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Lifestyles and carbon footprints- A scenario analysis of lifestyles in France in 2050 and carbon footprints

Cyria Emelianoff, Elsa Mor, Michelle Dobré, Carine Barbier, Nathalie Blanc, Christine Castelain-Meunier, Damien Joliton, Nicolas Leroy, Prabodh Pourouchottamin, Pierre Radanne, et al.

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Lifestyles and carbon footprints

A SCENARIO ANALYSIS OF LIFESTYLES IN FRANCE
IN 2050 AND CARBON FOOTPRINTS

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Lifestyles and carbon footprints

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ABRIDGED VERSION OF THE FINAL REPORT
(published in French in December 2012)

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- a 25-member foresight group, driven by Futuribles then Mana,
- on-site research projects in 6 areas
- about 20 other research projects
- thematic seminars driven by Université du Maine
- a website : www.villepostcarbone.fr

The final report will be available at the end of 2013.

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Introduction

Sustainable lifestyles and consumption patterns have become a central aspect of research on urban sustainability, which has been the subject of numerous publications in recent years (Hertwich *et al.*, 2005) (Charter *et al.*, 2006) (Geerken *et al.*, 2008). It is difficult to imagine a sustainable city in 2050 unless lifestyles are dramatically changed. Indeed, energy savings made thanks to certain infrastructure or technologies are more than offset by the overall increase in consumption. Conversely, promoting sustainable lifestyles seems contradictory when infrastructure encourages an ever greater consumption of resources (Southerton *et al.*, 2004). The question of the adaptability of cities in physical terms is therefore increasingly coupled with that of changing lifestyles, which are as much the result of technical knowledge as of the prevailing social, ethical and multicultural values.

Research conducted at the international scale on the environmental impacts of lifestyles and consumption patterns has particularly analysed the role of urban morphology and the importance of individual's environmental values. These studies reveal the complex interactions between variables. Although urban morphology has a considerable impact on direct energy consumption (fuel, heating, electricity), indirect energy consumption increases with household income in a non-linear manner (Moll *et al.*, 2006). People living in cities spend more time on shopping and cultural activities, and a type of "compensatory mobility" may be observed (Perreels, 2005). In addition to infrastructure, free time use seems to be a decisive factor in people's ecological footprints. There does not appear to be a positive correlation between individual's pro-environmental values and a reduction in energy consumption.

Social change theories are challenged by the complexity of the interacting factors. Whether they focus on the determinants (social, technical or ecological) or, on the contrary, on individual freedom of choice, or even on the "interplay" between stakeholders involved in action, they generally lack a forward-looking dimension (establishing a model for change). The goal of our research is particularly to propose structured syntheses of complex data of different kinds (ecological, economic, geographical, socio-anthropological and historical).

On a more political level, lifestyles today raise the question of environmental justice and the sharing of resources at the global scale, building on the debates on eco-development. Research studies on "ethical consumption" (Crocker and Linden, 1998), "responsible consumption" (*State of the World*, 2004) or "sustainable consumption" (Jackson, 2006) attempt to rearticulate environmental and social issues at the North-South scale. Although Western lifestyles are responsible for two-thirds of global environmental impacts, while only concerning a sixth of the world population (SCORE, 2008), a high social and cultural variability of ecological footprints is observed. Given comparable living standards, the material intensity of consumption varies from one to four depending on the country (*State of the World*, 2004). There is thus considerable room for improvement.

This work is original in the field of research on lifestyles in that it takes a resolutely forward-looking approach. Thus, the aim was first to identify the key variables of lifestyle changes in France and their impacts on CO₂ emissions, whether weak signals revealing new behaviours (co-housing, diet, the local food movement, new mobility practices, voluntary simplicity, etc.) or, more generally, changes in

social representations and in ways of living, working and consuming that are not motivated by environmental concerns but may have significant positive or negative effects on energy consumption.

Climate change corresponds to a profound change in civilisation through the radical transformation it requires in the relationship between people and their planet. As with every shift of this kind, we see not only economic and technological changes, but also a dramatic modification of lifestyles and cultural expressions, along with political institutions and governance practices.

Unfortunately, these periods of civilisation change are also characterised by a considerable increase in tension: interpersonal conflicts, political and religious opposition and often clashes between countries. This conflictual situation will only abate when a vision of the future emerges for the collective project and for personal fulfilment. The issue of the development of "successful 21st century life stories" will be at the heart of forthcoming changes.

The first stage of this research was the production of a state of the art on lifestyle changes, with the identification of key variables inducing behaviours that generate greenhouse gases (GHGs). The temporal context of this state of the art led us first to explore the past, through a retrospective of the major socio-economic lifestyle trends from 1960 to the present day. A dense retrospective analysis of lifestyles was conducted, focusing on several areas: demography, income, consumption, housing, mobility, residential choices, education, relationships to work, relationships to time, values, social ties, and, finally, leisure and cultural practices. This research enabled us to understand the key trends at work over the last few decades. Next, the research looked at the present, analysing a range of weak ecological signals and the ground from which they emerge, and thereby examining the emergence of new social movements. Analysis of lifestyles linked to ecology or sustainability (voluntary simplicity, slow life, etc.) was given preference. Other alternatives to the dominant social norms are developed where they are relevant to the Factor 4 issue, but the

list is not exhaustive due to the breadth of the subject. After a certain number of readings, these weak signals were grouped according to three major expressions: resistance to forms of dependence on certain consumer goods (cars, televisions, etc) and, more generally, resistance to consumerism; the rapid development of new ways of living in urban areas; and the search for modes of existence that substitute "being" for "having", social relationships for property relations and a "connection-based" economy for a "goods-based" one.. Since the 1970s we have seen a wider dissemination and diversification of practices linked to these critical positions and an assertion of the urban dimension. In addition to identifying, characterising and analysing these different practices, we will examine the capacity of these scattered movements to form a social movement. Are weak signals symptoms of cultural change, elements of political subversion or simply pressure relief valves? Are we observing weak signals or new social movements?

- The research went on to look at the near future by detecting, amid the boom of information and communication technologies, nanotechnologies and biotechnologies, the prospects as well as the health and ethical risks. The ethical dimensions particularly concern the possible convergence of these technologies in the coming decades. Indeed, over the last thirty years, the extraordinary pace of scientific progress and innovation has profoundly changed our lifestyles. This is why it is important to analyse these changes in order to create possible future scenarios, even if it is difficult to predict their medium- and long-term carbon footprints.

Finally, dealing with the imaginary in this way blurs the boundaries in the structure of this state of the art. Following on, it stepped into science-fiction by examining lifestyles and the role of nature in the future.

- The second stage of the research involved the implementation of a collective exercise to build visions of the future and of lifestyles in 2050, from a multi-disciplinary, multi-stakeholder approach, with the group being mainly composed of sociologists, geographers and energy economists (first part).

- A quantitative evaluation of greenhouse gas emissions from households according to their socio-demographic characteristics was then conducted for the households emblematic of the visions established for 2050 (second part).
- The findings are discussed and interpreted in the conclusion in order to draw lessons for research and action.

This exercise, a first in France, is an exploratory study aimed at proposing avenues for research in the complex field of lifestyles, the determinants of their evolution and their environmental impacts. Cross-disciplinary dialogue, which is essential to this type of approach, is never easy and is in itself a long and demanding process.

Four of the five visions of the future voluntarily take a radical departure from the existing situation, and are somewhat stereotyped in order to push each of the approaches described to its limits. In this sense, 2050 is not intended to be seen as a specific point in time; instead, it evokes a relatively distant perspective, leaving time for radical changes to take place. Finally, we have not attempted to paint a supposedly ideal picture. Each of the visions described has a specific driver, which is not necessarily linked to an environmental objective, and neither is more desirable than another. Our goal is to present life stories that are specific to each of these contrasting visions, which may inspire later work.

Description of five visions of lifestyles in 2050

Methodology for building 2050 visions

Given the uncertainty they involve, lifestyles could have long been the subject of special attention in future studies. Indeed, *uncertainty* regarding the direction of change is one of the key criteria of future studies. Only directions that are subject to uncertainty can produce highly contrasting visions of the future, which is the main objective of this exercise. However, the future studies literature does not in fact include scenarios in which the driving force is the intrinsic change taking place in lifestyles. There are several reasons for this. It is clear that there is considerable difficulty in defining the semantics of "lifestyles". The complexity of the factors that come into play even when attempting to describe lifestyles and their changes, before even thinking about producing scenarios, may prove dissuasive. It is very difficult to reach an agreement on the definition of lifestyles, whether between the different branches of sociology, or between the different disciplines. The dynamics of change, according to the theory or discipline followed, do not involve the same aspects of lifestyles in the representation of the future. Depending on whether we focus on the role of policy action, that of

consumption, of forms of sociability, or even of technologies, the reasoning behind the development of the scenarios will be different. Most often, and by default, lifestyle changes are described exogenously, as a *consequence* of action taken elsewhere, in political, technological, economic or environmental fields. In our approach, population change (plotted by INSEE), the environmental crisis and the economy are part of the context, the backdrop against which we have varied the different dimensions in order to produce the scenarios.

The process to build the visions presented hereafter was long and complex. It is impossible here to go back over the two years that led the working group from the initial discussions to the crucial moment of the final stabilisation of scenarios. But we will outline the key elements.

In terms of methodology, the cross-disciplinary working group, composed of geographers, sociologists, political scientists, engineers and economists, among others, worked on two parallel and simultaneous levels: the backdrop (theoretical, conceptual and analytical) fuelled by seminars with participants invited according to specific

topics, as well as discussions; and the actual production workshops for these imaginary situations, where discussions and proposals gradually led to the definition of guidelines for the development of the different versions of lifestyle change scenarios.

The main characteristic of this definition process was openness: first, epistemological openness, through the interaction between the different disciplines and fields involved in the discussions; then methodological openness, once several established methodological principles had been reiterated¹ in an initial memorandum. Without prioritising the areas chosen, considered in various capacities to structure lifestyles, we deferred the issue of the decisive role of each dimension for the second phase of the definition of 2050 visions. The definition of the content and structure of the conceptual field of “urban lifestyles” was established during seminars with external participants, followed by discussions, and with the bibliographical support of the state of the art. The series of seminars focused on the different terms of the definition of the lifestyles and fields concerned, without any decision on the hierarchical positions of the various fields: the socio-demographic distribution of wealth and inequalities (R. Bigot, B. Filippi), consumption and ways of life (S. Juan), values (B. Héroult, C. Tarot), space (J. Levy), social temporalities (H. Rosa), and urban areas and sociability (J-Y. Authier). At the same time, scenario building workshops were launched based on a series of “variables” identified in the most relevant fields that structure lifestyles. The concept of “exploratory fields” was preferred to that of “variables”, being more open and less tied to the idea of a quantification that would be premature at this stage. In this exercise, the meaning of the “dimension” is more abstract than the thematic area, but broader than the limited variable. The dimension is a “structuring” characteristic,

but is also “dividing”, and therefore binary, in the same way as “equality”, for example, which can cut right through a society: it ranges from high inequality to high equality, and is an area that can be compared with one or two others. The subjects selected were: *demography, consumption, daily life, culture and values, politics, state of the environment, urban life, economics, and technology*. Within these subjects, the potential “dividing” or non-dividing nature of the dimension in question was discussed. Thus, for example, within *culture and values*, the individual/community relationship was considered as a dividing factor. For the five final scenarios, this factor remained as one of the areas determining the future evolution of lifestyles.

Throughout the process, certain areas stood out, giving rise to a wide range of proposals for contrasting visions. Thus, the area focusing on the future of individuals and their articulation with the collective entity was combined with a meta-relationship with resources, considered as an economic (materialistic) or cultural relationship (based on motives other than the economic motive, such as personal fulfilment, control over one's lifestyle, or performance, etc.). Within the five scenarios finally selected, we find all of the subjects present in the “exploratory field” since they are, in different ways for each of the visions, the mainsprings that structure the description of lifestyles in 2050. Thus, in scenario 2 (Enhanced Human Society), the technological dimension is of far greater importance than in scenario 3 (Dual Society and Multiple Frugal Lifestyles) or scenario 4 (Environmental Citizenship). But with more collective social directions, we may find the same importance of the technological dimension in scenario 5 (Age of Knowledge), which is consistent with the operation of information technology, which cannot be removed from the social context in which it is deployed.

¹ GODET M., 2007. *Manuel de prospective stratégique*, two volumes, CNAM, Dunod ; DATAR, 1975. *La méthode des scénarios. Une réflexion sur la démarche et la théorie de la prospective*, DATAR, La Documentation française, Coll. Travaux et recherches de prospective, n° 59.

The Green Consumer Society

The spirit of this vision

The *green consumer* society is situated in a business-as-usual scenario with regard to lifestyles in Europe; technological innovation certainly provides new goods and services, but with no major change. The driver of change is adaptation to the globalisation of the economy, based on individualism. Consumerism is still at the basis of trade relations and of their materiality. However, the continuation of this trend in a context of constraints on material resources (and high costs linked to the consequences of climate change and to the adaptation of infrastructure) requires a reduction in the ecological impact of the consumer society, including GHG emissions. The greening of consumption attempts to respond to this need to reduce the carbon impact, while first satisfying the desire for comfort and material well-being of the dominant groups of this social model.

During the first half of the 21st century, the OECD experienced low economic growth. Economic globalisation has continued, but has been marked by repeated economic and financial crises. The main centres of innovation have moved to the Asian countries, fuelled by their booming domestic demand, which enabled them to attain high economic growth over the period. Some African countries are following suit. Despite the stabilisation of energy consumption in Western countries, global demand for energy continues to grow, increasing pressure on fossil energy resources. Consequently, the use of non-conventional energy (both primary energy, such as oil shale and shale gas, and final energy, such as liquefied gas and coal) has grown significantly, helping to keep the price of oil below \$150 per barrel.

Climate change is growing steadily worse. The average global temperature rose by 1°C

during the first half of the 21st century, and by 2°C in France. Rainfall is decreasing every year, especially in spring and summer, with high inter-annual variability. In spite of some severe flooding, the land has dried out. The long periods of drought have accelerated the abandonment of agricultural land.

The demographic trends observed at the beginning of the century have persisted. The population of mainland France (63.1 million people in 2011) reached 72.3 million people in 2050². The natural increase declined over the period, falling from 283 000 in 2011 to 32 000 in 2050, and the migratory balance increased slightly. It stood at +75 000 people in 2011 and is estimated at +100 000 per year over the whole period. Migration at the international level has diversified in the direction of countries where economic growth is relatively high (the Middle East, Asia, and Latin America). Immigration towards the OECD countries has remained at the same level as at the beginning of the century. The reasons for this migration are environmental and climatic rather than economic.

The population has continued to age. The number of people over 60 years of age has risen by more than 10 million: in 2050, one in three people are thus over 60 and 16% are over 75, compared to 9% today. Female life expectancy at birth was 84.5 years in 2011; it stands at 90 years in 2050. Male life expectancy was 77.8 years in 2011, and is 84.6 in 2050. The fertility rate is almost unchanged, at 1.95 children per woman.

Political organisation

Economic tension at the international level has made it impossible to establish a sufficiently ambitious international climate regime. The European Union crisis has given States

² Source: Insee's central scenario.

new room for manoeuvre. Proactive national policies have been implemented to offset the damage caused by climate change and to overcome the growing problems of access to fossil fuels for Europe. The goal is to develop a so-called "green" economy and to thereby open up new markets. Lacking the means to guarantee a "Green New Deal", the State intervenes both downstream, to support the worst hit sectors, and upstream, through a set of incentive, financial and fiscal measures focusing on adaptation to environmental change and the deployment of a green economy. The decarbonisation of the energy system and adaptation to climate change are the core features of environmental public policies.

Carbon offset mechanisms have been widely developed for both individuals and businesses, financing reforestation projects and renewable energy installations in developing countries. The regional authorities are trying to achieve carbon neutrality through the use of these mechanisms. Nevertheless, the offshoring of industry and services to the developing countries has continued, and with it that of CO₂ emissions through imports (Jackson, 2011). Since the new carbon accounting methods include the carbon balance of foreign trade, the European governments support "clean" development programmes in partnership with the exporting countries.

In spite of the offensive marketing strategies that the regional authorities are implementing in order to maintain jobs, the situation is rather precarious. The overall level of social inequalities has continued to grow, exacerbated by environmental vulnerabilities. The constrained part of household budgets has become very high, particularly due to increasing prices of insurance policies and to a relatively non-redistributive eco-tax system. Social tension therefore runs high and is managed by the public authorities in a rigid, defensive manner. Local riots, demonstrations against the loss of purchasing power, and hunger strikes to prevent offshoring or to protest against public sector job losses all accompany the increasing insecurity of part of the population and the decline of the public sector. Conflicts over

the control of information, especially via the Internet, are recurrent. Communication networks and information flows are monopolised and strategically controlled by several large groups, in cooperation with the Ministries of the Interior, Foreign Affairs and Defence, which have set up a heavily subsidised joint department to monitor communication networks. But this has not brought hackers and "Net neutrality" movements under control.

Production systems

Production systems have remained centralised and capitalistic, with the predominance of international firms, while incorporating cooperation and resource sharing strategies. We thus see the emergence of industrial parks designed according to the principles of industrial ecology. Design systems for products focus on life cycle assessments, with a view to optimising resources, the means of production and recycling solutions. Recycling has been extensively developed in all industrial processes. However, consumerist attitudes and the continued high demand for energy lead to high levels of risk-taking in terms of health and environment. Pollution is increasingly ubiquitous (chemical components, genes from GM crops, nanoparticles, etc.), and spreads to all environments.

Reducing France's energy dependence is a pressing concern. However, energy demand-side management is still seen as secondary to supply policies. The difficulty of influencing numerous actors remains an obstacle that the State lacks the means to overcome. The periods of economic recession, the erratic evolution of oil prices, the growing insecurity of an increasing number of households and their vulnerability to rising energy prices have fostered acceptance of the exploitation of shale gas in France and the rest of Europe. The maintenance of nuclear plants at 2010 levels with the replacement of end-of-life power stations accounts for 50% of electricity production.

Following on from the European "20-20-20" policy, the State is also placing the emphasis

on the development of renewable energy, mainly through economic and fiscal instruments. The carbon tax is in place at last, at about 100 €/tonne, or around 30 centimes per litre of petrol, an amount that is too low to change behaviour. However, personal carbon footprints are beginning to be commonly used by individuals as a means of managing their budget. These measures are offset by the general increase in consumption, especially due to the obsolescence of products, which explains why energy demand in France remains at 2010 levels.

The carbon content of food products is also controlled. The agri-food industry and distributors are subject to strict regulations. Displaying the carbon content of food is now common practice, and is becoming a criterion for choice and for determining value for money. We see a general increase in prices and a growing differentiation in the quality of food. Two types of agriculture coexist: first, a competitive, low-quality agriculture partly aimed at export (intensification, but with a relative decrease in the level of inputs due to the optimisation of their use, biofuels); and second, a multifunctional agriculture (extensive livestock farming, organic farming, polyculture-livestock farming), which provides environmental services for payment. Its development is linked to the proximity of outlets for short supply chains, close to urban areas, and to the existence of a natural, landscape and cultural heritage to be promoted. In the other areas, agriculture is still highly specialised with high output.

The consumption of organic products in food has significantly increased. These products come from both the international market (especially Eastern Europe and North Africa), which has access to cheap labour and is distributed by supermarkets, and from French production, which is better quality but more expensive. Agricultural production is not directly supported by the public authorities. Aid is limited to crisis management and payments for environmental services. People are eating less meat, following the trend observed at the beginning of the century, mainly for public

health reasons. The consumption of plant proteins is encouraged.

The decarbonisation of food thus stems from a global diet that contains less animal protein, but also from the increasing use of renewable energy (including biofuels and biogas), from tools to optimise inputs in the agricultural sector and from loss reduction at every stage of the process. The agri-food sector has also benefited from the partial decarbonisation of the global energy system. The transport of goods has barely changed. The share of imported animal products has risen sharply, along with that of imported animal feed, since priority is given to crops and to biofuel production. This results in the “outsourcing” of GHG emissions linked to the consumption of animal products, even if there has been a shift towards the consumption of poultry and pork.

Technological innovation

The development of renewable energy (RE) helps to maintain low-carbon energy production, even though demand continues to grow. But RE is struggling to meet requirements for heating and mobility, which remain very high, due to a lack of impetus from the public authorities and to insufficient funding. Despite the energy shocks, energy production and supply networks remain centralised, with economic benefits prevailing over energy resilience. Wind power has expanded, and some major offshore wind farms have been built off the Atlantic and northern coasts. Several carbon capture and storage facilities have been created, fed by vast sites including coal-fired power stations and energy-intensive industries. Technological progress has enabled a gradual increase in the output from the solar photovoltaic panels that have equipped most new buildings since 2030, which nevertheless make up a small proportion of the building stock in 2050. Photovoltaic systems are being installed on large roof areas, derelict urban sites and wasteland. The European electricity transmission grid has grown substantially and can merge the wind systems from all over Europe with Scandinavian hydroelectric power

and Southern solar power. The DESERTEC project has been a success.

Second generation biofuels have matured and gradually entered the market in 2030. They are the result of a rationalisation of logging, the utilisation of ligno-cellulosic waste, and the development of plantations for this purpose. New generations of GM seeds are primarily aimed at energy production. These sectors are highly profitable, but conflicts over land use with food and materials sectors limit their development, while algae fuel sectors are still poorly understood and remain marginal. They are supplemented by agricultural methanation, which has developed in some major cattle farms.

Intensive agricultural production has resulted in reduced soil fertility. It is nevertheless subject to the rising costs of chemical fertilisers due to the depletion of oil resources, but also to weather variations, seed diseases and the proliferation of crop pests due to global warming. All of this has led to the development of new soil-free systems in ever more artificial environments, "vertical farms" that secure the most fragile, high nutritional value agricultural products. These systems are also used for the cultivation of plants useful to the pharmaceutical industry. These vertical farms (Despommier, 2011) are being developed in urban buildings with hydroponic systems. They use compost from the recycling of the fermentable fraction of household waste, thereby limiting the use of chemical inputs, and run on renewable energy (solar, geothermal, biogas). They may also be used as ecological services for the recycling of grey water into drinking water and may thus become an integral part of a wider urban ecosystem and of a heat regulation system (artificial air conditioning based on natural processes).

Another field of innovation is of course that of new information and communication technologies (NICTs). Their continued development has led to the creation of intelligent and reactive environments at all scales, from smart grids to smart cities, and from intelligent buildings to interactive districts. Information systems have facilitated the use of

alternatives to private vehicles. Anyone may at any time use their mobile phone to find out the cheapest, lowest carbon means of transport between their point of departure and their destination, with the journey time indicated along with any changeovers. Smart cities are equipped with sensors, beacons, computers and emitters, as if covered by a layer of beams and invisible information flows. These have become essential to everyday life, but are also a powerful means of controlling the lives of individuals, and are the subject of recurrent conflicts within society.

Smart rooms detect, adapt and communicate with the individuals present. Companies are competing to design sensitive, communicating objects that contain information systems, and can be used to control the virtual world by manipulating physical objects (Rheingold, 2005). The "box computer" has disappeared, leaving just a touch screen without wires or keyboard. Microchips blend into the environment and biometric devices enable identification. Computers are becoming "pervasive" and connection is permanent. Small, low-cost network processing systems are integrated and distributed throughout all aspects of daily life. For example, refrigerators are "aware" of their labelled content and propose a variety of menus with the foods present, and also warn consumers if food is past its use-by date or has gone off. Individual biometric sensors sewn into clothing adjust lighting and heating in an occupied room, imperceptibly and with no interruption.

All communications, whether in the private sphere or the public sphere, now systematically associate image with sound. In professional environments, webinars (online conferences), which are a more flexible and rapid way of bringing together a large number of participants, have become the norm, made possible by the powerful systems installed by the major companies, public institutions and universities, etc. A variety of communication systems with image is available for all budgets. Thus, video calls between family and friends involving multiple callers have become commonplace.

Many nanotechnology-based products have entered the market, having proved their worth in a variety of fields (materials, equipment, energy systems, etc.). Society has chosen to adopt these nanotechnologies en masse, but research on their impact on health is still insufficient and largely overlooked. In spite of the many associations that are attempting to mobilise public opinion, for example in view of the rise in cases of lung cancer that smoking alone cannot explain, no global health surveillance has been put in place. Environmental health remains the subject of conflict.

Socio-spatial organisation and mobility

Population growth largely concerns urban areas. The urbanisation rate has stabilised at around 80%. Urban areas are surrounded by leisure zones and agriculture in an attempt to limit the need to travel, but the urban sprawl has not been controlled. The peri-urban population continues to grow, to the detriment of city centres. Social polarisation has increased. Segregation is leading to a rise in the number of gated, monitored neighbourhoods. Some of these neighbourhoods are designed according to environmental criteria, and are accessible to the middle and upper classes.

The renovation of existing buildings has reached a rate of 30% in 2050, while many others are deteriorating. Being often left to private initiative, energy savings are not always up to expectations, especially as the surge in air conditioning to cope with heat waves limits the savings made. The imbalance between the wealthier and poorer classes in terms of the way they protect themselves against the effects of pollution is flagrant. For around 10 years, office and residential buildings, and new luxury hotels and shopping centres have been equipped with air filtration systems, making them impervious to atmospheric pollution.

Since the greater part of population growth is situated in peri-urban areas, mobility has continued to rise, with an increase in the average distance travelled. But for low incomes, the use of private cars is often limited by the cost of fuel. These households turn instead to two-wheeled vehicles or to new small, light vehicles that meet demand for constrained low-cost mobility. Average household vehicle ownership has continued to grow, especially as environmental constraints and urban congestion have led those who can afford it to acquire a wider range of vehicles: a car for long distances, one or two small urban cars, and a scooter or electric bicycles.

The modal share of public transport has increased for two reasons. Under the impetus of local authorities seeking to reduce the transport budget of the poorer households, peri-urban areas have nevertheless become more dense. This has also enabled the development of diversified, complementary transport networks, combining cycling, walking, personal transporters³ and small automated shuttles, which converge towards public transport lines (trams or underground trains). However, the level of investment in transport by municipalities largely depends on their budget, and the least well endowed municipalities remain on the periphery of this evolution. Their inhabitants see their transport options deteriorating. Mobility is also highly differentiated for non-essential travel, especially for leisure reasons. For wealthy households, "leisure" travel and "visits" continue to increase, to the detriment of professional and educational trips. The number of second homes is rising, as is dual residency. While this increases long-distance mobility, rentals of two-, three- or four-wheeled vehicles from railway stations and luggage transport services are facilitated. This type of transport thus helps to reduce car use, even for long distances, but this remains a luxury for the majority of the population.

European rail links have considerably improved in terms of speed and comfort, regaining market share for this type of

3 A one-seater electric vehicle, featuring two-wheeled platform on which the user stands.

journey. Despite the unpredictable impacts of climate change on air travel, more international flights are taken than before, and are primarily motivated by professional mobility, and visits to friends and family. Indeed, moving abroad is more common than several decades ago, especially due to the fact that almost all under 65s can speak English. Since the language barrier has been removed, going to live in a different country has become common practice.

Sociability and values

The work ethic is central to social identity and recognition. Those who fail to obtain paid employment of any kind, especially young people, are at a particular disadvantage. Competition for access to jobs has increased. Flexibility and new ways of organising work have also led to the individualisation of working hours and professional constraints, making it difficult to articulate them with other activities (family, social, leisure, etc.). The desynchronisation of social time, which began several decades ago, has continued to increase, even within the family, and is weakening family ties. Communication between family members or friends is mainly by Internet and on 3D screens, in addition to occasional visits. Online relationships are increasing to the detriment of face to face relationships.

The changes that marked the 1960-2010 period (a threefold increase in the number of single people, a doubling of the share of single-parent families, and a 10% increase in childless couples) have intensified. The percentage of single people is thus 25% in 2050 (15% in 2010), and the share of single-parent families is 17% (9% in 2010). With the ageing population, the number of people developing long-term illnesses has increased (cancer, stroke, Alzheimer's disease, etc.). The number of dependent elderly people has thus doubled, reaching 2 million in 2050⁴. Thanks to the development of home help networks, 9 out of 10

people over the age of 75 live at home in 2050, as was the case in 2010.

In terms of the typology of values, the dominant group is that of the conformists. The value system to which they subscribe was formed in reaction to globalisation and under the pressure of the recurrent theme of security: it is based on the triptych of tradition, conformity and security (including ecological security). The need for security and conformity dominates the need for tradition, and xenophobic sentiment has been building. The handful of cosmopolitan elites that are very open to the rest of the world have failed to convince people of the value of multiculturalism, migration or forms of global governance. Insubordinate groups (artists, ecologists, hackers, etc.) are marginalised when they fail to move into potentially lucrative niche markets. Environmental awareness has grown on the whole, but in a somewhat defensive manner. There is considerable concern about the degradation of resources, natural areas and landscapes. The French *Chasse, Pêche, Nature et Tradition* party (Hunting, fishing, nature and tradition) has gained many followers and is not against alliances with an extreme-right that can garner as much as 30% of votes.

Lifestyles and consumption patterns

For those who work, time is continually accelerating and becoming more dense. Salaries that are partly linked to individual productivity have become the norm in most jobs. The development of telecommuting has reinforced this pressure seven days a week, and contributed to blurring the boundaries between work and free time. Asynchronous communication and storage tools (email, answering machines, etc.) contribute to multitasking and increase the density of time. For those who are able, going away at the weekend and disconnecting is the only way of having a break.

This has led to the extension of daily and weekly consumption periods and to activities

⁴ Based on the pessimistic scenario of the Charpin group.

being conducted until later at night. The 24-hour stores and deliveries enable this flexibility. Consumer goods are “green” and low-carbon, in order to maintain consumption volumes. Waste sorting has progressed considerably: the tax on household waste is systematically adjusted according to weight. Bulk buying in local stores has become a habit once more, and personal carbon footprints and carbon offsetting have grown substantially.

Access to consumer goods still varies greatly according to household income. High-tech products are still a social marker and new products are constantly being put on the market with no apparent saturation point for households that can afford them. The minimum electronic equipment of a household, including low-income households, is one computer per person (multifunctional tablets) and two widescreens in the home. In high-income households, all rooms are equipped to access the Internet, programmes or correspondents. Mass dissemination and the rapid obsolescence of products characterise consumption patterns. People aspire to use “services”, especially to save time, which in fact translate as “goods”. At the same time, measures taken to label products with their carbon content have generated new purchasing habits that are gradually spreading through all segments of the population. The rebound effects limit the environmental benefits of the measures implemented.

While two-thirds of households took holidays in the 2000s, now only 50% do so. The cost of

transport remains a considerable constraint for a large proportion of households, whatever the means of transport. The preference for short trips has reversed, returning to a smaller number of trips per year, for a longer period for those who can afford it. For many, the escalation of precarious work, temping, and working hours that are increasingly flexible, erratic and uncertain make it difficult to plan any leisure activities, even short ones. Finally, many elderly people prefer to stay at home. The more frequent heat waves, the uncertainties about weather conditions at all times of the year, and the recurrent fires in the south of France have led many holiday-makers to turn to breaks in leisure parks, where everything is planned so that many different activities can be enjoyed, whatever the weather. A wide range of sporting, cultural and leisure activities are available in protected places, with air conditioning if necessary. Natural habitats with flora and fauna, and “exotic” environments are artificially developed, providing a complete change of scenery just a few hundred kilometres from home. These parks provide services to suit the purses of different segments of the population and are more accessible than air travel. In addition, the last pandemic that occurred in 2046 is still on everyone's mind and has reduced international travel. Drastic measures to limit and control international trade had to be imposed for six months. A new virus that was initially carried by mosquitoes mutated and became transmissible between individuals.

The Enhanced Human Society

The spirit of this vision

The enhanced individual, with its sights set on the cyborg⁵, translates a desire to be freed from the unhappy human condition, and from

a humanism that has shown its limitations (war, genocide, ecocide, colonialism, poverty, exclusion, environmental degradation, etc.). Through a hybridisation with artificial

⁵ The *chiemgauer* is a local “melting currency,” created in a region of Bavaria in 2003. Its value declines over time, encouraging consumption and investment over hoarding.

intelligence and mechanical prostheses, the cyborg could succeed in overcoming the failings of the human race: illness, ageing, death, domination and conflict. Technical progress has, perhaps involuntarily (mutations, ICTs, GMOs and genetic engineering, etc.), opened up new possibilities for responding to ancient dreams and myths about surpassing humanity (Besnier, 2009). In the Anthropocene age, a new step in our evolution could be taken.

Progress in medicine (genetics, tissue regeneration, implants, prostheses, chemistry, etc.) has resulted in a significant increase in life expectancy. The promise is that of a much longer, healthier life, at the price of a growing hybridisation with artefacts. "Natural" demographic trends have been modified by voluntary manipulation of procreation, birth control and rejuvenation, etc. As the number of children per woman has decreased, the population in 2050 remains the same as in the business-as-usual scenario, at 72 million people. Very old age is however only possible for the most efficient: it is one of the drivers of the race for greater competitiveness.

The quest for performance, whether at the individual or the systemic level, is central to this scenario. The market has become the universal model of social organisation, and is capable of giving access to eternity, admittedly at an as yet undetermined and controversial timescale. Individuals seek to increase their adaptive capacity and their chances of success. In order to adapt to the faster pace of life and to increase their performance, they have no qualms about incorporating more and more prostheses. But the latter are not available to all people with the same degree of sophistication. Hyper-performance gives a transnational elite access to the prestigious positions and the most enviable life choices, through heavy dependence on technical devices. This elective heteronomy is seen as positive, since improving their physical and cognitive capacities gives people a sense of greater (prosthetic-assisted) individual autonomy.

This scenario leads to an ecological and social dualisation: a confined urban living environment is created artificially for the enhanced

humans, while the outside world contends with climate change, pollution, and the maximum exploitation of natural resources in a context of scarcity (biodiversity, diminishing oil reserves, raw materials) through increasingly powerful technologies. Human life is difficult without the support of prostheses and protective environments, while living organisms are modified and evolve in response to chemical, genetic and nanotechnological pollution. Not everyone is able to take shelter in safe environments. As in the work of fiction *Globalia* (Ruffin, 2004), the "enhanced" world, which is "adapted" to the ecological crisis and kept under a dome, where an artificial nature is recreated for the needs of the integrated workers (the "pluses"), coexists with a bordering world that is far more uncertain and uncontrollable. This world is inhabited by the least efficient people (the "minuses"), who are also enhanced, but who, by way of compensation, are living second lives, in multiple virtual realities, where they are reduced to realistically simulating what the "plus cyborgs" accomplish in reality. The boundary between reality and fiction is blurred.

In a context of unlimited performance, the goal of enhancement tends to get further away the closer one gets to it. Frustration on the part of not only the "pluses", but also the "minuses", may result in resistance, hacking and forms of cyber violence where clashes result in a redistribution of power to control enhancement resources. In the 2030s, the right to an enhanced mind and body was laid down in the constitution.

Political organisation

The coalition between political and economic powers could not be closer. Techno-science and the industrial production system are politically supported and protected. The search for profit and power serve the purpose of surpassing human limitations, or perhaps it is the other way round. Competitiveness has been elevated to the rank of natural law (enabling the shift from human to cyborg), but does not make the empowerment of individuals

possible, especially on the political level. The enhancement of human beings increases not only their capacities, but also collective control over them. Prostheses are a powerful instrument for surpassing ordinary experiences, and also for control. They result in functional specialisations that restrict personal choice, especially as robots enable individuals to offload daily chores and activities in order to concentrate on their areas of excellence. Through prostheses, bodies are networked, which heralds the planetary and hybrid symbiote, combining artificial intelligence and the mobilisation of brain and body (De Rosnay). Political institutions are globalised. Global governance also functions at the regional and local levels through deconcentrated networks that are managed by the “pluses”. The “minuses”, on the other hand, are losing interest in politics. Highly specialised public institutions and territorial-level management bodies work in close collaboration with companies specialising in technological innovation (information technology, nanotechnology and biotechnology). States as such no longer exist, nor is there any yearning for national identity: the German cyborg is no more desirable than the Chinese cyborg, and this geographical distinction is no longer relevant. The evolution of societies is terrestrial and integrated. However, some cities and regions are more productive than others, since they have obtained better access to resources or have ensured a greater redistribution of prostheses, which has increased the overall level of performance. The geography of territorial competition remains unchanged.

The political world is focusing primarily on the democratisation of prostheses, as this is the driving force behind growth and social cohesion. The right to prostheses is an unflinching social demand. However, citizens are losing interest in politics, seen as a stage on which a few “celebrities” perform. The government, which is both global and local, is personalised and charismatic, playing the card of the inventive neo-human, part god, part beast. Its legitimacy is based on the promise of future

prostheses for the masses, or for the greater good of the economy. The goal is of course to reduce the cyborg divide, which persists due to the shortening of innovation cycles. Everyone has the right and the obligation to enhance themselves, but not everyone succeeds in doing so at the same pace. The right to enhancement, irrespective of individual financial resources, mainly concerns repair prostheses. Nevertheless, the gaps are widening between the people heading the movement and those who are unable to follow; between the poorer and wealthier households; between the ins and the outs; and between those we see everywhere (especially government officials, who are the most visible), and who we admire, and the “invisibles” (the “minuses” are far less visible, except in the virtual worlds). Survival benefits are provided by the public authorities, particularly for connection devices and basic prostheses. The difficult living conditions are made bearable by virtual worlds.

Production system

The economy operates at the global scale thanks to a financialised but regulated form of capitalism. The global currency has been dematerialised. Work is becoming more intense and all connected workers are competing in a single job market.

The new economy is based on a gradual convergence of information technologies, nanotechnologies and biotechnologies. Robotics has undergone spectacular growth. Numerous individual or collective services are now accomplished by robots and have thus multiplied (24-hour assistance, cleaning, maintenance, reconstruction, companion robots, deliveries, etc.). Robots populate living, working and leisure areas, as well as public spaces. The transformation and commoditisation of bodies is the other major area of market expansion. The monitoring and orientation of the ways individuals spend their time through prosthetic devices is the focus of intense competition and economic battles.

The society is hyper-industrial, and the use of ICTs, robotics and artificial environments

has expanded, invading the social space. The majority of material consumption is due to envelopes, interfaces and cohorts of robots and prostheses. Far fewer actual objects are used in daily life. They are multifunctional, programmable and compact. Artefacts are no longer in objects, but in bodies and in the environment.

Agricultural production systems are now entirely artificial. Highly intensive and efficient, they almost exclusively produce raw materials needed to make food products and pharmaceuticals. This production is computerised and optimised using high-technology tools. Satellite monitoring is increasingly used to manage crops, to measure their biophysical parameters and to optimise nitrogen application, etc. A good deal of agriculture is soil-free. GMOs are in widespread use for energy and food production. Functional foods are booming, and meet strict physiological requirements.

More generally, the planning of all types of production has become widespread, thanks to the powerful calculation, coordination and miniaturised storage of information. Production and consumption can be matched in a very precise and flexible manner, and changes are made in real time. Waste is considerably reduced and product shelf life has been lengthened: the renewal of consumption depends on the emergence of new environmental products and functions, rather than on the replacement of existing products. Old prostheses and robots are recycled after a long life.

Technological innovation

Social innovation is giving way to technological innovation, which is rapidly evolving. The technologies presented here are not particularly futuristic, given that history has undergone a remarkable acceleration: we have gained 80 years in 40 years.

The merging of intelligent environments and wearable computing technologies has broadened the scope of possibilities. Envelopes (second skins, clothing, habitats, inner

streets, etc.) have integrated information systems. Intelligent rooms have visual, audio and "haptic" (tactile) interfaces, while clothes incorporate wearable computers that enable them to adapt to users and their environment. Mural displays are intended to stimulate citizens' performances, or to provide rest and a sense of wellbeing. Thus, the four seasons, the starry night sky or the Milky Way are regularly displayed on walls in order to rest the imagination.

Human beings in turn integrate physical and digital prostheses that connect to one another in intelligent environments, thanks to human-machine interfaces. Individual performances are greatly enhanced by the development of molecular nanotechnology and nanochips, which are likely to one day surpass the capacities of the human brain. Genetic and tissue engineering also make it possible to repair bodies, to slow down the ageing process and to improve individual physical performances.

Information technologies have of course permeated the world of objects. All consumer goods can be monitored and tracked using wireless RFID chips (the object's identity and circulation card). It is now possible to see how these objects are moved, to optimise their design, to automate the production and logistic flows, and to develop better sorting and recycling systems. RFID chips also make it possible to identify the everyday practices of individuals and to direct their choices through different types of advertising. For example, the internal and external envelopes of buildings show adverts, which helps to pay for intelligent rooms.

More generally, we are seeing the rapid dissemination of nanotechnologies developed particularly for biotechnological purposes. Nanotechnology has fostered the miniaturisation of products and has helped to produce more resistant, lighter materials, thereby helping to reduce energy consumption.

In the energy production sector, solar sensors are integrated into the envelopes of new buildings and use diffuse light conditions. Smart grids have been widely implemented, along with small heating systems, and coexist

with centralised systems. These energy savings are offset by the computerisation of everyday life. ICTs and robotics use a substantial amount of energy for activities that were previously done using metabolic energy (human work). Nuclear power generation is keeping pace with demand for electricity, which has considerably expanded into the passenger transport sector. Conventional and non-conventional fossil fuels still account for a significant proportion of energy supply.

At the same time, research on nuclear fusion is prioritised, as this energy would make it possible to explore outer space. High-speed urban public transport is electrified, as are individual vehicles, thanks to the miniaturisation of storage and to energy efficiency improvements. Some vehicles also run on biofuels and biogas. The articulation of nanotechnological and biotechnological innovations has also led to the emergence of production plants for algae fuel and artificial biofuels.

Socio-spatial organisation and mobility

Urbanisation is gaining momentum, and now stands at 95%. Cities are interconnected metropolitan areas, surrounded by agricultural zones and industry. People have withdrawn from physical space. Only the intensity of the virtual experience counts, except in the case of a few elites, who leave their bubbles more often. The artificial reconstruction of environments and sensory spaces to provide new experiences reduces the need to explore and discover new places. The economic and commercial centres of cities, which have been partly renovated, are futuristic and decontextualised, which encourages experiential journeys.

Housing is very dense, and new buildings are collective, intelligent, and adapted to suit single households. Living area per person has decreased: fewer objects, multifunctional rooms, and a very high price per square metre for urban housing. All devices are connected and can communicate with each other: prostheses, envelopes, objects. The virtual and

real worlds are hybridising. A considerable amount of time is spent in hospitals, clinics and residences for the very elderly, where experimental research is conducted (many are attempting to prolong life). Leisure areas have been developed indoors: at home, in sports halls and places of collective relaxation, or in natural areas recreated under domes, presenting a range of ecosystems.

This degree of sophistication is not available to all, however. Just outside the dense cities lies the disorganised and threatening world of the "minuses", which is connected and improvised, and survives any way it can by entering virtual realities, which have become the opium of the people. The "minuses" live in 20th century housing, which has had barely any improvement. This peri-urban landscape is full of data cables, wastelands, ruins, and landfill sites that have become major recovery centres, but also workshops, market gardens and pastures. Inside the ring roads, the dense cities are now covered in gated communities and other security, monitoring and surveillance systems, as the hypnotised world of the "minuses" could one day awaken. Cohorts of dissuasive robots keep the peace.

Some major industrial and intensive agriculture and aquaculture zones are developing not far from the large cities, and are linked by high-speed rail and motorway transport. Beyond, rural areas are largely deserted. They are dotted with abandoned small and medium-sized towns, which serve as quarries for materials. Agricultural land is being abandoned, and forests are growing in size. Small parts of the countryside have been made into sanctuaries for the leisure pursuits of the elites, in picturesque villages and landscapes. But people get bored there if they stay more than a few days. Long-distance mobility only concerns this type of travel, along with metropolitan business tourism. The "plus cyborgs" often use door-to-door air transport thanks to rooftop heliports.

Interaction within cyberspace and the increase in telecommuting for white collar workers have largely reduced the need for mobility. Levels of mobility are strictly

dependent on social category. The “minuses” are the most confined, and are highly sedentary. The elites tour the world, mainly to find the most efficient partners or verify the accuracy of their partners’ online identity, as virtual reality can be manipulated. The others mainly move within the cities, using small vehicles (such as personal transporters). New types of “transitory nomadism” are developing there, linked to professional practices and to leisure. Citizens are glued to their computer screens, even when travelling.

Sociability and values

Virtual contacts and exchanges have greatly increased, but lasting social relationships are rare. Friendship groups are smaller, based on affinities, and vary according to identity, age and functional specialisation. The family in its nuclear or extended form has disappeared; family associations are freer, although many people live alone. However, robots are entering homes and populating daily lives. People may become attached to these robots, especially as they are programmed to show emotion, to communicate and to help. The permanent interaction with sensitive, responsive machines (AI) is even producing new beliefs and forms of techno-animism attributing subjective qualities to technologies and to artificial environments. The syncretism of beliefs, including religious ones, and the reversal of human/machine relationships are commonplace.

Parent to child knowledge transfer no longer works, as technologies have made the experience of older people obsolete. Parenthood is hazy and is limited to emotional relationships; sometimes empathy has to be stimulated using chemicals. The desire for intergenerational transmission has disappeared, as the promises of enhanced humans have made this type of legacy irrelevant. The desire for children is therefore flagging. Instead, the way forward is the advent of cyborgs and of radically new potentialities. “Natural” reproduction by couples is declining, and seen as outdated, but is more common among the “minuses” due to a

lack of means. Cloning and artificial procreation are gradually replacing it, making it possible to improve the performances of children, in a blatant example of eugenics.

Having children is in any case discouraged by public policy: difficulties finding childcare and a lack of “nanny” robots, except for the elites, who pay high prices for them. Public finance is reserved for the fight against mortality, from scientific research to infrastructure facilitating life for the very elderly. The number of children authorised per woman is limited (two, to take into account changes of partner); and abortion is compulsory after one child for the “minuses”, who are not sufficiently selective and tend to reproduce indiscriminately.

The quest for performance is reinforcing the trend towards individualism and solipsism. Forms of voluntary isolation are developing within self-sufficient bubbles, which explains the political disinvestment and the lack of conflict in this world (except for hacking and the diversion of resources). Success and the desire for power are longstanding values, which now govern most individual choices. The scope of these choices has expanded, except for bare minimum enhancement, which is imposed at the outset by social norms and the regulatory demands of public health management. This enhancement results in forms of remote control, which relieve the moral imperative (deciding for oneself what is right and wrong) and partly configure action.

The commoditisation of time and experience has followed on from the appropriation of areas and of material goods. Real estate can no longer be passed on to family. Property no longer has any value, and the only thing that counts is ability. Success is measured in terms of the accumulation of prostheses and power upgrades. One means of power consists in acquiring the capacity for time dilation, through the differentiated lengthening of life or the intensity of experiences. It is now necessary to relate one's experiences, to make them public and to exhibit them using tools such as Facebook.

Access is the essence of the new social hierarchy. Invisible barriers (electronic, chemical,

and many others) are being recreated, and are the cause of binary in/out situations, with no intermediate states. Likewise, an individual may or may not be able to accomplish an action; he may or may not have the access code. In a certain sense, he is himself a walking code, which provides access to different realities or virtualities, determining and defining his place in society. All places fall within a hierarchy, depending on professions and fields (aesthetic, recreational, cerebral, sensitive, etc.).

This results in a high level of specialisation and functional diversity between individuals. Society is highly unequal, with a growing range of inequalities that now tends to infinity. But the permanent confrontation with screens and “new forms of reality” may produce protean personalities. People now juggle several lives and personalities, which are developed in different contexts: public, professional, private and virtual lives. Integrated prostheses may be made invisible; this is then a type of resistance to functional specialisation. The “neo-human”, with a lack of attachment to the outside world and to others, always requires an “audience” to confound with his artifices, which maybe either carefully hidden or exhibited.

Lifestyles and consumption patterns

The boundaries between work and daily activities are becoming blurred, with the growing interconnection and the increase in telecommuting, which saves time and energy, and increases productivity. Everyone can be seen as a start-up, which occasionally does well through an innovation, a patent or a performance. Virtual socialisation is accompanied by a high level of physical inactivity. This is offset for some categories (the “pluses”) by higher personal mobility and by sporting activities.

The pace of life has accelerated and intensified, with strategies for letting off steam and playing for time in cyberspace. Attempts to adapt to the pace imposed by technological innovation and the quest for performance result in specific pathologies that are treated as required, without undermining the social pace that accompanies the human enhancement

project. For the “minuses”, escaping to cyberspace bubbles is less prestigious than real time dilation through the enhancement of experiences, or even the multiplication of the different lives one may lead (through cloning, dual personalities, or other devices). On a material level, the “minuses” also depend on the “second life” of objects. The consumption structure is clearly highly unequal, but the reduction of investment cycles and the acceleration of innovation provide rapid access to goods. Objects and prostheses are sent into a second life cycle, repaired and reused.

On the face of it, a higher level of individual autonomy seems to be developing. But in reality, there is high technical, energy and food dependence. Experience requires technical devices, and cannot be achieved simply by meeting other people or visiting places: those types of experience are ruled out. Fields of self-production have considerably diminished and social norms leave little room for dissidence; or rather, dissidence involves unusual prostheses that have been modified and may even be counter-productive. But this little game is generally short-lived (adolescent crises, rites of passage, etc.), as it leads to exclusion and to the forfeiture of social rights: in a word, it is suicidal.

On a daily basis, material life is made easier by the high level of robotisation of domestic chores, the collective planning of work and leisure, and the lack of objects, while social life is particularly standardised. Health and the lengthening of life are unquestionable objectives. Efficiency is of prime importance. Mealtimes are reduced to a minimum, and are only seen as a time of conviviality on special occasions, such as holidays or celebrations. Culinary art has become a leisure activity, reserved for enthusiasts. A specific, high quality agricultural sector is dedicated to these activities and to high-income households. It is marginal in the overall food production sector. Food contains a high proportion of nutritional supplements, functional foods and other products guaranteeing ever greater physical and intellectual performances. This food is more concentrated and has a lower

water content, which helps to promote e-commerce and local shops. The concept of fresh produce no longer applies, which means that the transport and storage of goods is less constrained by time.

Most public health problems are managed in an authoritarian manner using integrated markers that record the state of health and detect any anomalies. Health rules (physical exercise, diet, etc.) have become obsolete to some extent, since numerous services ensure health: muscle stimulation while working on the computer, functional foods, artificial sleep regulation, etc. But in other respects, they have become compulsory: performance sports from childhood, a ban on smoking in

all public and private places, etc. People can always smoke or get drunk on Second Life, or simulate a trip with cerebral evasion prostheses. Neo-humans spend long periods in hospital for tuning, transplants, adjustments, revisions and repairs. The clinic is a second home, and hospital stays are felt to be invigorating and heartening, especially as permanent medical surveillance of individuals makes it possible to treat problems at the source, and has removed the negative burden formerly attached to medical intervention. However, since the funding of health care beyond the mandatory minimum is private, not everyone has the possibility of regularly visiting the most prestigious places for enhancement.

The Dual Society and Multiple Frugal Lifestyles

The spirit of this vision

Social change is driven by an economy that is suffering a chronic crisis. The recurrent crises occurring at regular intervals are putting paid to the quest for comfort and material achievement, in the same way as barbarian invasions or epidemics in the olden days. The permanent threat of collapse in a system of this kind, based on instability, and its failure to integrate humanity as a whole into its project, is causing a profound identity crisis. In the first decades of the 21st century, xenophobia has grown, but urban guerrillas and unacceptable outbreaks of violence are leading the various political parties and intellectuals from all backgrounds to strive to educate the people and to condemn en masse the far-right movements. Their followers are forced into hiding and society is looking for other ways out. A large proportion of the population is thus turning away from the dominant economic system, following in the footsteps of the cultural creatives and degrowthists who paved the way at the beginning of the century.

People are stepping back and sheltering, in search of meaning and values such as security, shared interests, or solidarity. In 2050, 60% of society continues to fuel the traditional economic system, predominantly in the large cities, while the other 40% have opted out and created new forms of social organisation inspired by community life, and are reviving rural areas and small towns.

The supremacy of a dominant social model has faded. Weakened by an economy in recession and by mass unemployment, the State is no longer able to oppose this System D and the growing number of alternatives. The plurality of organisational structures and lifestyles becomes a condition for the survival of the system and, consequently, a value that is tolerated or even encouraged by the authorities holding the financial and political power. This results in a high level of social differentiation, based on the possible coexistence of different worlds, where the most common social form, an alternative to the dominant social model, is the network linking cells of communities on

the Internet. The closest model we have is that of the extended family, but this time based on affinity. We can also take the example of the Amish. They have their own economic and educational system, pay no tax, live totally juxtaposed to the American society, and are tolerated there. Imagine tens or hundreds of communities like those of the Amish, with varying degrees of ideology and coherence.

This scenario is built around the rapid development of alternatives, with the idea that it is necessary to self-organise in order to adapt to resource shortages, since policy makers are unable to respond to this problem, are becoming weaker and must give way to the communities and delegate more power to them. Initially, those dropping out of the system were the "cultural creatives" (Ray and Anderson, 2001), then their world visions spread (they actively disseminated them) to a large segment of the population, seen as being environmentally responsible. The communities have ties with other alternative systems around the world, and they support one another in their experiments and their convictions. Two types of adherence to the alternative model coexist. The first is voluntary, with environmentally aware people deciding to take a different social path, and to take things in hand in order to immediately change their way of life. The second is a matter of necessity, and characterises individuals who have been left behind by economic development and its recurrent crises. In this case the path change is seen as a means of survival and is encouraged as such by the political authorities, which are capable, thanks to the development of systemic management tools, of giving a panoptic indication of the gaps where people can settle away from the large cities and the globalised economy.

Political organisation

The geopolitical situation is structurally the same as in 2012, but the hegemonic countries are China allied to Brazil, and several other new emerging countries. The United States and Europe owe allegiance to the new financial powers that possess rare raw materials

and resources, including land to be occupied by climate refugees, and their economies have been weakened. The international institutions responsible for coordinating sustainable development policies at the global level have not emerged. The political authorities no longer intervene in the economy, and action is left either to companies in the conventional economy, or to the relatively autonomous communities, which are proliferating in many countries in response to the crisis. The people who have not opted out are integrated into world trade.

National policies manage the regulatory framework and the crisis situations, and ensure basic facilities for all communities. The French State works primarily to ensure the regions remain interconnected: health infrastructure, transport and communication networks, energy re-routing, if necessary, etc. Adaptation measures have also been taken at different levels, in order to provide emergency response to the effects of climate change. The State and the communities function in juxtaposition, but with certain minimal forms of complementarity. The communities are chiefly responsible for ecological and landscape management in non-urbanised areas, and for the maintenance of biodiversity and ecosystem services, which are delegated to them. Additionally, they contribute to national food production (market gardening and small-scale livestock production). In return, the State provides the minimum infrastructure in terms of communication, information and health. Health facilities are naturally better in cities, but everyone has access to them through universal health care in case of serious illness.

This burden sharing between taxpayers and the communities, which only pay taxes "in kind", is a source of friction, but guarantees a certain level of social peace; indeed pluralism has become a key value of society. The "defectors" exclude themselves from competition and leave the field open to the "high-achievers". The "high-achievers" make use of the "defectors" for a healthier food supply and to take care of the rural environment. But these

worlds are not entirely self-contained: within families or friendship groups, individuals make different choices. Citizens who are part of the liberal economy sometimes go to the community territories for recreational purposes. The dominant economy thus tolerates the alternatives as long as they are useful to the country and have no intention of attempting to gain more power. The communities have no military defences in case of conflict (and are monitored on this point), and depend on non-violent means of persuasion to renew their numbers. They are also fully aware that this type of almost self-sufficient, extensive development cannot be extended as such to the whole population, due to a lack of space, which limits their expansionist designs. Ultimately, there is still little coordination between national and local policies. The two social models communicate in their economic exchanges, but not really on the political level. The alternatives are no longer interested in ordinary political life, based on representation. Depending on their specificities, they have developed different means of social organisation, which are nevertheless guided by democratic participation as a rule. There are, however, several more autocratic voluntary communities (such as Scientology or the Amish).

Production systems

The plural economy depends at both ends of the scale on the global market and on short supply chains, self-production and reciprocity; between these, a small redistributive economy continues to exist. The market is relocated for goods that the alternatives see as meeting their needs, as well as for a large proportion of agricultural production. The communities are content with very little, and are fuelled by an ideal of frugality and by the intensity of social ties. The alternatives develop trade in goods and services within the framework of a partially demonetised framework, since local currencies have proliferated. Self-production of food, furniture and clothing, and self-construction and self-renovation (of buildings but also of water and energy networks) cover a

large part of material needs, with exchanges at the regional level or even beyond. Indeed, crafts and local products are popular with metropolitans who yearn for nature and “fresh” produce. These limited monetary resources enable the communities to equip themselves with computers, to travel from time to time, or to pay for costly therapeutic treatments when necessary.

For around 60% of consumers, the economy remains globalised and continues to produce consumer goods and equipment at least cost, in a context of recession. Although market share is reduced by the autonomy of certain territories in terms of consumer staples, it remains critical for large-scale collective developments: transport, NICTs, urban planning, health and research. Educational systems are diversified and autonomous.

The agricultural and food sector is undoubtedly the one that has become the most hybrid, between the practices of the market economy and those of the communities. In response to the health crises and to the slowdown in international trade, as well as to the dramatic increase in oil prices that has badly affected many farms, food sovereignty has become an issue. National intervention in the agricultural sector has been replaced by aid at the regional level, which is granted in order to maintain jobs and to improve food self-sufficiency. In exchange, local short supply chains must be developed. Production for export is declining in favour of meeting local needs: the diversification and relocation of agricultural production, extensification, fewer inputs, organic crops, and non-food crops for certain construction materials. This regionalisation of agriculture is aimed at increasing food security and responding to environmental, health and social concerns. Consequently, agricultural prices are high and food accounts for a higher proportion of household budgets.

Multifunctional agriculture based on local and community sectors has grown considerably. Livestock production has become more extensive, especially as factory farming (pigs and chickens) has diminished because of high feed prices. Due to this

extensification, competition for land makes the development of biofuels impossible. However, methanation and the use of wood energy have significantly developed.

Technological and social innovation

Within the communities, social innovation is in full swing. Social innovation in the broad sense is motivated by the need to create alternatives to the historic social forms that have dominated Western societies. Group housing, for example, enables people to pool areas and goods, as well as to ensure effective care for elderly people and a lower level of dependence. Mutual support makes it possible to accompany vulnerable people at the end of their lives by keeping most of them at home. Education on conflict management, environmental and social psychology, non-violent communication, and consensus building within a framework of direct democracy are some of the conceptual tools of many communities: moving beyond ideals, it has been necessary to learn specifically to live together, to share, and to pool efforts, by mobilising alternative educational methods. Strong disagreements result in a change of community.

In this community-based world, we have also seen the proliferation of small technical innovations enabling the decentralised management of water, energy and resources. In particular, there is a wide variety of forms of energy production and a thousand ways of saving energy. Energy saving innovations abound, and are more or less acceptable depending on the individuals or communities. Some have become resistant to cold, while others choose to have animals living on the ground floor of their homes while they live upstairs, and many have meals together in order to share cooking energy and to foster sociability. In addition to these age-old solutions, considerable use is made of passive solar energy, materials with high thermal inertia, metabolic, wind and micro-hydro energy, heat exchange between the ground and buildings, and any other form of territorial or biotic pooling that contributes

to energy autonomy. The communities arbitrate at different levels (regional, local, village, community) between production and consumption.

Some communities are completely disconnected, like Robinson Crusoe dreaming of self-sufficiency. But the majority make considerable use of the Internet as a tool for the free exchange of a wide range of instructions on self-production, maintenance and repairs. Indeed, the communities recover many obsolete objects from the market economy in order to give them a “second life”, a new, creative purpose, or to use the raw materials they contain. For short distances, animal-drawn transport is back in use.

Alongside and within the first world, energy production is being partially decarbonised under heavy budget constraints; the production of renewable energy is developing in fields where relatively short-term profitability is guaranteed. Demand for energy in the second world has fallen sharply, and some major production units have consequently been progressively shut down. One in two nuclear power stations is not replaced. The development and improvement of the efficiency of renewable energy through highly diversified systems go hand in hand with the relocation of production, even for metropolitan areas. Influenced by community innovations and the ideal of frugality, the infrastructure and production methods of the dominant economy are becoming more efficient. The intensive recycling of raw materials (energy production and source of materials) has developed alongside alternative recovery sectors, fuelling competition and conflicts, as well as black markets for raw materials that have become costly.

Socio-spatial organisation and mobility

The most salient feature is the repopulation of small and medium-sized towns and of the countryside, where a quarter of the French population now lives. Houses built using organic materials have sprung up around the outskirts of towns. Self-renovation of old

housing gives landscapes a jumbled, colourful appearance. Colours have returned to façades, and the *Bâtiments de France* architects have had to retreat to historic heritage in the strict sense. The diversity of developments makes the communities recognisable at first glance, and the territory is a patchwork of construction and cultivation initiatives (heirloom varieties are being grown again). Small and medium-sized towns are being re-inhabited and greened. In comparison, the large cities seem homogenous and somewhat stereotyped.

In terms of living areas, the average size of housing is growing in places where cohabitation has developed, but is tending to decrease in the cities. Sharing living spaces makes it possible to pool energy, resources and goods. People make a virtue of necessity, to a certain extent, even if cohabitation is appreciated. Living space per person is thus diminishing.

A whole segment of the French population is becoming sedentary, by choice (to slow down the pace of life and to lay down territorial roots) and by necessity. The readjustment of salaries between the different parts of the world is a critical factor in this. Unless people use autonomous means (walking, bicycles, scooters, etc.), travel has become too expensive as wages have fallen dramatically. Co-presence and face to face relations are prevalent in small friendship or family groups, making physical travel less necessary. Such travel has diminished not only for daily mobility, but also for residential and recreational mobility. Inner quests and roots, as well as individual and collective experiences have partly replaced the desire for mobility. The virtual world also enables people to quench their thirst for discovery. "Travel" nevertheless still exists, as opposed to "tourism", and is understood as a long learning experience: in a sense, it is the return of craft guilds. Several long journeys are made in a person's lifetime, partly by soft modes. For groups living in communities, holidays tend to be less frequent, but are still taken every year. These are often touring holidays using soft modes.

Couchsurfing has considerably developed (food and lodging in exchange for work). For city dwellers, holidays are often spent in regional leisure parks, or for the more daring, in the communities.

Contacts and exchanges between communities primarily involve public transport, where it exists, or car-pooling and ride-sharing, which are facilitated by ICTs. Public transport networks have been preserved and maintained year after year, but have not been developed since the beginning of the 21st century. The car-dependent model is challenged by most individuals, for whom it is in any case too costly. Due to a lack of investment in this field, second generation biofuels have never reached the industrial production stage. In rural areas, old vehicles are repaired and patched up to last longer, but their use is limited by the cost and/or availability of fuel. Small biogas or biodiesel units provide enough fuel for urgent requirements. In cities, bus lanes (using methane) have multiplied alongside former underground or tramway routes, especially as cars have given back some of the space they once took up on the roads.

Air travel mainly concerns the elites, who travel for professional reasons. International transport, which is too costly for leisure purposes, is only accessible to a minority of the population. Because of the energy crisis, a progressive relocation of the economy is being seen, as export-import sectors are smaller than in 2010. On the other hand, France continues to receive flows of foreign visitors from the BRICs: the cost of living is lower there, and picturesque landscapes and good food are still greatly appreciated. In other words, France is an old world that piques the curiosity of wealthy tourists, or attracts alternatives from other countries.

Sociability and values

Competition for jobs and the quest for performance are still the norm in the metropolitan world. Defensive reflexes have to some extent reinforced individualism and renewed family solidarity in order to stand firm in the

face of socio-economic difficulties. Paradoxically, the situation is undoubtedly more comfortable for those who have opted out. Indeed, the alternatives have developed a new context of pooling, sharing and providing mutual assistance, by extending family solidarity to the community area and thereby recreating social safety nets. The price to pay is the low level, or even lack of financial resources. But advantages in kind such as the quality of the living environment, the slower pace of life and the value of social ties make up for this.

The communities that have come together are not necessarily ideological or spiritual (though they may be), and are first and foremost communities of peers: people join together through affinity, through attachment to a place or simply through chance encounters. Each community has its own way of living together, with its own specific conflicts that the members learn to manage. The desire for conviviality helps to ease the feeling of community pressure. In the same spirit, special attention is given to personal, emotional and family life, as well as to cultural diversity. Like group housing communities today, people live their lives with shared rules, areas and times that are voluntarily accepted. Social functioning is more collective, but individuation is not challenged.

We nevertheless see certain homogeneity within the communities, due to the specific, commonly accepted rules, as well as a stronger differentiation between them. For example, some communities may be more normative and intolerant when they adopt demanding requirements in spiritual and ecological terms. They all coexist with a certain status quo, as their organisation requires limited numbers. They operate within a network, of course, through the Internet, but gaining more members is not a priority. Instead, the groups focus on enhancing their experiences, which can only be achieved if there is a certain stability of members and of affiliations.

The social group at the origin of these changes, in other words of the disconnection process, is that of the "cultural

creatives", who detach themselves from material success in order to adopt other ways of living. They are joined by the group of environmentally responsible people, or degrowthists, who are concerned by ecology, equity and global justice, and then by a range of people who are no longer happy with life in the market society. After repeated episodes of depression, those who are failed by this society can regain personal resources by adopting the new systems of representations and values: the ethics of simple living, the ethics of care and ecological ethics, which are the basis of the alternative communities, but in varying proportions. These core values provide new sources of satisfaction: giving greater attention to others and improving one's ability to listen, empathise and give; seeing oneself evolve through social rather than material relations; or contemplating, understanding and restoring nature. However, the work ethic is still central, as activities linked in particular to agriculture and to social tasks require a good deal of time, availability, and physical and mental energy. Working hours have not decreased, but are perceived as being more valuable in relational terms.

Those who opt out of the dominant economy by necessity come first as observers to recover in the communities. This adjustment process helps to build trust within the group, which is vital to the existence of the communities. Learning to trust others is no easy task for individuals marked by "the weariness of the self", a loss of identity and competitive and aggressive reflexes. Cultural change, beyond the pioneer groups, is primarily a learning curve and an experience. Some people may return to "business as usual", being unable to accept these new ways of living together.

Lifestyles and consumption patterns

Although the importance of work is not called into question, in both the metropolitan world and in that of the alternatives we see greater overlapping of work time and

daily life. In urban areas, working hours have lengthened as telecommuting has increased, in order to externalise equipment and operating costs. Working days at home are long, and interrupted by face to face meetings and videoconferences. To keep their jobs, people are willing to work at weekends and to reduce their holidays, especially as financial resources are lacking. E-commerce has expanded considerably. The syndrome of staying indoors, for fear of going outside, has grown somewhat, resulting in physical malaise and new illnesses. The high level of segregation, the relative insecurity of public places, the deployment of NICTs and the lack of social ties outside the family all fuel this self-confinement.

Where the “defectors” are concerned, meeting basic needs also requires considerable effort, due to the small size of the communities (lack of economies of scale). There is however a wider range of ways of organising daily life. Some of the time is devoted to community relationships, to exchanges of services and to collective decision making. Meals are often taken communally, which reduces time spent cooking and is more convivial. Agriculture and small-scale livestock production, sometimes for recreational purposes, take up a good half of each day. These are followed by self-production activities (clothing, furniture, etc.) and odd jobs. Self-organisation, doing it yourself or with others, and limiting the use of techniques that make people heteronomous and dependent are fairly widespread attitudes. This is the age of “doing”. Consequently, there is always something to keep people busy. Finally, time spent on personal, educational, cultural and artistic activities, connecting with nature or meditating varies depending on the community, on individual priorities and also on the seasons. This society has naturally returned to a high level of seasonality.

In this second world, by virtue of the principle of self-moderation or simplicity, consumption has been radically reduced and mainly meets physiological needs. Food

intake has decreased, reaching on average 3,000 kcal/person/day. Diets are largely vegetarian and seasonal, with a high consumption of pulses, fruits, vegetables and cereals. Capital goods (tools, washing machines, computers, etc.) are shared. This frugality is motivated or legitimised either by growing environmental awareness, by a concern for equity, or by spiritual and cultural reasons. Individuals and communities are now characterised by the diversity of their cultural preferences, their hobbies and their existential beliefs. Differences and experimentation are cultivated and encouraged. Everything coexists without any real hierarchy, raw foodism alongside halal or kosher diets, and Thai food alongside Roman cuisine, as long as people can get the basic ingredients.

The market is taking advantage of this taste for diversity by also proposing plural and “frugal” consumer products. Consumption patterns have changed little in urban areas, except for the fact that the share of food, housing and unavoidable expenditure, which includes NICTs, has risen. Food products are fresher and more seasonal, as they are partly supplied by the rural communities. Companies turn them into ready meals that are often delivered to homes. Intensive agricultural sectors and supermarkets still exist, but they are of less importance in the diets of French households.

The contrasts between conventional city dwellers and new-rural populations are more obvious in terms of their physical condition and health. City dwellers continue to be over-exposed to stress and to certain types of pollution, although exhaust fumes have been considerably reduced. The alternatives have redeployed a preventive and “natural” medicine, which takes elements from different traditions. They are less subject to serious and degenerative diseases. Their practices have influenced urban medicine, since alternative medicines and natural molecules are used in equal proportions with chemical medication, which nevertheless remains widely used with gene therapies.

The Environmental-Citizenship Society

The spirit of this vision

Facing limits on natural resources and farmland, together with a collective awareness of the pollution generated by our development model, societies worldwide have restructured. Unfortunately, it took periods of violence, international health crises, innumerable victims of climate change and skyrocketing prices of raw materials to get there. By the year 2030, the boom-and-bust economy and migratory movements, which proved increasingly difficult to contain, led to an overall conclusion: the model of unlimited production and over-consumption was incompatible with the planet's resources.

The increasing power and networking of civil societies in developing countries also contributed to this widespread realization. Socio-environmental injustices and the appropriation, by the most industrialized nations, of the global environmental space have been roundly criticized. The environment is no longer distinct from other social problems - specifically, social inequality - because the most disadvantaged bear the brunt of environmental degradation. Climate disruption, including hurricanes, floods, droughts and the salinization of coastal aquifers, affects poor countries more than wealthy ones and fuel poverty strikes the most disadvantaged at many levels.

The sense of insecurity generated by economic hardship and environmental damage, which pose an increasing threat to human lives, has led individuals to place renewed emphasis on intimate realms of collective protection, including family, friends, neighbourhood, district and town, as well as international solidarity.

This scenario is characterized by an awareness of the limits of anthropocentrism and an acknowledgement of the importance of "co-existence" in maintaining quality of life. Environmental and social issues are now at the forefront of collective action and social organisation. The environment is central to

a restatement of the principles of justice, which is transforming society and social dynamics. Edgar Morin's proposals have been widely disseminated, thanks to large social movements. They call for citizen engagement and promotion of values that encourage solidarity, empathy and collective involvement.

The notion of ecology also involves taking responsibility for one's own lifestyle and the right to influence others'. The notion of Environmental Citizenship has earned recognition and seeks, if possible, to combine connection, commitment, quality of life and ethics. It reasserts human rights and solidarity beyond performance and profit. The defines of universal rights now involves environmental rights, from the struggles of landless peasants opposing land expropriation for palm plantations and movements opposing the construction of polluting factories, unhealthy diets, and harmful medicine (although this does not necessarily preclude opportunism, quackery and negative effects). The defence of individual rights and the redefinition of solidarity intermingle and clash, confronting complexity and inequality. An alternative vision of life is taking shape, centred on concern for others and human interdependence. Struggles against exclusion, withdrawal, increasing insecurity, environmental ignorance and lack of respect for the biosphere have become central. While the unifying class struggle of the 20th century focused on conflicts involving work and the industrial production of commercial goods, the struggles of the mid-21st century address the preservation of global and local "common goods" (including climate, air, water and land quality, biodiversity, natural areas and landscape), for or against the appropriation and proper use of natural resources. This has led to community actions and efforts on behalf of new lifestyles, new rights and a new hierarchy of values.

An understanding of the impact of lifestyle on the environment has resulted in collective and individual changes, characterized by: Reduced energy use, locally-based agriculture and shared transportation options;

- Pro-environmental tax policies and resource conservation and pricing policies and incentives designed to reduce the carbon footprint;
- The replacement of GDP by EDP (Environmental Domestic Product), which incorporates quality of life and sustainability of development; and,
- Refinement of environmental capital as a parameter, with the emergence of new qualitative indicators.

Political organisation

Ulrich Beck's reference to "cosmopolitanism" (2007), combining principles of tolerance, democratic legitimacy and effectiveness, has taken hold, as has the principle of precaution through prevention. The legitimacy of decisions is based on a democratic system in which citizens and civil society organisations play a more active role than they did under earlier parliamentary models. Decision-making methods at all levels are the subject of on-going debates and conflicts. The French Ministry of the Interior has been renamed the Ministry of Citizenship. The national agency that regulates electronic and digital media, the *Conseil supérieur de l'audiovisuel et du numérique*, receives public funding to ensure multiple sources of information. Citizen conferences, held to encourage consultation and discussion, are widely-used tools for developing policy choices at the local level.

Internationally, the principle of subsidiarity rules. A world federation responsible for the governance of global public goods has been established within the United Nations.

Strong measures, including laws, directives and fiscal policies, have been taken at the international, national, regional and local levels. The mission of political institutions is to create conditions that foster equality and equity, now seen through the perspective of

environmental justice. Governments at various levels are working to adapt by creating multi-scalar governance. A global policy has been implemented, though not uniformly or evenly. However, benchmarks do now exist, including, for example, the success of anti-GMO efforts undertaken following peasants' struggles for freedom, adopted and promoted by extensive consumer and activist movements in the 2030s.

Growing numbers of economic and political leaders have adopted eco-citizen behaviours in the areas of housing, transportation, work and recreation. They recognize their responsibility to History, given the impact of decisions made (or not made) on the decades that will follow the 2050s. The timescale of political action has lengthened, following a series of foreseeable and deadly climate and health disasters. Working proactively, taking preventive measures, adopting a long-term view and incorporating intergenerational justice have become basic principles of political action. The relationship to time has changed, with an increased focus on the long-term. Speed is no longer beautiful.

Economic organisation

The business world, which previously emphasized profitability, is increasingly concerned, directly or indirectly, by sustainable development and Environmental Citizenship. For example, employers are encouraged to consider job candidates' "moral values, concern for others, compassion, commitment to the public good and concern for justice and equity" (Morin) in hiring. Working conditions have also improved in other areas, such as employee transportation and individualized work schedules.

Reducing the costs of production to improve competitiveness requires recycling and reducing the consumption of materials. Industrial ecology, previously considered an innovation, has achieved widespread acceptance, together with detailed studies of material and energy flows and efforts to create synergies with other companies. Waste produced by

some companies is thus used as "inputs" by others. All recycling processes are involved, from paper to steel.

The economic system has undergone profound change and is highly regulated and supervised by international bodies. The monetary system no longer has the same scope, with the individual carbon quota constituting its equivalent today. Frequent government intervention in the economy is legitimized by a strengthened democratic process. Productive sectors are favoured over those considered non-essential. Consumer associations play an important role in consultative processes and launch regular boycotts of goods and services considered to be unsustainable. Goods are designed to be sustainable.

Property ownership has been reformed. Property rights are no longer an inviolable constitutional principle with precedence over ownership of the commons, which include environmental goods. Citizen pressure has led governments to reassert their authority over economic and financial power. Strong measures have been taken to reduce social inequality and improve the distribution of added value between capital and labour. The income scale has thus been sharply compressed. Asset redistribution is to be achieved via an environmental tax to prevent capital gaps from widening.

The rebalancing among social groups has eased the impacts of resource shortages (including water, energy and raw materials), allowing new innovative technologies to emerge that for reduced energy use and increased efficiency and resource sharing. The growing power of civil society organisations in Southern countries, whose actions have been popularized in Northern ones, has helped to achieve greater control over natural resources and more balanced North-South development.

Public services play a central role in the productive sphere. The public banking service is a significant tool for financing public choices. Military budgets have dropped sharply in favour of priority sectors, such as health, food, agriculture, education and communication. As

the share of basic social goods and services sectors grows, those activities are relocating, when possible, to reduce transport's environmental footprint.

Productive work time has been reduced to ensure more equitable distribution among all members of society. The share of work time devoted to meeting social needs has increased. A form of craftsmanship, combining work that meets production and social needs and that produces personal satisfaction, has developed with support from Internet forums. Energy restrictions and objectives to limit greenhouse gas (GHG) emissions have led to large-scale energy management programs, coupled with new regulations and implementation of a quota system. Large, centralized forms of production are abandoned as they reach the end of their useful life, as they are inconsistent with the frugal mindset that predominates. While "energy black markets" did flourish for a time alongside quota-based regulatory systems, these marginal initiatives disappeared quickly under the influence of social norms.

The electrical system is managed optimally, with each territory developing its own resources and giving priority to renewables. Massive windmill and solar panel installations can thus be found in the northern regions and along the Atlantic and Mediterranean coastlines. Rural and mountainous areas can rely on biomass. A single public operator manages the energy supply pool and develops appropriate infrastructure to carry out its main mission: ensuring that supply meets demand throughout the entire country.

Efforts are also underway to achieve synergies in agricultural production, with ecologically intensive agriculture (crop rotation, the widespread use of nitrogen-fixing plants and direct seeding) on the great plains and multifunctional agriculture in intermediate and mountainous areas and around cities. Regional sectors seek to meet local demand. Regulation determines vegetable and animal production, biomass-material production and energy production to ensure that land use is environmentally sound.

This complementarity optimizes production circuits, encourages co-production, reduces inputs and costs and thus helps to guarantee that a significant portion of the population has access to good-quality foods. Profitability is based on reducing intermediate consumption and processing of agricultural products, rather than maximizing yields. Residents in urban and peri-urban areas grow some of their own produce in neighbourhood common spaces. Shared gardens are found throughout cities. All these initiatives have significantly reduced the food system's energy consumption and carbon footprint.

A comprehensive training program for farmers in agronomy, energy and the environment has been established. Resources have been assigned to support the restructuring. Everyone is strongly encouraged to work in agricultural production for a limited period of time, primarily through the "woofing" system, which offers farm volunteers food and lodging in exchange for work. Other players - in distribution, logistics and mass catering - have also been mobilized. Transportation and distribution chains are based on environmental and social criteria.

Technological and social innovation

The new system encourages all actors to adopt eco-citizen behaviours:

- managers have created a progressive rate structure for energy and water consumption and waste management, which encourages individuals to reduce resource use;
- experts are thus encouraged to develop new energy-saving and recycling technologies and to promote local businesses and the use of salvaged and reused products; and,
- consumers have adopted environmentally-responsible behaviours, which are profitable thanks to the new technologies and progressive rates.
- With research and development focused intensely on sustainable development, technological developments have been rapid;
- many positive-energy buildings have been built;

- lighter vehicles consume increasingly less fuel; biogas-fuelled vehicles and small electric vehicles (2-4 wheels) are used extensively in urban areas; and,
- renewable energies (wind, sun, geothermal, ocean and river) and their storage have diversified and expanded, as have recycling industries (including glass, paper, textile and metals).

These changes have had major impacts on both consumers and professionals. Relationships to technology and ownership have changed, as have social relationships. A higher value is thus placed on empathy. Access to goods and services has reduced the importance of possession and ownership. In addition to increased participation in the democratic system and the strengthening of territorial levels in decision-making, grassroots-based non-profit organisations have grown dramatically. Development of networks has promoted the value of services (activities, information, education, training, prevention and care of the elderly) and the non-profit sector (shared housing, carpooling, car-sharing, locally-produced food and child care) has heightened this trend.

Innovation focuses on both the social and technological spheres. Considerable research and experimentation is devoted to democratic processes and governance at all levels, with laboratories and university curricula focused on them. Innovation is flourishing in this area, both with regard to institutional processes and the organisation of civil society and checks and balances. Information and telecommunications technologies (ICTs) serve and support Environmental Citizenship.

Technological progress focuses on low-energy-use technologies and systems that save energy and support slow travel, while providing access to multiple services.

Socio-spatial organisation and mobility

Urbanization has stabilized, to the detriment of mega-cities and peri-urban areas. Small metropolitan areas are particularly dynamic,

with employment achieving a new balance favouring them. They offer a better quality of life, more affordable prices and a larger housing stock, allowing sustainable neighbourhoods to develop and improving city life, and are thus more attractive. Peri-urban development has slowed considerably as a result of energy prices and restrictive planning measures, together with land use policies and residential mobility assistance. Spontaneous trends associated with an aging population, whose members want to live closer to social services and community centres, are occurring in conjunction with efforts to increase urban density in the inner suburbs. With greater value placed on community life, there is also a greater appreciation for the convenience of urban living.

While much of the housing stock has been energy retrofitted, fuel poverty remains a social policy concern. It is difficult for the most disadvantaged members of society to give priority to reducing their carbon footprint when survival remains a challenge. Housing, heating, transportation, employment, food, health and education remain the major concerns.

Beyond their role in food production, the significance of rural spaces in maintaining ecological balance is also recognized. The notion of "working the land" has taken on new value, leading to a revitalization of the countryside. Beyond the efforts to tame nature, which were necessary to meet social needs, a movement to preserve and restore natural spaces is underway. Active restoration of natural areas has been incorporated into planning policies to restore biodiversity and ecosystem services in natural and agricultural areas. In a word, planning has been "greened," in both urban and rural settings.

Investments in mobility have been redirected to public transport. Thanks to telecommuting (which has been adapted to use communal platforms), e-commerce and carbon offset delivery programs, mobility requirements have been reduced. The desire for mobility about remains strong, because individuals seek to share experiences with others. "Time capital," which is available to everyone,

favours environmentally-friendly (that is, non-nuclear- and non-fossil-fuel based) mobility solutions. Health considerations also support this "soft" mobility. People's willingness to wait, combined with greater sociability, works in favour of public transport and carpooling, particularly in low-density areas. Efforts to improve the public transport experience have encouraged this trend, with loosened time and schedule constraints helping to ease congestion and peak occupancy periods.

Transport networks are highly planned and passengers on every continent can travel long distances by train, similar to the Trans-Siberian railway. The goal of car ownership has been replaced by the goal of mobility. Most auto manufacturers now sell mobility, not vehicles. Public transport operators have also adapted by offering door-to-door service. Rail, river and ocean freight now predominate over road hauling.

Air transport has declined in relative terms because of its carbon footprint. Short holidays are discouraged and leisure travel thus involves a slower pace and longer periods. These trips are considered more as experiences and opportunities for encounters. Means of travel formerly thought to be outdated are fashionable, with dirigibles taking to the skies again.

Sociability and values

A new hierarchy of values favours "being" over "having", cooperation and the development of new systems of social protection. Society seeks justice and finds life's pleasures in contact with others and with nature. Public goods and equity are core values, including access to all essential social services and the preservation of natural balances. Responsibility and accountability are the rule, as people internalize a sense of environmental limits and concern for future generations (Jonas, 1979), both individually and collectively. Consideration of the consequences of one's actions, rather than a desire for the immediate use of goods or services, is the individual's prime motivation. Goods and services themselves incorporate this concern for "virtuous use"

from the outset. They are more sustainable, easy to repair, low-energy-consuming and economical - the opposite of "planned obsolescence." More and more people understand the notion of "footprint" as applied to the environment, energy and water - and it constitutes the framework that delimits lifestyle choices and decisions. On the other hand, marked improvements in the quality of life, the enjoyment of nature and a sense of daily solidarity - for example, between North and South - are sources of satisfaction.

The confined parent-child family unit is no longer the rule. Living spaces are more open to other family members, blended families, friends and the children of friends. The restricted family structure of earlier eras has been reordered, giving way to a life seen to offer greater freedom and that is organized around a collection of core groups with fluid boundaries, affinity groups, intergenerational living arrangements and "tribes" based on shared activities.

This way of life is characterized by multiple relationships and involves sharing certain spaces, which also provides a livelier, more convivial environment. Long-distance communications also play a significant role in maintaining social relationships.

The essential value of time for social life has been established through negotiation and political struggle. People seek sustainability - of relationships, decisions and goods - and concerns for the long-term are again at the forefront. Time for activities is now divided in a new way, into four equal parts: social concerns (connections, solidarity and politics); the planet (volunteer activity, virtual networks and ecological practices); productive work; and, oneself.

Culture and learning - "of all and for all" - are encouraged, both in terms of access and contribution, with the understanding that non-material exchanges predominate. The society favours the wide dissemination of knowledge and creative production. Diverse cultural production is encouraged, provided that it does not exhaust the supply of raw materials, pollute or reflect an inequitable vision of social relations (for example, in gender relations).

Difference is possible, but seems to be less of a draw given the cost of living on the margins in a context of limited resources and the extensive sharing of goods and services.

Lifestyles and consumption patterns

Consumer preferences have changed considerably as a result of widely-disseminated information about the environmental footprint of goods consumed and often-stormy debates on this issue. Consumption is also becoming less commodified, giving way, in part, to sharing and reciprocal exchange. With the recognition of the value of time, people now take pleasure in keeping an object for a long period. This reduces the need to constantly acquire new goods.

Collective and shared housing has become popular again, as has a focus on neighbourhood life, which encourages residents to make fewer trips. Major production centres remain outside of cities, but the "new artisanry" is integrated into city life. Local trips have risen sharply.

Social demands now include calls to reduce the environmental footprint of food production and restore equity in international agricultural trade. Public debates on diet, health and the environment have changed agriculture and food processing. Younger generations take a public health perspective and are very aware of the importance of environmental conservation and well-balanced dietary practices. Public budgets are shifting from health care to prevention, emphasizing the importance of good nutrition. Dietary habits and cooking practices have changed considerably, leading to a decline in meat and dairy consumption and an increase in the consumption of vegetable proteins, fish, fruits, vegetables and algae- and yeast-based food products.

Health care services focus, in part, on prevention, healthy lifestyles and environmental health. Medical services are no longer reimbursed based on the number of procedures performed, but on those avoided. Physical activity is recommended to prevent obesity and cardiovascular and other diseases. This has led to a significant increase in active local

mobility (including walking and biking). Alternative medicine is favoured and the use of drugs is limited to patients who need it. The

use of traditional medicine has increased, as has the time allowed for recovery and convalescence. Life expectancy has thus increased.

The Knowledge Age Society

The spirit of this vision

This scenario assumes a profound economic and energy crisis, resulting in a break with patterns of consumption. Anti-consumer movements and views have developed in the North for a variety of reasons: environmental and health (chemical pollution and workplace stress affecting health); economic (recession); geopolitical, with environmental justice issues resonating internationally and nationally (sharing of the planet's resources); and, last, cultural, with ICTs playing a role in daily life, disrupting the producer/consumer distinction.

Consumer goods are considered the cause of all ills and have been devalued symbolically. In their place, people are drawn to acquire knowledge and skills and to "create the self," as part of a process of cultural globalization driven by ICTs and the emergence of the knowledge society, which began in the 20th century. This is the knowledge age in the truest sense of the term - the "noosphere," or the sphere of human consciousness. It is characterized by widespread, increased access to knowledge, lifelong learning and the diversification and de-hierarchization of forms of knowledge and teaching methods. Massive numbers of people are connected to the Internet and have found new sources of expression, acknowledgement, social identity, activities and income.

This involves overcoming knowledge inequality - the basis of all power relationships - within the society. The democratization of knowledge is the result of struggles and efforts to "liberate" knowledge. Battles and conflicts over the commodification of the Internet and knowledge continued until the 2030s, on the

Web and within all knowledge-holding entities. They have become the ultimate stage on which trans-border and territorial conflicts are played out. The struggle to tear down borders limiting access to knowledge and create free access to all kinds of learning is one of the great battles of the first half of the 21st century. The deconstruction and hybridization of knowledge have gradually destroyed the barriers that were carefully constructed to separate scientific, population, esoteric, artistic and manual knowledge.

Private and institutional resistance has, of course, been strong. Nonetheless, a "contribution economy" is taking shape (Stiegler, 2009), with each person becoming producer and consumer simultaneously and, ultimately, neither one nor the other. Most of the space on the Web is free, but access to knowledge remains expensive in some areas. Many collectives issue diplomas when their members master a certain body of knowledge, thus competing with university diplomas. Knowledge institutions (teaching, research, media and cultural) are undergoing an in-depth restructuring. In France, dissidence within elite institutions of higher learning (the *grandes écoles*) has created greater openness to collaborative learning methods. These institutions are also working with whistleblowers (including hackers), distributing free software and re-emphasizing face-to-face encounters in public spaces, following the example of the (less-selective) university system. Street and neighbourhood discussions are frequently organized in open-air amphitheatres or halls. People come to listen to and participate in debates over a range of significant and minor topics. Primary and secondary schools and

universities organize knowledge-based activities in the public space, but spontaneous events (led, for example, by citizens and advocacy organisations) and fee-based cultural activities (theatre performances, exhibits and concerts) are also held there, with the latter heavily subsidized so that they are accessible. The social contract includes the promise to provide access to learning to all. This is required to allow for individual development (no longer for achieving higher social status) and ensure social equity (equal opportunity) and an effective democracy based on a system of checks and balances. In this society, knowledge is clearly the source of inequality. The struggle for democratized knowledge is the most vigorous political demand. Knowledge has become a vital need, like clean water and air. It is essential to personal development, one's social existence, and the collective intelligence that forms most organisations, as the principle of representation by elites no longer holds sway. All fields of knowledge are involved, both intellectual and manual. The decentralization of knowledge is the basis of political decentralization.

Political organisation

The inability of the public and private sectors to carry out the industrial restructuring necessary to address the economic and energy crises and protect health and environment convinced citizens that political guidance of the economy is critical and can come only from below, based on "demand." Simultaneously, the operation of all levels of government has been entirely restructured. It is now controlled by citizens and opposition civil society groups, who require that all political decisions be based on extensive information and a high level of transparency. A knowledge-driven society is a rapidly-changing one. Regulation is thus critical. It is organized primarily on two levels - local and global.

At the local level, the regulatory function is performed by metropolitan assemblies, composed of elected citizens, and neighbourhood assemblies. The purpose of regulation

at this level is to organize the foundations of collective life, from local food supply systems to decentralized energy production, water and waste management, maintenance and development of public space, transport, construction and retrofitting of housing and public facilities and cultural activities throughout the year. Neighbourhood assemblies are composed of groups of volunteers who are in charge of a sector (for example, food, green spaces or water), manage a budget and have decision-making authority. Residents who do not participate in neighbourhood life (because they are very involved in their work, for example) pay a surtax. The time involved in managing community life is equivalent to an in-kind tax, although individuals may make a financial payment in lieu of contributing time. Only those issues that cannot be managed at the local level are handled at a higher one (city, region or metropolitan area or national), based on the principle of active subsidiarity. Although all taxes are collected locally, the national government implements a strong revenue-sharing policy to achieve equalization in certain regions or to reduce certain areas' vulnerability to environmental change, under the inviolable principle of equal opportunity. That is the primary mission of the State. It is also responsible for inter-urban and international passenger transport, as well as for the transport of goods, energy and information, major research and health facilities and law enforcement. Education and training budgets are handled regionally.

Certain global decisions are made via tel-democratic processes, particularly with regard to drafting international agreements and laws during issue-focused global forums. Tensions related to resource conflicts have been eased by reduced consumer consumption in the North and the relocation of a significant share of production based on the location of raw materials. Consumers control the commercial economic sector. Transparency has been introduced into the consumer products sector via a search engine that carries out social and environmental assessments on all consumer goods. Non-profit rating agencies

have proliferated, with data provided by networks of journalists, community organisations and volunteers, who research product manufacturing conditions, recycling and reuse. Businesses must transform their work processes and working conditions if they wish to maintain their customer base. Frequent product boycotts have caused polluting firms to go out of business.

The second major area of worldwide regulation involves scientific progress. The potential implications of this progress are discussed at monthly global forums. Concern for the exploitation of living organisms and the manipulation and misuse of minds and bodies has generated carefully-monitored international agreements dealing with bioethical, biomedical, and psycho-ethical issues. Cyborgs, clones and GMOs will not be developed until the potential of the human brain and the collective intelligence are used to their full capacity and bio-knowledge has been thoroughly decoded. This will require decades or centuries of research and investigation.

The results of all scientific research must be published on the Internet to prevent information monopolies. Withholding knowledge is considered a diversion of collective investment for private use (in a parallel to the misappropriation of public funds in the 2010s) and is severely punished. Offenders may be denied Internet access throughout their entire sentence and excluded from ICTs, which prevent them from connecting via visual or tactile recognition.

Of course, conflicts are always rife among specialized collectives over which research paths to follow and which to abandon. Major conferences are held to seek consensus on whether to pursue an idea or put it aside for 10 years or more. Certain collectives then operate clandestinely, forming alternative societies that experiment with rejected or tabled ideas, on a territorial or secessionist basis. They join up with the "knowledge underground," which helps gangs of delinquents to take power by providing prohibited prostheses or to become Internet terrorists, launching viral attacks or falsifying data and

knowledge. The virtual police, supervised by ethics committees, are thus extremely watchful and very active in their efforts to flush out these Internet saboteurs and gangsters. The Web is under constant surveillance. Based on the risk posed by their experiments, the secessionists are either quarantined (prohibited from leaving the area where they are performing their experiments, a sort of territorial prison that is monitored constantly) or their tools are confiscated and they are assigned to projects of general interest. Despite this virtual and territorial police force, defence budgets have shrunk, freeing up more resources for basic products and services (health care, diet, maintenance and expansion of ICTs and cultural facilities).

Economic organisation

Economic exchanges are based on a contribution economy. All production is designed to meet social, knowledge and material needs, from children who make animated drawings to the elderly, who remain involved in community life or on the Web. The notion of ownership - whether intellectual or material - is no longer particularly relevant. It continues to operate with regard to ownership of housing, but the land belongs to the municipality. A system of voluntary contributions to the knowledge society and the public economy, which has been partially demonetized, operates alongside the market economy. Paid work time for adults has been reduced to two days per week, plus an additional two days' work to meet community needs (including improvements, infrastructure maintenance, services for dependent individuals, cultural activities and school events). Remaining time is spent on activities chosen by the individual. Telecommuting is very widespread.

Basic needs are met via the local economy. Production is closer to consumers, with local supply systems and craft production experiencing a renaissance. Several currencies circulate. The "glob" is an international currency that was adopted after the international financial crash of the 2030s, following massive

public riots that destroyed the financial districts. Local currencies are set at parity with the glob and have been important in helping to relocalize production (such as the Bavarian *chiemgauer*). Within the market economy, small- and medium-sized businesses and co-operatives dominate. Large companies are limited to several very specific sectors, including hospital equipment, railroads, and ICTs. The State employs a smaller workforce, which is responsible for national and international infrastructure, local equalization and law enforcement. The largest category of public expenditure is for teachers, who are managed at the regional level. Students are required to attend classes two days per week. They have considerable free time, which they may devote to activities that are loosely supervised by volunteers.

The self-production sector is very extensive, thanks to the demonetization of part of the economy and individuals' enhanced skills. People spend considerable time on the Internet and, as an antidote, are involved in manual and artistic production and in physical and spiritual activities. Community gardens and workshops and resource centres in each neighbourhood offer training and opportunities to acquire manual, technical and artistic skills and learn about nature. These activities occupy a significant amount of individuals' leisure time and are encouraged to prevent Internet addiction, which has become a public health problem.

"Made-to-order" is back in fashion as a result of a high degree of individuation, self-production and the development of the manual arts and trades, such as carpentry, tailoring and cooking, which are highly valued because they are a source of expertise. Large supermarkets have been replaced by local businesses.

Technological and social innovation

Technological innovations are associated primarily with the environment, bionics, organic materials (carbon sinks) and technological decentralization. Bio-knowledge is recognized (Serres, 1994) and honoured, which has allowed

bionics to flourish, based primarily on oceanographic research and studies of living organisms about which little was previously known. Scientific ecology has become very important. There is a greater understanding of all forms of life, which has inspired technological and agronomic innovations. Permaculture (including in urban areas), agro-forestry and eco-aquaculture have improved plant production by ecosystems that naturally promote their growth. Nanotechnologies do play a role, but require considerable equipment and materials. They are limited to those sectors where they are critical (including solar energy and medicine) and are discussed in the global forums.

Energy conservation, durability and eco-compatibility are key factors in product design. Products are adapted to regional raw materials, except those that require imported raw materials for specific sectors (specifically for ICTs). Organic and biodegradable materials must be used in construction, plastics and many items of daily life, along with the development of bionics. Recycling is widespread and international law prohibits the export of wastes.

The demand for energy has fallen sharply and most of the remaining supplies are produced on a decentralized basis from renewable sources. Knowledge has expanded significantly in this area and is directed towards energy production in very small units, at low cost, adapted to local resources, and environmentally friendly (micro-cogeneration, photovoltaic skins, urban windmills and biogas for transport). Individual energy production units are incorporated into certain products or connected to users. Simultaneously, more centralized forms of energy, such as geothermal in sedimentary basins, offshore wind farms and marine photovoltaic power stations (10-50 MW) operating on biomass, complement decentralized production. Equipment costs represent the limiting factor of these large systems.

Innovation is occurring in technology and the social realm in connection with the processes for organizing the society, means of access to learning and dissemination of knowledge.

These issues involve a growing number of service companies. Innovation is also taking place in the areas of education and health care. Instructional methods have been entirely redesigned. Given the aging of the population and illnesses long thought to be untreatable, Western and non-Western medicine have been combined in treatments that target *all* aspects of the individual. Treatment is directed to both the body and spirit.

Socio-spatial organisation and mobility

Knowledge exchange is the driving force for peaceful coexistence. 85% of the population live in urban settings, primarily in metropolitan areas. Continuing social and cultural exchanges occur on the Internet and within neighbourhoods, which are the focus of renewed attention. Many cultural hubs have developed in cities. Peri-urban environments have become denser, more diversified and less sprawling by transforming themselves into urban areas. These sectors have been incorporated gradually into public transit networks and have experienced the greatest changes within metropolitan areas. Outlying business and commercial areas have been deurbanized or converted.

As the sphere of the market has shrunk, purchasing power has declined and income equality has improved, land pressures in metropolitan areas have eased. Housing has lost significant value. However, historic centres remain segregated. Only real estate heirs are able to live there. This inheritance has not been challenged because residents must bear the cost of maintaining their property. City centres feel frozen in time, with the status of historic preservation district and occasional recreation area. People visit them periodically. Although tourists are much less frequent, these areas are destinations for virtual visitors, who watch the many videos filmed there. Library and museum content has gone online, as have cultural events. However, major cultural sites continue to draw visitors. Much of urban life has been decentralized to

the neighbourhood, based on more horizontal relationships. Public space is dedicated to relationships and is no longer defined by the flows that cross it. Vehicles are rare and have been miniaturized. There are many recreational vehicles for all ages, fuelled by human metabolic energy (including bicycles and all forms of tricycles) or electrically assisted. Public transit has also diversified and now includes cable cars, tramways, hot air balloons and trains on tires. Utility vehicles operate partially on biofuel.

Telematic exchanges reduce the need for physical mobility and the price of inter-urban transportation is high. People travel less frequently and for longer periods. Young people often take an around-the-world trip that may last one or two years. These rites of passage are often repeated at important moments in a person's life. As these trips are long and slow, they require considerable savings, even if couch-surfing has expanded considerably (transportation remains expensive). Parents no longer pay for their children's higher education (people may study at any age), but contribute instead to their "grand tour." Annual vacations often involve "soft" modes of transport and travellers tend to wander.

Rural communities host agricultural workers, whose numbers have grown with more extensive methods of agriculture, and individuals who are seeking a (more or less) temporary retreat. Those who want to maximize their time for personal creativity (music, writing or another passion) can live in those areas on very little income. On the other hand, small cities are in crisis. They are rarely revitalized by communities pursuing a specific project (for example, to transform a city into a permanent film site for historical documentaries or science fiction works).

Sociability and values

Sociability is characterized primarily by an active life via ICTs and individuals' contributions to content, works or political decisions. Many professional and scientific communities form and disband, inspired by a desire to produce

new knowledge together. The family has transformed and opened up to the community. While the nuclear family continues to exist, it plays a less rigid role in individuals' daily lives. Family members are highly individuated and children are more autonomous. The age of majority has been reduced to 16. Co-housing has expanded, including for traditional households, single people, and adolescents who have chosen to live as a group with their parents' permission.

The division of labour is under challenge, which has disrupted social insurance systems. Social security is organized nationally by resource equalization and locally (at the neighbourhood level) by community service. Social security institutions continue to meet needs arising from aging and illness, at a certain threshold of dependency. International solidarity also exists and operates on an *ad hoc* basis in response to calls that circulate on the Internet during crises (specifically, climate events and epidemics) or violent political upheavals. Civil societies occasionally support each other. Regular international cultural exchanges strengthen this kind of solidarity.

In terms of value typologies, autodidacts - life-long learners - connected on the Web predominate. Individuals continue to learn through their work, recreation and social relationships. This access to knowledge is accompanied by a marked process of individuation and cultural diversity. Thanks to cyberspace and affinity communities, each person belongs to multiple spheres, which evolve over time. Social distinctions are no longer based on income, which is insignificant, but on the intensity and methods of self-creation. The ability to challenge oneself is part of the cognitive process. Autonomy, cooperation, de-hierarchization, liberation, creativity, anti-institutionalism and free links characterize a society that is both highly integrated and diverse.

This search for knowledge is dominated by virtual space. More marginal groups set themselves apart in radical spiritual or artistic communities, for example, but most are willing to network. While the Web's immediacy and the ease of access to knowledge it offers (at least

apparently) fascinate and absorb, traditional and experiential forms of knowledge (collecting and using plants, planting, navigating and climbing) have not disappeared. Rather, the exchange of knowledge that the Internet offers has strengthened them.

However, inequalities are being reproduced between those who are looking for packaged, ready-made knowledge and are quite happy to take a little of this and a little of that, creating a sort of personalized cocktail (dilettantes), and those who dedicate themselves to the solitary, time-consuming task of struggling to acquire new skills, from exercise to mediation, scientific research or literary creativity. They represent the two extremes. The democratization of knowledge does not occur at a steady pace, which has allowed the elites to preserve their status. The society may be as elitist as it was before, but in non-institutionalized fashion. These elites are freer and more improbable. They are less likely to emerge from the reproduction of social classes; rather, they are more likely to have taken a zigzagging path, marked by opportunities and a certain combativeness. They are adaptable and cannot claim institutional prerogatives to maintain their position. Society has vigorously battled corporatism, attacking every effort to close off knowledge (specifically, by hackers). Those who have separated themselves have worked long and hard to do so. These figureheads - the great thinkers, inventors, pioneers and virtuosos - construct myths that lead the entire society toward knowledge and new paths to freedom or exploration.

Society has broken with the model based on power relations, domination and the holding of knowledge and goods. As access to knowledge is more or less universal, there is no reason to battle for control of modes of transmission and content. Collective intelligence predominates and has sped the pace of cultural change considerably. However, cooperation has not disappeared. People cooperate because they hope to make greater individual progress by doing so. Collective intelligence and individual skill feed each other.

Lifestyles and consumption patterns

Consumption has declined sharply and consumption gaps have narrowed considerably. An ethic of voluntary simplicity has taken hold in relation to material needs, offset by an enhanced, expanded cultural life. The world of "do-it-yourself" has grown because it offers a path to knowledge and know-how. Artisanry - from handmade furniture to made-to-measure clothing - is now a form of recreation, as is urban agriculture. Tiny planted areas dot cities, including community gardens, at the base of buildings, on rooftops and in sidewalk planting strips. Most people have chosen to be vegetarians for reasons of both health and cost. The slow food movement created an enthusiasm for regional and traditional foods, resulting in the protection of many agricultural products that were becoming extinct.

Gardening and spending time in urban green spaces are antidotes to the "plugged-in" life, which occupies most of daily experience. Advances in ethology and interspecies communication have enabled exchanges with the living world in the local area. Buildings have become biodiversity-positive and house multiple species. Cities are planted extensively and are "bio-conditioned" to adapt to climate change. Nature is finally being used to serve health and well-being, which many consider to be a priority. Preventive practices, self-care and alternative medical treatment have led to a significant decline in the use of traditional pharmaceuticals. Cutting-edge (and highly subsidized) medical treatment, which requires major equipment, is still provided for certain illnesses, such as cancer and genetic diseases. Housing has become safer, both for health and the environment. People spend more time at home involved in their activities and take great care in designing and arranging their space. Apartments are the rule, while habitable space in peri-urban houses has increased, with the addition of floors and add-ons. Each person has his or her own room and common space, which can function on the scale of an apartment, but more frequently a floor, house or building (including dining rooms, play rooms, laundry areas, saunas and workshops).

This sharing of space offers greater amenities. Exterior insulation has been installed on a large scale, thanks to collective work projects. Organic and inexpensive materials (including mud brick, straw, wood and hemp) are favoured for construction and retrofitting. However, energy systems remain expensive because of the high cost of metal.

People spend much of every day in front of their screen and in local public space. Small cafeterias and local restaurants, gardens, art and DIY workshops, media libraries and performance sites, all inexpensive, are popular and regularly visited. However, while students receive subsidized technology, the budget dedicated to ICTs is significant, as is the cost of the many trainings that people pursue over the course of their life. This is a source of inequality, beyond the common foundation of open access to knowledge.

Initial assessment of greenhouse gas (GHG) emissions based on the five alternative lifestyles projected for 2050

The exercise presented here is a trial assessment of GHG emissions associated with the five lifestyles described above. First, we wanted to describe these five societies through a set of households with distinct lifestyles to capture their diversity and impacts on GHG emissions. We present the methodological choices made in building this set of household typologies. It was used to assess annual baseline household emissions and for the prospective analysis. The variables chosen (income, family structure and residential location) allow us to describe the changes imagined under each of these five visions. The household emissions analysis based on socio-demographic characteristics for the baseline year (2008)

is innovative and offers many insights. However, it was not feasible to assess all of the households' emissions for this prospective analysis. We thus chose three emblematic household types for each of the lifestyles envisioned. Their emissions by item will be presented in the second section.

Because the goal of this exercise is to highlight the impacts of lifestyle on GHG emissions, each household will be quantified twice for each scenario. We first sought to isolate the effects of reduced energy needs and, next, to determine the effects of technological developments and energy source substitution. We will conclude with the initial lessons learned from this quantification exercise.

Segmentation of the French population and household carbon footprint assessment method

Household typologies based on socio-demographic characteristics

To account for the disparities of lifestyles that exist within the French population and to assess the impacts on GHG emissions, we segmented the households according to three socio-demographic factors:

- Available income
- Family structure
- Residential location

While standard of living clearly determines household energy consumption, family composition (the number of people/household) allows us to understand the impact of one household's intra-family sharing of all uses (housing, mobility, food and purchases of goods and services) on GHG emissions. Last, to obtain a detailed understanding of mobility needs, we used the residential location criterion.

Income

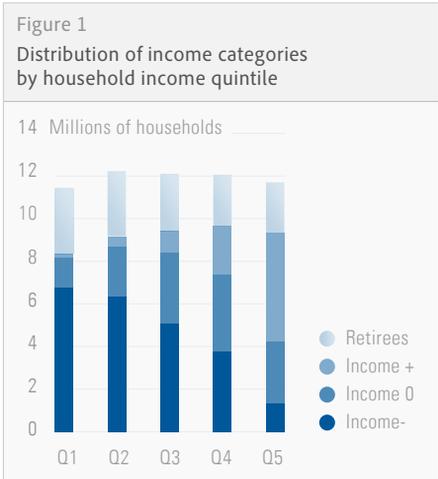
We sought a differentiation of households on the basis of available income. However, available statistical data rarely cross-check

household differentiation by income fractile with the data needed to populate our model for assessing household GHG emissions. To come close to household income, we had to use the reference person's socio-professional category (SPC).

By cross-checking average household income data and the reference person's SPC, we created three income classes. We chose to build an additional category for households whose reference person is retired because retirement has a significant impact on mobility. The matches made for this study are explained in Table 1. **T1**

We note that segmenting the population by SPC creates categories in which income variations are still large. When we try to assign the households identified based on membership in the four income categories defined for this study to each of the income quintiles, it appears that the distribution chosen is not highly selective. The households identified as "income -" are in the last quintile and half of those identified as "income+" fall outside the last quintile.

| Income group | Reference person SPC |
|--------------|---|
| Income - | Employees |
| | Workers |
| | Unemployed |
| Income 0 | Farmers |
| | Tradesmen, merchants, business owners |
| | Technicians and associate professionals |
| Income + | Managers and professionals |
| Retirees | Retirees |



Consequently, income disparities between low income (-) and high income (+) in our segmentation are more limited than the income disparities between quintiles 1 and 5. **F1**

characteristics referred to above: a low-income urban household composed of a couple with children.

Numbers

Figure 2 shows the distribution of the French population in 2008 by the 48 groups used for this study, cross-referencing income level (based on SPC), family structure and residential location. The numbers vary considerably by group. Assumptions regarding changes in these numbers will be presented in the prospective section of this document. **F2**

According to this typology, 60% of France's population lives in urban areas, 22% in peri-urban areas and 18% in rural areas.

More than half of the population falls in the low-income group, 7% in the high-income group, and 20% are retired.

Half of the French population lives in a household composed of a couple with children. 15% of households are composed of single individuals and 9% are composed of single-parent families. 20% of the population are concentrated in a single group, combining the dominant

Quantification methodology

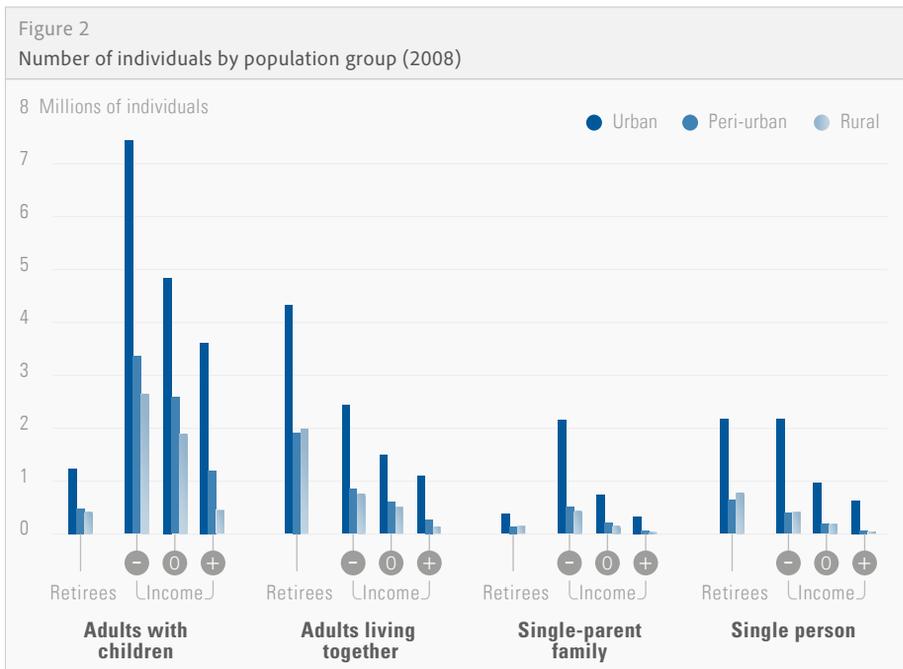
To conduct a detailed assessment of the impact of diversity of household lifestyles on GHG emissions, those emissions were evaluated according to six items: housing, daily and long-distance mobility, food and the purchase of goods and services.

Housing

The "individuals" database describes housing based on the following determinants:

- Surface area (six brackets)
- Main heating energy
- Period built (eight periods)
- Building type: private house or apartment
- Number of occupants

The Enerter model, developed by Énergies Demain, describes all of France's housing stock. It was used to determine the unit consumption per dwelling (kWh/m²/yr) by energy source, for heating, hot water, cooking and specific electricity consumption based on the variables above.



National energy consumption was calculated by cross-referencing the “individuals” database and consumption by unit. The ADEME’s Bilan Carbone® emission factors were used to convert the results into GHG emissions.

Mobility

The French National Transport and Travel Survey (ENTD 2008), conducted by the French National Institute of Statistics and Economic Studies (INSEE) and the French National Institute for Transport and Safety Research (INRETS), provides a detailed description of mobility within the French population. The raw data in this survey were used to calculate emissions produced by daily mobility and long-distance mobility.

Food

The personal carbon footprint (Bilan carbone personnel, ADEME) was used to calculate food-related emissions. It specifies a French person’s annual emissions based on type of food. The INSEE report on household expenses describes household spending in each food category based on the SPC of the household’s reference person, as well as the French average. To determine average spending per person, rather than per household, the average household size based on the SPC of the household’s reference person was calculated using the “individuals” database.

The emissions per person for each food category may be determined from the average emissions of a French person and from the deviation from the mean in terms of spending among the different SPC.

Purchase of goods and services

Services. On a national level, the Enerter Tertiaire (service sector) model provides consumption by energy source and use for the entire service sector in the following seven branches: offices and agencies; cafés/hotels/restaurants; businesses, educational institutions; community-based housing; the health/social services sector; and, and sports/recreation/cultural activities. This energy consumption, matched with that calculated by the French Centre for Economic Studies and Energy Research (CEREN), is converted into GHG emissions using the ADEME *Bilan carbone* emissions factors.

Goods. The personal carbon footprint is used to calculate both food and household emissions from the consumption of material goods. However, unlike in that case of food, the tool does not provide a national average. However, GHG emission ratios per euro spent may still be determined for several major categories of goods.

By cross-referencing these ratios with the household spending survey, we can determine GHG emissions based on the SPC of the households’ reference person. However, the categories of goods included in the personal carbon footprint do not cover all households’ spending on material goods, particularly vehicle purchases.

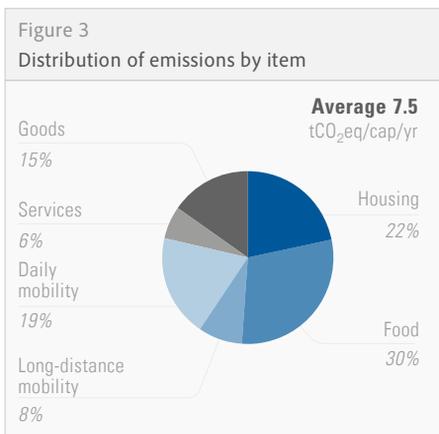
A GHG emissions ratio was calculated for automobile purchases based on the 2011 study, *Preparing for a Life Cycle CO₂ Measure*, and applied to the budget of the various SPC, as with the ratios from the personal carbon footprint.

GHG emissions in the reference year

By applying the methodology described above, we obtained an annual quantity of GHG emissions for each household type, per person, measured in CO₂ equivalent and broken down into the six expense items.

Overall results

Average overall 2008 emissions are estimated at 7.5 tonnes of CO₂ equivalent per year and per person. Approximately 50% of that amount are attributable to direct household



energy consumption (housing, daily mobility and long-distance mobility). The other half is associated with the consumption of goods and services. **F3**

Disparities based on household type

The average of 7.5 tonnes of CO₂ equivalent/person/year masks significant variations among households. Table 2 shows the emissions of each of the 48 household types characterizing the French population in this study. **T2**

Based on household type, emissions per person vary from 5.34 tonnes of CO₂ equivalent (for individuals living in a low-income, single-parent family in an urban setting) to 14.11 tonnes of CO₂ equivalent (for employed, high-income individuals living alone in a rural setting) - or by nearly a factor of three.

Personal GHG emissions by income group of the household reference person confirm that emissions increase as resources available to the household rise.

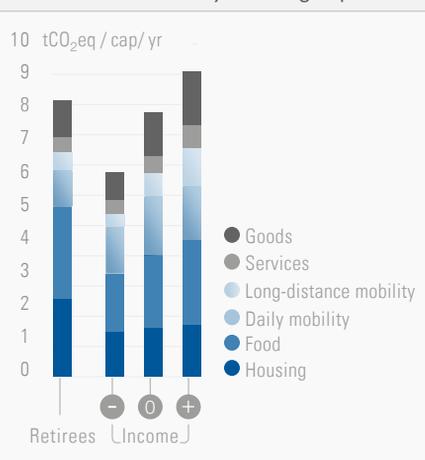
Income thus appears to be the most influential variable among the household segmentation criteria that we chose. **F4**

We noted in a prior chapter that the income categories are fairly crude because they are based on the SPC of the reference person in each household, not on household disposable income. The study of CO₂ emissions generated by the French economy, *Les émissions de CO₂ du circuit économique en*

Table 2
Household emissions

| Family structure | tCO ₂ eq/cap/yr | | |
|-------------------------------|----------------------------|-------|------------|
| | Income | Rural | Peri-urban |
| Adults with children | | | |
| Income - | 6.3 | 6.3 | 5.8 |
| Income 0 | 7.4 | 7.8 | 7.5 |
| Income + | 9.3 | 9.0 | 8.5 |
| Retirees | 8.0 | 8.4 | 7.9 |
| Adults living together | | | |
| Income - | 7.1 | 7.2 | 6.4 |
| Income 0 | 8.7 | 9.3 | 8.8 |
| Income + | 11.0 | 10.9 | 10.0 |
| Retirees | 8.3 | 8.6 | 8.1 |
| Single-parent family | | | |
| Income - | 6.3 | 6.0 | 5.3 |
| Income 0 | 7.7 | 8.0 | 7.2 |
| Income + | 9.5 | 9.9 | 8.2 |
| Retirees | 8.1 | 8.1 | 7.4 |
| Single person | | | |
| Income - | 8.2 | 8.4 | 6.7 |
| Income 0 | 10.7 | 10.5 | 9.4 |
| Income + | 14.1 | 14.0 | 10.9 |
| Retirees | 8.9 | 9.3 | 8.6 |

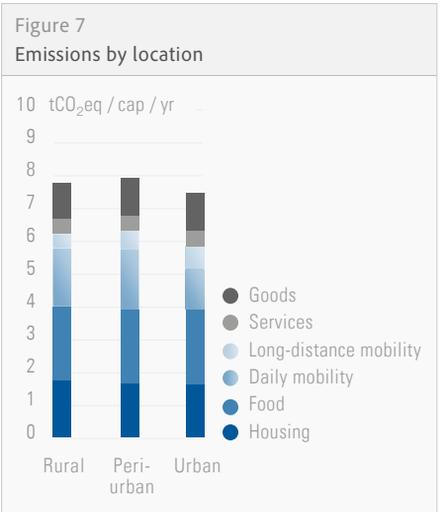
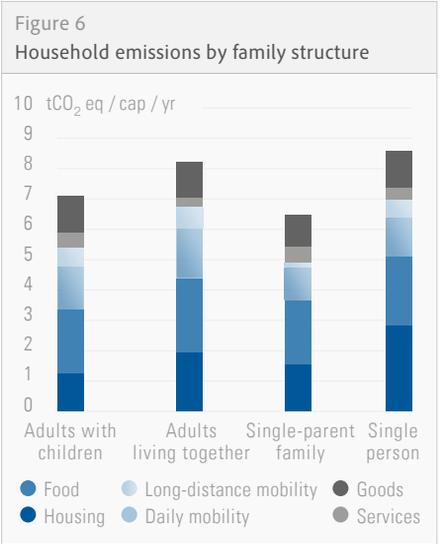
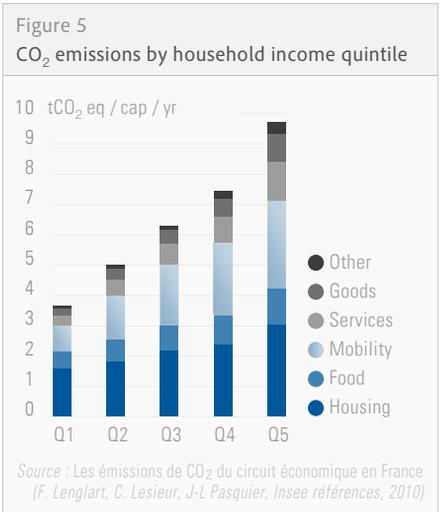
Figure 4
Household emissions by income group



France (F. Lenglard, C. Lesieur, J.-L. Pasquier, Insee Références, Édition 2010), confirms the strong relationship between the level of emissions and of household income. Household CO₂ emissions based on income quintile show considerably greater contrast than those we

obtained for that exercise because income differences are more sharply marked in the quintile approach. Only inter-group variations should be compared here because the methods used by the INSEE study and those we used here are not identical. In particular, we calculated the emissions of six GHG in CO₂ equivalent, while the INSEE study assessed only CO₂ emissions. This has major impacts, particularly on the food item. F6 Family structure is the second influential parameter that appears in this exercise. Individuals living alone and childless couples (several adults living together) do not benefit from the pooling effects that appear to be at work for families (whether they are single parent or not). For example, the housing item changes inversely to the number of people/family (2.1 for multiple adults living together, 2.6 for single-parent families and 3.9 for couples with children). This pooling effect is heightened by an income effect. Three-quarters of the families with children are low-income. Conversely, retired people are well-represented among single people and adults without children (approximately 45% of households in these two categories) and have, on average, an intermediate income. The average income of households without children is thus greater than that of households with children and contributes to a larger carbon footprint for the first two household categories. Last, the

location criterion appears to be less influential with regard to overall emissions per person, considering that the available data did not allow us to take into account the direct location effect on the “food,” “services” and “goods consumption” items. F6 F7 Only those items related to mobility vary sharply based on this criterion. In addition, the interaction between the “daily mobility” and “long-distance mobility” items, already documented in the literature, has been confirmed here. Urban residents’ daily mobility generates fewer emissions than those of individuals living in rural or peri-urban settings (-33%),



but the spread is partially offset by higher-emitting long-distance mobility. The overall “mobility” item varies only 15% between urban and rural/peri-urban populations.

In the following chapters, we will explain the basis of the variations observed according to typology for each of the emission items.

Housing

Housing-related CO₂ emissions range from 1.2 tonnes of CO₂ equivalent to 3.73 tonnes of CO₂ equivalent, or a ratio of more than 1:3 between emissions/person for low-income adults with children and retirees living alone (regardless of location). The first category of households is the largest in the population in terms of numbers (22 million). The number of retirees living alone totals 3.7 million. **T3**

The features of the average living area per person, based on household type (Table 4), are similar to those in Table 3 representing emissions/person. The “housing area/person” parameter is thus the determining factor with regard to emissions produced/person for the “housing” item.

It explains the particularly high level of emissions for retirees living alone, regardless of where they live. Their average housing measures approximately 80 m².

Emissions related to useful floor area per capita

The useful floor area varies considerably, from 22 m² to 95 m² per person, depending on household type. The largest category, representing 12 million people, is composed of low-income urban households with children. Their average area is the smallest, totalling 22 m². Approximately 6 million people have more than 60 m² per person; these are primarily individuals living alone and adults with high income living together. **T4**

Shared housing with children present in the household thus limits the average area/person. This also differs markedly between urban and rural or peri-urban areas. Income plays an important role, particularly in urban areas.

Table 3
Housing-related emissions
by household group (2008)

| Family structure | tCO ₂ eq/cap/yr | | | |
|-------------------------------|----------------------------|-------|------------|-------|
| | Income | Rural | Peri-urban | Urban |
| Adults with children | | | | |
| Income - | 1.14 | 1.12 | 1.09 | |
| Income 0 | 1.25 | 1.21 | 1.20 | |
| Income + | 1.36 | 1.29 | 1.31 | |
| Retirees | 1.44 | 1.45 | 1.36 | |
| Adults living together | | | | |
| Income - | 1.70 | 1.66 | 1.45 | |
| Income 0 | 1.92 | 1.87 | 1.65 | |
| Income + | 2.18 | 2.06 | 1.78 | |
| Retirees | 2.15 | 2.19 | 2.12 | |
| Single-parent family | | | | |
| Income - | 1.41 | 1.35 | 1.29 | |
| Income 0 | 1.58 | 1.50 | 1.43 | |
| Income + | 1.75 | 1.64 | 1.58 | |
| Retirees | 1.99 | 2.04 | 1.88 | |
| Single person | | | | |
| Income - | 2.72 | 2.63 | 2.04 | |
| Income 0 | 3.05 | 2.86 | 2.24 | |
| Income + | 3.34 | 3.07 | 2.28 | |
| Retirees | 3.69 | 3.73 | 3.28 | |

Table 4
Useful floor area per person

| Family structure | m ² | | | |
|-------------------------------|----------------|-------|------------|-------|
| | Income | Rural | Peri-urban | Urban |
| Adults with children | | | | |
| Income - | 28.0 | 27.9 | 22.5 | |
| Income 0 | 33.0 | 32.9 | 28.0 | |
| Income + | 37.4 | 36.8 | 32.1 | |
| Retirees | 34.3 | 34.5 | 28.7 | |
| Adults living together | | | | |
| Income - | 44.4 | 44.0 | 33.6 | |
| Income 0 | 54.4 | 54.1 | 41.8 | |
| Income + | 65.3 | 64.1 | 47.3 | |
| Retirees | 52.5 | 53.2 | 47.9 | |
| Single-parent family | | | | |
| Income - | 34.1 | 33.8 | 28.3 | |
| Income 0 | 41.3 | 40.6 | 33.8 | |
| Income + | 47.6 | 46.5 | 38.7 | |
| Retirees | 45.9 | 46.4 | 39.9 | |
| Single person | | | | |
| Income - | 71.0 | 70.5 | 51.4 | |
| Income 0 | 84.9 | 82.4 | 58.8 | |
| Income + | 95.7 | 94.0 | 61.3 | |
| Retirees | 86.4 | 87.3 | 74.7 | |

Mobility

Mobility-related GHG emissions by household type vary more than they do for housing. They range from 0.9 tonnes of CO₂ equivalent for an urban, low-income, single-parent family to more than 6.1 tonnes of CO₂ equivalent for a high-income single person living in a peri-urban area. **T5**

While retirees' housing-related carbon footprint is large because of the considerable amount of space they occupy, their mobility-related GHG emissions are among the lowest. Income is a determining factor of mobility-related emissions. The five highest-emitting household types under the mobility item are those with high incomes. The location of households in urban areas makes it possible for them to limit their daily mobility.

Figure 8 shows that the “long-distance mobility” item, not the “transport” item overall, creates the disparity in households' GHG emissions, based on the latter's income. **F8** Retirees' GHG emissions are attributable to relatively low daily mobility, compared to

other households, because they are not required to travel to and from work every day. Emissions associated with daily mobility are lowest for urban households, regardless of income. Peri-urban and rural households have comparable emissions. In urban areas, average- and high-income households have similar emission levels. Emissions in urban areas are considerably less income-sensitive.

| Family structure | tCO ₂ eq/cap/yr | | |
|-------------------------------|----------------------------|------------|-------|
| Income | Rural | Peri-urban | Urban |
| Adults with children | | | |
| Income - | 2.1 | 2.1 | 1.6 |
| Income 0 | 2.3 | 2.5 | 2.1 |
| Income + | 3.0 | 2.8 | 2.2 |
| Retirees | 2.2 | 2.6 | 2.1 |
| Adults living together | | | |
| Income - | 2.5 | 2.6 | 2.0 |
| Income 0 | 3.0 | 3.5 | 3.1 |
| Income + | 4.0 | 4.0 | 3.4 |
| Retirees | 1.9 | 2.0 | 1.7 |
| Single-parent family | | | |
| Income - | 1.7 | 1.5 | 0.9 |
| Income 0 | 2.1 | 2.3 | 1.6 |
| Income + | 2.7 | 3.2 | 1.6 |
| Retirees | 1.8 | 1.8 | 1.2 |
| Single person | | | |
| Income - | 2.6 | 2.8 | 1.7 |
| Income 0 | 3.8 | 3.7 | 3.1 |
| Income + | 6.0 | 6.1 | 3.8 |
| Retirees | 0.9 | 1.2 | 1.0 |

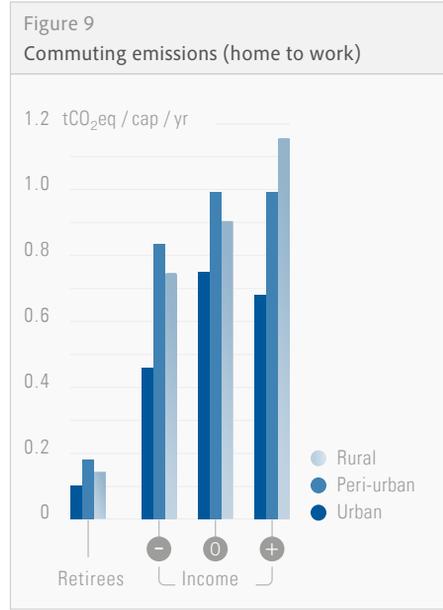
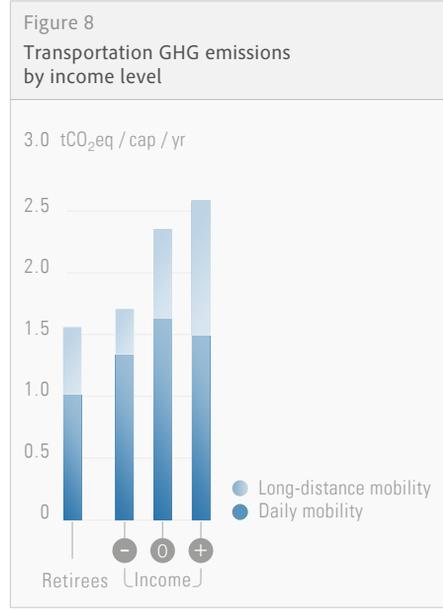
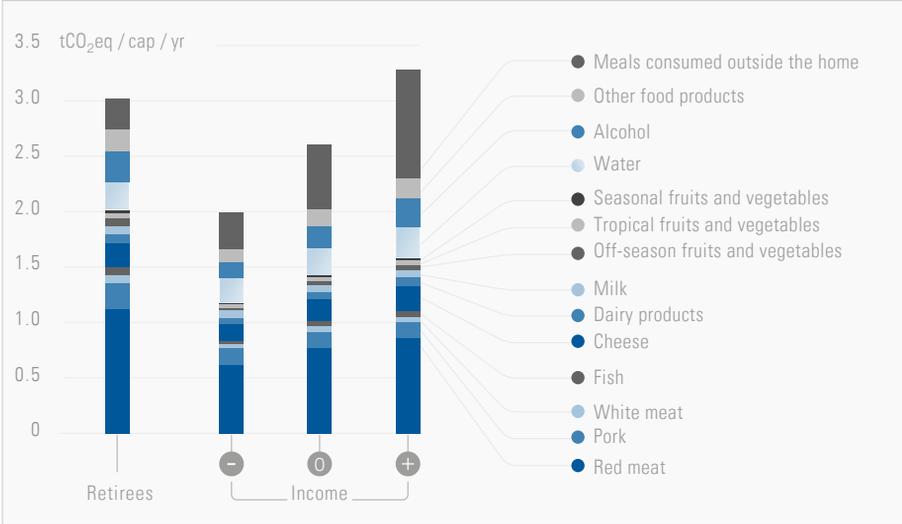


Figure 11
Food: annual emissions/product by income group



We note that the higher the income, the higher the food-related emissions, except for retirees. This is explained by the fact that retirees' tend to eat out less, particularly for weekday lunches, while employed persons rely on institutional catering. This is why emissions related to meals eaten outside the home were taken into account.

The disparities among the three income groups are based more on volumes than expenditure structure. High-income households purchase more food. Retirees often purchase more expensive food at neighbourhood stores.

Consumption of material goods

As in the case of food, the lack of available data on the consumption of material goods prevents us from quantifying household emissions using criteria other than income.

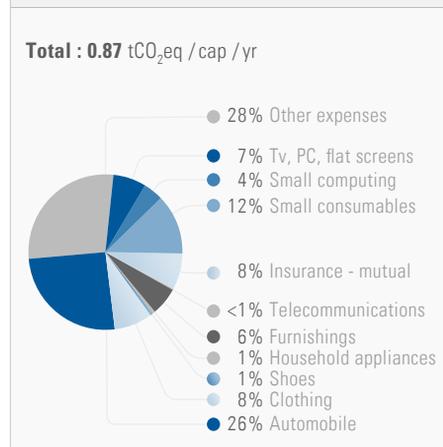
The proportions of budgets of different categories of goods differ only slightly across income categories. The difference involves primarily the total volume of goods purchased, which explains the footprint in terms of emissions. Low-income households' emissions thus total 873 kg of CO₂ equivalent/person/year, with emissions of 1,297 and 1,640 kg of CO₂

equivalent/person/year, respectively, for average- and high-income households. Retirees' emissions total 1,114 kg of CO₂ equivalent/person/year.

Emission factors per euro of audio-visual and computer goods are the highest, followed by automobiles and small consumables.

The structure of emissions by type of good is presented in Figure 12 for low-income households (which constitute the majority of the population). F12

Figure 12
Breakdown of annual emissions by item for low-income households

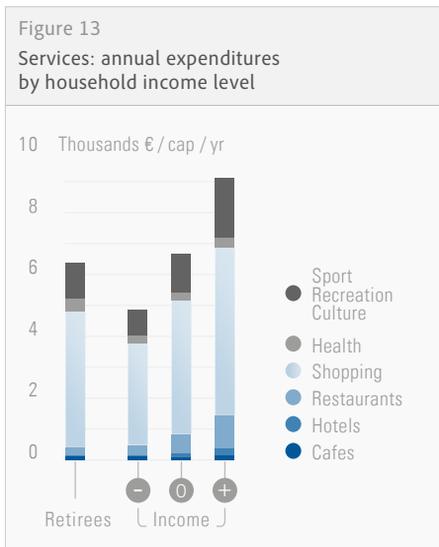


Services

The service sector emissions considered here total 27.1 MT of CO₂ equivalent and are relatively evenly-distributed across various types of services. Businesses emit 7.7 million tonnes of CO₂ equivalent, educational institutions emit 5.2 million and the health sector emits 4.6 million. Cafés/hotels/restaurants and the sports/recreation/culture sector emit close to 4 million tonnes of CO₂ equivalent.

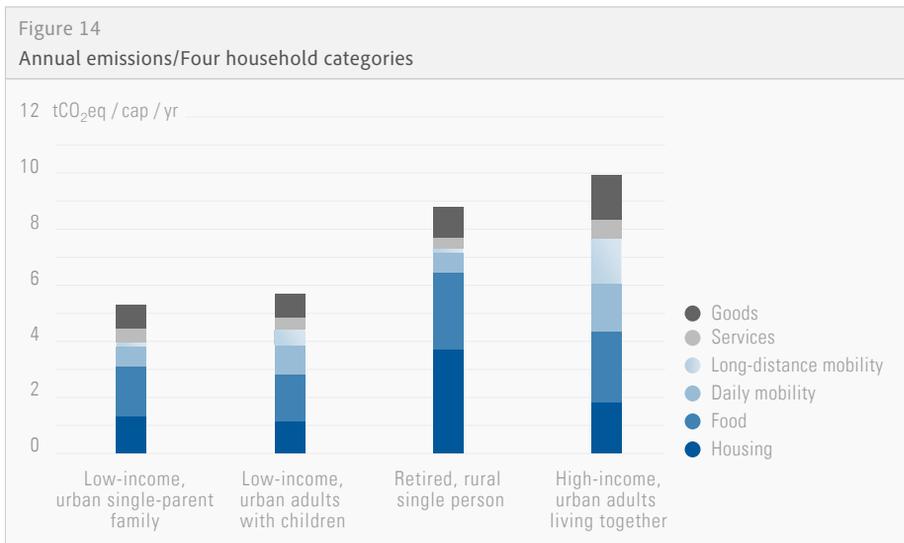
Note: In figure 13, expenditures called “businesses” are, in fact, expenditures for goods purchased at businesses, which explains their

considerable weight relative to the others'. The underlying assumption is that the “use” of businesses is proportional to spending on goods. As with food, the differences noted among income groups are based more on the overall volume of spending than on their distribution. Hotels, restaurants and the sports/recreation/culture item increase as incomes rise. As might be anticipated, health expenditures are higher for retirees. This refers only to direct health spending and does not include social transfers. **F13**



Conclusions

Half of household emissions come from the “food,” “goods” and “services” items, but the data needed for a fine disaggregation by household category are not available. We will return to this in the overall conclusions to this section. This produces a smoothing of the results among categories, while for the “housing” and “mobility” items, we note a strong variation in household carbon footprint by category. In conclusion, Figure 14 presents emissions for four household types and their structure, which are relatively differentiated. The single-parent, urban, low-income family has the smallest carbon footprint of all the categories described. However, we have set aside the highest-emitting households (14 tonnes



CO₂/person/year), which are composed of single, high-income individuals living in rural or peri-urban areas and who were very few in number in 2008. Housing and food show the highest emissions among single, retired persons living in rural areas. The three other

household types are urban. Household size and income group have a significant impact on emission levels. However, long-distance mobility and its carbon impact, linked to income level, differentiate these three types of urban households most. **F14**

Carbon footprint for a selection of households in 2050, based on their uses

Scenario design method

We wanted to include quantified components in order to compare the different lifestyles characterizing the societies described above from the perspective of GHG emissions. However, we have not quantified overall emissions for each society. That exercise would have required a level of specificity that is difficult to achieve for visions of the future, which are often quite removed from the current situation. We chose to quantify GHG emissions produced by three types of households in each scenario, characterized by its income group, family structure and location. The household types chosen vary by scenario and symbolize the scenario analysed. They are not necessarily the most predominant in terms of numbers, but their numbers are most often growing by comparison to 2010.

The comparison of each household's 2050 emissions in each scenario uses the 2010 household from each category (same income group, family structure and location), referred to here as "2010 counterpart." We note that the 2050 households are composed of a whole number of individuals, which is not the case of the 2010 counterparts, which are presented as averages for each category. The 2050 "adults with children" category is composed either of two adults and one child (scenarios 1, 2 and 3 in the conventional world) or two adults and two children for

scenario 3 in the alternative world and scenario 4, and single-parent families are composed of one adult and one child. In addition, as a result of the societal changes incorporated in the scenarios, comparisons with a third 2010 household are sometimes more relevant than with the counterpart. In that case, we make that additional comparison and will specify the characteristics of this third household for each scenario.

Two types of successive quantifications

Because the goal of this exercise is to highlight the impacts of lifestyle on GHG emissions, each household is quantified twice, in succession, for each scenario. We first sought to isolate the effects of reduced energy needs and, subsequently, the effects of technological developments and energy source substitution. The first simulation, referred to as "uses," thus incorporates only changes in demand, without an in-depth modification of the energy supply system (the energy mix and carbon content of the energy sources thus reflect 2010). The components incorporated in this quantification process are:

- housing and office retrofitting;
- variation in specific electricity needs;
- variation in distances travelled;
- change in modal shares; and,
- variations in consumption of food, goods and services (by quantity and quality).

The second simulation, referred to as “uses + change in CO₂ content,” includes all the components referred to above, as well as:

- variation in the heating mix in buildings;
- vehicle technology changes;
- variation in the electricity production mix; and,
- variation in the “carbon content” of goods purchased.

The main parameters influencing the final result are thus (with the parameters relevant only in the second quantification process noted in italics: “uses + change in CO₂ content”):

- Housing:
 - Useful floor area per capita
 - Heat consumption for housing based on s useful floor area (need)
 - Users' heating and energy-conserving behaviour
 - Consumption per person (hot water, cooking, specific electricity)
 - Variation in heating mix, hot water and electricity carbon content
- Personal mobility:
 - Number of kilometres travelled by purpose (number and distances of trips)
 - Modal share by purpose
 - Vehicle technology changes (efficiency of former transport modes and emergence of new modes)

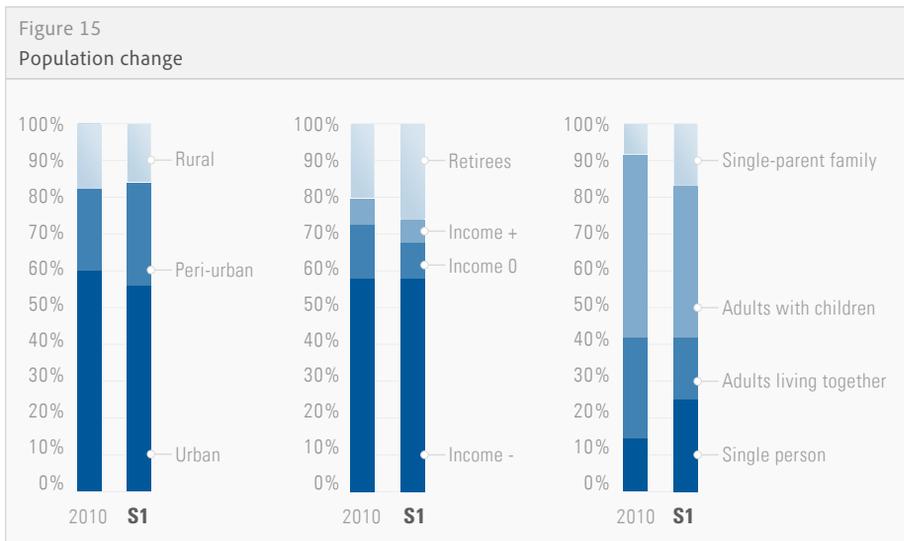
- Food consumption:
 - Quantities consumed by type of food
 - Share of consumption/organic food
 - Propensity to waste
 - Carbon efficiency of production methods
- Consumption of material goods:
 - Quantities consumed by typology of goods
 - Carbon efficiency of production methods
- Services:
 - Changes in surface area of service businesses frequented by households
 - Office energy retrofitting
 - Carbon efficiency of office heating mix

The Green Consumer Society

Population changes

The “green consumer” scenario (S1) extends the current trends in socio-demographic changes in the population, with the over-60 population increasing by 10 million and urban sprawl and household break-up into smaller units continuing to 2050. We assume that the society will be slightly more polarized than in 2010, with the proportion of middle-income households dropping slightly. **F15**

Given this population composition, this vision of the future characterizes the lifestyles



of a single person, single-parent family and a couple with children. (The latter remains the largest of the various family structures.) These three households will be compared to 2010 households with the same characteristics (their “counterpart”) and, for two of them, to a second household, described below, in order to illustrate the socio-demographic changes.

Changes in key lifestyle indicators

Housing retrofitting has been fairly limited in this society, resulting in a 20-40% useful energy gain compared to 2010 (Table 6). Heating control systems based on time and use of rooms are in widespread use. Specific energy consumption rose by 50% between 1970 and 2010 and, under this scenario, will continue to grow by more than 30% to more than 75%, based on household.

The expansion of online shopping has reduced shopping trips. Daily mobility is thus stable

overall, but long-distance mobility is increasing among households with means, particularly because it is much more common for family members to live abroad than it was in 2010.

Needs for goods and services continue to grow. An increase of nearly 50% in the use of services (expressed in m²/person) by 2050 corresponds to an upward trend (Table 6, SIM1). Retrofitting of service sector buildings has reduced demand for heat by 40%, although this is more than offset by increased surface areas. For health reasons and given rising food prices, most households have reduced the share of meat consumed by 50%. This is offset by consumption of cereal, eggs and fish. **T6**

Adults with children, peri-urban area, average income (SIM1)

The lifestyle of this household (Table 6, SIM1) is quite similar to that of the same household type in 2010. As noted above, heating needs have

| Family structure Location Income | Adults with children peri-urban area average income | Single person urban area high income | Single-parent family peri-urban area low income |
|---|---|--|---|
| | S1M1 | S1M2 | S1M3 |
| Useful floor area 2010 (m ² /capita) | 33 | 61 | 34 |
| Useful floor area 2050 (m ² /capita) | 33 | 74 | 25 |
| Heating 2010 (kWh/m ²) | 132 | 139 | 146 |
| Heating 2050 (kWh/m ²) | 92 | 109 | 94 |
| Specific electricity 2010 (kWh/capita) | 1,251 | 1,059 | 1,173 |
| Specific electricity 2050 (kWh/capita) | 1,877 | 1,854 | 1,525 |
| Daily mobility 2010/capita | 12,243 | 9,691 | 11,894 |
| % individual vehicle | 90% | 72% | 78% |
| Daily mobility 2050/capita | 13,264 | 13,582 | 11,519 |
| % individual vehicle | 65% | 87% | 48% |
| Long-distance mobility 2010/capita | 6,675 | 15,054 | 1,122 |
| % airplane | 29% | 43% | 15% |
| % individual vehicle | 58% | 30% | 73% |
| Long-distance mobility 2050/capita | 9,942 | 31,200 | 1,500 |
| % airplane | 27% | 58% | 0% |
| % individual vehicle | 61% | 23% | 20% |
| Food - % meat | -50% | -25% | -50% |
| Goods - % ICT + household appliances | 80% | 100% | 20% |
| Goods - % other | 20% | 50% | 20% |
| Services - % needs in surface area/capita | 47% | 70% | 14% |
| Services - % needs in heating/m ² | -40% | -40% | -40% |

decreased as a result of insulation and heating control systems, but specific electricity use is nearly 1,900 kWh/person/year.

Distances travelled are identical to 2010, on average. Green modes of transport are used more often, but two-thirds of the kilometres travelled still involve the use of a car. Long-distance mobility within this household rose from nearly 7,000 km/year to 10,000 km/year as a result of two annual trips to visit family members living elsewhere in Europe. Cars, followed by airplanes, are the most common modes of travel on these long trips.

Because of continued peri-urbanization in this society, and to demonstrate the carbon impact, this house will be compared to both its counterpart and a similar household but living in an urban area in 2010.

Single person, urban area, high income (S1M2)

This individual's income allows him or her to obtain spacious housing, measuring 74 m², and to pay for major retrofitting. However, this is offset by an increase in interior temperature to 22°C in both winter and summer. Energy consumption to achieve thermal comfort thus remains at 109 kWh/m². This person owns multiple pieces of electric and electronic equipment, increasing specific energy use by 75% compared to 2010.

Mobility, both daily (for work and recreation) and long-distance, has increased sharply. As in the case of the household described above, this person has friends or relatives abroad and visits them several times a year. His or her executive status also requires frequent business trips averaging 1,000 km/month. This individual almost always uses a car or motorbike for daily mobility and uses other modes of transport for only 13% of total kilometres travelled. The latter include green modes (3%) and public transit (10%). Long trips involve three other modes: airplane (for more than half of the kilometres travelled) and train and car (equal shares).

This person also uses cultural, recreational and sports services more frequently than the other households.

Because of the break-up of households into smaller units, this person will be compared to adults living together in 2010.

Single-parent family, peri-urban area, low income (S1M3)

This family's lifestyle is severely constrained by limited income in a world characterized by increasing inequality. The family is composed of one adult and one child living in low-energy-efficient housing that measures 50 m². The main room is usually the only one heated in winter. However, reflecting broader social trends, this family owns electrical and electronic equipment that consumes 1,525 kWh/person/year in specific electricity.

This household lives in at some distance from the downtown area, so daily distances travelled remain high. The family does not own a private car and uses a two-wheeled vehicle (usually electric). All other travel involves green modes (walking and biking, for 3% of travel) or public transit (10%). This household rarely takes vacations.

Its consumption of goods and services has increased, but by a much smaller proportion than the other two households'.

Results in GHG emissions

This simulation seeks to assess the impact of lifestyles in terms of energy needs with the CO₂ content of the same energy sources as in 2010. However, because modal shifts have been taken into account, there may be related energy substitutions.

Only use by single-parent families is declining, based on building energy efficiency improvements and the use of electric two-wheeled vehicles for daily mobility (as distinguished from the primary use of an internal combustion engine vehicle in 2010). This is combined with a 25% decline in housing surface area. Conversely, high-income single persons living in urban areas have sharply increased their long-distance mobility. The carbon footprint for all other items (except food) is also larger than in 2010. The 50% decline in meat consumption for two of the households has

reduced the carbon footprint associated with this item by 15 to 20%. **F16**

The table of GHG emission reduction factors compares household emissions in 2050 and those of their counterpart in 2010. For the first household (adults with children, peri-urban area, average income), the footprints per item have moved in opposite directions. It is slightly smaller for housing, daily mobility and food, but larger for long-distance mobility and goods and services.

The only notable change is the reduction, by a factor of seven, of the carbon footprint within the single-parent family (M3), which has shifted from travel based primarily on an internal combustion engine vehicle to an electric two-wheeled vehicle, which is produced on a large scale and thus at low cost. **T7**

The Enhanced Human Society

Population changes

The Enhanced Human Society (S2) is characterized by: a significant increase in urban density; continuing employment among the elderly despite increasing life expectancy and a sharp drop in the age at which women have their first child; greater social polarisation; and, a marked increase in the break-up of households into smaller units. 50% of the population thus made up of single people. **F17**

The two characteristic households in this society are composed of two single persons living in an urban area. One is working, although elderly, and earns an average income. The other is a manager with a high income. They

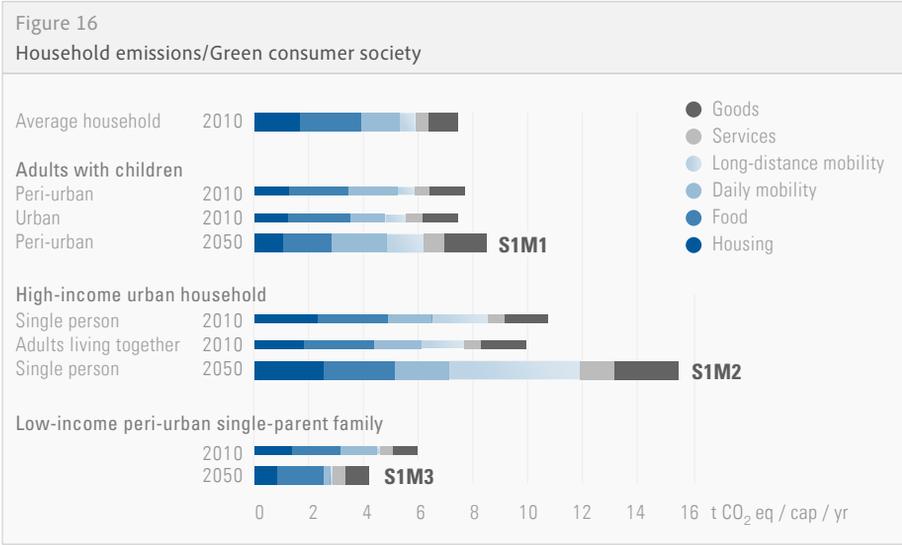
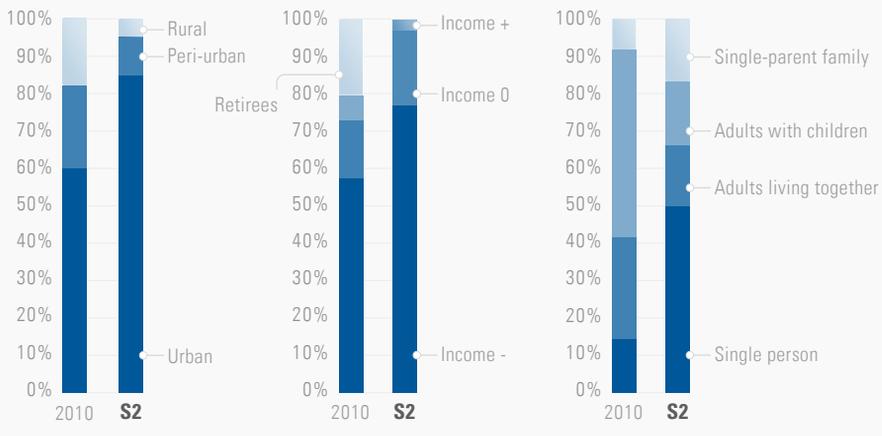


Table 7
GHG emissions reduction factors
2050 households compared to their 2010 counterpart

| | S1M1 | S1M2 | S1M3 |
|------------------------|------|------|------|
| Housing | 1.2 | 0.9 | 1.6 |
| Daily mobility | 0.9 | 0.8 | 7.6 |
| Long-distance mobility | 0.5 | 0.4 | 1.1 |
| Food | 1.2 | 1.0 | 1.1 |
| Goods | 0.8 | 0.7 | 1.0 |
| Services | 0.7 | 0.5 | 1.0 |
| Total | 0.9 | 0.7 | 1.4 |

Figure 17
Population trends



are among the Enhanced Humans. The third household belongs to the “minus” group. It is composed of a low-income couple with children living in an urban area.

Changes in key lifestyle indicators

In this society, life in the virtual world has relegated the need for space (both interior and exterior) to second place. The per-person surface area of housing is often one-third less than the average surface area by 2010 household category. Population density has increased in cities, reducing the distance of daily travel by 15%.

Residential energy retrofitting remains at the individual's initiative. As a result, some housing has been partially retrofitted, resulting in a 25% gain in heat efficiency (among the two single-person households with average and high incomes). Other housing remains outdated because the households concerned cannot afford to pay for retrofitting (third household).

The number of shopping and recreation trips has been reduced, respectively, by 50% and 75%. The expansion of e-commerce and virtual activities means that people almost no longer need to leave home.

Food is entirely artificial and designed solely to meet individuals' needs. The 75% decline in the share of meat in the diet was nearly unnoticed, with vegetable, synthetic and insect-based

proteins serving as substitutes. Very few fresh products are consumed and the notion of “season” no longer has any meaning. Consequently, waste has dropped sharply.

Households that belong to the Enhanced world have significantly increased their consumption of high-technology goods (+400%). These goods include intelligent equipment (including chips and screens), which involve more energy-intensive production (50% more than that of furniture, clothing, shoes and other goods). The production of prostheses has become an activity that uses as much materials and energy, worldwide, as automobiles did in 2010.

Many services have been dematerialized and thus occupy 25% less surface area. The cafe/hotel/restaurant (CAHORE) sector has nearly disappeared, given the loss of interest in food and dining and the drastic reduction in tourism, which is limited to a small elite. On the other hand, the personal service and rental services sector is growing rapidly, offsetting the sharp decline in retail surface area. Last, the hospital sector has grown significantly. Households with adequate resources spend one month per year, on average, in the hospital to have prostheses implanted that are intended to enhance their abilities. Hospital facilities have thus expanded ten-fold compared to 2010. **T8**

Table 8

Main indicator trends

| Family structure Location Income | Single person urban average income | Single person urban high-income | Adults with children urban low-income |
|--|--|---------------------------------------|---|
| | S2M1 | S2M2 | S2M3 |
| Useful floor area 2010 (m ² /capita) | 59 | 61 | 23 |
| Useful floor area 2050 (m ² /capita) | 35 | 46 | 16 |
| Heating 2010 (kWh/m ²) | 144 | 139 | 148 |
| Heating 2050 (kWh/m ²) | 108 | 105 | 148 |
| Specific electricity 2010 (kWh/capita) | 1,067 | 1,059 | 1,153 |
| Specific electricity 2050 (kWh/capita) | 2,668 | 3,178 | 2,018 |
| Daily mobility 2010/capita | 10,441 | 9,691 | 7,464 |
| <i>% individual vehicle</i> | 69% | 72% | 82% |
| Daily mobility 2050/capita | 12,674 | 25,346 | 7,074 |
| <i>% individual vehicle</i> | 40% | 40% | 30% |
| Long-distance mobility 2010/capita | 8,288 | 15,054 | 5,660 |
| <i>% airplane</i> | 31% | 43% | 31% |
| <i>% individual vehicle</i> | 40% | 30% | 56% |
| Long-distance mobility 2050/capita | 4,144 | 33,200 | 1,887 |
| <i>% airplane</i> | 30% | 64% | 31% |
| <i>% individual vehicle</i> | 30% | 12% | 56% |
| Food - <i>% meat</i> | -75% | -75% | -100% |
| Goods - <i>% ICT + household appliances</i> | 400% | 400% | 200% |
| Goods - <i>% other</i> | 50% | 50% | 50% |
| Services - <i>% needs in surface area/capita</i> | 147% | 161% | 67% |
| Services - <i>% needs in heating/m²</i> | -20% | -20% | -20% |

Single person, urban area, average income (S2M1)

This person's consumption of specific electricity has risen by 150% because of the extensive presence of robots, screens, networks and smart household equipment intended to increase his or her abilities and that control human bodies and assist with household tasks. Telecommuting has thus halved the number of trips made for this latter purpose. However, travel to specialized clinics has become very frequent. Public transit (60% of modal share) and on-demand transport (including taxi-type transport, for 25%) dominate. They are very efficient, thanks to ICTs.

Single person, urban area, high income (S2M2)

This person's housing measures 46 m², which is quite spacious for this society, with

one room dedicated to medical equipment and physical exercise. This pressured senior executive's work keeps him or her in perpetual motion. Work and travail are performed simultaneously, thanks to embedded technologies. The number of business trips has thus increased four-fold, with on-demand transport and three-wheeled electric vehicles used most often. To escape stress, this person takes short trips to distant places. This activity is restricted to a very limited group, which takes one intercontinental trip by plane, four 200-kilometre trips by helicopter and eight 500-kilometre trips by car every year, on average. Long business trips are also often necessary (16,000 km; half by plane and half by train). Long-distance mobility within this household category has thus increased from 15,000 km to more than 30,000 km/year.

Adults with children, urban area, low income (S2M3)

This household has “dropped out” and can no longer keep up with the pace of the society. Its members alternate periods of work and unemployment, thus halving the number of home-work trips. However, the household’s members travel regularly to medical facilities for care covered by social security. Their long-distance mobility is limited to rare family visits and a few excursions to parks and recreation areas developed on the city’s outskirts. These trips total one-third of those taken in 2010. A significant part of the household budget is spent on electronic equipment in an effort to stay in tune with the society. That budget has thus increased by 200%.

Results in GHG emissions

Unsurprisingly, the carbon footprint of goods consumed for these three households has risen sharply. The structure of the footprint for these services has changed, but has remained stable overall. The housing carbon footprint of high-income individuals has grown. Increases in surface area (and limited increases in thermal insulation) have been largely offset by higher specific energy consumption. Increased urban density has resulted in extensive use of shared transport and small low-GHG-emitting vehicles. However, long-distance mobility varies considerably by income and has risen sharply among executives, both for recreation and work needs. **F18 T9**

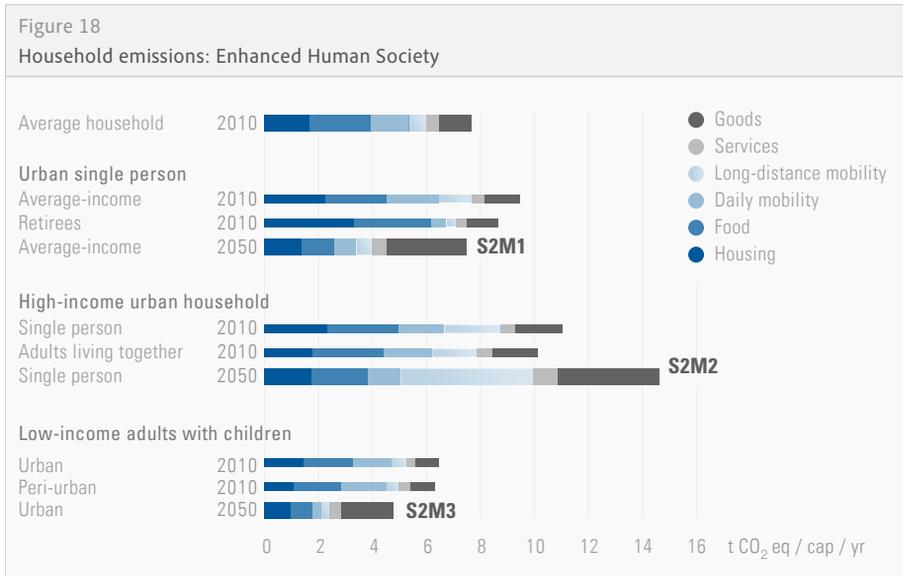


Table 9
GHG emissions reduction factors
2050 households compared to their 2010 counterpart

| | S2M1 | S2M2 | S2M3 |
|------------------------|------------|------------|------------|
| Housing | 1.6 | 1.4 | 1.5 |
| Daily mobility | 2.4 | 1.3 | 4.0 |
| Long-distance mobility | 2.1 | 0.4 | 2.2 |
| Food | 1.7 | 1.6 | 2.2 |
| Goods | 0.5 | 0.4 | 0.5 |
| Services | 0.8 | 0.6 | 0.8 |
| Total | 1.3 | 0.8 | 1.4 |

Changed lifestyles have resulted in reduced GHG emissions for two of the three households, from 30% to 40% (at unchanged CO₂ energy supply content). These reduced emissions are the result of housing, modal shift in daily mobility, food, and long-distance mobility among the most energy-conserving households. As in present-day society, emissions vary drastically based on available household income. This factor is the leading explanation of the emissions observed, with the discrepancies increasing even further.

Dual Society and Multiple Frugal Lifestyles

Population changes

This dual society is composed of a majority of the population that maintains a consumer lifestyle, despite an economic system in crisis, and a large minority (40%) that has “dropped out” and adopted alternative lifestyles. One of the alternatives chosen is to move to a rural area, home to 25% of the population in 2050. This society is sharply divided, with 65% of households falling into the low-income category. Many are part of the “second world.” Family structure is largely unchanged from 2010. Persons over 60 - more numerous in 2050 - are part of the “adults living together” category. **F19**

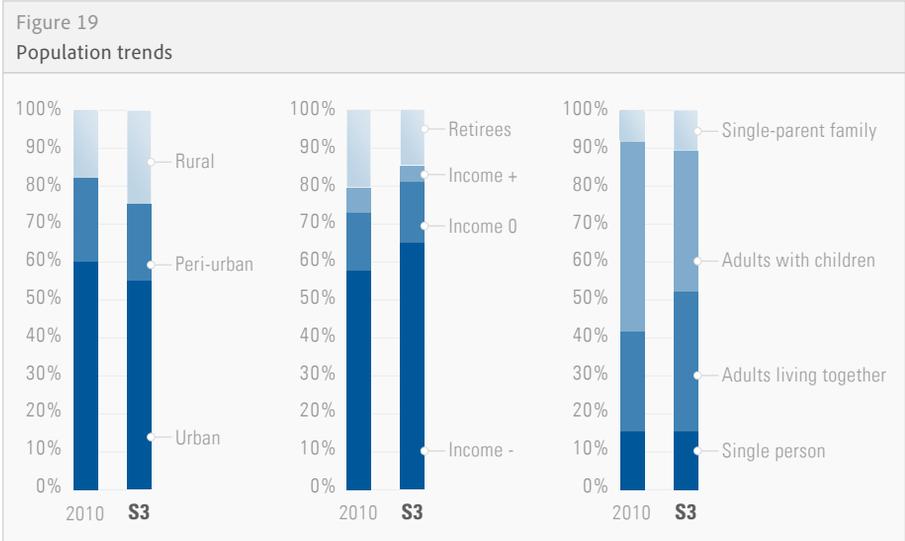
For this society, the composition of the population has thus led us to characterize the lifestyles of three households: one that remains part of the traditional system (couple with children, peri-urban area, average income) and two that are part of the alternative system (couple with children, urban, low income and a household composed adults living together, rural, low income).

Changes in key lifestyle indicators

As noted above, nearly two-thirds of the population are part of the conventional system, such as the first household described below. Their lifestyle is similar to that of 2010 but economic conditions have worsened. The households that have abandoned this consumption model, by choice or necessity, have chosen to live simpler lives and to share certain goods and services within their community. **T10**

Adults with children, peri-urban area, average income (S3M1, conventional system)

Because they lack adequate income, these families, who are part of the conventional system, must live in smaller spaces (-25%) than similar households occupied in 2010. The pressure and competition they face to remain part of the “first world” requires them to accept jobs involving a longer commute (+25% increase in



distances travelled). Public transit is not well-developed, so these households must use a car or motorized two-wheeled vehicle (50/50) to get to work because of the long commute distances. The car is used only for commuting to work. Two-wheeled vehicles and green modes of transportation are used for other travel. Long-distance mobility has been halved, with train travel most common and rare plane trips on low-cost carriers. Meat consumption has dropped slightly. ICTs are required to stay connected to this society. However, the extensive economic crisis has led to a decline in the consumption of other kinds of goods, compared to 2010.

Adults with children, urban, low income (S3M2, alternative system)

These households, whose income is lower compared to the same household category

in 2010, have chosen to live in small towns. With several families sharing older housing, useful floor area per person has dropped dramatically (-30%). Limited retrofitting, which the residents perform themselves, sometimes using salvaged materials, together with temperatures kept low in some rooms and off altogether in others, has reduced heating needs by 50% (83 kWh/m²). This "voluntary simplicity" can also be observed with regard to electricity consumption, which is 50% below that of 2010 (577 kWh/person). Busy social and cultural lives involve frequent travel, but substitutes for home-work travel as paid work time has dropped sharply. This daily mobility primarily involves trips inside the city, using non-motorized transportation modes. Shared vehicles are used for longer trips or to move heavy loads.

Table 10
Main indicator trends

| Family structure Location Income | Adults with children peri-urban area average income | Adults with children urban low income | Adults living together rural low income |
|---|---|---|---|
| | S3M1 | S3M2 | S3M3 |
| Useful floor area 2010 (m ² /capita) | 33 | 23 | 44 |
| Useful floor area 2050 (m ² /capita) | 25 | 16 | 33 |
| Heating 2010 (kWh/m ²) | 132 | 148 | 168 |
| Heating 2050 (kWh/m ²) | 112 | 83 | 63 |
| Specific electricity 2010 (kWh/capita) | 1,251 | 1,153 | 1,219 |
| Specific electricity 2050 (kWh/capita) | 1,564 | 577 | 609 |
| Daily mobility 2010/capita | 12,243 | 6,233 | 12,390 |
| % individual vehicle | 82% | 80% | 95% |
| Daily mobility 2050/capita | 12,813 | 4,665 | 4,295 |
| % individual vehicle | 62% | 20% | 70% |
| Long-distance mobility 2010/capita | 6,675 | 5,660 | 1,349 |
| % airplane | 29% | 31% | 1% |
| % individual vehicle | 58% | 56% | 78% |
| Long-distance mobility 2050/capita | 2,800 | 1,000 | 500 |
| % airplane | 15% | 0% | 0% |
| % individual vehicle | 55% | 20% | 50% |
| Food - % meat | -25% | -75% | -50% |
| Goods - % ICT + household appliances | 50% | -75% | -75% |
| Goods - % other | -25% | -75% | -75% |
| Services - % needs in surface area/capita | 20% | 0% | 21% |
| Services - % needs in heating/m ² | 0% | -30% | -30% |

Long-distance travel is very limited (1,000 km/year/person). Trains are used for the majority of such trips but carpooling is a travel option as well, if necessary, and some trips are made by bicycle. Consumption of new goods is extremely limited; rather, people rely on used goods and trade and lend goods and materials.

Adults living together, rural, low income (S3M3, alternative system)

Thanks to DIY construction and co-living arrangements with other families, these households occupy 33 m²/person of living space. The thermal quality of new construction is quite high (insulated with natural materials), which reduces heating needs by 50% over

2010. Energy conservation efforts (keeping rooms at a lower temperature, for example) further limit heating (63 kWh/m²) and specific electricity needs.

Work and social life is strongly rooted in the community and neighbouring areas. Daily mobility is thus one-third of that among rural households without children in 2010. Vehicles (cars and utility vehicles) are shared. Given the short distances, two-wheeled vehicles and walking are the most common forms of transportation. Long-distance mobility is extremely low (500 km/year). Public transit and carpooling are used equally.

All foodstuffs consumed are produced locally and most products are organic. Meat consumption has fallen and often includes

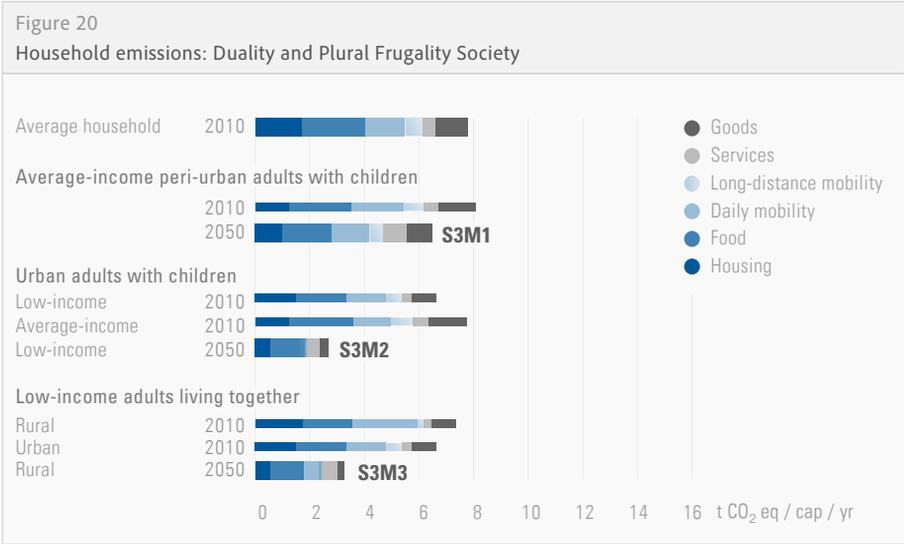


Table 11
GHG emissions reduction factors
2050 households compared to their 2010 counterpart

| | S3M1 | S3M2 | S3M3 |
|------------------------|------|------|------|
| Housing | 1.3 | 2.6 | 3.2 |
| Daily mobility | 1.3 | 7.0 | 4.0 |
| Long-distance mobility | 1.5 | 12.4 | 2.7 |
| Food | 1.3 | 2.0 | 1.7 |
| Goods | 1.4 | 3.2 | 3.2 |
| Services | 0.7 | 0.7 | 0.6 |
| Total | 1.2 | 2.5 | 2.3 |

poultry. All fruits and vegetables are seasonal. Consumption of material goods has declined considerably. Where possible, goods are produced locally by craftspeople, small- and medium-sized businesses or the individuals themselves.

Results in GHG emissions

Emissions of households under the conventional system (adults with children, peri-urban, average income) have fallen by 30%, due primarily to reduced income in a period of economic crisis. Long-distance mobility is the item that has declined most significantly. Emissions among households under the alternative system have been reduced by a factor of 2.5. Housing and mobility represent less than half of GHG emissions. The drop in goods consumption also has a marked impact on household emissions. **F20 T11**

has tightened, which explains the lack of high incomes. Commuter towns in the outer suburbs are no longer appealing and urban sprawl has been halted because of its excessive environmental footprint. In addition, the family unit limited to parents and children is no longer the rule. Sharing housing and goods has become the social norm. Living spaces are open to other members of the family - and well beyond. The number of single people has declined and single-parent families are also less common. **F21**

Households emblematic of this society, and whose lifestyles we have chosen to characterize, include two with adults living together in an urban area. The first of these is composed of several average-income households living in shared housing and the second is composed of several young adults living as roommates, with low incomes. The third household includes a low-income couple with children living in a rural area.

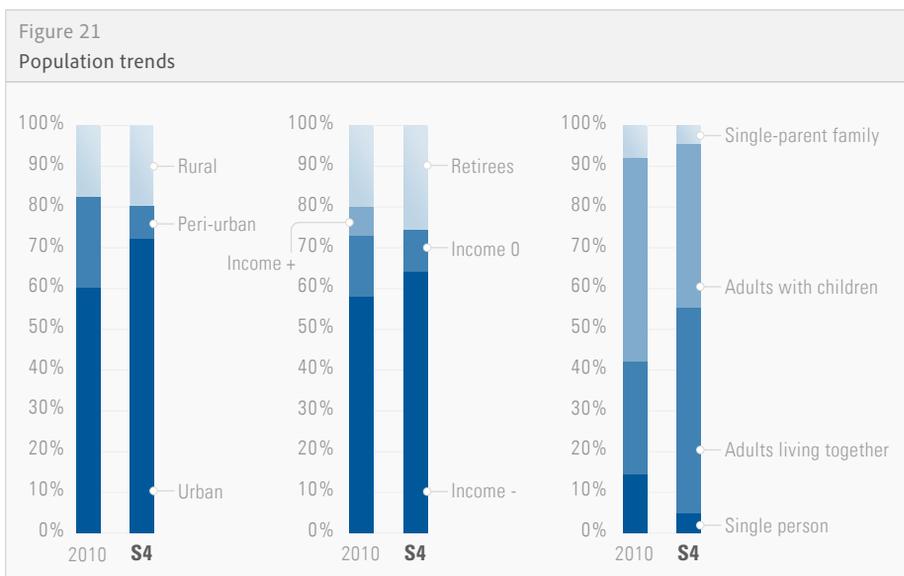
The Environmental Citizenship Society

Population changes

The "collective lifestyle" is now recognized as the best way to maintain quality of life. Environmental and social issues are at the heart of collective action. The income scale

Changes in key lifestyle indicators

Residents have emphasized energy conservation, resulting in a four-fold drop in heating needs, both in new housing and retrofitted existing housing. These energy-conserving buildings have made it possible to maintain the same thermal comfort level (19° C).



However, areas set aside for telecommuting, which is quite common, require slightly higher temperatures, resulting in a 10% increase in heating needs there.

ICTs play an important role in the population's daily life, as tools for exchange and consultation. Manufacturers are required to sharply increase appliance energy efficiency, which has enabled many households to reduce specific energy consumption over 2010, by approximately 600 to 900 kWh/year. In addition, extensive sharing of equipment, both in the home and within the neighbourhood, has limited power consumption, particularly in standby mode. By lengthening the life cycle of materials, high-tech expenditures remained constant compared to 2010. Reduced commodification, equipment-sharing and the purchase

of sustainable products have reduced the consumption of other goods by 30%.

However, daily mobility has dropped by approximately half. Thanks to telecommuting and e-commerce, shopping and work trips have fallen by 30%. Travel for recreation and other purposes is 50% higher than in 2010 to maintain active social and cultural lives. Distances travelled have fallen by half, with the growth of neighbourhood-based activities. In urban areas, given a transport system that encourages green modes, environmental and financial motivations and the short distances travelled, 80% of trips are made on foot, bicycle or public transit. Two- and three-wheeled shared vehicles complement those modes. In general, the importance of face-to-face relationships and encounters with other cultures means maintaining a certain level of mobility,

Table 12
Main indicator trends

| Family structure Location Income | Single person urban average income | Single person urban high-income | Adults with children urban low-income |
|---|--|---------------------------------------|---|
| | S4M1 | S4M2 | S4M3 |
| Useful floor area 2010 (m ² /capita) | 29 | 28 | 25 |
| Useful floor area 2050 (m ² /capita) | 138 | 154 | 151 |
| Heating 2010 (kWh/m ²) | 38 | 31 | 45 |
| Heating 2050 (kWh/m ²) | 1,185 | 1,242 | 1,110 |
| Specific electricity 2010 (kWh/capita) | 889 | 621 | 1,332 |
| Specific electricity 2050 (kWh/capita) | 11,224 | 7,722 | 7,706 |
| Daily mobility 2010/capita | 89% | 95% | 76% |
| % individual vehicle | 5,880 | 6,468 | 4,020 |
| Daily mobility 2050/capita | 20% | 78% | 0% |
| % individual vehicle | 8,107 | 4,407 | 5,784 |
| Long-distance mobility 2010/capita | 34% | 0% | 36% |
| % airplane | 44% | 63% | 41% |
| % individual vehicle | 8,107 | 4,407 | 6,074 |
| Long-distance mobility 2050/capita | 18% | 5% | 10% |
| % airplane | 22% | 30% | 20% |
| % individual vehicle | -100% | -50% | -100% |
| Food - % meat | 0% | 0% | 40% |
| Goods - % ICT + household appliances | 80% | 100% | 20% |
| Goods - % other | 20% | 50% | 20% |
| Services - % needs in surface area/capita | 47% | 70% | 14% |
| Services - % needs in heating/m ² | -40% | -40% | -40% |

particularly with regard to long-distance mobility. The latter remains, overall, unchanged compared to 2010.

80% of food production is organic and organized regionally. Many households are vegetarian and consume seasonal fruits and vegetables, as do the urban households described here. Improved diet and a healthy lifestyle have reduced the need for health care. Hospitals and clinics have thus been transformed into community centres. Meeting places (cafés and restaurants) are very busy, as social life is quite active (+100%). This is also the case for cultural and sports facilities (+75%). **T12**

Adults living together, urban area, average income (S4M1)

Sharing housing among several couples or individuals has significantly reduced living area per person (-30%). However, common spaces have been set aside for telecommuting and other activities. Long-distance mobility for personal purposes is identical to 2010, but everyone takes the time to travel. The share of air travel has fallen by half; 50% of trips are made on public transit and the rest are by boat or green modes of travel. Business travel has dropped by half, with virtual meetings partially substituting. Carbon footprint restrictions and slowed production have reduced air travel and favour lower-carbon forms of travel (primarily by train).

Adults with children, rural, low income (S4M2)

Government-funded retrofitting programs have improved housing insulation. Domestic electrical equipment has been voluntarily reduced to the minimum (refrigerator, computer, audio/video and basic household appliances) and is quite high-performing, which has halved energy consumption compared to 2010.

The organisation of rural space and changes in agricultural production, involving more workers than previously, has brought home and farmland closer. Distances travelled have thus fallen by a third. Children still travel five days/week to go to school, primarily

via bus (80% on public transport). Parents occasionally organize to pick up groups of children by car after school (occupancy rate +30%). Thanks to the revival of rural communities, most services can be found in surrounding villages.

Overall, modes of transport are unchanged compared to 2010. However, non-motorized transport modes (walking and bicycling) are increasing; each represents 5%. Small public transit systems handle 20% of trips. Last, thanks to the use of motorized two-wheeled vehicles, which consume less energy than cars, the latter are used for only 60% of trips. Long-distance travel is increasing, both for personal reasons (visiting family throughout France) and professional ones (visits to exchange information on agricultural practices). Most travel is by train (60%). When a car is required, occupancy is maximized via car-pooling platforms.

The share of meat in these households' diets has been halved and they eat only seasonal fruits and vegetables.

Young adults living together, urban, low income (S4M3)

These young adults, whether workers or students, occupy 25 m² of habitable space per person. However, they are major users of ICTs. Despite the high energy performance of electrical goods, their specific electricity consumption is 1,300 kWh/person/year, or slightly above that of an average household in 2010. The high-tech budget has increased 40%.

Travel for work, school and civic activities uses non-motorized transports only. Trips are short, thanks to the local nature of social activities. Long-distance mobility is similar to 2010. Trips are long but infrequent and often by train, boat or carpool, with a smaller carbon footprint. Airplane travel constitutes 10% of distances travelled.

Results in GHG emissions

The carbon impact of all uses has fallen sharply. Emissions produced by adults living together in shared housing have been cut by a factor of nearly 2.5 compared to their

2010 counterpart, attributable to greater cohabitation in this society, as well as a narrowed salary scale.

The emissions of rural families have barely increased over prior households' (respectively, 4.3 and 3.9 tonnes of CO₂ equivalent/person). Daily mobility is still high because of their location, with 78% of distances travelled using individual motor vehicles.

Young adult GHG emissions are limited to 3 tonnes of CO₂ equivalent/person. This result is attributable to the very low carbon impact of daily mobility, a vegetarian diet, energy-conserving housing and a surface area/person similar to the current average of low-income urban families. **F22 T13**

The Knowledge Age Society

Population changes

This society, based on access to knowledge for all, operates preferably in an urban environment where private property has largely lost its value. Peri-urban areas have become denser or have been abandoned because they are dysfunctional. However, a significant number of agricultural workers remain as a result of more extensive agriculture. Knowledge is no longer transmitted primarily within the family. The age of majority is 16, resulting in an earlier emancipation for young people and their departure from the family. The number of households without children is thus automatically larger. **F23**

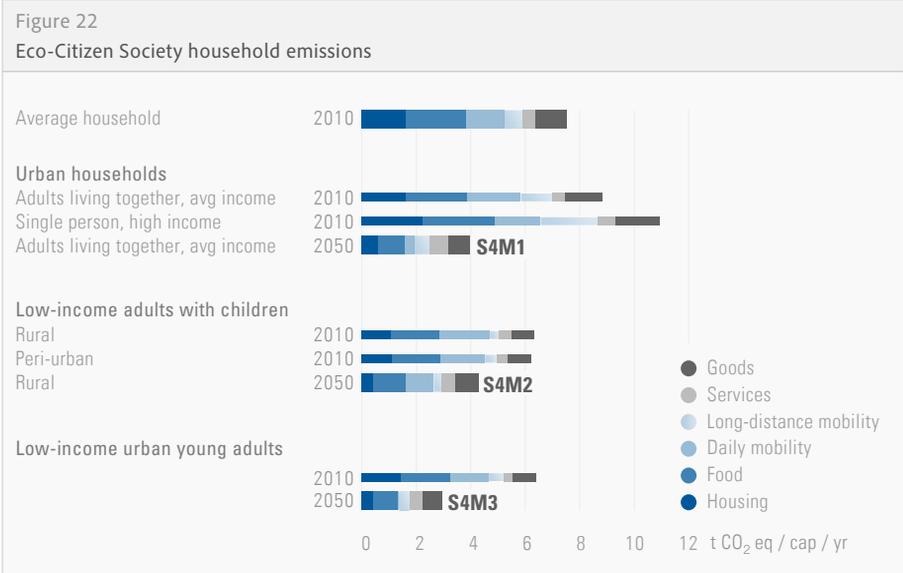
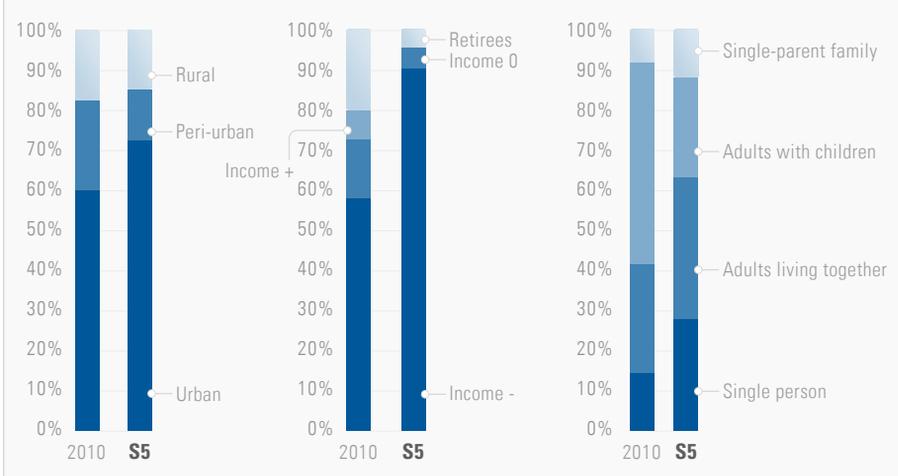


Table 13
GHG emissions reduction factors
2050 households compared to their 2010 counterpart

| | S4M1 | S4M2 | S4M3 |
|------------------------|------|------|------|
| Housing | 2.6 | 2.6 | 3.1 |
| Daily mobility | 6.0 | 1.7 | 28.6 |
| Long-distance mobility | 1.9 | 1.2 | 1.5 |
| Food | 2.8 | 1.8 | 2.7 |
| Goods | 1.7 | 1.0 | 1.2 |
| Services | 0.7 | 0.8 | 0.7 |
| Total | 2.2 | 1.5 | 2.2 |

Figure 23
Population trends



To characterize the lifestyles in this society, we will use the following three types of households: two types of adult communities, one more female and the other more youth-based (age 16-20, all considered adult in this society). Both communities live in urban areas and are low income. The third type of household is composed of single people living in rural areas, also low income. Monetary income is not the only form of income available to households in this society, where the exchange of services and uncompensated work is quite prevalent and explains why the majority of the population is categorized as low income.

Changes in key lifestyle indicators

Buildings have been redesigned to create shared and private living spaces to meet the needs of communities in urban areas. This has reduced surface area/person by 25% and up to 50% for young people occupying smaller bedrooms. Like most of the housing stock, buildings have been fully retrofitted and externally insulated with reclaimed materials. In addition, plantings throughout the city have helped to reduce temperature variations. **T14** Building quality has generated unit heating savings of 50 to 60% over 2010. The high cost of energy has encouraged extreme vigilance.

People devise all sorts of strategies to avoid unnecessary consumption. ICTs are used widely and constitute a major share of the electricity consumed. However, improved energy efficiency has led to a 30% drop in specific energy consumption compared to 2010 for most households. Consumption among young people is slightly higher. Long-distance business travel is quite rare, as ICTs are so sophisticated that such trips are not necessary. All households have reduced their long-distance mobility significantly because of cost, offset by the use of ICTs. Self-care and knowledge of one's own body limit the use of health care. People visit museums and community centres frequently (+100%), as well as neighbourhood cafeterias and bistros. A significant part of social life outside the immediate neighbourhood occurs there (+100%).

Adults living together, urban, low income (SSM1)

Business travel has fallen by 50% thanks to telecommuting. Although people previously participated in lifelong learning activities at the workplace or other facilities, online courses mean that these women never have to travel to continue their studies. Travel for recreation and personal visits has increased (+25%) due to the importance of social

Table 14

Main indicator trends

| Family structure Location Income | Adults living together urban low income | Single person rural low income | Young adults living together, urban low income |
|---|---|--------------------------------------|--|
| | S5M1 | S5M2 | S5M3 |
| Useful floor area 2010 (m ² /capita) | 34 | 71 | 34 |
| Useful floor area 2050 (m ² /capita) | 25 | 64 | 17 |
| Heating 2010 (kWh/m ²) | 151 | 177 | 151 |
| Heating 2050 (kWh/m ²) | 75 | 124 | 60 |
| Specific electricity 2010 (kWh/capita) | 1,110 | 1,159 | 1,110 |
| Specific electricity 2050 (kWh/capita) | 777 | 811 | 888 |
| Daily mobility 2010/capita | 7,706 | 11,191 | 5,607 |
| % individual vehicle | 76% | 95% | 12% |
| Daily mobility 2050/capita | 4,572 | 2,980 | 2,823 |
| % individual vehicle | 20% | 55% | 0% |
| Long-distance mobility 2010/capita | 5,784 | 2,518 | 5,784 |
| % airplane | 36% | 0% | 36% |
| % individual vehicle | 41% | 49% | 41% |
| Long-distance mobility 2050/capita | 1,500 | 2,000 | 1,000 |
| % airplane | 0% | 0% | 0% |
| % individual vehicle | 20% | 40% | 15% |
| Food - % meat | -100% | -30% | -30% |
| Goods - % ICT + household appliances | 30% | -90% | -30% |
| Goods - % other | -50% | -90% | -40% |
| Services - % needs in surface area/capita | -6% | -8% | -21% |
| Services - % needs in heating/m ² | -30% | -30% | -30% |

connections. However, shopping trips have declined (-25%).

Distances travelled for all purposes have fallen by 25% because most trips are within the neighbourhood. Virtual contact offsets travel to more distant locations. Non-motorized transports are preferred for very short trips (20% on foot and 40% by bicycle). Public transit is used for longer trips (20%), with trips by car and motorized two-wheeled vehicle (widely shared). These women take only a few major trips in their lifetime and travel at a relaxed pace, by train (60%), carpool (20%) and boat (10%). Some even travel by bicycle.

Consumption of high-tech goods and communications tools has increased (+30%). Consumption of other goods has fallen sharply. They are sometimes self-produced and are repaired for as long as possible.

Single person, rural, low income (S5M2)

These individuals occupy rural homes that existed in 2010 and are slightly smaller (-10%). They have been only minimally retrofitted because of very limited incomes and indifference to comfort. Extensive activities outside the home reduce the use of heat (-30%).

These individuals work primarily on the outskirts of their municipality, which has been revitalized by new residents drawn by agriculture. While the volume of business travel is identical to that of 2010, distances are considerably shorter because most trips occur within a radius of 5 kilometres and fewer than 10% of trips are further than 10 kilometres. This neighbourhood-based way of life generates daily mobility of approximately 3,000 km/year. Meat consumption has declined compared to 2010 (-30%) and meat is produced locally.

Consumption of seasonal fruits and vegetables, which are produced locally and organically, is quite high. These individuals do not consume lots of goods and produce most of them themselves.

Young adults living together, urban, low income (S5M3)

Although the Internet is an omnipresent source of knowledge, young people aged 16-18 still travel to school five days/week. They make fewer shopping trips, with each person taking his/her turn to shop for the group (-40%). The living space is the community and these young people spend a good part of their social life there, thus reducing their travel to visit other people (-30%). However,

they travel more than in 2010 for recreation, specifically for sports (+15%). Because most travel is neighbourhood-based, distances have fallen by 24%. These young people travel almost only by green modes of transport (90%). They use public transit occasionally (10%).

They are not yet old enough to take major trips, but do take vacations (1,000 km/year), via car-pool (15%), train (60%) and bicycle (25%).

Their income is low and their consumption of high-tech goods, similar to other goods, is reasonable. Sharing is a regular practice.

Results in GHG emissions

These three households' emissions have been halved (at constant energy carbon content). Single persons living in rural areas

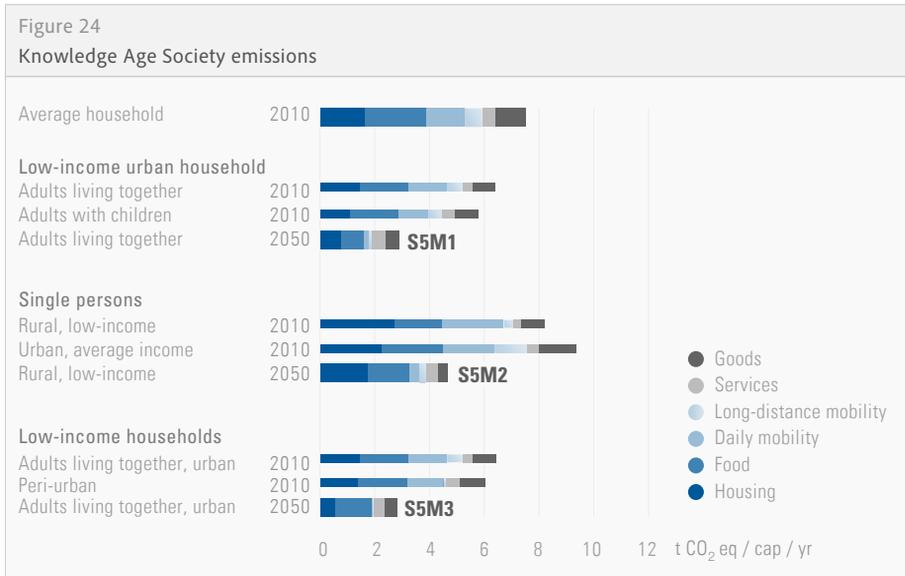


Table 15
GHG emissions reduction factors
2050 households compared to their 2010 counterpart

| | S5M1 | S5M2 | S5M3 |
|------------------------|------|------|-------|
| Housing | 2.0 | 1.6 | 2.6 |
| Daily mobility | 6.1 | 6.2 | 101.8 |
| Long-distance mobility | 7.5 | 1.5 | 13.9 |
| Food | 4.0 | 1.4 | 1.6 |
| Goods | 1.7 | 2.3 | 2.0 |
| Services | 0.7 | 0.7 | 0.8 |
| Total | 2.2 | 1.8 | 2.3 |

have a large amount of living space (64 m²) that is not energy-efficient, resulting in a high carbon footprint. Their diet, like that of young people (third type of household), still includes a fair amount of meat (only a 30% drop compared to 2010), which explains the significance of this item compared to the

women in the first household, who have chosen a vegetarian diet.

Mobility needs are low in this knowledge society, where ICTs are used extensively. CO₂ emission reduction factors range from 6 to 100. Young adults do not use motorized vehicles. **F24 T15**

Impact on the results of a change in energy sources

The preceding pages calculated GHG emissions for different households in different social contexts. However, these exercises were conducted assuming constant carbon content for the various energy carriers consumed, without changing the 2010 energy mix. We thus wanted to present the lifestyles' "raw" effects, without confusing the reading of the results with marked technological differences.

However, technological change, changes in energy mix and the possible decarbonisation of energy carriers may provide leverage in transitioning towards a Factor 4 society. Thus, we must also present the results obtained taking all this into account. That is

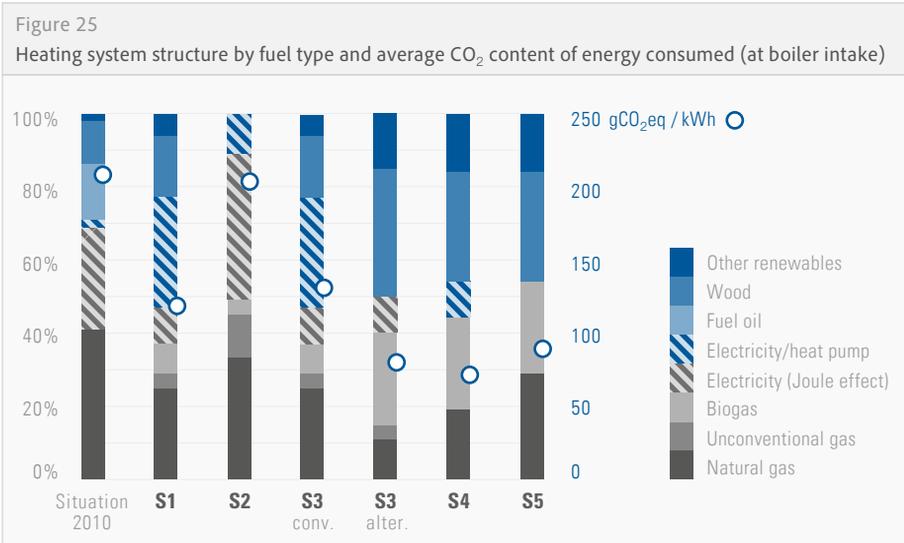
the purpose of this chapter.

The primary changes concern the heat and hot water production systems for housing and offices, the electricity production system and the technologies used in the private vehicle fleet. We thus set out all these assumptions.

Last, we present the new results obtained after incorporating all these elements into the modelling exercise.

Heat and hot water

By 2050, existing boilers and other methods of producing residential heat and hot water could have been entirely replaced. It is thus



possible to design equipment totally different from that currently in use. The graphs below present the assumptions chosen for the heating and hot water systems under each of the scenarios. Note that scenario S3 is divided in two. The duality within this vision of the future led us to conclude that the systems characterizing the two societies existing side-by-side societies - “conventional” and “alternative” - could be very different. F25

All the scenarios assume that fuel oil will no longer be used for space heating. However, significant quantities of gas will continue to be used (never less than 20% for a scenario). That proportion of gas is a strong assumption because it is the only fossil fuel used for heating in 2050. Development of shale gas may even increase the share of gas (scenario 2).

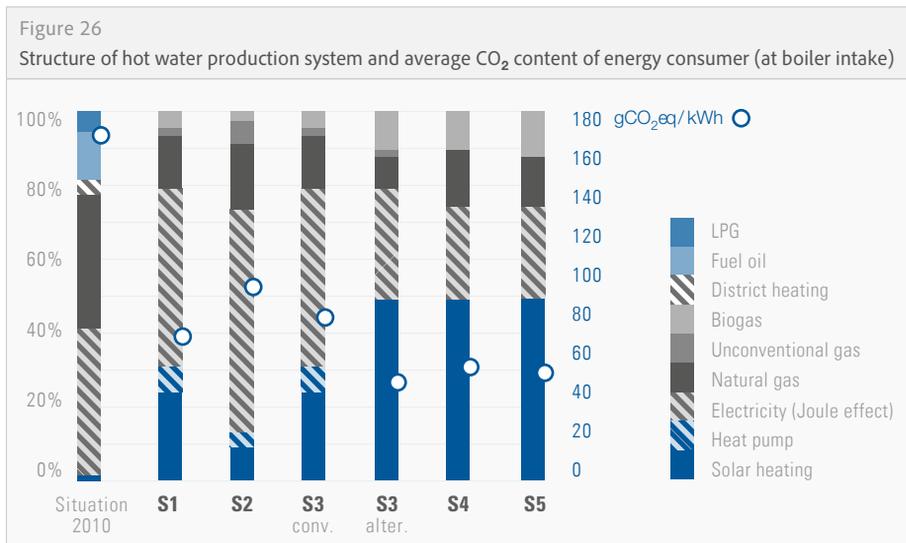
The non-gas or fuel oil energy scenarios may be grouped into two categories: electricity scenarios (scenarios 1, 2 and 3/conventional), in which heat pump technologies and the Joule effect play a prominent role (often more than 40%); and renewables scenarios (scenarios 3/alternative, 4 and 5), where wood and biogas have a significantly larger share of the market. These latter scenarios achieve an average carbon content of energy consumed that is lower than the first three scenarios. The drop as compared to the baseline may thus be significant—that is -65% for S4 for example. The

more proactive assumptions of market penetration of renewable energy (substituting for fossil gas), that would be possible under scenarios S3/alternative, S4 and S5 (where energy demand has dropped sharply), would, of course, have a marked positive impact on households' final carbon footprint in 2050. F26

Hot water energy sources were chosen consistent with the assumptions presented for heating systems. Thus, there are three electricity-dominant scenarios and three renewables-dominant scenarios (here, solar energy is favoured). The resulting levels of carbon content are ranked in the same way as those calculated for heating.

Electricity production systems

The electricity production system characterizing the 2010 situation is strongly influenced by nuclear power. We may thus distinguish the scenarios based on whether or not they retain this characteristic and we then return to the prior classification of “electricity scenarios” and “renewable scenarios.” The scenarios in which the thermal use of electricity continues (heat and hot water production) are those where nuclear power still plays a leading role (S1, S2 and S3/conventional). On the other hand, the other scenarios illustrate a non-nuclear



situation, with further development of renewable energy sources. Scenario S3 is unique, with two different electricity mixes existing simultaneously. The dual nature of the scenario presents the possibility that the entire country will no longer be connected to a single interconnected grid. Small, autonomous systems operating at the community level are created. However, in the alternative society, certain buildings in urban areas remain connected to the main electrical grid. This explains the small share of nuclear power in the S3/alternative scenario electricity mix. **F27**

Despite very different mixes, all the electricity carbon content falls within a fairly narrow range of values (between 85 and 112). The S1 and S3/conventional mix are identical. However, they generate different values because 25% of the electricity production facilities that use fossil fuels are assumed to be equipped with carbon sequestration technologies under scenario S1.

Private cars

Under scenarios S1, S2 and S3, the share of the heat engine fuelled by gasoline or diesel fuel falls, but remains close to 50%. Most of the rest is provided by electricity (except under S3/alternative, where independent, unconnected electricity grids do

not allow such use). The electricity mix is the one described in the preceding paragraph. The resulting emission factors are one-third of those of 2010. They vary slightly around the value of 75 gCO₂eq/km (the “A” label is currently assigned to every vehicle in France that emits less than 100 gCO₂eq/km). **F28**

For scenarios S4 and S5, the development of biogas and a high rate of electrification have reduced the share of gasoline and diesel fuel vehicles by a factor of four or five. This has reduced the emission factors even further (to approximately 40 gCO₂eq/km).

Modelling results

Changes in energy sources used have a striking effect. These changes reduced emissions by 22% to 40% for all households tested under all the scenarios. The average reduction is approximately 35% for households modelled here. Daily mobility is the item most affected by these technological changes. **F29**

GHG emissions per person cannot be reduced to levels compatible with the Factor 4 objective only by implementing efficiency or conservation measures but without changing the energy mix or modifying the energy sources used.

When energy conservation, reduced needs and changes in the mix and sources of energy used

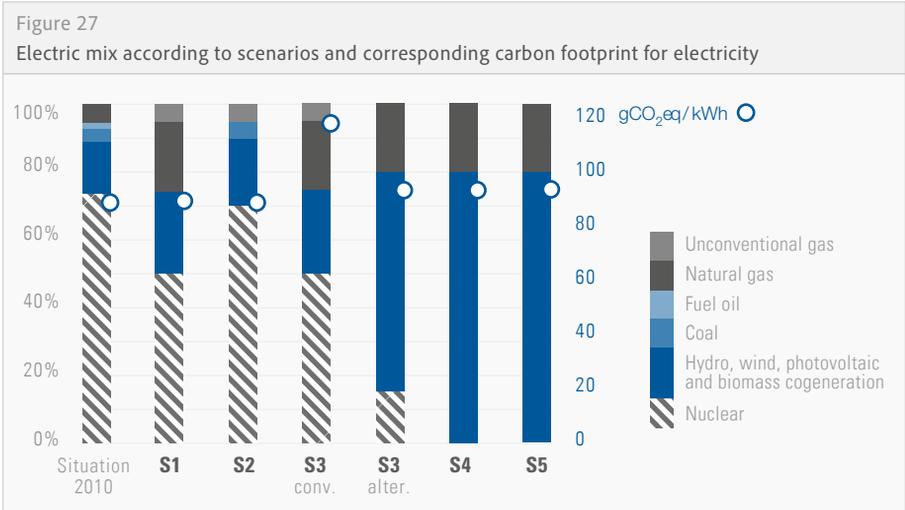
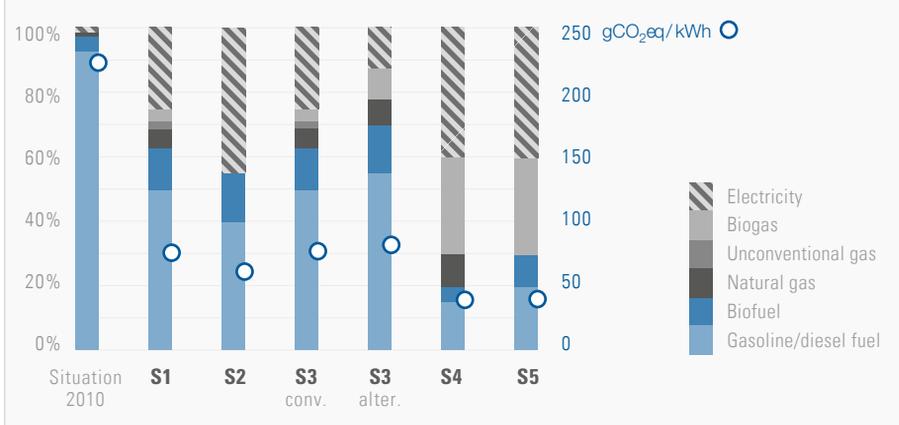


Figure 28

Structure of private automobile fleet based on energy sources used and related emissions



are combined, the modelling results achieve levels of GHG emission reductions compatible with Factor 4 for certain households in certain scenarios. As in the case of heating, the mixes chosen are based on certain assumptions, selected from among many others, and the relative share of renewable energy compared to fossil fuels may sometimes be considered fairly conservative. A sensitivity analysis could have been performed, but that is not the purpose of this research project, which sought primarily to address lifestyles.

These results reveal, first, that only a small number of households in the scenarios tested here reduced their emissions to a level close to 2 tonnes of CO₂ equivalent/year, consistent with a Factor 4 objective in 2050. Those household categories are:

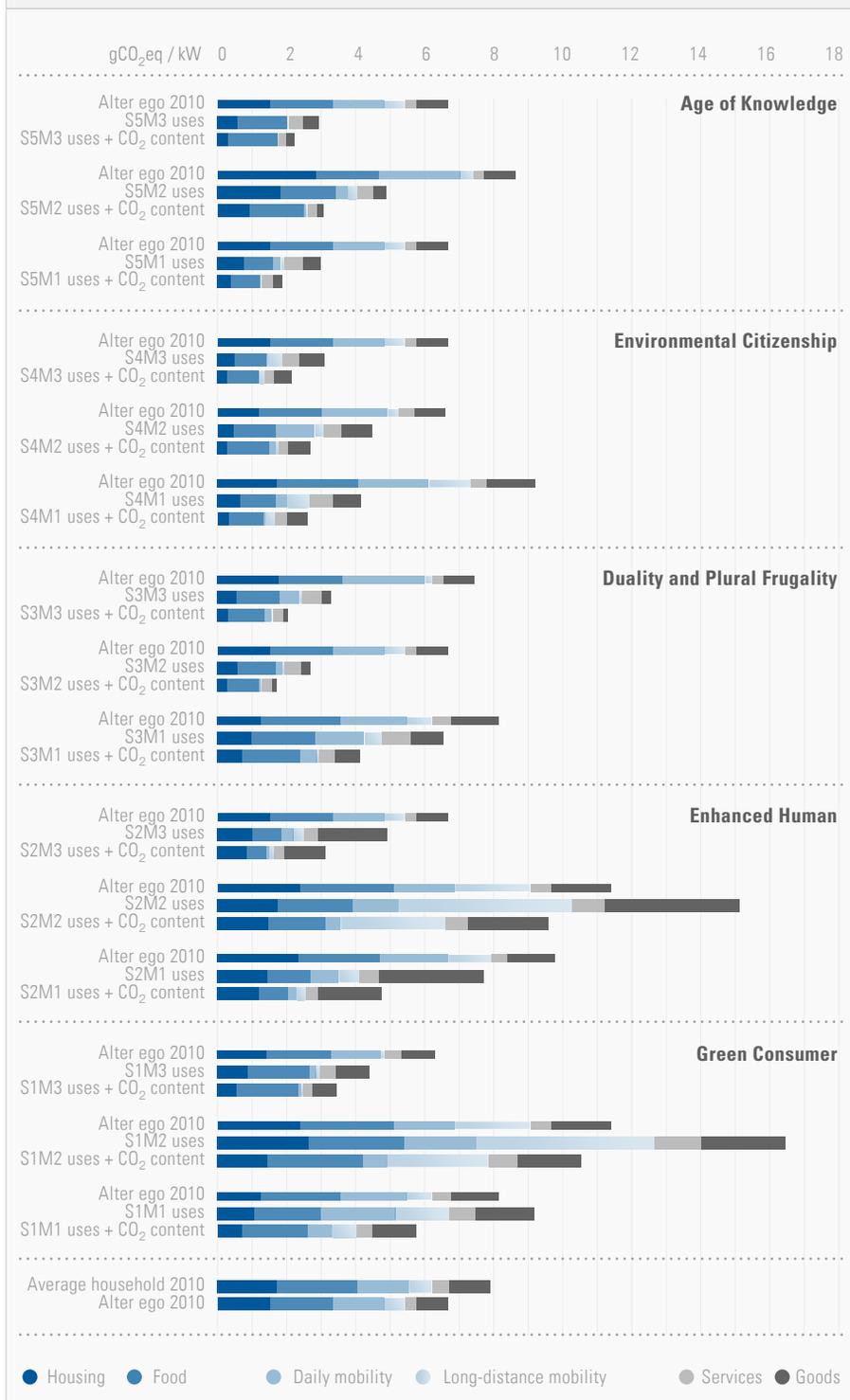
- S3M2: The Dual Society and Multiple Frugal Lifestyles/adults with children/urban/low income (alternative)
- S3M3: The Dual Society and Multiple Frugal Lifestyles/adults living together/rural/low income (alternative)
- S4M3: Environmental Citizenship Society/adults living together/urban/low income
- S5M1: Knowledge Age Society/adults living together/urban/low income
- S5M3: Knowledge Age Society/adults living together/urban/low income

The effects of technological changes and energy mixes have a particularly strong impact

on mobility, both daily and long-distance. Changes in energy carriers and technologies achieve sharp reductions in GHG emissions for these emission items. When kilometres travelled are also reduced significantly and non-motorized transport modes are also expanded considerably, remarkable rates of reduction can be achieved.

The five household categories noted above as having the smallest carbon footprints travelled 2,800 to 4,600 km/year on an daily basis, compared to 6,400 km/year for employed urban households, whose mobility was lowest in 2010. Households S4M3 and S5M3 are composed of urban young adults who do not use a car and whose emissions are thus very low. Households S3M2 and S5M1, composed of urban adults with or without children, use an individual vehicle for only 20% of their trips. Their daily mobility emissions are, respectively, 0.04 and 0.06 tonnes of CO₂ equivalent/year (compared to 1.25 tonnes of CO₂ equivalent/year for employed urban households, who travelled the least in 2010). Last, the S3M3 household, composed of adults living together in a rural area use an individual vehicle for 70% of distances travelled, but gasoline and diesel fuel represent only 55% of the fuel used by this household category. In this case, emissions total 0.2 tonnes of CO₂ equivalent/person.

Figure 29
Results in GHG emissions



In terms of housing, these five household categories occupy 16 - 33 m² per person; energy consumption for heating is 43 - 85 kWh/m². Their emissions for this item are 0.27 - 0.37 tonnes of CO₂ equivalent/person. Last, food-related emissions remain relatively high, representing approximately one-third of total household emissions and even nearly half for the S5M3 household. The meat share for this latter household fell

only 40% over its 2010 counterpart, compared to 50% to 100% (S4M3) for the other households. These emission levels show a potential reduction in GHG emissions that is probably smaller than for the other items but, above all, they reveal that detailed data on energy consumption and CO₂ emissions for this "farm-to-table" item is very limited. Consequently, it is difficult to propose ambitious assumptions.

Conclusion

The goal of this exercise was to highlight the lifestyle change levers that may reduce GHG emissions. To do that, we sought to dissociate the latter's effects from the technological effects and the effects of modifying the energy mix.

Based on this research, we conclude that lifestyles are indeed a relevant point of entry for characterizing household GHG emissions, even if it is very difficult to perform the modelling and quantification. The differentiations expected in the area of emissions based on the lifestyles adopted, and that were not erased by technological effects, thus show that energy-conserving lifestyles exist that may be compatible with a Factor 4 perspective and others that would not.

The emissions of three households in scenarios 1 and 2 are linked to their usage, which is increasing. Their carbon footprints are shrinking (7% to 30%, based on the case) only as a result of technological changes and improvements in the carbon content of the energy sources. For scenarios 3, 4 and 5, implementing only use-related energy conservation actions (including retrofitting of housing and modal shift in transport) can achieve emissions reductions of 48% to 84%, based on household, by using all the levers: conservation in use, changes in technologies and reduction in the carbon content of energy sources.

Lifestyles have a particular impact on emissions linked to housing and daily and

long-distance mobility, but also to food. The levers highlighted and that appear to be effective in climate change control efforts include:

- Reducing useful floor area per person, which leads us to conclude that the current trend towards larger spaces must be reversed. This will involve adapting housing to household size throughout life (by facilitating residential mobility) and encouraging new shared living arrangements. Retired households may be the first to be affected by such measures.
- Maintaining reasonable residential temperature setpoints, regardless of retrofitting performed, strengthening our belief that a building's users must re-learn how to use it.
- Resisting the expansion of additional electrical equipment in households.
- Sharing of uses, in general.
- Rebuilding local community ties.
- Reducing daily distances travelled by reducing trip distances.
- Using non-motorized transport and public transit on a daily basis.
- Drastic reduction in distances travelled for long-distance mobility.
- Reducing the quantities of meat consumed.
- Sharply reducing food waste.

These levers are compatible with the areas already researched in the energy/climate policies implemented by governments. However, this exercise highlights new issues that public authorities have not fully or properly

explored. Having completed this research, we believe it is essential to pursue the question of how a world where mobility is sharply reduced can be made attractive and to identify the conditions for changing cultural habits, such as diet and consumption practices.

We cannot ignore any of these levers if we want global warming to remain below 2 °C by the end of the century. Governments will have to include lifestyle changes in the solutions they promote.

Furthermore, the quality of the exercise we conducted depended, in large part, on the data we were able to obtain. This work would be strengthened by adapting the statistical tool to the new need for knowledge and the ability to describe French households' lifestyles, particularly in considering follow-up efforts.

The problems experienced fall into two groups:

- lack of statistical data needed to characterize populations based on their "lifestyles;" and,
- lack of detailed, centralized and consistent data on indirect GHG emissions from consumption of food and goods.

With regard to the characterization of populations based on lifestyles, the following information would have significantly improved this study:

- The INSEE "individuals" database, drawn from the population census, characterizes each person based on his/her SPC. However, information that would permit a refined characterization of these individuals' financial resources and of their households is not available. Incorporating data that characterizes individuals' income in the "individuals" database would be a definite improvement.
- The mobility surveys do not allow mobility patterns to be defined based on lifestyles. The samples surveyed become too small to be useful when the populations observed are characterized by two or three parameters, such as urban residence, age, income and family structure.

Enlarging the sample size would add real value for the kind of study we have just conducted.

- The statistical consumption data (food or goods) are available only by analysing the information characterizing household expenses by item. Converting this monetary data into consumption volumes (for example, kilos of food products or number of televisions) and, then, into indirect GHG emissions leaves the result dependent on many assumptions. In particular, the quality of consumption is not fully understood in this kind of exercise.

It would thus be useful to develop a statistical system that distinguishes household consumption based on the criteria that have an impact on indirect production of emissions. For food consumption, data for each population category on volumes consumed, distinguished by product type (including white meat, red meat, fish, vegetables fruits and dairy products) and by quality (including traditional fresh, organic fresh, canned traditional, canned organic and frozen), would provide new opportunities to differentiate the carbon impact of different lifestyles.

The characterization of indirect GHG emissions generated by the consumption of food and goods poses a common limitation: the available databases used in this study cannot be used to define the causes of the emissions or the relevant items. This limits opportunities to assess savings.

The different kinds of consumption (food or goods) are currently characterized by overall emissions. They include (without differentiation) emissions generated by production, transport, and distribution. Data that provide emissions differentiated by phase for a wide range of products would provide a better understanding of the kinds of actions that could be taken to reduce GHG emissions. Recommendations concerning, for example, the use of organic agriculture or local supply systems could thus be improved and strengthened.

Nonetheless, improving the statistical tool will not address all the difficulties. An in-depth methodological review is required to develop lifestyle forecast models.

In support of an open public debate over lifestyles

Afterword by Pierre Radanne

This prospective analysis of lifestyles sought to identify the conditions under which GHG emissions in France could be reduced by a factor of four.

A different kind of debate

As a national debate begins in France over the energy transition, it is particularly timely to consider how French energy consumption and GHG emissions will evolve over the long-term and to do so with an open mind.

Energy consumption and changes in consumption are too often presented very narrowly. They are:

- broken down based on statistical categories that are far removed from daily behaviour and life choices, thus preventing citizens from making a connection between their concrete choices and the very abstract notion of “energy;”
- presented in the form of household consumption averages, when such consumption is very dispersed and based primarily on income level;
- focused on potential energy efficiency achievements via technological advances in equipment but ignore changes associated with improvements in the way society is organized and in consumer behaviour (households, businesses and public authorities). We must, however, acknowledge that this is based on a concern for individual freedom

and privacy. Nonetheless, we cannot divide GHG emissions by a factor of four by 2050 unless every one of us considers all of the collective constraints we face. If we fail to do so, progress towards greater efficiency will be largely eroded by new consumption, made possible by the savings from energy efficiency (rebound effect);

This latter limitation remains operative because it is incorporated into forecasting exercises based on a linear projection of past changes and corrected only by introducing energy efficiency measures. However, our society could take multiple paths, which cannot be reduced to technical choices or different economic management models. We must thus open up the range of possible choices by recognizing different lifestyles, individual preferences and daily behaviours.

The difficulty in describing lifestyles

Increasing the average educational level, access to information and professional and geographic mobility all contribute to a diversification of lifestyles. Socio-professional categories thus group together life situations and behaviours that are increasingly heterogeneous.

In this research, the effort to better understand these lifestyles was based on three distinctions: income level (by grouping of SPC); family structure; and, geographic location.

Thanks to bibliographic (Part 1) and analytic (an assessment of current household GHG emissions) (Part 3) work, this research has contributed to a better understanding of concrete actions in relation to life situations.

The quantitative analysis revealed differences in GHG emissions that are determined primarily by income level. However, the classification of living standards based on SPC limits the dispersion observed and offsetting effects appear.

- The differences linked to housing are weak because of offsetting factors in many cases, including the size of housing, quality of insulation, performance of equipment and appliances, heating temperature setpoints and the number of residents, although behaviours are not homogenous within each social category.
- A similar complexity exists with regard to daily transport. Low-income and better-off families both rely significantly on the automobile as they often have a long commute to and from work. Personal situations are simultaneously diverse and often very constrained.
- Long-distance mobility is less ambiguous and clearly correlated with income level.
- Consequently, lifestyles show strong compensating processes among various types of priorities, including a preference for comfort inside the home, travel, housing comfort, and relational mobility.

In general, the results are extremely sensitive to personal choices made.

In-depth research is needed

Considerable work remains to be done to analyse household energy consumption and GHG emissions based on differences in social and economic situations. In addition, such analysis is complicated because it requires a broad analytic framework, given the globalization of economic exchanges. The tools available are inadequate because the categories developed for other purposes (based primarily on professional categories) do not correspond to lifestyle types (including housing and diet).

More in-depth research needs to be done, using surveys designed specifically for this purpose. Multi-year reports are also necessary. Without such a tool, behavioural changes cannot be followed over time.

In addition, a descriptive statistical approach must be based on further analysis of the psychosociological factors that affecting the learning of individual behaviours. Otherwise, the public debate lacks benchmarks and proposals for change will be met with considerable scepticism.

The five long-term scenarios studied

It was then tempting to compare this extreme complexity of the individual attitudes observed in 2008 in highly-contrasting long-term scenarios. However, this could be done only by maintaining an equivalent disaggregation with regard to social situations.

After lengthy discussions, the research team agreed on the choice of five scenarios, all based on positive values (without, however, constituting homogeneous societies). These five scenarios were built on consistent psychological bases.

- [The Green Consumer Society](#) posits the continuation of the current consumer society, with a corrective “greening” of the means of production and consumption.
- [The Enhanced Human Society](#) offers a different promise than our current consumer society - that of improved human performance and longer life expectancy. However, this promise is not available to all. The scenario described thus has a dual nature, because one part of the population lacks access to it.
- [The Dual Society and Multiple Frugal Lifestyles scenario](#) is based on the notion that part of the population has “dropped out” of the consumer society. While some people have adopted simpler lifestyles in the context of a shrinking economy and develop local production, others maintain current forms of production and consumption. This is thus a dual scenario that will have to develop over time.

- **The Environmental-Citizenship Society** reflects a sharper renunciation of the current consumer society. Its faint signals can already be observed, with the reaffirmation of broad social values that frame individual behaviour, optimize energy consumption and reduce GHG emissions.
- **The Knowledge Age Society** holds out the promise of a new development frontier, focused on deeper personal exchanges. Knowledge and cultural expression become the new areas of societal expansion, clearly relying on the possibilities created by the new communication technologies.

The forecasting exercises conducted for each vision highlight major differences in GHG emissions, which extend the differences in household situations identified for 2008.

Prohibitions, essentials and optimizations needed

Several kinds of lessons may be drawn from the simulations conducted:

Prohibitions

- Electricity production based overwhelmingly on fossil fuels.
- A transport sector that uses primarily petroleum-based fuels.

Essentials

- High-quality new building construction and retrofitting of the existing building stock.
- Widespread adoption of energy efficiency in all sectors.
- Expansion of shared goods and services.
- Improvements in social organisation, particularly with regard to urban planning.
- Promotion of renewable energy, the only energy resource produced nationally and, thus, employment-generating and protected from international fluctuations.
- Improvements in individual behaviour based on an improved understanding of the scope of actions.
- Gradual shift to electricity-based short-distance travel.
- Raw materials recycling.

Optimizations needed

- Preference for local production, particularly for foodstuffs.
- Reduction of meat consumption.
- Air travel only when no substitutes are available (long-distance travel).
- Prices that more accurately reflect costs.

Obstacles and areas of research

However, there are some obstacles that are difficult to overcome at this time:

- Ending dependency on petroleum for long-distance transport.
- Electricity storage, which is critical to implementing the shift to renewable energies.
- This work has revealed the difficulty of achieving a Factor 4 scenario in a context of globalized industrial trade. It assumes a reterritorialization - a rescaling of territorial organisation - of relationships against a backdrop of interdependent economies and the ability to organize major transformations without generating significant social imbalances.

The political issues that remain

The conclusions of this research are not limited to a description of technological choices and organisational methods. They raise other serious questions:

Collective strategy, protection of individual freedom, diversity of expression and personal incentives.

While the research has shown that significant energy-conserving lifestyles were required to achieve Factor 4 under certain scenarios (3, 4 and 5), obviously not applied uniformly, we must still address the issue of extending such practices throughout the entire society and beyond differences in personal income. Achieving widespread energy-conserving behaviour requires not only broad social change guidelines, but changing individual choices as well. Many initiatives are underway to influence behaviour via education, information and incentives that encourage small changes. However, there is no evidence that such

efforts will produce behaviour change that is significant enough to counterbalance the rebound effect and to achieve "optimal" behaviour on a daily basis.

Despite frequent criticism of the prevailing individualism, we must still carefully analyse the clear and growing differentiation in individual behaviours.

This raises the following question: will injunctions to standardize individual behaviour in the name of the collective interest restrict individual freedom?

More fundamentally, given that universal suffrage is the basis of government legitimacy in democratic societies, the majority must support such choices. Will strong pressure to change behaviour thus lead to voter rejection? Economic tools, such as tax policy, that are used to influence individual behaviour, may encounter the same problems; that is, lower-income households have much less flexibility than others, while energy represents a much larger share of their budget.

How can we influence behaviour?

This question cuts across all the scenarios. In all likelihood, weaker social cohesion and a weaker commitment among the population to its value system (including simple lifestyles, personal development, access to knowledge, and quality of relationships) are likely to produce more heterogeneous behaviours. This results in higher energy consumption that technical options alone cannot offset.

In addition, there is a considerable gap between stated opinions and actual actions. This attitude - the cognitive dissonance that exists between opinion and practice - is heightened when it involves an issue that produces unease and anguish, such as facing limits (access to resources or the need to reduce GHG emissions by a factor of four).

Under these conditions, repeated injunctions to improve behaviour could produce the opposite outcome - denial, refusal or evasion.

Seven steps: from awareness to action

The conditions that must be met to move from awareness to action.

First, once an individual understands the seriousness of climate change and energy issues, he or she must be able to confirm that they are being addressed. Many people base their opinions on the consensus achieved within the society. Are the media giving these issues the prominence they deserve? Are political, administrative and economic leaders incorporating this new, fundamental issue into their choices and decisions? This is not the case today, particularly with regard to the audio-visual media and advertising messages. Without that confirmation, the message conveyed is that the problem is not being addressed and, thus, is not urgent.

The second condition is that the issue must be understood rationally. We cannot act without understanding the processes at work and visualizing their impacts. The scope of the climate change issue must be examined in terms of its causes, extent and rapidity. Only education can establish a link between personal responsibility and future climate change. To fight climate change, we must both educate our children and work hard to educate the population on a continuing, permanent basis. Local municipalities will play a critical role here.

The third condition involves identifying one's own contribution to GHG emissions. Cutting the annual contribution of seven tonnes of CO₂ equivalent per person by a factor of four can make your head spin. We must recognize the sources of those emissions and understand their effects on our personal life. Otherwise, we will be able to imagine only the dramatic collapse of our own way of life, which will certainly increase anxiety. Conversely, recognizing that one of the main sources of household emissions is home heating and understanding that it can be addressed by better insulation, a more efficient heating system, use of renewable energies and greater attention to one's daily behaviour is unlikely to trigger a personal crisis. This phase - noting, observing and recording what needs to change in one's life - is critical.

The fourth condition is access to information about the many possible solutions, from the

technology to forms of social organisation to the level of individual behaviour, in all relevant spheres, including domestic life, food, transport of persons and merchandise and consumer goods.

If we carry out these four steps - see that the issue is being addressed seriously, develop an understanding of the problem, identify our responsibilities and anticipate the possible responses - then we will be able to construct a new sense of ourselves, our future, and our children's future. Climate change will then no longer constitute a challenge to our way of life or, worse, the expression of our personality. Yes, life will change. But given the technical changes that will allow us to adopt fundamentally different behaviours, we can also anticipate a satisfying personal life. However, if we are to achieve a broad-based shift to action, this image of our future life must be part of a common scenario. We must recognize that many of these changes will require a different form of collective organisation that involves distributing jobs based on where we live, high-quality housing construction and accessible public transport. Addressing climate change thus involves three additional steps that require politicians to act as stage director.

The fifth condition involves creating greater awareness of exemplary accomplishments by public authorities and businesses in all areas, including construction, transport, agriculture and energy production. Local municipalities clearly play a large part. A woman walking past a new building with her child must be able to explain that the building will save energy and have a minimal environmental impact - and that those are the kinds of buildings that will be built throughout the child's lifetime. That awareness will be reassuring.

Sixth, these exemplary achievements must be part of an actual scenario and individual action must be carried out within timelines set by law and applicable to all. It would be useful to develop a "Factor 4 timetable" leading up to 2050. We cannot expect every person to change his or her behaviour if those changes are not part of a collective process. Political entities must propose a timetable and lay out

a series of steps for each sector, based on its specific characteristics. The future would thus be transformed from a blurry, traumatic unknown to a path marked by small, tangible milestones. Government must implement this transformation and the pace must be tailored to each sector and technology. Designing a scenario for the future will also highlight the economic and employment benefits of taking action.

The final condition involves ensuring that businesses, public authorities and citizens are equally committed to these changes, based on their responsibilities and social conditions. The challenge cannot be solved unless we take a democratic approach based on solidarity. "I will, if you will, if we all will!"

Equally likely futures

We must explore visions of the future in order to rank the solutions and clarify potential leeway. If we do not create visions of the future, we cannot imagine ourselves there. However, presenting technical solutions is clearly not enough. We will not be able to achieve widespread optimization of our energy choices and behaviours in the face of climate change unless it is part of a vision that allows people to achieve success in their individual lives and is part of a democratic process. This research was intended to help us move forward on these new paths to achieving personal fulfilment and democratic progress.

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