Energy Research & Social Science 130 (2025) 104441

Contents lists available at ScienceDirect

Energy Research & Social Science

journal homepage: www.elsevier.com/locate/erss

Original research article

A diversity of sustainable lifestyles in 2050: Future SLIM scenario narratives for deep climate change mitigation

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ARTICLE INFO

Keywords:
Sustainable living
Lifestyle change
Scenario development
Storylines
Narratives
Multidisciplinary

ABSTRACT

Sustainable lifestyle changes can play a critical role in climate change mitigation. This paper presents and discusses a set of four comprehensive lifestyle scenario narratives, collectively named Sustainable Living in Models, or SLIM, scenario narratives. These narratives describe plausible alternative long-term pathways in which lifestyle changes play a major role in achieving many sustainability goals. As narratives, they are designed to both support strategic dialogue and form the basis for model-based scenario analysis. The four SLIM scenario narratives emerged from multidisciplinary workshops with lifestyle change experts, scenario analysts and integrated assessment modellers. The narratives diverge along two critical uncertainties: focus on individual versus communal values and the level of access to centralised versus distributed support for the transition to sustainable lifestyles. These SLIM scenario narratives enable explorations of our underlying assumptions of lifestyle changes while also determining the robustness of plausible developments and strategies. The SLIM scenario narratives emphasise the role of society, enablers, lifestyles *and* behaviours in systems change. We also describe the SLIM scenario narratives in terms of contrasting characteristics. The SLIM scenario narratives provide a theoretical contribution by supporting a greater understanding of the role of sustainable lifestyles in climate change mitigation while also providing less-stylised assumptions for model-based scenarios. The enduring impact of this scenario development process is to enable continued exchange among an emerging community of practice of modellers and sustainable lifestyle practitioners. Most notably, the narratives can allow for strategic discussion and climate action by policymakers.

1. Introduction

Achieving the goals of the Paris Climate Agreement requires major changes in demand and supply-side systems [1]. In the past, most scenario studies assessed by IPCC focused on technological changes and energy efficiency improvements to reduce emissions – the 'supply-side'. In the last few years, several studies have shown that lifestyle and behaviour changes – the 'demand-side' – can also contribute significantly to climate change mitigation [1–8]. Based on recent studies, IPCC estimates that with the right sociocultural factors, technologies, policies and infrastructure in place, demand-side options, including lifestyle and behaviour changes, can result in a 40–70 % reduction in greenhouse gas emissions by 2050 [1]. Furthermore, Cap et al. [9] even state that "a robust mitigation pathway for 1.5°C will require demand-side mitigation contributions nearing the upper limit estimated by the IPCC."

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https://doi.org/10.1016/j.erss.2025.104441
Received 29 April 2025; Received in revised form 29 October 2025; Accepted 5 November 2025
Available online 14 November 2025
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1.1. Problem statement

Understanding lifestyle changes within a complex and uncertain future is challenging, and we cannot predict what will happen by only projecting based on past experiences and trends. Imagined futures or scenarios can support a more nuanced understanding of plausible alternative futures and stimulate strategic discussions and actions. In the context of climate change, there is a clear research gap on scenario narratives describing how lifestyles can change in the long-term *with* concrete contributions to mitigating climate change. This is mainly because existing studies on lifestyle and behavioural change in the context of climate change focus either on qualitative or on quantitative analyses, with very few studies combining these two.

Qualitative approaches to developing scenarios often include narratives. Various studies contributing to the literature show different approaches on how lifestyles can change in the long-term. For example, the SPREAD 2050 scenarios [10] were built around different approaches to technology, governance and social values, and specifically how to spread sustainable lifestyles. In the study on the GLAMURS backcasting scenarios [8,11,12], they develop their scenarios by envisioning a desired future and then the steps needed to reach that future, with one of the scenarios focusing on sufficiency. In this project, they explored various aspects including time-use, lifestyle domains, regional variations and social innovation. Furthermore, through a more empirical approach, the study by Schmidt-Scheele [13] systematically analysed German citizens' preferences and values through a discrete choice experiment to illustrate references for or against certain energy pathways. Furthermore, at the city-level, a set of reports envision future low-carbon lifestyles and transitioning instruments in 2030 for New Delhi in India [14], Cape Town in South Africa [15], Kyoto in Japan [16] and Nonthaburi in Thailand [17]. These mostly-qualitative approaches tend to focus purely on 'how', 'who' and 'why' lifestyles could change, but lack the quantitative 'when', 'how many' and 'what impact' in the dynamic long-term pathways.

Contrastingly, quantitative studies (focusing on the 'when', 'how many' and 'what impact') typically use some form of modelling to translate narrative assumptions into a description of quantitative changes, statically, or over time. Socio-technical transitions have been represented in some model-based scenarios and include more nuanced qualitative descriptions of possible societal changes and the dynamics with technological changes [18,19]. A notable example of a quantitative scenario study is the Shared Socio-economic Pathways (SSPs), which describe plausible major global changes leading to various challenges for adaptation and mitigation of climate change [20,21]. Even though these SSPs include a brief description of lifestyle changes, they do not focus deeply on the possible contribution of lifestyle changes to climate mitigation. Over the past years, many model-based scenario studies have been published, looking specifically into the role of lifestyle change [4,5,7,22]. Some studies have integrated lifestyle changes as part of scenarios such as the Sustainable Development Pathways [23]. However, these quantitative studies typically use rather stylised assumptions and rarely describe the transition pathway and underlying logic for change. Rather, they explore questions like "what if substantial changes in diet are achieved in 2050?" without a strong focus on underlying motivations for changes in lifestyle or value shifts that enable these scenario outcomes [24].

Combining qualitative and quantitative scenario development approaches can help to better understand the possible motivations and drivers of lifestyle changes over time and how these contribute to climate change mitigation [25]. However, current qualitative scenario studies are not developed to be modelled in global models, and global models are often not equipped to incorporate scenario narratives. There is a disconnect between qualitative studies that focus on the intent (i.e. motivations) of behavioural actions that are diverse and context-specific, and quantitative studies that focus on the impact (i.e. outcomes) of these actions [24]. These different disciplines and approaches often get lost in translation, or are unable to be modelled as the models are at present, and could benefit from a combined approach to improve the translation, and avoid stylised assumptions in models.

Therefore, there is a gap in the literature on a set of comprehensive and engaging qualitative narratives that showcase possible pathways of sustainable lifestyles combined with their quantified contributions to climate mitigation. Combining scenario narratives with modelled scenarios can inform policymakers, lifestyle change actors, and foresight specialists more holistically. This approach can support policymaking by providing a qualitative and quantitative picture of lifestyle change under various contexts. It strengthens lifestyle scenarios in policymaking through memorable, complex, and well-represented narratives that are also concretely quantified.

1.2. Objectives

Based on these considerations, in this paper, we focus on the development of four lifestyle-focused qualitative scenario narratives, named the Sustainable Living in Models, or SLIM, scenarios, which were built through multiple stakeholder engagement sessions involving experts in modelling, scenario planning, transition studies and sustainable lifestyles. It should be noted that this article is focused on the qualitative narratives, but is part of a larger project (see Fig. 1), where we also quantified the narratives using an Integrated Assessment Model (IAM), named IMAGE, that was published in a separate article [26]. Therefore, the novelty of this approach is that these scenario narratives are developed, through both qualitative and quantitative assumptions, to be quantitatively modelled. In these SLIM scenario narratives, we developed a set of alternative scenarios about the motivation, enablers, speed and extent of lifestyle change adoption (the latter two aspects, in particular, link this article with the article on quantitative modelled scenarios [26]). We illustrate various possibilities of sustainable lifestyle changes and systems change working in tandem to mitigate climate change.

We address the larger focal question, "How can lifestyle changes accelerate deep climate change mitigation by 2050?". We chose the year 2050 as it is within a time horizon in which it is possible to explore plausible alternative futures while still representing a significantly distant time horizon in which technological, sociocultural and infrastructural changes can emerge and lead to different lifestyle scenarios. We emphasise *deep* climate change mitigation, as transformative sustainable lifestyles *and* systems change are necessary. As such, we present a set of detailed and nuanced SLIM scenario narratives for enriching qualitative and quantitative scenario analysis. These scenario narratives can be used to strategically discuss the possible impact of lifestyle change and explore possible pathways and policies to stimulate such changes. They can also be used as input to subsequent quantitative scenario work and modelling.

We first introduce the concepts and theories used for this research. Secondly, we describe the method of scenario narrative development. Third, we illustrate the SLIM scenario narratives through summarised figures, tables, and detailed descriptions. Fourth, we discuss the SLIM scenario narratives and explore overlaps and divergences. Finally, we conclude with the main aspects that should be taken from this research.

2. Key literature for scenario planning on sustainable lifestyles in systems change

This section elaborates on the theoretical background and conceptual basis for the scenario planning of the SLIM scenarios. We begin by elaborating on some key literature on sustainable lifestyles, and then discuss the scenario planning literature that forms the basis for this research.

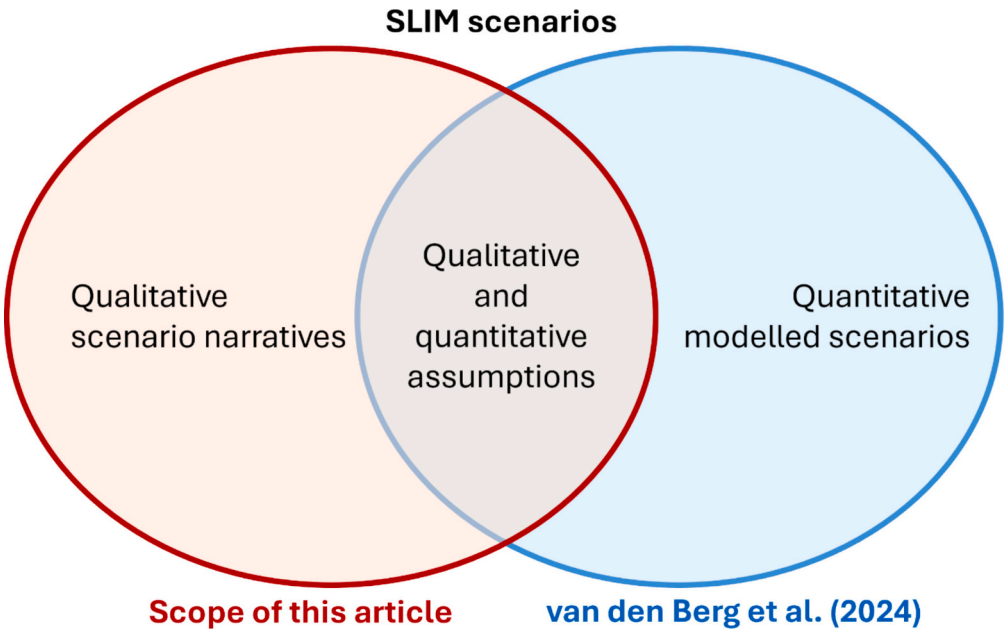

Fig. 1. The scope of SLIM scenario narratives developed within a larger project to be modelled in quantitatively modelled scenarios.

2.1. Sustainable lifestyles in systems change

In this section, we highlight some key definitions of sustainable lifestyles forming the basis for the scenario narratives in this research. Since sustainable lifestyles are embedded in systems change, we analyse the changes at the 'enablers' and 'society' level. These terms are also used extensively throughout this paper, and we clarify how these terms should be interpreted and how they are related to each other.

In this research, we adopt a definition of sustainable lifestyles based on a framework for shaping sustainable lifestyles [27] as patterns of behaviour that minimise the use of natural resources and waste generation while maintaining a fair and decent living. These actions are embedded in and facilitated by societal institutions, norms and infrastructures that frame individual choices and practices. Furthermore, we use another definition on how behaviours and lifestyle changes are related: "Individual behaviours which form a part of lifestyle change are studied in environmental psychology as pro-environmental behaviour, which is defined as 'behaviour that harms the environment as little as possible, or even benefits the environment" [28,29]. In this research, we emphasise that the sustainable lifestyles – at the individual level – do not necessarily have to be driven by (only) pro-environmental behaviour, but also influenced by other motivations such as health, cost-savings, technological innovations, and convenience could result in sustainable behaviour as well [27]. Lifestyles are not only shaped by individual choice, but by the systemic context within which people live.

In this research, we acknowledge the influence of structures as key elements in shaping sustainable lifestyles. Therefore, we will elaborate on how we represent these structures in this research. As defined by Giddens [30] a structure is a sum of "rules and resources, or sets of transformation relations, organised as properties of social systems.", and "We should view structural components of society, or, more specifically, structural factors asserted in the literature that hinder or enable a shift toward 1.5°C lifestyles." [31]. Therefore, we acknowledge that lifestyles can be shaped by enablers and constraints, in a variety of ways as structural changes. We represent these structural changes as enablers and not necessarily constraints, as we want to highlight the latter in this research as solutions in each scenario narrative.

In this research, we distinguish between these terms as behaviours forming part of lifestyles influenced by enabling factors within society, that lead to certain consumption patterns or preferences (the latter is more relevant in the quantitative modelling in the counterpart article [26]).

2.2. Scenario planning and interpretation

Understanding lifestyle changes within a complex and uncertain future is challenging. We cannot always rely on historical data or past experiences to predict what will happen, especially during times of rapid and turbulent changes. Rigorously imagined futures or scenarios can support this understanding of plausible futures and can usefully stimulate strategic discussions and actions. Scenario planning is a method to represent and deal with deep uncertainties for decision-makers [32]. This approach can help us imagine a future that we cannot predict and understand the potential implications of our decisions. Scenario narratives, resulting from scenario planning, are alternative images of our future – the plausible stories of future landscapes. They combine the possible, probable and preferable while keeping us honest about what is uncertain [33–35].

Scenario planning is not just about imagining the future. It is also about improving our ability to anticipate critical changes ahead of time while identifying strategic actions that could mitigate or shape the future we want. In other words, the intention of this foresight tool is to create the conditions in which decision-makers, including diverse groups of stakeholders, can better understand a fuller range of options before them and thus make better strategic choices in the present. The reasons that scenario planning does this effectively can be explained through the futures cone (see Fig. 2). The futures cone shows where different perceptions of the future may land across a spectrum of possibilities [36,37]. For example, a scenario that suggests futures very similar to current trends would be considered a "Probable Future", whereas a future that defies natural laws (e.g. physics) would be considered a "Preposterous Future". In scenario planning practice, the intent is to explore "Possible Futures" that extend past the probable. By allowing for exploration in this space, futures that are not contingent on how "things currently are" are formed and teased out to explore complexities and make sense of how these proposed scenarios may emerge. Scenario planning is often used in an exploratory sense for distant futures (e.g. 10 to 50 years) where the uncertainties are high, and the givens are low [38]. A notable example of scenario planning is the Mont Fleur scenarios - this study asked "what would South Africa be like in

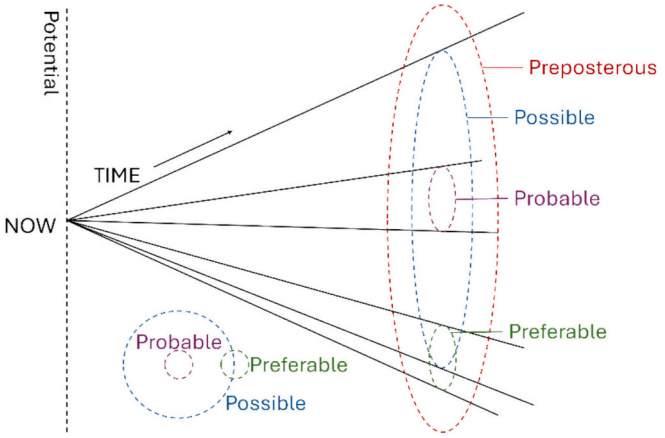

Fig. 2. Futures cone adapted from Voros [36].

2002?". This research was conducted in the midst of a political shift towards ending Apartheid, and imagined four pathways by which these transitions may occur [39].

The process of scenario planning often begins with identifying key driving forces, such as cultural values or economic concerns. Consequently, scenario building in response to these key driving forces, identifying and discussing key questions, and then addressing the current systems in place that either support or deny these scenarios [40]. Commonly, there are three methodological approaches within scenario planning: the matrix approach, a deductive method that compares two determined uncertainties (i.e. axes) across a matrix on four distinctly different scenarios; the incremental approach, which explores alternatives to an 'official future' or dominant nature about the future; and the emergent/key choices approach, an inductive method that explores possible futures that emerge from potentialities [41–43].

Therefore, scenario planning is a method for critically and strategically exploring and identifying innovative responses under conditions of uncertainty and complexity [32,44]. This flexibility of scenario planning proved valuable to our research as we were able to adapt and respond to the variability of workshop outcomes as our research continued over multiple years. The cyclical scenario development is shown in Fig. 3 [45]. This version of the Pierre Wack scenario approach [40] provides a cyclical and iterative way of building scenarios to encourage developers to undertake continuous scenario thinking and testing, adapting and evolving scenarios over time. This process emphasises the importance of incorporating the iceberg analogy for a systems perspective to capture how different variables are connected. The 'events' part of the iceberg (above the surface), is usefully focused on. However, to understand the events, it is essential to consider below the surface to identify the behaviour patterns. A further understanding of the events is found deeper at the structural level of forces.

3. Methodology

We explain the methodology of this research, by first describing the reference scenario Behaviour-as-Usual from which the SLIM scenario narratives diverge. Then we describe the scenario narrative development, including the details of engaging with advisors and policymakers. We also define the criteria set for the narratives that was used in developing the narratives. In the scenario development, we adopted a combination of the matrix and incremental approach, and for the scenario planning process, we followed the Pierre Wack scenario approach [40] (as described in Section 2.2 above).

3.1. *Reference SLIM scenario narratives "Behaviour-as-Usual"*

We define a reference scenario narrative from which the SLIM scenario narratives diverge, based on the commonly-used SSP2 "Middle of the Road" mitigation scenario with climate policies [20]. We name our reference scenario "Behaviour-as-Usual" and describe it as a world in which "technological innovation is the dominant climate mitigation strategy, and lifestyle changes play a minor role" (see Table 1). This

Table 1
Behaviour-as-Usual reference scenario description.

Reference Scenario	*Tagline:* net-zero by tech change
Behaviour- as-Usual	Technological innovation is the dominant climate mitigation strategy, and lifestyle changes play a minor role.
Individual agency	Low
Technology support for lifestyle change	Digitally enhanced
Pace of life	Fast pace
Inclusive access / Social equity	Low
Security and safety	Low
Public / Private / Community	Private
Speed of lifestyle transition	Low
Extent of lifestyle change adoption	Low

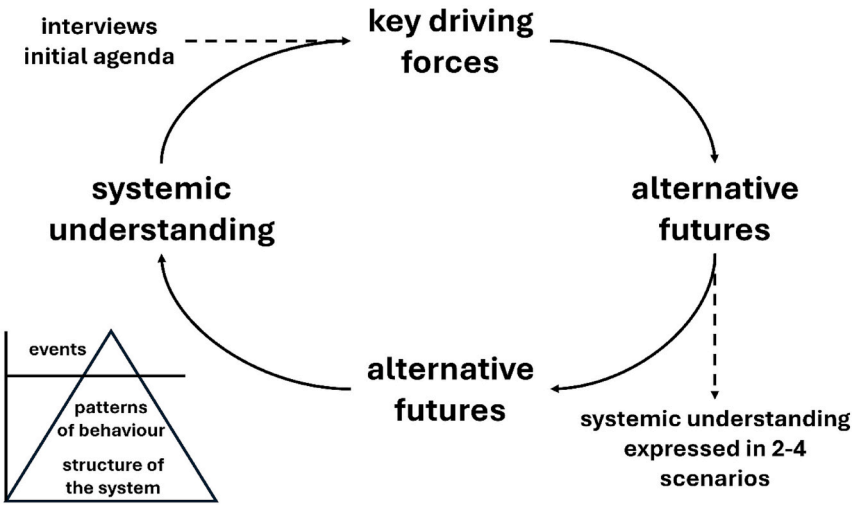

Fig. 3. The Pierre Wack Scenario Approach in a cyclical, iterative visualisation [40,45].

reference provides a good contrast to the other scenario narratives that include behaviour changes in different ways. The tagline "net-zero by tech change" highlights the pathway to emission reductions through technology change for reaching net-zero carbon targets. Some key characteristics are listed in Table 1. Note that these were developed based on the workshops, and through analysis, but have been included in the methodology as the Behaviour-as-Usual scenario is a reference from which the SLIM scenarios deviate. There is a low individual agency to change lifestyles and behaviours. Furthermore, technology that is digitally enhanced mainly facilitates efficiency. There is a fast pace of life, favouring fast and efficient ways of travelling, eating, living, etc. Overall, there is low inclusivity and social equity regarding lifestyles. Security and safety would be at risk with increasing technology reliance and artificial intelligence. The market would be primarily private. The extent and speed of adopting lifestyle changes would be largely dependent on motivations and contextual factors, such as infrastructural changes and social changes. In this reference scenario, the transition speed and extent of lifestyle change would be relatively low, and more reliant on technological changes.

3.2. Criteria definition

The criteria for the scenario development were presented and used as a basis throughout the stakeholder engagement and scenario development process. Building on scenario planning methodologies (see Section 2.2), we used five criteria to help guide participants in creating scenarios that are analytically useful while mitigating some of the cognitive biases common to people when thinking into the future. They include:

- Relevant – addresses our focal question "How can lifestyle changes accelerate deep climate change mitigation by 2050?" and is framed towards key target audiences (notably policymakers).
- Plausible – the changes could happen within the time frame.
- Divergent – the scenario narrative diverges from the others and the reference scenario narrative "Behaviour-as-Usual".
- Clear – memorable, and compelling narratives that can be easily shared and circulated among key target audiences.
- Challenging – challenge conventional thinking about the future, surface assumptions and taboos.

3.3. Developing the SLIM scenario narratives

We undertook a number of key steps in our scenario development process. We started with the focal question "How can lifestyle changes accelerate deep climate change mitigation by 2050?"

The SLIM scenario narratives have been in development since 2020 through a series of interactive workshops between the project team, researchers and selected participants, policymakers and advisors. A diversity of disciplines and professional experience in the participant group was sought to enrich the complexities of the SLIM scenario narratives. Our project team and participants include researchers and professionals from climate science, modelling, lifestyle change, transition studies, strategy and foresight. As most of our workshops were conducted online (due to the pandemic at the time), we were able to include participants from a diversity of locations, with almost half of the participants having close ties (e.g. lived experiences, expertise) to Global South countries (see S1 for details on the regional perspectives and expertise). These participants were selected and invited to join our workshops based on their expertise and regional perspectives, ensuring as wide a representation as possible. As the highest income groups have the highest carbon footprints, shifts in sustainable lifestyles are necessary, especially in these groups [46]. Therefore, we do have a stronger representation of participants from high-income countries in the Global North compared to the Global South. While not all participants/advisors could attend every workshop, we had a pool of 58 people who were continually invited to attend workshops, with our most attended workshop (the scenario matrix advisor workshop) with 39 participants/advisors (see Table 2). To update new participants and remind the other participants, we sent information about the earlier workshops before each new workshop and presented this at the beginning of each workshop. As the project team, we had a facilitating role in the workshops by asking questions, encouraging all participants to contribute and clarifying when necessary. Therefore, we were able to stimulate discussions when the participants needed some guidance. We documented the workshops via recordings and note-taking of the sessions, and also via MIRO for participants to share their ideas directly.

Fig. 4 provides a schematic of developing the SLIM scenarios based on the Pierre Wack scenario approach [40] (see associated text in Section 2.2). Each iteration produces versions of the SLIM scenarios, and at each new phase, these scenarios go through the Pierre Wack scenario approach [40] again, while adopting a systems perspective.

In Fig. 5, a more detailed process is shown. In each iteration, the project team defined the 'aim and scope' steps (see Fig. 5; shown in yellow) in which relevant research questions were defined, the 'engagement' steps (shown in blue-purple) which provided a systemic understanding through insights from advisors, policymakers and/or testers, and the 'analysis and synthesis' steps (shown in blue) where key driving forces were identified. From here, a new iteration would begin. Outcomes of this iteration are shown as the 'outcomes' step (shown in pink-purple), representing a draft of the alternative futures, or SLIM scenario narratives. Each iteration is explained in detail below. For specific details on the engagements with advisors, policymakers and testers, see Table 2.

3.3.1. Iteration 1: scenario logics

In this initial iteration, we began by defining scenario criteria to determine the scenario logics, or building blocks, that form a basis for the scenario narratives.

In the 'scenario logics' workshop, we presented the scenario criteria, aims and scenario planning approach, and encouraged the participants to create narratives around lifestyle change on a blank slate. We primed the participants to have individual brainstorms, by posing the questions and statements to the participants, in group exercises, facilitated discussions, and in plenary, discussing the group exercises' outcomes (see Table S3 in Section S2 for details).

In the analysis and synthesis of the workshop, we created mind maps of potential themes and logics to build on further in the next iterations. These mind maps are the first outcomes of the SLIM scenarios, where we were able to determine draft critical uncertainties to build a scenario matrix on. The intermediate results of this first iteration workshop are described in S3.1. and illustrated in Fig. S1, and the synthesis and analysis of this mind map in Fig. S2.

3.3.2. Iteration 2: scenario matrix

Based on the mind maps, we aimed to detail the scenario uncertainties (i.e. the axes) and matrix in the second iteration of the scenario development.

In a scenario matrix workshop, we presented the mind maps and the draft uncertainties. We give a short explanation of scenario planning essential for building the scenarios. Using the MIRO platform, we offered a space for participants to contribute to the details of the scenario quadrants (one breakout group per quadrant) of the draft matrix skeleton (based on the scenario uncertainties). We also offered a 'game-changers' breakout group outside of the matrix to explore lifestyle changes in general. The participants were asked to develop: end-states, storylines, names and lifestyle changes. In plenary, we reported back on the results of the group exercises. Thereafter, we explored strategic implications in breakout groups, by categorising insights and implications by community: modelling, sustainable lifestyles and policy/other.

In the analysis and synthesis of this workshop, we determine stated themes, comparative divergences, potential events and timelines of each scenario quadrant of the matrix, forming the more detailed SLIM

Table 2
Details of advisor, policymaker and tester engagements.

Engagements	Aim	Process	Product	Dates (Duration)	Number of participants
Scenario logics advisors workshop	To create building blocks for scenario narrative development from criteria	plenary: presentation of scenario planning and criteria breakout groups: discussions of how lifestyles could change plenary: report back and discussion	Framework of four key uncertainties to build the SLIM scenario narratives on	20/01/2021 (3 h) 04/02/2021 (2 h)	36 11
Scenario matrix advisors workshop	To get feedback and detailed input on draft SLIM scenario narratives framework	plenary: presentation of SLIM scenario narratives framework breakout groups: brainstorm on details of one of the four SLIM scenario narratives using the MIRO interactive platform plenary: reporting back and sharing ideas of the different SLIM scenario narratives	Detailed SLIM scenario narratives with timing and events	30/03/2021 (3 h) 08/04/2021 (3 h)	39 13
Policymakers meeting	Test detailed SLIM scenario narratives in a policy context	exercise: on anticipated changes presentation of project and SLIM scenario narratives exercise: potential policy interventions exercise: wild cards, unexpected, but likely events discussion: what outcomes are useful for policymakers in connecting lifestyles to climate change?	Refined SLIM scenario narratives with policymakers' feedback	01/07/2021 (2 h)	7
Scenario narrative advisors meeting	Finalise SLIM scenario narratives	presentation of SLIM scenario narratives and scenario inputs based on: behavioural actions, motivations, contextual factors, adoption rates and speed of transition	Finalised SLIM scenario narratives	15/12/2021 (1.5 h)	20
Testing online workshop	Get detailed feedback	Presentation of latest scenario narratives and their usability	Scenario narrative feedback	30/05/2023	17
Testing in-person workshop	Get first insights and from SCORAI conference 2023 participants	Presentation of latest scenario narratives and draft visualisations, explore implications and strategic dialogues	Scenario narrative and visualisation feedback	07/07/2023	30

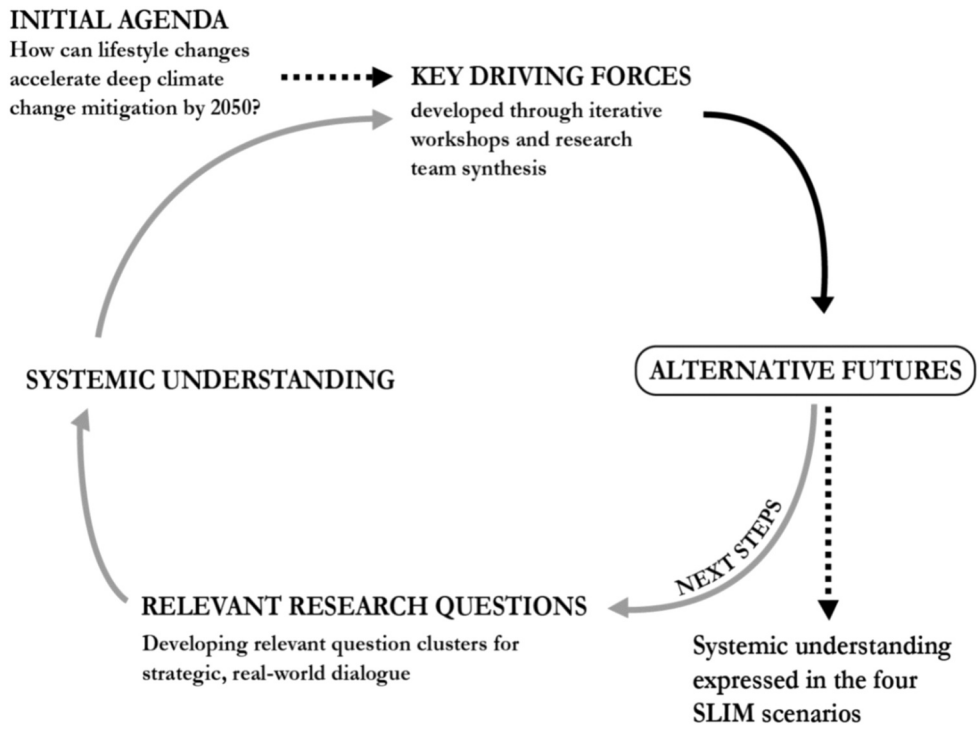

Fig. 4. Pierre Wack approach [40] adapted to our scenario development process of the SLIM scenarios.

scenarios as outcomes in this iteration. The intermediate results of this second iteration workshop are illustrated in Figs. S3–9, and the synthesis and analysis of the workshop outcomes in Fig. S10.

3.3.3. Iteration 3: scenario characteristics

With the scenario matrix more structured from the previous iteration, we explored and identified policy-relevant characteristics key to the SLIM scenarios in this third iteration.

First, we engaged with key policymakers, where we presented the scenario matrix, scenario names and critical uncertainties (i.e. the axes of the matrix). We presented the scenario descriptions and visualisations for a clearer view of how these scenarios could take place in different contexts and regions. We asked the policymakers to explore potential policy interventions in each scenario to promote positive outcomes and

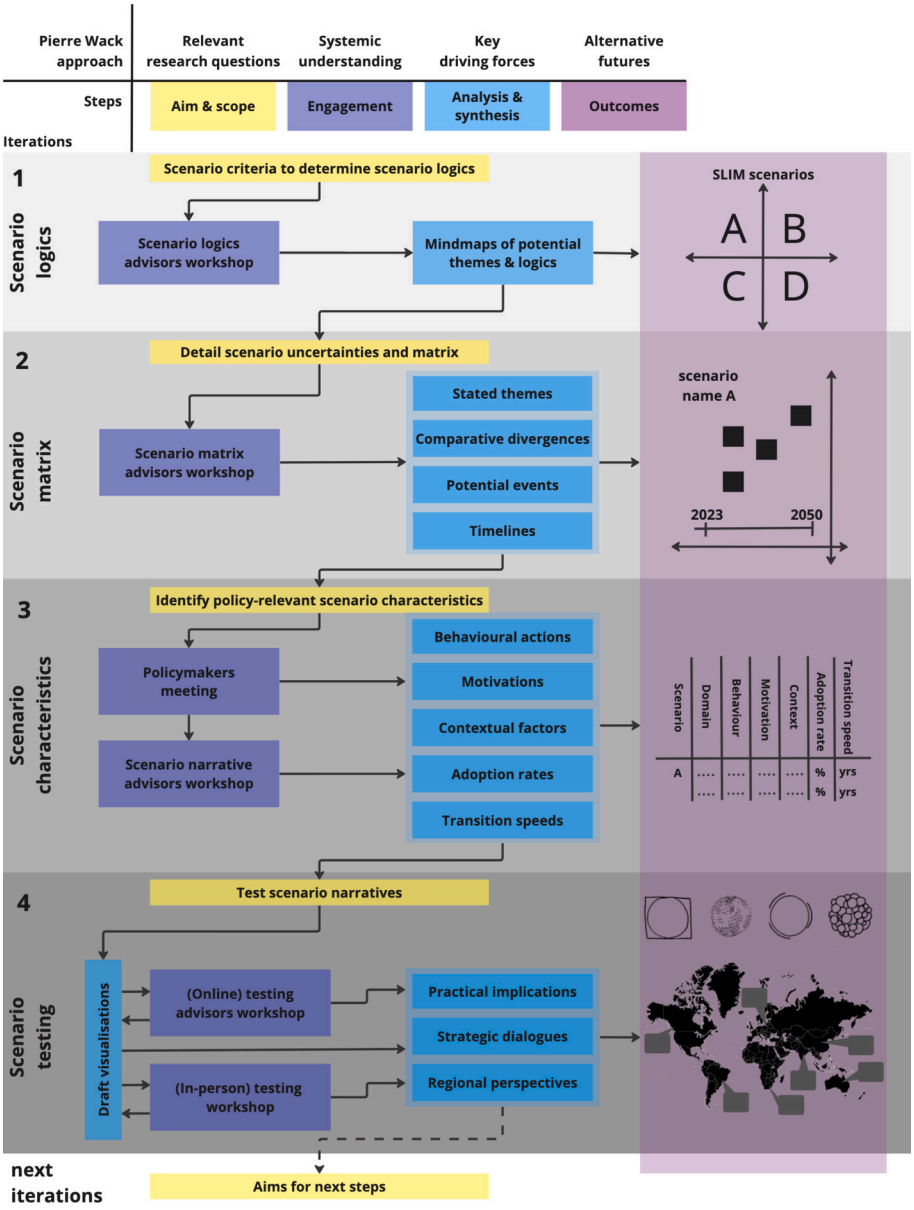

Fig. 5. Scenario development process (based on the Pierre Wack approach [40]).

dissuade negative outcomes. Furthermore, we prompted them to hypothesise about unexpected events in each scenario that could happen that would have a major impact. In addition, we asked them what outcomes from the scenarios or process they would find useful in their work on connecting lifestyles to climate change.

Second, we held a scenario narrative workshop with advisors, where we presented draft qualitative and quantitative assumptions (developed by the project team) that were translated to the models in the quantitative counterpart article [26] (see Fig. 1). These are identified for each SLIM scenario in key consumer domains, namely transport, residential, food and cross-cutting changes. Since this workshop was more detailed than the others, we sent guiding slides before the workshop to get everyone up to speed. The draft assumptions were discussed in detail. For further feedback, we encouraged participants to read through the assumptions after the workshop, sharing their comments and suggestions on specifics. The assumptions were developed through the co-creation process and validated with literature. This formed the starting point for the modelling assumptions.

After the policymaker meeting, scenario narrative workshop and feedback review, we analysed and synthesised these outcomes. We identified the qualitative and quantitative assumptions on the behavioural actions, the motivations, enabling factors that help determine the adoption rates and transition speed of each scenario. These assumptions helped detail the scenario narratives with different levels of change within and across domains – a key outcome of the SLIM scenario narratives. These outcomes are shown in the tables in S4, and the results of the synthesis and analysis are shown in the main article in Fig. 6. The characterisation of the assumptions was based on the workshop and the definitions from Section 2.1 on behaviour, lifestyles, enablers and society.

3.3.4. *Iteration 4: scenario testing*

With the scenario descriptions, critical uncertainties that separate them, and the assumptions, the scenario narratives were at a stage where they could be tested. First, we tested the scenario narratives in an online workshop, incorporating feedback and gaining insights about the usability, strategies, and implications of the scenarios in practice. In parallel, we worked with graphic designers to develop visualisations of the

Fig. 6. Visualisation of the SLIM scenario narratives.

SLIM scenarios so that users can imagine the futures in different contexts (see an example of these visualisations as intermediate results in S5 and Fig. S11). These scenario narratives and draft visualisations were tested in an in-person workshop at the SCORAI conference 2023, contributing to the insights from the online testing workshop. From these testing workshops, we were able to synthesise the practical implications, strategic dialogues and regional perspectives of the SLIM scenarios. These steps have laid the groundwork for the next iterations to continue the testing and development of the scenarios, and to support the strategic discussions among stakeholders engaged in climate action.

4. Results: SLIM scenario narratives

In this section, we first discuss the framing of the SLIM narratives. Second, we introduce the SLIM scenario narratives and compare them to their placements on the spectrum of uncertainties. Third, we dive deeper into the scenario narrative details across societal, enabling, lifestyle, and behavioural factors and provide examples of how they could happen. Lastly, we analyse the SLIM scenario narratives in terms of different characteristics. In S3, we present the results of the iterations of the scenario development process (see details of this process in Fig. 5), to show the outcomes that led to the SLIM scenarios.

4.1. SLIM scenario narratives framing

The SLIM scenario narratives represent alternatives along a continuum of uncertainties. These uncertainties were developed in the 'scenario logics' workshop with participants and refined by the project team, as described in Section 3.3.1 with intermediate results shown in S3.1. They formed the basis on which the SLIM scenario narratives were built (see Fig. 7 and Section 4.3):

Individualistic vs *collective values.* We identified a first continuum of uncertainty as driven by different types of values, individualistic and collective. In the first case, individualistic values (a society oriented more around individualised needs) lead to changes in behaviour. In the second case, the collectivist values (a society oriented more around the collective) often lead to collective action. Both types of values can lead to sustainable outcomes, but in different ways.

Centralised vs *distributed access to structural support.* We identified this second uncertainty regarding access to structural support, namely, centralised or distributed. Societal support is critical to sustainable lifestyles [10]. The types of lifestyles differ by whether people have centralised access to structural support, such as infrastructure, legislation and government programs, or whether opportunities and access are devolved to local or household levels, such as community-supported education, local food distribution, or private car ownership. The importance of structural support in realising sustainable futures reflects that our ability to live sustainable daily lives is supported or constrained by our context.

4.2. Scenario narrative descriptions

The four SLIM scenarios are developed based on research criteria (see Section 3.2). These scenario narratives are defined as: Designed World (sustainable lifestyles by default), Global Commons (an inclusive global governance system), Big Village (community-based sustainable living), and Pocket Lifestyles (peer-to-peer lifestyle platforms). In Table 3, we describe the four SLIM scenario narratives compared to the reference Behaviour-as-Usual scenario narrative with their distinct divergences (see Section 4.1) and descriptions. In S7, we describe the SLIM scenario narratives in more detail with some examples of specific changes that lead to the end-states. These can give some insights into how these changes could happen. Furthermore, these scenario narratives describe how they can be found in different parts of the world today and in the future.

As shown in Table 3, Designed World and Global Commons would be mostly driven by centralised access to structural support, such as government interventions and global governance structures. In contrast, Big Village and Pocket Lifestyles have distributed access to structural support, relying on bottom-up initiatives and innovations, taking it upon themselves to spread sustainable practices. Designed World and Pocket Lifestyles would be more individualistic in their actions, while Global Commons and Big Village would be more collectivistic. These characteristics of the SLIM scenario narratives are visualised in Fig. 6. We emphasise that these SLIM scenario narratives are possible "what-if" futures to imagine how lifestyles and systems could change under different contexts and should be interpreted as such (see Section 2.2 on scenario planning for more details).

Fig. 7. Overview of the SLIM scenario narratives (i.e. Designed World, Global Commons, Big Village and Pocket Lifestyles) varying in type of support (distributed vs. centralised) and values (individualist vs collective) across different characteristics, namely changes in society, enablers, lifestyles and behaviours, diverging from the reference scenario narrative (i.e. Behaviour-as-Usual represented by the circle in the middle). There is no fixed direction or starting point of change.

4.3. Levels of change in lifestyle narrative scenarios

In Fig. 7, we illustrate the four SLIM scenario narratives across different types of changes: society, enablers, lifestyles and behaviours (see Section 2.1 where we describe these terms). The details and categorisations for the different narratives were developed by the project team based on the workshops and meetings with policymakers. More specifically, we developed these details in iteration 2: scenario matrix (see Section 3.3.2) and iteration 3: scenario characteristics (see Section 3.3.3) that resulted in the qualitative and quantitative assumptions (see Table S4.1 and Table S4.2 for more specific details). We focus on changes in the domains: food (e.g. diet), transport (e.g. active travel), residential (e.g. type of dwelling), and those cross-cutting domains (e.g. leisure) that are related to sustainable behaviour.

We highlight key behaviours and related lifestyle changes, and how these are supported by specific enablers and society for each scenario narrative. The behaviours and lifestyle descriptions are positioned in relation to the other scenarios. For example, the closer a behaviour and lifestyle description is to another scenario triangle, the closer it resembles another scenario. If a behaviour and lifestyle description shares a dividing line with another scenario narrative, this behaviour or lifestyle is consistent with both SLIM scenario narratives. This figure is not exhaustive, as there are many behaviours and lifestyle descriptions that may emerge in and across the SLIM scenario narratives. Through the function of this figure, we attempt to address the limitations of the matrix cited by workshop attendees. It is also important to note that behavioural changes do not necessarily happen linearly. There is no fixed direction or starting point of change (shown by the multidirectional arrow), but it should rather be interpreted as complex and dynamic. For example, change does not always start at society and influence the other levels, but could start at enablers that influence behaviours that, in turn, affect society. We describe the SLIM scenario

Table 3
Overview of value positions and summary statements regarding the SLIM scenario narratives.

Reference Scenario Behaviour-as-Usual	*Tagline:* net-zero by tech change Technological innovation is the dominant climate mitigation strategy, and lifestyle changes play a minor role.
Lifestyle Scenario Designed World	*Tagline:* sustainable lifestyles by default Individualistic values / Centralised access to structural support Governments, corporations and cities leverage existing values and market systems to shape citizen and consumer preferences and practices
Lifestyle Scenario Global Commons	*Tagline:* inclusive global governance system Group / Collectivist values / Centralised access to structural support Universal values shape ways of living, new institutions, and a global governance structure with less emphasis on sovereignty, with a more active Global South participation.
Lifestyle Scenario Big Village	*Tagline:* community-based sustainable living Group / Collectivist values / Distributed access to structural support People band together in communities regionally while remaining networked globally to support bottom-up innovation, shared infrastructures, and belonging.
Lifestyle Scenario Pocket Lifestyles	*Tagline:* peer-to-peer lifestyle platforms Individualistic values / Distributed access to structural support People take it upon themselves to adopt and rapidly spread ambitious sustainable lifestyles, behaviours and practices through digital technology.

narratives across the different levels of changes below.

4.3.1. Societal changes

We show how societal changes in the SLIM scenario narratives diverge from Behaviour-as-Usual in the central layer of Fig. 7. In Designed World, we elect sustainable leaders to make sustainable decisions on our behalf. Where Designed World and Global Commons overlap is in transformative policy-making that supports sustainable lifestyles. Furthermore, we redefine social welfare in the Global Commons to accommodate and empower different groups of society. A central element in both Big Village and Global Commons is that collective action becomes a social norm. In Big Village, a shift to back-to-basics is a vital societal change, embracing the simplicities in life. A commonality in Big Village and Pocket Lifestyles is the rise of grassroots movements in society, taking it upon themselves to ask for and adopt changes. Societal changes in Pocket Lifestyles would be based on the desirability of sustainable actions to the masses. An overlapping societal change in Pocket Lifestyles and Designed World is the acceptance of sustainable shifts, respectively facilitated by bottom-up initiatives and enacted by sustainable governance.

4.3.2. Enabling factors

The differences in enablers highlights how lifestyle changes are facilitated across the SLIM scenario narratives (see 'enablers' layer in Fig. 7). In Global Commons, universal basic services (e.g. free access to public basic income and public transport) would be provided through a societal redefinition of social welfare. A common enabling factor in Global Commons and Big Village is the development of infrastructure for shared actions, where collective action can be amplified. A vital characteristic in Big Village is community facilitation, engaging the back-to-basics in a strong community setting. For both Big Village and Pocket Lifestyles, private incentives for local initiatives would be essential to facilitate grassroots movements. A key enabler in Pocket Lifestyles is the availability of peer-to-peer apps and open-source assets (e.g. tool share sheds, community learning) that makes certain lifestyle changes convenient and accessible. For Pocket Lifestyles and Designed World, the provision of sustainable innovations enables the level of sustainable shifts. In Designed World, because of the strong sustainable leadership, radical sustainable subsidies incentivize sustainable lifestyles. In Designed World and Global Commons, enabling factors overlapping include the redesigning of infrastructure to facilitate lifestyle changes.

4.3.3. Lifestyle changes

The types of lifestyle changes (see 'lifestyles' layer in Fig. 7) differ significantly between the SLIM scenario narratives. In Big Village, there would be a shift to sufficiency, slower living, shorter workweeks and living in multi-generational homes. A lifestyle focused on less-is-more is common in both Big Village and Pocket Lifestyles. For Pocket Lifestyles, social exchanges, minimalism, trendy/tech-savvy changes and digitalised lifestyles would be amplified by peer-to-peer sharing and a desire to be more sustainable. Technology-related lifestyle changes would be key in both Pocket Lifestyles and Designed World. In Designed World specifically, lifestyles would be fast-paced, focused on sustainable innovations, shifts to low-carbon, and frugality would be central to the motivation behind the changes. Both in Global Commons and Designed World, lifestyle changes would be based on convenience and diverse accessibility to adequate options. The lifestyles central to Global Commons would be collaborative, flexible, related to shared facilities and services, and focused on more radical innovations. For both Global Commons and Big Village, social cohesion would be key in lifestyle changes.

4.3.4. Behavioural changes

The behavioural changes (see 'behaviours' layer in Fig. 7 and specific assumptions on motivations, contextual changes, adoption speed and capacity in S5) within the dominant domains of transport, residential, and food are influenced by the lifestyle changes cross-cutting the domains and taking into account the complexity of various lifestyles (discussed above). In Pocket Lifestyles, the food-related behavioural actions vary from shifts to vegetarian diets (based on trends) to meal sharing and prepping (facilitated by apps and digital lifestyles). Residential-related actions include adjusting thermostats, renting out rooms, living in minimalist homes and hang-drying laundry (amplified by trends and social exchanges). In transport, behavioural actions consist of peer-to-peer car sharing (facilitated by apps and digital lifestyles), smaller vehicles (based on minimalism), active transport (e.g. cycling and walking becomes trendy) and telecommuting (expanded by tech-savvy digital lifestyles).

For Designed World, the behavioural actions in transport include replacing personal cars with taxi use (matching fast-paced lifestyles), autonomous electric vehicles (shifting to low-carbon and adoption of sustainable innovations). Residential behavioural actions include heat recovery (e.g. shower heat recovery), heat pumps, insulation and rooftop PV motivated by frugal lifestyles to save money on energy use. Food-related behavioural actions include lab-grown meat and eco-restaurants, facilitated by subsidies and sustainable innovation provision.

In Global Commons, behavioural actions related to food include vegetable gardening, flexitarian diets, and local and seasonal produce, supported by (time-)flexible lifestyles (i.e. dedicating more time and effort for conscious choices). In transport, commercial car sharing (influenced by the shared facilities), fewer long-distance trips and more bus and rail transport (matching the flexible lifestyles). For residential behavioural actions, shared gardens, appliances, and heat pumps would be collectively adopted through lifestyles focused on collaboration, shared facilities and services, and radical innovation.

In Big Village, transport-related behavioural actions include staycations, living closer to amenities and carpooling. In residential, communal living areas, modular homes, repair and renovation, community gardens, and natural ventilation would be vital. For behaviours related to food, the adoption of vegan and sufficient diets and communal dining is prominent. These behaviours would all be heavily motivated by slower living, a shorter workweek, social cohesion, multi-generational homes and sufficient lifestyles.

4.4. Scenario narratives compared across characteristics

The complexity of the developed SLIM scenario narratives can be unravelled by comparing them across their main characteristics regarding individual agency, technological support, the pace of life, social equity, security, and the relationships between public, private, and community enterprises (see Table 4). These defining characteristics were developed by the project team based on the outcomes from iteration 3: scenario characteristics (see Section 3.3.3). We have included the Behaviour-as-Usual scenario narrative in Table 4 as a reference point (see description in Section 3.1 of the Methodology). The outcomes from our SLIM scenario narratives are based on expected trends from now until 2050, such as population increase and generational shifts. The resulting lifestyle changes discussed below may overlap or have similarities to one another, may differ slightly, or may stand alone and far from other scenario narrative outcomes. The comparisons of our SLIM scenario narratives in this fashion allow a deeper engagement with the possibilities of these stories, and to explore strategic implications, and to explore which directions may be most favourable in climate change mitigation. For a further overview of scenario narrative descriptions for the different characteristics, refer to S6.

Designed World shares significant similarities with Behaviour-as-Usual. However, it does have higher inclusive access and social equity, security and safety, and would be more public-private than just private. Global Commons relies on technology support that is digital but low-tech, pace of life slower (i.e. medium), with higher inclusivity and equity, and more public-driven. As Big Village is also collective, it is also more public-driven, but then through community, however, with a slower pace of life, low-tech, with medium inclusivity and social equity and security and safety. As there is distributed access to structural support (as opposed to centralised access), individual agency would be high. Similarly, Pocket Lifestyles also has high individual agency for the same reason. However, as behaviours are mostly driven by individual values, and technology support is more digitally enhanced, the pace of life is most likely faster, like Designed World and Behaviour-as-Usual. Inclusive access and social equity are lower, but with medium security and safety, while the market and private organisations play a key role in this scenario.

We identify how fast and how many people would change their behaviours and lifestyles in each scenario, so that we can translate the SLIM scenario narratives to quantitative assumptions for modelling (as was done in the counterpart article [26]). The speed and extent are determined from the quantitative assumptions that resulted from the iteration 2: scenario matrix (Section 3.3.2) and developed in the iteration 3: scenario characteristics (Section 3.3.3), by identifying behaviour changes, the motivations, enabling factors that determined the adoption rates (i.e. extent) and speed of transition (i.e. speed) (see S3.2 for the tables for the different domains). Note that the extent does not refer to the impact on emissions but rather the number of people who would adopt particular changes. As shown in Fig. 8 (which is purely illustrative), the extent and speed of adopting changes vary among the scenarios (see specifics for quantitative assumptions in dominant domains transport, residential and food in S3.2 and distinguished between Global North and Global South). Designed World would have a slower to medium speed due to a strong reliance on technology and infrastructural changes to facilitate lifestyle changes, but the extent of lifestyle change adoption is high, as it facilitates the changes well. In comparison, Global Commons has a medium speed, with collective action speeding up the process, the extent is medium to high, with centralised access to structural support from public organisations. In Big Village, the speed is medium to fast based on the largely distributed access to structural support and collective action, however, the adoption rates are low to medium, because of the lack of centralised access to structural support and limited amount of people that would adopt the lifestyles in this scenario narrative. For Pocket Lifestyles, similarly, speed of transition is fast, based on the relative ease of adoption the lifestyles, however, the adoption is low to medium as it requires a lot of individual agency.

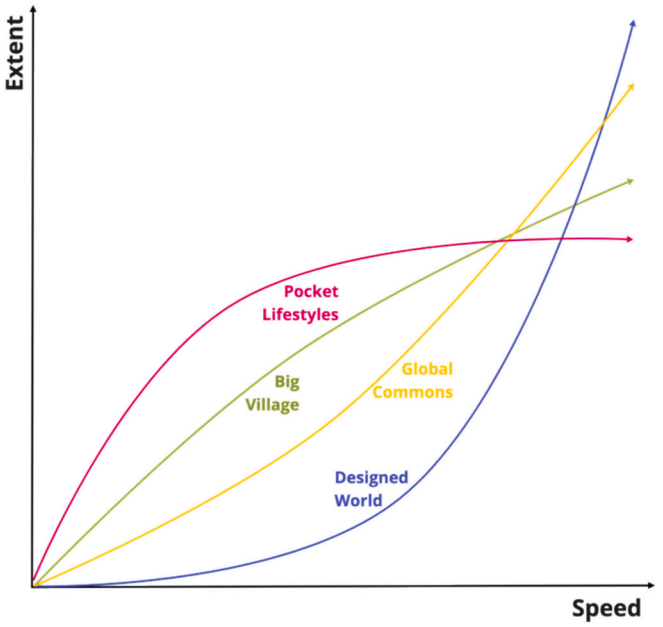

Fig. 8. Conceptual and purely-illustrative visualisation of speed vs extent of the SLIM scenario narratives.

5. Discussion

Creating nuanced and supported SLIM scenario narratives to imagine sustainable futures is important to have a fuller understanding of how policies affect both society and the individuals within them. The SLIM scenario narratives focus on the 'demand-side' drivers of climate emissions - including the behaviours, lifestyles, community support, technologies, and infrastructures that shape how people live. Policymakers, modellers, sustainable lifestyles experts, and foresight specialists can find the implications of this work helpful in guiding strategic dialogue and decisions towards global climate change mitigation.

Some limitations of this work lie in the fact that qualitative scenario development is inherently subjective. These SLIM scenario narratives were developed through expert workshops and scenario planning

Table 4
Comparison of the SLIM scenario qualitative characteristics.

SLIM scenario narratives Characteristics	Behaviour-as-Usual	Designed World	Global Commons	Big Village	Pocket Lifestyles
Individual agency	Low	Low	Medium	High	High
Technology support for lifestyle change	Digitally enhanced	Digitally enhanced	Digital, low-tech	Low-tech	Digitally enhanced
Pace of life	Fast pace	Fast pace	Medium pace	Slower pace	Fast pace
Inclusive access / Social equity	Low	Medium	High	Medium	Low
Security and safety	Low	High	High	Medium	Medium
Public / Private / Community	Private	Public-private with city	More public	Community public	Market/ Private

methods. Yet, they might not fully align with the perspectives of other professionals or policymakers. There are many opportunities for future work building on these SLIM scenario narratives and the process of lifestyle scenario development.

We included a range of advisors from different disciplines and regions to advise on developing these SLIM scenario narratives. This stimulated great discussions and challenged biases of the project team and other participants and assumptions about lifestyle changes in plausible alternative futures. Even though we included Global South representatives as advisors or policymakers, a more specific Global South focus could improve our SLIM scenario narratives in future work. Due to their continued development, Global South leaders are important to climate change mitigation. Furthermore, we do not include business representatives in the scenario development process, as it was out of the scope of this research. Some advisors provided a business viewpoint from their engagement with the private sector; however, a richer and more varied business perspective would be valuable, especially as the private sector plays a strong role as an enabler for lifestyle changes. Therefore, the SLIM scenario narratives could be further refined for future work with a range of business representatives.

The online setting (a result of the pandemic) for the workshops allowed for a range of different advisors. However, it did result in some other limitations. Compared to in-person workshops, online workshops might limit trust-building, dynamics among participants and communication, and shorten attention spans. These limitations were accounted for in the workshop design in the following ways. First, by keeping the workshops short enough, i.e. less than 3 h, and with a break in between, we tried to keep them engaged. Secondly, incorporating enough breakout sessions in smaller groups allowed for better participant dynamics. Thirdly, we made use of an interactive online workspace, MIRO, to facilitate participant engagement. Despite this, some key interactions or insights might still have been lost through the online setting of the workshops. Furthermore, as this set of workshops was hosted over several years, and not everyone was able to attend all the workshops, this could have influenced the results. For example, the regional representation would likely have been different per workshop, as it is difficult to ensure that the regional mix would be the same across workshops, as we were dependent on the availability of the participants However, having new participants join the workshops at later stages could have provided interesting insights, compared to if the list of participants remained the same.

As we show in this paper, our methods thus far have yielded valuable insights and early implications that illustrate sustainable lifestyle research through narratives. However, we continue to look forward to further insights as we complete the next stage in the scenario development process (see Fig. 5) —the next steps—where we would evaluate the best portfolio of strategic implications, actions and policies for each scenario and synthesise the most robust options that work across all scenarios and plausible futures. While we have assessed strategic options to a certain degree in the process that is captured in this paper, there are further steps to be taken, including where we "wind-tunnel" or test existing options and policies to see their efficacy and resilience over time and under different contexts. Future work into why and how these scenarios could unfold, the "scenario logics", will also reveal critical systems dynamics and high-impact places to intervene. These can also provide an important feedback loop into the modelling assumptions (for which these scenario narratives were developed). As best practices in the scenario literature show, good scenario processes are not just one-off efforts but iteratively improved over time as we test, further interrogate and evolve our assumptions and insights. Even though we developed these scenario narratives to be divergent and distinct from one another, combining different aspects of different narratives could be interesting to identify in future research. Complementary or perhaps conflicting behaviours and contexts could then be explored. The enduring impact of this scenario development process is that it aims to continue as a longer-term research and action program. The aim is to engage the emerging community of practice of modellers and sustainable lifestyle practitioners in an ongoing way, and enable strategic exchange with, and climate action by, policymakers.

SLIM scenario narratives built for quantitative modelling and qualitative research could be applied to specific regions to diversify individual and community motivations. For example, analysis of the SLIM scenario narratives in specific regions could show that some SLIM scenario narratives are more suitable for some regions than others. They can lead to new, vernacular, cross-disciplinary, and sustainable actions. Although the SLIM scenario work has drawn on multiple disciplines, many disciplines have yet to be included in the scenario development, for example, health sciences that could inform us about lifestyle changes for health-related changes. This expansion of disciplinary input could be further explored in future work. Exploration of differentiating value evolution may result in new variations of adoption rates and climate mitigation solutions. Those interested in using models to support sustainable scenario building or view the quantitative outputs of these SLIM scenario narratives, can look to this paper's quantitative counterpart [26]. When scenario planning is supported by integrated assessment modelling, SLIM scenario narratives give compelling outlooks to policies that allow for broader engagement from various climate community stakeholders, in exploring and delivering possible policy options.

The SLIM scenario narratives were developed to be modelled in Integrated Assessment Models. The bolstering of qualitative scenarios with quantitative inputs (see adoption rates and speed of transition in Table S1) to be used in models, as was done in the counterpart article [26] allows for a richer, demonstrable example of lifestyle change impacts and avoids oversimplification common in polarised utopian or dystopian scenarios, or through omission of interconnected, previously unsupported factors of change. We have translated the scenario narratives to the traditional domains (e.g. transport, residential and food) and identified key behavioural actions and contextual factors that affect them. Therefore, modellers would be able to quantify the narratives to model parameters. However, the scenario narratives are not limited to only modellers' use. By exploring these distinct scenarios, stakeholders and decision-makers (e.g., modelling community, policymakers, business and community leaders) can challenge their assumptions about future lifestyles, analyse what is possible, remain honest about what is uncertain, and identify robust strategies adaptive to different plausible pathways. Further research opportunities in this realm include a more extensive inclusion of diverse stakeholders, disciplines and initiatives.

Equity considerations were central in developing the SLIM scenario narratives. Firstly, we explicitly cover a section on social equity in comparing characteristics (see Section 4.4 and S6 under social equity for more details), comparing the social equity between the different scenarios, and the underlying values that enable more equitable societies. Secondly, in determining the speed and extent, we consider differences between Global North and Global South, considering the responsibility, equality, and capability equity principles [47,48] (see S4.2). However, these assumptions are still very aggregated and limited to only regional differences. In the modelling of the SLIM scenarios [26], we also accounted for income differences within regions, but this was limited in these SLIM scenario narratives. There is value in further exploration of the equity considerations of the SLIM scenarios.

Systems change and lifestyle change can be considered two sides of the same coin [3]. However, often these are considered separately, leading to 'consumer scapegoatism' [49], in which the responsibility and burden are placed on consumers to change their lifestyles, while many conditions influencing their behaviours are locked in by their context or out of their direct control. The multidisciplinary nature of this research allowed for an integrated systems approach and furthers the insight that our lifestyles are both influenced by our actions and shaped by our context [27]. It allowed us to analyse technology and consumption changes alongside each other and account for the various enabling factors that influence which and how impactful lifestyle changes can be.

As mentioned in the introduction and methodology, these scenarios

were developed with the aim of determining what sustainable lifestyles could evolve by 2050 and were developed to be modelled in integrated assessment models. Therefore, the novelty of this research is that the qualitative narratives, as developed in this article, and consequently modelled quantitatively, as was done in an accompanying article [26] allowing for an iterative and integrated approach.

When comparing our qualitative SLIM scenario narratives to the SPREAD 2050 scenarios [10], they used a backcasting methodology, focused on different ways to spread lifestyles, while we adopted a scenario planning approach with research criteria for how different lifestyles can evolve from different contexts. They had specific regional insights through their workshops, while we focused on policymakers and advisors at a global level to gain insights relevant for a more global perspective. Furthermore, the studies on the GLAMURS backcasting scenarios [8,11,12] were more focused on specific regions and European policymakers. The more empirical approach on Germany [13] focuses on the preferences and values around scenarios. In contrast, the SLIM scenario narratives allow for a 'what-if' approach, exploring different lifestyles and the enabling system in which they change. Additionally, the SLIM scenario narratives differ quite substantially from the narratives modelled in Integrated Assessment Models [4,5,7,22]. These modelling studies focus more on stylised assumptions on behaviour change. The SLIM scenario narratives, in contrast, were specifically developed for modelling not only behaviours, but also cross-cutting lifestyles and the enabling factors that facilitate them, by engaging with different disciplines and regions in the development of the narratives. However, it should be noted that these scenario studies can complement the SLIM narratives developed in this research, and vice versa, as they focus on different scopes, have different starting points and approaches that allow for a multitude of perspectives on future sustainable lifestyles. However, the SLIM scenario narratives offer a holistic approach by combining the qualitative and quantitative perspectives in the scenario development, as shown in the quantitative counterpart article [26].

6. Conclusion

Our research aims to illustrate, via novel SLIM scenario narratives, various possibilities of how sustainable lifestyle changes – enabled by systems change – can play a role in mitigating climate change. The scenario narratives bring to light details and complexities about different routes to sustainable lifestyles diverging in dominant values and the degree of structured support.

6.1. Structural support and value systems can shape lifestyle changes in different ways

Based on the co-creation of the SLIM scenario narratives with policymakers and experts, lifestyles can diverge based on centralised or distributed access to structural support and individual or collective value systems. Some pathways with centralised access to structural support might be less transformative regarding behavioural changes but have the advantage of being convenient for many people by making sustainable lifestyles the default (i.e. Designed World). In contrast, another scenario (i.e. Global Commons) would involve substantial system changes. A scenario with distributed access to structural support could be driven by bottom-up initiatives (i.e. Pocket Lifestyles), through social interactions via peer-to-peer technology and sharing of ideas. In contrast, a scenario driven by distributed access to structural support and collective values (i.e. Big Village), could be characterised by simpler living in communities and shared activities. Therefore, these narratives highlight that there is not only one single lifestyle change scenario, but different contexts shape different lifestyle changes with climate change mitigation potential.

6.2. Behaviours and lifestyles can change dynamically in response to systemic enablers and shifts in society

The SLIM scenario narratives (co-created by experts and policymakers) showcase that changes at various levels are vital, emphasising the dynamics between behaviours, lifestyles, enablers and society. We show through these narratives that lifestyles could change in numerous ways, depending on many factors. Designed World and Pocket Lifestyles shift to sustainable lifestyles through more individualised actions. In Designed World, these sustainable lifestyles are enabled by, for example, decisions by government, policymakers and city planners. In Pocket Lifestyles, bottom-up initiatives drive the change through peer-to-peer interactions enabled by technology. In Global Commons and Big Village, collective action is central to living sustainably. In Global Commons, sustainable governance facilitates and encourages collective changes. In Big Village, social movements and community support and amplify sustainable living.

6.3. The SLIM scenario narratives highlight various characteristics of how and why lifestyles could change

The qualitative nature of these narratives highlight that although lifestyle changes are central to these SLIM scenario narratives, the many factors, such as individual agency, the pace of life, equity, security and safety, technology support, public, private or community surrounding those changes reveal interesting and dynamic distinctions that are important for strategic discussion on climate action.

6.4. Details on the extent and speed of lifestyle changes can be vital for scenario quantitative modelling

By expanding the food, residential and transport domains into smaller, recognisable characteristics, a scenario narrative can paint a fuller picture of what life may be like in 2050 and beyond. This translates effectively into scenario inputs for quantitative modelling in integrated assessment models, which can then determine the extent to which the scenarios have climate mitigation potential. The holistic and multidisciplinary nature of this approach is the novelty of this research, and these qualitative scenario narratives should be read as part of a larger story with the quantitative counterpart article [26].

6.5. A transdisciplinary, iterative, co-creation process can create novel scenario narratives essential for including sustainable lifestyles in policymaking and models and useful for a variety of users.

We propose a novel participatory methodology that enables the development of long-term scenario narratives through multiple iterations in a transdisciplinary setting. With the step-by-step process described in detail, this methodology could be replicated in other sectors, where multiple disciplines are involved. This methodology allowed for useful advice and scenario narratives from participants rooted in social sciences, modelling, and policy. With these diverse SLIM scenario narratives, we can inform about fuller, more dynamic visions of 1.5 °C lifestyles in 2050 for a range of different users such as social scientists, modellers, policymakers and civil society. Understanding these alternative SLIM scenario narratives can enable a fuller dialogue about what futures are possible, from policymaking to voting behaviour, while highlighting that there is no single pathway but many plausible possibilities. These SLIM scenario narratives provide valuable insights that can position lifestyle changes in the context of systems change as solutions to climate mitigation.

6.6. The SLIM scenario narratives can enable policymakers and other stakeholders on strategic discussion and action for sustainable living

The inclusion of lifestyle changes in mitigation scenarios can inform

climate negotiations. Approaching this process via scenario planning allows us to explore possible pathways, make our assumptions about our futures explicit, and support more strategic dialogue about impactful climate policy and action.

CRediT authorship contribution statement

Nicole J. van den Berg: Writing – review & editing, Writing – original draft, Visualization, Validation, Methodology, Investigation, Formal analysis, Conceptualization. **Lauren Thu:** Writing – review & editing, Writing – original draft, Visualization. **Andries F. Hof:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Methodology, Investigation, Formal analysis, Conceptualization. **Vanessa J. Timmer:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Project administration, Methodology, Funding acquisition, Formal analysis, Conceptualization. **Lewis Akenji:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Methodology, Investigation, Funding acquisition, Formal analysis, Conceptualization. **Nicole-Anne Boyer:** Writing – review & editing, Writing – original draft, Visualization, Methodology, Formal analysis. **Detlef P. van Vuuren:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Conceptualization.

Declaration of competing interest

There is no conflict of interest to report.

Funding by the KR Foundation.

Acknowledgements

The authors of this paper are immensely grateful for the financial support from the KR Foundation.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.erss.2025.104441.

Data availability

No data was used for the research described in the article.

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