

Lifestyles and consumption behaviors in energy transition scenarios

Technical file #5

Information and recommendations for scenario producers

This document is part of a set of 12 technical files. These files have been produced by *The Shift Project* after nearly 2 years of research and experts consultations on the different aspects of energy transition and the future studies around these aspects.

Our project, “Power Systems 2050 – Guidelines for future studies on energy and power transitions,” started in January 2018, involved approximately 60 experts through interviews and workshops, reviewed more than 300 works, including about 20 future studies. The objectives and approach of this project are discussed in the executive summary of the framework.

Several aspects of the energy transition are handled in these technical files. However, **on the energy supply-side only the power system has been studied**. The main reason for this choice is that we had to start from somewhere with limited resources, and the power system seemed to be a key system to study in the energy transition context, towards a low-carbon economy, as shown by the growing number of future studies focusing on this system. However, the guidelines we propose could be completed by analyzes on the other energy supply-side systems (the gas system, oil system, heat system and so on).

Each technical file tackles several aspects of future studies for the power (and energy) transition. Here is the complete list of the technical files produced during the project:

#	Technical file title
1	Future studies on energy transition
2	Energy transition models
3	Boundary conditions for energy transition scenarios
4	Long-term evolution of energy consumption in energy transition scenarios
5	Lifestyles and consumption behaviors in energy transition scenarios
6	Long-term evolution of the power system supply-side in energy transition scenarios
7	Power system operation in energy transition scenarios
8	Impact assessment in energy transition scenarios
9	Transition desirability in energy transition scenarios
10	Environmental assessment of energy transition scenarios
11	Economic evaluation of energy transition scenarios
12	Employment assessment of energy transition scenarios

Altogether, these files cover the fields described on the following map of the guidelines for future studies on the energy transition. The document you are reading covers the red-circled topics.

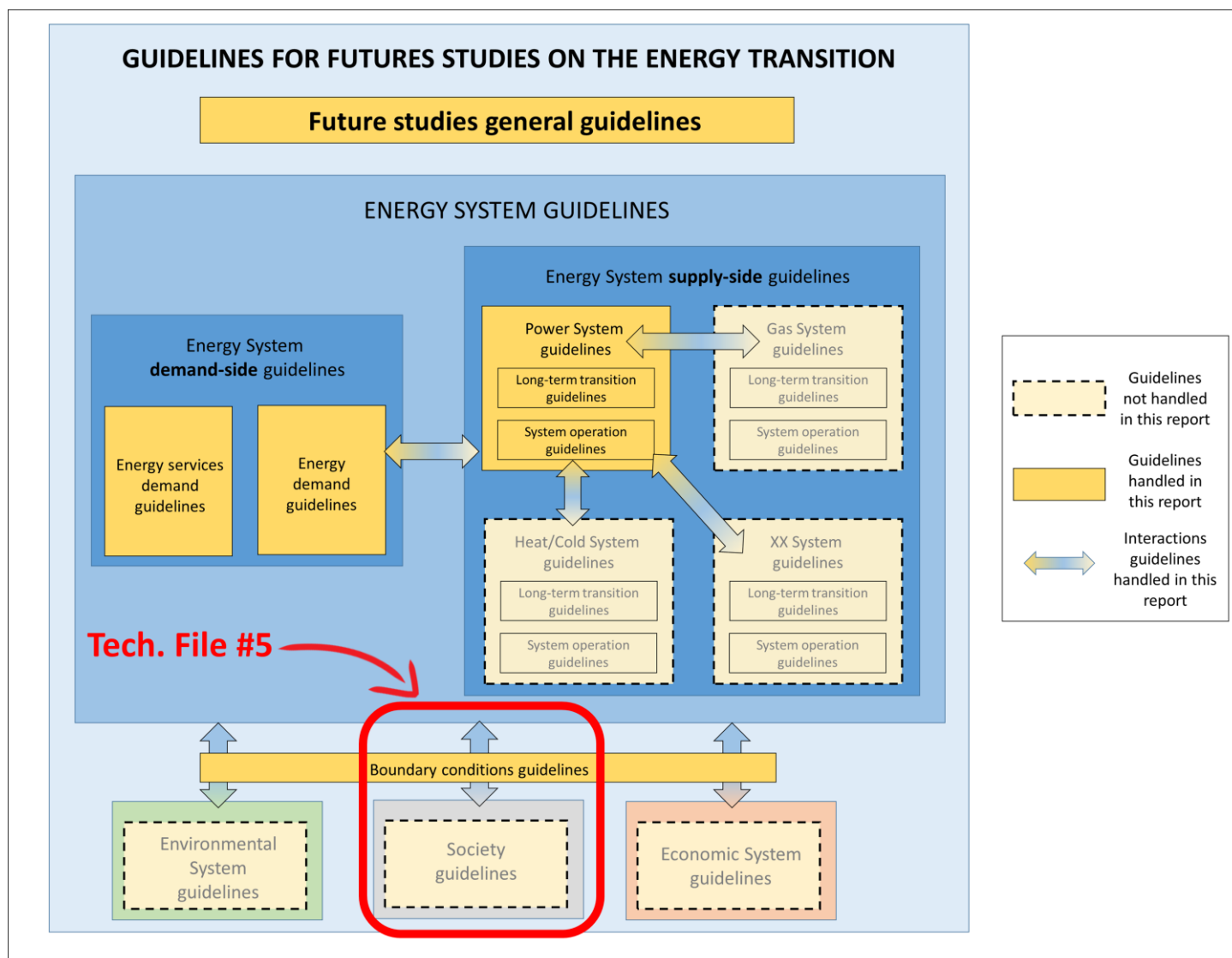


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Reading keys

Explanation box, containing key information for a better overall understanding of the subjects.

Recommendations to scenario producers:

These boxes contain the recommendations for scenario producers.

The word “should” means that scenario producers, if they are to follow the guidelines, must substantiate the corresponding point. The words “may” or “might” relates to suggestions, ideas to help the scenario producer respond to the point.

Questions in italic are examples of questions scenario producers might ask to substantiate the points. They are here in an illustration purpose.

Phrases in italic relate to words which are being defined and will be subsequently used in the framework.

Phrases which are highlighted in yellow refer to other technical documents of this series.

I. Main aspects of consumption behaviors: lifestyles and inertia

There is a strong link between energy system evolution and society evolution.

The first, clear interaction between both systems appears when people negatively reacts when an energy related infrastructure (a new power plant, a new high-voltage line...) is being installed. These reactions have pushed research to study the public acceptance phenomenon: why do people desire, accept, or reject, a project? Too often, scenarios assume that if a technology is cost beneficial it will be readily adopted (Stern, 2017). **Section about desirability** handles this question.

But further than this aspect, energy is at the core of our lifestyles, having a strong influence on public health, economic inequality, employment, and even social stability and international relations (Stern, 2017). Energy is embedded in our socio-cultural systems, as one may realize when she thinks about the changes brought about by the electrification of our lifestyles (Ruotsalainen, Karjalainen, Child, & Heinonen, 2017), or by the uptake of oil mass production (Auzanneau, 2018).

Some future studies recognize the importance of the psychological, sociological and cultural determinants of energy demand (IIASA, 2012), which complements the usual technical and economical approaches. Integrating lifestyle and behavior considerations in energy transition scenarios makes them more robust to social reality, and provides useful tools for decision makers to understand the social risks associated with a scenario.

This section investigates the causes of lifestyles and consumption behaviors changes, as evoked in future studies and as handled by behavior sciences.

A. Lifestyles and consumption behaviors are deeply intertwined

The notion of lifestyle is ill-defined but relates to "our ways of "doing", "having", "using" and "displaying", our behavior and all of the related products, objects and infrastructures. They are marked by our relationships to time, to space, to others, and to ourselves" (Le Gallic, Assoumou, & Maïzi, 2017).

Lifestyle is often evoked as linked to, or as a determinant of, consumption behaviors. Lifestyles "contain a set of key determinants of mobility, housing, spatial planning or the organization terms of the productive sectors (industry, agriculture, services). They thus constitute a fundamental component of direct and indirect energy consumption" (Le Gallic et al., 2017).

"Energy services demand is determined by needs and preferences for multiple services, which in turn depend on, in addition to income level and prices, home country characteristics, dwelling area and type, job and leisure activities, diet preferences, cultural context, religion, etc. A certain lifestyle is characterized by a bundle of these determinants combined with a more or less explicitly framed worldview, a set of values and convictions, preferences, and behaviors. (IIASA, 2012)"

Concretely, the concept of lifestyle is used through typologies. Most proposed typologies are developed along two broad types of dimensions: the first type gathers the aspects pertaining to the environment in which the individual lives, such as her physical environment (dwelling area and type, home country geographical and climate characteristics...) and social environment (people the individual gets along with for example colleagues, friends, family members) and economic resources (income level and prices, savings). The second type gathers the aspects pertaining to more subjective, less concrete, concepts such as values, cultural capital, or life objectives (Tabbone, 2017).

Pragmatically, we consider here that the first dimension (social, physical, economic contexts) represents the different aspects of the present context whereas the second dimension (values, cultural capital...) represents an internalization of the past environment of the individual, that is, a more or less conscious memorization of past experiences¹ which still influence current practices, intertwined with an expression of her inner tastes (Baum, 2016a, 2016c).

¹ Such as received education, upbringing, past interactions with significant others, book readings, or any significant past experience.

In that sense, lifestyles can be said to determine consumption behaviors: the present context (physical, social, economic, institutional...) influences consumption for example through prices, advertisement, imitation of significant others, marketing, physical accessibility² and so on; past experiences with consumption also influence present consumption, through learning how fulfilling a product, or a service is on the short and long run, through past reactions of significant others to one's consumption and so on (these learning effect are sometimes called "brand attachment" when their outcome is positive for the product, or service).

The other way round, "material goods are important to us, not just for their functional uses, but because they play vital symbolic roles in our lives. This symbolic role of consumer goods facilitates a range of complex, deeply engrained 'social conversations' about status, identity, social cohesion, group norms and the pursuit of personal and cultural meaning. In the words of Mary Douglas (1976) 'An individual's main objective in consumption is to help create the social world and to find a credible place in it'" (Jackson, 2005). Hence lifestyles can be said to be influenced by the results of these consumption behaviors. For example, the use of an acquired good can trigger positive reactions from a group of people the individual wants to, or already, belong to, acting as a positive mirror and reinforcing the type of consumption and lifestyle shared within this group of people.

In a word, lifestyles and consumption behaviors co-evolve.

B. Some behaviors require more time to evolve than others: behavioral inertia is a key determinant of transition desirability

Two aspects of this co-evolution are key for our understanding of energy services demand: diversity of lifestyles among a population, and inertia.

Diversity of lifestyles is inherent to the concept of lifestyle, which is mostly applied at the individual level (Tabbone, 2017).

The inertia of the co-evolving couple "lifestyle and consumption behaviors" is often talked about in terms of "identity", "values", "convictions", "social norms", such as in (Bögel & Upham, 2018; Martin & Gaspard, 2016; Roy et al., 2012). These factors of inertia are said to be "internalized". They are deeply rooted in individuals as they emerge and build up from an early age, through social interactions with significant others, local community and society as a whole, including parenting and education. They are also generally shared, and maintained, by a large number of individuals through social norms and cultural traits. Hence they represent high inertia aspects of individuals' behaviors and thoughts.

Some behaviors³ driven by inertia are sometimes described as "habits, routines and automaticity" by cognitive psychology (Jackson, 2005), in the sense they have been acquired within a context which might have changed since then, but they are not questioned yet. Habits and routines can be said to be partly driven by deeper values, convictions and so on, and partly by more short-term considerations (fashion, prices...). In that sense, some habits and routines present a lower inertia than values, convictions or social norms.

Behavior inertia also occurs through the architecture of incentive structures, including institutional barriers, inequalities in access and restricted choice for consumption behaviors (Jackson, 2005). The physical environment (homes, urban planning, artefacts such as tools and technologies...) is also a source of inertia, shaping and maintaining lifestyles (Martin & Gaspard, 2016).

Changes in lifestyles thus require a sustained change in the environment of individuals, whether it be their physical, social or economic environments. On the medium term, such changes eventually get internalized and build up into new shared values.

High inertia behaviors are those behaviors which are very slow to change. They correspond to more rooted behaviors, such as behaviors linked to convictions, values, identity. If such behaviors are required to change in a fast way, this may lead to desirability issues. This situation much resembles that of stranded assets: because the transition is too fast, some assets become useless and their value is lost. Some values and convictions, in a fast

² Some products or services may be more accessible in urban areas than in rural ones, in summer than in winter, and so on.

³ We use a very broad definition of behaviors here, including thinking, talking ("verbal behavior"), or behaviors in the usual meaning of the term (such as driving, walking to the bank, taking care of children and so on), following the behaviorist philosophy (see Box 1).

transition, may become useless or go against what would be required to do by the transition. This produces psychological pain, frustrations, and may lead to aggressive behaviors.

C. Different roles in the same individual embed different inertias

Individuals play roles other than their consumer's roles. Each role embeds a certain amount of behavioral inertia.

For example, professional skills are a major source of inertia for employees because acquiring new skills (that is, new behaviors and ways of thinking in the professional setting) takes time, all the more in economies based on labor division into highly specialized jobs (requiring up to several years of training) (Bögel & Upham, 2018) (also see Jobs section).

Similarly, "society decision-makers" have a certain amount of inertia in the ways they make-up their decisions, would it be citizens as voters or as elected representatives or participants in social organizations. Note that the inertia of the latter role (society decision-maker) does not interest future studies, as they aim at influencing this role rather than describing it.

"Business decision-makers" (board of directors and business executives) have a certain amount of inertia, which is partly modelled in simulated agents studies. For example, PRIMES model, or the model used by RTE, represent investment decisions based on assumptions on technology maturity and associated risks (E3Modelling, 2018; RTE, 2017).

II. Addressing the question(s) of behavior change in transition scenarios

A. Most studies do not consider behavior change during transitions

Often, scenarios just assume lifestyles changes without explaining how they happen. Behavior change is not seen as a lever nor as a constraint. It is simply ignored. Assumedly, if technique and economic viability is ensured, then people will accept to change their behaviors and accept the installation of new infrastructures.

Future studies can be separated into a few broad groups regarding how consumption behavior changes are modeled:

1. No behavioral model

Some studies assume no changes in behaviors at all assumedly because the economic and technological conditions are favorable enough for daily life behaviors not to evolve during the proposed transition. Hence these studies do not need any model (even mental model) on behaviors. The subject of daily life behaviors is not covered in these studies and there is no reason why it should be. The underlying, unspoken model is a lifestyle-as-usual model: external conditions are the same, so lifestyles and behaviors must remain the same. These studies include (Barton et al., 2013; ECF, 2010; Lappeenranta University of Technology / Energy Watch Group, 2017).

In (Lappeenranta University of Technology / Energy Watch Group, 2017), individuals can invest in producing their own electricity, through a rational choice model (see below) on the supply-side. This is the only consideration on behaviors which is made in this study.

In these studies, desirability is not a subject as the proposed transitions are easy from the end-consumer point of view. The transition efforts are borne by corporations, which have to strongly improve technologies, and markets, which have to keep on properly operating.

2. Opaque behavioral model

Some studies certainly assume some behavior changes but provide no concrete information about lifestyle evolutions. In those studies (such as (ADEME, 2015; ADEME / Artelys, 2018; CGDD, 2016; Fraunhofer ISE, 2015)), it is difficult for the reader to imagine what the lifestyles would look like even though energy demand changes in some aspects. In (Fraunhofer ISE, 2015), global energy service demand is reduced without substantiation about impacts on behaviors and about their desirability, if any. In (ADEME, 2015; ADEME / Artelys, 2018), demand-side management for electricity is largely used without concretely describing the associated lifestyles. Hence the reader cannot know if lifestyles are impacted, how, and if these impacts are acceptable. In (CGDD, 2016), behavior changes are assumed under aggregated values, and desirability is considered through a minimal inertia value. However, these values are opaque in that no concrete description of associated behaviors is provided.

This does not come as an issue for scenarios in which lifestyles little evolve, but may trigger desirability questions for scenarios in which lifestyles significantly evolve. By being largely opaque about lifestyles, these studies do not address the key issue of desirability.

3. Market-based behavioral model

Some studies assume no lifestyles changes happen but those induced by market mechanisms.

In these studies, individuals are either modeled as consumers⁴ through the “*rational choice model*” which assumes they make decisions by calculating the individual costs and benefits of the different courses of action and choosing the option that maximizes their expected net benefits” (Jackson, 2005), as in partial equilibrium models such as PRIMES ; or they are modeled as “*consumers-as-usual*,” who consume like the previous years modulated by GDP assumptions, and with small extra-variations depending on prices, as in econometric models such as POLES or the WEM. In both cases, individuals keep thinking in an economically “rational” way and keep the same preferences during the whole scenario timeframe. “Consumer preferences are exogenous to the model – that is to say they are given without further elaboration as to their origins or antecedents” (Jackson, 2005).

Most often the consumption behaviors changes happen under “easy” situations, such as a GDP steadily increasing over the scenario timeframe, energy service technologies continuously improving and a better information being provided about the products (E3MLab & IIASA, 2016; European Commission, 2011; European Commission, 2016). Hence, individuals are never described as engaging in more energy-sufficient behaviors (which could happen if GDP hypotheses were negative).

Hence, (nearly) perfect markets are the main drivers of the transition, with the help of engineering improvements towards more efficient technologies.

Levers to curb consumption behaviors are market levers. They are of two types:

- one lever to compensate for the acknowledged weakness of markets mechanisms: internalizing the externalities which are deemed unacceptable for society, as private decisions do not always take account of social costs. This is why those studies implement a carbon price, which does curb consumption behaviors towards more energy efficient and lower-carbon technologies along the scenario timeframe. However, those behaviors changes are not concretely described and their desirability is not discussed (see box below).
- The second lever to improve markets towards the rational-choice model: providing better information about products, such as their energy efficiencies, their carbon contents and so on, so that consumers can direct their choices towards products and services which are better for society (Jackson, 2005).

The use of carbon pricing as a market-based lever to reach social objectives

⁴ Generally, one representative macro consumer, with different techniques to simulate a distribution of different behaviors around the behavior of the macro consumer. The macro consumer has predetermined and stable preferences, which are assumed not to be determined by the social or institutional contexts (Jackson, 2005).

Carbon pricing policy lever to reach a GHG emission target is used in many transformational scenarios built on a market-based behavior model. **Carbon price is computed in such a way that simulated agents behave to reach the GHG reduction objective**, such as in (European Commission, 2011; IIASA, 2012). However, in some studies, when the carbon price which is required to reach the GHG emissions objective is above an arbitrarily high value, the scenario is considered as “infeasible”, such as in (IIASA, 2012).

For their Sustainable Development Scenario, World Energy Outlooks (WEOs) define a carbon price trajectory (reaching 140\$2016/tCO₂ by 2040 for WEO 2017 and 140\$2017/tCO₂ for WEO 2018) to reach emissions targets (International Energy Agency, 2017; International Energy Agency, 2018; OECD/IEA, 2017; OECD/IEA, 2018).

In some scenarios using PRIMES model, assumed carbon tax or cap and trade mechanisms alone may not be sufficient to reach the CO₂ emissions reduction. In those scenarios, PRIMES model computes an implicit carbon value corresponding to the achievement of the CO₂ emissions objective and make all the economic agents act as if their consumptions included this carbon value in their prices. In other words, economic agents act as if they perfectly had in mind the CO₂ emissions objectives to optimize their decisions (E3MLab, 2017).

All these mechanisms **use carbon price, or carbon implicit value, to model the changes in economic behaviors so as to respect a set GHG emissions objective**. As a consequence, the carbon value which is reached actually reflects the intensity of economic behavior changes. These methodologies to alter behaviors may hide desirability issues because they use a single value to depict behavior changes, which is not concrete enough about behaviors changes during the scenario. Desirability issues should be concretely discussed in these studies (see [section on desirability](#)).

As a consequence, these studies are largely mute about lifestyles, because they implicitly consider the few behavior changes they describe are largely desirable. In those cases, individuals are assumed to get equipped with more energy-efficient, and lower carbon technologies through effortless consumption behaviors, such as investing in house insulation, or getting a more fuel-efficient car, with an ever growing budget to do so. The release of more efficient technologies, and the changes in relative prices, trigger changes in bought products towards the most rational choice.

4. Cause and effect behavioral model

Some studies assume significant changes in lifestyles towards energy-sufficiency in addition to changes in energy efficiency of energy service equipment. These studies qualitatively explain the origin of such changes by different causes. Vision 2050 by ADEME, ZEN 2050 by epe or négaWatt scenario (ADEME, 2012; Association négaWatt, 2014; epe, 2019) propose such narratives about behavior changes.

Behavior changes are linked to the implementation of policies, or they are described as happening without constraints or incentives from economic or State actors. For example, policies about urban planning, development of telework, taxation of air transportation, development of high speed train and so on are assumed to alter behaviors in the négaWatt scenario or in the Visions scenario. Food habits are assumed to “naturally” evolve in Visions due to increased considerations on health by individuals by 2050.

In those studies, the desirability of behavior changes are sometimes substantiated through a technical storyline, and sometimes not substantiated. In (The Shift Project, Kahraman, Guérin, & Jancovici, 2017), which is also based on a cause and effect behavior model, the possible impacts in terms of desirability of the proposed transition are described for different actors (households, corporates).

Vision 2050 and ZEN 2050 both include a sociological description of lifestyles in 2050, using a few typical households to concretely illustrate the different lifestyles (ADEME, 2014; epe, 2019).

- ADEME studies 8 different households, representative of different household structures (couple, single person, children...), different income levels and different territories. The carbon emissions associated with each household are assessed, and the consistency between these assessments and the global assessment performed in the scenarios is ensured. Methodological guideline is provided in this report.
- ZEN 2050 presents nine types of households, according to their consumption level and their motivation to reach and maintain low-carbon lifestyle.

5. Collectively, future studies assume no measure can be taken to promote energy consumption decrease, or that such measures are not needed

As just shown, apart from studies built on the cause and effect behavior model, studies and scenarios assume no lifestyle changes, and no changes in average personal preferences. Most often, values and other inertial behavior components are implicitly considered as part of the most unalterable elements of the described world⁵ (Bögel & Upham, 2018) and as such are assumed to remain in line with current lifestyles. This may **lead scenario readers, including decision makers, to believe that no measure can be taken to promote energy consumption decrease through lifestyle changes, or that such measures are not needed** (Samadi et al., 2017). At best policy makers are assumed to react to the new, emerging social norms (such as a “heightened environmental consciousness”), as opposed to triggering and fostering them (Samadi et al., 2017).

Recommendations to scenario producers

Scenario producers should make their strategy about behavior change explicit. In case they chose not to address this question, they should substantiate the fact that this choice does not hide desirability issues.

In case behavior changes are considered and happen in scenarios, the resulting behaviors and lifestyles should be concretely described. Methodological guidance can be found in (ADEME, 2014). The following aspects should be considered:

- Types of households which are represented: what households have been represented? What criteria have been used to select them, and why?
- Consistency between described lifestyles and the rest of the scenario. Quantification of key indicators may be provided, such as carbon emissions of the different households, energy consumption, purchased appliances and goods...

Recommendations on desirability issues can be found in the [corresponding section](#).

B. Proposing and testing alternative behavior models

1. In reality, behaviors can and do change

However, behavior science has extensively shown that behaviors do change during one’s lifetime and has explained the reasons for the changes in large parts (see box below).

Theoretically, two broad types of political levers account for significant behavior changes (Samadi et al., 2017):

- Modification of relative prices, comfort, or any other preference criteria between several activities through policy levers. For example, reducing car speed modifies the relative speed between car and public transportation, fostering a modal shift from car to other modes. (possible feeling of coercion)
- Politically imposed bans or limits (possible feeling of coercion)

In addition, other causes than political levers may lead to behavior changes and modifications of preferences. From a political point of view, it can be said to happen through politically unguided, or “grass roots”, culture evolution. We call this type of behavior change the “*no-lever*” behavior change. Such cultural tendencies, mostly expressed within the social environment, influence the effectiveness of political levers because changing habits is much easier in a supportive, social environment (Jackson, 2005).

Levers to change behaviors have been extensively studied by behavior analysis

⁵ These inertial elements are called “landscape level” in the Multi-level perspective of transition.

The science called behavior analysis have extensively studied the determinants of behavioral changes. Along the view of behaviorism, the philosophy associated with behavior analysis, changing behaviors is equivalent to changing the determinants of behaviors. Behavior is defined in a very broad sense: thinking, talking ("verbal behavior"), or behaviors in the usual meaning of the term (such as driving, walking to the bank, taking care of children and so on) are behaviors. Behavior analysis studies the determinants of all these behaviors.

Here are the main findings of this science on behaviors (summarized from (Baum, 2016b)):

Human behaviors are determined by what has been called 3-terms contingencies, and which corresponds to *incentive feedback loops* (increasing the occurrence of behaviors under an incentive) and *constraint feedback loops* (decreasing the occurrence of behaviors under a constraint). Incentive feedback loops provide rewards when the behavior considered as appropriate happens. In our societies, short-term rewards include smiles, nice words, or money and in the long-term diplomas, a rewarding job, good health, rewarding relationships, and more globally a rewarding environment. Constraint feedback loops produce punishment when the behavior considered as inappropriate happens. In our societies, short-term punishment include cold or angry reactions by others or fines, and in the longer-term, lawsuits, imprisonment, a lack of, or negative relationships, bad health and more globally a difficult to live environment.

The better these feedback loops are known (through communication campaign, through imitation of others knowing these feedback loops, through mouth-to-ear tips, advice...), the more easily individuals can engage in preferred, more rewarding feedback loops.

These feedback loops, to have a lasting effect on behaviors, must themselves remain stable.

The more probable and systematic the consequences of these feedback loops are, the more efficient they are to change behavior and maintain novel behavior.

The faster the consequence of the feedback loop after the occurrence of the behavior, the more efficient the feedback loop.

Box 1: Overview of the overarching results of the science called "analysis of behavior," which mostly focuses on understanding the determinants of behavior changes.

2. Alternative types of behavior models are possible

Most behavior models assume consumption behaviors follow rules which do not evolve through time (as consumer preferences do not evolve). Hence behaviors evolutions cannot be studied, or projected with such a model (Guivarch, 2011), which seems like a serious limitation for studying the energy transition.

There exists other types of (mental) behavior models, which account for the fact that "human behaviors are not purely rational and self-interested". For example, these models take into account the following:

- Habits, routines and automaticity in our behaviors. These patterns illustrate what the rational choice model would consider as "suboptimal" behavioral inertia and that it would avoid through "better information." Indeed many frequent, routine behaviors do not call for a deliberation anymore after they have been tested out several times and their consequences are known by the individual, even though they might not be optimal anymore because conditions changed. They are nonetheless very useful rules of thumb for not spending energy into endless deliberation before each behavior.
- "Our preferences are largely dependent on social and interpersonal factors" (Jackson, 2005). This implies that these preferences can change not only within individuals during one's lifetime but also within a whole culture⁶. Preferences apply largely on non-commensurable commodities (that is, commodities which cannot be measured under the same unit because they are different in essence, such as health, safety, comfort, speed and so on), making the evolution of their relative weights in a "utility function" difficult to understand in terms of cultural changes and as a consequence difficult to tune.

⁶ Equivalently, the "distribution of preferences" might significantly evolve within a population.

These alternative behavior models are not used by scenario producers, even though they could provide more diversity across studies in hypotheses about lifestyles.

Recommendations to scenario producers

The behavior model either endogeneized in the computational model, or a mental model which is used should be described: is it a *market-based* (rational choice, or consumers-as-usual), or a larger *cause and effect* model? What are its main features with regards to routines and habits, or preferences?

If behaviors change in a scenario, the reasons for the changes should be made explicit. The following reasons may be considered: no-lever change, or political levers activations (more details in the following sections).

C. Fully integrating social sciences instead of relying only on engineers and economists for producing future studies

Part of the issue comes from the fact that evolutions of lifestyles are mostly studied by social sciences but results from this field are rarely included in future studies (Hache & Palle, 2018). Future studies are largely led by economists teams, which more readily use market-based models or by engineers teams which consider the technical aspect of the transition; sociologists, or behavior scientists are poorly, inadequately (e.g. too late in the scenario production process), or not at all included in the future studies teams.

The exclusion of behavior scientists from scenario production lead to two main risks for the scenario community as a whole:

- Ignoring interesting political and economic levers (such as public investment in infrastructures, bans, imposed standards and so on), by focusing only on market-based levers. This is one collective shortcoming for studies using market-based models. As a result of this collective ignorance by future studies, scenario readers, including decision makers, may conclude that measures promoting non-market levers (such as energy-sufficient lifestyles) are not efficient, not available or even detrimental for society (Samadi et al., 2017).
- On the opposite, underestimating behavioral inertia and hence overestimating behavioral changes' speed. This bias is equivalent to neglecting some non-desirability issues induced by the speed of change. Such a bias may appear in studies using a cause and effect model, when strong assumptions on behavior changes are made. E.g., some scenarios assume a large increase in average car occupancy rate without dealing with the desirability of such a change.
This bias could also appear in studies using market-based behavior models, if they implemented a strong carbon price, lower GDP assumptions and/or less optimistic technological assumptions: in this case consumption behaviors would change unrealistically fluently under the effect of the carbon price (implicitly assuming this effect, called "disutility,"⁷ is deemed desirable by citizens) (E3MLab, 2017). E.g., some scenarios assume mass building insulation without dealing with the subject of desirability of the investment decision and of the works. However, as already described, in these studies, individuals are usually supposed to live in wealthy situations (GDP is assumed to grow) and they can easily afford more expensive, more efficient, and lower carbon technologies so that the induced disutility might be argued to be acceptable.

As a conclusion, when a collective look is taken at published future studies, either behavior changes are not considered at all (true for most scenarios using a market-based model), or they are assumed to change fluently and naturally. When behavior change occurs in scenarios, no account is provided for the expected changes and no political lever is proposed except for the studies using a cause and effect behavior models (such as (Association négaWatt, 2014; The Shift Project et al., 2017) and some aspects of Vision 2050 (ADEME, 2012)). As a result, costs associated to behavior changes are not taken into account (sometimes referred as transition costs).

⁷ Disutility is an assessment of the utility loss compared to a situation in which the constraint does not exist. It is concretely composed of buying more expensive technologies, paying for more expensive energy, and consuming less in some sectors due to this buying more expensive goods and services, all those effects being in comparison to a situation without (carbon) constraint.

Recommendations to scenario producers

Scenario producers should report the way they consulted social sciences in the course of the study: who they got in touch with, or what social sciences sources they resorted to, in what ways, and at what points in time during the study. Good practices include:

The study of lifestyles should be an integrated part of the process of scenario production. Social scientists, such as sociologists or psychologists should be involved at the very beginning of the process and remain part of the team during the whole process. Their role is to inform scenario producers

- about the implications (in terms of desirability, costs, or any other relevant impact) of their hypotheses during the storyline definition
- about the implications (in terms of desirability, costs, or any other relevant impact) of their results during the interpretation of results

III. Addressing desirability issues in scenarios in which cultural trends are curved

A. Changing behaviors may require time and lead to desirability issues

Understanding cultural trends (new, emerging ones as well as solidly rooted ones) and their translation into consumption behaviors is key for properly integrating behavior considerations in scenarios.

The more social norms are shared and associated with a strong social punishment in case of deviation from them, the more difficult to change they are. Body hygiene, eating and drinking habits or dwelling habits are examples of behaviors whose trends are difficult to change. For example, constraining dwelling surface per inhabitant may be a real challenge. They are anthropologic realities which evolve little and slowly (Martin & Gaspard, 2016). Hence **cultural trends are socially shared behavior patterns which have a certain inertia.**

If such trends are to be changed through judiciary norms, the costs to enforce the new trends through coercion means can be extremely significant. They can include mass monitoring of individuals' behaviors and means to punish deviations from the new trend as systematically as possible. **In case coercion power is limited, new judiciary norms must be first accepted within large parts of the population** (Martin & Gaspard, 2016). By and large, this fact legitimates the idea that proposed transitions should be desirable. This concept is developed in the **desirability section**. In other words, the social body should not be considered as an adjustment variable, as it is not necessarily more flexible than the built environment.

B. Detecting cultural trends is complex but improves storyline design by rooting it in the current culture

Understanding and monitoring cultural trends is complex and requires a certain amount of data. Indeed, different groups of people can exhibit different cultural trends, as a function of their characteristics, such as: their revenue level, their age, their gender, the type of urban fabric they live in, their working status (unemployment, retirement, etc.), their rural or urban lifestyle, their household structure (number of children, are the parents together, how many persons of the same family are living in the house, etc.), information about their housing context (owner or tenant status, house or apartment, suburb or city-center, metropole or village, etc.), their attitude towards environment. These are factors which can highlight some cultural trends in some domains. For example, younger generations in developed countries are less attracted to owning, or using a car than older generations.

A typical way to gather data about ongoing trends is to include in future studies some feedback from citizens with various backgrounds. For example, sociology studies can be performed about specific consumption behaviors (such as what the Forum Vies Mobiles performed in a study about aspirations about passenger mobility (Forum Vies Mobiles/L'ObSoCo, 2016)). Scenarios can also be designed directly with stakeholders who make decisions about hypotheses following a defined decision process (such as in (Bibas, Mathy, & Fink, 2012)). ZEN 2050 scenario

imagines that a significant part of the population is proactive in changing its behaviors, another significant part resists to these changes, while the majority stands in between (epe, 2019).

The collection of ongoing narratives and counter-narratives about the energy transition (see [section on desirability](#)) is another way to connect to the current views civil society has on this subject.

Some “no-lever” cultural changes can be noticed in developed countries such as France. Here are examples of some of them, applying to small, but growing, portions of the population:

- Regional, or local governance is preferred. The emergence of this preference is accompanied by a loss of trust in national governance.
- Preference towards more energy autonomy/autarchy
- New collaborative and local investment practices (local crowdfundings) (Hache & Palle, 2018)
- Small project size in electricity supply (OECD/IEA, 2017)
- Buying bigger and more powerful cars (Sport Utility Vehicles, SUV) for buyers of new cars in France (Chassignet, 2019).
- Meat consumption reduction in younger generations (ADEME/CREDOC/RDC Environment, 2015)
- Attachment to material goods and strength of habits for people above 40 year-old (ADEME/CREDOC/RDC Environment, 2015)
- Decrease in the number of domestic flights due to “flying shame”, such as in Sweden (« The concept of “flying shame” is growing in Sweden – shame if you fly too much – due to the CO2 emissions », 2018).

Recommendations for scenario producers

Scenarios should make their strategy about cultural trends consideration explicit.

If they are considered, a description of the observed and expected cultural trends should be provided for the studied geographical perimeter. These trends can be observed through popular narratives of the transition.

If observed cultural trends (including emerging trends) are curved in a scenario, discussion about the inertia of those trends as well as the levers which are used to curve them should be provided. Inertia should be assessed with regards to how shared the trends are among the population and how associated to a social punishment in case of deviation from them they are. In case of high inertia, considerations on desirability of these changes should be made (see [desirability section](#)).

In cases trends are curved through “no-lever”, grass roots, cultural changes, narratives about what triggered them, or what makes them expectable, may be provided. *Does a specific event, speech from a personality, social movement, etc, trigger the change?* Here are two examples:

- If the scenario assumes the trend towards new energy production and consumption structures (local production, short supply chains, etc) reverses back to a centralizing trend, this reversal should be explained in a narrative.
- In France, the trend is currently that people have greater and greater living area. Hence scenarios assuming a reduction, or stabilization of the living area per inhabitant should warn about this trend discontinuity and provide a narrative to justify this trend reversal.

IV. Properly framing the effects of policy levers on behaviors during transitions

We now develop some ideas about the different levers on behaviors, such as the different useful levels at which they can be thought out, the main different types of levers available to policy-makers, and some considerations on the way they should be discussed in future studies.

A. Behaviors are driven by several *drive categories*: close relationships, society and the physical environment

Behaviors evolve, and are maintained, by incentives and constraints applying to them. Several categories of incentives and constraints apply on individuals. Here are the three *drive categories* usefully framing discussions about levers on behaviors (Martin & Gaspard, 2016):

- People closely related to the individual (such as family members, friends, colleagues, neighbors...) produce incentives and constraints through their interactions with the individual. They drive one's behaviors through advice, tips, education (for children within the family), exemplification followed through imitation...
- society as a whole (including institutions, economic rules and economic structure, justice, social norms...). Economic structure directly drives our behaviors through the services it proposes, as well as indirectly via our physical environment, through the goods it produces. It also drives our behaviors through advertisement ("information campaigns") (IIASA, 2012). Business practices can also drive the behaviors of their employees. Institutions drive our behaviors through the taxes, subsidies, bans and so on they implement and enforce through administration, police, justice etc.
- the physical environment (such as infrastructures, technologies and tools). It most directly drives our behaviors and also constitutes an element of inertia (see future studies).

To be as efficient as possible, measures towards behavior changes should implement incentives and constraints on all those aspects. However, policies are best applicable on society as a whole (laws, bans, taxes and subsidies...) and on the physical environment, directly through design and building of public spaces, and indirectly through production standards for the technologies and tools individuals use. As was explained above, levers on society as a whole can be implemented only if they are deemed acceptable, that is, only if they are largely accepted at the small group level.

B. Policy makers have access to four *policy levers* to change behaviors

These different levels can be derived into four different policy levers to change behaviors (Martin & Gaspard, 2016).

- **Communication and information tools**, including individual counselling or group support. They aim at informing about the existence of alternative behaviors or about the pros and cons of each alternative. They can also aim at altering the perceptions on these pros and cons. Examples include consumption labelling for appliances or cars or communication campaigns about car accidents for speed limits enforcement. Exemplifying the desired changes within State's own policies and practices also belongs to communication tools (Jackson, 2005).
- **Public space design tools**, aiming at providing new possibilities for alternative behaviors, by providing new goods or services, or at making more difficult former behaviors. Examples include new cycling or pedestrian infrastructure or city planning to reduce trip distances or car use. Infrastructure and public space design can have an influence on behaviors with so-called "nudges". However, this technique has a more anecdotal and less sustainable effect since they seek to modify behaviors without individual knowledge building: with this technique individuals change their behaviors sometimes without knowing why they should do so.
- **Economic tools (taxes and subsidies)**. They aim at modifying the relative weights of pros and cons between alternative behaviors. Examples include purchase taxes depending on the fuel consumption of cars, or subsidies to reduce public transportation price. Subsidies towards specific fields of research, such

as specific technologies or tools, can also lead on the medium-term to changes in the physical environment, which is in part composed of the technologies and tools we use.

- **Legal tools (obligation or ban, standards).** They also aim at modifying the relative weights of pros and cons between alternative behaviors, through coercion. Examples include car bans in some parts of cities, speed limits for vehicles, or emission standards for cars. It also includes standards for companies leading to producing products with novel characteristics, which in turn end up in individuals' physical environment as new available technologies and tools. It also includes laws to promote novel behaviors among employees, such as changing commuting trips.

C. The ways policy packages are framed is key for efficiency and desirability: the *lever activation modes*

For more efficiency of the levers, the following aspects are key (Bögel & Upham, 2018). We call them the four *lever activation modes*.

- **Ability to adopt:** As previously mentioned, behavior changes happen much more easily when they are deemed acceptable, that is, when they are already shared and largely encouraged within portions of the population. In other words, some form of knowledge and emerging cultural norms should be present to enable behavior change. Many scenarios evoke an environmental consciousness to explain the adoption of novel, eco-friendly behaviors in a "no-lever" way.
- **Tailored approach:** several levers should be activated together and in a consistent way, that is, they should clearly all direct towards a limited set of behaviors, as opposed to directing towards novel behaviors and former behaviors at the same time. Generally speaking, goods and services providers invest large amounts of money in marketing and advertisement, contributing to shape shared cultural norms directing behaviors towards consuming those goods and services (Martin & Gaspard, 2016), which may go against measures implemented in transformational scenarios. This illustrates how incentives and constraints in place can be contradictory and lead to desirability issues. Ideally, levers should be activated along all the mentioned levels (small groups of close relationships, society and the physical environment).

Different types of levers should be activated together for each targeted behavior:

- **push measures** (that is, incentive feedback loops promoting the novel behavior)
 - **pull measures** (that is, constraint feedback loops constraining the former behavior)
 - information campaign *if needed to inform about the presence of the new feedback loops*. Note that the information campaign informs about the novel situation (shaped by the new pull and push measures) in which behaviors take place. On the contrary, leading an information campaign about the existing situation without any new push or pull measure have little chance to be efficient if its goal is to signal the presence of opportunities that people assumedly (in a collective way) have not understood or seen the presence of opportunities around them. "Information campaigns have been widely used for achieving public interest goals. But they are known to be less effective than other forms of learning. Research suggests that learning by trial and error, observing how others behave and modelling our behavior on what we see around us provide more effective and more promising avenues for changing behaviors than information and awareness campaigns" (Jackson, 2005).
- **Continuous priming:** Behavior changes cannot be maintained by sole information, even continuous information. Context has to evolve and be sustained in its novel state to maintain new behaviors. This applies to all the mentioned levers (infrastructure, economic incentives and so on).
- **Extent:** Information and context changes lead to behavior changes more readily if they target behaviors with direct consequences on the individual than if behavior consequences are further away in space, time, and probability. For example, parking ban in some places is more efficient if it systematically and quickly enforced. Energy use is more easily reduced if it is directly monitored and displayed to the consumer. On the contrary, far ahead consequences of climate change have less effects on behaviors. Communication campaigns may be useful to act on the extent aspect of levers, by presenting the long-term consequences of a behavior in order to make them more concrete so that individuals better take them into account. For example, communication campaigns could highlight the links between some behaviors and climate impacts.

Introducing and sustaining lifestyle change is thus not as straightforward as a (prescriptive) modeling approach may suggest. The design of a successful policy strategy requires knowledge of all these factors that determine and sustain changes in specific behaviors.

D. Different behavior changes require different levers

1. The specific case of investment decisions

Social sciences for energy has mostly studied changes in **daily behaviors** as opposed to household decisions to invest in insulation, or other **investment decisions**, even though such decisions can be more powerful at changing energy consumption (Stern, 2017).

Indeed, it has been noticed that behaviors characterized as *investment* behaviors are much closer to those assumed in the rational choice model. For example, energy is most commonly framed as a basic need by individuals, except when they consider investment decisions in energy savings: in this situation, they frame energy as a commodity, with considerations on return on investment and cost reductions (Demski, Thomas, Becker, Evensen, & Pidgeon, 2019). For this category of behaviors, economic incentives are key, as well as knowledge about the investment opportunity and its consequences (in terms of savings, comfort and so on). Hence favorable enough⁸ economic incentives and a communication campaign about them is likely to be efficient to direct household's investment.

Other levers may be more adapted in the case of daily consumption behaviors, which are most often habitual (Bögel & Upham, 2018). "A vital ingredient for changing habits is to 'unfreeze' existing behavior - to raise the behaviour from the level of practical to discursive consciousness." And as for any other behavior change, "this process is known to be more effective in a supportive, social environment" (action at the small group level) (Jackson, 2005).

Hence the targeted influencing levels, the selected policy levers, and the lever activation modes will certainly be different for these two types of behaviors.

2. Practical case: changing "car buying" behaviors

As an example, we consider here the case of car buying. Let us consider the different levels of incentives which apply to individuals when they buy a car, and enumerate the different incentive feedback loops probably applying:

- The physical environment: public spaces are greatly designed for car use, through a very dense and well maintained road network, with a high speed road network. City planning and activity location often requires the use of a car to have access to basic services and resources as well as to activities required to live a decent life and to stand one's role for society (access to work, to schools for children, to healthcare...). Also influencing the physical environment, standards and bans from the State affect the type and characteristics of cars which are accessible to buying.
- Society as a whole:
 - Economic system: several services are proposed everywhere on the territory for car owners, such as garages and insurances. The economic system also largely implements communication campaigns (advertisement) associating car ownership to long-term rewards, such as high social positions, positive relationships (love relationships, friendship, family...), and socially highly-valued activities (traveling, taking care of one's family...).
 - Institutions, through taxes and subsidies, as well as costs induced by car ownership (insurance, maintenance...) impact car buying.
- Small groups of close relationships: the type of car that close relationships own and the way they use it, as well as what they say about it also have an influence on car buying.

If car buying behaviors are to be changed (for example, towards less powerful cars, or towards low-carbon cars, or even towards buying less cars), then incentives and constraints around car buying must be altered in the desired way. However, they must be so in a sustained way (stability of a novel built environment and city planning, stability of price incentives...) to change behaviors and maintain novel behaviors. Plus, the overall set of incentives and

⁸ Considering the specific economic situation of the different households.

constraints must be readable and consistent. For example, modifying taxes and subsidies (e.g. taxes for owning a powerful car and subsidies for replacing one's car by bikes...), or the built environment (less space for car flows and for parking) without modifying advertisement for powerful cars decreases the probability to change behaviors compared to a no advertisement situation. Furthermore, such discrepancies can lead to discontent (see desirability section).

Recommendations to scenario producers

Behavior changes should be explained. For each behavior change, a narrative about the following aspects should be developed:

- The policy levers which are activated:
 - communication and information tools. For example: *What kind of communication campaign? Is exemplification used? What changes in labelling practices?*
 - infrastructure tools. For example: *what changes in urban planning? What new transport infrastructure?*
 - economic tools (taxes and subsidies). For example: *what activities are more taxed/ more subsidized? For what actors? Are CO2 emissions taxed, and with which tool? For who? Are some research fields subsidized?*
 - legal tools (obligation or ban, standards). For example: *what activities are banned? Is driving in city centers banned? Are there car production standards imposed?*
- The lever activation modes which are used:
 - ability to adopt: *why would actors accept the proposed levers?*
 - tailored approach. For each behavior change, push measures, pull measures and in some cases, information campaigns, should be considered. Internal consistency of the whole policy package, as well as consistency with the other incentives and constraints in place, should be considered, for the different actors and with regards to the different targeted behaviors within the scenario. *For example: is advertisement based on the price indicator still allowed when new labelling seek to promote other indicators such as energy consumption and CO2 emissions?*
 - continuous priming. *How are the proposed measures sustained during a long-enough time?*
 - extent. *Do the proposed measures implement incentive / constraint feedback loops which directly act on the targeted behaviors?* If not, considerations on the efficiency of the lever should be provided.
- Drive categories which are impacted by the activated policy levers, duration over which they are impacted, and how they shape new behaviors and practices.

For all the impact assessments which are performed in the study, the impacts of the levers which are activated should be taken into account within the considered impact inventory.

Bibliography

- ADEME. (2012). *L'exercice de prospective de l'ADEME - « Vision 2030-2050 »*.
- ADEME. (2014). *Visions énergie climat 2030/2050—Quels modes de vie pour demain ?* (N° 8102; p. 132).
- ADEME. (2015). *Un mix électrique 100% renouvelable ? Analyses et optimisations*.
- ADEME / Artelys. (2018). *Trajectoires d'évolution du mix électrique 2020-2060—Synthèse*.
- ADEME/CREDOC/RDC Environment. (2015). *Actualisation et étude de valorisation des modes de vie dans le cadre du scénario prospectif « Empreinte allégée » de la consommation des Français à l'horizon 2030* (p. 52).
- Association négaWatt. (2014). *Scénario négaWatt 2011-2050—Hypothèses et méthode*.
- Auzanneau, M. (2018). *Oil, Power, and War: A Dark History*. Chelsea Green Publishing.
- Barton, J., Huang, S., Infield, D., Leach, M., Ogunkunle, D., Torriti, J., & Thomson, M. (2013). The evolution of electricity demand and the role for demand side participation, in buildings and transport. *Energy Policy*, 52, 85-102. <https://doi.org/10.1016/j.enpol.2012.08.040>
- Baum, W. M. (2016a). The Evolution of Culture. In *Understanding Behaviorism* (p. 227-255). <https://doi.org/10.1002/9781119143673.ch13>
- Baum, W. M. (2016b). *Understanding Behaviorism—Behavior, Culture and Evolution* (Third Edition). John Wiley & Sons, Ltd.
- Baum, W. M. (2016c). Values. In *Understanding Behaviorism* (p. 207-226). <https://doi.org/10.1002/9781119143673.ch12>
- Bibas, R., Mathy, S., & Fink, M. (2012). *Un scénario bas carbone « "acceptable" » pour la France: Élaboration participative et analyse macroéconomique*. 49.
- Bögel, P. M., & Upham, P. (2018). Role of psychology in sociotechnical transitions studies: Review in relation to consumption and technology acceptance. *Environmental Innovation and Societal Transitions*, 28, 122-136. <https://doi.org/10.1016/j.eist.2018.01.002>
- CGDD. (2016). *Trajectoires de transition bas carbone en France au moindre coût*.
- Chassignet, M. (2019). Le monde croule sous les SUV. Pourquoi c'est un problème et pourquoi ça risque de durer. Consulté à l'adresse Pour une mobilité durable et solidaire website: <https://blogs.alternatives-economiques.fr/chassignet/2019/01/17/le-monde-croule-sous-les-suv-pourquoi-c-est-un-probleme-et-pourquoi-ca-risque-de-durer>
- Demski, C., Thomas, G., Becker, S., Evensen, D., & Pidgeon, N. (2019). Acceptance of energy transitions and policies: Public conceptualisations of energy as a need and basic right in the United Kingdom. *Energy Research & Social Science*, 48, 33-45. <https://doi.org/10.1016/j.erss.2018.09.018>
- E3MLab. (2017). *PRIMES Model, Version 6, 2016-2017—Detailed model description*.
- E3MLab & IIASA. (2016). *Technical report on Member State results of the EUCO policy scenarios* (p. 381).

- E3Modelling. (2018). *PRIMES MODEL VERSION 2018—Detailed model description* (p. 221).
- ECF. (2010). *Roadmap 2050—A Practical Guide to a Prosperous, Low-Carbon Europe* (p. 100).
- epe. (2019). *ZEN (séro émission nette) 2050—Imaginer et construire une France neutre en carbone* (p. 88).
- European Commission. (2011). *Energy Roadmap 2050—Impact assessment and scenario analysis*.
- European Commission. (2016). *EU reference scenario 2016: Energy, transport and GHG emissions: trends to 2050*. Luxembourg.
- Forum Vies Mobiles/L'ObSoCo. (2016). *Modes de vie et mobilité—Une approche par les aspirations—Phase quantitative* (p. 165).
- Fraunhofer ISE. (2015). *What will the energy transformation cost? - Pathways for transforming the German energy system by 2050*.
- Guivarch, C. (2011). *Évaluer le coût des politiques climatiques: De l'importance des mécanismes de second rang*. Paris-Est.
- Hache, E., & Palle, A. (2018). *Intégration des énergies renouvelables variables dans le système électrique: Analyse bibliométrique et enquêtes auprès des acteurs*. 18.
- IIASA. (2012). Energy Pathways for Sustainable Development. In *Global Energy Assessment Towards a Sustainable Future*.
- International Energy Agency. (2017). *World Energy Model Documentation—2017 Version* (p. 77).
- International Energy Agency. (2018). *World Energy Model Documentation—2018 Version* (p. 82).
- Jackson, T. (2005). *Motivating Sustainable Consumption—A review of evidence on consumer behaviour and behavioural change* (p. 170). Centre for Environmental Strategy - University of Surrey.
- Lappeenranta University of Technology / Energy Watch Group. (2017). *Global energy system based on 100% renewable energy—Power sector*.
- Le Gallic, T., Assoumou, E., & Maïzi, N. (2017). Future demand for energy services through a quantitative approach of lifestyles. *Energy*, 141, 2613-2627. <https://doi.org/10.1016/j.energy.2017.07.065>
- Martin, S., & Gaspard, A. (2016). *Changer les comportements, faire évoluer les pratiques sociales vers plus de durabilité* (p. 181). ADEME.
- OECD/IEA. (2017). *World Energy Outlook 2017* (p. 782).
- OECD/IEA. (2018). *World Energy Outlook 2018* (p. 661).
- Roy, J., Dowd, A.-M., Muller, A., Pal, S., Prata, N., & Lemmet, S. (2012). Lifestyles, Well-Being and Energy. In T. B. Johansson, N. Nakicenovic, A. Patwardhan, & L. Gomez-Echeverri (Éd.), *Global Energy Assessment (GEA)* (p. 1527-1548). <https://doi.org/10.1017/CBO9780511793677.027>
- RTE. (2017). *Bilan prévisionnel de l'équilibre offre-demande d'électricité en France*.

- Ruotsalainen, J., Karjalainen, J., Child, M., & Heinonen, S. (2017). Culture, values, lifestyles, and power in energy futures : A critical peer-to-peer vision for renewable energy. *Energy Research & Social Science*, 34, 231-239. <https://doi.org/10.1016/j.erss.2017.08.001>
- Samadi, S., Gröne, M.-C., Schneidewind, U., Luhmann, H.-J., Venjakob, J., & Best, B. (2017). Sufficiency in energy scenario studies : Taking the potential benefits of lifestyle changes into account. *Technological Forecasting and Social Change*, 124, 126-134. <https://doi.org/10.1016/j.techfore.2016.09.013>
- Stern, P. C. (2017). How can social science research become more influential in energy transitions? *Energy Research & Social Science*, 26, 91-95. <https://doi.org/10.1016/j.erss.2017.01.010>
- Tabbone, L. (2017). *Consommations énergétiques et cadres de vie : Analyses en termes de modes de vie*. 414.
- The concept of “flying shame” is growing in Sweden – shame if you fly too much – due to the CO2 emissions. (2018). Consulté à l’adresse Airportwatch website: <http://www.airportwatch.org.uk/2018/11/the-concept-of-flying-shame-is-growing-in-sweden-shame-if-you-fly-too-much-due-to-the-co2-emissions/>
- The Shift Project, Kahraman, Z., Guérin, A.-J., & Jancovici, J.-M. (2017). *Décarbonnons ! 9 propositions pour que l’Europe change d’ère*. Odile Jacob.

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