipt, in context it reflects a process in which knowledge is reworked through local practice over time; I could sense my interlocuters found JICA's intervention empowering. What matters here is less where knowledge originates, and more how, when, and for what purpose it is put to work.

Hybrid subjectivities of transformation in which actors inhabit positions in both the universalist and situationally embedded geometry are perceptible. In A4, several actors - particularly diaspora entrepreneurs - are positioned as drawing on experiences and networks from outside Africa to apply them to specific contexts within it. Multiple actors highlight how diaspora often become funders of, and investors in, innovation, particularly that which primarily tackles practical challenges. One such actor explained "In Africa, many of the funds [considered transformative] are run by diaspora who bring that knowledge and financial expertise. Many of these actors want to come back to the continent and make an impact". Accessing capital or becoming a financier often requires alignment with universalist expectations around scale and technological legitimacy. As a result, actors with the requisite privileges may temporarily access positions within the universalist geometry to secure resources, before enacting or supporting more situationally embedded transformation efforts. This reflects both spatial and temporal circumstances: movement between geometries over time becomes a pragmatic strategy for navigating unequal access to financial resources.

7 Discussion

In this discussion, I reflect on some of the key threads which emerge from this thesis, engaging in particular with the previously introduced concepts of coloniality and agency. First, I discuss the persistence and coloniality of innovation interpreted and enacted in relation to a universal technology frontier which emerges across the thesis. Second, I discuss the agency of unequal participation in transformation across space, to show how agency is exercised as people engage with, and become subjects of, transformation. Finally, I discuss instances and implications of performative agency across the thesis, understood as those moments when actors resist the positions ascribed to them and instead participate in creating alternative positions and pathways of transformation.

7.1 The persistence and coloniality of the universal technology frontier

The data which I have gathered largely appear to evidence the durability of the universalist geometry in shaping how transformation is imagined and enacted. This persistence is not only a function of present-day funding flows or institutional arrangements; it is also historically constituted and continually rearticulated through them. In many cases, dominant ways of thinking about innovation - particularly those that frame it as cutting edge and globally novel - encourage forms of transformation that reproduce long-standing relations of dependency, echoing histories of coloniality (Fanon, 2002; Quijano, 2007; Rodney, 2018). This resonates strongly with Senghor's observation that "the evil of colonization is less these ruptures than that we were deprived of the freedom to choose those European contributions most appropriate to our spirit" (quoted in Táíwò, 2022). Within the universalist geometry, engagement with globally circulating knowledge is rarely framed as a matter of selective appropriation; it is framed as necessity. Certain pathways of transformation appear not only desirable but inevitable, narrowing the space in which alternative trajectories can be recognised as legitimate.

Whilst I acknowledge the potential of articulations and practices associated with the universalist geometry to enact relations of coloniality, making such allegations is rarely simple. Many of the individual actors, positions and flows can be thought of as enacting relations of coloniality in some regards whilst simultaneously working against them. This is most notably those actors located within Africa facilitating the capital flow I study in A4. At the same time as corrosive myths which dissociate Africa and innovation are extinguished, millions of people across the continent are positioned as passive adopters of technologies from a universal frontier. And likewise, there are simultaneously myriad other flows which engender alternative ways of positioning these same people. This ambivalence sits at the heart of this thesis; relations of coloniality are persistent but not all-encompassing. They form part of the patchwork of relations which unfold across what I have studied.

This universalist geometry is nonetheless actively reproduced within and stabilised by national projects of transformation. In my own research, this is particularly noticeable through the role of the state in Rwanda. Across A2 and A3, the Rwandan Government emerges as an actor that operates across multiple power geometries. In fact, the geometries I describe provide a lens through which to point out tensions

in the different ways the Rwandan Government pursues transformation, resonating with analysis of tensions between the Rwandan Government's participatory and developmental state ambitions (Hasselskog, 2018). Despite this multiplicity, the government mobilises resources most consistently in support of the universalist geometry. This reflects its highly modern, technocratic and entrepreneurial orientation towards socioeconomic development and sectoral transformation. Within this framing, the universalist geometry offers a relatively tried-and-tested means of achieving transformation: identify cutting-edge technologies, mobilise abundant capital, and designate recognised experts to deliver transformation at scale. This resonates with analysis of "imperial invitations" in which colonial legacies continue to shape decisions by governments of postcolonial nations to invite collaborations which reproduce relations of coloniality, particularly when large-scale infrastructural projects of transformation are pursued (Kimari & Ernstson, 2020).

By contrast, situationally embedded approaches require a slower and more complex process: establishing shared understandings of specific problem situations, identifying which actors in which places are best positioned to address them, and supporting iterative and context-sensitive experimentation. Temporalities are often gradual and stop-start, and impacts are transient. In contexts of material constraint, this approach can be difficult to justify politically and economically, even where its value is recognised. This helps explain why actors - including those within the state - may simultaneously recognise the importance of more plural, context-sensitive approaches while continuing to reproduce universalist configurations in practice. Different geometries offer different possibilities and the universalist geometry (expressed in A2 as the first socio-technical imaginary of rapid technology-import) often aligns more readily with the temporal pressures, thematic concerns of international funders and resource constraints associated with large-scale transformation. In such cases where actors make sense of innovation through a universalist framework but lack access to expertise deemed legitimate, they must rely on investors or technical partners. In this way, unequal access to recognition as an innovator is not only a reflection of existing inequalities but actively reproduces these inequalities through the processes intended to catalyse transformation.

7.2 The agency of spatially unequal participation in transformation

"I am in Kenya… but who is going to talk to a woman in Botswana or Namibia? I consider myself very privileged to have had the opportunity to receive finance from [CF Investments]. Through this, I have connected with many investors. But I am speaking about women who have never had the opportunities like this. It is certainly not because there is a lack of people who can work on these issues."

- Interlocutor from A4

Across the transformation efforts I have traced in this thesis, a central pattern is how different people participate in them unequally across space. Flows of technologies, knowledge and finance shape how people and places are connected, making specific forms of participation in certain places visible and legitimate while rendering others peripheral or absent.

Agency is exercised differently by actors across this thesis as they inhabit contrasting subjectivities. The power-laden flows described above contribute to the formation of diverse positions in transformation through which agency is both ascribed and exercised, shaping who is understood to have the capacity to act and in what ways (Ahlborg & Nightingale, 2018). Agency emerges relationally through these processes of recognition (Burkitt, 2017). Certain actors attribute the capacity to act to others. In this thesis, those who claim positions as financiers (A2, A4), policymakers (A2) and academics (A1, A3) all tend to attribute the capacity to act to others. Most typically, they point to companies of sufficient size and bank balance to mobilise technology flows at scale, as well as those who undertake or participate in R&D activities considered cutting edge. This results in these actors and the places they are located being drawn into flows of capital, knowledge and technology that position them as drivers of change, while others are more likely to be positioned as recipients, limiting how their capacity to act is perceived or supported.

In the quotation above which begins this sub-section, one woman in Kenya finds her place as a dynamic innovator of high-tech solutions thanks to her intersecting privileges, strong networks and (by her own admission) luck. Meanwhile others - more specifically the many women in Rwanda and across Africa who are overlooked or excluded from recognition as drivers of the transformations studied in this thesis - remain excluded from the platforms that might regard them as such. It follows that these people may find their position in such transformations to be marginal. This is not because they lack potential to exercise agency in transformative ways but rather because dominant ways of delivering innovation and transformation do not recognise them as legitimate actors in legitimate locations. This resonates with critique from Wahome & Graham (2020) that imaginaries of innovation in Sub-Saharan Africa are often premised on faith in a universal ability to successfully inhabit the entrepreneurial archetypes which people aspire towards (derived from Silicon Valley) and which mediate participation in the digital economy.

The positions which different actors can inhabit in transformation can in principle be broadened. For example, actors who might otherwise be marginalised can be recognised or supported as situationally-embedded problem-solvers or co-producers of innovations. However, in practice, many actors continue to be guided - through educational programmes (A2, A3), funding structures (A2, A4) and technology disbursement (A2) - towards exercising agency through inhabiting more constrained positions, particularly that of innovation recipient. The positions which different actors inhabit - whether they be innovator, problem-holder, recipient, or co-producer, are stabilised through situated encounters with transformation efforts in combination with other dimensions of their intersectional subjectivity.

From this perspective, agency emerges continually through processes of subject formation, including how individuals come to internalise and act upon the expectations attached to their positions in transformation (Butler, 2014; Hansson & Hellberg, 2015). This means that even practices associated with the receipt of technologies can be understood as forms of agency, enacted within the conditions through which these subjects are formed (Carpenter, 2020). The community members I engaged with near IPRC Tumba exercise agency as they become recipients of innovation by requesting technology and expressing their inability to engage with innovation processes. More broadly, both agency and

power are exercised through all of the geometries I describe in Sections 6.3 and 6.4 as they are stabilised to varying extents.

7.3 Performative agency and the continual emergence of alternatives

A final area of reflection relates to the marginal yet continual emergence across the articles of alternatives to universalist ways of thinking about and enacting transformation and what might be done with them. The above analysis of agency can give off a somewhat deflating impression of what I have studied, implying that many actors simply become agents of their own subordination. Across the thesis, there are nonetheless many examples of people from diverse circumstances engaging in transformation on their own terms, resisting how they might otherwise be positioned in transformation. Across A2 and A3 there are many moments where assigned positions are unsettled. One community member living near IPRC Tumba, in a location typically thought of as disconnected from innovation, insisted on being seen as someone with ideas that could change their local area and actively sought to contribute. In A2, users initially framed as end-point recipients of energy technologies sometimes became co-designers through repair, adaptation, and local modification, shifting their relationship with technology from passive use to production. Technologies like IPRC Tumba's solar water heater, which some dismiss as a failure and consequently results in the college being seen as a peripheral backwater, can instead become a source of inspiration. This encourages those who engage with the technology to see themselves as innovators; and the place they are located as dynamic and generative of solutions. Likewise in A4, diaspora actors sometimes draw resources associated with universalist logics of rapid scale-up and technology receipt from outside of Africa but nonetheless redirect them towards locally pressing situations and problem solvers. In these moments, the geography of transformation becomes more open, and apparent universalist boundaries between core and periphery blur or dissolve.

These moments described above can be understood as instances of performative agency (Butler, 2010), in which possible positions are iteratively brought into being through what people say and do. From this perspective, actors do not step outside existing relations of power, but act within them in ways that subtly challenge dominant assumptions - about what counts as innovation, who can be recognised as an innovator, and where meaningful change can come from. When a locally produced technology is treated as meaningful despite being marginalised, or when individuals assert themselves as innovators in the absence of external validation, alternative ways of being and acting become intelligible (Butler, 2010).

However, these openings are often partial and temporary. Even longer-term initiatives, such as JICA's support programme to IPRC Tumba, create opportunities for alternative positions, such as the rurally located and knowledgeable innovator, whose lack of financial resources, global networks and formal education have no inherent bearing on their ability to tackle pressing issues. However they do not fully displace more established patterns. These moments reflect what Butler (2014) describes as "promising moments of instability": they interrupt dominant ways of organising the world without fully replacing them. At the same time, they make visible how flows of capital, knowledge, and technology continue to

stabilise particular arrangements, shaping the conditions under which agency can be exercised. The positions in transformation which different people come to inhabit are not fixed, but they might be thought of as sticky.

At a broad level, this thesis therefore shows how transformation efforts can have ambivalent effects in shaping how people find their place in the world. On the one hand, they can reproduce enduring hierarchies between recognised centres of innovation and places cast primarily as recipients or adapters, echoing the quotation from Mavhunga (2017) which I opened this thesis with. On the other hand, they can unsettle these hierarchies through situated practices that reshape how people and places are positioned, while also creating opportunities to question and rework how agency - and thus the capacity to act in the world - is distributed and enacted.

The Akan[8] principle of *Sankofa* advocates that one must learn from the past to build a better future. Scholarly applications of Sankofa have sought to emphasise the value in recognising how African pasts might be reclaimed or refined in articulations of possible futures: thus also cautioning against forgetting these histories (Osei, 2020). As described above, the recurrence of universalist framings and flows between actors and places can at times replay relations of coloniality through transformation whilst simultaneously obscuring the historically situated character of these relations (Arora & Stirling, 2023). This resonates with scholarly claims that modernist articulations of innovation oriented towards singular technological frontiers can, despite gesturing towards the future, simultaneously reproduce relations of coloniality (Tarvainen, 2022). I draw parallels to this literature cautiously and without judgement of those actors pursuing universalist agendas of catch-up or leap-frogging. I recognise the agency exercised within doing so as well as the potential of these agendas to drive meaningful change in people's lives and to create emergent and plural modernities (Ferguson, 1994).

Nonetheless staying with the principle of Sankofa, I believe the particular acts of performative agency (Butler, 2010) I have observed in this thesis re-engage and embody a deep tradition of performative acts seeking to bring new realities into being (Osei, 2020). These acts echo the claim made by Thomas Sankara, first President of Burkina Faso, that "you cannot carry out fundamental change without a certain amount of madness… the courage to invent the future" (quoted in Mavhunga, 2023), as well Senghor's proposal of Négritude as a means of forging alternative identities which resist subjugation (Mavhunga, 2023). The situationally embedded geometry's emphasis on basing the legitimacy of knowledges on their relevance to a given situation, regardless of their provenance, likewise echoes Senghor's calls for people to be able to freely choose the knowledge they engage with without this being understood to confine them to subaltern relations (Táíwò, 2022). These seminal contributions resonate today in subjectivities of innovation and energy transformation which performatively resist relations of coloniality.

[8] The Akan are an ethnolinguistic grouping of people speaking Akan languages, primarily concentrated in present-day Ghana (Britannica, 2026).

8 Conclusion

8.1 Concluding thoughts

This thesis has shown that transformation efforts are not only about changing technologies or systems, but about organising how people and places relate to each other - and, in doing so, how these people come to know their place in the world. Across the empirical material, multiple ways of spatially relating people and places to each other through transformation - the "power geometries" (Massey, 1993) I characterise in this kappa - coexist and overlap. Actors move between them, sometimes simultaneously inhabiting different subjectivities depending on how they are positioned within flows of capital, knowledge and technology. Despite this multiplicity, universalist approaches to understanding and enacting innovation and transformation remain the most strongly stabilised, underpinned by larger and more consistent flows of capital and by widely shared assumptions about what counts as innovation and who is qualified to enact it. This configuration tends to reproduce spatial hierarchies in which certain locations are recognised as sources of expertise and innovation, while others are positioned as sites of uptake or adaptation. These patterns echo longer histories of coloniality which are re-enacted through contemporary practices of funding, expertise and technological development (Nkrumah, 2004; Quijano, 2007; Oliveira, 2021).

At the same time, the thesis has highlighted the presence of alternative ways of spatially relating people and places to each other. Locationally and situationally embedded configurations demonstrate different ways of organising transformation, in which legitimacy is tied to context, relevance and use rather than to proximity to global technological frontiers. These are not abstract possibilities: they are materially enacted in practices such as collaborative design, local fabrication, and the adaptation of circulating knowledge to specific situations. These alternative configurations do not sit outside dominant arrangements. They are enacted within the same broader landscape of flows and constraints, but point towards more contextually grounded forms of transformation.

The effects of these dynamics are uneven. While dominant interpretations of innovation which aspire towards universalist technology frontiers continue to structure who is most readily recognised as an innovator or transformation catalyst, alternative practices create openings - however partial - for different subjectivities to emerge. These openings may be fragile, temporary, or only locally recognised, but they nonetheless expand what transformation can look like and who can participate in it. Seen in this way, transformation is not a singular process moving in a single direction, but a field of ongoing negotiation. It involves the continual reproduction of more dominant ways of ordering spatial relations alongside the emergence of alternative ways of relating actors, places and practices. The significance of these alternatives does not depend on their immediate dominance. In the context of this thesis, their significance rather lies in expanding the range of African energy futures considered possible by making different configurations thinkable and practicable.

8.2 Limitations and further work

Several limitations of this thesis point towards productive avenues for future research. First, the subjectivities and power geometries identified here emerge from a specific set of empirical cases and from the research design through which they were assembled. The analysis therefore does not seek to provide an exhaustive account of the possible ways in which actors may be positioned within, or make sense of, transformation. Other configurations, subject positions and spatial relations are undoubtedly enacted in different contexts and sectors. My contribution here lies less in identifying a definitive set of transformation subjectivities than in demonstrating how actors claim, negotiate and move between subject positions associated with different power geometries. The findings suggest that there are always multiple possibilities for how actors may be understood in relation to transformation, even where particular configurations become more strongly stabilised than others.

Second, while the thesis has shown how different subject positions are associated with particular interpretations of innovation and transformation, it has only begun to explore how these positions intersect with other dimensions of social difference. Questions of gender, class, age, ethnicity, nationality and professional identity appear throughout the empirical material, but they were not the primary focus of analysis. Future research could build upon the framework developed here to examine more systematically how innovation and transformation subjectivities are shaped through the intersection of multiple social categories and forms of power. Such work could provide a more detailed understanding of why some actors are more readily recognised as innovators, experts or transformation catalysts than others, and how these recognitions vary across contexts.

Third, the thesis has primarily focused on how actors understand, articulate and perform different positions within transformation. While this provides insight into the interpretative dimensions of transformation, further research could examine more closely how these subject positions are sustained, contested or transformed over time. Longitudinal research could be particularly valuable in tracing how shifts in funding arrangements, policy priorities, technological trajectories or institutional structures affect the positions available to different actors and the power geometries through which transformation is organised over time.

Finally, the theorisation I have developed in this thesis may be useful beyond the empirical settings examined in this thesis. Future work could apply, refine or challenge the concepts of power geometries and transformation subjectivities in different geographical regions, sectors and domains of sustainability transformation. This kind of work might help to establish which aspects of the patterns identified here are specific to the cases examined and which may reflect broader dynamics in the organisation of innovation and transformation (whilst remaining cautious about generalisation).

Taken together, these limitations point towards a broader research agenda concerned with the relationship between spatial relations, subjectivities, innovation and transformation. By drawing attention to how actors are positioned within different configurations of knowledge, capital and technology, this thesis opens up further questions about how alternative ways of organising transformation become imaginable, legitimate and actionable.

Disclosure statement on usage of artificial intelligence

Large Language Models such as ChatGPT were not widely available at the outset of my PhD (Lee, 2025), and Articles 1, 2, 4 and 5 were produced entirely without them. I have been a relatively late adopter of the technology, and I remain an intermittent user; a combination of initial ignorance of its capabilities and some (remaining) suspicion about its impacts upon both myself and wider society. However I have used ChatGPT sparingly in the later stages of this PhD to develop Article 3 and this thesis kappa in two ways. First, I have used it on occasion as a tool for clarifying theoretical concepts or checking my interpretations. For instance, I used it to help unpack Butler (2010)'s distinction between illocutionary and perlocutionary performatives when I initially struggled to fully grasp the difference, whilst sensing it was highly relevant to my work. I have also experimented with using it more playfully - for example, asking it to narrate a fictionalised argument between theorists based on their conflicting claims. I do not treat this as a reliable reflection of their work, and acknowledge some tension in having done this due to the likelihood that these theorists have not consented to LLMs being trained on their work. Second, I have used ChatGPT as a practical tool to suggest reductions in word count, given my habitual tendency to write excessively lengthy drafts. I review and selectively apply these suggestions.

Both of these uses have been guided by principles which have emerged somewhat organically through ongoing internal dialogue (as well as seemingly unavoidable conversation amongst friends and colleagues about AI). First, I do not use LLMs to do data collection or analysis. Whilst I do not propose this as a dogmatic rule to be followed by all academics, I personally believe that doing qualitative analysis of the kind I undertake in this thesis is best undertaken by a (human) author. It has enabled me to become deeply familiar with the source material, helped me to see patterns, re-engaged micro-observations from the original fieldwork I thought I had forgotten (particularly around gendered and racialised elements of subjectivities), and ultimately led me to feel confident in defending this analysis. Second, I do not use LLMs to write original text, only to cut it. As a social scientist, my positionality would be fundamentally altered if a LLM analysed or wrote this thesis on my behalf (Jowsey et al., 2025). I attribute significant personal importance to being able to clearly recognise this work as my own, for better or worse (see Section 4.7). Whilst I do not cast judgement on works of more involved co-production between humans and LLMs (and my limited usage of LLMs in the ways described above means it can still be understood as such an act of co-production), I do not believe my usage of LLMs has fundamentally altered my positionality as the author of this thesis.

References

Adebisi, Foluke Ifejola. “Decolonising Education in Africa: Implementing the Right to Education by Re-Appropriating Culture and Indigeneity Special Issue: The Right to Education.” *Northern Ireland Legal Quarterly* 67, no. 4 (2016): 433–52.

Adesina, Jimi O. “2 - Variations in Postcolonial Imagination: Reflection on Senghor, Nyerere and Nkrumah.” *Africa Development* 47, no. 1 (2022). https://doi.org/10.57054/ad.v47i1.1789.

AFDB. “Accelerating Africa’s Energy Transition.” Text. African Development Bank Group, African Development Bank Group, 2025. https://www.afdb.org/en/mission-300-africa-energy-summit/accelerating-africas-energy-transition.

AFDB. “RWANDA COUNTRY FOOD AND AGRICULTURE DELIVERY COMPACT.” 2023. https://www.afdb.org/en/documents/rwanda-country-food-and-agriculture-delivery-compact.

African Union. *African Union’s Digital Education Strategy and Implementation Plan | Digital Watch Observatory*. n.d. https://doi.org/2022.

Agnew, John A. *Place and Politics: The Geographical Mediation of State and Society*. Routledge, 2014. https://doi.org/10.4324/9781315756585.

Ahlborg, Helene. “Changing Energy Geographies: The Political Effects of a Small-Scale Electrification Project.” *Geoforum* 97 (December 2018): 268–80. https://doi.org/10.1016/j.geoforum.2018.09.016.

Ahlborg, Helene. “Towards a Conceptualization of Power in Energy Transitions.” *Environmental Innovation and Societal Transitions* 25 (December 2017): 122–41. https://doi.org/10.1016/j.eist.2017.01.004.

Ahlborg, Helene, Kavya Michael, Samuel John Unsworth, et al. “Thirty-Five Years of Research on Energy and Power: A Landscape Analysis.” *Renewable and Sustainable Energy Reviews* 199 (July 2024): 114542. https://doi.org/10.1016/j.rser.2024.114542.

Ahlborg, Helene, and Andrea J. Nightingale. “Theorizing power in political ecology: the ‘where’ of power in resource governance projects.” *Journal of Political Ecology* 25, no. 1 (2018). https://doi.org/10.2458/v25i1.22804.

Ahlborg, Helene, Ilse Ruiz-Mercado, Sverker Molander, and Omar Masera. “Bringing Technology into Social-Ecological Systems Research—Motivations for a Socio-Technical-Ecological Systems Approach.” *Sustainability* 11, no. 7 (2019): 7. https://doi.org/10.3390/su11072009.

Ahmed, Kaamil. “Sweden and Germany Slash Aid Budgets to Focus on Ukraine and Defence Spending.” Global Development. *The Guardian*, December 21, 2025. https://www.theguardian.com/global-development/2025/dec/21/sweden-and-germany-slash-aid-budgets-to-focus-on-ukraine-and-defence-spending.

Alalade, F. O. “Senghor, the Rise of the Dominant Party and Return to Limited Multi-Party System in Senegal.” *Journal of the Historical Society of Nigeria* 11, no. 1/2 (1981): 36–51.

Allan, Joanna, Mahmoud Lemaadel, and Hamza Lakhal. “Oppressive Energopolitics in Africa’s Last Colony: Energy, Subjectivities, and Resistance.” *Antipode* 54, no. 1 (2022): 44–63. https://doi.org/10.1111/anti.12765.

Alum, Esther Ugo. “The Role of Indigenous Knowledge in Advancing the Therapeutic Use of Medicinal Plants: Challenges and Opportunities.” *Plant Signaling & Behavior* 19, no. 1 (2024): 2439255. https://doi.org/10.1080/15592324.2024.2439255.

Amarante, Verónica, Ronelle Burger, Grieve Chelwa, et al. “Underrepresentation of Developing Country Researchers in Development Research.” *Applied Economics Letters* 0, no. 0 (2021): 1–6. https://doi.org/10.1080/13504851.2021.1965528.

Anderson, Ben, Matthew Kearnes, Colin McFarlane, and Dan Swanton. “On Assemblages and Geography.” *Dialogues in Human Geography* 2, no. 2 (2012): 171–89. https://doi.org/10.1177/2043820612449261.

Andersson, Claes, and Petter Törnberg. “Wickedness and the Anatomy of Complexity.” *Futures* 95 (January 2018): 118–38. https://doi.org/10.1016/j.futures.2017.11.001.

Andersson, Johnn, Hans Hellsmark, and Björn Sandén. “The Outcomes of Directionality: Towards a Morphology of Sociotechnical Systems.” *Environmental Innovation and Societal Transitions* 40 (September 2021): 108–31. https://doi.org/10.1016/j.eist.2021.06.008.

Andersson, Johnn, Kristina Hojcková, and Björn A. Sandén. “On the Functional and Structural Scope of Technological Innovation Systems – A Literature Review with Conceptual Suggestions.” *Environmental Innovation and Societal Transitions* 49 (December 2023): 100786. https://doi.org/10.1016/j.eist.2023.100786.

Anseeuw, Ward. “The Rush for Land in Africa: Resource Grabbing or Green Revolution?” *South African Journal of International Affairs* 20, no. 1 (2013): 159–77. https://doi.org/10.1080/10220461.2013.780326.

Archer, Matthew. “Governing through ESG and the Green Spirit of Asset Manager Capitalism.” *Environment and Planning A: Economy and Space* 56, no. 2 (2024): 662–78. https://doi.org/10.1177/0308518X231156611.

Archibong, Belinda, Brahima Coulibaly, and Ngozi Okonjo-Iweala. “Washington Consensus Reforms and Lessons for Economic Performance in Sub-Saharan Africa.” *Journal of Economic Perspectives* 35, no. 3 (2021): 133–56. https://doi.org/10.1257/jep.35.3.133.

Arora, Saurabh, and Andy Stirling. “Colonial Modernity and Sustainability Transitions: A Conceptualisation in Six Dimensions.” *Environmental Innovation and Societal Transitions* 48 (September 2023): 100733. https://doi.org/10.1016/j.eist.2023.100733.

Ash, James, Rob Kitchin, and Agnieszka Leszczynski. “Digital Turn, Digital Geographies?” *Progress in Human Geography* 42, no. 1 (2018): 25–43. https://doi.org/10.1177/0309132516664800.

Ashukem, Jean-Claude N. “Land Grabbing in the Anthropocene and the ‘Questionable’ Pursuit of Sustainability in Africa – Highlighting Ecological Disproportionality.” In *Human Rights and the Environment in Africa*. Routledge, 2023.

Atamanov, Aziz, Pablo Facundo Cuevas, Jeremy Aaron Lebow, and Daniel Gerszon Mahler. “New Evidence on Inequality of Opportunity in Sub-Saharan Africa : More Unequal Than We Thought.” *Policy Research Working Paper Series*, Policy Research Working Paper Series, March 18, 2024, 10723. https://ideas.repec.org//p/wbk/wbrwps/10723.html.

Augusto, Geri. *Plants of Bondage, Limbo Plants, and Liberation Flora: Diasporic Reflections for STS in Africa and Africa in STS*. June 9, 2017. https://doi.org/10.7551/mitpress/10769.003.0007.

Avelino, Flor, and Julia Wittmayer. “Shifting Power Relations in Sustainability Transitions: A Multi-Actor Perspective.” *Journal of Environmental Policy & Planning* 18 (July 2016): 628–49. https://doi.org/10.1080/1523908X.2015.1112259.

Ayeta Mulyanyuma, Aaron, and Julius Niringiyimana. *Vulnerability of Energy Infrastructure to Climate Change in East Africa and Peter Nareeba*. June 1, 2024, 240–50.

Ayim, Claudia, Ayalew Kassahun, Chris Addison, and Bedir Tekinerdogan. “Adoption of ICT Innovations in the Agriculture Sector in Africa: A Review of the Literature.” *Agriculture & Food Security* 11, no. 1 (2022): 22. https://doi.org/10.1186/s40066-022-00364-7.

Ba, Mame-Penda, and Philippe Cury. “The Transformation of Africa’s Knowledge: Thinking African Futures in Response to Global Challenges.” *Global Africa*, Vol. 1, n° 1, p. 10-21, 2022.

Backhouse, Maria. “Global Inequalities and Extractive Knowledge Production in the Bioeconomy.” In *Bioeconomy and Global Inequalities: Socio-Ecological Perspectives on Biomass Sourcing and Production*, edited by Maria Backhouse, Rosa Lehmann, Kristina Lorenzen, et al. Springer International Publishing, 2021. https://doi.org/10.1007/978-3-030-68944-5_2.

Baker, Lucy. “New Frontiers of Electricity Capital: Energy Access in Sub-Saharan Africa.” *New Political Economy* 28, no. 2 (2023): 206–22. https://doi.org/10.1080/13563467.2022.2084524.

Baker, Lucy H., Umberto Cao, Ellen Fungisai Chipango, Hilman Syahri Fathoni, Paul G. Munro, and Shanil Samarakoon. “Electricity Capital and Energy Poverty.” In *Electricity Capital and Energy Poverty: Perspectives From Developmental States and Decentralised Markets*, edited by Lucy H. Baker, Umberto Cao, Ellen Fungisai Chipango, Hilman Syahri Fathoni, Paul G. Munro, and Shanil Samarakoon. Springer Nature Switzerland, 2025. https://doi.org/10.1007/978-3-031-94358-4_1.

Baker, Max, and Sven Modell. “Rethinking Performativity: A Critical Realist Analysis of Accounting for Corporate Social Responsibility.” *Accounting, Auditing & Accountability Journal* 32, no. 4 (2019): 930–56. https://doi.org/10.1108/AAAJ-11-2017-3247.

Barakabitze, Alcardo Alex, Anangisye William-Andey Lazaro, Neterindwa Ainea, et al. “Transforming African Education Systems in Science, Technology, Engineering, and Mathematics (STEM) Using ICTs: Challenges and Opportunities.” *Education Research International* 2019, no. 1 (2019): 6946809. https://doi.org/10.1155/2019/6946809.

Barrie, Jack, and Heather J. Cruickshank. “Shedding Light on the Last Mile: A Study on the Diffusion of Pay As You Go Solar Home Systems in Central East Africa.” *Energy Policy* 107 (August 2017): 425–36. https://doi.org/10.1016/j.enpol.2017.05.016.

Behuria, Pritish. “Learning from Role Models in Rwanda: Incoherent Emulation in the Construction of a Neoliberal Developmental State.” *New Political Economy* 23, no. 4 (2018): 422–40. https://doi.org/10.1080/13563467.2017.1371123.

Bellacasa, Maria Puig de la. “Matters of Care in Technoscience: Assembling Neglected Things.” *Social Studies of Science* 41, no. 1 (2011): 85–106. https://doi.org/10.1177/0306312710380301.

Bennett, Nathan J., Jessica Blythe, Andrés M. Cisneros-Montemayor, Gerald G. Singh, and U. Rashid Sumaila. “Just Transformations to Sustainability.” *Sustainability* 11, no. 14 (2019). https://doi.org/10.3390/su11143881.

Bergek, Anna, Staffan Jacobsson, Bo Carlsson, Sven Lindmark, and Annika Rickne. “Analyzing the Functional Dynamics of Technological Innovation Systems: A Scheme of Analysis.” *Research Policy* 37, no. 3 (2008): 407–29. https://doi.org/10.1016/j.respol.2007.12.003.

Berkovic, Danielle. *Chapter 13: Interviews*. March 21, 2023. https://oercollective.caul.edu.au/qualitative-research/chapter/13/.

Bertolt, Boris. “Thinking Otherwise: Theorizing the Colonial/Modern Gender System in Africa.” *African Sociological Review / Revue Africaine de Sociologie* 22, no. 1 (2018): 2–17.

Bhuiyan, Johana, and Dara Kerr. “Zuckerberg’s Swerve: How Diversity Went from Being a Meta Priority to Getting Cancelled.” Technology. *The Guardian*, February 11, 2025. https://www.theguardian.com/technology/ng-interactive/2025/feb/11/dei-meta-facebook.

Biedermann, Zsuzsánna. “The Case of Rwanda as a Developmental State.” In *Entrepreneurship and SME Management Across Africa: Context, Challenges, Cases*, edited by Leona Achtenhagen and Ethel Brundin. Springer, 2016. https://doi.org/10.1007/978-981-10-1727-8_9.

Biggar, Nigel. *Colonialism: A Moral Reckoning*. William Collins, 2023.

Binz, Christian, and Carolina Castaldi. “Toward a Normative Turn in Research on the Geography of Innovation? Evolving Perspectives on Innovation, Institutions, and Human Well-Being.” *Progress in Economic Geography* 2, no. 2 (2024): 100018. https://doi.org/10.1016/j.peg.2024.100018.

Bisaga, Iwona, and Priti Parikh. “To Climb or Not to Climb? Investigating Energy Use Behaviour among Solar Home System Adopters through Energy Ladder and Social Practice Lens.” *Energy Research & Social Science* 44 (October 2018): 293–303. https://doi.org/10.1016/j.erss.2018.05.019.

Bois, W. E. B. Du, Mahmood Mamdani, and Gerald Horne. *The World and Africa and Color and Democracy*. Edited by Henry Louis Gates Jr. OUP USA, 2014.

Borger, Julian. "Trump's Territorial Ambition: New Imperialism or a Case of the Emperor's New Clothes?" News. *The Guardian*, January 10, 2026. https://www.theguardian.com/news/ng-interactive/2026/jan/10/trump-territorial-ambition-imperialism.

Boschma, Ron. "Proximity and Innovation: A Critical Assessment." *Regional Studies* 39, no. 1 (2005): 61–74. https://doi.org/10.1080/0034340052000320887.

Bourdieu, Pierre, and Loïc Wacquant. "On the Cunning of Imperialist Reason." *Theory, Culture & Society* 16, no. 1 (1999): 41–58. https://doi.org/10.1177/026327699016001003.

Bouzarovski, Stefan, and Håvard Haarstad. "Rescaling Low-Carbon Transformations: Towards a Relational Ontology." *Transactions of the Institute of British Geographers* 44, no. 2 (2019): 256–69. https://doi.org/10.1111/tran.12275.

Braun, Virginia, and Victoria Clarke. "Using Thematic Analysis in Psychology." *Qualitative Research in Psychology* 3, no. 2 (2006): 77–101. https://doi.org/10.1191/1478088706qp063oa.

Bridge, Gavin. "The Map Is Not the Territory: A Sympathetic Critique of Energy Research's Spatial Turn." *Energy Research & Social Science*, Spatial Adventures in Energy Studies:, vol. 36 (February 2018): 11–20. https://doi.org/10.1016/j.erss.2017.09.033.

Brien, Philip, and Philip Loft. *UK to Reduce Aid to 0.3% of Gross National Income from 2027*. February 28, 2025. https://commonslibrary.parliament.uk/uk-to-reduce-aid-to-0-3-of-gross-national-income-from-2027/.

Britannica. "Akan | West African, Ghana, Ivory Coast | Britannica." February 26, 2026. https://www.britannica.com/topic/Akan.

Britwum, Kofi, and Matty Demont. "Trading off Consumer Preferences Induced by Cultural and Colonial Heritage: Lessons from New Rice for Africa (NERICA) in Casamance, Senegal." *Q Open* 1, no. 2 (2021). https://doi.org/10.1093/qopen/qoab014.

Brunori, Paolo, Flaviana Palmisano, and Vitorocco Peragine. "Inequality of Opportunity in Sub-Saharan Africa." *Applied Economics* 51, no. 60 (2019): 6428–58. https://doi.org/10.1080/00036846.2019.1619018.

Bryant, Gareth, and Sophie Webber. *Climate Finance: Taking a Position on Climate Futures*. 2024. https://library.oapen.org/handle/20.500.12657/88193.

Bufacchi, Vittorio. "Trump's Greenland Threat Exposes a New Era of American Empire-Building." Irish Examiner, January 23, 2026. https://www.irishexaminer.com/opinion/commentanalysis/arid-41780297.html.

Bülow, Nele, and Chigozie Nweke-Eze. "Investigating Green Colonialism and Energy Justice in the Development of Lake Turkana Wind Power Project in Kenya." In *The Emerald Handbook of*

Sustainable Energy Transition and Social Justice: Contemporary Issues and Debates in the Global South, edited by Julius Omokhudu Irene, Bridget Nneka Irene, Kingsley Obi Omeihe, and Regina Frank. Emerald Publishing Limited, 2025. https://doi.org/10.1108/978-1-83708-812-620251003.

Bunyan, Elle. "Is the Mzungu Phenomenon a Help or Hinderance?: The Repercussions of Western Childcare Interventions among Street Children in Kampala, Uganda." *International Journal of Research in Business and Social Science (2147- 4478)* 10 (September 2021): 242–55. https://doi.org/10.20525/ijrbs.v10i6.1320.

Burkitt, Ian. "Relational Agency: Relational Sociology, Agency and Interaction." *European Journal of Social Theory* 19, no. 3 (2016): 322–39. https://doi.org/10.1177/1368431015591426.

Busumtwi-Sam, James, and Rina Kashyap. "Racialised Representations and the Global South: Insights from Critical Race Studies." *India Quarterly* 81, no. 2 (2025): 158–80. https://doi.org/10.1177/09749284251328227.

Butler, Judith. *Bodies That Matter: On the Discursive Limits of "Sex."* Routledge, 2014. https://doi.org/10.4324/9780203760079.

Butler, Judith. "Performative Agency." *Journal of Cultural Economy* 3, no. 2 (2010): 147–61. https://doi.org/10.1080/17530350.2010.494117.

Carpenter, Carol. "Subject Formation in Foucault." In *Power in Conservation*. Routledge, 2020.

Castree, N. "The Epistemology of Particulars: Human Geography, Case Studies and 'Context.'" *Geoforum* 36, no. 5 (2005): 541–44. https://doi.org/10.1016/j.geoforum.2005.08.001.

Cederlöf, Gustav. "Energy as Object and Relation: Thermodynamics, Space, and Emergent Energy Geographies." *Geoforum* 150 (March 2024): 103968. https://doi.org/10.1016/j.geoforum.2024.103968.

Cetina, Karin Knorr. *Epistemic Cultures: How the Sciences Make Knowledge*. Harvard University Press, 1999. https://doi.org/10.2307/j.ctvxw3q7f.

Chalmers. "About Genie | Chalmers." 2023. https://www.chalmers.se/en/about-chalmers/Chalmers-for-a-sustainable-future/initiatives-for-gender-equality/gender-initiative-for-excellence/Pages/about-genie.aspx.

Chalmers University. "Processing of Personal Data." October 17, 2025. https://www.chalmers.se/en/about-chalmers/about-the-website/processing-of-personal-data/.

Chancel, Lucas, Denis Cogneau, Amory Gethin, Alix Myczkowski, and Anne-Sophie Robilliard. "Income Inequality in Africa, 1990–2019: Measurement, Patterns, Determinants." *World Development* 163 (March 2023): 106162. https://doi.org/10.1016/j.worlddev.2022.106162.

Cheeseman, Nic. *Democracy in Africa: Successes, Failures, and the Struggle for Political Reform*. New Approaches to African History. Cambridge University Press, 2015. https://doi.org/10.1017/CBO9781139030892.

Chipanda, Blessing. “Tackling Working Poverty and Informality in Africa’s Labour Future.” 2025. https://futures.issafrica.org/blog/2025/Tackling-working-poverty-and-informality-in-Africas-labour-future.

Chipato, Farai. “The Global Politics of African Identity: Pan-Africanism and the Challenge of Afropolitanism.” *Global Studies Quarterly* 3, no. 3 (2023): ksad046. https://doi.org/10.1093/isagsq/ksad046.

Chirikure, Shadreck. *The Metalworker, the Potter, and the Pre-European African “Laboratory.”* June 9, 2017. https://doi.org/10.7551/mitpress/10769.003.0006.

Chu-Fuluifaga, Cherie. *Decolonizing Methodologies: A Pacific Island Lens*. 2023. https://doi.org/10.1007/978-3-031-04394-9_19.

Churchman, C. West. *Challenge to Reason*. First Edition. Mcgraw- Hill Book Company, 1968.

Cirolia, Liza Rose, Rike Sitas, Andrea Pollio, Alexis Gatoni Sebarenzi, and Prince K. Guma. “Silicon Savannahs and Motorcycle Taxis: A Southern Perspective on the Frontiers of Platform Urbanism.” *Environment and Planning A: Economy and Space* 55, no. 8 (2023): 1989–2008. https://doi.org/10.1177/0308518X231170193.

Climate Action 100+. “Climate Action 100+ Progress Report Records Accelerated Company Commitments to Net-Zero Emissions but Gaps Remain.” Climate Action 100+, December 17, 2020. https://www.climateaction100.org/news/climate-action-100-progress-report-records-accelerated-company-commitments-to-net-zero-emissions-but-gaps-remain/.

Coban, Alev. *Performing Technocapitalism: The Politics and Affects of Postcolonial Technology Entrepreneurship in Kenya*. Social and Cultural Geography, 21, 2024. https://www.ssoar.info/ssoar/bitstream/handle/document/93798/ssoar-2024-coban-Performing_Technocapitalism_The_Politics_and.pdf?sequence=1&isAllowed=y&lnkname=ssoar-2024-coban-Performing_Technocapitalism_The_Politics_and.pdf.

Coenen, Lars, Christian Binz, James Murphy, and Bernhard Truffer. “Place and Scale in Sustainability Transitions.” Preprint, Cambridge Open Engage, December 3, 2024. https://doi.org/10.33774/coe-2024-tk5mm.

Collins, Harry. *Changing Order : Replication and Induction in Scientific Practice*. Chicago University Press, 1992.

Collins, Patricia Hill. “Intersectionality and Epistemic Injustice.” In *The Routledge Handbook of Epistemic Injustice*. Routledge, 2017.

Collins, Patricia Hill, Elaini Cristina Gonzaga da Silva, Emek Ergun, Inger Furseth, Kanisha D. Bond, and Jone Martínez-Palacios. “Intersectionality as Critical Social Theory.” *Contemporary Political Theory* 20, no. 3 (2021): 690–725. https://doi.org/10.1057/s41296-021-00490-0.

Construction Hub. “Major Infrastructure Projects Completed and Inaugurated Across Rwanda in 2025.” *CONSTRUCTION HUB*, 2026. https://constructionhub.rw/major-infrastructure-projects-completed-and-inaugurated-across-rwanda-in-2025major-infrastructure-projects-completed-and-inaugurated-across-rwanda-in-2025/.

Cottrell, Michael. *Critical Theory*. 2023. https://doi.org/10.1007/978-3-031-04394-9_17.

Cranston, Sophie. “Expatriate as a ‘Good’ Migrant: Thinking Through Skilled International Migrant Categories.” *Population, Space and Place* 23, no. 6 (2017): e2058. https://doi.org/10.1002/psp.2058.

Crivello, Gina. “‘There’s No Future Here’: The Time and Place of Children’s Migration Aspirations in Peru.” *Geoforum* 62 (June 2015): 38–46. https://doi.org/10.1016/j.geoforum.2015.03.016.

Damoah, Benjamin, and Richard Boglo. “Nuances of Economic Development and Environmental Sustainability in Sub-Saharan Africa.” *Discover Sustainability* 6, no. 1 (2025): 999. https://doi.org/10.1007/s43621-025-01796-4.

Darko, Christian, Giovanni Occhiali, and Enrico Vanino. “The Chinese Are Here: Import Penetration and Firm Productivity in Sub-Saharan Africa.” *The Journal of Development Studies* 57, no. 12 (2021): 2112–35. https://doi.org/10.1080/00220388.2021.1956468.

Davies, Maia, and Imogen Foulkes. “UN Risks ‘Imminent Financial Collapse’, Secretary General Warns.” BBC News, January 30, 2026. https://www.bbc.co.uk/news/articles/cr579mdv4m7o.

Dawson, Neil, Adrian Martin, and Thomas Sikor. “Green Revolution in Sub-Saharan Africa: Implications of Imposed Innovation for the Wellbeing of Rural Smallholders.” *World Development* 78 (2016): 204–18. https://doi.org/10.1016/j.worlddev.2015.10.008.

De Becker, Laura. “Imagining the Post-Colonial and Post-Genocidal Nation in the National Museum of Rwanda, Butare.” *Critical Interventions* 10, no. 3 (2016): 293–308. https://doi.org/10.1080/19301944.2016.1227587.

Deberdt, Raphael, and Philippe Le Billon. “Green Transition’s Necropolitics: Inequalities, Climate Extractivism, and Carbon Classes.” *Antipode* 56, no. 4 (2024): 1264–88. https://doi.org/10.1111/anti.13032.

Dei, George J. Sefa, and Alireza Asgharzadeh. “What Is to Be Done? A Look at Some Causes and Consequences of the African Brain Drain.” *African Issues* 30, no. 1 (2002): 31–36. https://doi.org/10.2307/1167087.

Diagne, Souleymane Bachir. *Négritude*. May 24, 2010. https://plato.stanford.edu/entries/Negritude/.

Dorn, Felix Malte. “Green Colonialism in Latin America? Towards a New Research Agenda for the Global Energy Transition.” *European Review of Latin American and Caribbean Studies* 0, no. 114 (2022). https://doi.org/10.32992/erlacs.10939.

Duarte, Mary T. “Education in Ruanda-Urundi, 1946-61.” *The Historian* 57, no. 2 (1994): 275–84. https://doi.org/10.1111/j.1540-6563.1995.tb01492.x.

Ducastel, Antoine, and Bregje Van Veelen. “Green Finance and Capital Landing.” *Finance and Space* 3, no. 1 (2026): 2616494. https://doi.org/10.1080/2833115X.2026.2616494.

Earthy, and Cronin. “Narrative Analysis.” In *Researching Social Life*, 3rd edition. University of Surrey, 2008. https://openresearch.surrey.ac.uk/esploro/outputs/bookChapter/Narrative-Analysis/99513072602346/filesAndLinks?index=0.

Eisenhardt, Kathleen M. “Building Theories from Case Study Research.” *The Academy of Management Review* 14, no. 4 (1989): 532–50. https://doi.org/10.2307/258557.

Eltis, David, and Lawrence C. Jennings. “Trade between Western Africa and the Atlantic World in the Pre-Colonial Era.” *The American Historical Review* 93, no. 4 (1988): 936–59. https://doi.org/10.1086/ahr/93.4.936.

Faguy, Anna. “USAID Officially Closes, Attracting Condemnation from Obama and Bush.” BBC News, July 2, 2025. https://www.bbc.co.uk/news/articles/c307zq8ppj6o.

Fairhead, James, Melissa Leach, and Ian Scoones. “Green Grabbing: A New Appropriation of Nature?” *The Journal of Peasant Studies* 39, no. 2 (2012): 237–61. https://doi.org/10.1080/03066150.2012.671770.

Falola, Toyin. *A History of West Africa*. Routledge, 2024.

Fanon, Frantz. *Black Skin, White Masks*. Repr. Pluto Classics. Pluto Press, 2002.

Fanon, Frantz. *The Wretched of the Earth*. Translated by Constance Farrington. Penguin Classics, 2001.

Feola, Giuseppe. “Societal Transformation in Response to Global Environmental Change: A Review of Emerging Concepts.” *Ambio* 44, no. 5 (2015): 376–90. https://doi.org/10.1007/s13280-014-0582-z.

Ferguson, James. *Anti-Politics Machine: Development, Depoliticization, and Bureaucratic Power in Lesotho*. University of Minnesota Press, 1994.

Ferguson, James. *Global Shadows: Africa in the Neoliberal World Order*. Duke University Press, 2006.

Fischer, Lisa-Britt, and Jens Newig. “Importance of Actors and Agency in Sustainability Transitions: A Systematic Exploration of the Literature.” *Sustainability* 8, no. 5 (2016). https://doi.org/10.3390/su8050476.

Flanagan, Kieron, Elvira Uyarra, and Iris Wanzenböck. “Towards a Problem-Oriented Regional Industrial Policy: Possibilities for Public Intervention in Framing, Valuation and Market Formation.” *Regional Studies* 57, no. 6 (2023): 998–1010. https://doi.org/10.1080/00343404.2021.2016680.

Foucault, Michel. “The Subject and Power.” *Critical Inquiry*, ahead of print, July 1, 1982. World. https://doi.org/10.1086/448181.

Franz, Tobias, and Angus McNelly. “The ‘Finance-Extraction-Transitions Nexus’: Geographies of the Green Transition in the 21st Century.” *Antipode* 56, no. 4 (2024): 1289–307. https://doi.org/10.1111/anti.13049.

Freire, Paulo. *Pedagogy of the Oppressed*. Penguin Education edition. Penguin, 1996.

Fussell, Jim. *Group Classification on National ID Cards as a Factor in Genocide and Ethnic Cleansing*. January 1, 2001.

Gabor, Daniela. "The Wall Street Consensus." *Development and Change* 52, no. 3 (2021): 429–59. https://doi.org/10.1111/dech.12645.

Gaillard, Jacques, and Johann Mouton. "The State of Science, Technology and Innovation in Africa: Trends, Progress and Limitations." *Science, Technology and Society* 27, no. 3 (2022): 318–26. https://doi.org/10.1177/09717218221078548.

Geels, Frank W. "Technological Transitions as Evolutionary Reconfiguration Processes: A Multi-Level Perspective and a Case-Study." *Research Policy*, NELSON + WINTER + 20, vol. 31, no. 8 (2002): 1257–74. https://doi.org/10.1016/S0048-7333(02)00062-8.

Gereffi, Gary, John Humphrey, Raphael Kaplinsky, and Timothy J. Sturgeon. *Introduction: Globalisation, Value Chains and Development*. 2001.

Giddens, Anthony. "Comments on the Theory of Structuration." *Journal for the Theory of Social Behaviour* 13, no. 1 (1983): 75–80. https://doi.org/10.1111/j.1468-5914.1983.tb00463.x.

Giddens, Anthony. *The Constitution of Society: Outline of the Theory of Structuration*. California University Press, 1986.

Gieryn, Thomas F. "Boundary-Work and the Demarcation of Science from Non-Science: Strains and Interests in Professional Ideologies of Scientists." *American Sociological Review* 48, no. 6 (1983): 781–95. https://doi.org/10.2307/2095325.

Giller, Ken E., Thomas Delaune, João Vasco Silva, et al. "Small Farms and Development in Sub-Saharan Africa: Farming for Food, for Income or for Lack of Better Options?" *Food Security* 13, no. 6 (2021): 1431–54. https://doi.org/10.1007/s12571-021-01209-0.

Godin, Benoît. "The Linear Model of Innovation: The Historical Construction of an Analytical Framework." *Science, Technology, & Human Values* 31, no. 6 (2006): 639–67. https://doi.org/10.1177/0162243906291865.

Golooba-Mutebi, Frederick. "Politics, Political Settlements and Social Change in Post-Colonial Rwanda." SSRN Scholarly Paper No. 2386700. Social Science Research Network, October 1, 2013. https://doi.org/10.2139/ssrn.2386700.

Goodfellow, Tom, and Alyson Smith. "From Urban Catastrophe to 'Model' City? Politics, Security and Development in Post-Conflict Kigali." *Urban Studies* 50, no. 15 (2013): 3185–202. https://doi.org/10.1177/0042098013487776.

Graeber, David, and David Wengrow. *The Dawn of Everything: A New History of Humanity*. Allen Lane, 2021.

Gregson, Nicky, and Gillian Rose. "Taking Butler Elsewhere: Performativities, Spatialities and Subjectivities." *Environment and Planning D: Society and Space* 18, no. 4 (2000): 433–52. https://doi.org/10.1068/d232.

Grosfoguel, Ramón. "The Epistemic Decolonial Turn." *Cultural Studies* 21, nos. 2–3 (2007): 211–23. https://doi.org/10.1080/09502380601162514.

Grubb, Michael, Paul Drummond, Alexandra Poncia, et al. "Induced Innovation in Energy Technologies and Systems: A Review of Evidence and Potential Implications for CO2 Mitigation." *Environmental Research Letters* 16, no. 4 (2021): 043007. https://doi.org/10.1088/1748-9326/abde07.

GSMA. "AI for Africa: Use Cases Delivering Impact." *Mobile for Development*, 2024. https://www.gsma.com/solutions-and-impact/connectivity-for-good/mobile-for-development/gsma_resources/ai-for-africa-use-cases-delivering-impact/.

Haag, Steffen, Johanna Tunn, Tobias Kalt, Franziska Müller, and Jenny Simon. *Who Profits from the Green Energy Rush? Derisking and Power Relations in Africa's Renewable Energy Finance*. The Transnational Institute, 2024. https://www.tni.org/en/article/who-profits-from-the-green-energy-rush.

Hailu, Yerasework Kebede. "Did Ethiopia Survive Coloniality: Eurocentric Colonial Interpretations of Ethiopian History: Struggle against Territorial Colonialism; The Three Unique Historical Aspects of Ethiopia; Challenges of Modernization; Did Ethiopia Avoid Colonialism." *Journal of Decolonising Disciplines* 2, no. 2 (2020). https://doi.org/10.35293/jdd.v2i2.18.

HANSSON, STINA, and SOFIE HELLBERG. "Power, Freedom and the Agency of Being Governed." In *Studying the Agency of Being Governed*. Routledge, 2015.

Haraway, Donna. "Situated Knowledges: The Science Question in Feminism and the Privilege of Partial Perspective." *Feminist Studies* 14, no. 3 (1988): 575. https://doi.org/10.2307/3178066.

Harper, Shaun. "Where Is The $200 Billion Companies Promised After George Floyd's Murder?" Forbes, 2022. https://www.forbes.com/sites/shaunharper/2022/10/17/where-is-the-200-billion-companies-promised-after-george-floyds-murder/.

Harvey, David. *The Condition of Postmodernity: An Enquiry into the Origins of Cultural Change*. Wiley-Blackwell, 1989.

Hasselskog, Malin. "Rwandan 'Home Grown Initiatives': Illustrating Inherent Contradictions of the Democratic Developmental State." *Development Policy Review* 36, no. 3 (2018): 309–28. https://doi.org/10.1111/dpr.12217.

Hategekimana, Sylvère, Helene Ahlborg, and Innocent Ndahiriwe. "Conceptualising Energy Geographies in East Africa: A Research Agenda for Exploring Spatial Dimensions of Renewable Energy Transitions." *Environmental Innovation and Societal Transitions* 54 (March 2025): 100936. https://doi.org/10.1016/j.eist.2024.100936.

Hermanussen, Carla. “Too White, Too Privileged, Too Blind? Field Research in Global South in the Shadow of Whiteness.” *International Journal of Qualitative Studies in Education*, 2026. https://www.tandfonline.com/doi/abs/10.1080/09518398.2026.2647224.

Hicks, Dan. *The Brutish Museums: The Benin Bronzes, Colonial Violence and Cultural Restitution*. Pluto Press, 2020.

Hojčková, Kristina, Björn Sandén, and Helene Ahlborg. “Three Electricity Futures: Monitoring the Emergence of Alternative System Architectures.” *Futures* 98 (April 2018): 72–89. https://doi.org/10.1016/j.futures.2017.12.004.

Holloway, Sarah L., Louise Holt, and Sarah Mills. “Questions of Agency: Capacity, Subjectivity, Spatiality and Temporality.” *Progress in Human Geography* 43, no. 3 (2019): 458–77. https://doi.org/10.1177/0309132518757654.

Hölscher, Katharina, Julia M. Wittmayer, and Derk Loorbach. “Transition versus Transformation: What’s the Difference?” *Environmental Innovation and Societal Transitions* 27 (June 2018): 1–3. https://doi.org/10.1016/j.eist.2017.10.007.

Hopkins, Debbie, Johannes Kester, Toon Meelen, and Tim Schwanen. “Not More but Different: A Comment on the Transitions Research Agenda.” *Environmental Innovation and Societal Transitions* 34 (March 2020): 4–6. https://doi.org/10.1016/j.eist.2019.11.008.

Huang, Yiping. “Understanding China’s Belt & Road Initiative: Motivation, Framework and Assessment.” *China Economic Review* 40 (September 2016): 314–21. https://doi.org/10.1016/j.chieco.2016.07.007.

Hunter, Emma. “Revisiting Ujamaa: Political Legitimacy and the Construction of Community in Post-Colonial Tanzania.” *Journal of Eastern African Studies* 2, no. 3 (2008): 471–85. https://doi.org/10.1080/17531050802401858.

IEA. “Tracking SDG7: The Energy Progress Report, 2025 – Analysis.” IEA, June 25, 2025. https://www.iea.org/reports/tracking-sdg7-the-energy-progress-report-2025.

IMF. “Sub-Saharan Africa’s Growth Requires Quality Education for Growing Population.” IMF, April 25, 2024. https://www.imf.org/en/blogs/articles/2024/04/25/sub-saharan-africas-growth-requires-quality-education-for-growing-population.

Ingelaere, Bert, and Marijke Verpoorten. “Trust in the Aftermath of Genocide: Insights from Rwandan Life Histories.” *Journal of Peace Research* 57, no. 4 (2020): 521–35. https://doi.org/10.1177/0022343319899136.

Ingold, Tim. *Being Alive: Essays on Movement, Knowledge and Description*. Routledge, 2011. https://doi.org/10.4324/9780203818336.

Inikori, Joseph E. “Slavery and Atlantic Commerce, 1650-1800.” *The American Economic Review* 82, no. 2 (1992): 151–57.

Jagger, Pamela, and Ipsita Das. “Implementation and Scale-up of a Biomass Pellet and Improved Cookstove Enterprise in Rwanda.” *Energy for Sustainable Development* 46 (2018): 32–41. https://doi.org/10.1016/j.esd.2018.06.005.

Jasanoff, Sheila. “Ordering Knowledge, Ordering Society.” In *States of Knowledge*. Routledge, 2004.

Jasanoff, Sheila, and Sang-Hyun Kim, eds. *Dreamscapes of Modernity: Sociotechnical Imaginaries and the Fabrication of Power*. University of Chicago Press, 2015. https://press.uchicago.edu/ucp/books/book/chicago/D/bo20836025.html.

Jilani, Sarah. “Becoming in a Colonial World: Approaching Subjectivity with Fanon.” *Textual Practice* 38, no. 10 (2024): 1583–600. https://doi.org/10.1080/0950236X.2023.2243908.

Jolaosho, Omotayo. “Singing Politics: Freedom Songs and Collective Protest in Post-Apartheid South Africa.” *African Studies Review* 62, no. 2 (2019): 6–29. https://doi.org/10.1017/asr.2018.16.

Jöns, Heike, Michael Heffernan, and Peter Meusburger. “Mobilities of Knowledge: An Introduction.” In *Mobilities of Knowledge*, edited by Heike Jöns, Peter Meusburger, and Michael Heffernan. Springer International Publishing, 2017. https://doi.org/10.1007/978-3-319-44654-7_1.

Jowsey, Tanisha, Virginia Braun, Victoria Clarke, Deborah Lupton, and Michelle Fine. “We Reject the Use of Generative Artificial Intelligence for Reflexive Qualitative Research.” *Qualitative Inquiry*, December 17, 2025, 10778004251401851. https://doi.org/10.1177/10778004251401851.

Kabwete, Charles Mulinda, -Bititi Gisaro M. Ya, and Emmanuel Mushimiyimana. “A History of Technological Innovations of Gakinjiro Wood and Metal Workshops.” *African Journal of Science, Technology, Innovation and Development* 11, no. 1 (2019): 85–95. https://doi.org/10.1080/20421338.2018.1550928.

Kadyschuk, Leanne. “Interpretive Analysis.” In *Varieties of Qualitative Research Methods: Selected Contextual Perspectives*, edited by Janet Mola Okoko, Scott Tunison, and Keith D. Walker. Springer International Publishing, 2023. https://doi.org/10.1007/978-3-031-04394-9_40.

Kaplinsky, Raphael, and Erika Kraemer-Mbula. “Innovation and Uneven Development: The Challenge for Low- and Middle-Income Economies.” *Research Policy* 51, no. 2 (2022): 104394. https://doi.org/10.1016/j.respol.2021.104394.

Kelly, Max. “Researching the Rural: A Mzungu Loose in Africa.” In *Women Researching in Africa: The Impact of Gender*, edited by Ruth Jackson and Max Kelly. Springer International Publishing, 2019. https://doi.org/10.1007/978-3-319-94502-6_7.

Keskin, İbrahim, and Mohd Juma Abdalla. “The Sociological Analysis Of The Failure Of Ujamaa Policy.” *Academic Review of Humanities and Social Sciences* 2, no. 3 (2019): 297–313.

Kimari, Wangui, and Henrik Ernstson. “Imperial Remains and Imperial Invitations: Centering Race within the Contemporary Large-Scale Infrastructures of East Africa.” *Antipode* 52, no. 3 (2020): 825–46. https://doi.org/10.1111/anti.12623.

Kitchin, Rob. “Geographers Matter! Doreen Massey (1944–2016).” *Social & Cultural Geography* 17, no. 6 (2016): 813–17. https://doi.org/10.1080/14649365.2016.1192673.

Kivimaa, Paula, Wouter Boon, Sampsa Hyysalo, and Laurens Klerkx. “Towards a Typology of Intermediaries in Sustainability Transitions: A Systematic Review and a Research Agenda.” *Research Policy*, New Frontiers in Science, Technology and Innovation Research from SPRU’s 50th Anniversary Conference, vol. 48, no. 4 (2019): 1062–75. https://doi.org/10.1016/j.respol.2018.10.006.

Kivimaa, Paula, and Florian Kern. “Creative Destruction or Mere Niche Support? Innovation Policy Mixes for Sustainability Transitions.” *Research Policy* 45, no. 1 (2016): 205–17.

Kizilcec, Vivien, and Priti Parikh. “Solar Home Systems: A Comprehensive Literature Review for Sub-Saharan Africa.” *Energy for Sustainable Development* 58 (October 2020): 78–89. https://doi.org/10.1016/j.esd.2020.07.010.

Köhler, Jonathan, Frank W. Geels, Florian Kern, et al. “An Agenda for Sustainability Transitions Research: State of the Art and Future Directions.” *Environmental Innovation and Societal Transitions* 31 (June 2019): 1–32. https://doi.org/10.1016/j.eist.2019.01.004.

Kortetmäki, Teea, and Suvi Huttunen. “Responsibilities for Just Transition to Low-Carbon Societies: A Role-Based Framework.” *Environmental Politics* 32, no. 2 (2023): 249–70. https://doi.org/10.1080/09644016.2022.2064690.

Kraemer-Mbula, Erika, Robert Tijssen, Matthew Wallace, and Robert McLean. “Introduction.” In *Transforming Research Excellence: New Ideas from the Global South*. 2020.

Kuchler, Magdalena, and Gubb Marit Stigson. “Unravelling the ‘Collective’ in Sociotechnical Imaginaries: A Literature Review.” *Energy Research & Social Science* 110 (April 2024): 103422. https://doi.org/10.1016/j.erss.2024.103422.

Kumar, Ankit. “Energy Geographies in/of the Anthropocene: Where Now?” *Geography Compass* 16, no. 10 (2022): e12659. https://doi.org/10.1111/gec3.12659.

Kunz, Sarah. “Privileged Mobilities: Locating the Expatriate in Migration Scholarship.” *Geography Compass* 10, no. 3 (2016): 89–101. https://doi.org/10.1111/gec3.12253.

Kutsyuruba, Benjamin, and Rebecca Stroud. *Narrative Inquiry*. 2023. https://doi.org/10.1007/978-3-031-04394-9_51.

Langellier, K. M. “Personal Narrative.” In *Encyclopedia of Life Writing: Autobiographical and Biographical Forms*. Fitzroy Dearborn, 2001.

Lather, Patti. “Research as Praxis.” *Harvard Educational Review* 56, no. 3 (1986): 257–77.

Law, John. *After Method: Mess in Social Science Research*. Routledge, 2004. https://doi.org/10.4324/9780203481141.

Law, John. “On Sociology and STS.” *The Sociological Review* 56, no. 4 (2008): 623–49. https://doi.org/10.1111/j.1467-954X.2008.00808.x.

Leal Filho, Walter, and Gouvidé Jean Gbaguidi. “Using Artificial Intelligence in Support of Climate Change Adaptation Africa: Potentials and Risks.” *Humanities and Social Sciences Communications* 11, no. 1 (2024): 1657. https://doi.org/10.1057/s41599-024-04223-7.

Lee, Deborah. “The ChatGPT Effect: In 3 Years the AI Chatbot Has Changed the Way People Look Things Up.” The Conversation, November 25, 2025. https://doi.org/10.64628/AAI.w6h7c46s5.

LEFEBVRE, HENRI. *The Production of Space*. BLACKWELL PUBLISHING, 1991.

Lenz, Luciane, Anicet Munyehirwe, Jörg Peters, and Maximiliane Sievert. “Does Large-Scale Infrastructure Investment Alleviate Poverty? Impacts of Rwanda’s Electricity Access Roll-Out Program.” *World Development* 89 (January 2017): 88–110. https://doi.org/10.1016/j.worlddev.2016.08.003.

Levine-Spound, Daniel. “Rwanda’s Aggression in Eastern Democratic Republic of the Congo: Avenues for Accountability.” *SSRN Electronic Journal*, ahead of print, January 1, 2026. https://doi.org/10.2139/ssrn.6212258.

Li, Tania Murray. *Land’s End: Capitalist Relations on an Indigenous Frontier*. Duke University Press Books, 2014.

Linehan, D. “Modernity.” In *International Encyclopedia of Human Geography*, edited by Rob Kitchin and Nigel Thrift. Elsevier, 2009. https://doi.org/10.1016/B978-008044910-4.00975-5.

Lisimba, Alpha Furbell, and Swati Parashar. “The ‘State’ of Postcolonial Development: China–Rwanda ‘Dependency’ in Perspective.” *Third World Quarterly* 42, no. 5 (2021): 1105–23. https://doi.org/10.1080/01436597.2020.1815527.

LONGMAN, TIMOTHY. *Limitations to Political Reform:: The Undemocratic Nature of Transition in Rwanda*. 2011. https://doi.org/10.2307/jj.36106120.9.

Loorbach, Derk, Niki Frantzeskaki, and Flor Avelino. “Sustainability Transitions Research: Transforming Science and Practice for Societal Change.” *Annual Review of Environment and Resources* 42 (October 2017): 599–626. https://doi.org/10.1146/annurev-environ-102014-021340.

LSE. “Emerging Powers in Africa.” The London School of Economics and Political Science, 2013. https://www.lse.ac.uk/ideas/publications/old-reports/emerging-africa.

Lunstrum, Elizabeth. “Green Grabs, Land Grabs and the Spatiality of Displacement: Eviction from Mozambique’s Limpopo National Park.” *Area* 48, no. 2 (2016): 142–52. https://doi.org/10.1111/area.12121.

Lyons, Terrence. “The Importance of Winning: Victorious Insurgent Groups and Authoritarian Politics.” *Comparative Politics* 48, no. 2 (2016): 167–84. https://doi.org/10.5129/001041516817037745.

Mahlangu, Jacob. “Decolonising Development: Why African Solutions Must Replace IMF Prescriptions.” 2025. https://www.semanticscholar.org/paper/Decolonising-Development%3A-Why-African-Solutions-IMF-Mahlangu/b5569e7ee9e059fe3445e2c61218af3c65213792.

Mäki, Uskali, and Caterina Marchionni. “Is Geographical Economics Imperializing Economic Geography?” *Journal of Economic Geography* 11, no. 4 (2011): 645–65. https://doi.org/10.1093/jeg/lbq021.

Makortoff, Kalyeena. “Finance Firms’ Claim to Be ‘Saving the World’ Was a Mistake, Says City Veteran.” Business. *The Guardian*, July 1, 2025. https://www.theguardian.com/business/2025/jul/01/city-finance-firms-aberdeen-asset-managers-esg-issues.

Mann, Laura, and Marie Berry. “Understanding the Political Motivations That Shape Rwanda’s Emergent Developmental State.” *New Political Economy* 21, no. 1 (2016): 119–44. https://doi.org/10.1080/13563467.2015.1041484.

Mansfield, Becky. “Rules of Privatization: Contradictions in Neoliberal Regulation of North Pacific Fisheries.” *Annals of the Association of American Geographers* 94, no. 3 (2004): 565–84. https://doi.org/10.1111/j.1467-8306.2004.00414.x.

Marchais, Gauthier, Paulin Bazuzi, and Aimable Amani Lameke. “‘The Data Is Gold, and We Are the Gold-Diggers’: Whiteness, Race and Contemporary Academic Research in Eastern DRC.” *Critical African Studies* 12, no. 3 (2020): 372–94. https://doi.org/10.1080/21681392.2020.1724806.

Mariam, Alemayehu G. “Ethiopia Shall Rise!” *Ethiopian Review*, 2013. https://ethiopianreview.com/content/47382.

Markard, Jochen, Rob Raven, and Bernhard Truffer. “Sustainability Transitions: An Emerging Field of Research and Its Prospects.” *Research Policy*, Special Section on Sustainability Transitions, vol. 41, no. 6 (2012): 955–67. https://doi.org/10.1016/j.respol.2012.02.013.

Marks, Zoe. “African Popular Protest and Political Change.” *Journal of Democracy* 35, no. 3 (2024): 99–114.

Marques, Pedro, and Kevin Morgan. “Innovation without Regional Development? The Complex Interplay of Innovation, Institutions, and Development.” *Economic Geography* 97, no. 5 (2021): 475–96. https://doi.org/10.1080/00130095.2021.1972801.

Massey, Doreen. *For Space*. 1st edition. SAGE Publications Ltd, 2005.

Massey, Doreen. “Power-Geometry and a Progressive Sense of Place.” In *Mapping the Futures*. Routledge, 1993.

Mavhunga, Clapperton Chakanetsa. *Dare to Invent the Future: Knowledge in the Service of and through Problem-Solving*. The MIT Press, 2023. https://doi.org/10.7551/mitpress/14744.001.0001.

Mavhunga, Clapperton Chakanetsa. “Introduction: What Do Science, Technology, and Innovation Mean from Africa.” In *What Do Science, Technology, and Innovation Mean from Africa?* Massachusetts Institute of Technology, 2017.

Mbembé, J. A., and Sarah Nuttall. “Writing the World from an African Metropolis.” *Public Culture* 16 (September 2004): 347–72.

McCord, Gordon, Jeffrey Sachs, and Wing Woo. *Understanding Africa Poverty: Beyond the Washington Consensus to the Millennium Development Goals Approach*. December 1, 2005.

McKie, Anna. “More than Half of Authors of Leading Research Say Funding Is Declining.” *Nature*, ahead of print, January 21, 2026. https://doi.org/10.1038/d41586-026-00054-5.

McKittrick, Meredith. “Environmental History of Sub-Saharan Africa.” Obo, 2025. https://www.oxfordbibliographies.com/display/document/obo-9780197768709/obo-9780197768709-0043.xml.

Mead, Margaret. “Cybernetics of Cybernetics.” In *Purposive Systems : Proceedings of the First Annual Symposium of the American Society for Cybernetics*. Spartan Books, 1968.

Meeteren, Michiel van, and David Bassens. “Financial Geography Has Come of Age: Making Space for Intradisciplinary Dialogue.” *Finance and Space* 1, no. 1 (2024): 27–34. https://doi.org/10.1080/2833115X.2023.2258046.

Mensah, Joseph. *Africa and the Political Economy of Time-Space Compression and Space of Flows*. 2008. https://doi.org/10.1057/9780230617216_7.

Merriam-Webster. “Definition of AGENCY.” February 8, 2026. https://www.merriam-webster.com/dictionary/agency.

Merriam-Webster. “Innovation Definition & Meaning.” 2023. https://www.merriam-webster.com/dictionary/innovation.

Midgley, Gerald. “The Systemic Intervention Approach.” *Journal of Systems Thinking*, December 12, 2023, 1–24. https://doi.org/10.54120/jost.000050.

Mienye, Ibomoiye Domor, Yanxia Sun, and Emmanuel Ileberi. “Artificial Intelligence and Sustainable Development in Africa: A Comprehensive Review.” *Machine Learning with Applications* 18 (December 2024): 100591. https://doi.org/10.1016/j.mlwa.2024.100591.

Mignolo, Walter D. “Epistemic Disobedience, Independent Thought and Decolonial Freedom.” *Theory, Culture & Society* 26, nos. 7–8 (2009): 159–81. https://doi.org/10.1177/0263276409349275.

Mignolo, Walter D. “Introduction: Coloniality of Power and de-Colonial Thinking.” In *Globalization and the Decolonial Option*. Routledge, 2010.

MINECOFIN. “Government and Development Partners Call for Joint Efforts to Achieve NST-1 Goals.” 2022. https://www.minecofin.gov.rw/news-detail/government-and-development-partners-call-for-joint-efforts-to-achieve-nst-1-goals.

MINECOFIN. “Rwanda Vision 2050.” Government of Rwanda, 2015. https://www.minecofin.gov.rw/fileadmin/user_upload/Minecofin/Publications/REPORTS/National_Development_Planning_and_Research/Vision_2050/English-Vision_2050_Abridged_version_WEB_Final.pdf.

MININFRA. “ENERGY SECTOR STRATEGIC PLAN : 2018/19 - 2023/24.” Government of Rwanda, 2018. https://www.reg.rw/fileadmin/user_upload/Final_ESSP.pdf.

Mirumachi, Naho, Amiera Sawas, and Mark Workman. “Unveiling the Security Concerns of Low Carbon Development: Climate Security Analysis of the Undesirable and Unintended Effects of Mitigation and Adaptation.” *Climate and Development* 12, no. 2 (2020): 97–109. https://doi.org/10.1080/17565529.2019.1604310.

Mkandawire, Thandika. “Thinking about Developmental States in Africa.” *Cambridge Journal of Economics* 25, no. 3 (2001): 289–314. https://doi.org/10.1093/cje/25.3.289.

Mol, Annemarie. *The Body Multiple: Ontology in Medical Practice*. Duke University Press Books, 2002.

Moriarty. *BlackRock CEO Larry Fink Says Iran War Will Not Derail Economy despite Surging Gas Prices*. March 12, 2026. https://www.foxnews.com/media/blackrock-ceo-larry-fink-argues-us-iran-conflict-wont-derail-economy-gas-prices-surge.

Mudimbe, V. Y. *The Invention of Africa: Gnosis, Philosophy, and the Order of Knowledge*. Indiana University Press, 1988.

Mugisha, Joshua, Mike Arasa Ratemo, Bienvenu Christian Bunani Keza, and Hayriye Kahveci. “Assessing the Opportunities and Challenges Facing the Development of Off-Grid Solar Systems in Eastern Africa: The Cases of Kenya, Ethiopia, and Rwanda.” *Energy Policy* 150 (March 2021): 112131. https://doi.org/10.1016/j.enpol.2020.112131.

Muli, Celestine, Nicolas Gerber, Tekalign Gutu Sakketa, and Alisher Mirzabaev. “Ecosystem Tipping Points Due to Variable Water Availability and Cascading Effects on Food Security in Sub-Saharan Africa.” *SSRN Electronic Journal*, ahead of print, January 1, 2018. https://doi.org/10.2139/ssrn.3266355.

Müller, Franziska. “Energy Colonialism.” *Journal of Political Ecology* 31, no. 1 (2024): 1. https://doi.org/10.2458/jpe.5659.

Müller, Martin, Quentin Rihoux, and Laura Neville. “Toward Change in the Uneven Geographies of Urban Knowledge Production.” *Nature Cities* 2, no. 3 (2025): 234–45. https://doi.org/10.1038/s44284-025-00202-4.

Murenzi, Romain, and Mike Hughes. “Building a Prosperous Global Knowledge Economy in Africa: Rwanda as a Case Study.” *International Journal of Technology and Globalisation*, 2007. https://www.inderscienceonline.com/doi/10.1504/IJTG.2006.011914.

Mutesi, Florence, and Prince H. Kayigire. “Home-Grown Solutions: Key Drivers of the Development Process in Rwanda.” In *Democratizing Public Governance in Developing Nations*. Routledge, 2017.

Nakyeyune, Annet. *Understanding the Diffusion and Adoption of Improved Cookstove Technologies in Uganda through the Technological Innovation System*. June 14, 2022. https://hdl.handle.net/1842/39096.

National Institute of Statistics of Rwanda. *Fifth Population and Housing Census, Rwanda, 2022 District Profile Rulindo*. Ministry of Finance and Economic Planning, 2023. https://statistics.gov.rw/publication/rphc5-district-profile-rulindo.

NCST. *Science, Technology and Innovation Policy*. Government of Rwanda, 2020. https://www.mineduc.gov.rw/index.php?eID=dumpFile&t=f&f=17135&token=c64ea84e90450da788598d96cc37bcd124d001e7.

Ndame, Thomas. “Case Study.” In *Varieties of Qualitative Research Methods: Selected Contextual Perspectives*, edited by Janet Mola Okoko, Scott Tunison, and Keith D. Walker. Springer International Publishing, 2023. https://doi.org/10.1007/978-3-031-04394-9_11.

Newell, Peter. “Trasformismo or Transformation? The Global Political Economy of Energy Transitions.” *Review of International Political Economy* 26, no. 1 (2019): 25–48. https://doi.org/10.1080/09692290.2018.1511448.

Nightingale, Andrea. “The Nature of Gender: Work, Gender, and Environment.” *Environment and Planning D: Society and Space* 24, no. 2 (2006): 165–85. https://doi.org/10.1068/d01k.

NISR. “Labour Force Survey 2023 | National Institute of Statistics of Rwanda.” 2023. https://statistics.gov.rw/sites/default/files/documents/2025-01/RW_LFS2023_Annual_report.pdf.

Nkrumah, Kwame. *Consciencism: Philosophy and Ideology for De-Colonization*. Monthly Review Press,U.S., 1964.

Nkrumah, Kwame. *Neo-Colonialism*. Panaf Books, 2004.

Nkurunziza, Michel. “Rwanda: Govt Hires New Firm to Design Settlement Sites Nationwide.” News. *The New Times* (Kigali), February 17, 2026. https://allafrica.com/stories/202602170018.html.

Novo, Andrew R. “The Empires Strike Back: A New Age of Imperialism.” *CEPA*, August 29, 2022. https://cepa.org/article/the-empires-strike-back-a-new-age-of-imperialism/.

Nsengimana, Théophile, Leon R. Mugabo, Hiroaki Ozawa, and Pheneas Nkundabakura. “Science Competence-Based Curriculum Implementation in Rwanda: A Multiple Case Study of the Relationship between a School’s Profile of Implementation and Its Capacity to Innovate.” *African Journal of*

Research in Mathematics, Science and Technology Education 25, no. 1 (2021): 38–51. https://doi.org/10.1080/18117295.2021.1888020.

Ntagwabira, Andre, and Chapurukha M. Kusimba. "Ritual and State Making in Precolonial Rwanda." *The African Archaeological Review* 38, no. 4 (2021): 569–95.

Ntibagirirwa, Symphorien. "Ubuntu as a Metaphysical Concept." *The Journal of Value Inquiry* 52, no. 1 (2018): 113–33. https://doi.org/10.1007/s10790-017-9605-x.

Nwobodo, Ratzinger E. E. "AFRICA AND THE CHALLENGES OF MODERNITY." *Nnadiebube Journal of Philosophy* 2, no. 2 (2022). https://journals.ezenwaohaetorc.org/index.php/NJP/article/view/2105.

Nyairo, Joyce, and James Ogude. "Popular Music, Popular Politics: Unbwogable and the Idioms of Freedom in Kenyan Popular Music." *African Affairs* 104, no. 415 (2005): 225–49. https://doi.org/10.1093/afraf/adi012.

Nyerere, Julius. *Ujamaa - The Basis of African Socialism*. 1962. https://www.juliusnyerere.org/resources/view/ujamaa_-_the_basis_of_african_socialism_julius_k._nyerere.

Nyerere, Julius K. *The Arusha Declaration Ten Years After*. Government Printer, 1977.

Obeng-Odoom, Franklin. "Africa: On the Rise, but to Where?" *Forum for Social Economics* 44, no. 3 (2015): 234–50. https://doi.org/10.1080/07360932.2014.955040.

Ocheni, Stephen, and Basil Nwankwo. *Analysis of Colonialism and Its Impact in Africa*. January 1, 2012, 46–54. https://doi.org/10.3968/j.ccc.1923670020120803.1189.

Okeke, Remi. "Politics, Music and Social Mobilization in Africa: The Nigeria Narrative and Extant Tendencies." *International Letters of Social and Humanistic Sciences* 86 (March 2019): 28–41. https://doi.org/10.18052/www.scipress.com/ILSHS.86.28.

Okoko, Janet, Scott Tunison, and Keith Walker. *Introduction to a Variety of Qualitative Research Methods*. 2023. https://doi.org/10.1007/978-3-031-04394-9_1.

Oliveira, Vanessa Machado De. *Hospicing Modernity: Parting with Harmful Ways of Living*. North Atlantic Books,U.S., 2021.

Olutumise, Adewale Isaac. "A Systematic Review of the Economic Impact of Artificial Intelligence on Agricultural Productivity, Sustainability, and Rural Livelihoods." *Discover Agriculture* 4, no. 1 (2026): 70. https://doi.org/10.1007/s44279-026-00510-w.

Omotoso, Abeeb Babatunde, Simon Letsoalo, Kehinde Oluseyi Olagunju, Christopher Seleke Tshwene, and Abiodun Olusola Omotayo. "Climate Change and Variability in Sub-Saharan Africa: A Systematic Review of Trends and Impacts on Agriculture." *Journal of Cleaner Production* 414 (August 2023): 137487. https://doi.org/10.1016/j.jclepro.2023.137487.

Onyebadi, Uche. “Political Messages in African Music: Assessing Fela Anikulapo-Kuti, Lucky Dube and Alpha Blondy.” *Humanities* 7, no. 4 (2018). https://doi.org/10.3390/h7040129.

Osei, Elisabeth Abena. “Wakanda Africa Do You See? Reading Black Panther as a Decolonial Film through the Lens of the Sankofa Theory.” *Critical Studies in Media Communication* 37, no. 4 (2020): 378–90. https://doi.org/10.1080/15295036.2020.1820538.

Oyeniyi, Bukola Adeyemi. “Orality, History and Historical Reconstruction.” Edited by Akintunde Akinyemi and Toyin Falola. Springer International Publishing, 2021. https://doi.org/10.1007/978-3-030-55517-7_4.

Oyěwùmí, Oyèrónkẹ́. *The Invention of Women: Making an African Sense of Western Gender Discourses*. U of Minnesota Press, 1997.

Öztürk, Oğuzhan, Rıdvan Kocaman, and Dominik K. Kanbach. “How to Design Bibliometric Research: An Overview and a Framework Proposal.” *Review of Managerial Science* 18, no. 11 (2024): 3333–61. https://doi.org/10.1007/s11846-024-00738-0.

Pansera, Mario. “Frugality, Grassroots and Inclusiveness: New Challenges for Mainstream Innovation Theories.” *African Journal of Science, Technology, Innovation and Development* 5, no. 6 (2013): 469–78. https://doi.org/10.1080/20421338.2013.820445.

Parcell, Erin Sahlstein, and Benjamin M. A. Baker. “Narrative Analysis.” In *The SAGE Encyclopedia of Communication Research Methods*. SAGE Publications, Inc, 2017. https://doi.org/10.4135/9781483381411.

Passas, Ioannis. “Bibliometric Analysis: The Main Steps.” *Encyclopedia* 4, no. 2 (2024): 1014–25. https://doi.org/10.3390/encyclopedia4020065.

Perros, Tash, Sam Unsworth, Muez Ali, Iwona Bisaga, and Julia Tomei. “Towards Responsible and Fair Pay-as-You-Go Energy Access in Sub-Saharan Africa.” *Nature Energy*, 2024, 1–6.

Pinch, Trevor. “The Sociology of the Scientific Community.” In *Companion to the History of Modern Science*, edited by R. C. Olby, G. N. Cantor, J. R. R. Christie, and M. J. S. Hodge. Routledge, 1990.

Pinnegar, Stefinee, and J. Daynes. “Locating Narrative Inquiry Historically: Thematics in the Turn to Narrative.” *Handbook of Narrative Inquiry: Mapping a Methodology*, ahead of print, January 1, 2007. https://doi.org/10.4135/9781452226552.n1.

Pino Robles, Rodolfo. “Colonialism: When will it End?” CIENCIA Ergo-Sum. *CIENCIA ergo-sum* 9, no. 2 (2002): 139–50.

Poelsma, Felix, Stephanie Moser, Susanne Wymann von Dach, and Thomas Breu. “Researchers’ Roles in the (Dis)Empowerment of Societal Actors: A Reflexive Framework Applied during a Transition towards Climate Neutrality in the Swiss Alps.” *Sustainability Science*, ahead of print, December 23, 2025. https://doi.org/10.1007/s11625-025-01774-9.

Prudham, Scott. “Poisoning the Well: Neoliberalism and the Contamination of Municipal Water in Walkerton, Ontario.” *Geoforum*, Themed issue on “Neoliberal nature and the nature of neoliberalism,” vol. 35, no. 3 (2004): 343–59. https://doi.org/10.1016/j.geoforum.2003.08.010.

Purdeková, Andrea, and David Mwambari. “Post-Genocide Identity Politics and Colonial Durabilities in Rwanda.” *Critical African Studies* 14, no. 1 (2022): 19–37. https://doi.org/10.1080/21681392.2021.1938404.

Purtschert, Patricia. “The Return of the Native: Racialised Space, Colonial Debris and the Human Zoo.” *Identities* 22, no. 4 (2015): 508–23. https://doi.org/10.1080/1070289X.2014.944183.

PwC. “Financing Net Zero.” PwC, 2021. https://www.pwc.com/gx/en/issues/esg/financing-net-zero.html.

Querejazu, Amaya. “Pluriversality as Methodology.” *Third World Quarterly* 47, no. 3 (2026): 629–40. https://doi.org/10.1080/01436597.2025.2601814.

Quijano, Aníbal. “Coloniality and Modernity/Rationality.” *Cultural Studies* 21, nos. 2–3 (2007): 168–78. https://doi.org/10.1080/09502380601164353.

Quijano, Aníbal. “Coloniality of Power and Eurocentrism in Latin America.” *International Sociology* 15, no. 2 (2000): 215–32. https://doi.org/10.1177/0268580900015002005.

Radjou, Navi, and Jim Euchner. “The Principles of Frugal Innovation: An Interview with Navi Radjou.” *Research-Technology Management* 59, no. 4 (2016): 13–20. https://doi.org/10.1080/08956308.2016.1185339.

Rattenbury, and Peters-Stanley. “KOKO’s Collapse: Corresponding Adjustments, CORSIA and Wider Implications.” 2026. https://www.sylvera.com/blog/koko-networks-collapse-corsia-carbon-credits-loa.

Reyntjens, Filip. “Rwanda, Ten Years on: From Genocide to Dictatorship.” *African Affairs* 103, no. 411 (2004): 177–210. https://doi.org/10.1093/afraf/adh045.

Riessman, Catherine Kohler. “Narrative Analysis.” In *Narrative, Memory & Everyday Life*, edited by Nancy Kelly, Christine Horrocks, Kate Milnes, Brian Roberts, and David Robinson. University of Huddersfield, 2005. http://www2.hud.ac.uk/hhs/nme/books/2005/Chapter_1_-_Catherine_Kohler_Riessman.pdf.

Rodney, Walter. *How Europe Underdeveloped Africa*. Verso, 2018.

Rogers, Alisdair, Noel Castree, and Rob Kitchin. “Power-Geometry.” In *A Dictionary of Human Geography*. Oxford University Press, 2013. https://www.oxfordreference.com/display/10.1093/acref/9780199599868.001.0001/acref-9780199599868-e-1451.

Rojo, Luisa Martín. “Hegemonies and Inequalities in Academia.” *International Journal of the Sociology of Language* 2021, nos. 267–268 (2021): 169–92. https://doi.org/10.1515/ijsl-2020-0077.

Roopnarain, Ashira, and Rasheed Adeleke. “Current Status, Hurdles and Future Prospects of Biogas Digestion Technology in Africa.” *Renewable and Sustainable Energy Reviews* 67 (January 2017): 1162–79. https://doi.org/10.1016/j.rser.2016.09.087.

Rudek, Tadeusz Józef. “Capturing the Invisible. Sociotechnical Imaginaries of Energy. The Critical Overview.” *Science and Public Policy* 49, no. 2 (2022): 219–45. https://doi.org/10.1093/scipol/scab076.

Rukato, Wadeisor. “Student Movements and Autocracies in Africa.” In *Gender, Protests and Political Change in Africa*, edited by Awino Okech. Springer International Publishing, 2020. https://doi.org/10.1007/978-3-030-46343-4_3.

Rutazibwa, Olivia Umurerwa. “Studying Agaciro: Moving Beyond Wilsonian Interventionist Knowledge Production on Rwanda.” *Journal of Intervention and Statebuilding* 8, no. 4 (2014): 291–302. https://doi.org/10.1080/17502977.2014.964454.

Rwigema, Pierre Celestin. *BELGIUM’S LEGACY IN THE AFRICAN GREAT LAKES REGION: A CRITICAL ANALYSIS OF NEGATIVE IMPACTS ON RWANDA, BURUNDI, AND THE DEMOCRATIC REPUBLIC OF CONGO*. April 30, 2025, 2012–22.

Sabiiti, Daniel. “60,000 Homes Own A Vehicle In Rwanda - Survey.” *KT PRESS*, May 27, 2025. https://www.ktpress.rw/2025/05/60000-homes-own-a-vehicle-in-rwanda-survey/.

Said, Edward. *Orientalism*. First ed. New York: Pantheon Books., 1978.

Sakariyahu, Rilwan, Temitope Fagbemi, Rasheed Adigun, Rodiat Lawal, Oluwagbenga Seyingbo, and Olayinka Oyekola. “Severity of Environmental Degradation and the Impact on Quality of Life in Africa.” *Journal of Environmental Management* 356 (April 2024): 120537. https://doi.org/10.1016/j.jenvman.2024.120537.

SALIH, SARA. *On Judith Butler and Performativity*. January 1, 2007.

Schmidt, Peter, and Donald H. Avery. “Complex Iron Smelting and Prehistoric Culture in Tanzania.” *Science* 201, no. 4361 (1978): 1085–89.

Scoones, Ian, Andrew Stirling, Dinesh Abrol, et al. “Transformations to Sustainability: Combining Structural, Systemic and Enabling Approaches.” *Current Opinion in Environmental Sustainability*, Advancing the science of actionable knowledge for sustainability, vol. 42 (February 2020): 65–75. https://doi.org/10.1016/j.cosust.2019.12.004.

Scott, Bernard. “Second-order Cybernetics: An Historical Introduction.” *Kybernetes* 33, no. 9/10 (2004): 1365–78. https://doi.org/10.1108/03684920410556007.

SE4All. “Sustainable Energy for All.” Sustainable Energy for All | SEforALL, June 12, 2024. https://www.seforall.org/.

Serneels, Vincent, Robion-Brunner Caroline, and Sébastien Perret. *Variability in Iron Smelting Practices: Assessment of Technical, Cultural and Economic Criteria to Explain the Metallurgcial Diversity in the Dogon Area (Mali)*. 2013.

Severi, Matteo. "Focus2move| Rwanda Cars Sales - Data & Facts in 2019." *Focus2Move*, April 7, 2020. https://www.focus2move.com/rwanda-toyota-held-47-8-of-market-down-2-1-in-2019/.

Sherman, Carter. "Trump Administration to Block Aid from Subsidizing DEI and Trans Rights Overseas." US News. *The Guardian*, January 22, 2026. https://www.theguardian.com/us-news/2026/jan/22/trump-foreign-aid-dei-trans-rights.

Sial, Farwa. "Blended Finance Can Perpetuate Climate Colonialism." Climate Home News, February 15, 2024. https://www.climatechangenews.com/2024/02/15/blended-finance-can-perpetuate-climate-colonialism/.

Silva, Angie, and Laura Stocker. "What Is a Transition? Exploring Visual and Textual Definitions among Sustainability Transition Networks." *Global Environmental Change* 50 (May 2018): 60–74. https://doi.org/10.1016/j.gloenvcha.2018.02.003.

Singirankabo, Uwacu Alban, Maurits Willem Ertsen, and Nick van de Giesen. "The Relations between Farmers' Land Tenure Security and Agriculture Production. An Assessment in the Perspective of Smallholder Farmers in Rwanda." *Land Use Policy* 118 (July 2022): 106122. https://doi.org/10.1016/j.landusepol.2022.106122.

Smith, Adrian, and Andy Stirling. "INNOVATION, SUSTAINABILITY AND DEMOCRACY: AN ANALYSIS OF GRASSROOTS CONTRIBUTIONS." *Journal of Self-Governance and Management Economics* 6, no. 1 (2018): 64–97.

Smith, Adrian, Andy Stirling, and Frans Berkhout. "The Governance Of Sustainable Socio-Technical Transitions." *Research Policy*, January 7, 2005, 1491–510. https://doi.org/10.1016/j.respol.2005.07.005.

Smith, Adrian, Jan-Peter Voß, and John Grin. "Innovation Studies and Sustainability Transitions: The Allure of the Multi-Level Perspective and Its Challenges." *Research Policy*, Special Section on Innovation and Sustainability Transitions, vol. 39, no. 4 (2010): 435–48. https://doi.org/10.1016/j.respol.2010.01.023.

Smith, Jessica M., and Abraham SD Tidwell. "The Everyday Lives of Energy Transitions: Contested Sociotechnical Imaginaries in the American West." *Social Studies of Science* 46, no. 3 (2016): 327–50. https://doi.org/10.1177/0306312716644534.

Smith, Neil. *Uneven Development Nature, Capital and the Production of Space*. Third Edition. The University of Georgia Press, 2008.

Snyder, Hannah. "Literature Review as a Research Methodology: An Overview and Guidelines." *Journal of Business Research* 104 (November 2019): 333–39. https://doi.org/10.1016/j.jbusres.2019.07.039.

Soedirgo, Jessica, and Aarie Glas. “Toward Active Reflexivity: Positionality and Practice in the Production of Knowledge.” *PS: Political Science & Politics* 53, no. 3 (2020): 527–31. https://doi.org/10.1017/S1049096519002233.

Sovacool, Benjamin K., Andrew Hook, Mari Martiskainen, Andrea Brock, and Bruno Turnheim. “The Decarbonisation Divide: Contextualizing Landscapes of Low-Carbon Exploitation and Toxicity in Africa.” *Global Environmental Change* 60 (2020): 102028. https://doi.org/10.1016/j.gloenvcha.2019.102028.

Spiegel, Thomas J. “Academia’s Class Problem.” *Frontiers in Research Metrics and Analytics* 10 (April 2025): 1566023. https://doi.org/10.3389/frma.2025.1566023.

Stirling, Andy. “Emancipating Transformations: From Controlling ‘the Transition’ to Culturing Plural Radical Progress.” In *The Politics of Green Transformations*. Routledge, 2015.

Stirling, Andy. “How Deep Is Incumbency? A ‘Configuring Fields’ Approach to Redistributing and Reorienting Power in Socio-Material Change.” *Energy Research & Social Science* 58 (December 2019): 101239. https://doi.org/10.1016/j.erss.2019.101239.

Surawy-Stepney, Nick, Fabien Provost, Shagufta Bhangu, and Carlo Caduff. “Introduction to Qualitative Research Methods: Part 2.” *Perspectives in Clinical Research* 14, no. 2 (2023): 95–99. https://doi.org/10.4103/picr.picr_37_23.

Táíwò, Olúfẹ́mi. *Against Decolonisation: Taking African Agency Seriously*. C Hurst & Co Publishers Ltd, 2022.

Tamale, Sylvia. *Decolonization and Afro-Feminism: An Afro-Feminist-Legal Critique*. Daraja Press, 2020.

Tarvainen, Antti. “The Modern/Colonial Hell of Innovation Economy: Future as a Return to Colonial Mythologies.” *Globalizations* 0, no. 0 (2022): 1–23. https://doi.org/10.1080/14747731.2022.2048460.

Taylor, Ben. “PhD Thesis - A Guide to Writing Yours.” Www.FindAPhD.Com. Accessed March 12, 2026. https://www.findaphd.com/guides/phd-thesis.

Tuan, Yi-Fu. “Place: An Experiential Perspective.” *Geographical Review* 65 (April 1975): 151. https://doi.org/10.2307/213970.

Tuck, Eve, and K. Wayne Yang. “Decolonization Is Not a Metaphor.” *Decolonization: Indigeneity, Education & Society* 1, no. 1 (2012). https://jps.library.utoronto.ca/index.php/des/article/view/18630.

Tunison, Scott. *Observational Study*. 2023. https://doi.org/10.1007/978-3-031-04394-9_54.

Ulrich, Werner, and Martin Reynolds. *Ch. 6. Critical Systems Heuristics: The Idea and Practice of Boundary Critique*. Edited by Martin Reynolds and Sue Holwell. London, 2020. https://oro.open.ac.uk/70336/.

UNCTAD, United Nations Conference on Trade and Development. *Commodities at a Glance: Special Issue on Access to Energy in Sub-Saharan Africa*. 2023. https://unctad.org/system/files/official-document/ditccom2023d1_en.pdf.

UNFCCC. "Commitments to Net Zero Double in Less Than a Year | UNFCCC." 2020. https://unfccc.int/news/commitments-to-net-zero-double-in-less-than-a-year?utm_source=chatgpt.com.

Van Dijk, Meine Pieter. "Triple Helix Approach to Innovation in Rwanda's Agriculture Resulted in a Partnership between Educational Institutions and a Private Firm Producing Clean Seed Potatoes." *Journal of Agribusiness in Developing and Emerging Economies* 15, no. 4 (2023): 832–48. https://doi.org/10.1108/JADEE-06-2023-0139.

Wahome, Michel, and M. Graham. "Spatially Shaped Imaginaries of the Digital Economy." *Information, Communication & Society* 23, no. 8 (2020): 1123–38. https://doi.org/10.1080/1369118X.2019.1701696.

Wang, Jiguang, and Bing Ran. "Balancing Paradoxical Missions: How Does Microfinance Rebuild a Sustainable Path in Poverty Alleviation?" *SAGE Open* 9, no. 2 (2019): 2158244019857838. https://doi.org/10.1177/2158244019857838.

Watson, Frank. "COP26: Capital Committed to Net-Zero Emissions Surges to $130 Trillion: GFANZ." S&P Global Energy, March 11, 2021. https://www.spglobal.com/energy/en/news-research/latest-news/energy-transition/110321-cop26-capital-committed-to-net-zero-emissions-surges-to-130-trillion-gfanz.

WB Doing Business Archive. "Ease of Doing Business in Rwanda." Text/HTML. World Bank, 2026. https://archive.doingbusiness.org/en/data/exploreeconomies.

Whyte, Christine. "Between Empire and Colony: American Imperialism and Pan-African Colonialism in Liberia, 1810–2003." *National Identities* 18, no. 1 (2016): 71–88. https://doi.org/10.1080/14608944.2016.1095493.

Willett, Joanie. "Challenging Peripheralising Discourses: Using Evolutionary Economic Geography and, Complex Systems Theory to Connect New Regional Knowledges within the Periphery." *Journal of Rural Studies* 73 (January 2020): 87–96. https://doi.org/10.1016/j.jrurstud.2019.11.016.

WIPO. *Global Innovation Index 2025 - GII 2025 Results*. 2025. https://www.wipo.int/web-publications/global-innovation-index-2025/en/gii-2025-results.html.

WITS. "Sub-Saharan Africa Trade | WITS Data." 2026. https://wits.worldbank.org/countrysnapshot/en/SSF.

Wittmayer, Julia M., Flor Avelino, Frank van Steenbergen, and Derk Loorbach. "Actor Roles in Transition: Insights from Sociological Perspectives." *Environmental Innovation and Societal Transitions* 24 (September 2017): 45–56. https://doi.org/10.1016/j.eist.2016.10.003.

Wolsink, Maarten. “Framing in Renewable Energy Policies: A Glossary.” *Energies* 13, no. 11 (2020): 11. https://doi.org/10.3390/en13112871.

World Bank. “Net Official Development Assistance Received (Current US$) - Sub-Saharan Africa.” World Bank Open Data, 2026. https://data.worldbank.org.

World Bank. “Off-Grid Solar Could Provide First-Time Electricity Access to Almost 400 Million People Globally by 2030.” 2024. https://www.worldbank.org/en/news/press-release/2024/10/08/off-grid-solar-could-provide-first-time-electricity-access-to-almost-400-million-people-globally-by-2030.

World Bank. “Rwanda Renewable Energy Fund.” World Bank, 2017. https://documents1.worldbank.org/curated/en/181631493253644281/pdf/Appraisal-Project-Information-Document-Integrated-Safeguards-Data-Sheet-Renewable-Energy-Fund-P160699.pdf.

Wrong, Michela. *Do Not Disturb: The Story of a Political Murder and an African Regime Gone Bad*. Fourth Estate, 2021.

Yıldız, Tolga. “Concepts in Motion: Toward a Relational Ontology of Meaning, Practice, and Mind.” *Integrative Psychological and Behavioral Science* 60, no. 1 (2026): 9. https://doi.org/10.1007/s12124-026-09976-1.

Yongabo, Parfait, and Bo Göransson. “Constructing the National Innovation System in Rwanda: Efforts and Challenges.” *Innovation and Development* 12, no. 1 (2022): 155–76. https://doi.org/10.1080/2157930X.2020.1846886.

Zúñiga, Didier. “How Many Worlds Are There? One, but Also Many: Decolonial Theory, Comparison, ‘Reality.’” *European Journal of Political Theory* 24, no. 2 (2025): 264–87. https://doi.org/10.1177/14748851231214252.

Annex 1: Approaches to data across the thesis articles

Article	Data collected for article	Means of data collection and analysis	Actors that the data relates to
A1	• Academic articles focused on energy which engage with the concept "innovation" from a range of sub-disciplines and fields • Articles from across the world, subsets of articles from a) authors based in Africa and b) writing about Africa	• Targeted Boolean search strings to shortlist articles • Literature review - close reading of selected articles • Thematic analysis and qualitative coding using Excel	• Diverse set of actors who are understood to somehow either participate in or be affected by innovation • Both actors and roles spread across the world - widely divergent • Particular focus on actors involved in innovation related to African countries including Rwanda
A2	• Accounts and practices of actors across the world who position themselves as somehow contributing to energy systems change in Rwanda • Grey literature (e.g. policies and strategies) pertaining to energy systems change in Rwanda	• Semi-structured interviews and observation • Literature review - close reading of selected articles • Thematic analysis and qualitative coding using NVivo	• Transnational actors who are understood by respondents to somehow either participate in or be affected by energy systems change benefiting people within Rwanda (including end users of innovation outputs in Rwanda)
A3	• Accounts and practices of actors within Rwanda who have a stake in efforts to practice innovation at IPRC Tumba college • Grey literature (e.g. policies and strategies) connecting higher education, innovation and sectoral transformation in Rwanda	• Same as Article 2	• Transnational actors who are understood to somehow be relevant to efforts to practise innovation at IPRC Tumba. • This includes for example staff and students, surrounding communities, wider actors within Rwanda (e.g. private sector, policy, regulatory) and actors outside Rwanda who

			certain actors at Tumba aspire towards, for example
A4	• Accounts of actors across the world who are involved in the flow of climate finance for technological innovation upstream and downstream of CF Investments, a venture capital impact investor • Internal and external materials from CF Investments including deal flow data, internal policies and strategies	• Semi-structured interviews • Literature review - close reading of selected articles • Thematic analysis and qualitative coding using NVivo	• Transnational actors who are understood to be relevant to efforts to practise innovation engendered by climate finance disbursed by CF Investments, centred on Kigali, Rwanda as CF Investments' regional hub of activities • Relevant actors include end users of innovation outputs in countries across Africa
A5	• Bibliometric data about funding, location of institutional authorship, citations and collaborative networks for academic articles pertaining to energy policy in lower income countries	• Targeted Boolean search strings to identify relevant articles and to gather relevant data • Bibliometric regression and network analysis to reveal correlations and relationships	• Transnational actors who fund, cite and/or conduct academic research advising topics related to policy-driven energy systems change in lower income countries including Rwanda