EUCALC

Explore sustainable European futures

Exploring lifestyle changes in Europe to the horizon 2050

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Short Description
This report summarizes the presentations, discussions and lessons learned during the EU calculator expert workshop on lifestyles and lifestyle changes in Europe. Consumption choices and patterns can have significant implications on energy consumption. Hence the need to account for the consumer perspective in modelling future energy consumption patterns. Current research projects in the field of sustainable lifestyles were presented and energy intensive (buildings, transportation and food/diets) were discussed more specifically. The conclusions identify what the calculator modules should take into account to represent the changing nature of energy consumption.

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1 Executive Summary

From rising inequalities and fuel poverty to the distribution of carbon footprints, lifestyles have different impacts on resource consumption and energy use in particular. A sustainable lifestyle can be defined as "*a cluster of habits and patterns of behaviour embedded in a society and facilitated by institutions, norms and infrastructures that frame individual choice, in order to minimize the use of natural resources and generation of wastes, while supporting fairness and prosperity for all*". New research shows how lifestyle choices and patterns can have significant implications on energy consumption. Hence the need to account for the consumer perspective in modelling future energy consumption patterns. The EU Calculator expert workshop on lifestyles built on both perspectives, consumers' capacity to make their own choices (consumer agency) on the one hand and enabling conditions on the other.

Among the most important drivers of energy consumption, income and age distribution are directly linked to lifestyles. The evolution of both of these variables was therefore identified as priorities to be integrated in the EU Calculator. In practice, space heating represents the largest part in the energy consumption of European households. As shown by the results of current research, much can be achieved at the policy level to encourage sufficiency. For instance, space heating could be measured per capita rather than surface area. Such changes put consumption into perspective, bringing back the distinction between basic needs and economic desires. Housing is particularly sensitive given long life time and slow turnover in buildings. Moreover, the budget constraint limits consumer choices in ownership, housing type, location, or level of energy efficiency.

Diets and food was also identified as an activity where indicators of energy consumption can be greatly improved. While the uncertainties in the energy content of food items remains comparably low, those of the impact of diets are much higher. Food and dietary choices vary with income, age, and many other socio-cultural factors. In addition, an important share of the food and feed is imported in Europe which raises the question of system boundaries, pointing to food-miles as a potentially more relevant indicator than calories consumed as it stands in the calculator

In the transportation sector, the nature of the automobile as a positional good proves difficult to substitute, including with electric vehicles. This is also where some of the most disruptive changes are expected with autonomous mobility which might increase the number of km travelled significantly. How people spend their time and work will also affect transportation, and infrastructure investment as well as fiscal policies play an important role in shaping people's behaviour.

The context in which consumption takes place is key and should be reflected in the methodology underlying the calculator. Accounting for differences across socio-economic groups sends a very different message than relying on national averages. If the calculator is used to encourage and discourage certain behaviours, the widening gap between rich and poor should be taken into account. From a policy making point of view, income distribution at the European level might be more relevant in energy terms than geographical representation in the calculator.

2 Introduction

Energy has traditionally been a technical question, with well-defined patterns of electricity and fuel production and consumption. Yet, given changes on the supply and demand side in relation to energy transitions, the perspective on energy consumption has shifted towards non-technical aspects, patterns of time use, socio-economic issues, etc. From rising inequalities and fuel poverty to the distribution of carbon footprints, different lifestyles have different impacts on resource consumption and energy use in particular (e.g. Steinberger et al., 2010; Chitnis et al., 2014). In addition to income distribution, social norms have a growing impact, positive or negative, on energy consumption (Jansson et al., 2017). Recent research shows how different lifestyle choices and patterns can have significant implications on energy consumption (Schanes et al., 2016). Hence the need to account for the consumer perspective in modelling future energy consumption patterns.

In doing so the EU calculator team intend to build on the latest developments and in particular current research projects in the field of sustainable lifestyles (e.g. UNEP, 2016; Akenji and Chen, 2016; Ivanova et al., 2017; Lorek and Spangenberg, 2017). The EU calculator takes a holistic approach and accounts for multiple sectors, especially the most energy intensive ones such as buildings, transportation and food, as well as country specific issues and socio economic groups. Multiple measures and frameworks now define "sustainable lifestyles" and one of the goals of WP1 is to identify relevant levers and their drivers by consulting with experts in the field.

A sustainable lifestyle is generally defined as "*minimizing ecological impacts while enabling a flourishing life for individuals, households, communities, and beyond. It is the product of individual and collective decisions about aspirations and about satisfying needs and adopting practices, which are in turn conditioned, facilitated, and constrained by societal norms, political institutions, public policies, social and physical infrastructures, markets, and culture*" (UNEP, 2016). Minimizing impacts, however, does not necessarily lead to sustainable consumption. Alternatively, a sustainable lifestyle is "*a cluster of habits and patterns of behaviour embedded in a society and facilitated by institutions, norms and infrastructures that frame individual choice, in order to minimize the use of natural resources and generation of wastes, while supporting fairness and prosperity for all*" (Akenji and Chen, 2016).

The EU calculator workshop on lifestyles was organized with the goal of identifying broad relationships between lifestyles metrics, their underlying drivers and possible futures in Europe. More specifically, the objectives of the workshop were to challenge and validate current assumptions considered in the calculator regarding the evolution of lifestyles to 2050 and explore how shifts in consumer behaviour might be accounted for. Changes discussed included both efficiency gains, doing more with the same or less and sufficiency, satisfying current needs with less in absolute terms.

The workshop took place back to back with the Global Research Forum on *Sustainable Production and Consumption conference on Sustainable Lifestyles, Livelihoods and the Circular Economy*, co-hosted with the Institute of Development Studies (IDS) and the Science Policy Research Unit (SPRU) at the University of Sussex. A programme and list of participants can be found in the annex. In order

to maximize interaction, the programme was planned jointly by the EUCalc team and the workshop facilitator. This report follows a similar structure by funnelling the outcomes of discussions from a general perspective to the specific energy intensive sectors: building, transportation and food/diet. The workshop began with an introduction to the calculator and inspiring talks on the state of the art in lifestyles determinants and impacts globally and in Europe. Three short presentations or 'spark talks' over the course of the workshop stimulated the discussions with insights from four research projects, ENERGISE (European network for research, good practice and innovation in sustainable energy), EUFORIE (European Futures for Energy Efficiency), LILI (Living well within limits) and GLAMURS (Green Lifestyles, Alternative Models and Upscaling Regional Sustainability). A list of participants can be found in the Annex.

3 Setting the scene

3.1 Preliminary insights

In lieu of an introduction, each participant was asked to share one insight on sustainable lifestyles. All participants contributed based on their own research and experience. Their initial contributions can be reported in two broad categories, the impact of individual behaviour and that of consumption choices, lock-in and enabling conditions.

A. Individual behaviour

- **A linear relationship exists between households' carbon footprint and income.** Hence the need to look at direct and indirect rebound effects. Saving energy in a home through insulation decreases energy bills but these energy gains are often undermined when individuals increase the temperature in their home as a response to the cheaper energy bill (direct rebound) or alternatively redirect the money gained from energy cost savings to purchase a greenhouse gas (GHG) emitting flight to remote destinations for a holiday (indirect rebound).
- **Mitigating rebound effects in countries with high rates of energy poverty is essential.** In other words, efficiency gains combined with increased indoor temperature should be seen as a way to improve issues such as health, comfort, etc.
- **If you ask people around the world what they aspire to, it tends not to be sustainable lifestyles.** We have failed dramatically to articulate and describe what inspirational, positive "one planet lifestyles" can be and in the absence of that, people continue to eat burgers and drive cars.
- **The correlation between the level of education and carbon emissions should be accounted for**. Ironically, people who vote for green political parties tend to have large carbon footprints, so called inconsequential behaviour.
- **We know but we don't know.** We know that some things are not good (e.g., flying, eating red meat) but we are still behaving like we do not know.

- **The number and variety of drivers that influence consumer choices is fascinating.**
- **The connection between climate change and demographics need not be linear**; population can grow but energy use can decrease.
- **The relationship between diets and land use change** must be further explored.
- **Looking at and approaching lifestyles from broader perspectives is important**. Time use, for instance, is a very important component. How people organize their everyday life affects their level and type of consumption. Another aspect has to do with **social motivations**, **what social factors and motivations are there that drive sustainability** and how can we harness those in a positive direction.
- **The nature of the debate around evidence and knowledge and how that impacts decision making, and our inability to properly project and predict the future in terms of the ways we behave.** This is a fundamental issue in developmental science.

B. Consumption choices, lock-in and enabling conditions

- Cost is often assumed to be a major factor in consumer preferences and technology related decisions (e.g. heating technology). Heating comprises up to 80% of household energy consumption. **Costs are a relevant factor but the existing infrastructure** (e.g. gas heaters in UK) **turns out to be a major factor influencing decisions and making it very difficult to switch from existing to other types of technologies.**
- In some domains and areas lifestyles are more sustainable, in some less, and it is not as much linked to behaviours and intentions as it is linked to **contexts and environments in which this consumption takes place**. We need to look at lock-in factors and enablers for sustainable or unsustainable lifestyles such as infrastructure.
- **Environmental destruction driven by advertisement and change in consumer preferences** (The Lorax by Dr Seuss's (1972)). The environmental policy community and environmental economists almost never talk about the role of advertisement in changing preferences. Preferences are assumed to be exogenously given and that they are formed by individuals using their own agency to fulfil those preferences rather than that they are socially shaped and structure-dependant and advertisement has a major role in that.
- **What can individuals really change in their behaviours and move away from all the lock-in such as infrastructure and social constructs.** How do we harness all these uncertainties, narrow them down and translate them into the EUCalc.
- **In general, we refuse to acknowledge how limited the individual agency is** despite all the research and evidence that suggest otherwise. This is striking. We continue with **consumer scapegoatism, blaming consumers, instead of looking at the context and power dynamics that are in place and are driving consumption.**

- **Lifestyles are often framed in relation to individual choice but we need to understand and take into account necessities and how these are not met,** and also constraints versus choices. Web of dependencies are quite invisible; those with more choices tend to have large web of dependencies while at the same time there are those who only have needs and those needs are not met. The latter's environmental impact differs significantly and we need to make these webs of dependency more visible.
- **We don't have a single clue about sustainable lifestyles since we are so busy trying less unsustainable options**.
- **Social lock-in and technology lock-in.** Norms can be challenged through participative methods, including norms around individual choice. Similarly, sufficiency strategies, satisfying human needs with lower material and energy throughputs (Alcott, 2008), can be scaled up through participative methods, discussion of sustainable lifestyles.

Box 1 The ENERGISE project

Marlyne Sahakian outlined the Horizon 2020 project ENERGISE, emphasizing the importance of community engagement and dialogues for the actual reduction of energy consumption in households across Europe and not just energy efficiency.

- A collaborative research project looking at what can be done on both individual and collective levels to reduce household energy consumption in Europe;
- Going beyond energy efficiency to explore ideas about energy sufficiency in households in terms of consuming differently and consuming less energy;
- Investigating lifestyles in relation to every day practices, and how that relates to habits routines, social norms and how that changes across cultural contexts in Europe;

ENERGISE will develop an innovative conceptual framework. Thousands of existing initiatives that look at how we can reduce household energy consumption in Europe will be reviewed and translated into a searchable database. 16 Living Labs in 8 countries will be conducted and the observations evaluated in terms of energy consumption reduction potential. Cross cultural analysis will examine what works and why, and policy implications will be identified and recommendations developed to guide policies and decision making.

3.2 A global perspective on Lifestyles

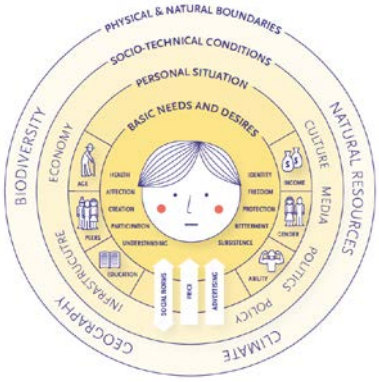
Lewis Akenji drew a broad picture of our understanding of (un)sustainable lifestyles and emphasized the relevant aspects for energy calculators such as EUCalc. He referred to his latest UNEP report for the state of research as well as the next steps (Akenji and Chen, 2016). His key messages are the following.

- **Calculators and numbers, how they relate with lifestyles?**

  Living on "one-planet lifestyles" can be measured and translated in different ways either through CO2 emissions per capita or material footprints, etc. The required reduction for European countries is massive (e.g. 80% in the case of Finland).

  The key sectors where lifestyles have a high environmental impact are food/diet, transport, housing and leisure. These are often framed differently and analysed separately, depending on each researcher.

- **A broader perspective on lifestyles is required before they can be quantified**



  Energy is particularly interesting because production is primarily a technical issue but consumption embodies multiple aspects including non-technical ones. How to capture the latter in a proper way within energy calculators is a very interesting question. For example, the numbers behind product labels can be puzzling, yet consumers make up their minds within seconds. The complexity of people's decision making process is high and our understanding of these processes remains low.

- **Look at lifestyles before framing them in the context of sustainability**

  Interfering with people's aspirations is tricky and inevitable to move towards sustainability. Every day practices are not about harming the environment, but about meeting essential needs, social expectations, personal desires. The choices available through market and non-market platforms determine what people consume. Consumption must be framed in the context of needs and wants or desires (e.g. Max-Neef et al., 1992). However, the definition of basic needs is changing rapidly.

- **The ring of lifestyles, putting consumption in the context of needs**

  As shown in the figure above, our *personal situation* has a strong impact on our consumption (Akenji and Chen, 2016). Choices are influenced by our social networks, level of education, income and fiscal ability, and we have some control over these factors. Research and awareness about this first layer is growing.

  The second layer are *socio-technical conditions*, infrastructure, economic implications of consumption, culture, media, etc. This level is where most of the research challenges lie. Usually, this is hardly translated into numbers.

  The outer layer of the figure above is what frames and limits *boundaries of consumption* e.g. biogeochemical and physical boundaries.

- **Consumer *scapegoatism*, shifting responsibility onto consumers, is widespread and there is a lack of recognition of how limited individual agency is.**

  When we explore the food system, for example, the 'consumption phase' is often a black box with a lot of complexity in decision-making that is not often explored. If one really wishes to understand how to drive change towards sustainable lifestyles, one needs to consider 3 main determinants: (1) the **attitudes** of consumers, policy makers, producers, managers, etc. which depends partly on their preferences, (2) the set of **facilitators** that connect consumer attitudes and knowledge with practices that you would like to engage (e.g. norms, practices, prices). (3) the **infrastructure** which sets the conditions for lifestyle patterns –in other words, the socio-ecological interfaces that support consumption activities including physical infrastructure (for housing, mobility, and leisure), and the design of systems of provision (e.g. pricing and capacities of utilities like water and energy) used to satisfy consumer needs and desires.

3.3 A European perspective on Lifestyles

Sylvia Lorek provided some lessons on (un)sustainable lifestyles from research done within the EUFORIE project (European Futures for Energy Efficiency). She emphasized the distance separating us from sustainable consumption and introduced the distinction between weak and strong sustainable consumption. In the context of energy, a parallel can be drawn with energy efficiency and sufficiency. Her main messages are the following.

- **Sustainable consumption means different things to different people**

  Should we have household consultants advising us on our decision making, experts in economics, researchers on resources and material consumption from extraction to consumption to waste.... These different individuals use the same words but mean different things.

  Different professions mean different things when they talk about sustainable consumption: household consultants provide advice on sustainable behaviours and purchasing decisions. Economists approach consumption as factors in economic models addressing actors in public and private consumption to become more sustainable. A third group highlights that production already involves consumption – the consumption of natural resources all along the supply chain.

  To approach sustainable consumption in a meaningful way, one must focus on the cornerstone of resource consumption. Otherwise there is a risk of getting lost in marginals.

- **Weak sustainable consumption is necessary but not sufficient, strong sustainable consumption is needed**

  Weak sustainable consumption focuses on the economy, products and development of markets (the EU approach falls here, focusing on being the most competitive and on strengthening consumption).

  Strong sustainable consumption also takes into account patterns and the level of consumption that leads us away from markets only and provides room to consider degrowth and sufficiency in order to reduce resource consumption.

  In the context of energy, weak and strong sustainable consumption can be associated with energy efficiency and sufficiency, respectively.

- **Highlights from the EUFORIE project on efficiency and sufficiency**

  Space heating is the most energy intensive sector in almost all EU countries observed within the project (Spain is the exception). Optimizing electrical appliances and lighting is fine and needed but this is not as important as space heating in moving towards sustainability.

  Germany is very efficient; Eastern European countries waste a lot of energy due to poor insulation of buildings and inefficient heating technology (low efficiency boilers, etc.). Despite its efficiency, Germany uses up much more energy and this discrepancy is caused by the higher than average size of apartments and dwellings.

  Square meters matter. We are still in favour of single standing houses with a room for every person, each with all the electric equipment possible (e.g.

Røpke, 1999).

Results from efficiency pathways show that it is very unlikely that we will reach EU efficiency targets through efficiency gains alone. Policy instruments remain focused on technology and we talk a lot about new buildings but existing ones need to be brought up to standard as well.

- **The challenge of space heating can be tackled by measuring energy use per capita rather than per square meter.**

  Public policy and financial sector can achieve much through price signals, shifting e.g. public loans from square meter to per capita measures.

  The example of a Swedish company that tried to construct a "one-ton lifestyle" is particularly telling. A highly efficient, 130m^2, house was built for inhabitants who had to go vegan, yet the project failed to achieve a "one-ton (of carbon emissions) lifestyle" on a per capita basis.

  More successful experiments systematically reduce surface area per capita such as vertical cities with small private units and plenty of common space, for example in Cologne. The tiny house movement is also an example of sufficiency and degrowth.

  Housing cooperatives invest/crowdfund to buy and renovate space so that people can live a different lifestyle in a more collective and communal way.

- **Wide stakeholder engagement as a prerequisite for change**

  Designers, architects and builders must be involved in providing new housing and renovating old buildings and their terms of reference and ways they are paid needs to change so that new ideas can be implemented at lower costs.

  Housing developers and cooperatives have a role to play, for example a housing cooperative in Zurich rents apartments where the space must correspond to the size of the family/household.

  Municipalities usually have efficiency consultants, and should have sufficiency consultants as well. When families are shrinking they are nonetheless staying in big houses, and even if they would like to move, they usually don't know how. We need institutions to facilitate such moves and people's participation.

In short, energy consumption in the building sector is an enormous challenge and given the incremental improvements and long life times of buildings, behavioural and in particular sufficiency solutions needs to be implemented.

4 Implications for the EU Calculator

4.1 Insights from the participants

Participants were invited to discuss the key points raised above in relation to the EU Calculator. The results are summarised below.

- **How can we account for the different goals of the calculator and how can we unpack the diversity of opinions and debate?**

  The EU Calculator accounts for different consumption patterns through levers parameterized against a set of overarching criteria on four levels (1 to 4). For every action point or lever one can set a level of ambition to mitigate climate change; level 1 is no ambition to mitigate climate change, level 4 is extreme ambition. For instance, the way the potential for bioenergy is contextualized is an expression of existing debate, and users set levers in a way that manages bioenergy. There are very specific deterministic calculations underlying the impacts of different choices that affect bioenergy provision.

- **Moving from weak to strong sustainable consumption**

  Strong sustainability is different from strong sustainable consumption, and a distant target as resources and production factors are more substitutable than complementary. Strong sustainable consumption asks questions how we should live with available resources, considering the levels and patterns of consumption (Lorek and Fuchs, 2013). Weak sustainable consumption means thinking in terms of products and services, things happening in the market.

  Consuming efficiently means optimization of products (goods and services) per unit of consumption whereas consuming differently explores how those goods could be shared or co-produced. Consuming sufficiently considers the global perspective of resource constraints such as the global carbon budget to limit climate change. A fourth approach is focusing on sustaining well-being or thriving which considers sustainable ways of living beyond material consumption.

- **Differentiating between the intention and the impact of behavioural changes**

  People may intend to behave sustainably, but their impact may be insignificant. We need to differentiate between intention and impact, focus on inconsequential behaviours, enabling conditions and choices that have lower impacts and correlate these with strong sustainability.

- **Developing interactions between disciplines and methodological approaches to understand individual decision making processes**

  Understanding the factors which influence consumer choice and lifestyle patterns is challenging, the complexity in people's head and in their actions is huge. The problem is that there is not enough dialogue and interaction across approaches for understanding decision making. Economists focus on rational decision making and we know from empirical research that decision making is often irrational and influenced by emotions. Heuristics and

emotions play a much more important role than we thought. Contextual factors also shape choice. Multiple perspective can help promote sustainability initiatives without placing the burden of responsibility on final consumers and lever levels could account for equitable vs. hierarchical scenarios.

- **Talking with people where they are and with their language**

  In business, from industry to services, the discourse that catches attention is that it would be enough to do the "wrong things" better, which correlates with weak sustainability. Instead, doing the "right things" should be associated with economic opportunities. The language used makes a big difference in getting people's attention and understanding, this is key for the target audience of the Calculator.

- **The interface between technology and behaviour needs more research**

  There are different factors influencing lifestyles and we need to pay more attention to the relationship between technological development and individual behaviour. We understand what constrains people when they shop, but the way people shop is changing rapidly including shopping online. Similarly, automated production will have significant impacts on employment and how people earn a living. If we look at production and consumption as a coupled system, there is automated production as well as consumption. This is a fast evolving trend and will have implications for energy calculators. Algorithms can already anticipate our needs and wants and could replace individual consumer choices soon. These developments should be captured in the debate and anticipated in a calculator.

- **The changing nature of work is also a key factor**

  Not only are consumers changing how they choose things but the nature of work is changing. Artificial intelligence is taking over many tasks and jobs. There is high unemployment in specific sectors and inequalities in terms of how the evolution of work is impacting different segments of the population. Consumption is not separate from who is earning what. This should be reflected in the calculator.

- **Sufficiency has different meaning across contexts and time scales**

  If the goal of sufficiency is clear, the question remains what it means in different cultural, geographical or economic contexts. Sufficiency across Europe has a very different meaning in North and South, now and in 2050. In most European countries, the challenge is to deal with overconsumption and over flooding of consumer goods, including food. The advertising industry continuously creates new desires with their respective impacts. However, curbing unneeded or unwanted consumption is not a priority for the industry, but the calculator could anticipate such changes, voluntary or mandatory.

Box 2 The LILI project

Julia Steinberger presented approaches to sustainable lifestyles developed within the research project LILI.

- **Emissions will need to go down steeply in a relatively short period of time** (Figueres et al., 2017). It's not optional anymore.
- **What are the biophysical resources required to sustain human well-being?** This is the reverse question, it starts from a well-being perspective and human needs perspective.
- **What influences social and technical provisioning systems, and not lifestyles.** This is about production and supply chains, power and ownership structures and political economy approach.
- **A structural approach to lifestyle.** Large infrastructure systems are run in a way that the consumer has very limited scope for choice/action. If one takes for instance water and electricity systems, the way those systems are structured, the way they generate revenue, inevitably comforts the dominant industry.
- **Methods and components of the project.** The quantitative part of the project consists of mapping evidence for satisfying human well-being at different levels of resource use, international/national, socio economic group/income, household levels. There is a political economy component, focusing on electricity and transport with community case studies, and some scenario development.

4.2 The EU-Calculator lifestyle module

Following the general discussion, the specifics of how the EU calculator accounts for lifestyles were presented and discussed. In addition to the general levers, the discussion focused on the most energy intensive sectors, buildings, transportation and food/diet. The objective of this discussion was to test and improve the assumptions that had already been made in the calculator and include additional critical drivers that might have been missed. From a modelling perspective, the team was interested in identifying factors that can be measured in a way that balances simplicity and complexity. How far can we push our ambition without destabilizing the energy system?

Participants discussed in small groups, each one of which had a member of the EUCalc team. In addition to the discussion, participants were asked to fill in worksheet where they had to rate the different drivers and levers. The main messages and questions that came out of the discussion are summarised below.

- **Clarify the system boundaries. What about embodied energy and emissions in trade?**

  Emissions arise where they arise. Emissions from the manufacturing of imports abroad will be accounted for in the Rest of the World (RoW). The EUCalc will include a metric between the member states and Europe and between Europe and the RoW. The model is driven by self-sufficiency, meaning that demand must always be met, whether endogenously or exogenously. The RoW is defined as in the Global Calculator, which is a closed system, such that the impacts of European imports in the RoW are calculated from the impacts of production in Europe. China will be encapsulated and parameterized in the RoW.

- **Behavioural changes from a landfill tax in the UK**

  A landfill tax has made it very expensive to dispose of waste in landfills, leading to changes in behaviour and investments, not just on the part of consumers but of local governments and businesses who now look at ways of diverting waste from land fill into recycling, reuse or remanufacture of products in order to avoid the land fill tax (cf. risks and rewards lever). Other examples

- **In the relationship between diets, health and cost (public and private), how can the latter be accounted for?**

  The higher the expenses on food do not necessarily mean the healthier the diet. Expenses include a significant share of value added, convenience or processing.

- **Can we include social norms not only in terms of behaviour, but also in terms of structural factors that influence and lead to sustainable lifestyles and choices such as time use?**

- **On disruptive changes and tipping points, what aggregate phenomena should be considered?**

  Accounting for hybrid models between individual agency and structure would likely overcome polarizations, although non-linear dynamics are challenging.

- **How do we also include considerations beyond lifestyles – happiness, satisfaction, compassion in the calculator?**

Lessons for the calculator are that levers should integrate more explicitly two of the most important drivers of energy consumption: income and age distribution. Both of these influence housing and transportation as well as food/diets. The calculator should also allow for sharp changes, such as deep cuts in emissions.

Box 3 The GLAMURS project

Adina Dumitru presented the findings from GLAMURS. The project worked to identify major drivers and obstacles for sustainable lifestyles and green economy, by assessing present day information and developing dynamic models of lifestyles change, looking at social, economic and environmental tipping points, how social phenomena contribute to shifting the system from one state to another and what's possible from the bottom up and what really needs to be top down.

- Integrating theory across different disciplines, especially psychology and economics and also environmental assessment. A set of methods and tools (including modelling and scenario development).
- Going beyond the dichotomy of individual and structure, looking at what can be done by collectives, sometimes small collectives, sometimes large collectives, that can actually change the system in a particular direction.
- Evaluation of drivers and constraints of present day lifestyles and technologies (interviews, surveys) but then also looking into the future by developing participatory scenarios and assessing their feasibility against economic and environmental indicators through simulations.
- Seven regions in Europe, with 3 sustainability initiatives in each one, in different domains: food, energy and consumption of manufactured goods, housing.
- Lifestyles categories: work life balance, status, use of buildings, energy use, mobility, nutrition and consumption of goods.
- **Lifestyles as patterns of time use**

  Material consumption and infrastructures are considered as patterns of time use which is liberating in terms of looking at how the same activities and consumption patterns can be accomplished with different levels of energy and material requirements.

  Approaching lifestyles from this perspective is considered more compelling than looking at it

through the lens of environmental impact as has often been the case (e.g. sustainable lifestyles are often assumed as people driven by environmental concerns).

- **Social connectedness and meaning are more important motivations than environmental impact**

  Looking at sustainability initiatives in different regions, they are not principally driven by environmental considerations but by social connectedness motivations.

  Slower mindful pace of life enters into what people consider more sustainable lifestyles Deceleration and more time for collective, neighbourhood quality, and community activities is desirable.

  Physical and psychological well-being are important determinants for people to choose particular lifestyles, whereas well-being is a societal aspect of lifestyles (e.g. work, disconnection with the environment, etc.).

- **Focusing on sustainable food is a very promising approach**

  Activities around sustainable food bring together production and consumption patterns while also addressing other values such as health.

- **Sustainable lifestyles changes require supportive contexts**

  Having more **control over time and flexibility** is very important for well-being and sustainability. Time use and affluence are important entry points for sustainability. There is a polarization in a society between people who have a lot of time, wanted or unwanted, and those, who do not enough have time. This is closely related with income and footprint.

  Landmark life transitions (e.g., moving house, having a child, retiring) are powerful moments to shift people's habits. People are actively choosing where they live and work.

  Promoting pro environmental behaviour is relevant since **identity and social norms have a significant impact on choices** but also social tipping points. This was found through quantitative and microeconomic modelling. Who we are and how we define ourselves, in relation to the environment and particular groups such as sustainability initiatives, has a very important role.

- **Changes in patterns of consumption are important but not sufficient**

  Changing lifestyles will impact changes in consumption, including social norms to support these changes. Efficiency and sufficiency models have been tested through macroeconomic modelling. Even if changes occurred on a large scale, e.g. 50% of population, it would not be sufficient in itself. Institutional and policy changes as well as low carbon technologies will be required.

4.2.1 Lifestyles and buildings

The presentation of the EUCalc building module raised several questions and complemented the presentation on the results of the EUFORIE project shared by Sylvia Lorek. The key questions raised and the answers that were built in a collective thinking process are provided below.

- **How will the calculator account for electric cars that can be plugged at home and possibly provide energy services to the grid?**

  The calculator should make it explicit if electric cars are considered as part of appliances or means of transportation or both.

- **How does the calculator account for climate change?**

  Positive or negative feedback on electricity or fuel use from more or less heating degree days (including heating types) or cooling degree days (including air

conditioning) should be taken into account. Spain, Italy and the rest of Europe have different profiles (Wenz et al., 2017).

- **The ownership structure of the building stock is an important enabler / barrier / constraint**

  The landlord and tenant responsibilities for renovation and energy bills remains a challenge for improving energy efficiency of heating systems and buildings in general.

  Can the level at which one sets a lever in the calculator influence the proportions of social and private housing? More social housing creates leverage for government action and takes a decision out of individual domain.

- **Preferences or tolerance to certain indoor temperatures is country dependent**

  There are cultural differences when it comes to perceptions and understanding of comfort. The calculator should ideally take this into account as room temperature has a strong influence on energy consumption for heating and cooling.

4.2.2 Lifestyles and transportation

Similar to the building module, transportation raised many questions and more interestingly, it is a sector in which disruptive changes are expected to be the most prominent. This includes for instance autonomous vehicles, electric mobility and new rules in air travel such as taxes or even quotas. Participants were also asked to fill in worksheet during the discussion. The key questions and the outcome of the discussion are provided below.

- **Decoupling of GDP and km travelled**

  Better urban planning and mixed use urbanizations combining working and living spaces reduce the number of km travelled per unit of GDP or shift the share of km travelled for work and leisure, hence the transportation mode.

- **Flexible work hours, telework**

  What are the impacts of working from home, shorter distances travelled, but does this lead to more space heating when people live in larger spaces to accommodate work-at-home? The calculator should take this into account.

- **Our societies are increasingly mobile, scattered around the globe, hugely dispersed, and trapped into air travel**

  Considering the trend in air travel for future modes of transportation and passenger-km in the calculator is necessary. We have ways to deal with cars, but aviation will keep growing. Short haul flights account for almost 90% of flight emissions in some countries such as Germany. Curbing air travel is politically difficult.

- **Freight transportation should be considered in the calculator**

  This is especially important given the growth in online shopping.

- **Usage of cars is influenced by the status associated with cars in a society**

  Social norms vary across cities, socio economic groups, etc. making it either more or less preferable to drive. Also, people believe that it is more comfortable to travel by car even while the number of hours in traffic and time spent looking for parking increases. In particular, the comfort of cars will increase significantly with the advent of autonomous vehicles. This should be accounted for in the calculator.

- **Fuel types and costs have an important impact on the choices of technology for travel, as well distance travelled and consequently GHG**
- **Electric vehicles are projected to increase by 2050, with large implications for the electric grid**

  Owners of electric vehicles might even be paid to manage the load, to plug in and store electricity from the grid. Vehicle-to-grid should thus be considered in the calculator.

- **Does car ownership make a difference?**

  If someone travels 10,000 km in a private car or 10,000 km in hired car, what is the GHG difference, can it be quantified? Perhaps contrary to buildings, if everyone leased or hired a car, changing to more efficient ones would become easier, more energy and resource efficient.

- **Does ownership of multiple cars change fuel choice and consumption?**

  People are adopting electric vehicles, but are they replacing their old ICE car or keeping them for the weekends? Or worse, moving away from public transport, pretexting that EVs are clean. How does that impact material consumption and GHG emissions?

- **Car sharing services might increase distances travelled**

  Those who do not own or don't wish to own a car and use public transportation or car sharing services for urban transportation may spend the monetary savings on air travel, increasing distances and emissions (Heinonen et al., 2011). On the other hand to book a car, plan a trip, distance and time might negatively affect passenger km.

- **Car sharing and ownership yield similar emissions – as explained by the reasons for driving**

  The purpose is different, those who own a car tend to have higher emissions for work related travel, those who car hire have higher emissions for private and leisure travel. Overall, emissions are very similar (Garcia Mira and Dumitru, 2017).

- **Financial incentives are important**

  Fuel prices are one thing but fiscal policies in some European countries allow income tax deduction for commuting by car, turning travel costs virtually free.

- **We need to look at the nature and dimensions of systems of provision and infrastructure and how these are changing**

  Railroads have influenced aspects of everyday life. What about the investments in aircraft design, manufacturing, and in airport expansion, people will continue to fly.

- **Autonomous vehicle may enable more people to travel even longer distances** (including the elderly). Commuting might also see an increase in the average distance travelled.
- **Technology is important but we should consider the overall system**

  Infrastructure largely influence preferences that people will be pushed into. There's a lot of R&D and investments in aircrafts which will create demand.

Participants noted that defining levers, pathways or outcomes in the transportation sector is difficult. A few years ago the discussion would have been very different. Now a revolution is underway and disruption in individual transport is around the corner.

4.2.3 Lifestyles and food / diets

The levers for food were demonstrated in the Global calculator and the variety of suggestions from participants was large, similar to the uncertainties in the energy cost of food. Again, income, social norms and health are all important decision making criteria. The key questions and the outcome of the discussion are provided below

- **Dairy production is intimately linked with meat production and consumption**

  How is dairy accounted for in the lever? Eggs and dairy are simplistically parameterized, they are in the spreadsheet, but remained hidden (online tool) as a result of simplicity / complexity trade-offs.
- **Calories consumed are misleading**

  Perhaps calories produced or calorie supply would be a more complete indicator of energy consumption in food production since the issue is how much food is available for consumption.
- **Consumption of calories depends on income, physical activity, age and gender**

  On a national scale it depends on demographics, e.g. younger generations eat more, elderly and adults have different energy requirements.
- **Food waste is also linked to income**, around (at least) 20% of the food is wasted on a global scale, and at the European level this is close to 50% (over the whole food production chain, including crop wastes, storage, retail and household consumption).
- **If health effect and longevity are considered, then not only calories should be measured to estimate energy consumption**

  Fats and sugar consumption should be accounted for as well as the amount of processed food, as these have a significant impact on upstream energy consumption for producing these goods.
- **In terms of practices, does cooking at home and eating in a restaurant have different impacts on energy consumption and GHG emissions?**

  This depends on income, household size, and essentially influenced by distance

to restaurants and food markets. A large rebound effects was also observed for vegetarian households, re-spending savings obtained on meat and dairies onto equally intensive energy services (Grabs, 2015).

- **In terms of food production and globalized transport, there are footprint and GHG consequences.**

  External footprint, food miles, GHG emissions accounting should reflect that more clearly.

- **A large share of the feed and food in Europe is imported**

  The global food market means food miles might be a relevant indicator for the calculator along with calories produced/imported. In Europe, food is also transported internally south to north, which should be accounted for in the calculator**.**

Finally, limited consumer choices are also an issue for ecological, organic and seasonal foods, all at an affordable price. Moreover, there are production issues with organic food, as it cannot produce the same yields per hectare and the transition will take time.

5 Conclusions and challenges

5.1 General conclusions

The importance of socio-economic determinants of energy consumption and carbon emissions, such as income, age and possibly gender cannot be overlooked. Empirical research by the workshop participants and their research provide many ways in which sustainable lifestyles insights could be integrated more explicitly in the calculator.

The initial discussion revealed that lifestyles as not just a matter of individual agency but are largely constrained and enabled by structural factors. The energy system spreads across both perspectives as energy supply and demand covers everything from basic needs to economic desires. Thus, behavioural aspects, as well as structural, institutional, political conditions should be accounted for.

As Lewis Akenji reminded participants at the beginning of the workshop, people do not intend to emit large amounts of carbon emissions in the atmosphere, their choices are motivated by satisfying needs and aspirations. Hence it is paramount to show how wellbeing and prosperity can be satisfied and maintained at varying levels of energy consumption and carbon emissions by carefully choosing levers.

With respect to the methodology underlying the calculator, the context in which consumption takes place is key. A good model cannot include every parameter but accounting for differences across socio-economic groups sends a very different message than relying on national averages. If the calculator is used to encourage and discourage certain behaviours, the widening gap between rich and poor should be taken into account. From a policy making point of view, income distribution at the European level might be more relevant in energy terms than geographical representation.

The EU calculator should attempt to take an integrated approach and account for second order effects. These can be of at least two types. First, changes in one sector, for example building, can induce changes in another, say transportation. The consequences on energy consumption might be unexpected, positive or negative. Such interactions are particularly relevant for policy making when scaled at the national level.

Second, rebound effects from energy or time savings in one sector also have implications for another. Thus rebound effects can change the whole picture significantly. Much empirical research already exists on rebound in buildings, transport and food, including disaggregation by socio economic groups (e.g. Sorrell et al., 2009; Chitnis et al., 2014; Grabs, 2015).

More practically, the calculator could add a layer of simplicity for the users by accounting for space heating per capita or transportation per km/h to challenge the convenience of automotive travel. Since social norms determine consumption, looking at collective actions or upscaling individual ones, might facilitate the acceptability of more radical options such as sufficiency or energy quotas. This directly relates to the levels on each lever. For instance, how extreme is level 4 and for whom? Establishing a level of ambition taking collective actions into account may not be so extreme as for an individual household. The ongoing Transit project on social innovation research at the European level could contribute to assess the potential of collective action. The labels of each level could also be reconsidered for less value laden terms.

Finally, the calculator could provide scenarios that meet policy targets on a global level, the Paris agreement and Sustainable Development Goals for example, to highlight the magnitude and scale of lifestyle changes required to 2030 and 2050.

5.2 Challenges for the EU-calculator

At the foremost, the lifestyle workshop has identified a number of needs and detailed a number of challenges for the EU-calculator team. Knowing in advance that not all of them can be tackled during the time frame of the project, it seems paramount to isolate those which we deem as more critical to be discussed in the light of the EU-calculator modelling strategy.

Some of the needs and challenges raised during the workshop were very specific and shall be discussed as part of each module in the calculator (e.g., transport, buildings, energy and land). A number of cross cutting issues have been identified and are particular relevant for the work on lifestyles.

In Table 4 we summarize those for which a broader discussion in the EU-calculator should take place. In addition, we attempt to frame important questions to be discussed.

Table 4 – Relevant practical challenges and action points for the modelling work of the EU-calculator

Workshop input	Discussion
How to capture and account for disruptive changes in the presented sectors?	Although lever settings of the EU-calculator attempt to provide a broad-enough quantification of potential futures, perhaps efforts should be made for the explicit accounting of a "disruptive" level in some of the levers. Naming the level disruptive would communicate to the user that there are many uncertainties associated with the estimation of the level, but at the same time underline the potential of disruption. Although the term disruption is often used in the technological domain, its effects will be measurable as changes in lifestyles due to the tight coupling of the technology-behavior interface. There is a strong need to clarify the following aspects: 1. What does the project consider as disruption? The understanding of disruption will have to be incorporated in the definition of the highest levels of lever ambition in the calculator. For the case of lifestyles this has been previously defined as an "*extraordinarily ambitious and extreme effort*", interpreted as a "*revolution in behaviour and the maximum that could be considered socially acceptable and consistent with economic growth*". On the technological side the highest ambition level has been defined as "*extraordinarily ambitious and extreme*", "*not constrained by costs" and interpreted as a "as a situation in which there have been major technological breakthroughs that have reduced costs*". 2. *How to capture/include the effect of potential disruptions in the levers of the EU-calculator mode?* In regards to measure/simulate the effect of disruptions in the EU we foresee this to take place at different levels and via different strategies. The disruption could be made by the modification of past trends pointing for a turning point in the historical development. For example, in the

	case of road transport there are indications of a saturation effect followed by a slight decline of between km travelled with high and very high per-capita GDP. This observation has many possible explanations; changes in the type of commuting (people's preferences and travel for leisure, work, shopping, etc.), urban planning (services distribution or vertical cities), or remote activities (e.g. online shopping, teleworking). Although the weight and combination of factors remain unclear, in the EU calculator we are more interested in the effect itself, rather than on the causes. Therefore, a disruption in the EU calculator could take the form of an enhanced decoupling rate superior to the one we are currently observing. Meaningful intervals for the enhanced decoupling could be matter of discussion in the dedicated stakeholder workshops (in this particular case the transport workshop). There is the need to look for studies which managed to quantify the potential for decoupling (e.g. Schroten et al., 2011). The effect of disruptions could be informed directly via stakeholder consultation, in the sense that the expert would inform the team on the disruption potential of a given lifestyle of technological change. This information would then need to be contextualized for other socio-economic realities different from those supplying evidence to the expert judgement. Finally, disruption can also take the form of conditional lever selection within or across sectors/modules. Disruption that could happen with Musk's hyperloop might decrease flight passenger km by 2050 as a result of changed mode of transport preferences (price competitiveness, speed, convenience and other enabling factors). This could be presented in the model as sharp decrease in flight pkm in level 4. During the workshop, few people mentioned flying as unavoidable fact of life due to work and family reasons, and this trend will probably only become more widespread across Europe and globe, without technological disruptions it is hard to imagine disruption or change in flight pkm. ***Action 1: Systematically account for the lifestyle and technological disruptions that are more relevant in each WP.***
Individual agency in changing lifestyle is conditioned by existing infrastructure and services. **The ownership structure of the building stock is an important enabler / barrier / constraint.**	More than pointing implications on how to define lifestyle levers it points the need of having at least some of the levers depending on each other (see also above). Having a strong adoption of electric vehicles implies that the infrastructure (and technology) is in place, or that it will follow. If for one country the foreseeable infrastructural developments are slow, then the ambitions levels for lifestyle lever depending on that technology should be limited. ***Action: Identify the potential lifestyle-infrastructure lever interactions in EU-calculator modules***
Demographic changes are important to account for. E.g., calories consumed depend on age structure of the population, longevity, physical activity.	Incorporating the effect of a changing demographic profile in lifestyles metrics needs to be discussed further. As in the cases above, in some sectors the effect of demography on energy consumption might be stronger than in others. Prioritizing modeling efforts will therefore be needed. The particular example given of demographics influencing calories consumption might be valid also for other lifestyle domains (e.g., transport and buildings). On the positive side these are easily approximated by looking at calorie demand with changing age, body weight and physical activity. Importantly, there needs to be an agreement of whether demography should be incorporated as a lifestyle level in the form of e.g., children per woman; or as “external” demographics, following the strategy in the global calculator. The fertility rate and longevity will then dictate the age composition. In addition, it might be difficult to define levels of levers when it comes to a controversial issue such as demography. On the technical side, there would be the need to have the separation of distinct age groups influencing the final level of levers. Presently there is a simple linear dynamic, if number of population increase/decreases that is applied consistently across sectors.

Action 2: Decide if demographics should be a lifestyle lever or be considered at scenario level (exogenous to the calculator)

Action 3: Take stock of which modules and in which form, different demographic profiles of the population can lead to substantial differences in the levels of levers.

How to account for the rebounding effects that a lifestyle change can entail.	Incorporating the issue of rebound effect in the EU-calculator should be a matter of discussion as it might proof attractive for some users. Several strategies could be envisioned: 1) Make a thorough investigation of quantified rebound effects from based on literature research. 2) Identify the levers in the EU-calculator model for which a robust quantification of rebound effects exist. 3) Make the respective levers depend on each other according to the rebound effect investigated (e.g., less car travel leading to more international flights). 4) Rebound is simulated manually through lever settings, but we may identify critical rebound effects and position alarms in the calculator for users (e.g. beware, selected setting in lever "x" is intimately connected and impacts lever "y"). Regarding the buildings and transportation sectors research on rebound effect and estimates are now becoming relatively robust, across EU member states (e.g. Freire-González, 2017). A few studies, in particular for the UK also look at socio economic groups (Chitnis et al., 2014). Indirect rebound from diets and food choices and non-energy services remain much more uncertain, given the lack of research. One study shows that rebound from dietary changes might exceed that found in building and transportation sectors (Grabs, 2015). ***Action 4: Evaluate the appropriateness of including direct rebound effect in the building, transportation and food modules.***
The effect of climate change in lifestyles, E.g., heating and cooling thresholds are not the same for every country.	The effect of climate in lifestyles has not yet been a matter of concern in the EU-calculator. The example pointed is relevant but will also ultimately have to be seen in combination with the infrastructure dependencies (see previous points). The first priority in the EU-calculator should be to first assess what are the current heating and cooling thresholds in each EU country and suggest a strategy on how to make these evolve in the future. ***Action 5: List the main entry points in which climate influences changes in lifestyles, or, causes impacts to particular modules (e.g., energy, land).***
Looking at production and consumption as a coupled system, there is automated production as well as consumption. This is a fast evolving trend and will have implications for energy calculators.	Automation is a fast evolving trend that cuts across different sectors, including transport or industrial/manufacturing robots. On the consumption side, “algorithms can already anticipate our needs and wants and could replace or facilitate individual consumer choices soon.” AI and automated production might be modelled indirectly through its estimated efficiency gains, if any, as well as its impacts (social impacts) on employment and income distribution. Algorithmic consumption can be modelled through its implications on transport, passenger km and freight km as in case of online shopping. Several people during the workshop mentioned the importance of well estimated freight due to online shopping and imports.

Action 6: Discuss in which module/modules the implications of automation are critical and discern on the significant benefit for CO2 decrease (any efficiency gains to be expected?).

Action 7: Discuss how automation can at least indirectly be presented in the calculator, what implications are for energy, resource use, and society?

Those people with more choices tend to have large web of dependencies while at the same time there are those who only have needs and those needs are not met (....) their environmental impact differs significantly and we need to make these webs of dependency more visible.

Incorporating the effect of a changing income distribution profile could be pursued in some of the key identified sectors/levers e.g. diets or home heating patterns. Bottom income households live in low efficiency dwellings, and even so have lower than average energy consumption at the expense of their health. Diets, indirect emissions from agricultural products, are also different. Distinguishing footprint of different income groups, as Julia says, implies different levels of responsibility for action and change. Empirical research for the UK shows that mainly socio-economic rather than geographic and infrastructural factors strongly determine the carbon footprints, namely education level, income and car ownership (Minx et al, 2013).

Action 8: Discuss how to include the effect on consumption of income distribution in the EU-calculator.

Action 9: Discuss whether the effect of income distribution need to be considered to set the level of levers, or are the effects more important at the level of model outcomes?

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7 Annexes

Further reading

ENERGISE project

EUFORIE project

Glamurs project

LILI project

Transit project

Innovation for the Earth: Harnessing technological breakthroughs for people and the planet (2017), PWC UK

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