NAVIGATE

Next generation of advanced integrated assessment modelling to support climate policy making

Report on methodologies for taking lifestyle changes into account in IAMs identified

Lifestyles in public health, marketing and pro-environmental research

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Summary

In this report, we synthesise insights from 82 conceptual and empirical studies of lifestyle from four main research fields: general lifestyle studies; public health; marketing and consumer behaviour; pro-environmental behaviour and climate mitigation (termed 'low-carbon'). The first four sections cover each of these fields. The final fifth section draws out similarities, differences and lessons learnt. It concludes with some insights to strengthen future-oriented scenarios and modelling of low-carbon lifestyles.

Throughout the report, we summarise our findings in response to four main questions:

(1) how are lifestyles and lifestyle change defined and applied?
(2) how are lifestyles identified and measured?
(3) how heterogeneous are lifestyles, and what lifestyles groups are commonly identified?
(4) how is lifestyle change promoted through public policy interventions?

Details of the literature search criteria and sample characteristics are included in the Appendices, and the full annotated bibliographies are available on request.

Key findings: Lifestyle concepts and elements

Three common elements of lifestyle are *behaviours* (which are observable), *cognitions* (which are not observable), and *contextual factors* which shape how behaviours and cognitions interact. The World Health Organisation, for example, defines lifestyle as patterns of behaviour determined by the interplay between individual characteristics, social interactions, and socioeconomic conditions. In marketing, lifestyle is viewed as a way of everyday life that leads to choices between goods, services and expenditure which reflect values, intentions and opinions. Lifestyles are evident in behavioural patterns and routines, in intentions and goals, and in the construction of self-identity and social identity.

In public health and marketing, lifestyles tend to be interpreted in a general integrative sense (we each have one lifestyle), whereas in low-carbon research lifestyles are also applied to specific domains (we each have a food lifestyle, a travel lifestyle, a domestic lifestyle). Domain-specific lifestyles can result in inconsistencies between behaviours and cognitions in different domains, which means it is problematic to identify low-carbon lifestyles from behavioural patterns alone. Lifestyles and behaviours are also not synonymous: lifestyles are an integrative concept whereas behaviours are discrete actions. Low-carbon research in particular tends to blur this distinction by focusing on certain high or low impact behaviours and how they might be changed.

Key Findings: Application of lifestyle concepts

Lifestyle concepts are applied in research in three main ways: *descriptively*, to characterise heterogeneity and clustering of behaviours and individuals in a population; *analytically* to understand

outcomes of interest; and *instrumentally* to design lifestyle-change interventions. Public health, marketing and pro-environmental research share these three applications but to different ends. In marketing, for example, *descriptive* applications of lifestyle classifications are used to segment markets and position products and services relative to specific lifestyle groups. In low-carbon research, for example, *analytical* applications are used to associate lifestyle elements or groups with high or low carbon footprints. In public health, for example, *instrumental* applications of risk factors associated with morbidity are used to design targeted interventions to alleviate disease burdens.

There are many similarities in how lifestyle is conceptualised, measured and analysed across public health, marketing and low-carbon research fields, but there are also some important differences. For example, public health and low-carbon research place more emphasis on motivated reasoning for lifestyle change and so lifestyle elements such as values, problem awareness, and self-efficacy. In contrast, marketing research places more emphasis on identity and social positioning, as well as the private benefits of lifestyle change. Public health and marketing research also tend to find or assume consistency in lifestyles whereas low-carbon research points to inconsistencies between behaviours and cognitions (e.g., knowledge-action gap, value-action gap) or inconsistencies between domains (e.g., low-carbon diet but high-carbon travel).

Key Findings: Measurement of lifestyles and lifestyle groups

Each research field has a variety of widely-used frameworks for measuring lifestyles. In public health, for example, the Health Promoting Lifestyle Profile (HPLP) framework measures individual practices associated with health, attitudes, mental resilience and social relationships. In marketing, frameworks tend to be proprietary to market research companies, but also include the VALS2 framework which measures values, interests in technology, and social character, using publicly-available data from the World Values Survey. In low-carbon research, there are no dominant frameworks as lifestyles are measured in at least five different ways, based on behavioural commitment, basic orientations, perceptions of self and world, consistency across domains, or contextual influences. Integrative frameworks recognise the entwined challenges of public health and environmental protection. For example, the Lifestyle of Health and Sustainability (LOHAS) framework identifies five dimensions of sustainable economy, health, personal development, alternative health care, and ecological lifestyles. Data used to measure lifestyle elements in these frameworks are collected in a variety of ways, from case studies in defined contexts to nationally-representative questionnaire surveys. The large sample quantitative studies commonly use latent class, factor, or cluster analytic techniques to identify distinct lifestyle groups with similar behaviours and cognitions.

Key Findings: Lifestyle change and interventions

Lifestyle change may be motivated by intentions and a striving for self-consistency, or may be caused by a change in context. In marketing, lifestyle change is explained by shifts in the lifestyle landscape including contextual and cognitive factors that influence consumption patterns. Public policy interventions in health, environment and other fields promote or enable lifestyle change towards beneficial private and societal outcomes. Evidence from public health shows that changing lifestyle to improve health and wellbeing involves a reassessment of values, attitudes and goals, within the constraints of personal circumstances. This means lifestyle-change interventions need to (1) be tailored to specific circumstances, (2) empower individuals by reinforcing problem awareness and self-efficacy, and (3) change the wider social and physical environment to support healthy outcomes. Low-carbon interventions tend to place stronger emphasis on values and motivated action as drivers of lifestyle change, but can also abnegate individual responsibility by emphasising the need for deep and long-lasting systemic change. Low-carbon lifestyle change is therefore awkwardly positioned between behavioural change on the one hand and systemic change on the other.

Key Findings: Insights for low-carbon research and modelling

There are many useful insights from public health and marketing which can be applied to research on low-carbon lifestyles. As examples, low-carbon research could usefully: (1) identify wellbeing, social relationships, and other cognitions and contextual factors necessary to understand lifestyles; (2) draw on national panel datasets used to track healthy lifestyles or distinguish consumer-based lifestyle groups; (3) design interventions which act on behavioural, cognitive and contextual influences on lifestyle in a concerted manner.

Representing lifestyles in global modelling of low-carbon futures is a relatively new field with significant challenges. Lifestyle change to-date has been implemented as a relatively arbitrary set of behavioural changes (within existing technological and infrastructural contexts) motivated by normative awareness of climate change described in scenario narratives. These do not typically recognise lifestyle heterogeneity (within and between countries) as well as potential inconsistencies between intentions and actions. For scenario narratives as well as endogenous representations of lifestyle change, a small number of lifestyle archetypes or generalisable groups are necessary. These should be informed by analysis of historical data on consumption activity which tracks both change over time and between countries, as well as other globally generalisable lifestyle measurement frameworks.

Contents

1. General Concepts, Definitions, and Elements of Lifestyle

Summary

This section introduces basic lifestyle concepts, their meaning, and the different perspectives taken on what constitutes a lifestyle. Three common elements of lifestyle are observable behaviours, non-observable cognitions, and contextual factors which shape how behaviours and cognitions interact. Lifestyles and behaviours are not synonymous: lifestyles are an integrative concept whereas behaviours are discrete actions. Different perspectives on lifestyle emphasise behavioural patterns, intentions and goals, or the process through which self-identity is constructed. Lifestyle change may be motivated by intentions and a striving for self-consistency, or may be caused by a change in context. Public policy interventions in health, environment and other fields promote or enable lifestyle change towards beneficial private and societal outcomes. Lifestyles concepts are used in research in three main ways: descriptively, to characterise heterogeneity and clustering of behaviours and individuals in a population; analytically to understand outcomes of interest such as morbidity or greenhouse gas emissions; and instrumentally to target differentiated interventions at specific lifestyle groups.

1.1 What does lifestyle mean? What constitutes a lifestyle?

'Lifestyle' means a coherent pattern of behaviours and cognitions consistent with specific contextual factors. *Behaviours* are observable and include actions, activities, technology adoption, and consumption. *Cognitions* are non-observable and include worldviews, concerns, beliefs, perceptions, and self-identity. *Context* can be social (e.g., culture, social connectedness) or material (e.g., infrastructure, geography). Contextual factors influence whether certain behaviours are possible and how certain cognitions can be acted upon. Context therefore shapes how the interplay between behaviours and cognitions constitutes lifestyle. This is important as lifestyle is not simply a matter of choice (1).

Three common perspectives on lifestyle emphasise patterns of behaviour, intentions and goals, or self-identity and social positioning. Behaviours, cognitions and contextual factors are the common elements of lifestyle in all three perspectives, but with different emphases.

A *patterned* perspective on lifestyles emphasises routine, habitual patterns of behaviour or consumption activity (2, 3). These behavioural patterns are context-specific and so are observable in the home, at work, on the move, during leisure time, and in other contexts (4, 5). Put simply, lifestyle describes "how people spend their money and their time" (6) or "how individuals live their lives" (1).

A *cognitive* perspective on lifestyles emphasises how intentions, problem awareness and other cognitions direct behaviours towards overarching goals (7). Lifestyles are therefore purposeful as well as responsive to context, and are linked to broader cognitive constructs such as values or worldviews (8).

A *reflexive* perspective on lifestyles emphasises how individuals organise and express their self-identity through their behaviour, while the behaviours then reflexively help constitute an individual's identity (9). This reflexive perspective is associated with the work of the sociologist, Anthony Giddens, who defined lifestyles as "routines that include the presentation of self, consumption, interaction and setting" (10). It blends the patterned perspective's emphasis on routine behaviours with the cognitive perspective's emphasis on both inward and outward-facing goals. The reflexive perspective also builds on a long historical tradition of research into lifestyles as a means of differentiating social position and status through outward signalling of identity. For example, Max Weber defined lifestyle as "*a means of affirmation and differentiation of social status*".

Despite these differences in emphasis, the patterned, cognitive, and reflexive perspectives all recognise their dynamic and plural nature of lifestyles. This is reflected in the lack of convergence around a singular meaning or definition (see Box 1).

Box 1. Contrasting definitions of lifestyle.

Historical definitions of lifestyle

- “a means of affirmation and differentiation of social status” (Max Weber, 1864-1928)
- “a system of rules of conduct developed by individuals in order to attain their goals in life” (Alfred Adler, 1870-1937)
- “a consequence of culture, values, the symbolism of certain objects, moral values, and ethics" (11)
- " the system of constructs an individual elaborates and develops personally" (12)

Simple descriptive definitions of lifestyle

- "a way of living everyday life" (13)
- “how individuals live their lives” (1)
- “the way people live, and how they spend their money and time” (14)
- “the characteristic manner in which a person lives (or chooses to live) his or her life" (15)

Definitions emphasising patterned behaviours, routines and habits

- “habitual activity patterns woven into the practices of everyday life” (16)
- “a combination of modifiable behaviours that influence health” (17)
- “a way of living that influences and is reflected by one’s consumption behavior” (18)
- “consistency of behaviour and patterns of behaviour that are linked to values, socio-demographic characteristics and influenced by structural forces” (19)
- “a way of living selected by an individual which is expressed in both work and leisure behavior patterns … and in activities, attitudes, interests, opinions, values and allocation of income” (20)
- “the behavioural patterns of individuals” (21)
- “a pattern of behavior conforming to the individual’s roles as household member, worker and leisure consumer subject to external constraints" (22)
- “the pattern of individual and social behavior characteristic of an individual or group … which is usually expressed in behavior, but need not be” (23)
- “a set of habitual practices that can be understood as a result and a condition of everyday activities” (24, 25)
- “a pattern of attitudes and behaviours that are in some way consistent across an individual's life, or a particular domain of their life” (26)
- “expressed as typical attitudes and behaviour patterns”(27)
- “an approach to living that includes habitual behaviours and moral attitudes" (28)
- “a mixture of habits, conventional ways of doing things, and reasoned behavior" (29)
- “everyday actions and modes of consumption that form part of normal life” (30)
- “the way people live and influences on their behavior in consuming products or services” (31)

Definitions emphasising cognitions, intentions and goals

- “a mental construct, which is different from, but explains behaviour … the system of cognitive categories, scripts, and their associations, which relate a set of products to a set of values” (32-35)
- “set of habits that are directed by the same main goal" (23)
- “the integration of an individual’s system of values, attitudes, activities, and consumption methods" (36)
- “how people live and organize their priorities, integrating both big ideas and small practices” (37)
- “an intervening system of cognitive structures that link situation-specific product perceptions to increasingly abstract cognitive categories and finally to personal values” (38, 39)

Definitions emphasising self-identity, signalling, social positioning and differentiation

- “routines that include the presentation of self, consumption, interaction and setting” (10)
- “engagement in several related practices that construct and express a common aspect of self-identity" (40) also “a grouping of related practices that can reflect and inform the consumer's self-concept" (41)
- “the different personal actions that allow us to differentiate ourselves from others in society” (42)
- “a social construct that determines an individual’s identification with a social group and manifests itself in all facets of everyday life, such as consumption habits and the demonstration of tastes” (24)
- “ways of doing, having, using and displaying our behavior and all the related products, objects and infrastructures” (43)
- “distinctive modes of existence that are accomplished by persons and groups through socially sanctioned and culturally intelligible patterns of action” (44)
- “consumption patterns shared by social groups or market segments” (45)

1.2 What is the difference between lifestyle and behaviour?

Lifestyles and behaviours are commonly used interchangeably in the literature. This is incorrect. Although lifestyles are observable through behaviours, lifestyles are not synonymous with behaviour. Behaviours are discrete actions associated with specific personal and contextual influences (depending on the analytical framework used). Lifestyles are made up of constellations of actions linked with some degree of consistency to broadly-defined cognitions and contexts (26).

Whereas behaviours are specific *within* a domain of everyday life (e.g., commuting behaviour, food purchasing behaviour), lifestyles are a meta-concept which tends to be applied *across* domains of everyday life. However, this is not always the case. The proposition for domain-specific lifestyles is based on an argument that a person’s lifestyle need not be consistent across domains and therefore “descriptions of lifestyles should be restricted to specific life domains” (33, 34).

1.3 What is lifestyle change?

Definitions of lifestyle change tend to be specific to each research field with its characteristic interest in particular outcomes or impacts such as health or climate change. Research and practice seek to identify the potential for lifestyle change, the enabling and constraining factors for such lifestyle change, and the design of strategies and interventions to encourage or promote lifestyle change. Lifestyle change tends to be associated with public policy goals which help distinguish risky, undesirable, or ‘worse’ lifestyles from those which are desirable, consistent with broader social welfare, or ‘better’ from a societal perspective. However, lifestyle change can equally be applied by marketers or commercial firms seeking to position niche products and services or create brand associations linked to status or other private benefits.

Lifestyle change implies a before and an after state which can be linked causally: why do individuals change their lifestyles, and with what outcome? These two aspects of lifestyle change broadly distinguish intention and impact (46).

Lifestyle change may be motivated by intentions and a striving for self-consistency. For example, a green lifestyle is “a collection of practices by which people today try to address an interrelated set of environmental problems” (37). However, lifestyle change may also be caused by a change in contextual conditions. For example, lifestyles change when people migrate from the countryside into cities (47) or when new infrastructure is built (21), even people’s values and other cognitions remain the same.

There are also different impacts of lifestyle change on outcomes of interest. For example, change towards more healthy lifestyles may reduce risk factors associated with cardiovascular or respiratory disease (48). Change towards lower-carbon lifestyles can be identified by reductions in energy and material use or other consumption-based reductions in greenhouse gas emissions (43, 46).

It's important to emphasise that the causes and outcomes of lifestyle change may not be consistent. For example, a climate scientist with strong environmental intentions may have a large carbon footprint as a result of frequent long-distance flights to participate in climate negotiations and conferences. Similarly, observed impacts of lifestyle change should not be used to infer intentions. For example, a household with a very low carbon footprint from minimal use of winter heating may have invested in energy-efficiency measures or may be living in fuel poverty. These tensions between behaviours, cognitions, and outcomes of interest from lifestyle change help reinforce that lifestyles are contextual and reflexively constructed, so can never offer a single unifying explanation for an individual's impact on emissions.

1.4 How are lifestyle and lifestyle change concepts applied?

Lifestyle and lifestyle change concepts are applied descriptively, analytically, and instrumentally.

Descriptively, lifestyle concepts are used to identify common groups of inter-related behaviours, and to characterise heterogeneity or clustering of similar individuals in a population. Marketing researchers can tease out a distinction between milieus (groups of like-minded people) and lifestyles (groups of similar behaviours) (49, 50). Linking lifestyle heterogeneity to contextual variation also helps identify which contextual factors most strongly shape lifestyles. For example, data from the periodic World Values Survey reveals systematic differences in lifestyles between regions with certain cultural characteristics such as pragmatism or respect for tradition. Variation can also be situational. For example, housing-related lifestyles are similar across different European countries whereas food-related lifestyles are not (33, 34).

Analytically, lifestyle concepts are used to explain or predict the consequences of lifestyles on outcomes of interest such as morbidity, expenditure, or greenhouse gas emissions. Specific lifestyle studies tend to define outcomes of interest quite narrowly. Examples from public health, marketing and environment research respectively are risk of dementia (51), food preferences (29), or propensity to buy an electric vehicle (9).

Instrumentally, lifestyle concepts are used to analyse how undesirable patterns of behaviours can be changed, and how differentiated interventions can be effectively targeted at specific lifestyle groups. Instrumental applications are therefore associated with lifestyle change. They can be strongly normative (i.e., based on prior assumptions about what is better) when tied to public policy objectives such as reducing ill health or ensuring clean air.

Any given study may combine all three applications of lifestyle concepts. For example, a national level study on the potential for low-carbon lifestyle change may first characterise lifestyle heterogeneity at the population level (descriptive), estimate carbon footprints for the different lifestyle groups (analytical), and then devise differentiated policy strategies for reducing carbon footprints in the high emitting groups as a basis for scenario modelling (instrumental) e.g., (43).

Lifestyle concepts are also applied in different fields of research and practice. The three main fields are: public health, marketing and consumer behaviour, and environment (including climate change). The remainder of this report synthesises literature from each of these three fields, and then concludes by drawing out insights for advancing research on low-carbon lifestyles.

2 A Public Health Perspective on Lifestyles and Lifestyle Change

Summary

The concept of lifestyle is widely applied in public health literature as a set of modifiable risk factors (e.g., inactivity, poor diet, obesity, smoking, alcohol excess and substance abuse). The constituent elements of lifestyle are patterns of behaviour (linked to health outcomes) that are outward expressions of cognitive processes. Health lifestyles are also shaped by contextual factors such as socio-economics and demography, and grounded in cultural identities and traditions. The concept of lifestyle in public health research is used in three main ways: *descriptively* to characterise lifestyle heterogeneity (e.g., health vulnerability); *analytically* to understand links between lifestyle elements and health outcomes; *instrumental*ly to design lifestyle change interventions for managing or preventing chronic disease. Adjusting lifestyle practices to improve health and wellbeing involves a reassessment of values, attitudes and goals, within the constraints of personal circumstances. Integrative frameworks suggest that the challenges to public health and environmental sustainability are intertwined. Interventions to improve public health should be tailored to personal circumstances that empower the individual but are also directed at the wider social and physical environment which support and sustain healthy lifestyles.

2.1 How is lifestyle defined in public health? What are its constituent elements?

> *"Lifestyle is a way of living based on identifiable patterns of behaviour which are determined by the interplay between an individual's personal characteristics, social interactions, and socioeconomic and environmental living conditions .. "*
>
> *"… There is no "optimal" lifestyle to be prescribed for all people. Culture, income, family structure, age, physical ability, home and work environment will make certain ways and conditions of living more attractive, feasible and appropriate*" World Health Organisation (52p.16).

Lifestyle is a commonly used concept in public health, but despite this quite comprehensive entry in the Health Promotion Glossary, it is rarely and explicitly defined in public health literature. Lifestyle is presented as a set of multiple modifiable risk factors (48, 53). A lifestyle that builds health resilience (54) is associated with better disease outcomes (55). Conversely, an unhealthy lifestyle is associated with increased risk of chronic disease (56). Lifestyles are represented by particular behaviours (57) that include diet and nutrition, physical activity, alcohol consumption, smoking status, wellbeing and emotional resilience (58). Graham and White (16) describe these behaviours or habitual activity patterns as "*woven into the practices of everyday life*". Healthy lifestyles generally promote regular physical exercise, calorie-controlled nutrient rich diets, avoidance of smoking and alcohol excess (17, 51, 55). Underlying this behaviour-defined lifestyle, is a more implicit acknowledgement of the importance of attitudes, perceptions and interpersonal relations e.g., (54).

Risk-focused conceptualisations of lifestyle in public health e.g., (17, 48)) tend to be developed around modifiable behaviours associated with specific situations and habitual practices such as a sedentary lifestyle, poor diet and substance abuse. Other conceptual frameworks such as the Health Promoting Lifestyle Profile (HPLP) (59) and the 'total health framework' (58) also include cognitive dimensions that are related to emotional resilience, health responsibility, and interpersonal relations (54). Values and beliefs shape lifestyles and health consequences (1). This interplay between cognitive processes and 'traditional' lifestyle risk factors is embedded in a contextual layer that includes broad societal level factors such as social deprivation e.g., (53) and polygenic variation (51).

In sum, from a public health perspective, the constituent elements of lifestyle are patterns of behaviour (associated with particular health outcomes) that are the outward observable actions of cognitive processes (60, 61). Lifestyles are also shaped by contextual factors such as socio-economic settings (including education, income, and social norms), demographic factors (such as gender and life stage), and grounded in cultural identities and traditions. Table 1 summarises the constituent elements of lifestyles and lifestyle change from the perspective of public health. (See Appendices for further details of the underlying studies).

Table 1. Lifestyle elements used in public health studies.

Lifestyle type	**Behaviours, practices, modifiable risk factors**	**Cognitions**	**Contexts**
Healthy lifestyle	Non-smoker, healthy diet (e.g., calorie-controlled, low in salt, red meat and processed foods, rich in fruit and vegetables), regular physical activity, sufficient sleep, regulated alcohol consumption.	Knowledge of risk factors and disease, positive attitude, perceived responsibility, purpose in life, feeling at peace with oneself, emotional resilience, mindfulness, stress management, strong social relationships.	Socio-economic conditions (e.g., higher income / level of education), socio-cultural heritage supportive of healthy living (e.g., Mediterranean diet and culture, cycling in the Netherlands), good access to health care, low exposure to toxins.
Unhealthy lifestyle	Smoker, unhealthy diet resulting in poor weight management, physically inactive / sedentary lifestyle, insufficient sleep, excessive alcohol consumption, substance abuse.	Low awareness of disease risk factors, negative attitude to health, psychosocial stress, depression, lack of motivation or goal setting, weak social networks, weak sense of community.	Socio-economic conditions (e.g., social deprivation, ready access to cheap unhealthy food, limited access to exercise facilities / health services, sedentary job), social norms associated with poor diet or physical inactivity, high exposure to toxins.
Promoting and sustaining healthy lifestyles	Lifestyle behaviours (e.g., diet and exercise) that are tailored to particular health outcomes such as reducing the risk of hypertension, type 2 diabetes, cardiovascular disease, and dementia.	Clear and specific goals, knowledge of the association between lifestyle factors and disease, motivation, self-efficacy, stress management, wellbeing, social connectedness.	Availability of resources to support healthy lifestyle choices, community group support, access to counselling services, environment supportive of physical exercise

2.2 What are the main applications of lifestyle concepts in public health?

In public health research, the concept of lifestyle is used in three main ways: *descriptively* to characterising lifestyle groups and heterogeneity; *analytically* to understand links between lifestyle elements and outcomes of interest; *instrumental*ly to design lifestyle change interventions.

First, lifestyle segmentation or categorisation is used to target groups of individuals that are particularly vulnerable or for which intervention strategies may be most effective. Studies tend to adopt a patterned behavioural approach in which lifestyle groups are identified using the weighted or unweighted total score across a set of lifestyle factors. Contextual influences (such as social deprivation) are found to be associated with groups defined by less healthy lifestyle behaviours. For example, the Office for National Statistics Office for National Statistics (1) found the lowest healthy life expectancy cluster was associated with lower scores of healthy lifestyle factors and have more long-term sickness or disability in the UK.

Second, lifestyle is used as a marker of some specific aspect of health. For example, a systematic review and meta-analysis found that the relative risks of mortality decreased proportionate to a higher

number of healthy lifestyle factors (17). This study conceptualised lifestyle as patterned behaviours. However, Aliberti, Cavallo (54) adopted a more cognitive approach in their study of lifestyle as an indicator of wellbeing and academic performance.

Third, lifestyle is used as a tool for either preventing or managing chronic disease. Examples include physician counselling on lifestyle behaviour modification to facilitate patient management of hypertension (55), and group-based lifestyle intervention to promote and sustain weight loss (60). Lifestyle measurement instruments such as the HPLP have been used to assess the effectiveness of interventions. Bodai, Nakata (58) reviewed lifestyle medicine and found growing evidence that healthy lifestyle choices can avert chronic conditions such as cardiovascular disease and type 2 diabetes, and made a passionate call on the medical community to effectively implement and share the power of lifestyle medicine. Faiola, Papautsky (61) argued that chronic diseases can be managed effectively with the use of technology such as apps that empower patients to adopt and sustain healthy lifestyles through self-regulation. Viewing lifestyle as a tool for improving health outcomes exemplifies a reflexive approach in which motivational skills training, personalised goal setting, and developing inner resilience are the precursor to behaviour modification.

Each of these three applications is discussed in more detail in the sections that follow.

2.3 How is lifestyle measured in public health? What data are used?

Structured questionnaires are commonly used to measure lifestyle elements including: attitudes to eating or to self, quality of life (54); lifestyle practices such as smoking, alcohol consumption, diet & nutrition, and physical activity (1, 17, 48, 51, 53). Contextual variables measured include socioeconomic or demographic variables (53, 54). *Table 2* provides examples.

Lifestyle factors relevant to particular health outcomes have also been identified through structured review (62, 63), narrative review (13) and through systematic review and meta-analysis (17).

Studies with a focus on initiating or sustaining lifestyle change tend to use a mixed methods approach that considers risk factors for disease (e.g., physical activity and diet), cognitive variables (such as knowledge, beliefs, and self-efficacy), medical characteristics (such as blood pressure and cholesterol levels), and socio-demographic variables (such as age, education and income) (55, 60).

Data of relevance to public health includes clinical metrics, socio-demographic, behavioural, psychological, and environmental information. The multiplicity of relevant data collected cover a wide variety of sources and measurement tools (see Appendices for further details). Primary data are collected through structured and semi-structured questionnaires, food diaries, and clinical observations and tests. Established questionnaires (validated and tested for reliability) such as the HPLP II questionnaire are applied to new areas of research or in different cultural settings (64). The UK Biobank is a large prospective health resource documenting the health and wellbeing of around 500,000 participants (www.ukbiobank.ac.uk). This resource has been mined to identify lifestyles associated with cardiovascular disease mortality and all-cause mortality (53) and with the incidence of dementia (51). The Office for National Statistics compiles information that enables a contextualising of health outcomes in the UK, according to differences in lifestyles (1).

2.4 How are different lifestyle groups identified in public health?

Public health research has different ways of distinguishing lifestyle groups (*Table 2*). Some studies on modifiable risk factors representing lifestyle elements are used as independent variables to estimate a particular health outcome e.g., (17, 54). Lifestyle groups represent levels of healthiness (51, 53) or they represent heterogeneous combinations of risk factors.

Common methods for identifying lifestyle groups include latent class analysis of unhealthy behaviours to produce risk classes which can then be associated with socioeconomic and demographic variables (48), factor analysis of lifestyle elements (64), and cluster analysis based on attitudes and behaviours (65). For example, Atzendorf, Apfelbacher (48) use latent class analysis to identify four heterogeneous lifestyle groups in Germany, a 'healthy lifestyle', 'risky drinking lifestyle', 'smoking lifestyle' and a 'cumulate risk factors lifestyle'.

Lifestyles are thus classified according to the relationships between defined elements (53), and may be weighted to adjust sample data for variation in gender, age or genetic traits (51). Identification of lifestyle groups is viewed as a useful tool for targeting or prioritising health promotion strategies and health behaviour intervention (48).

The frameworks and methods summarised in *Table 2* for identifying lifestyle groups in public health are commonly implemented either as part of case studies of specific risk groups (which control for variation in context) or as part of population-level studies with nationally-representative samples (which have to account for variation in contextual influences). Although both approaches share similar analytical frameworks and methods, case study approaches are closely linked to targeted intervention strategies, while national studies provide clearer evidence that wider aspects of the physical and social environment have an influence on lifestyle behaviours related to health. In the UK, for example, Foster, Celis-Morales (53) found that unhealthy lifestyles were associated with disproportionate harm in areas of socio-economic deprivation.

Table 2. Analytical frameworks for distinguishing lifestyle groups in public health.

Lifestyle study focus	**Study**	**Variables measured**	**Measurement tools**	**Lifestyle group identification**
Lifestyle factors associated with a specific health outcome.	Aliberti, Cavallo (54)	Sociodemographic, personal health, attitudes, quality of life.	HPLP II questionnaire (scale responses).	HPLP items used as independent variables
	Kuan, Kueh (64)	52 items developed around six domains	HPLP II questionnaire (scale responses)	Factor analysis.
	Atzendorf, Apfelbacher (48)	Eight lifestyle practices representing risk factors.	Pre-existing survey on substance abuse	Latent Class Analysis
	Foster, Celis-Morales (53)	Socioeconomic variables, unhealthy lifestyle practices.	UK Biobank; prospective population-based cohort	Categorised according to unweighted lifestyle score.
	Lourida, Hannon (51)	4 lifestyle practices (smoking, physical activity, diet, alcohol consumption)	UK Biobank; retrospective cohort study	Categories based on lifestyle factor scores weighted by socio-demographic variables
	Office for National Statistics (1)	5 lifestyle practices (smoking, BMI, physical activity, diet, alcohol consumption)	Existing health data by upper tier local authority (UTLAs)	Lifestyle factors for the 7 highest UTLAs ranked by Health Life Expectancy
	Loef and Walach (17)	5 lifestyle practices (smoking, BMI, physical activity, diet, alcohol consumption)	Systematic review and meta-analysis of 15 longitudinal / prospective studies	Combinations of lifestyle factors considered as independent variables
Lifestyle intervention and health	Andjelkovic (55)	Sociodemographic variables, medical characteristics, physical exercise, smoking, diet, self-management	Structured questionnaire to assess adherence to healthy lifestyle	None

promotion strategies		strategies, knowledge & beliefs		
	Faiola, Papautsky (61)	Scenario narrative (retired, overweight, inactive, pre-type II diabetes)	Theoretical development: mHealthy Lifestyle Management Model	None
	Jamal, Moy (60)	Clinical measures, diet, alcohol, smoking, physical activity, cognitive processes, socio-demographic variables.	Questionnaires: physical activity, psychological measures, QoL, automatic thought	Unhealthy lifestyle. Baseline and end of programme measures assessed intervention.
	Minich and Bland (63)	Recommendations for diet, activity, environment, stress	Literature review: Personalised lifestyle medicine	Interaction between lifestyle factors, and biomarkers, symptoms, genetics, epigenetics.
Integrated lifestyle models	Dernini, Berry (13)	Nutrition & diet, physical activity, environment, economy, society &culture.	Narrative review to develop: Mediterranean diet as a healthy & sustainable lifestyle	None
	Pícha and Navrátil (65)	15 items for 5 factors: sustainable economy, healthy lifestyle, personal development, alternative health care, ecological lifestyles	Lifestyle of Health and Sustainability (LOHAS), scaled responses	Confirmatory factor analysis, cluster analysis for market segmentation
	Quam, Rocklöv (62)	Active transport (cycling / walking), diet (reduced consumption of animal products)	Structured review to identify lifestyle choices with environment-health co-benefits.	None

2.5 What is the link between healthy lifestyles and sustainable lifestyles?

Common analytical frameworks such as the Health Promoting Lifestyle Profile (HPLP) are developed around lifestyle constructs covering individual practices associated with health, attitudes, mental resilience and social relationships (54, 64). Some studies have broadened the conceptualisation of healthy lifestyles to encompass sustainable lifestyles. For example, Graham and White (16) developed an integrated framework that draws on shared evidences and common features from the different fields of public health and environmental sustainability. This builds on the UN Millennium Ecosystem Assessment Health Synthesis Report (66). Lifestyle is viewed as a 'bridging' concept between public health and environmental sustainability, and a key driver of change (16).

The Lifestyle of Health and Sustainability (LOHAS) framework draws on perspectives from marketing, public health and sustainability to characterise lifestyle around five main categories: sustainable economy, healthy lifestyles, personal development, alternative health care, and ecological lifestyles (65, 67).

The 'Med Diet 4.0' framework is developed around four themes, nutrition & health, environment, society & culture, and the economy (13). The more plant-based diet of the Mediterranean has perceived health and environment benefits, with high socio-cultural value encouraging principles of mutual awareness, resource frugality, and the promotion of traditional crafts and skills.

These integrative frameworks are premised on the challenges to public health and environmental sustainability being intertwined. Lifestyle choices such as active transport and consuming a more plant-based diet have the potential both to protect the environment and to improve health (62).

2.6 What is lifestyle change in public health?

There is good evidence that chronic conditions are influenced by lifestyle, and lifestyle change can avert poor health outcomes (58, 63). Lifestyle change from a public health perspective involves adopting and maintaining a lifestyle that is beneficial to the health and wellbeing of both individuals and society. Strategies that promote healthy lifestyles can be identified on the basis of risk factors for vulnerable population groups (48). Gray, Kross (56) highlight the need for a theoretical basis to lifestyle change, to understand the drivers and the tendency for lifestyle practices to cluster (those with a healthy diet tend not to smoke and are more physically active). The ability and motivation to implement and sustain lifestyle change is associated with individual differences in psychological processes, such as a sense of individual responsibility (56), knowledge, individual empowerment (61), beliefs, self-management (55), self-efficacy and social support (60). Physical and social environments can further sustain or undermine lifestyle change (56, 57, 61).

2.7 How is lifestyle change promoted in public health?

> "*Individual lifestyles, characterized by identifiable patterns of behaviour, can have a profound effect on an individual's health and on the health of others. If health is to be improved by enabling individuals to change their lifestyles, action must be directed not only at the individual but also at the social and living conditions which interact to produce and maintain these patterns of behaviour*." (66)

Understanding the reasons for, and context to, lifestyle activities is a prerequisite for developing public health intervention strategies. From the broadest perspective, adjusting lifestyle practices to improve health and wellbeing involves a reassessment of values, attitudes and goals, within the constraints of personal circumstances.

A number of intervention strategies have been reviewed in the public health literature (see Appendices for details). Motivation is key to the initiation of lifestyle change (17). Middleton, Anton (57) outline four constructs of lifestyle change: knowledge, self-efficacy beliefs, self-regulatory skills and barriers to overcome. The first two constructs are important aspects of the initiation process; knowledge and appreciation of the risks of lifestyle behaviours on health outcomes, and self-efficacy and constructive beliefs. In a health care setting, initiation can take the form of counselling in which relevant information is provided at appropriate 'teaching moments' (56) and short-term achievable goals identified (57).

There are a range of intervention approaches to improve health through lifestyle change. These comprise one-off or regular counselling sessions (55), group intervention programs, and the practice of lifestyle medicine (58). Group intervention programs capitalise on the strength of connectedness, offering moral support, group discussion and feedback. Personalised lifestyle medicine (56, 63), arises from the concept that one size does not fill all in regard to a healthy lifestyle. Instead, recommendations are tailored for individual clinical characteristics, biomarkers and genetic variants. Alongside these general approaches to intervention, there are a range of specific tools or strategies. Faiola, Papautsky (61) frame these strategies around an 'inform – coach – empower' pathway. Patients and practitioners require relevant information on the benefits of lifestyle change for improving health and avoiding or managing chronic disease. Coaching is undertaken vis-à-vis group or one-to-one counselling, and involves cognitive behaviour therapy, stress management, and specific skills training (e.g., for handling situational cues and setbacks). The patient is empowered through self-management skills and developing inner resilience. Technology apps can be harnessed to share information, provide patient-generated data and allow self-monitoring (61) which develops self-regulatory skills (57).

Barriers (cognitive and contextual) impede the process of lifestyle change adoption and adherence (56, 57, 60, 61). The cognitive barriers are associated with a lack of appreciation about risks and health benefits of lifestyle behaviours, complacency, and feelings of low self-esteem, disbelief or negativity following minor lapses. Contextual barriers related to the physical and social environment are wide-ranging. In the community, unhealthy lifestyles may be the social norm. Intentions to reduce weight and improve nutrition are hindered by an overabundance of inexpensive unhealthy food and overexposure to advertising of such goods (57). Targets to increase physical activity are hampered by a lack of access to exercise facilities and the pervasiveness of sedentary jobs. There may be insufficient time or resources invested in implementing intervention programs or providing counselling sessions (58). In addition, cultural and ethnic influences can further undermine or restrict lifestyle choices (1).

Poor adherence to lifestyle change is widespread particularly in the longer term. Middleton, Anton (57) outlined the factors reducing adherence to lifestyle change. These include environment (access to unhealthy food, lack of exercise facilities), sociocultural conditions (sedentary jobs, limited leisure time) and psychological influences (e.g., perceived stress). However, there are a number of strategies (cognitive and contextual) that are found to be more effective for sustaining healthy lifestyle change. Foremost are those related to cognitive processes, enhancing self-regulatory skills, and building inner resilience (64) through overcoming obstacles and setbacks. Widening the support network (through friends and family, buddy systems and group-based programs) also improves the chance of long-term adherence (57). Regulations and policies should be directed at promoting healthy lifestyle change programs as beneficial for individuals and the wider society (1, 17). Specifically, these should encourage infrastructure supportive of maintaining a healthy lifestyle (e.g., access to exercise facilities, well-connected networks of pathways and cycle routes, and regulated advertising of unhealthy products). In addition, policies should address social inequalities and deprivation that have been linked to unhealthy lifestyles and poor health outcomes (53). Faiola, Papautsky (61) advanced an integrated 'mHealthly Lifestyle Management' model that involves five steps (Inform - Engage - Empower - Partner – Support) embedded in and interacting with a dynamic physical and social environment (the 'mHealthy' stands for mobile health).

There are lessons to be learnt from health approaches to lifestyle change. Lifestyle modification requires a comprehensive approach in which recommendations are individualised for clinical characteristics (63) and personal circumstances and contexts (62). Lifestyle medicine is a term used to describe the prescription of a set of lifestyle behaviours to improve health outcomes. Minich and Bland (63) review the complex interaction between lifestyle factors (nutrition, physical activity, stress management and environmental exposure) with individual biomarkers, genetic variants and epigenetic modification. This illustrates the potential benefits of personalised lifestyle medicine that is tailored to individual biomarkers, genetics and epigenetic variations, and individual circumstances.

Targeted changes in lifestyle behaviours should be accompanied by strategies that enhance cognitive processes and engage the support of the wider community (60). There is also growing evidence that multi-component intervention programs (e.g., combining counselling sessions with group-based sessions) are more effective than single-strategy approaches (57, 60).

3 A Marketing and Consumer Behaviour Perspective on Lifestyles and Lifestyle Change

Summary

From the perspective of marketing and consumer behaviour, lifestyle is simply viewed as a way of everyday life that leads to choices between goods, services and expenditure. More complex framings recognise these choices reflect values, intentions and opinions as consumers are complex decision makers. Marketing practitioners use lifestyle classifications to segment markets and position products and services relative to specific lifestyle groups. Lifestyle change is explained by shifts in the lifestyle landscape. This includes changes in contextual and cognitive factors that influence consumption patterns. Lifestyle change can be encouraged using marketing techniques which can also be applied as social marketing to encourage choices with public good benefits.

3.1 What does lifestyle mean in marketing? What constitutes a consumer lifestyle?

Marketing is a fairly new science. It emerged as part of a growing consumer culture in the USA during the 1950s (68, 69). Lifestyle marketing is a process of establishing relationships between products offered in the market and targeted lifestyle groups (70).

In marketing, lifestyle is simply defined as a 'way of everyday life' that leads to 'choices between goods and services' and 'expenditure' (31, 36, 71-73). These patterns are distinguished by social character observable in individual socio-demographic characteristics (36, 74).

Cognitive and reflexive lifestyle perspectives in marketing frame consumers as complex decision makers whose choices reflect their values, intentions and opinions (36). These choices are shaped by structural forces including social structures, ideology and socio-cultural differentiation (19, 50), self-expression and personal ideology (49, 72).

3.2 What is lifestyle used for in marketing?

> "*People are diverse, but their values, dreams, and attitudes place them in distinct lifestyle groups*" (75).

Marketing is fundamentally a science of persuasion (69). Marketing practitioners use lifestyle concepts descriptively to research and identify lifestyle segments, and analytically and reflexively to position products and services in a way that appeals to like-minded consumers (20, 68). An early proprietary lifestyle classification system was developed in the 1970s by social scientist Mitchell (75). The values and lifestyle classification (VALS) drew on early motivation theory (Maslow's hierarchy of needs 1954), and the concept of social character (76) to identify nine distinctive lifestyles. It had a 'dramatic' impact on marketing approaches in the USA during the late 1970s (74). There are now many proprietary lifestyle classifications including the Sinus-Milieus, Euro-Socio Style, Roper Consumer Styles, and Mosaic lifestyle classifications (see below for further details) (20).

3.3 What approaches and frameworks are used in marketing to measure lifestyles?

Measuring lifestyles from a marketing perspective consists of two key approaches: the AIO framework, and the value systems approach. The AIO (attitudes, interests and opinions) framework was introduced by Lazer (11). Lifestyle is defined as the manner in which people conduct their lives and includes their activities, interests and opinions (29). Activities consist of manifest actions and include work, leisure,

community, shopping. Interests relate to objects, events or topics and include family, home, work, and achievement. Opinions include a range of beliefs relating to one's self, products, society, culture, the future (31, 71). Typical statements could include "I drive my car daily" (activity), "I am not very interested in electric cars" (interest), "climate change is not important" (opinion). The broad framing means it is generalizable across domains or countries. Srihadi, Hartoyo (31) use AIO to identify four distinctive tourism-related lifestyle clusters. Hur, Kim (14) use AIO to identify six distinctive food related lifestyle clusters. Jain (71) use AIO to identify three distinctive consumption clusters in India. In all these studies lifestyle is measured using a multi-item survey from which unique lifestyle groups are identified using cluster analysis.

In the value systems approach, values are defined as guiding principles in people's lives that vary in importance (77). Unlike the AIO approach, the value systems approach uses a set of predetermined value statements adapted from the Rokeach Value Survey (78). This lists 18 different statements, distinguishing between two key dimensions. These are the inner and the outer self. Value items include the importance of 'self-respect', 'happiness', 'freedom', 'friendship', 'social recognition', 'national security', 'a world at peace'. The VALS lifestyle classification model (75) and the List of Values (LOV) (74) are aligned with this approach. Another important scale for assessing value systems was developed by Schwartz (79) and includes 56 values. Ten of these are measured within the World Values Survey which explores values and beliefs across almost 100 countries.

Hybrid approaches across these frameworks are not uncommon. For example Vyncke (77) developed the values, life visions, and aesthetic lifestyle typology (V-L-A). This takes a value systems approach adding further constructs related to life vision, aesthetic styles, media preferences, product attributes (cars, tourism, political parties), and demographics. For cars attributes included safety, design, engine power and reliability.

There are a range of other frameworks that align variously with these two approaches. For example, the food-related lifestyle model sees lifestyle as a mixture of habits, conventional ways of doing things, and reasoned behaviour (29). It is based on the simple attitude, behaviour, context (ABC) model (80) which is a specific representation of the three lifestyle elements: behaviours, cognitions, and context. Using this framework, Nie and Zepeda (29) distinguish four food-related lifestyle clusters, and Sanquist, Orr (44) distinguish between three energy-related lifestyle clusters (see Appendices for further details of relevant studies).

The voluntary simplicity lifestyle scale was developed by Leonard-Barton (81). It relates to an anti-materialistic lifestyle ideology defined as "*lifestyle choice that involves minimalizing consumption and divorcing oneself from material possessions*". It is associated with green, ethical, and sustainable consumption (19). A number of empirical studies have tested and identified variants of this scale. Cengiz and Torlak (19) use an online survey to test 15 items related to recycling behaviour, food (eating, growing), preference for physical forms of transport (walking, cycling), self-reliance (making things) and use of the second hand economy. They distinguish a single lifestyle group (voluntary simplicity). Rich, Wright (82) use a variety of qualitative and quantitative methods to test 67 items related to growing food, environmental attitudes, pragmatism, and spending.

3.4 What lifestyle groups are identified in marketing research?

Empirical studies identifying lifestyle clusters in marketing tend to use proprietary frameworks (Table 3), and focus on particular behavioural 'contexts' such as food, leisure and tourism, and energy use, as well as generalised consumption. Studies using national samples (USA, Europe, Asia, New Zealand) independently identified distinct lifestyle clusters. One of these draws on a nationally representative database of energy use (44). These empirical studies are valuable because they are fully transparent and offer key insights into measurement frameworks, analytical approaches, and detailed findings.

There are also a number of market research organisations that have a wider geographical reach and representation. These offer proprietary segmentation tools (at a cost) to help organisations (and governments) identify generalisable cross-national lifestyle clusters. As they use different definitions and models, they tend to arrive at different lifestyle groups (Table 3).

An important contribution of these proprietary frameworks is their focus on socio-cultural dimensions of lifestyle which include constructs such as inequality and 'milieu'. The concept of milieu was developed in the 1990s by the Vester group and the Sinus Institute. 'Milieu' is defined as "sub-cultural units within a society which group together people with a similar view of life and way of life" (50).

Table 3. Proprietary frameworks for identifying national and cross-national lifestyle groups

	Lifestyle items	**Main factors or dimensions**	**Lifestyle groups (prevalence)**	**Location and sample size**
Sinus-Milieu	items related to social status (socio-demographics) value orientation (aim in live, ideals, society) way of living (interests, leisure activities, social life, occupation attitudes towards work, family, leisure, work ethos, performance, aesthetic needs) consumption (leisure activities, social life)	two dimensions 1. social status (income, education, occupation) 2. degree of modernisation (from traditional to liberal). a distinguishing character is that lifestyle groups are not discrete but are allowed to overlap	<u>10 lifestyle groups</u> 1. modern mainstreamers (12.6%) 2. adaptive navigators (11.1%) 3. traditionalists (11.1%) 4. precarious (9.2%) 5. hedonists (14.8%) 6. established (10.0%) 7. liberal intellectuals (7.4%) 8. performers (7.9%) 9. cosmopolitan avant-gardes (8.7%) 10. social ecologists (7.3%)	latest database update: 3,000 qualitative and 300,000 quantitative interviews. (transnational model, German origin)
Euro-Socio-Styles	items include income, marital status (single, married, children), age, view of others, social engagement, aspirations, education	two dimensions contrasting differing needs 1. stability versus transformation 2. illusion versus reality	<u>8 different Euro styles</u> 1. new world 2. cosy tech world 3. crafty world 4. magic world 5. authentic world 6. secure world 7. steady world 8. standing world	survey (n=24,000) from 15 countries in Europe
Rope-Consumer-Styles	items include: openness to new things, traditional values, thriftiness, conservativeness, age, status/wealth, concerned with appearance / reputation, responsibility, favourite brands, family structure, faith, habits, personal interests, ambitions, personality traits, attitude to the environment	two dimensions contrasting differing needs 1. passionate life versus peace and security 2. materialism and price orientation versus post materialism and quality orientation (need to have versus need to be)	<u>8 lifestyle groups</u> 1. dreamers 2. adventurers 3. open-minded 4. homebodies 5. rational-realists 6. organics 7. settled 8. demanding	survey (n=35,000) from 25 core countries and changing additional countries
MOSAIC	demographic, geographic and psychographic items	multidimensional: young-elderly, asset poor-asset	<u>15 groups and 66 detailed types (Experian, 2015a):</u> A. city prosperity (3.5%)	49 million individuals and 26 million

	include: income, influence, country of origin, consumer behaviour, residential location, values, interests, marital status, and travel mode.	rich, high density-low density, low income-high income, traditional-cosmopolitan	B. prestige positions (8.2%) C. country living (4.4%) D. rural reality (8.7%) E. senior security (4.3%) F. suburban stability (11.2%) G. domestic success (5.8%) H. aspiring homemakers (5.9%) I. family basics (8.7%) J. transient renters (5.2%) K. municipal challenge (5.2%) L. vintage value (5.9%) M. modest traditions (7.4%) N. urban cohesion (7.0%) O. rental hubs (8.5%)	households. Method available in more than 29 countries but focus is on UK.
Research Institute on Social Change (RISC)	items cover: demographic; attitudes regarding fashions, institutions, environment; ambitions; consumption; ethical values; global outlook	3 dimensions: 1. exploration/ stability 2. social/individual, 3. global/local	1. researchers & explorers, 2. mobile networkers, 3. searchers of security, 4. enrooted traditionalists 5. worriers 6. energetic searchers for amusement and pleasure 7. guardians, 8. ethical signposts 9. social climbers, 10. greedy consumers	based on measurements in more than 40 countries, mostly European. Longitudinal surveys are conducted.
VALS2	18 value statements related based on Rokeach (78)Rokeach [1973] plus additional items that reflect values and interests in technology and social character (e.g., status)	two main dimensions: 1. self-orientation 2. resources	1. actualisers/innovators (8%) 2. thinkers (11%) 3. achievers (13%) 4. experiencers (12%) 5. believers (16%) 6. strivers (13%) 7. makers (15%) 8. survivors (14%)	proprietary framework developed in USA, with transnational application but cultural variants in proliferation of clusters

3.5 What is lifestyle change in marketing?

Lifestyle research in marketing seeks to constantly evaluate what is referred to as 'the lifestyle landscape' (20). Lifestyle change in marketing is observed by shifts in consumption patterns, related to changes in contextual and cognitive factors. Contextual factors include greater structural flexibility in terms of people's working and private lives, erosion of family structure, digitalisation of day-to-day living, and growing polarisation of wealth (49). Cognitive factors include shifts in attitudes and values, beliefs or ideology which challenge the dominant consumer culture (19, 72). For example, the term 'voluntary simplicity' defines a group of consumers who adapt their daily lifestyles towards an anti-materialistic lifestyle philosophy (19, 45, 82).

In marketing, lifestyle characterises individuals but is also socially motivated. Starr (83) argues that people adopt lifestyles common to their social groups and then modify them in standard ways as they age or follow lifecycle norms. Social marketing is described by Kotler and Zaltman (84) as an approach

to planned social change. It involves the use of marketing techniques applied to a social idea or public benefit (such as healthy or sustainable lifestyles). Interventions can occur at the individual level, but are more likely to be successful where the motivation for change comes from the community or where promising social groups act as role models or opinion leaders (7). Seegebarth, Peyer (45) suggests that this approach can redirect consumption from ecologically-friendly products to the question of whether consumption itself is necessary.

4 A Pro-Environmental and Low-Carbon Perspective on Lifestyles and Lifestyle Change

Summary

Like public health and marketing, pro-environmental and low-carbon research identifies behaviours, cognitions and context as the three common and interacting elements of lifestyle. As many different domains of everyday life are associated with environmental impacts, lifestyle concepts can be applied narrowly in specific domains like food, homes, and travel, as well as in a general integrative way across domains. There are also many inconsistencies in the behaviours, cognitions and contexts which make up low-carbon lifestyles: between knowledge and action; between values and action; and between action in different domains. This means it is problematic to identify low-carbon lifestyles from behavioural patterns alone.

Lifestyle concepts are applied in low-carbon research descriptively to characterise low and high impact behaviours in similar lifestyle groups, and analytically to assess options for reducing energy use or carbon emissions. Such applications tend to take a patterned view of lifestyle with its emphasis on routine or high frequency behaviours. Lifestyle concepts are also applied instrumentally to design or evaluate interventions for encouraging low-carbon lifestyle change. These instrumental applications tend to take a cognitive view of lifestyle with its emphasis on values, intentions, and individual responsibility. There are also some examples of reflexive approaches to low-carbon lifestyles in which individuals adopt pro-environmental behaviours to differentiate themselves from others in society.

A variety of quantitative and qualitative methods are used to measure lifestyle elements, ranging from large sample quantitative surveys for characterising lifestyle heterogeneity, to focus groups and interviews for developing narrative themes of sustainable living. These identify low-carbon lifestyles in five different ways, based on: (i) extent of pro-environmental behaviours and commitment; (ii) basic orientations towards technology, society, and the environment; (iii) inward- and outward-looking perceptions of the self and the world; (iv) consistency between behaviours and cognitions across different contexts; (v) contextual determinants of lifestyle such as affluence or location.

Low-carbon lifestyle change is most commonly framed from a cognitive perspective as being motivated and intentional, either with respect to specific behaviours, or more broadly to construct a consistent self-identity or standing within the world. Interventions tested range from short-term targeted campaigns to educate and inform (which blur the distinction between behaviour change and lifestyle change) and longer-term systemic shifts in infrastructure, regulatory measures and social structures (which blur the distinction between system change and lifestyle change).

4.1 What are low-carbon lifestyles?

Research on pro-environmental, sustainable, green or low-carbon lifestyles is variously concerned with what the adverse impacts of lifestyles are on environmental conditions, and on how and why people may seek to reduce these adverse impacts. In this section, we use ‘low-carbon lifestyles’ as shorthand for these different emphases.

Low-carbon lifestyles are defined and conceptualised in wide-ranging ways, reflecting patterns of behaviours, intentional action, and the shaping influences of the wider social and physical environment (Box 2). Contextual factors such as institutions and infrastructures can lock-in unsustainable behaviours and habits (85).

An important but often tacit distinction in low-carbon lifestyles research is between domain-specific lifestyles and ‘general’ lifestyles across domains. Do we have a single lifestyle? Or a lifestyle specific to

food, leisure, travel, homes, or energy use? Low-carbon lifestyles research assumes both. This differs from public health and marketing as it fragments integrative lifestyle concepts into specific behavioural domains or contexts. One consequence is that the 'lifestyle' in low-carbon research becomes closer in meaning to 'behaviour'.

General lifestyles across domains

Cognitive or reflexive perspectives on low-carbon lifestyles broadly consider "how we live our everyday lives" and "how we socialise, exchange, share, educate and build identities" (UNEP 2010). General lifestyles thus comprise both behaviours and cognitions (e.g., values, beliefs, environmental awareness, attitudes, intentions) which reflect household patterns of living. Cognitions as an "organising and guiding construct in a person's life" are particularly important in low-carbon lifestyles (33).

A majority of the low-carbon studies reviewed considered lifestyles across multiple domains such as food, energy, manufactured products, transport, tourism and leisure (28, 85-88). This approach helps identify salient lifestyle elements associated with environmental impacts. Sustainability lifestyle frameworks provide a way of organising, thinking, planning, and evaluating strategies for reducing adverse impacts (89, 90). Such studies inform social marketing and educational campaigns to encourage more sustainable lifestyles (2, 90).

The general multi-domain conceptualisation of lifestyle also lends itself to analytical assessments. These include lifestyle-based modelling analysis of how consumption and daily activity impacts carbon emissions or other environmental impacts or ecological footprints (18, 28, 47). General lifestyle frameworks are also used to assess the relationships between sustainable practices and wellbeing (91) or beliefs and attitudes (92) as well as perceptions and acceptability of environmental policy instruments (87).

Domain-specific lifestyles

As well as general frameworks of low-carbon lifestyles across domains, many studies focus narrowly on lifestyles in specific domains of resource-intensive activity. The many different examples include domestic energy use and waste generation (92), dwelling location and type (22, 33), mobility and travel (24, 35), leisure and tourism (5), and food (14, 34). Low-carbon lifestyles are also tested as generalisable explanations for technology adoption decisions in different domains, such as electric vehicles, solar panels and green electricity tariffs (9). Some studies find that much of the variation in energy or resource consumption can be explained by domain-specific lifestyle factors (44).

Comparative studies of context-specific lifestyles assess variation in behaviours and cognitions across different physical environments: e.g., rural or urban residents, transitional sites from home through journey to holiday destination, social settings such as members and non-members of grass roots initiatives (85), and socio-economic settings, such as transition economies or post conflict economies (93). In these studies, context is identified as a key driver of lifestyle but individuals respond differently according to their worldviews, values, perceptions and attitudes.

Box 2. Definitions of Low-Carbon (Green, Sustainable, Pro-Environmental) Lifestyles & Lifestyle Change.

Definitions emphasising purpose and intentional

- "rethinking our ways of living, what we buy and how we organise our everyday lives … altering how we socialise, exchange, share, educate and build identities" (94)
- "making changes to one's lifestyle in order to reduce one's carbon footprint through intentionally adopting new technologies and/or changing behaviour" (95)
- "something that needs to be changed to achieve sustainable development" (7)
- "consumers' behaviours and choices if these are intentionally aimed at fulfilling sustainable development

goals”(88)

Definitions emphasising impacts or outcomes

- “patterns of action and choices that are shaped by a group of factors capable of minimizing the wastage of natural resources, providing a better quality of life and do not jeopardize the needs of future generations" (96)
- “the changes that lead, or aim to lead, to the avoidance, shift and in some cases, improvement (depending on the context) in energy service demand, irrespective of their intent" (46)
- “shifts in the household demand for goods and services, mobility and housing choices” (97)

4.2 What are common elements of low-carbon lifestyles? How do these vary across domains?

Table 4 summarises evidence on the common behavioural, cognitive, and contextual elements of lifestyle in food, homes, and transport domains (see Appendices for further details on the underlying studies). Although the specific behaviours of interest necessarily vary by domain, the basic conceptualisation of lifestyle being constituted by three interacting elements is the same across domains, as are the types of cognitions and contextual factors considered relevant. Here we summarise some general insights as well as analytical emphases in food, homes and energy, and mobility-related lifestyles research.

Food-related lifestyles

Changes to eating habits and food choices are driven by individual attitudes, environmental awareness and intent (87). This cognitive approach relates a set of actions to a set of values e.g., (32) or intentional behaviours, driven by motivations, opportunities and habits (88). In developing or transitioning economies, a cognitive approach suggests that lifestyles shift as the goals of satisfying basic needs are replaced by goals of higher standards of living (93). However context as a strong lifestyle driver is emphasised in several food-related studies. At a global level, dietary choices and consumer purchases are driven almost entirely by cultural and socio-economic characteristics (28). Thøgersen (34) uses country of residence as an explanation for observed cross-national heterogeneity in food-related lifestyles within the EU.

Homes and energy-related lifestyles

Homes-related lifestyles in a domestic context are often narrowly concerned with direct and indirect uses of energy given its high relevance for carbon emissions. Energy-using behaviours are the result of individual psychological variables that influence decision-making (e.g., attitudes, perceptions, and beliefs) as well as and household characteristics (18). As in low-carbon research more generally, many studies take a cognitive approach in identifying housing or energy-related perceptions, beliefs, and choices (33, 98). For example, Barr and Gilg (4) explored sustainable lifestyles in and around the home by linking everyday energy-saving actions to attitudes, values and situational factors.

Mobility and transport-related lifestyles

Transport-related lifestyles in a low-carbon context are commonly concerned with mode choice, active modes, and EV purchasing. Access to infrastructure, and urban or built environments are more influential than in other domains (21). For example, Markvica, Millonig (27) defined lifestyle groups associated with active mobility (walking, cycling) on the basis of attitudes (e.g., to leisure and transport) and fundamental values within socio-economic structures (such as income, education, residential characteristics). Some transport-related studies also take a reflexive view of lifestyle as informing and conveying self-identity (40). For example, an individual may purchase an electric vehicle (EV) if this fits in with their current or aspirational self-concept as a pro-environmentalist or technological enthusiast.

Table 4. Lifestyle elements by domain, drawing on studies of domain-specific lifestyles and studies looking at general lifestyles across domains.

Domain (n studies)	**Behaviours**	**Cognitions**	**Contexts**
Food & diet (8)	**Sustainable dietary choices**: e.g., vegetarian diet, low nutritional value foods, highly processed foods, seasonal / local foods. **Food waste prevention**: use food waste as fertiliser or for composting. **Sufficiency**: e.g., benchmark 2424 calories per day / calorie intake. **Self-sufficiency**: growing own food.	**Values and perceptions**: e.g., food as necessity, luxury) **Attitudes**: environmental awareness, frugality, moral questioning of the excesses of consumption. **Motives and goals**: for food purchases, including quality, intentions for environmentally friendly food purchases, and anticipated consequences. **Self-efficacy**: control diet or food choices.	**Economy**: financial resources, economic crisis **Political conditions**: policy measures and regulation, conflict. **Social**: informal social networks or social structures, social norms regarding food choices, social values. **Culture and traditions**. **Media**: food advertising Country of residence as a broad contextual factor. Geo-physical conditions.
Housing (4) and Energy (9)	**Housing**: repair or renovate using environmentally friendly materials. **Choice of energy supplier**: renewables. **Reduce energy consumption**: for space heating / cooling, water heating, appliance use. **Use of energy-saving devices:** light bulbs, thermostat, insulation. **Home energy generation**: e.g., solar panels **Residence**: ecovillage, shared housing.	**Knowledge**: e.g., awareness of energy ratings for appliances. **Valued qualities of the home**: amenities, size of house, home-maker, bathing preferences, living standards. **Beliefs & attitudes**: environmental and climate issues, new technology such as smart meters / customer innovativeness. **Perceptions**: thermal comfort, logistics – ease and ability of taking action. **Motivations**: willingness to conserve energy. **Responsibility for action**: (individual, local authority, government), powerlessness.	**Economic**: cost of electrical appliances, financial resources for installation of energy saving / generating equipment. **Social**: sense of community, social identity, community micro-gen, social trends e.g., eco-upgrading is not fashionable. **Regulatory**: installation of energy saving devices in social housing, energy labelling of electrical appliances. **Physical environment**: size of dwelling, climate, infrastructure, access to energy saving devices.
Transport & mobility (13)	**Reduce vehicle ownership and use**. **Reduce air travel**. **Shift to public transport** instead of car use. **Shift to active transport**: cycling or walking. **Car-sharing**. **Purchase electric vehicle**. **Work from home** to reduce vehicle use, video-conferencing to reduce air travel.	**Knowledge**: awareness of the association between transport use and emissions. **Beliefs & values**: biospheric, altruistic, egoistic and traditional. **Attitudes**: Willingness to act, openness, concern about the environment, transport mode opinions, openness. **Motivations**: e.g., for EV use – environment, or interest in technology, cost savings. Perceptions: e.g., public transport is inconvenient. **Self-identity**: family orientation, pro-environmental activities, career, hobbies & interests, sense of power.	**Socioeconomic factors**: income, education. **Social**: sociocultural norms, social interactions, socio-demographic variables. **Regulation and policies**: e.g., government subsidies for purchasing an electric vehicle, investment in cycling facilities. **Physical environment**: infrastructure (e.g., density of cycling networks), access to EV recharge facilities.

4.3 What frameworks are used to measure low-carbon lifestyles?

Analytical frameworks in low-carbon research align with the patterned, cognitive and reflexive views of lifestyle set out earlier in this report (*Table 5*). All three views recognise the interrelationships between behaviours, cognitions, and contexts, but with different emphases.

Analysis taking a patterned view of lifestyles is structured around behavioural matrices in specific domains (e.g., home energy, transport, food and diet). In some studies lifestyles are identified solely on the basis of activity patterns to then explore the association between lifestyle and attitudes or contextual factors (4, 21, 28, 85). More often, the patterned approach explicitly considers context or situational factors in the identification of lifestyles such as household characteristics (18), and local infrastructure and available mobility options (27). Studies also exploit variation in context to assess the influence of contextual factors on lifestyle, as in studies of urban-rural differences in home energy use in China (99) and in Beijing (47).

From a cognitive perspective, analytical frameworks emphasise the role of certain cognitions such as altruistic values and awareness of environmental problems associated with climate change to motivate and direct behaviours. From this perspective, lifestyles are purposeful but also responsive to contextual factors ranging from living and consumption situations (35) to socio-economic factors such as levels of education and income (87), and physical and social structures (100). Thøgersen (34) constructs domain-specific lifestyle frameworks for food, housing, and travel. For example, the food-related lifestyle (FRL) framework measures five interacting lifestyle elements: two cognitive elements related to purchasing motives and food quality; two behavioural elements related to purchasing and preparing; and one contextual element related to the sites of food consumption (34).

A reflexive approach to low-carbon lifestyles emphasises the ways in which behaviours are used to express and reinforce self-identity. Blending behavioural patterns with motives and intentions, the constituent elements of lifestyle are broadly the same as in the patterned and cognitive approaches, but there is a greater emphasis on differentiation through social status and symbols of identity (40, 101). For example, Binder and Blankenberg (91) analysed UK household panel data to assess the degree to which pro-environmental behaviours influence and are influenced by subjective wellbeing and self-image. In a contrasting qualitative study of the lifestyles of 'home-front transitioners' in Sweden, Hagbert and Bradley (102) developed narrative themes with residents as agents of change in developing self-sufficient lifestyles. Axsen, Cairns (40) also use narrative themes which inform and reflect self-identity to explore pioneers' adoption of electric vehicles.

4.4 What data and methods are used in low-carbon lifestyles research?

A variety of quantitative and qualitative methods are used to identify and measure low-carbon lifestyles (*Table 5*). Quantitative methods collect data on lifestyle elements through questionnaire surveys (43) or other secondary datasets e.g., (90). Data reduction methods are commonly applied prior to analysis of lifestyle heterogeneity e.g., (4, 21). For example, composite lifestyle elements can be identified using factor analysis (92), principal component analysis (33, 34) or multiple correspondence analysis (93). Lifestyles defined by motivational homogeneity are also framed through rudimentary categorisation, such as members or non-members of environmental groups (103).

Qualitative approaches gather information though in-depth interviews or focus groups to develop narrative themes appropriate to sustainable lifestyles in general or 'voluntary simplicity' (104). Motivational narratives are developed for context-specific lifestyles, such as social housing tenants in Belfast (98), or engagement in community sustainability projects (105). Howell (95) used mixed methods (in-depth interviews and questionnaires) to explore values and motivations as routes to engagement in low-carbon lifestyles case studies. Hagbert and Bradley (102) used in-depth interviews to identify an emerging theme of 'home as a node of everyday life' as a starting point for low-carbon

lifestyles. Residents were viewed as agents of change and alternative conceptualisations were explored for more radical forms of low-carbon living. This reflexive approach is also used in domain-specific lifestyle studies, such as understanding the motives for electric vehicle purchase (40, 101, 106). Mixed methods approaches combine qualitative focus groups and in-depth interviews, with quantitative surveys (5, 27, 96). Vita, Lundström (85) for example, used backcasting workshops to develop narratives of low-carbon consumption narratives.

Low-carbon lifestyles research is concentrated in environmentally-conscious population segments in the global North. Available studies in emerging economies tend to place less emphasis on intentions, and more emphasis on demographic, social or institutional factors which shape emissions-intensive lifestyles such as migration from countryside to cities (47) or literacy, theft and corruption (96).

Table 5. Analytical frameworks, data & methods used in low-carbon lifestyles research.

Lifestyle approach	**Framework, data, methods**	**Lifestyle variables**	**Lifestyle domains (References)**
Patterned view: lifestyle as inter-related behaviours	Factor analysis of questionnaire items	Behaviours or habits	Multi-domain (4); Active mobility (107)
	Published surveys to develop lifestyle scenarios	Behaviours, situations	Multi-domain (43)
	Consumer Lifestyle Approach (CLA), National energy balance tables	Behaviours	Multi-domain, urban/rural (47, 99)
	Consumer Lifestyle Approach (CLA), Published survey data;	Behaviours, household characteristics	Multi-domain (18)
	Quantitative categorisation	Behaviour, GDP	Multi-domain, transitioning economies (108)
	Ecological footprints for cross-national data	Household consumption	Multi-domain (28)
	Mixed methods: survey data and stakeholder evidence	Behaviours	Multi-domain (90)
	Mixed methods: focus groups and survey	habits, options, local infrastructure, attitudes	Active mobility (27)
	Mixed methods: qualitative Interview and Questionnaire	Resource use, urban migration, socio-cultural factors, GDP.	Energy use, Transitioning economies (96)
	Mixed methods: Focus groups, in-depth interviews, questionnaire	Behaviours (home – journey – holiday settings)	Multi-domain Context-specific (5)
	Qualitative: narratives from backcasting workshops	Participant visions of consumption patterns	Multi-domain (85)
Cognitive view: lifestyles as values, goals and intentions	Factor analysis of survey items	Attitudes, awareness, beliefs	General lifestyle Context specific: Transition economy (92)
	Principal component analysis of survey items	Actions, perceptions, values, motives, living & consumption situations	Domain specific (separate for housing, food and transport) (33, 35)
	Multiple correspondence analysis - survey items. Frame: response to economic crisis	Practices (consumption & digital), values & attitudes	Context-specific: economic crisis (93)
	Questionnaire (web-based); environmental policy instruments.	Behaviours, habits, awareness, intention, education, income.	Generalised lifestyle (87)

	Standardised questionnaire for carbon footprints,	Behaviours, self-satisfaction (wellbeing), living standards	Multi-domain Context specific: members / non-members of environmental groups (85)
	Quantitative: published surveys, lifestyle scenarios around coherent hypothesis	Consumption, attitudes, preferences, demography, income	Multi-domain (97)
	Qualitative: focus groups – thematic analysis approach	Practices, knowledge, identity, values, perceptions, motivation, structural context.	Generalised – sustainable lifestyle (100)
	Qualitative: in-depth interviews	Values, awareness, attitudes, perceptions	Generalised simplifier lifestyles (104)
	Qualitative: semi-structured Interviews; Frame: perception of responsibility	Behaviours, environmental responsibility, willingness	Multi-domain Context specific – social housing tenants (98).
	Qualitative; in-depth interviews Frame: motives and interactions:	Engagement history, involvement, project type, motives	Context specific s: community sustainability project (105)
	Mixed methods: in-depth interviews & questionnaire	Values e.g., altruistic, biospheric, egotistic	General low-carbon lifestyle (95)
Reflexive view: lifestyles as self- and social identity	Quantitative, Household Longitudinal Study Self-identified lifestyle group by questionnaire	Behaviours, subjective self-image / wellbeing,	General lifestyle (91)
	Cluster analysis or composite score of survey items	Activities (environment or technological), liminality, environmental concern	Domain specific: Transport (Plug in EV) (101, 106)
	Qualitative: Narratives themes from in-depth interviews	Practices, perceptions, motivations, home characterisation.	General lifestyle 'home front transitioners' (102)
	Qualitative: semi-structured interviews – identify themes	Practices, social interactions that shape identify	Domain specific: Transport (EV) (40)

4.5 How is lifestyle heterogeneity characterised in low-carbon research? What lifestyle groups are identified?

Lifestyle groups in low-carbon studies are identified and characterised using a variety of techniques. Quantitative techniques include cluster analysis (4, 5, 27, 92, 93, 106), latent class analysis (33-35, 87), evidence-based expert opinion (90, 96), lifestyle scenarios based on a set of coherent hypotheses (97), categorisation based on a single lifestyle factor like perceptions of responsibility (98), and self-identified lifestyles (91). Qualitative techniques can also be used to develop evidence-based lifestyle typologies (105) or narrative themes (40, 102, 104).

Based on the 30 empirical studies reviewed (see Appendices for details), lifestyle groups of individuals or households at the population level can be characterised in five broad ways, based on their:

1. Pro-environmental action
2. Basic orientation
3. Perceptions of self and world
4. Consistency across domains
5. Contextual drivers

Pro-environmental action

Lifestyle groups differentiated by level of engagement with pro-environmental behaviours represent an action scale from most to least committed (4, 5, 91). Although behaviours are the focus of group identification, heterogeneity is associated with other cognitive and contextual factors such as social cohesion (4), perceived lack of time (92), and other contextual constraints. Middlemiss (105) identified engagement typologies linked to motivation which in some groups highlight the gap between intent and action. Barr, Shaw (5) note that segmenting populations on the basis of pro-environmental behaviour is problematic without also taking into account inconsistencies across sites of action (see below for further discussion of inconsistency).

Basic orientation

Lifestyle groups can be defined by basic orientations or preferences towards a range of needs, actions and values ranging from environment and technology (101), communication needs and information (27), family or career (34), or leisure activities such as 'active outdoors' or 'beach-oriented' groups (21). Basic orientation lifestyle groups tend to be domain-specific, identified using a variety of techniques such as cluster analysis and narrative themes combining behaviours with cognitions. Differing motivations and attitudes towards self-image, efficiency, or social connections and responsibilities are reflected in disparate preferences. These basic orientation-defined lifestyle groups are useful for targeting intervention strategies or tailored information to particularly receptive sub-populations.

Perceptions of self and world

Perceptions of self and the world are cognitions which direct actions in a coherent sense across domains, and can form the basis of distinct lifestyle groups. Inward-looking cognitions include self-satisfaction and wellbeing, whereas outward-looking cognitions include community resilience and reducing environmental damage. For example, Hayles and Dean (98) distinguish 'active' from 'passive' lifestyle groups (willingness to take individual responsibility vs. environmental action is others' responsibility). Focusing on alternative sustainability lifestyles, Hagbert and Bradley (102) developed narrative themes that were either more outward-looking ('building local resilience') or inward-looking ('self-sufficiency' through food production). These lifestyle groups were sensitive to contextual factors that variously constrained or widened lifestyle choices.

Consistency across domains

Internal consistency across behaviours, cognitions and contexts form the basis of lifestyle groups applicable in a general sense across multiple domains. Such studies use observational evidence (93) or a coherent set of prior expectations (43, 97). The important cognitions identified tend not to be related to basic orientations or particular preferences but relate to more generalised responses to situational factors (93), or a coherent assimilation of preferences and attitudes within multiple settings such as home, work and society (97).

Contextual drivers

Context-driven lifestyle groups emphasise actions or consumption patterns embedded in social and physical environments. Such studies use both local case studies and national assessments. One case study in Nigeria found key contextual drivers to be socio-cultural, including corruption, levels of literacy, and demography (96). In a global assessment of consumption lifestyles structured around a one-planet, two-planet, three-planet WWF framework (28), the key contextual drivers of differing lifestyle groups were identified as being urban structure, culture, and socio-economic characteristics. Within countries, differing income and development patterns in rural and urban environments also drive weaker or stronger trends in consumption patterns between lifestyle groups (47). Large social and economic differences can set some societies apart from others, but collective responses to contextual factors are also differentiated by attitudes (93).

4.6 How consistent are low-carbon lifestyles?

The basic conceptualisation of lifestyle suggests consistency between its constituent elements (behaviours, cognitions, contexts). However there are many potential inconsistencies in low-carbon lifestyles between actions on the one hand, and cognitions and contextual factors on the other.

First, the 'knowledge-action' gap makes clear that awareness of environmental damage and potential responses does not necessarily lead to action (2). Longo, Shankar (109) suggest that too much knowledge can become a source of dilemma that produces tensions and paralysis.

Second, the 'value-action' gap extends this inconsistency to inconsistencies between values, goals, intent, and sustainable behaviours (105). Binder and Blankenberg (91) distinguish between perceived lifestyle (e.g., green self-image) and actual lifestyle (e.g., actual pro-environmental behaviours).

Third, lifestyle practices such as recycling may be inconsistent when observed across different sites of practices, e.g., at home and on holiday (5). From a reflexive view, consistency of pro-environmental behaviours across contexts is related to environmental self-identity: 'I am therefore I do' (110). However, contextual constraints such as reduced availability of recycling bins in workplaces and holiday destinations can lead to inconsistency across domains (111).

4.7 What is low-carbon lifestyle change? How is it promoted?

> "*Green lifestyle change is a gradual, deliberate process that is a response to environmental harms. Thinking of going green as adopting a lifestyle creates a relatively coherent story and collective vision of the future … it encourages changes in everyday practices so individuals may live out the environmental themes they use to make sense of their actions*" (37).

In low-carbon research, lifestyle change involves a shift in everyday activities to reduce consumption or resource use (87, 112) or to transition towards more sustainable practices (100). As the opening quotation suggests, low-carbon lifestyle change tends to be framed through a cognitive view of lifestyles which implies individual responsibility (103). But lifestyle change can also be viewed reflexively if changes in behaviour fit self-identity aspirations or allow individuals to differentiate themselves from others in society (42). However, as noted in earlier discussions of inconsistency, intention to change may not always translate into action.

Low-carbon lifestyle change can also be driven by enabling or constraining contextual factors. For example, collective grassroots initiatives provide a supportive context to foster pro-environmental attitudes and habits across multiple domains. Conversely, structural factors such as resource access or information inadequacies may act as a widespread barrier to lifestyle change. The balance between cognitions and contextual factors as drivers of lifestyle change differs across lifestyle groups. For example, a lower use of resources may not arise out of environmental consciousness but out of financial need or motivations linked to social justice.

Interventions range from short-term targeted campaigns to educate and inform (7, 95, 100, 113) to longer-term and more radical shifts in infrastructure, regulatory measures and social structures (43, 97, 113). Interventions can be 'traditional' or 'alternative' (114). Traditional approaches frame lifestyle change as a process through which an individual becomes increasingly willing to act. Interventions to promote low-carbon lifestyle change therefore seek to motivate self-determined action and responsibility towards the environment (see Appendices for details of studies reviewed). Interventions aim to change perceptions, beliefs, desires, and strengthen intentions (7). Examples include campaigns to build awareness of the need to act (100), goal setting and feedback (113), targeted interventions for shifting values and attitudes (113) and behaviour-change campaigns to reduce energy and water

use (98). Such approaches tend to be effective only with a minority subset of motivated individuals (113). They are also often focused on behavioural change rather than the much broader integrative notion of lifestyle change.

Alternative approaches include 'habit discontinuities', 'choice architecture', and 'systemic' interventions (114). Habit discontinuity refers to changing unconscious behaviours or routines when they are disrupted by changes in context such as house moves, job changes, or infrastructure changes (114). Such approaches are criticised for their lack of practicality. The concept of 'choice architecture' refers to interventions that nudge people into a particular course of action by managing the information and influences which make up their choice environment. Such approaches are difficult to scale up (114).

Systemic approaches emphasise the wider socio-cultural contexts within which behaviour change occurs (113). Examples of interventions include those which seek to create 'information bridges' between opinion leaders of low-carbon lifestyles with clusters or groups of individuals (88). This recognises that intentions towards lifestyle change are strengthened by influential others including close social networks, co-workers, local communities, like minded others, as well as wider social norms (7) and community action (95, 105). Systemic approaches can be applied at many levels including communities, businesses, nations, cultures or sub-cultures. They can also result in lasting behaviour change which is embedded in structures that encourage and support change (114). These systemic approaches emphasise that not all interventions rely on individual action, particularly if 'agency' or responsibility is enshrined in government, industry, or technological infrastructure (98).

5 Synthesis and Insights for Low-Carbon Lifestyles Research

In this final section, we look across the distinct fields of lifestyles research to draw out similarities, differences, generalisable themes, and insights to inform analytical work on low-carbon lifestyles. We have kept this final section as a series of discrete points to emphasise that these are an initial set of ideas, reflections, as well as analytical insights.

5.1 What are the similarities across different research fields on lifestyles?

a) Behaviours, cognitions, context are the three main elements of lifestyles, i.e., lifestyles are constituted by the relationships between behaviours and cognitions in specific contexts.
b) Lifestyles are observable through patterns of behaviour in multiple domains of everyday life such as diet, travel, domestic living, and physical activity.
c) Contextual elements of lifestyle are both social (e.g., culture, inter-personal relationships) and material (e.g., urban form, housing stock, climate). Contextual influences on lifestyle are commonly proxied through socioeconomic variables such as age, gender, and income.
d) Lifestyles are measured at the individual level and sometimes at the household level (which can then be clustered into groups at a population level). Lifestyles are highly heterogeneous within any given population.
e) Cluster analysis, latent class analysis, and other grouping techniques are commonly used to identify behavioural lifestyle clusters in population-level data sets, often using nationally-representative questionnaire survey data.
f) Lifestyles are measured and analysed in order to understand how they can be changed through targeted interventions or strategies to benefit either individuals or society as a whole.
g) Motivation and ability to change lifestyle is constrained in practice by available socioeconomic resources (e.g., disposable income, social relationships) and contextual factors (e.g., social norms, access to infrastructure).
h) Empirical work on lifestyles is concentrated in the global North, with available studies in emerging economies placing more emphasis on demographic and institutional factors which determine lifestyles rather than values and goals as cognitive elements of lifestyle.

5.2 What are the differences between different research fields on lifestyles?

a) Public health research is focused on a narrow and fixed set of lifestyle elements (diet, physical activity, smoking and drinking), *whereas* marketing and low-carbon research are concerned with a broad and variable set of lifestyle elements.
b) Public health and marketing research tend to find or assume consistency in lifestyles *whereas* low-carbon research points to the possible inconsistencies between behaviours and cognitions (e.g., knowledge-action gap, value-action gap) or between domains.
c) Public health research uses the terminology of 'risk factors' associated with 'worse' outcomes (unhealthy lifestyles, morbidity, mortality), *whereas* marketing and environmental research use more neutral terminology recognising either personal or social outcomes.
d) Public health and low-carbon research make normative assumptions about 'better' and 'worse' lifestyles (or 'more' and 'less' desirable lifestyles) defined against public policy objectives, *whereas* marketing research is agnostic towards the social desirability of different lifestyles.
e) Public health research and marketing research are applied to promote lifestyle change towards 'better' outcomes for the individual (personal health, material wellbeing), *whereas* low-carbon research is applied to promote lifestyle change towards 'better' outcomes for society (which may involve a loss of personal wellbeing). However, integrative frameworks for promoting health and sustainability lifestyles are eroding this distinction.
f) Public health and low-carbon research place more emphasis on motivated reasoning for lifestyle change and so lifestyle elements such as values, problem awareness, self-efficacy and

social norms, *whereas* marketing research places more emphasis on identity and social positioning, as well as private benefits of lifestyle change.

g) Public health research and marketing research use lifestyle as a unifying, integrative concept across different domains of everyday life, *whereas* environmental research also sees lifestyle as domain-specific, as in 'energy-related lifestyle' or 'travel-related lifestyle'.

5.3 How can frameworks and lifestyle elements from public health and marketing inform research on low-carbon lifestyles?

a) Cognitions associated with a healthy lifestyle include both knowledge and awareness of health-related risk factors and morbidity outcomes, but also include broader cognitions such as purpose in life, emotional resilience, feeling at peace, managing stress, self-efficacy, strong social relationships, and mindfulness. These broader cognitions are useful for broadening out low-carbon lifestyles research beyond a narrow focus on specific behavioural changes (e.g., less flying, less red meat).

b) In public health research there is a tendency for lifestyle practices associated with poor health outcomes to cluster. For example those with a healthy diet tend not to smoke and be more physically active, whereas those with unhealthy diets tend to smoke and drink more and be less physically active. This emphasises the importance of individual cognitions such as self-efficacy and knowledge, as well as physical and social environments, in shaping lifestyle-related behaviours. It is less clear in low-carbon research whether 'good' and 'bad' behaviours are as consistently clustered, or whether there is more evidence of inconsistency between behaviours under similar cognitive and contextual conditions. This should be explored more systematically in available behavioural data sets.

c) Public health research emphasises well-being outcomes of lifestyles. Well-being could also serve as a useful foundational concept in low-carbon lifestyle research, in linking both to living standards and welfare, but also to self-identity and self-consistency with deeply-held values. Well-being concepts make salient that low-carbon lifestyle change will not simply be driven by motivated reasoning about the collective desirability of emission reductions, but also by the positioning of low-carbon lifestyles within people's understanding and awareness of what constitutes a good or desirable life.

d) Public health research has traditionally focused narrowly on health-related risk factors and related behaviours (diet, physical activity). However a wider understanding of public health to include personal development, livelihoods, social relationships, and so on, provide a broader set of connections between healthy and low-carbon lifestyles. The Lifestyle of Health and Sustainability (LOHAS) framework in public health is an example of the increasing recognition that health and environmental sustainability are strongly intertwined.

5.4 How can the use of data and analytical techniques in public health and marketing inform work on low-carbon lifestyles?

a) Empirical work in public health to characterise lifestyle heterogeneity and develop targeted interventions draws on a wide range of data including behavioural, psychological, contextual, sociodemographic, and clinical indicators or variables. Low-carbon lifestyle research can be narrowly concerned with behaviours, but this lacks the necessary cognitive and contextual information to understand lifestyles as an integrative concept distinct from behaviour.

b) Given the strong relationships between public health and environmental sustainability, data resources that are widely used and with a long track record in monitoring health-related lifestyles could be useful for low-carbon research. As an example, the UK BioBank has extensive health and well-being data on half a million people tracking different age cohorts over time. So far it has been extensively mined to identify lifestyles associated with poor health outcomes, but this analysis could extend to poor environmental outcomes also.

c) National statistical agencies in some countries have panel data sets for tracking lifestyle change with respect to health outcomes. For example, the UK Office for National Statistics (ONS) collects data through their Public Health Outcomes Framework which has been running since 1982 and is also spatially disaggregated. These types of national statistical data sets would lend themselves to comparative cross-country lifestyle-related analysis in a low-carbon context.
d) Analyses of health-related behavioural clusters in population-level data sets are typically linked to socioeconomic and other observable contextual factors which are readily measured. Linking national-level behavioural heterogeneity to cognitions is less common, presumably due to data constraints. This is a similar limitation in low-carbon research which should explore opportunities to link datasets measuring relevant cognitions.
e) The World Values Survey measures people's values and beliefs across almost 100 countries, using items from the widely-used Schwartz scale for assessing value systems. This aligns with the value systems approach used in marketing for identifying change over time and cross-cultural variation in lifestyles. This provides an available data resource for tracking the cognitive dimension to lifestyles at a global scale.
f) The widely-used AIO framework in marketing distinguishes attitudes, interests, and opinions. This is a simple framework for identifying lifestyle heterogeneity. Applied to low-carbon research it emphasises that both what people do as well as how concerned they are about climate change help define lifestyle in a general sense across domains. For example, a simple 2x2 application would be to use an activity dimension and a concern dimension, and map lifestyle groups in the high/high, low/low, high/low, low/high domains. Following precedent in marketing, this could be implemented using a multi-item survey at the population level across countries, with cluster analysis then used to identify unique lifestyle groups.

5.5 How can insights on lifestyle change and interventions in public health and marketing inform work on low-carbon lifestyles?

a) Public health research identifies risk factors associated with unhealthy lifestyles which are undesirable for both private reasons (morbidity, reduced quality of life) and public reasons (cost to health system). Similar language could be applied to high-carbon lifestyles to emphasise private and public undesirability. For example, frequent flyer membership and urban SUV ownership are 'risk factors' associated with high-carbon lifestyles. This may help increase the legitimacy of risk-mitigating public policy interventions promoting lifestyle change to reduce collective risks from climate change.
b) Public health research recognises broad societal factors like deprivation which shape and constrain lifestyles alongside intentions and other cognitions. Design and evaluation of low-carbon interventions should more strongly recognise the limits to intention-driven lifestyle change.
c) Public health interventions target specific lifestyle-related behaviours such as more regular physical exercise or better calorie controlled nutrient rich diets, but focus on a broad set of related cognitions and contextual factors. Interventions to promote low-carbon lifestyles tend to dilute the clear causal relationships between the intervention to change relevant cognitions or contextual factors, and the behavioural outcomes desired.
d) Lifestyle change approaches in public health, as well as associated theoretical frameworks for health interventions, strongly emphasise the importance of cognitions such as knowledge, self-efficacy, and awareness of barriers to change. This means that lifestyle change interventions tend to be strongly inter-personal with relatively low sample sizes of participants, and strong interaction with public health professionals. A similar approach in low-carbon lifestyle change would target and work directly with 'at risk' groups of high-emitters in specific contexts. However, the willingness or openness of such groups may be limited as the personal benefits of such change will be unclear or even negative (e.g., frequent flyers).
e) Apps are increasingly used in public health interventions to support self-monitoring and users' sense of control and self-efficacy. Similar approaches may be possible in low-carbon

interventions allowing users to track carbon footprints across different domains of consumption and activity.

f) Targeting of lifestyle interventions towards families and/or young people in social settings helps embed healthy practices and awareness at early stages, as well as the social reinforcement supportive of enduring lifestyle change. Similar approaches are possible for low-carbon lifestyle interventions.

g) Although public health interventions tend to focus on specific at-risk population segments, policies to promote healthy lifestyles clearly recognise the importance of available infrastructure (e.g., access to exercise facilities) and economic incentives and information (e.g., advertising of unhealthy products, relative pricing of healthy and unhealthy alternatives). Low-carbon lifestyle change interventions need to take a similarly comprehensive approach, combining multiple strategies tailored to specific circumstances. What are recognised as 'lifestyle-change interventions' in climate policy explicitly exclude economic measures such as carbon taxes, and tend to focus more narrowly on normative and educational approaches to shape cognitions.

h) Standardised scales for measuring voluntary simplicity in marketing date back to the 1980s, yet now correspond with a renewed interest in 'sufficiency' within sustainable consumption research.

5.6 What have we learnt from this synthesis of lifestyles research for advancing the analysis and modelling of low-carbon lifestyles?

This report synthesised insights from conceptual and empirical studies of lifestyle in public health, marketing, and low-carbon research. Only a few modelling studies were included within the sample of 82 studies reviewed and annotated (summarised in Box 3). This concluding section sets out some initial ideas for developing this research field based on the body of lifestyles research reviewed.

Box 3. Snapshot of the current state-of-the-art with global scenarios and modelling of low-carbon lifestyles.

Low-carbon lifestyles are incorporated into global modelling analysis of climate mitigation through scenario narratives which are mapped into changes in energy demand or changes in certain activities in mobility, housing, or food (112).

Scenario narratives describe major shifts in the longer-term lifestyle landscape including changes in normative values (from individualism to collectivism) (97), increasing consumer dependence on the digital economy (43, 97), increasing urbanisation and virtualisation of society (43), or widespread 'green' values motivating low-carbon lifestyle change (112).

One current research challenge is if and how to shift implementation approaches from exogenous representation of lifestyle change in scenario narratives to endogenous generation of lifestyle change dynamics within models (46). Another research challenge is to develop generalisable frameworks for identifying archetypal lifestyle groups which can be consistently implemented in global models.

a) Lifestyle change in global modelling to-date has been implemented as a fairly arbitrary set of behavioural changes (within an existing technological and infrastructural context) motivated by normative awareness of climate change described in scenario narratives. More robust scenario narratives should recognise lifestyle heterogeneity (within and between countries), as well as inconsistencies between intentions and actions.

b) Lifestyle concepts describe sets of behaviours and cognitions across multiple domains in which contextual factors vary. However a highly granular representation of lifestyles is neither possible nor desirable in global models. A small number of lifestyle archetypes or generalisable groups are necessary to ensure modelling is tractable. Historical data on consumption activity which tracks both change over time and differences between countries would help inform future-oriented implementations of lifestyle concepts.

c) Market research companies have established approaches for measuring lifestyle groups at national and cross-national scales. For example, the Sinus-Milieu approach distinguishes lifestyle groups along two dimensions (social status and degree of modernisation) to identify 10 lifestyle groups. Their latest database has 300,000 quantitative responses from people all over the world. Although powerful, and at a consistent scale to inform global modelling, access to market research methods and data is proprietary (and so costly). Some groups (e.g., the MUSE model led by Adam Hawkes at Imperial College, London) have integrated Sinus-Milieu classifications into their modelling.
d) Market research companies have 'catchy' classifications for distinguishing lifestyle groups. As an example, Rope-Consumer-Styles distinguishes dreamers, adventurers, open-minded, homebodies, rational-realists, organics, settled, and demanding. These describe lifestyle aspirations and values which would fit well with scenario narratives. As a contrasting example, MOSAIC distinguishes city prosperity, country living, rural reality, senior security, suburban stability, domestic success, aspiring homemakers, among other lifestyle groups. These describe basic sociodemographic and contextual lifestyles which would fit well with endogenous model representations.
e) Frameworks which distinguish lifestyle groups based on degrees of innovativeness and receptiveness to social influences (e.g., VALS2) align with theories of diffusion and social learning which have already been tested in global IAMs. Similar approaches to developing a generalisable set of lifestyle archetypes could provide a way to model a wider range of lifestyle interventions, from 'traditional' interventions which act on cognitions, to 'systemic' interventions which act on material infrastructures.

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Appendices

These appendices contain supplementary material to the main report. Full annotated bibliographies of all the lifestyle studies reviewed are also available from the authors on request.

Appendix: Additional Material on Literature Search Protocol.

Overview.
The research aim is to understand how lifestyles are defined and analysed in academic and grey literature. The research method is directed literature review, annotation and synthesis.

Key terms.
'Lifestyles' are coherent patterns of behaviour observable within specific social and material contexts. Lifestyles apply to individuals. Lifestyle groups are evident in populations. A lifestyle group comprises many individuals who share similar lifestyles.

'Low-carbon lifestyles' are constituted by groups of behaviours which reduce, or which try to reduce, CO_2 emissions.

'Analytical frameworks' are variables and relationships organised in a causal structure to guide analysis of a particular phenomenon. An analytical framework for lifestyles sets out the variables which need to be measured in order to explain membership of a lifestyle group or other lifestyle-related phenomena.

Data synthesis.
Data should be extracted from studies by annotation in a consistent and standardised form in a bibliography with defined column headings associated with three main themes:

1. Lifestyle concepts & analytical frameworks.
    - Aim: identify key concepts, frameworks and approaches for analysing lifestyles.
    - Scope: peer-reviewed and grey literature which (i) conceptualises what lifestyles are or what lifestyle change is, (ii) develops or proposes analytical frameworks for identifying or measuring lifestyles.
    - Method: selective identification of literature using convenience sampling
    - Data: record in annotated bibliography + add citations to EndNote

2. Low-carbon or pro-environmental lifestyles.
    - Aim: synthesise methods and findings on low-carbon lifestyles.
    - Scope: peer-reviewed literature which analyses quantitative data on low-carbon or pro-environmental lifestyles.
    - Method: systematic review of literature following standard protocols:
    - *database* = Web of Science
    - *search terms* = ("lifestyle") AND ("low carbon" OR "environmental" OR "climate friendly" OR "sustainable" OR "green")
    - *screening criteria* = title or abstract has to be about lifestyles or lifestyle change relevant to climate change or emission reductions
    - Data: record in annotated bibliography + add citations to EndNote

3. Global or national lifestyle groups.
    - Aim: identify type and prevalence of lifestyle groups globally

- Scope: national social survey or other statistical data, and market research or consumer behaviour studies, which characterise lifestyle groups, clusters or segments at the population level.
- Method: selective identification of literature using convenience sampling
- Data: record in annotated bibliography + add citations to EndNote

Any given study may have data relevant to more than one research stream. All studies are eligible regardless of geography. Particularly in theme 3, representative studies from each major world region should be identified if possible (Europe, North America, Latin America, Asia, Africa).

Outputs.
Targeted outputs are:

(1) Comprehensive annotated bibliography on low-carbon lifestyles.
(2) Summary report of method and main findings (as a working paper and project report). This will form the basis of a subsequent journal article, based around the systematic review.

Appendix: Additional Material on Literature Sample Characteristics.

Table 6. Number of studies reviewed and annotated.

Total number of studies	82
Themes	
Lifestyle concepts, elements of lifestyle, and lifestyle change	75
Analytical frameworks for measuring lifestyle	62
Identification of global or national lifestyle groups	31
Research fields	
Public health	18
Marketing & consumer behaviour	10
Pro-environmental & low-carbon	54
Other (inc. transport, leisure & tourism, housing, finance, energy investment)	5
Lifestyle domains	
Health	22
Food	36
Consumer goods	32
Transport	26
Homes	12
Energy	27
Other domains	
Wellbeing	16
Social justice	15
Technology	15
Leisure & tourism	13

Table 7. World regions or countries covered by the studies reviewed. (Note: studies can cover more than one region or country).

Region/country	Country	n studies
Canada		5
USA		10
Mexico		2
Central America	Bahamas, Barbados, Bermuda, Belize, Virgin Islands, Cayman Islands, Costa Rica, Dominica, Dominican Republic, El Salvador, Grenada, Guadeloupe, Guatemala, Haiti, Honduras, Jamaica, Martinique, Montserrat, Aruba, Netherlands Antilles, Nicaragua, Panama, Puerto Rica, St Kitts and Nevis, Anguilla, St Lucia, St Vincent and the Grenadines, Trinidad and Tobago, Turks and Caicos Island, Virgin Islands	2
Brazil		3
Rest of South America	Argentina 1, Bolivia, Chile 1, Colombia, Ecuador 1, Falkland Islands, French Guyana, Guyana, Paraguay, Peru, Suriname, Uruguay, Venezuela	3
Northern Africa	Algeria, Libya, Morocco, Western Sahara, Tunisia, Egypt, Arab Republic	0
Western Africa	Cameroon, Cape Verde, Central African Republic, Chad, Congo Rep, Congo Dem Rep, Benin, Equatorial Guinea, Gabon, Gambia, Ghana, Guinea, Côte d'Ivoire, Liberia, Mali, Mauritania, Niger, Nigeria, Guinea-Bissau, St Helena, Sao Tome and Principe, Senegal, Sierra Leone, Togo, Burkina Faso	2
Eastern Africa	Burundi, Comoros, Ethiopia, Eritrea, Djibouti, Kenya, Madagascar, Mauritius, Reunion, Rwanda, Seychelles, Somalia, Sudan, Uganda	1
South Africa		1
Western Europe	Andorra, Austria 3, Belgium 1, Denmark 4, Faeroe Islands 0, Finland 4, France 7, Germany 10, Gibraltar, Greece 1, Vatican City, Iceland, Ireland 1, Italy 10, Liechtenstein 0, Luxembourg, Malta, Monaco, Netherlands 6, Norway 1, Portugal, San Marino, Spain 7, Sweden 3, Switzerland 1, UK 21,	80
Central Europe	Albania 0, Bosnia and Herzegovina 2, Bulgaria 1, Croatia 2, Cyprus, Czech Republic 2, Baltic States 1 (Estonia, Latvia, Lithuania), Hungary 4, Poland 4, Romania 3, Slovak Republic, Slovenia 2, Macedonia, FYR, Serbia 3, Montenegro	24
Turkey		2
Ukraine Region	Belarus, Moldova, Ukraine	0
Central Asia	Kazakhstan, Kyrgyz Republic, Tajikistan, Turkmenistan, Uzbekistan	1
Russia Region	Azerbaijan, Armenia, Georgia, Russian Federation	2
Middle East	Israel 2, Iraq 1, Iran 1, Rest of Middle East (Bahrain, Islamic Rep, Israel, Jordan, Kuwait, Lebanon, Oman, Qatar, Saudi Arabia, Syrian Arab Rep, United Arab Emirates, Yemen Rep) 1	5
India		5
Korea region	Korea Dem Rep, Korea Rep	0
Japan		3
China Region	China, Taiwan, Hong Kong China, Macao China, Mongolia	6

South-eastern Asia	Brunei, Myanmar, Cambodia, Lao PDR, Malaysia, Philippines, Singapore, Vietnam, Thailand	4
Indonesia region	Indonesia , Papua New Guinea, East Timor	2
Oceania	American Samoa, Australia, Solomon Islands, Cook Isles, Fiji, French Polynesia, Kiribati, Nauru, New Caledonia, Vanuatu, New Zealand, Niue, Northern Mariana Islands, Micronesia Fed States, Marshall Islands, Palau, Pitcairn, Tokelau, Tonga, Tuvalu, Wallis and Futuna Island, Samoa	2
Rest of South Asia	Afghanistan, Bangladesh, Bhutan, Sri Lanka, Maldives, Nepal, Pakistan,	0
Rest of Southern Africa	Angola, Botswana, Lesotho, Malawi, Mozambique, Namibia, Zimbabwe, Swaziland, Tanzania, Zambia,	0

Appendix: Additional Material for Section 2 on Public Health

The following tables summarise relevant information from the annotated bibliographies from each of the studies reviewed. The full annotated bibliographies are also available from the authors on request.

Table 8. Lifestyle elements in public health studies. Note: studies reviewed consider healthy lifestyles, unhealthy lifestyles, and promoting lifestyle change.

Study	**Behaviours / practices / modifiable risk factors**	**Cognitions**	**Contexts**
Aliberti et al. 2019 Healthy lifestyle	None	Positive perceptions of change, purpose in life, feeling at peace with oneself, attitude to resilience, arrogance, social relationships	None
Andjelkovic et al. 2018 Healthy lifestyle	Avoid smoking, consume healthy diet prescribed for hypertension (limited salt diet, calorie limitation), physical activity (30+ mins daily.	Knowledge & belief about hypertension, perceived responsibility.	sociodemographic factors
Atzendorf et al. 2018 Patterns of lifestyle risk factors	smoking, alcohol consumption, diet, physical activity, pharmaceuticals use	Relationships and social networks are purported to be potential moderators / mediators of lifestyle risk factors.	sociodemographic conditions
Bodai et al. 2017 Lifestyle medicine	diet (type and calories), activity/exercise, smoking, alcohol consumption	Stress management, membership of a support group, social connections, emotional resilience, mindfulness.	None
Dernini et al. 2017 Mediterranean diet as a healthy & sustainable lifestyle model	Diet, production food, traditional / local crafts and activities.	social connectedness, community feeling, respect for diversity	social culture heritage and traditions
Faiola et al. 2019 Lifestyle change: Sustaining healthy lifestyle	lifestyle behaviours are the outward observable actions of cognitive processes	key goals, motivation, knowledge	Contextual factors or environment) that affect choices, social context of resources. Wide ranging and include available technologies and tools, infrastructure, policies, resource availability, community groups, living arrangements, family roles & responsibilities, culture, social norms, physical environment (e.g., temperature, air quality) and social environment.
Foster et al. 2018 Unhealthy lifestyle	diet, smoking status, alcohol intake, physical activity, TV viewing, sleep duration	psychosocial stress	Social deprivation, viewed as an effect modifier; access to health services.

Graham & White 2016 Lifestyle as a 'bridging' concept between the fields of public health & environmental sustainability	Physical inactivity, unhealthy diets, smoking, harmful intake of alcohol. Consumption practices protective of the environment e.g. buying recycled paper products, recycling household rubbish.	None	Working conditions, social, demographic, economic factors. E.g., social disadvantage associated with poorer diets/ greater physical inactivity.
Gray et al. 2019 Precision Medicine in Lifestyle Medicine	Non-smoker, physically active, healthy BMI, diet rich in fruit and veg / low in processed foods / red meat.	motivation to change	stimulus from the environment, social support
Jamal et al. 2016 Lifestyle change	Diet and nutrition, physical exercise.	process that include self-efficacy, thoughts, social pressure/relationship, motivation, comfort, support from friends/family	Socio-demographic factors including age, income, education; medical history.
Kuan et al. 2019 HPLP: Health Promoting Lifestyle Profile	'self-initiated actions': diet, activity / exercise, interpersonal relations	Health promoting 'perceptions': developing inner resources, wellbeing, stress management, self-actualisation	None
Loef & Walach 2012 Healthy lifestyle	smoking, alcohol consumption, physical inactivity, unhealthy diet, and obesity	None	Age, medical history, education, occupation, social class, marital status (viewed as confounders)
Lourida et al. 2019 Healthy lifestyle	physical exercise, non-smoking, healthy diet, moderate alcohol consumption	depression	socio-demographic variables
Middleton et al. 2013 Lifestyle change	Maintaining a healthy weight through diet and physical exercise.	psychological factors such as stress influence motivation to set aside time for exercise, negativity resulting from small lapses in program adherence	Factors related to the environment, society and culture can influence adherence to lifestyle change. These include, access to exercise facilities, overabundance of cheap unhealthy foods, sedentary jobs.
Minich & Bland 2013 Personalised lifestyle medicine	Smoking cessation, intake of nutrients / calories, regular physical activity.	Stress management / ability to modulate the response to stressors.	Environmental exposure to toxins, demographic status.
Office for National Statistics 2017 Healthy lifestyle	diet, physical activity / inactivity, alcohol consumption, smoking status	Lifestyles are shaped by values and beliefs, but no indicators considered.	Socioeconomic conditions influence health status, viewed as a context to the variability in lifestyle.
Pícha & Navrátil 2019 Sustainable healthy lifestyle	Purchasing preferences: e.g., environmentally friendly products, companies whose values are like mine.	Attitudes - e.g., physical health, protecting the environment, sustainable agricultural practices, renewable energy, social	None

		consciousness, women's issues.	
Quam et al. 2017 Sustainable healthy lifestyle	Biking, walking (replacing vehicular transport), reducing consumption of red meat / animal products	perceived risk e.g., of injury from cycling	Variation in culture, nutritional and health status, geographic density of individual communities, cost of lifestyle choices (e.g., changing diet), social norms - such as cycling in the Netherlands compared to the US.

Table 9. Applications of lifestyle concepts and elements in public health studies.

Study	Outcome of interest	Relevant aspects of lifestyle	Findings
Aliberti et al. (2019)	Academic progress (not on track, 'blocked') among undergraduates	Attitudes: Changing in a positive way, Purpose in life, Pleased and at peace with oneself, looking for new challenges.	Students who were not on track with academic performance had better health and lifestyle than on-track students. Low self-esteem was thought to be the cause.
Andjelkovic et al. (2018)	Patient management of hypertension through adherence to healthy lifestyle	Constructive attitude. Education/knowledge Strong patient-physician relationship	Lifestyle behaviour modification (particularly through physician counselling) led to better blood pressure control.
Atzendorf, et al. (2018)	Mental health	Low physical activity, smoking, unhealthy diet, age, gender and marital status (younger single men), substance abuse, lower education.	'Cumulative risk factors lifestyle' - more likely to report agoraphobia. 'Drinking lifestyle' - likely to report symptoms of depression. 'Smoking lifestyle' - more likely to report depression, PTSD or specific phobia.
Bodai et al. (2017)	Chronic conditions such as cardiovascular disease and type 2 diabetes.	Healthy living, active living, healthy weight, emotional resilience.	There is growing evidence that interventions (preventative lifestyle medicine) that promote specific changes in lifestyle can avert poor health outcomes.
Faiola et al. 2019	Managing chronic disease and mental health.	Key goals/desire, motivation, knowledge, healthy behaviours, access to resources, community, physical and social environment	Patients can be empowered to adopt and sustain healthy lifestyle choices through the use of health technologies combined with patient-provided collaboration.
Foster et al. (2018)	all-cause mortality and cardiovascular disease mortality and incidence	Unweighted lifestyle category based on diet, exercise, smoking, alcohol, sleep, TV viewing	Greatest risk of poor health outcome for the least healthy category, the harm is disproportionate in deprived populations.
Graham & White. (2016)	Chronic disease and environmental change	Social determinants and lifestyle factors (mobility and diet)	Shared evidence-base; high-consumption lifestyles have damaging (direct/indirect) impacts for health and environment
Jamal et al. (2016)	Clinically overweight / obese	Effectiveness of group-based lifestyle intervention compared to dietary counselling.	Group-based lifestyle intervention programme was more effective in sustaining weight loss, and improving quality of life, social connectedness, over 36-week period
Kuan et al. (2019)	Validation of the Health Promoting Lifestyle Profile (HPLP II) for Malaysia	6 domains: health responsibility, physical activity, nutrition, spiritual growth, interpersonal relations, stress management.	Six components of health-promoting behaviour outcomes provided a good fit, only 2 of the original 52 lifestyle items were not valid/reliable for Malay sample.
Loef & Walach (2012)	All-cause mortality.	five lifestyle factors (obesity, alcohol consumption, smoking, diet, and physical activity)	Systematic review and meta-analysis: relative risks decreased proportionate to a higher number of healthy lifestyle factors, 66% reduction for combination of at least 4 healthy lifestyle factors, a degree

			of healthy lifestyle might be more relevant.
Lourida, et al. (2019)	Incident all-cause dementia	Healthy lifestyle (3 categories) weighted by socio-demographic variables. Scored for: non-smoker, regular physical activity, healthy diet, and moderate alcohol consumption	Unfavourable lifestyle (lowest class) was associated with higher dementia risk. For participants with high genetic risk, those with a favourable lifestyle were associated with a lower dementia risk than those with an unfavourable lifestyle.
Middleton et al. (2013)	Initiating and maintaining healthy lifestyle (focus: weight loss)	Healthy diet, physical exercise, motivation, self-efficacy, stress influences, negativity	Lifestyle change is often compromised by nonadherence. Combinations of strategies for adherence are recommended around a 4-construct framework: knowledge, self-efficacy beliefs, self-regulatory skills, skills training to overcome barriers.
ONS (2017)	Healthy Life Expectancy (HLE)	diet, physical activity, alcohol consumption, smoking status, socio-economic conditions	Lowest HLE cluster had fewer economically active, more long-term sickness / disability, more physical/mental health conditions, lower score for lifestyle behaviours compared to the highest HLE cluster.
Pícha & Navrátil (2019)	Pro-environmental consumption	Lifestyle of Health And Sustainability (LOHAS):	LOHAS consumers – socially responsible consumption, preference for local / fair trade products
Quam et al. (2017)	Greenhouse gas emissions and health co-benefits	Active transport, reduced consumption of animal products, physical / social environment.	Review of relevant literature. Lifestyle behaviours not consistently measured between different perspectives (health, low-carbon). Effect of lifestyle varied greatly and precluded meta-analysis.

Table 10. Data used in public health studies of lifestyle.

Reference	n	Country	Year(s)	Data type
Aliberti et al. 2019	519 students	University of Salerno, Italy	2014-2015	self-administered questionnaire
Andjelkovic et al. 2018	362 hypertension patients	Kragujevac, Serbia	2015	structured questionnaire
Atzendorf et al. 2018	9204 adults	Germany	2015	Epidemiological Survey of Substance Abuse
Dernini et al. 2017	n/a	international	Manuscript submitted 2016	Narrative review of peer-reviewed publications
Foster et al. 2018	328,594 aged 40-69y	Great Britain (22 assessment centres)	2006-2010 Follow up: Until 2017	UK Biobank; prospective population-based cohort study
Jamal et al. 2016	194 overweight university employees	Kuala Lumpur, Malaysia	2011-2013.	Clinical observations; questionnaires, food diary
Kuan et al. 2019	997 undergraduates	Universiti Sains Malaysia	2016-2017	self-administered questionnaire
Loef & Walach 2012	15 studies	International (European / N American bias)	Start date: 2012	Systematic review and meta-analysis of lifestyle risk factors Outcome: all-cause mortality
Lourida et al. 2019	196,383 older adults	Great Britain (22 assessment centres)	2006-2010 Follow up: Until 2017	UK Biobank; Retrospective cohort study. Lifestyle risk factors Outcome: dementia incidence
Office for National Statistics 2017	14 UTLAs (Upper Tier Local Authorities)	England, UK	2013-2015 1982-2011	ONS, Public Health Outcomes Framework data tool (PHE); ONS longitudinal study
Pícha & Navrátil 2019	483 shopping centre customers	Czech Republic	Manuscript received 2018	face-to-face questionnaire Lifestyle of Health and Sustainability (LOHAS) Market segmentation
Quam et al. 2017	32 articles	International	Manuscript received 2017	Structured review; Sustainable healthy lifestyle

<u>Case-study analysis in public health studies of lifestyle.</u>

Case-study assessments from a behavioural perspective commonly consider a core set of risk factors as independent variables for a specific health outcome such as all-cause mortality, dementia and cardiovascular disease. The set of lifestyle behaviours generally considered relevant are physical exercise, diet, smoking status and alcohol consumption. However, a systematic review of lifestyle behaviours and all-cause mortality (Loef & Walach 2012) found heterogeneities in the numbers and combinations of lifestyle factors, and no consensus on the level of physical activity or dietary intake considered healthy.

The Health Promoting Lifestyle Profile (Walker & Hill-Polerecky 1996) comprises six dimensions: spiritual growth (inner resources), interpersonal relations, nutrition, physical

activity, health responsibility, and stress management measured using a 52-item questionnaire. The blending of behaviours (physical activity and nutrition) and psychological constructs (such as a sense of purpose, belonging, and accountability for one's own wellbeing, and stress management) is illustrative of the reflexive perspective on lifestyles. The HPLP instrument has been validated across different cultural and linguistic populations, for example in the Malaysian context using confirmatory factor analysis (Kuan et al. 2016).

Aliberti et al (2019) considered the relationship between healthy lifestyle and academic performance among students in Italy. They utilised a narrow subset of four HPLP items related to wellbeing (e.g., purpose in life, and at peace with oneself), and separate questionnaires relating to quality of life and attitudes to eating. An emphasis on psychometric measures to understand the role of lifestyle in wellbeing and academic performance constitutes an example of a more cognitive perspective.

The 'LOHAS' Lifestyle of Health And Sustainability is characterised by a concern for the environment, sustainable practices, human rights, and fair trade, alongside personal development and health. The integrating framework spans several fields of research and consists of five key factors, sustainable economy, healthy lifestyles, personal development, alternative healthcare, and ecological lifestyles. The LOHAS framework was developed and validated in western societies but has also found to be applicable to transition economies. For example in the Czech Republic, Pícha & Navrátil (2019) use this framework to identify three lifestyle clusters differentiated by level of interest in LOHAS. Similar levels of interest, particularly in ecological, healthy and sustainable economy lifestyles tend to cluster together. Although levels of health consciousness and sustainable consumption are generally lower in transition economies, this clustering of attitudes to health and environment suggest a potential for promoting the mutual benefits of LOHAS.

Table 11. Examples of case-study assessments in public health.

Study	Key findings
(Markvica et al. 2020)	In a case study of activity mobility in Austria, homogenous target groups (social milieu) were identified through a social science methods that group similar attitudes (e.g., to work, leisure, social relationships and modes of transport), mobility habits, shared norms and fundamental values. Boundaries to behaviour are viewed to be socio-economic structures such as income, education, residential characteristics.
Barr & Gilg (2006)	A study of actions in and around the home in Devon, UK, identified lifestyle groups on the basis of similar clusters of environmental actions. Heterogeneity was then examined on the basis of environmental attitudes and social values. "Overall, the environmentalist is a highly concerned individual, motivated by a range of issues, who is confident in the outcome of their actions and finds helping the environment relatively simple and socially desirable."
Etminani-Ghasrodashti et al. (2018)	Clusters of leisure activity were identified and then associated with attitudes, preferences and attributes of the built environment. This is an example of an analytical application in the transport and mobility domain in which lifestyle is used as an explanatory variable for recreational cycling (active mobility). It is also illustrative of studies that identify lifestyle homogeneity on the basis of behaviour, and subsequently heterogeneity on the basis of value, attitudes and contextual factors.
Barr et al (2011)	Sustainable lifestyles varied across sites of practice (e.g., home, holiday locations) expressed in habit discontinuity. They argue for a spatially extended conceptualisation that accounts for multiple lifestyle settings.

Table 12. Case-study assessments, distinguished by patterned, cognitive and reflexive perspectives on lifestyle.

Lifestyle perspective	**Lifestyle elements / dimensions**	**Lifestyle groups**	**Study scale**
Patterned Behaviours	Physical exercise Diet and nutrition (including body mass index) Smoking status Alcohol consumption Sleep	Lifestyle elements or risk factors tend to be used to predict a specific health outcome. There are heterogeneities in the number and combinations of lifestyles used and whether there is socio-economic adjustment.	Sample size is typically less than 1000 participants. There tends to be a European / North American bias.
Cognitive / reflexive	Illustrated by the Health Promoting Lifestyle Profile (HPLP): Physical activity Diet and nutrition Health responsibility Spiritual growth Interpersonal relations Stress management	HPLP items tend to be used as independent variables, and not for further classification into lifestyle groups. Some case-studies focus on cognitive HPLP items.	Sample size is typically less than 1000 participants.
Reflexive	Clinical (e.g., body mass index, blood pressure, cholesterol) Physical activity Diet and nutrition Psychological measures (e.g., self-efficacy, emotions, stress, quality of life)	Case studies do not generally consider lifestyle heterogeneities	Sample size tends to be smaller
Integrative	Five factors of the 'LOHAS' Lifestyle of Health And Sustainability. 1. Sustainable economy 2. Healthy lifestyles 3. Personal development 4. Alternative health care 5. Ecological lifestyles	Illustrative example of LOHAS segments identified (Pícha & Navrátil (2019): 1. Interested (43%) 2. Partially interested (23%) 3. Not-interested (35%)	Example sample: 483 shoppers, Czech Republic

Table 13. Lifestyle groups identified case-study assessments in public health.

Study	**Lifestyle elements / relative importance**	**Different lifestyle groups (prevalence %)**	**Study scale (**
Aliberti et al. (2019)	HPLP II items: 1. Changing in a positive way: 55% 2. Purpose in life: 70% 3. Pleased and at peace with oneself: 36% 4. looking for new challenges: 53%	No further grouping. 4 HPLP items were used as independent variables.	University of Salerno, Italy (n=519)
Andjelkovic et al. (2018)	Lifestyle variables (%): 1. Exercise 30+ min daily. Yes 35.6% 2. Smoke 23.4%, used to smoke 32.6%, never 44% 3. Special diet: Yes 39.5%, sometimes 15.2%, no 45.3% 4. Level of adherence to healthy lifestyle: High 34.8%, Low 65.2%	No further lifestyle analysis (categorisation)	Kragujevac, Serbia (n=362 hypertension patients)
Jamal et al. (2016)	Clinical measures (e.g., BMI, blood pressure, cholesterol), Dietary intake physical activities, psychological measures (e.g. eating self-efficacy, emotions, social pressure, quality of Life.	No further categorisation. Study assessed change in lifestyle items after intervention.	Kuala Lumpur, Malaysia (n= 94 overweight/obese university employees)
Kuan et al. (2019)	HPLP II questionnaire (52 items): Six domains: 1. health responsibility (9 items) 2. physical activity (8 items) 3. nutrition (9 items) 4. spiritual growth (9 items) 5. interpersonal relations (9 items) 6. stress management (8 items)	No further categorisation.	Universiti Sains Malaysia, Kelantan, Malaysia (n= 997 undergraduates)
Loef & Walach (2012)	smoking status, physically activity, BMI (Body Mass Index), diet, alcohol consumption, sleep (hours per day)	Heterogeneities in the numbers and combinations of lifestyle factors, and whether socio-economic adjustment is made. No consensus on definition of healthy lifestyle with respect to exercise / diet. The degree of healthy lifestyle might be more important than presence/absence.	Systematic review of 22 studies European and North American bias 15 studies included in meta-analysis
Pícha & Navrátil (2019)	5 factors (3 items for each) in 'LOHAS' Lifestyle of Health And Sustainability. 1. Sustainable economy 2. Healthy lifestyles 3. Personal development 4. Alternative health care 5. Ecological lifestyles	Three segments identified: 1. Interested LOHAS (43%): more females. 2. Partially interested LOHAS (23%): more people aged >36 years. 3. Not-interested LOHAS (35%):	Shopping centres, Czech Republic n= 483

National-level studies of lifestyle in public health.

Associations between health and lifestyle have also been assessed using nationally representative data. National studies that adopt a behavioural lifestyle approach use similar sets of behaviours to those at case-study level, although some studies (e.g., Foster et al. 2018) have extended these constructs to include sleep and TV viewing time. Individual items are scored on a binary system, with the total score across all items used to categorise participants into lifestyle groups.

Some studies use contextual factors as part of the identification of lifestyle groups (e.g., Lourida et al 2019). Other studies assess the contextual influence independently. In Germany, Atzendorf et al. (2018) found that patterns of multiple risk factors were associated with socio-demographic factors, e.g., smoking lifestyle was associated with a lower education and more likely to be divorced or single. In the UK, Foster et al (2018) found that unhealthy lifestyles were associated with disproportionate harm in areas of socio-economic deprivation. The inequalities in lifestyle-related risk for levels of deprivation are consistent with previous studies in the USA (Pampel & Rogers 2004) and Canada (Birch et al. 2000).

Table 14. Examples of national and cross-national studies of lifestyle in public health.

Study	**Key findings**
Axsen et al. (2015; 2016)	A survey of households in Canada identified lifestyles on the basis of two different dimensions: technological orientation and environmental orientation. Their construction of lifestyles had a specific application, to investigate differences in the motivations and purchase behaviour for plug in electric vehicles (PEVs). Lifestyles guide behaviour (PEV preferences and purchases) through differing motivations that represent characteristics of self-identify.
Vita et al. (2020)	This study differentiated lifestyles on the basis of membership or non-membership of a sustainability group, then assessed the role of contextual influences on lifestyle choices in. Lifestyle groups were adjusted for socio-economic and country effects in four regions of Germany, Italy, Spain and Romania. Although overall carbon footprints were lower for the membership group, this was not reflected in all lifestyle domains. For food and clothing domains the significantly lower carbon footprints for members were thought to reflect a wider level of choice. For transport and home energy domains, there were differences between the groups for some individual behaviours but no significant differences for domain-specific carbon footprints. Contextual factors (such as demography, household characteristics, and structural constraints) better explained domain-specific variability. Membership provided enhanced wellbeing (self-satisfaction), highlighting the role of social context in fostering environmental attitudes, behaviours and habits. The membership lifestyle group characteristics of higher wellbeing and reduced consumption supports a voluntary simplicity ideology, a pattern that generally held across the four European countries.

Table 15. Lifestyle groups identified in national-level studies in public health.

Study	**Lifestyle factors**	**Lifestyle groups (prevalence %)**	**Location and sample size**
Atzendorf et al. (2018)	Binary variables: Smoking, alcohol - episodic heavy drinking, nutrition index (based on 6 food items), physical activity (<30 min per day on 5 days p/w), substance abuse.	1. 'Healthy Lifestyle' (58.5%). 2. 'Risky drinking lifestyle' (24.4%). 3.'Smoking lifestyle' (15.4%) 4.'Cumulate risk factors lifestyle' (1.7%)	Germany n=9204 (18-64y)
Foster et al. (2018)	9 lifestyle items; current smoker, alcohol consumed daily or almost daily; < recommended physical activity, ≥4 h daily TV viewing time, <7 h or >9 h of sleep per day, <400 g of fruits and vegetables per day, <1 portion of oily fish p/w, >3 portions of red meat p/w; >1 portion processed meat p/w	Unweighted total score, 3 categories: 1. Healthy lifestyle (43%); scored 0-2 2. Moderately healthy lifestyle (52.8%); scored 3-5, 3. Unhealthy lifestyle (4.2%); sored 6-9	UK Biobank (22 centres) n= 328,594 (40-69y)
Lourida et al. (2019)	Established dementia factors: 1. Smoking status 2. Recommended level of physical activity. 3. Diet (recommended consumption of food groups) 4. Moderate alcohol consumption.	Scores were weighted by socio-demographic factors. 1. Favourable: 3-4 healthy lifestyle factors (68%) 2. Intermediate: 2 healthy lifestyle factors (24%) 3. Unfavourable: 0-1 healthy lifestyle factors (8%)	UK Biobank (22 centres) n= 196,383 (60+y; mean age 64y)

Table 16. Summary of lifestyle-change intervention strategies in public health.

Initiation (causes /processes)	**Intervention strategies (short term)**	**Barriers**	**Lessons learnt for maintaining lifestyle change in the longer term:**
<u>Constructs for initiating lifestyle change:</u> -Knowledge: appreciating the risk of behaviours, providing relevant information. -Beliefs: self-efficacy and constructive beliefs. -Motivation: use of motivational interviews for initiating change. -Timing: take advantage of 'teaching moments' for counselling. -Target setting: identify personal lifestyle (short-term and achievable) goals. -Start with activities that are within individual capabilities. -Adjust for individual circumstances. -Invitation to join lifestyle management program. -Use of instruments such as the Health promoting lifestyle profile (HPLP) to measure the effectiveness of interventions.	<u>Types of approach:</u> -Counselling for specific lifestyle behaviours. -Group intervention programmes - provides support, social connectedness, group discussion of problem solving strategies, and feedback. -Experimental intensive lifestyle intervention programs. -Practice of lifestyle medicine: lifestyle recommendations are personalised for genetic variants and biomarkers. -Technological tools, e.g., apps to inform – coach empower through shared information and patient-generated data allowing self-monitoring. <u>Strategies:</u> -Inform: Education of patients and health care workers – understanding the benefits of lifestyle change. -Coach: -Stress management, cognitive behaviour sessions, specific skills training, e.g., for handling situational cues for unhealthy activities and setbacks. -Empower: through self-management and developing inner resources. -Strengthening patient-physician relationships.	<u>Cognitive barriers:</u> -Lack of appreciation about the benefits of lifestyle change -Low self-esteem, efficacy, motivation. -Perceived stress. -Complacency. -Negativity e.g., from-minor lapses. <u>Contextual barriers</u> -Overabundance of accessible and inexpensive unhealthy foods. -Over exposure to advertising of unhealthy food. -Normalisation of unhealthy lifestyle. -Lack of access to exercise facilities. -Sedentary job. -Lack of access to counselling / support. -Health illiteracy. -Health care practitioners have insufficient time to address issues; intervention programs are not high priority. -Cultural/ethnic influences may undermine or restrict lifestyle choices.	<u>Cognitive strategies:</u> -Resilience emerges from the ability to overcome difficult situations / obstacles. -Enhancing self-regulatory skills. <u>Contextual strategies:</u> -Extended /ongoing care, collaboration between patient and health care team. -Widening the support network: Improving community support through friends and family, group-based programs, buddy systems. -Promote healthy lifestyle as the social norm. -Regulations e.g., to improve access to exercise, healthy and affordable food. -Polices to address social inequalities and deprivation, provision of supportive infrastructure for lifestyle change. -Evidence that multi-component intervention program / strategies are more effective than single strategy approaches in the long term. -Comprehensive approach to lifestyle management covering individualised lifestyle behaviour recommendations accompanied by cognitive strategies that consider individual and wider community contexts.

Table 17. Studies of lifestyle change in public health.

Study	Causes /processes of lifestyle change	Intervention strategies	Barriers	Adherence
Aliberti et al. (2019)	'Blocked' students show good health resilience, despite academic difficulties. "The blocked undergraduate students feel happy and at peace with themselves, they look for new challenges and they have a purpose in life."	Resilience emerges from the ability to overcome difficult situations (academic failure) Control tension through cognitive and physical resources.	low self-esteem	Not applicable
Andjelkovic et al. (2018)	Constructive beliefs, and intervention strategies	- Strengthening patient-physician relationships. - Education of physicians / patients on hypertension guidelines.	Rates of physician counselling were low, e.g., 29% for physical exercise). Health illiteracy among the elderly in Siberia.	Lifestyle behaviour modification led to better control. Physician counselling played a significant role in managing lifestyle change
Bodai et al. (2017)	Practice of lifestyle medicine to improve lifestyle choices.	Experimental intensive lifestyle intervention programs: target specific changes to diet and exercise, using a support group or stress management.	Health care practitioners have insufficient understanding of the benefits of lifestyle change, insufficient time to address the issues.	Not applicable
Faiola et al. 2019	Identify an individual's lifestyle goals and implement Healthy Lifestyle Management-targeting to individual context	Target technological tools: shared information, apps, patient-generated data – to inform, coach and empower.	Contextual: sedentary poor diet lifestyles, overabundance of unhealthy food advertising / availability	Collaboration between patient, health care team and wider community to support individuals to maintain lifestyle goals.
Foster et al. (2018)		A wider combination of lifestyle factors can highlight new targets populations	Socio-economic deprivation increases the lifestyle related risk	Policies to reduce deprivation are required in parallel with individual lifestyle interventions
Graham & White. (2016)	Historically industrialisation and urbanisation were the precursors to rapid lifestyle change, and rise in non-communicable diseases and unsustainable development.	Lifestyle as a bridge – beneficial integrating research focus.	Social disadvantage associated with poorer diets/inactivity; higher incomes associated with overconsumption lifestyles	

Gray et al. (2019)	Motivation, correct environmental stimulus, appreciating risk of unhealthy lifestyle, taking advantage of 'teaching moments', start with activities that are within individual capabilities.	Requires an approach that treats people as individuals using personalised lifestyle medicine	Not adjusting for individual differences in ability, motivation. Social environment can support or undermine change, normalisation of unhealthy lifestyle, complacency,	Challenge to make a healthy lifestyle the social norm. Ongoing suitable support through community-based programs, buddy systems, developing psychological skills for handling situational cues for unhealthy activities and setbacks.
Jamal et al. (2016)	Invitation to join group-support lifestyle modification	Multicomponent intervention programme involving: self-monitoring, cognitive-behaviour sessions, counselling for diet/exercise.	Cognitive process such as negative thoughts, low self-efficacy	Group provides support, social connectedness, group discussion of problem solving strategies, feedback
Kuan et al. (2019)		Empowering patients through self-management of health behaviours and developing inner resources		Health promoting lifestyle profile (HPLP) can be used as a tool for measuring the effectiveness of interventions.
Loef & Walach (2012)	Challenge is to establish how to motivate an individual to adopt a healthy lifestyle.	Intervention programs should be made a high priority		
Middleton et al. (2013)	Constructs involved in initiation /maintenance lifestyle change: 1. Knowledge: effect behaviours on health 2. Self-efficacy beliefs 3. Self-regulatory skills 4. Barriers to overcome Motivational interviewing – for initiating change.	Multi-component strategies: provide relevant information, short-term achievable goals, self-monitoring, skills training e.g., in overcoming obstacles	Accessible inexpensive high fat/calorie foods, lack of access to exercise facilities, sedentary job, perceived stress, negativity from minor lapses	Poor adherence to lifestyle change is widespread particularly over the long term. Extended care / improving social support (group intervention, friends & family
Minich & Bland (2013)	Lifestyle prescription for diet, exercise, stress and environment personalised for genetic variants and biomarkers	Comprehensive individualised approach to empower the patient, recommendations for personalised diet and exercise	Standard recommendations may not be sufficient to meet individual needs without accounting for risk factors associated	

		accompanied by stress management	with the environment, genetic variants, epigenetics	
ONS (2017)	Local / national government have a role in promoting healthy lifestyles to address inequalities (local authorities)		public health and employment inequalities, access to services, cultural/ethnic lifestyle influences	Wider community lifestyles influence individual choices
Quam et al. (2017)		Review of studies: less clear on best intervention methods but suggest strategies should be realistic, and it is important to consider the country/community context	Acceptability of taxation of high carbon foods will vary between countries, high perceived risk e.g., of cycling, high cost of lifestyle choices, longer commuting distances	Social norms (e.g., cycling in the Netherlands), supportive infrastructure (for active transport and low carbon food), community engagement

Appendix: Additional Material for Section 3 on Marketing

Table 18. Summary of empirical marketing studies. Notes: AIO = attitudes, interests, opinions; VALs=value and lifestyles; V-L-A=values, lifestyles and aesthetics; ABC=actions, behaviour, context; BCC= behaviour, cognitions, context.

Study & framing	**domain**	**measurement items**	**Survey approach**	**Lifestyle factors**	**Lifestyle clusters (cluster size %)**
Srihadi et al [2016]. AIO	general	•activities (12 items): related to vacations, entertainment, shopping, sports • Interests (12 items): related to home, recreation, food and achievement elements. • Opinions (14 items): related to social issues, education, products, future and culture.	•face to face survey of adult foreign visitors (n=393), location Indonesia, year of data collection: 2013	6 lifestyle factors •culture adventurous •shopaholics •aspiring indulgers •conservatives •sport adventurous •foodies	3 lifestyle clusters •culture interest shopaholic' (17.6%) •sporty culture explorer (15.8%) •aspiring vacationer (21.9%) •want-everything vacationer (44.8%)
Hur et al [2010] AIO	food	•activities (15 items): related to food entertaining •Interests (12 items): related to kitchen appliances •Opinions (19 items): related to environment, family, innovations & trends, price.	•multi-stage age-stratified random sample (n=518) females, location: USA	12 lifestyle factors •activities: 4 lifestyle factors: oriented towards social and dining, health, party, refrigerated food. • Interests: 4 lifestyle factors: size, interest in, cleanness, improvement requirements of appliances. • Opinions: 4 lifestyle factors: environment, family, trends and innovation, price-conscious.	7 lifestyle clusters •well-being oriented" (25%) •social- and dining-oriented" (11%) •family-oriented" (16%) •innovation- and action-oriented •price-conscious" (11%): •convenience-oriented" (17%)

Jain [2019] AIO	leisure and tourism	51 items • activities: e.g., work / leisure activities, shopping habits, memberships • Interests: related to work, family, consumption • Opinions about e.g., self, politics, future, social issues.	•Survey based on convenience sample (n=400), location Delhi and National Capital Region, year of data collection: 2019	12 lifestyle factors •group-oriented ’ •leadership •hygiene •family-oriented •inward-oriented •health-conscious •independent ’ •community-oriented •‘cost-conscious •outwards-oriented •conservative • adventurous	3 lifestyle clusters •nesters' (6%): group-oriented, conservative •opinion leaders' (63%): leadership, hygiene, health-conscious, independent. •collectivists seeking value for money'(31%): community-oriented, cost-conscious
Vyncke [2002] VALS/ V-L-A	general	35 bespoke value statements related to • being respected • wisdom; • joy and pleasure • fun in life; • simple life; • good health • safety Plus statements related to life vision, aesthetic styles, media preferences, product categories and demographics	• quota sample 18-65yrs (n=672), location Belgium	•26 value factors	8 cluster solution identifying 8 different lifestyle typologies •type 1 (12.7%) •type 2 (13.2%) •type 3 (12.2%) •type 4 (12.1%) •type 5 (8.8%) •type 6 (17.6%) •type 7 (9.4%) •type 8 (14.1%)
Kahle 1986 LOV	general	9 value statements, reduced form of Rokeach [1973]	•face to face interview of foreign and national students (n=193)	not identified	5 groups based on value rating •self-respect (17%) •security (10%) •warm relationships 17%) •accomplishment (17%) •self-fulfilment (25%) •belonging (7%)
Nie, C. and Zepeda, L. (2011) ABC	food	18 items • ways of shopping (4 items) • desired attributes (4 items) • cooking practices (2 items): • purchasing context (4 items)	• nationwide food consumer survey (n=956 adults), location: US (national), year of data collection: 2003	no data reduction	4 food related lifestyle clusters) •rational (29%) •adventurous (24%) •careless" (18%) •conservative uninvolved (29%)

Sanquist, T. F. et al. (2012) BCC	energy	17 items • geographic location •household appliances •thermal comfort: •technology •family structure: •electricity consumption	•national household energy survey (USA) n=2690, location USA, year of data collection 2001 - 2005	5 lifestyle factors (not identified)	4 energy related lifestyle clusters •Rural cluster: highest on laundry, lowest on TV and climate factors. •City cluster: high on climate factor, low on AC, laundry and PC factors. •Town cluster: high on laundry, lowest on climate factor.

Appendix: Additional Material for Section 4 on Low-Carbon Lifestyles

Table 19. Studies of low-carbon lifestyles (n=30 studies), organised by approach: general lifestyles (n=7), multi-domain (n=11), domain-specific (n=9), context specific (n=3).

Study	Generalised or domain-specific lifestyle	Approach and lifestyle elements	Application of lifestyle concepts	Geographic scale
Valeri et al. 2016	Generalised lifestyle	Cognitive (Behaviour, habits, awareness, intention, education, income.	Instrumental (to assess preferences for environmental policy instruments.	National (Italy),
Binder & Blankenberg 2017	General lifestyle	Reflective (environmental behaviours and wellbeing,)	Descriptive (how subjective self-image/ wellbeing relates to behaviour)	National (UK) Household level
Tudor et al. 2016	General lifestyle Context specific: Transition economy	Cognitive (Attitudes e.g., to time, information awareness, beliefs, e.g., social justice.	Analytical (relating perception constructed lifestyles to sustainable household practices)	Local: City-scale (Chennai, India)
Hagbert & Bradley 2017	General lifestyle – 'sustainable living beyond eco-efficiency''	Reflective (diversified perspective: perceptions, practices, motives	Descriptive Narrative themes of home-front transitioners – aspects of agency	Local: Single location (7 households), Sweden
Axon 2017	Generalised – sustainable lifestyle	Cognitive (knowledge, values, perceptions, motivation, practices, context)	Instrumental (thematic analysis approach to identify enablers / barriers to change)	National (7 UK communities)
Marchand & Walker 200	Generalised – simplifier lifestyles	Cognitive (values, awareness, attitudes, perceptions)	Descriptive (simplifier lifestyles differ by perceived benefits – product development)	Local: Case-study (location not reported, UK or Canada likely)
Howell 2013	General low-carbon lifestyle	Cognitive (motivations e.g., social justice, community, values e.g., altruism)	Analytical (values and motivations associated with low-carbon lifestyles)	Local case studies (2) (Scotland, England)
Barr & Gilg 2006	Multi-domain (Energy, water, waste, 'green' consumption	Patterned (environmental actions around 4 domains)	Descriptive (practices in the home used to segment population into lifestyle groups)	Local: Regional (Devon)
Le Gallic et al. 2018	Multi-domain (housing, mobility, consumables)	Patterned (Practices, demand, situations)	Descriptive & Instrumental (Explicit representation of scenario lifestyle at a macroscopic level)	National (France)
Ding et al. 2017	Multi-domain (clothes, household, food, transport); context-specific (rural / urban)	Patterned; CLA (household consumption patterns in urban/rural context)	Analytical (relationship between high / low household consumption and total energy use)	National (China),

Hubacek et al. 2007	Multi-domain (housing, appliances, home energy use) Context: transitioning economies	Patterned; Consumption patterns, GDP	Analytical (Relationship between shifting consumption lifestyles and CO_2 emissions)	Cross-national (China, India, Japan)
Vita et al. 2019 (EU GLAMURS)	Multi-domain (clothing, construction, food, man products, mobility, services, housing)	Patterned; Domain narratives (participant visions) for 'green' consumption; sufficiency	Analytical (qualitative / narrative lifestyle scenarios – potential mitigation using carbon footprints)	Global: Regional and cross national (Italy, Germany, Romania, Spain)
Bin & Dowlatabadi 2005	Multi-domain (home energy, travel, food))	Patterned; (individual determinants, household characteristics, consumer choices)	Analytical (relationship between consumer activities and energy used / CO2 emissions)	National (US)
Moore 2015	Multi-domain (food, buildings, consumables, transportation, and water)	Patterned Household consumption by domain – ecological footprints – lifestyle archetypes	Instrumental (to assess required lifestyle changes [consumption benchmarks] using ecological footprints)	Global: Cross-national
DEFRA 2011	Multi-domain (home energy, water, products & services, food, transport)	Patterned (sustainable behaviours based segmentation model)	Instrumental (sustainability framework tool for developing effective approaches to influence behaviour)	National (UK)
Vita et al. 2020 (EU GLAMURS)	Multi-domain (food, clothing, housing, transport) (Context: members / non-members environmental groups)	Cognitive (domain carbon footprints, self-satisfaction / wellbeing, living standards	Analytical (lifestyle-specific context – carbon footprints, controlled for socio-economic variables and countries)	Global: Regional case studies (Italy, Germany, Romania, Spain)
Millot et al. 2018	Multi-domain (mobility, housing, goods & services)	Cognitive; Coherent hypothesis around lifestyle dimensions that focus on practices and context, motivation	Instrumental (Digital, collective lifestyle scenarios – assess ability to meet carbon neutrality target by 2072)	National (France)
Hayles & Dean 2015	Multi-domain (Energy, water, waste) Context specific – social housing tenants.	Cognitive (behaviours, climate change perceptions, willingness to reduce energy/water use, responsibility)	Analytical & Instrumental (tool to assess key drivers of change. Active / passive responsibility lifestyles and willingness to change)	Local: City-scale (Belfast).
Thøgersen, 2017a & b, 2018	Domain specific (separate for housing, food and transport)	Cognitive (domain-specific perceptions, motives, actions, situations)	Descriptive (profiling of segments for target interventions)	Cross-national (10 European countries)
Markvica et al. 2020	Domain-specific (active mobility)	Patterned	Descriptive	National (Austria)

		(mobility habits, basic orientation, attitudes)	(milieu, shared mobility-related information needs)	
Etminani-Ghasrodashti et al. 2018	Domain specific (active mobility: recreational cycling)	Patterned (lifestyles as patterns of leisure activities)	Analytical (cycling use estimated from leisure lifestyles, attitudes, context)	Local: City scale (coastal city, Iran)
Axsen et al. 2015; 2016	Domain-specific (Transport: plug in EV)	Reflective (environment / technology activities, liminality, environmental concern)	Analytical (relationship between lifestyles and PEV motivations)	National (Canada)
Axsen et al. 2018	Domain-specific (Transport: EV)	Reflective (interests and social interactions – shape identity). Technology / environmental interests)	Analytical (PEV pioneers, potential owners, mainstreams estimated by lifestyle orientation, values, and attitudes	Local: City scale (Vancouver)
Chen et al. 2019	Domain specific (home energy); context specific (urban/rural)	Patterned CLA Home energy use, Rural/ urban setting	Analytical (lifestyles to estimate household direct / indirect energy use and carbon footprint / emissions)	Local: City-scale (Beijing)
George-Ufot et al. 2017	Domain specific (energy)	Patterned; socio-cultural factors e.g., corruption, GDP, resource use, urban migration	Analytical (relationship between contextual lifestyle factors and industries energy use)	Local: City-scale (Nigeria)
Barr et al 2011	Context-specific lifestyle (home – journey – holiday)	Patterned (environmental actions)	Descriptive (lifestyle consistency: home – journey – holiday)	Local: City (Exeter)
Katz-Gerro et al. 2017	Context-specific lifestyle (economic crisis)	Cognitive (attitudes and practices)	Descriptive (differing response to economic crisis by lifestyle group)	Cross-national (4 countries former Yugoslavia)
Middlemiss 2011	Context specific lifestyles community sustainability project participants	Cognitive (participant typologies - history and level of project engagement), values	Instrumental (to assess community project engagement for lifestyle change) – interactions & motivation	Local: Regional (5 case studies, UK)

Notes: CLA: Consumer Lifestyle Approach; EV: Electric vehicle

Insights from studies of low-carbon lifestyles in specific domains

Low-carbon lifestyles in the food domain

A number of multi-domain lifestyle studies highlight particular aspects of food and diet that are relevant to low carbon lifestyles and place particular emphasis on patterns of everyday consumption. Moore (2015) identifies the transformation required to achieve sustainability as a set of benchmark behaviours. The food benchmark is typified by a predominantly vegetarian diet limited to 2424 calories per day. Schanes et al (2016) used food as a case-study example for a framework structured around the lifestyle-change strategies of reduce and improve. Strategies included reducing consumption of low nutritional values foods and meat, using food waste as fertiliser or composing, and improving food use by purchasing food that might otherwise have been thrown away or buying seasonal food. Sustainable actions also include growing own food (Shirani et al. 2015). Vita et al (2019) developed scenarios for consumption and sufficiency lifestyles that have a wider and more integrated vision. For the food domain this involves a pathway from local food sustainability (plant-based diets and food sufficiency), through the food supply chain (seasonal and local food choices, reducing food waste) to global consequences and mitigation potential.

Low-carbon lifestyles in the homes & energy domain

Energy saving has been conceptualised as part of a home-focused lifestyle domain. For example, Hayles & Dean (2015) used a case study of social housing tenants in Belfast to assess the willingness of households to reduce energy use. Willingness was associated with perceptions of environmental consequences and responsibility (individuals or government authorities), influenced by social identity and a sense of powerlessness. Thøgersen (2017) also focused on energy saving within a housing-related lifestyle but from a pan-national perspective. Both studies were rooted in a cognitive approach, for which goals and values are expressed in housing-related perceptions, choices and actions.

A consumption patterned lifestyle perspective has also been used to assess the relationship between household activities and energy consumption (e.g., Chen et al. 2019). The approach is also typical of multi-domain assessments of lifestyle, with patterns of home energy consumption integrated across other domains to estimate overall energy use or emissions. DEFRA's Sustainable Lifestyles Framework (2011) outlines a set of headline behaviours that constitute a sustainable lifestyle. Behaviours such as home energy use are structured around the direct (space heating and cooling) and indirect consumption of energy (purchasing energy efficient appliance and energy saving devices).

A consumer lifestyle approach (CLA) has been adopted in some environmental impact assessments. This approach views lifestyle as an intervening system of cognitive structures (e.g., Bin & Dowlatabadi 2005, Chen et al. 2019, Ding et al. 2017). Consumer behaviour (in this case energy use) reflects individual psychological variables that influence decision-making (e.g., attitudes, perceptions, and beliefs), and household characteristics (Bin & Dowlatabadi 2005). Adopting a social-psychological perspective, Barr & Gilg (2006) explored sustainable lifestyles in and around the home. Lifestyles are reflected in everyday actions (including energy saving) and constructed around socio-environmental values (e.g., anthropocentrism, biospherism, eco-centrism, techno-centrism), attitudes towards specific energy-saving behaviours and their situational circumstances. Intention to purchase

domestic solar PV systems has also been analysed in relation to ecological lifestyle concepts constituted by beliefs, attitudes, preferences and behaviours (Chen 2014).

Contextual factors also contribute to housing and energy-related lifestyles analysis. For example, the CLA has been used to compare residential energy use within urban and rural settings in China (Chen et al. 2019, Ding et al. 2017). In developing economies, the influence of factors such as affluence, inflation, corruption, and political stability, are also tested as influences on electricity consumption patterns (e.g., Hubbacek et al. 2007, George-Ufot et al. 2017).

Low-carbon lifestyles in the transport & mobility domain

A reflexive approach to assessments of lifestyle in the transport domain is adopted by Axsen et al. (2015, 2016, 2018). Lifestyle is defined as "engagement in several related practices that inform and convey self-identity" (Axsen et al. 2018). Consumer behaviours (e.g., engagement in environmental or technological activities), social interactions (e.g., with family or friends), values (biospheric, altruistic, egoistic and traditional), attitudes (e.g., openness to change), perceptions and motivations (e.g., environmental concerns or cost), interact and shape or confirm self-identify (Axsen et al. 2015, 2016, 2018). An individual engages in an activity, such as purchasing an electric vehicle (EV), if this fits in with the current or aspirational self-concept (e.g., a pro-environmentalist or technological enthusiast).

As an example of active mobility lifestyles, attitudes, preferences and features of the built environment have been explored in relation to recreational cycling in a coastal city in Iran (Etminani-Ghasrodashti et al. 2018). Included in their conceptualisation were behaviours (patterns of leisure activities), attitudes towards cycling paths, preferences (e.g., landscape design, trees and green spaces) and built environment attributes (such as network connectivity).

In another case study of active mobility in Austria, Markovica et al. (2020) defined lifestyle groups (social milieu) on the basis of attitudes (e.g., to leisure and transport) and fundamental values, that are bounded by socio-economic structures (such as income, education, residential characteristics).

Thøgersen's (2018) notion of lifestyle is domain specific. Using a multi-level approach, he described a transport-related lifestyle framed around two broad cognitive elements and three consumption elements. The cognitive categories considered were vehicle purchase motives (e.g., anticipated sense of power or status) and quality aspects (e.g., perceived reliability, energy efficiency or safety). Consumption practices included ways of consumption, usual travel routines, and consumption situations (e.g., social aspects of travelling).

Table 20. Analytical frameworks for measuring low-carbon lifestyles.

Lifestyle approach	**Lifestyle type**	**Framework, method of data collection**	**Lifestyle variables or items**	**Scale, data type**
Patterned approach	Multi-domain (Energy, water, waste, 'green' consumption) (Barr & Gilg 2006)	Questionnaire items (36); Factor analysis	Behaviours – environmental actions around 4 themes: energy, water, waste and 'green' consumption.	Local: Regional (Devon), Primary survey data
Patterned approach	Multi-domain (housing, mobility, consumables) Le Gallic et al. 2018)	National published surveys Develop lifestyle scenarios.	Practices: consumption of goods and service, demand for housing and mobility, situations.	National (France); Secondary: surveys (
Patterned approach	Multi-domains (clothes, household items, food, transport) Context-specific (rural / urban) Ding et al. 2017)	Energy balance tables CLA,	Household energy through consumption patterns, context (urban, rural)	National (China), Secondary: published national data e.g., Statistical yearbook (
Patterned approach	Multi-domain (housing, appliances, residential energy use Context: transitioning economies (Hubacek et al. 2007)	Quantitative Published data. Categorisation based on patterns of consumption, and GDP	Per capita consumption of goods & services), per capita GDP	Cross-national (China, India, Japan); Secondary: Published national data
Patterned approach	Multi-domain (clothing, construction, food & diet, food supply chain, manufactured projects, mobility, services and shelter) (Vita et al. 2019)	Patterned domain narratives. Qualitative lifestyle scenarios developed from backcasting workshops Assess potential mitigation (carbon footprints)	Consumption by domain (participant visions) for 'green' consumption; sufficiency	Global: Regional and cross national (Italy, Germany, Romania, Spain) GLAMURS project, Primary qualitative data
Patterned approach	Multi-domain (food, buildings, consumables, transportation, and water) (Moore 2015)	Quantitative Lifestyle archetypes developed from ecological footprints / household consumption patterns	Urban household consumption data by domain (domain benchmark developed which represent required changes)	Global: Cross-national; Secondary: published statistics
Patterned approach	Multi-domain (food, buildings, consumables, transportation, and water) DEFRA 2011	Evidence-based segmentation model Sustainable lifestyles framework tool Constructed from 30 key sustainable lifestyle behaviours.	Sustainable behaviours, e.g., insulating, maintaining & repairing, buy seasonal foods, car sharing, Attitudes (e.g., environmental concern)	National (UK); Primary data: DEEFRA survey and qualitative evidence (stakeholders).

Patterned approach	Multi-domain (Home energy use, personal travel, food & beverages) Bin & Dowlatabadi (2005)	Published surveys, CLA: (Methods not described) Lifestyle derived estimates of CO_2 emissions.	External environment, individual determinants, household characteristics, consumer choices	National (US), Secondary: national surveys.
Patterned approach	Domain-specific (active mobility) (Markvica et al. 2020)	Hypothetical clusters from 12-milieu focus groups – developed 32 survey statements	Attitudes towards transport modes, values, mobility habits, local infrastructure, mobility options.	National (Austria), Secondary: Existing national survey Primary: focus groups and additional survey
Patterned approach	Domain specific (active mobility: recreational cycling) (Etminani-Ghasrodashti et al. 2018)	Questionnaire items reduced through factor analysis	Behaviours patterns: leisure activities	Local: City scale (coastal city, Iran) Primary survey data
Patterned approach	Domain specific (home energy); context specific (urban/rural) (Chen et al. 2019)	Quantitative; Energy balance table CLA described but unclear whether lifestyle factors other than consumption was included;	Household energy consumption, industrial energy consumption, Context (urban, rural)	Local: City-scale (Beijing), Secondary: Statistical yearbook
Patterned approach	Domain specific (energy) Context specific: Transition economy (George-Ufot et al. 2017)	24 item questionnaire developed around 5 lifestyle factors (from literature) Scale: degree of influence.	Patterned; socio-cultural factors e.g., corruption, GDP, resource use, urban migration	Local: City-scale (Nigeria), Primary data: face-to-face questionnaire (energy industry)
Patterned approach	Context-specific lifestyle (home – journey – holiday) (Barr et al 2011)	Mixed methods Focus groups, in-depth interviews Questionnaire items	Pro-environmental behaviours in different contexts	Local: City (Exeter); Primary: survey data; focus groups
Cognitive approach	Generalised lifestyle Valeri et al. 2016	Questionnaire (web-based); preferences for environmental policy instruments.	Changes in mobility behaviour / eating habits, environmental awareness / intention, education, income.	National (Italy), Primary data: survey
Cognitive approach	General lifestyle Context specific: Transition economy (Tudor et al. 2016)	Factor analysis of questionnaire items Perception constructed lifestyles	Attitudes (e.g. lack of time), awareness (e.g., lack of information), beliefs (e.g., social justice)	Local: City-scale (Chennai, India) Primary: questionnaire
Cognitive approach	Generalised – sustainable lifestyle Axon 2017	Focus groups – thematic analysis approach to identify enablers/barriers	Knowledge, identify values, perceptions, motivation, practices, structural context.	National (7 UK communities); Primary: qualitative.

Cognitive approach	Generalised – simplifier lifestyles (Marchand & Walker 2008)	in-depth interviews Groups of simplifier lifestyles based on cognitions	Values, awareness, attitudes and perceptions	Local Case-study (n=11), Primary: qualitative: interview
Cognitive approach	General low-carbon lifestyle (Howell 2013)	Mixed methods: in-depth interviews & questionnaire	Values e.g., altruistic, biospheric, egotistic	Local case studies (2: Scotland, England) In-depth interviews & questionnaire
Cognitive approach	Multi-domain domain (food, clothing, housing, transport) (Context: members / non-members (Vita et al. 2020) GLAMURS project	Standardised questionnaire - carbon footprints, members / non-members environmental groups	environmental behaviours, self-satisfaction (wellbeing), living standards	Global: Regional case studies (Italy, Germany, Romania, Spain) Primary: questionnaire
Cognitive	Multi-domain (mobility, housing, goods & services) Millot et al. 2018	Quantitative: published surveys, lifestyle scenarios (Digital, collective); Constructed around coherent hypothesis	Consumption patterns (current and past), attitudes and preferences, situation (demography, income)	National (France); Secondary: published national surveys (transport, household, population, housing)
Cognitive approach	Multi-domain (Energy, water, waste) Context specific – social housing tenants. Hayles & Dean 2015.	Semi-structured Interviews Lifestyles groups categorised according to perception of responsibility	Behaviours, environmental responsibility, willingness to reduce energy/water consumption,	Local: City-scale (Belfast) Primary: survey;
Cognitive approach	Domain specific (separate lifestyles for housing, food and transport) Thøgersen, 2017a b, 2018	Survey items (71 for housing, 69 for food and transport) principal component analysis Segment profiles	Domain specific perceptions, values, motives, actions, living and consumption situation	Cross-national (10 European countries) Primary: survey
Cognitive approach	Context-specific lifestyle (economic crisis) (Katz-Gerro et al. 2017)	survey items multiple correspondence analysis Groups: response to economic crisis	Values & attitudes, consumption & digital practices	Cross-national (4 countries former Yugoslavia; Primary survey data
Cognitive approach	Context specific lifestyles lifestyles community sustainability project participants (Middlemiss 2011)	Qualitative; in-depth interviews Lifestyle groups: interactions, motives with community project	History of participant engagement, level of involvement, type of project, sustainable outcomes	Local: Regional (5 case studies, UK); Primary: qualitative survey
Reflective approach	General lifestyle (Binder & Blankenberg 2017)	Questionnaire Self-identified lifestyle group by questionnaire	Self-identified lifestyle, subjective self-image / wellbeing, environmental behaviours	National (UK); secondary (UK Household Longitudinal Study)

Reflective approach	General lifestyle – 'sustainable living beyond eco-efficiency'' (Hagbert & Bradley 2017)	Narrative themes about low-impact way of living from in-depth interviews 'home front transitioners'	Home characterisation, perceptions, practices, motivations.	Local: Single location, Sweden (7 households), Primary qualitative survey.
Reflective approach	Domain specific: Transport (Plug in EV) Axsen et al. 2015; 2016	Questionnaire (47 items) Quantitative Cluster analysis (2015) composite score (2016)	Practices (engagement in environment or technological activities), liminality, environmental concern	National (Canada), Primary survey
Reflective approach	Domain specific: Transport (EV) Axsen et al. 2018	Qualitative methods – semi-structured interviews – identify themes & lifestyle categories b	Practices (interests, hobbies choices) and social interactions that shape identify	Local: City scale (Vancouver), Primary: qualitative survey

Table 21. Identifying lifestyle groups from a low-carbon perspective.

Method for identifying lifestyle groups	Lifestyle factors, dimensions (by approach)	Characteristics of lifestyle groups	Heterogeneity of lifestyle groups
Level of engagement or commitment (multi-domain or generalised lifestyles)			
Cluster analysis of lifestyle elements or factors (Barr & Gilg 2006, Barr et al. 2011, Tudor et al 2016) Qualitative engagement typologies (Middlemiss 2011) Participant identified lifestyle (Binder & Blankenberg 2017) Simple categories: low / high consumption (Ding et al. 2017)	Patterned (environmental actions) that might be context specific, e.g., in the the home (Barr & Gilg 2006), or across different sites (e.g., Barr et al. 2011). Cognitive (beliefs, .perceptions, behaviours) in specific contexts, e.g., for transition economies (Tudor et al. 2016), or sustainable community groups (Middlemiss 2011) Reflexive behaviours linked to life satisfaction and wellbeing (Binder & Blankenberg 2017))	Groups are identified on a scalar dimensions of commitment or engagement and categorised from most to least committed (Barr & Gilg 2006, Barr et al. 2011, Binder & Blankenberg 2017). Groups are identified by level of engagement and motivation, e.g., 'holding sustainable values but limited behaviours' (Middlemiss 2011)	Values and attitudes, e.g., social power and cohesion (Barr & Gilg 2006). Perceptions, e.g., lack of time or information (Tudor et al. 2016), life-satisfaction ((Binder & Blankenberg 2017)) Social interactions / cohesiveness (e.g., Middlemiss 2011). Context Demographic and socio-economic (Barr et al. 2011, (Binder & Blankenberg 2017))
Perceptions of self and world (inward and outward focus), multi-domain or generalised lifestyles			
Latent class analysis of preferences for environmental policies (Valeri et al. 2016) Categories of responsibility, self or others (Hayles & Dean 2015), context specific categories e.g., membership (or not) of sustainability groups (Vita et al. 2020) Evidence based segmentation model (DEFRA 2011) Narrative themes from mixed methods (Howell 2013), simplifier themes (Marchand & Walker 2008), 'home front transitioners' (Hagbert & Bradley 2017) and narrative scenarios (Vita et al. 2019).	Patterned environmental behaviours identified by stakeholders (DEFRA 2011, Vita et al. 2019) Cognitive behaviours linked to perceptions of climate change, responsibility Hayles & Dean 2015), policy preferences linked to awareness, intent, sensitivity to change, and context (Valeri et al. 2916). Motivations for low-carbon lifestyles (Howell et al. 2013, Marchand & Walker 2008), motivations and opportunities (Vita et al. 2020) Reflexive: motivations for sustainable practices connected to alternative identify of 'going beyond eco-efficiency'. (Hagbert & Bradley 2017)	Perception of responsibility: Active / Passive (Hayles & Dean 2015) Perceived benefits for policy instruments: cost, polluters pay, lifestyle change (Valeri et al. 2016). Private –better quality of life /public benefits - better world (Marchand & Walker 2008, Vita et al. 2019) motivated by social justice, community, wellbeing and personal integrity (Howell, 2013), mainstream alternative, self-sufficient, simplifier, local resilience (Hagbert & Bradley 2017) Perceived benefits & levels of engagement e.g., 'positive greens', 'sideline supporters', 'honestly disengaged '(DEFRA 2011) Motivated	Beliefs altruism more than biospherism (Howell 2013) Perceptions e.g., environmental awareness / intent (Valeri et al. 2016, Marchand & Walker 2008), social justice (Howell 2013) Context: e.g., some lifestyles are cost sensitive (Valeri et al. 2016), influenced by living standards (Vita et al. 2020). Cost is a key driver for social housing tenants (Hayles & Dean 2015), differences in culture and resource access (DEFRA 2011), structural constraints and opportunities (Vita et al. 2020)
Basic orientation (domain specific lifestyle)			

Cluster analysis of lifestyle factors (Markvica et al 2020, Axsen et al. 2015) Multilevel latent class analysis of domain specific factor scores (Thøgersen, 2017a, b and 2018) Factor analysis of leisure activities (Etminani-Ghasrodashti et al. 2018) Composite scores for engagement activities (Axsen et al 2016) Narrative themes: related to technology / environment orientation (Axsen et al 2018)	Patterned: social status and basic orientation (Markvica et al 2020), leisure activities (Etminani-Ghasrodashti et al. 2018), technology or environment activities (Axsen et al 2016) Cognitive: domain specific activities & routines motives, and situations (Thøgersen, 2017a, b and 2018) Reflexive: Activities, liminality, environmental concern (Axsen et al. 2015),	Communication, e.g., highly informed, digital illiterates (Markvica et al 2020). Environmental and technological orientations (Axsen et al 2016, 2018) linked to openness / concern (Axsen et al. 2015) Domain specific lifestyle segments based on orientation (e.g., family), level of engagement and sensitivity to cost (Thøgersen, 2017a, b and 2018). Leisure preferences e.g., active and beach-oriented (Etminani-Ghasrodashti et al. 2018)	Values: Preferences: Communication and information needs (Markvica et al 2020). Motivations: related to self-identify or symbolism (Axsen et al. 2015, 2018), liminality, environmental concern (Axsen et a. 2016) Context: Demographic factors, country class (Thøgersen, 2017a, b and 2018), socio-demographics and features of the built environment (Etminani-Ghasrodashti et al. 2018). Functional PEV cost (Axsen et al 2018)
Holistic (or balanced, internally consistent) representations of multi-domain or generalised lifestyles			
Cluster analysis of attitudes and practices (Katz-Gerro et al. 2017) Scenarios based on a set of coherent hypotheses (Millot et al. 2018) using a regression tree (Le Gallic et al. 2018)	Cognitive approach: response to economic crisis on two dimensions: production-consumption, proactive-reactive (Katz-Gerro et al. 2017)	Response strategy clusters e.g., self-provision, passive endurance (Katz-Gerro et al. 2017) Contrasting scenarios: digital individual, collective local ((Le Gallic et al. 2018, Millot et al. 2018)	Preferences and attitudes: to work, cohabitation, social relations, mobility (Millot et al. 2018) Context: lifestyle response is strongly context driven – socio-economic and location factors (Katz-Gerro et al. 2017)
Context-driven lifestyles			
Mixed methods: survey and expert option (George-Ufot et al. 2017) Qualitative descriptions based on consumption benchmarks (Moore 2015) Simple categories: Consumption levels (Hubacek et al. 2007), urban-rural (Chen et al. 2019)	Patterned: lifestyle factors influencing energy use (George-Ufot et al. 2017). Multi-domain patterns of household consumption (Moore 2015, Hubacek et al. 2007). Trends in household energy use (Chen et al. 2019).	Consumption lifestyles framed around influencing factors (George-Ufot et al. 2017), one- two- three-planet consumption (Moore 2015), national levels of affluence (Hubacek et al. 2007), urban-rural contexts (Chen et al. 2019)	Key contextual drivers: Local: socio-cultural: e.g., corruption and literacy (George-Ufot et al. 2017). National: Urban structure, culture, socio-economic characteristics (Moore 2015). Affluence: increases opportunity and aspiration (Hubacek et al. 2007) Urban-rural differences in income and development (Chen et al. 2019)

Table 22. Studies which identify lifestyle groups from a low-carbon perspective.

Method for identifying lifestyle groups (domain and application)	**Lifestyle factors, dimensions (lifestyle approach)**	**Characteristics of lifestyle groups**	**Heterogeneity of lifestyle groups, e.g., on basis of context (e.g., socio-economic, county level factors)**
Cluster analysis. Multi-domain. Descriptive: environmental actions in the home. (Barr & Gilg 2006)	3 factors: 1. purchases decisions, 2. habits (conservation of water / energy), 3. recycling (patterned approach)	1. committed environmentalists 2. mainstream environmentalists 3. occasional environmentalists 4. nonenvironmentalist (Level of commitment)	Attitudes (e.g. wealth, social power, social cohesion), Values (anthropocentrism and bio-spherism)
Cluster analysis Context-specific generalised lifestyle Descriptive: lifestyle consistency (home – journey – holiday) (Barr et al 2011)	Not reported (Patterned approach – pro-environmental behaviours)	1. most committed on holiday, 2. least committed on holiday, 3. tend to engage in environmental action (Level of commitment)	Associated with demographic and employment status. In-depth interviews revealed segmenting on the basis of pro-environmental behaviours is problematic.
Cluster analysis of attitudes and practices Generalised lifestyle Descriptive: lifestyle as response to economic crisis (Katz-Gerro et al. 2017)	2 axis (household): 1. Production to consumption 2. Proactive to reactive approach to economic crisis (Cognitive approach)	5 lifestyle strategy clusters: self-provisioning, passive endurance, mixed, consumer proactive, consumption reduction (holistic crisis response) (Context driven)	Context: Income, education, social status, rural – urban location Large social changes set some societies apart from other societies.
Cluster analysis Mobility domain Descriptive: milieu based on shared mobility information needs. (Markvica et al 2020)	2 dimensions (Sinus Milieus framework): 1. Social status 2. Basic orientation: tradition, modernisation, re-orientation. (Patterned approach)	6 hypothetical target clusters: spontaneous, highly informed, efficiency-oriented, interested conservatives, low demand, digital illiterates. (basic orientation)	Different information needs and communication channels, Active mobility strategies differentiated for each cluster
Cluster analysis Transport domain. Analytical: lifestyle and PEV motivation (Axsen et al. 2015)	Engagement in environment, Engagement in technology, liminality, environmental concern. (Reflective approach)	6 lifestyle-based clusters: Pro-environmental: strong, techno-enviro, concerned Non-environmental: techie, open, unengaged (basic orientation and motivation)	Basic orientation, PEV motivations – reinforce self-identify.
Cluster analysis, Context specific lifestyle –transition economy, Analytical: relating perception constructed lifestyle to sustainable household practices (Tudor et al. 2016)	Factor analysis : 1. Lack of time 2. Blame others 3. information 4. Correct recycling bins 5. Environmentally friendly –Self opinion 6. Pollution beliefs 7. Global warming beliefs	5 lifestyle clusters: 1. Non-environmentalist 2. Occasional environmentalist 3. Main stream environmentalist 4. Committed environmentalist 5. Dedicated (Level of commitment)	Perceptions (lack of time / information) more important than values: altruism, biocentric and anthropocentric constructs and ecocentric-technocentric factors.

	(Cognitive approach)		
Multilevel latent class analysis of factor scores Home energy domain. Descriptive: profiling segments for target interventions (Thøgersen, 2017)	16 dimensions around 5 lifestyle elements: quality, acquisition motives, ways of shopping, home improvement, living situation. (Cognitive approach)	7 housing-related lifestyle (HRL) segments: basic, cautious home-oriented, average, unengaged, enthusiastic, careless, engaged homemakers.	Differences between North, South and Middle countries of Europe. HRL segments associated with openness to new energy saving opportunities using a general linear model.
Food domain Descriptive: target lifestyle interventions (Thøgersen, 2017)	23 dimensions around 5 lifestyle elements: quality, purchasing motives, ways of shopping, **cooking methods, consumption situatio**n. (Cognitive approach)	5 food-related lifestyle (FRL) segments: everyday food providers, food ignoramuses, enthusiastic, uninvolved, traditional family-oriented	Associated with demographic factors, country class. FRL and country class account for differences in sustainability food choices
Transport domain Descriptive: target lifestyle interventions (Thøgersen, 2018)	18 dimensions around 5 lifestyle elements: quality, buying motives, ways of shopping, **travel routines, consumption situation**	6 travel-related lifestyle (TRL) segments: family oriented, unenthusiastic drivers, uninvolved, engaged, enthusiastic, cost-conscious	Associated with demographic factors, country class. Relationship between TRL and sustainable travel choices.
Multilevel latent class analysis of factor scores Domain specific: Home, Food, transport Descriptive: profiling segments for target interventions (Thøgersen, 2017a, b and 2018)	18-23 dimensions, around 5 lifestyle elements (4 core elements: quality, buying motives, ways of shopping, living or consumption situations, and either cooking methods, travel routines or home improvements) (Cognitive approach)	7 housing-related lifestyle (HRL), 5 food-related lifestyle (FRL) segments, 6 travel-related lifestyle (TRL) segments, e.g., family-oriented, uninvolved, engaged, enthusiastic, cost-conscious. (orientation and engagement/ holistic)	Demographic factors, country class. Relationship between TRL, FRL, HRL and sustainable choices. Broad clusters of countries identified, e.g., north, central, south for the FRL.
Latent class analysis Generalised lifestyle (mobility, diet) Instrumental: preferences for environmental quality instruments. (Valeri et al. 2016)	• Sensitivity to policy instrument • Sensitivity to lifestyle change (mobility, diet) • Environmental awareness • Environmental intention • Socio-demographics (cognitive approach)	latent classes: 1. Cost sensitive, negative to environment 2. Polluters pay more, environmental awareness not intention 3. Sensitive to lifestyle change, positive to environment. (perceived benefits)	Most respondents are cost sensitive, the remainder are sensitive to changes in personal engagement (lifestyle) Perceived as both negative or positive benefits (environment and health)
24 questionnaire items reduced to 14 by expert opinion (industrial). Energy domain. Analytical: lifestyle factors and energy use. (George-Ufot et al. 2017)	4 Lifestyle factors developed from literature: 1. Socio-cultural 2. Economic 3. Political 4. Environmental (Patterned approach)	4 clusters of lifestyle factors, examples: 1. Corruption, literacy, lifestyle attitude. 2. Inflation rate, GDP, rural-urban migration. 3. Government instability, climate, 4. Green design, pollution, resource use. (contextual driven)	Fuzzy logic used to determine sustainable key lifestyle factors: socio-cultural and include corruption, planning, theft, demography and lifestyle attitude.

Evidence-based segmentation model; stakeholder identified key sustainable behaviours, groups based on values, beliefs, attitudes. Multi-domain Instrumental: framework tool for developing effective strategies for change (DEFRA 2011)	9 Headline behaviours: 1. Eco-improving home 2. Using energy & water wisely 3. Extending life 4. Sustainable diet 5. Eco-products & services 6. Sustainable travel 7. Community initiatives 8. Future proofing outdoors 9. Volunteering (Patterned approach)	7 population segments: 1. Positive greens 2. Waste watchers 3. Concerned consumers 4. Sideline supporters 5. Cautious participants 6. Stalled starters 7. Honestly disengaged. (Perceived benefits and levels of engagement)	Differing values, experiences, attitudes, habits and situational factors (culture, geography, resource access)
Contrasting lifestyle scenarios based on a set of coherent hypotheses; Multi-domain Instrumental ability to meet carbon targets. (Millot et al. 2018)	8 dimensions: 1. Demography 2. Cohabitation practices 3. Use of technology 4. Mobility practices 5. Work attitude 6. Location (rural, urban) 7. Living standards 8. Tourism practices (Cognitive approach)	2 contrasting scenarios: 1. Digital: ambitious, single, virtual working, urban. 2. Collective: social ties, shared housing, more local (holistic representation)	Differentiated along the basis of lifestyle practices, attitudes and contexts. Digital – does not result in carbon neutrality Collective – carbon neutrality achieved. – lower use of resources
Unclear method Domain Mobility (recreational cycling) Analytical: cycling use estimated from leisure lifestyles, attitudes, context. (Etminani-Ghasrodashti et al. 2018)	Factor analysis of leisure activities (Active, tourism attractions, adventure, beach oriented) (Patterned approach: leisure activities)	4 lifestyle patterns: 1. Tourism-attraction lover 2. Active and socialiser 3. Adventure and beach oriented 4. Active and beach oriented (Basic orientation)	Leisure Lifestyles, attitudes (towards features of the built environment), and socio-demographics estimated recreational cycling.
Classified by environmental responsibility (self/others) survey item. Multi-domain Instrumental: lifestyles with greatest mitigation potential (Hayles & Dean 2015)	1. Behaviours e.g., energy saving devices / behaviours. 2. Perception of climate change importance. 3. Reaction to climate change 4. Responsibility – each person must change their lifestyle (Cognitive approach)	Lifestyle categories: 1. 'Active' Individual responsibility 2. 'Passive' Others responsibility (Perceptions of responsibility)	Engagement in energy saving behaviours was significantly greater for the active lifestyle group. No significant different for perception of climate change. Cost is a key driver for social housing tenants
Typologies based on engagement in sustainability. Context specific lifestyle – sustainable community groups Instrumental: potential for change	1. History of engagement 2. Sustainability behaviours, e.g., recycling, decision not to fly. 3. Sustainable values, ethos	5 participant typologies: 1. Historically engaged 2. Recently engaged 3. Engaged in ethos with complementary behaviours 4. Holding sustainable values, but limited behaviours 5. Unengaged	'Realistic evaluation': Level of interaction (active/peripheral) Cohesiveness of the community group Group motivation: changing specific activity or changing lifestyle

(Middlemiss 2011)	(Cognitive approach, values, behaviours)	(level of engagement and motivation)	
Questionnaire items Generalised lifestyle Descriptive: behaviour & wellbeing, self-image (Binder & Blankenberg 2017)	Questionnaire items – self identified lifestyle (no further reduction analysis) (reflective approach)	5 groups (environmental behaviours): from 'nothing' to 'everything'	Multiple regression to relate behaviour groups and attitudes, life satisfaction and socio-demographic variables
Themes developed from in-depth interview, values from email survey. Generalised *low-carbon lifestyle* Analytical: adopters motivations & values (Howell 2013)	Themes around adopters of low-carbon lifestyles: 1. Social justice 2. Community 3. Frugality 4. Personal integrity (Cognitive approach)	Motivations associated with each of 4 themes: 1. Human suffering 2. Community support 3. Happiness does not follow consumerism 4. Doing what is right (perceived benefits)	Social justice – key motivation, high on altruism, lower for biospheric values, low on egotistic values. Environmental concern not a key motivator
Narrative simplifier profiles developed through in-depth interview. Generalised lifestyle Descriptive & instrumental: perceived benefits (Marchand & Walker 2008)	Voluntary simplicity themes: Better living with less, 'Simplicity' as a new consumer brand (Cognitive approach)	4 simplifier profiles: 1. Eco-efficient 2. Better world – altruistic environmentalists 3. Quality of life – sufficiency 4. Involuntary – financial (private / public benefits)	Ecological consciousness, social awareness, perceived personal factors or benefits, relationships with objects, financial constraints Lifestyle profiles for product development.
Semi-structured interviews to identify themes. Domain: Transport (EV) Analytical: orientation, values related to potential PEV owners (Axsen et al 2018)	Lifestyle sectors, e.g., pro-environmental, technology-oriented practices, family-oriented, career, outdoor lifestyle. (Reflexive approach)	4 categories of lifestyle engagement: 1. Tech enthusiast 2. Low tech green 3. High tech green 4. Practical (Basic orientation)	Motivations (e.g., symbolic, functional, cost, environmental) for PEV purchase tended to correspond to lifestyle engagement.
Narrative scenarios developed around 8 domains, from backcasting workshops Multi-domain context specific: members/non members env. groups. Analytical: lifestyles mitigation potential. (Vita et al. 2019)	40 items constructed around 8 domains: clothing, construction, food & diet, food supply chain, manufactured projects, mobility, services and shelter. (Patterned approach)	2 sustainable lifestyle scenarios representing participant visions: 1. Green consumption green-growth, more sustainable alternatives 2. Sufficiency: reduce consumption, de-growth. (motivations / benefits)	Modelling complemented by literature review of quality of life benefits Sufficiency: wellbeing, social relationships, time affluence, voluntary simplicity. Green consumption – aspire to sustainable / smarter use of resources
Narrative themes from in-depth interviews. General lifestyle: 'beyond eco-efficiency'	Conversations around: home characterisation, perceptions, sustainable practices, motivations. (Reflexive approach)	Narrative themes: mainstream criticism, self-sufficiency, voluntary simplicity, building local resilience. (motivations / benefits)	Diversified perspective (alternative narratives) on sustainable living using home as the starting point for transitions to a low-impact society.

Descriptive: narratives 'home-front transitioners' (Hagbert & Bradley 2017)			
Household consumption. Multi-domain specific context (rural/urban) Analytical: consumption and total energy use. (Ding et al. 2017)	Level of household consumption in China (clothing, food, household appliances, car ownership) (Patterned approach)	• High consumption household • Low consumption household (resource use behaviours - level of engagement)	Urban household consumption almost 3 times that of rural households.
National ecological footprint at the One-, two-, three-planet (WWF) level of consumption Multi-domain Instrumental: tool to assess required lifestyle changes (Moore 2015)	Level of household consumption (and benchmarks) for domains: food, buildings, consumables, transportation, and water Human development indicators, income. (Patterned approach)	Lifestyle archetypes and qualitative descriptions: • 1 planet: lowest except water. • 2 planets: average; highest public transport • 3 planets: generally high, food highest. • 3+ planets: generally highest except food. (resource use contexts)	Differing patterns of consumption are partly determined by urban form, and heavily influenced by cultural and socio-economic characteristics
Consumption and affluence lifestyles. Context specific. Analytical: consumption and CO_2 emissions. (Hubacek et al. 2007)	1. Consumption (appliances, housing, energy use) 2. Affluence (GDP per capita) (Patterned approach)	3 categories (High, Middle, Under-consumers) (Durning 1992) but not clearly tied to current study. (opportunity, aspiration)	Income (affluence) is the driver of lifestyle shift from 'poverty' to 'adequate' to 'well to do' lifestyle. Increasing choices and aspirations.
Context specific (urban rural) lifestyles. Energy use domain. Analytical: household consumption and emissions (Chen et al. 2019)	Trends in household energy use (direct/indirect) and carbon emissions by residents in either urban or rural settings (Beijing) (patterned approach)	Urban residents: stronger upward growth, more indirect use. Rural residents: upward growth but weaker; more direct energy use. (context, opportunity)	Widening gap in urban and rural lifestyles, due to differences in income and diversified urban use of goods and services, rural infrastructure less developed.
Context specific lifestyles (group membership) Multi-domain. Analytical: lifestyle and carbon footprints. (Vita et al. 2020)	Member or non-member of sustainability group. Wellbeing / life satisfaction. Controlled for socio-economic variables (living standards) and country differences. (cognitive approach)	Members: carbon footprints greatest reduction for clothing & footwear, higher on life satisfaction (may reflect voluntary simplicity ideology) (Motivation, benefits opportunity)	Clothing and footwear have more choice, mobility domain has contextual constraints. Housing / mobility mitigation require greater lifestyle changes.
Regression tree used to build a population matrix of homogenous practices. Multi-domain. Lifestyle scenarios both descriptive and tool. (Le Gallic et al. 2018)	10 dimensions cover: demographic, household characteristics & location, activities, possessions, consumer behaviour, mobility. (patterned approach)	Single future lifestyle constructed: 'individual and virtual society' (context driven activities)	Future lifestyle (2050) compared to baseline (2010) in key areas: demand for housing and specific goods, short-distance mobility.

Lifestyle orientation dimension scores. Transport domain Analytical: lifestyle orientation and PEV motivation. (Axsen et al. 2016)	2 dimensions based on 5 engagement activities with either technology or environment) 1. environmental orientation 2. Technological orientation (patterned approach)	Composite scores for: 1. environmental orientation, 2. Technological orientation (orientation/activities)	Values, environmental concern, liminality, lifestyles, differentiated PEV pioneers, potential early / late mainstream (latent class model for reflexive consideration of motives)

Table 23. Intervention strategies tested or proposed for lifestyle change.

focus of study	**motivation for change**	**intervention strategies tested or proposed**	**barriers to change identified or conceptualised**	**effectiveness**
Identifying best practices for sustainable lifestyles: 'what works' approach. Axon [2017]	Meaningful (affordable) lifestyle	Campaigns which educate, inform, and engage (individuals and collectives) Ecological taxation to reduce prices of sustainable products	Inner conflict, lack of knowledge, time pressures, lack of agency Inconvenience, cost of sustainable alternatives, lack of organisational and governmental action	Not tested. Insights gained from focus groups consisting of UK residents. At least 50% of whom held negative attitudes towards sustainability
Theoretical paper based on mobility and consumerism Capstick et al. [2014]	Infrastructure change which provides choice of alternatives, shifting values and attitudes	targeted interventions that shift values and attitudes towards low carbon lifestyles infrastructural and regulatory change	consumerism as dominant culture	theoretical outcomes (longer term) point towards habit discontinuity and dismantling of consumer culture
Resource saving behaviour among social housing tenants Hayles and Dean [2015]	Trialability of energy and water saving devices	Active intervention (providing controllable energy and water saving devices) and passive intervention (installing resource saving devices)	willingness to change ratings awareness, use and access to energy saving devices	Overall willingness to adopt further energy saving measures
Understanding motivations for adopting low-carbon lifestyles. Howell [2013] Sustainable lifestyle	Improved social justice and community	Campaigns which emphasise the social benefits of a low-carbon; social justice: sense of community, frugality/simple living, personal integrity	Climate change is not necessarily viewed as interesting by those engaged in low-carbon lifestyles	Untested. Proposals based on insights gathered from in-depth interviews with adopters of low carbon lifestyles
Mechanisms for lifestyle creation/change Jensen [2009]	Cognitive change (shifting beliefs, desires, intentions)	Use of positive metaphors, reinforced by close social networks. Reliable feedback on actions e.g., product labelling (GHG emissions)	Individual efficacy	Theoretical
Case studies in mobility, and ecology Middlemiss [2011]	Social influences (inclusion, conforming to norms)	Community interventions including schemes to promote walking to school,	Community-based projects only attract people who are willing to volunteer	Substantial lifestyle change (4.5%), incremental lifestyle change (29.5%), single behaviour change

		conservation, carbon footprints		(18.2%), change in values, knowledge but not behaviour (18.2%), no change (29.6%)
Behaviour change interventions as part of life course changes Verplanken & Roy [2016]	Habit discontinuity through relocation of home	Information on sustainable choices (green directory)	Infrastructure, e.g., inadequate public transport, limited finances; conflicts between immediate self-interest and longer-term collective interests; habits	The intervention was effective in changing behaviour in a sustainable direction (statistically significant).

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