

LIMITS TO TOURISM ? A BACKCASTING SCENARIO FOR A SUSTAINABLE TOURISM MOBILITY IN 2050

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*Et j'en dirais et j'en dirais
Tant fut cette vie aventure
Où l'homme a pris grandeur nature
Sa voix par-dessus les forêts
Les monts les mers et les secrets
Et j'en dirais et j'en dirais*

Louis Aragon

« On ne sait pas où on va, mais on y va tout droit »

Edouard Herriot

INTRODUCTION

Times have changed ! Significant numbers of middle class employees fly to the south Mediterranean for cheap holidays, the British settle their second homes in France or Spain; it would be easy to develop the list of current practices that were unthinkable just a couple of decades ago would be very long. And... what next ?

Facing this reality of a rapidly evolving tourism, social scientists try to describe the phenomena and to analyse their meaning: what do these travel patterns tell us about the society we are living in ? Have the meanings of tourism changed? Is the end of tourism in sight because people would become reluctant to travel to all alike destinations, because of various moral pressures condemning travel, or because unceasing departures would kill the idea of holidays as privileged times in the year?

A second type of question is where is this leading us to? Is the compulsion of mobility we see, sustainable? Could there be an end of tourism due to environmental constraints?

The argument of "limits to growth" stated by Meadows (Meadows 1972) at the beginning of the seventies was highly discussed (Sachs 1972). Anyway, one can agree that the explosion of mobility is one of the major features of the development patterns in the second half of the last century. The trend to increased mobility concerns miscellaneous aspects of our lives including tourism and leisure.

After an elitist period of tourism, which, more or less, ended with WWII, the 1950-2000 period corresponded to a progressive access to leisure and tourism for the majority of the population of industrialized countries. The rise of car ownership and the intensification of its use accompanied this development of tourism, so closely that private cars are called in France "véhicules de tourisme".

The period starting in the eighties is characterized by the democratization of air transport. People have no longer their country for horizon, they want to access the world, as often as

possible, with a "private jet" if they are wealthy. Advertising promotes hypermobility as a way of life : a new Renault car is sold as your "new address", French railways invites us to "live while traveling", Airbus promise we will gamble and find hotels in its new A380, and Virgin Galactic propose to send us all in space in a near future.



Source : <http://www.virgingalactic.com>

Environmental constraints seldom interfere with this fantasy of travelling. In the meantime however, two new issues have emerged: the decline in biodiversity and climate change on which this paper will focus insofar as it relates to tourism and leisure mobility.

Climate change is seen as a major threat for our civilizations (IPCC 2001). It has been shown that tourism, through the mobility it implies, significantly contributes to greenhouse gas emissions and that mitigation policies regarding climate change should have major impacts on tourism (Peeters 2003; Dubois 2005; Dubois 2005; Gössling 2005).

This paper deals with this last issue using the following starting point.

There is a certain scientific agreement on the fact that if we want, by 2100, to maintain the effects of climate change within manageable boundaries, the CO₂ content of the atmosphere should be limited to 450ppmv, which would correspond to a global increase in temperature of 2°C. Such a target implies that, by 2050 developed countries should diminish their emissions by 4, which would leave room for developing countries to increase theirs and develop. Such an objective has been validated by the French government and similar targets have been set by the British government and the European commission.

The aim of this paper is to examine what tourism and leisure would be possible for the French under this constraint, using a backcasting scenario: what are the steps necessary to reach the goal, or what efforts are required to reach the desired situation.

1. THE METHOD

1.1 MODELLING TO BUILD A BACKCASTING SCENARIO

This work is linked to research in progress for the Scientific directorate of the French Ministry of Transport: « Temps hors travail, loisirs , tourisme et mobilités : scénarios à 20-30 ans ». With the objective of confronting tourism/ leisure mobility to its spatial and environmental constraints, a multi-steps methodology was retained :

- a) the elaboration of individual mobility patterns, taking into account recent and emerging trends observed in the French demand (Ceron 2005);

- b) the shift from an approach focusing on individual travellers or households, to a more global approach of French demand for mobility and its associated impact. This means dealing with several questions : size of households, repartition of patterns in French demand, individual mobility within households etc.. The methodology is based on the elaboration of a computer model for French tourism leisure mobility and its calibration with the year 2000 situation;
- c) the analysis of the sensitivity of tourism / leisure mobility to various factors until 2050 (Dubois 2005). The model enables to test the sensitivity of tourism/ leisure GHG emissions to a number of parameters such as total population and number of households, size of households, vehicle load factors, mobility patterns, modal distribution, and GHG emission factors. The objectives of the research were to analyze the tourism/ leisure demand as a result of socio-economic forces, for example, economic growth and technological change. To this end, six categories of driving forces, with thirteen subcategories were defined: 1) demographics (population size, ageing, generational effects, evolution of family structure, 2) economy (growth, unemployment and inequalities, diminution of working time), 3) international security context, 4) transport technology and policy (technological change, transport infrastructure, transport pricing), 5) the tourism market, and 6) society and lifestyles (habitat, cultural change towards travel). For each sub-category, a central assumption was made, often related to bibliographic sources, and a range of minimum and maximum effects on GHG emissions defined.
- d) the elaboration of consistent scenarios for 2050 following this sensitivity analysis, with associated story lines;
- e) the discussion of the impact on lifestyles (the uses of time...), territories (infrastructure requirements, congestion...), resources (energy, materials, finance), the environment (noise, habitats, conventional pollutions etc.)..

Step d), from which the present paper is derived, includes four scenarios, using two different methods :

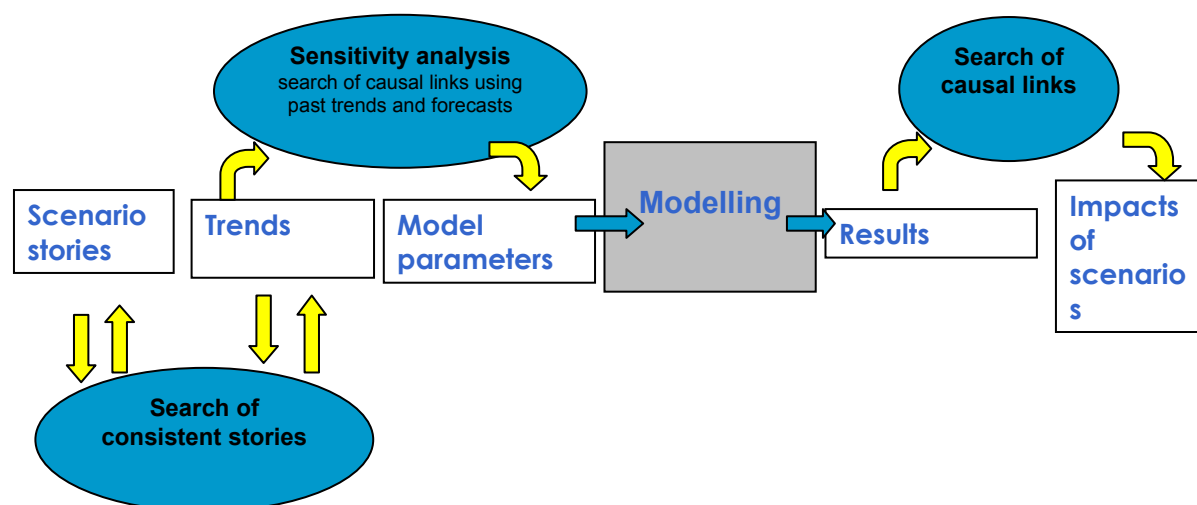
- three scenarios (central, high and low, with respect to the greenhouse gas emissions of tourism) lead to contrasted outcomes in 2050;
- a sustainable development scenario was elaborated using the *backcasting* method : to determine which steps are needed to reach, from the year 2000 situation, a sustainability target for 2050 which is defined as a combination of objectives : the mitigation of GHG emissions (a decrease by a factor 4), the improvement of departure rates, the limitation of diverse environmental impacts (congestion and noise...) etc.

The detailed characteristics of the model are available in previous publications, especially in the intermediary reports of the project (accessible on our site www.tec-conseil.com, publication section).

Type of trips	Patterns
Very long distance: they have for main motivations, visiting a country, discovering culture, exotism, benefiting from a tropical environment	Great traveler: 1 VLD, 2 LD, 4 outings...
Long distance: they correspond to the conventional vacation patterns of Europeans : a trip to a seaside or a ski resort, taken within the country or in a neighbouring one	Conventional: 2 or 3 LD, 3 outings...
Outings: daily trips and short distance trips which include an overnight stay	Home centred: 1 VLD every 3 years, 2 outings...
Bi-residential: between main home and secondary home, or, in an extreme case, between two main homes	Bi-residential: 1 VLD every 3 years, 2 outings, 22 trips to the second home
Short distance: within the city of residence or in the immediate neighbouring	Home bound: 1 outing

The main advantage of this approach combining modelling, sensitivity tests and scenario analysis, is to enable a combination of quantitative and qualitative perspectives in scenarios development.

Figure 1 : Methods



1.2 SETTING SUSTAINABILITY TARGETS

Sustainable development refers to a set of economic, environmental and social goals. The World business council for sustainable development sets, in its *Mobility 2030* report (WBCSD 2004), seven objectives to which our work can conveniently refer (Table 1). Matching with WBCSD objectives is all the more interesting as this organization cannot be suspected of eco-fascism.

Two of these seven objectives can be prioritized, for different reasons.

First, the goal of reducing GHG emissions :

- if the planet does not remain livable, the other goals make no sense. The point is not to negate or minimize the existence of other stakes which might prove more immediate limits to the development of activities. For instance, the local impacts on the people who live near airports (e.g. noise, local pollution) can be a far more obvious obstacle to creating or extending airports than the GHG emissions of air transport. The point is neither to set up some kind of dictatorship to tackle climate change (a dictatorship of scholars as Plato suggests or a dictatorship of fear as Hans Jonas does)(Larrère 1997). It is certainly not desirable to head straight to a collapse, nor to play with fire, ignoring the risks, but scientific knowledge and a reasonable conception of the precautionary principle should help, together with democratic discussion, to define a frame within which in a second stage democratic processes should decide which kinds of mobility should be preserved or limited, which modes of transport or which research directions should be privileged etc;
- setting the limitation of greenhouse gas emissions as the first of all goals also makes sense because complying with that objective should give an answer to a substantial part of other issues: for example curbing energy consumption, traffic congestion etc. Yet, the possibility of negative feed backs should not be overlooked: for example noise from railways can increase owing to the substitution of trains to cars and planes, emissions of some conventional pollutions can increase if technology focuses on reducing CO2 etc.

Second the access to holidays for those who are currently excluded should be prioritized. The surveys by Insee (National statistic service) and the Direction du tourisme periodically stress the fact that 40% of French residents do not take holidays away from home. Currently 10% of travelers are responsible for 30% of passengers.kms and 47% of GHG emissions from tourist transport. The social dimension cannot be overlooked in a sustainable development perspective and it is totally independent from the goal on GHG emissions. In fact, at a first glance it is contradictory with it. The only possibility to harmonize the two goals is a fairer distribution of tourism and leisure mobility.

The attention we pay to this second objective witnesses our will to build a sustainable development scenario which is desirable from a social point of view. Our previous work (sensitivity tests, central, low and high scenarios) lead to the disturbing conclusion that most tendencies which reflect economic and social progress (economic growth, a larger access to international travel, a peaceful international context favouring travel, a decrease in working time...) have, together with contemporary representations regarding travel (hypermobility as a token of success, the appeal of exotics, of long distance travel or of adventure, the new possibilities opened by technology), some rather catastrophic consequences in terms of

green house gas emissions. The very optimistic (socially and economically) "high" scenario, leads to a multiplication by 10 of French tourism GHG emissions.

Is it possible to harmonize strong environmental constraints with a just as strong desire for travel and discovery ? Can we be ambitious in dealing with climatic change and maintain welfare? If so, how radical must we be in inventing alternative patterns of mobility, given the prospects technology offers?

Table 1 : Seven objectives for a sustainable mobility

WBCSD Objectives	Sustainable development scenario objectives
Limit transport-related GHG emissions to sustainable levels	Include tourism transport in a factor 4 reduction strategy of GHG emissions in France
Narrow the « mobility opportunity divides"...	Increase the holiday departure rate
Preserve and enhance mobility opportunities for the general population of both developed and developing-world countries	The choice of a factor 4 reduction of GHG emissions leaves room for developing countries to increase their mobility
Ensure that the emissions of transport-related conventional pollutants do not constitute a significant public health concern anywhere in the world	The trend is to a reduction of conventional pollutants a) with the enforcement of European standards, b) with a reduction of tourism transport by road. An attention should , however , be paid to feed-back effects between GHG reduction and conventional pollutants
Reduce transport related noise	Stabilization or reduction of road transport in the scenario; concern about rail and air transport-related noise
Mitigate congestion	Stabilization or reduction of road transport ; concern about rail and air traffic congestion
Significantly reduce the total number of road vehicle-related deaths and serious injuries	a) Stabilization or reduction of road transport compensated by less hazardous collective transport b) Improvement of road security measures (speed limitations...)

Source :(WBCSD 2004)

1.3 THE CONSTRAINT OF MITIGATING GHG EMISSIONS : WHAT TREATMENT FOR TOURISM MOBILITY

As it has been explained in the introduction the scenario relies on the objective of a reduction by four of GHG emissions in France in 2050. What emissions from tourism does this allow?

The assessment of GHG emissions at the country level is guided by a UNFCC framework dedicated to setting the emissions goals within the Kyoto protocol. It must be pointed out that the emissions of international travel are not included in the assessment (whereas the emissions from domestic air transport are). This ought to be corrected but there is a debate on how it should be. A country such as France both sends its residents to foreign countries and receives flows of international tourists and the question is whether the emissions should be affected to the country of origin or to the destination. The international discussion on the subject seem to indicate we are heading for an equal share. In our work, we have decided

to focus on the responsibility of French tourists, because with this starting point it is easier to discuss the modifications in their behaviour they should adopt.

- To calculate French GHG emissions including French travelling abroad, we add to the UNFCCC evaluation the whole of the emissions of French tourists going abroad, which means adding 21 MT CO₂-e (calculated by our model) to the 502MT assessed within the UNFCCC framework in 2001.
- The total emissions of tourism transport in 2000 (calculated by our model again) amount to 39.1MT (i.e. 7.5% of the total emissions for France, and 23% of the emissions of the transport sector);

Nevertheless, to 2050, the dynamics of the economy and of the society will by itself change the emissions profile of each country. Moreover, it is economically reasonable to share the effort between activities taking into account the marginal costs of implementation which differ between them.

Prospects diverge, however, on the target to set for 2050 :

- On one hand, the current growth trend in transport and the fact that it is highly dependent on fossil carbon energy, suggest that it should benefit from a favourable treatment in the attribution of GHG emission rights. This might be done by setting less stringent goals, or by allowing the sector to buy emission permits. Tourism would in principle benefit from this context, the more as it depends on air transport whose emissions are the most difficult to curb. The “realistic” attitude which underpins current policies tend to support this hypothesis. The French plan for reducing GHG emissions (MIES 2004) sets the goal of avoiding 16MT CO₂-e from transport, compared to the business as usual trend in 2012; this does not prevent the emissions of transport from increasing.
- On the other hand, the factor 4 scenarios of the Ministry of environment for France (Radanne 2004) do not suggest the same prospects. In 4 of their five scenarios, transports account for 20% to 30% of the emissions (apart from the “hydrogen scenario” which allows them 43%) which is rather less than now. This is simply due to the fact that for the other activities there are also difficulties in curbing the emissions: some sectors have already done major efforts (industry) , others are highly resilient owing to the lifetime of their equipments (housing). If transports, and tourism within them, were to keep the same share of emissions as now this would lead strictly to allocate tourism transport 8.4MT CO₂-e, which is to be compared to its emissions in 2000: 39.1MT. No technological progress, no favourable treatment privileging tourism within transport can allow to reach this goal.

We build a sustainable development scenario which is intermediate to these two prospects, based on the following hypothesis:

- the share of transports in French emissions remains at the current level: 30% which leads to 40MTCO₂-e in 2050 (523MT/4 x 0.3)
- within, transports, mobility for tourism and leisure are privileged, owing to the values of liberty, and self achievement they carry and to the fact that it is more difficult to use carbon neutral energy for long and very long distance trips than for daily mobility. We thus admit their share in mobility could climb from 23% now to 30% in 2050.

This leads to a goal of 13MT CO₂-e in 2050 for tourism and leisure related transports.

1.4 ELABORATING A COHERENT SCENARIO STORYLINE

The scenario storyline was elaborated, as for the three previous scenarios, following a step by step methodology :

- making, for the 14 subcategories of trends analysed during the sensitivity tests, an assumption (e.g "The fuel prices will increase by 20% by 2050");
- checking the consistency of these assumptions (e.g. a low birth rate is not compatible with a diminution of household size);
- translating the assumptions into parameters for the model (e.g "the average distance of overseas flights could decrease of 10%, and number of trips by 5% if fuel prices increase by 50%");
- summing these parameters, testing them in the model, and changing assumptions or hypotheses on parameters, so as to reach the GHG emissions target in a manner that remains coherent and as reasonable as can be.

Compared to other methods of scenario development, this method allows to combine qualitative and quantitative thinking on prospects, and rather than making a few global assumptions involving all parameters of the model, allows to make some more limited assumptions (and thus easier to check and discuss and to benchmark using the literature). The final result is a sum of small errors (obviously unavoidable while forecasting), which are not guaranteed to constitute a more reliable result than one error made by an expert on a global and major assumption.

2.1 SCENARIO STORYLINE

A) DEMOGRAPHICS

Population growth. The total population (58.7 millions in 2000) could reach 64 millions in 2050, according to the central scenario of the National Statistic Institute (*Insee*)(Brutel 2001; Brutel 2003).

Ageing of population. In *Insee's* central scenario for 2050, the proportion of French people over 65 (16% in 2000) will reach 29.2%, and the share of people over 75 will increase from 7.2% to 18.1%. This will tend to diminish the rate of departure on holidays, especially for the over-75s, if one considers that departure rates, for each class of age, will remain the same. Ageing only has a minor effect on the average of travel distances, but it does increase the share of collective means of transport to the detriment of car use.

Generational effects. Past trends show that departure rates at the same age improved gradually with wealth, a better access to places (transport infrastructures), and travel experience: today's adults are the children of those who first experienced mass domestic travel and the next generation will have for parents those who first traveled frequently overseas. As this culture of travel settles into habits, traveling has become more frequent and for longer distances (including to non francophone foreign countries). The trend is to more travel to far or very far destinations for those over 65, with a much lesser increase for people over 75, owing to the handicaps linked to age. For the other types of travel (medium and short distances), there would be no increase linked to a generational effect since all generations are already used to travel over such distances.

The sustainable development scenario shifts away from prolonging these trends, with a change in the attitude towards travel. The hypotheses made here are that:

- traveling, particularly to environmentally and culturally exotic destinations is still as attractive;
- but a package of constraints (economic :cost of travel, environmental and also cultural: the end of hypermobility as a sign of social status) lead to less frequent but longer and more enriching travel. The average number of long and very long distance trips per individual thus tends to decrease; but current generations having reached the age of retirement still travel a lot, whereas departures would be less frequent for the new generation (those who will be less than fifty years old in 2050), owing to this changing attitude towards travel.

Evolution of family structure. Household size shows a continuous decline, from 3.2 persons in 1962, to 2.4 in 2000 (Cristofari 2001). The scenario considers this decline will slow down, which is coherent with a stable birth rate (see above : population growth). Owing to the aging of population and to the increase of single persons this leads to a moderate decline of the number of households;

B) ECONOMIC CONDITIONS

Economic growth. In this scenario, the growth rate would be around 1.5 to 2%. This would mechanically favour an increase in the departure rate which could rise to a mid term

between the current and the maximum departure rate that could be attainable (taking into account the ageing of the population). The sustainable development scenario does not follow this scheme, because a significant part of the economic surplus is devoted to investments in infrastructures, energy, industry etc. to reshape the economy along a more sustainable pattern. Thus the effects on departure rates are more limited than they could be and there is a small increase for home centered patterns (which allow for a little more mobility than the home bound pattern) and for great travelers and conventional patterns. The effects on the average number of trips are also less important than in the central scenario

Unemployment and inequalities. One of the aims of the sustainable development scenario is to improve the access to tourism and leisure activities, through an increase in departure rates. Since the income that can be devoted to traveling does not grow rapidly (see above), which would allow both more, very long distance travel for great travelers and an access of far more people to travel, complying with this goal implies a more equalitarian distribution of income, or at least voluntarist policies regarding the access to holidays. In this scenario, unemployment decreases significantly, owing to the ageing of population, and to full employment policies, which are a necessary component of sustainable development. Distributive policies permit an access to holidays (at least to the conventional pattern) for the majority of population. The divide between those who work and have sufficiently high income but little time to travel and those who have the time but not the income diminishes but does not disappear. The conventional pattern penetrates among the former home bound who even gain exceptionally, once in their life, access to very long distance trips

Reduction of working time. The scenario is built on the hypothesis that working time will continue to diminish but at a slower pace owing to the increase in the number of retired people which the economy has to support. This decrease, be it moderate could favour, as it has been recently seen with the law fixing the standard of 35 hours of work per week, to an investment of free time on the main home (more home centred patterns) but also more shots holidays and, outings and more bi-residential patterns.

C) INTERNATIONAL SECURITY CONTEXT

International tensions, as we know them currently, persist and the reactions of tourism to them remain identical. The increase of international travel continues and is accompanied by substitutions between destinations according to the geopolitical context and the crises as they occur, but this does not change significantly the total volume of international departures, nor the respective shares of domestic and European travel versus more distant destinations.

D) TRANSPORT TECHNOLOGY AND POLICY

Technology. The scenario relies on the hypothesis of a strong technological progress. Nevertheless we do not take into account the most optimistic forecasts on technologies that do not exist (hydrogen for aviation) or bet on a quasi immediate penetration of technologies that are not fully developed (fuel-cells, bio-fuels or electricity for cars). Owing to a high price level of energy and stringent environmental constraints (emission standards for vehicles), energy efficiency though, progresses rapidly and the effects of most of the above technologies start being felt before 2050. Simple measures such as lower speed limits on motorways are also used. GHG emissions per passenger.km fall down by 60% for air transport, 70% for cars, 50% for train and 35% for other collective means of transport.

Infrastructure. The scenario relies on a massive investment in train infrastructures, both for high speed trains and conventional ones that allow to reach disseminated destinations. It

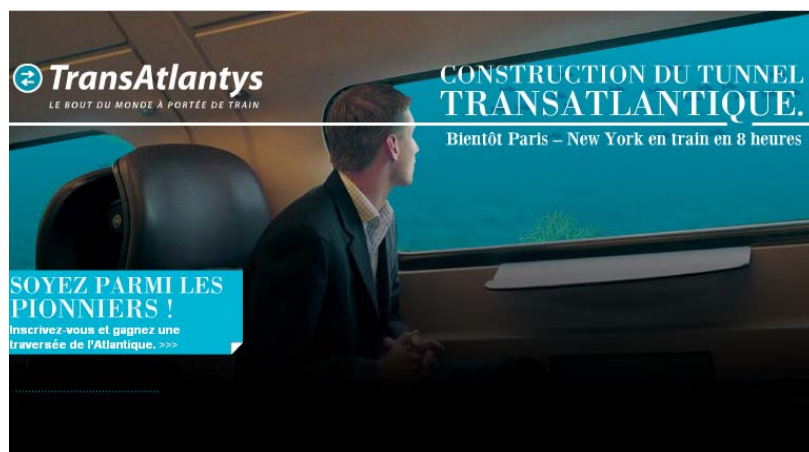
pays particular attention to soft mobility within destinations, so as to supply tourists with a complete transport chain throughout their holidays deterring them from taking their car. Urban planning tries to prevent the development of disseminated tourism , which are difficult to serve by collective means of transport.

The most important changes are:

- a fast spreading of the high speed train network: speed remains in spite of changes in values a major criterion for the choice of a means of transport, together with other criteria that are rather favourable to rail transport: reliability and safety in particular. The decisive novelty is the integration of the different high speed networks at the European level , which allow a substitute for car and planes for the holiday travels of the European. A trip from London to Barcelona or from Munich to Florence is usually made by train with comfort and service conditions (catering, rest...) which render travel time pleasant, a characteristic it has lost (Jean Viard qualifies the time spent in transport as a "social tunnel"). The most significant project of this kind is the London-Istanbul high speed connection which allow the growing numbers of tourists from central and eastern Europe to access the east Mediterranean and the Black sea. Europe has chosen to extend its transport network to the East using railways rather than motorways...
- a reinvestment in secondary lines which are complementary to high speed lines;
- a renewal of inter urban bus transports with high levels of comfort, better frequencies and round the clock timetables;
- a stop in the development of regional airports following the collapse of low cost companies related to a dramatic increase in air transport prices.

The high figures of modal transfer this scenario uses reflect both the effort on infrastructures and the changes in relative prices, one being linked to the other: a transfer towards train demands a change in economic conditions, an investment in infrastructures and an improvement in the quality of service.

Photo 1 : The Future of train.....



Source : SNCF (french railways) advertising campaign, www.transatlantys.com

Photo 2 : ... has some limits



Source : SNCF (french railways) advertising campaign, www.transatlantys.com

Pricing. The dramatic change is that prices rise enough to question the choices prevailing at the end of the 20th century. Leisure and tourism travel are far from being as much privileged in consumers choices and preserved in the trade-offs they make. But a minimal access to holidays is guaranteed for all those who wish through social policies.

The price increases are focused on air and road transport:

- at last a tax on air fuel is applied (between 100 and 200€ per seat and departure) which is the end of the low cost model, but does not impact very much very long distance travel for which it is difficult to substitute plane, and which is characterized by a low price/ demand elasticity;
- the new motor technologies for road transport, which benefit the environment, stay costly and increase the cost of individual mobility. The share of the fleet which still relies on conventional fuel is struck by a high price of fuel (owing to high world demand);
- the competitiveness of train and collective means of transport facing the car improves, which is a total change compared to the past decades but, overall, reflects more an internalization of environmental costs than a decrease in the operating costs of collective transport.

The impacts of this new situation (high prices and renewal in supply) are diverse:

- on the share of patterns, with a clear fall of great travelers and bi-residential patterns which are the most transport intensive. Conversely, the home centred pattern develops and there is a slight tendency for low income households to adopt the home bound pattern, but this is mitigated by the social policies already mentioned;
- on the number of trips: very long distance trips fall down by one third and long distance trips by one fifth;
- on the average distance of trips: the average distance of trips diminishes, naturally more for very long distances, even though the shortening is not proportional to the distance, which reflects the high income level of great travelers, the type of tax applied to air transports (not proportional to distance) and also a trade off between

environmental and economic goals, aiming for example not to ruin the economies of small island states that live essentially on tourism;

- on the modal shares, with for very long distances a high share of train for intra European travel and for other categories of distances a transfer from car to train and bus.

E) THE TOURISM MARKET

In such a scenario consumers are driven responsible for their choices, the more as traveling is expensive. They share cars more frequently than they currently do: behaviours of the fifties and sixties when cars were rarer and more expensive reappear, but their impact is limited. Consumers are more frequently led to call on tour operators to rationalize their trips (which reinforces the use of collective means of transport). So the environmental concerns that underpin this scenario do not lead in the field of tourism to more self-organisation, contrary to what has been the case at the end of the twentieth century. In terms of organization the demands of this scenario are high and one can expect there will be a competition in that field between tour operators and some organizations of civil society.

As they face changes in the economic context of their activity, the major tourism operators start dealing with the markets of leisure activities near the home. They develop products which are less transport intensive (slow travel by train, sailing cruise ships, several months stays in exotic destinations, specific products for the elderly...). In fact they contribute to accelerate the transition towards a more environmentally friendly tourism. Products that are currently unthinkable find a place in this new context, such as long stays associating temporary work and tourism in distant destinations, pluri-annual stays for the retired in warm countries in individual or collective housing with the insurance of a return to the home country in case of health problems etc.

In terms of modal share this means more train and overall more bus transport for disseminated destinations.

F) SOCIETY AND LIFESTYLES

Habitat. Diminishing by a factor four GHG emissions surely implies dramatic changes in the energy consumption of housing. Revisiting completely the insulation and the heating equipment of existing dwellings, building new homes consuming very small quantities of energy will demand an important financial effort for low and middle class households, and there will be a time lag before the financial benefits of these investments appear. The costs increase in building and maintaining homes will set up a barrier to the increase of housing space per individual and to its contribution to the improvement of the comfort of housing. The available space per individual might even decrease in dense cities, unifamilial suburban houses might be found too costly to build and to run and be less appreciated, and prices in city centers might soar up.

The trends above at the same time maintain the desire to travel and escape and refrain it (increase of the share of income devoted to housing). To escape from this sub optimal situation, public policies try to improve the access to leisure facilities near the home as well as to upgrade the local environment: even if the flats are not larger, they are more pleasant to live in (less noise, less air pollution, and above all better urban services, sporting and cultural facilities, more nature within the cities). On the whole, outings (using collective means of transport) and short distance leisure mobility (+10% each) tend to compensate less frequent departures and the "home centred" pattern tends to develop for those who have the financial means to access very long distance travel.

Cultural change, values and cultural attitudes to travel. The period from 2000 to 2050 is characterized by a dramatic cultural change regarding travel, which is both a consequence of the new context of transport policies (hyper-mobility is no longer possible except for a tiny minority) and appears as a development of some marginal behaviours currently observed (slow travel, hiking, cyclo-tourism, river tourism...)

This factor is decisive to ensure that the sustainable development scenario works. People no longer dream of possessing a private jet but to have time and to be able to devote it for example to long enriching trips (spending six months or a year living in Asia, even if working part of this time, which is another way, and perhaps the best to discover a country). Ecotourism is now an usual way of traveling but it has deeply changed and left aside the moralizing claims it had at its beginning. One no longer travels to Madagascar or Costa Rica for one week with the pride of behaving decently towards the environment at the location just after having emitted huge amounts of GHG during the travel. People still travel for purely hedonistic motives but once every 5 or ten years. Retired people, for example settle for long periods in Foreign countries and return to their home country to benefit from health care adapted to very old age.

The desire to travel persists but it is admitted that trips must be exceptional events, and the time spent in transport regains a sense. Great travelers (whose number fall down) only take a very long distant trip every four years (which is allowed by their high income) Households with conventional patterns only go on holiday once a year and only travel exceptionally on very long distances. Stays are longer and the travel between home and destination is often slower (more train, bus and boat), considered as pleasant and interesting. For a very long distance trip one can often chose (in terms of quality/price/time) between a slow travel with a life on board of trains or boats, or a high speed sleeper train if the destination can be reached by ground.

The home centred patter is boosted while the conventional pattern declines. Voluntary home bound people increase in number. The decrease in long and very long distance trips is partly compensated by an increase in outings and in short distance mobility (+10% each);

There is also an increasing consciousness of the environmental impacts of travel

2.2 SYNTHESIS OF HYPOTHESIS

Finally, a few characteristics dominate this scenario :

- the strong investment in environmentally friendly ground transport mode, especially the train;
- the rupture in the attitude and behaviours towards very long distance mobility and air transport, which becomes an exception, but whose content and value in term of well-being is increased;
- the substitution / compensation of this loss in very long distance mobility with short distance mobility and more attention granted to local environments.

Following this description of assumptions made on subcategories, the hypotheses made on the parameters of the model are summarized in Table 2.

Table 2 : Hypothesis on parameters

		Nombre moyen de voyages					Répartition des différents schémas dans la demande				
		TLD	LD	Bi-rés	Sorties	Loisirs proximité	Grand voyageur	conventionnel	Centré Maison	Bi-rés	Non partant
1	Démographie	10% pour conventionnel, -10% pour gr. Voyageurs et centré maison	-10	0	0	0	0	-5%	0	0,00%	4,00%
1.1	Croissance démographique	0	0	0	0	0	0	0	0	0	0
1.2	Veillissement	0	0	0	0	0	0	-7%	0	0	7%
1.3	Effets générationnels	10% pour conventionnel, -10% pour gr. Voyageurs et centré maison	-10	0	0	0	1%	2%	0	0%	-3%
1.4	Structure famille	0	0	0	0	0	0	0	0	0	0
2	Conditions économiques	30% Gd voyageur +20% autres (inégalités sociales), 10% conventionnel	0	0	40%	0	2%	5%	2%	1%	-10%
2.1	Croissance économique	30% Gd voyageur +20% autres (inégalités sociales), 10% conventionnel	0	0	20%	0	2%	2%	1%	0%	-5%
2.2	Chômage inégalités	0	0	0	0	0%	4%	0	0	-4%	
2.3	Temps travail	0	0	0	20%	0	-1%	1%	1%	-1%	
3	Sécurité internationale	0	0	0	0	0	0	0	0	0	
4	Transports	-20%	-10%	0	0	0	-1%	1%	0	-1%	1%
4.1	Technologie	0	0	0	0	0	0	0	0	0	0
4.2	Infrastructures	0	0	0	0	0	0	0	0	0	0
4.3	Tarification	-20%	-10%	0	0	0	-1%	1%	0	-1%	1%
5	Marché du tourisme	-5%	-5%	0	10%	0	1%	-1%	0	0%	0
6	Société et styles de vie	-20%	-20%	0	20%	0	-3%	-7%	8%	0%	2%
6.1	Logement	0	-10%	0	10%	0	0	-3%	2%	0%	1%
6.2	Changement culturel[8]	-20%	-10%	0	10%	0	-3%	-4%	6%	0	1%

		Distance moyenne					Substitutions modales					Population	Taille moyenne des ménages
		TLD	LD	Bi-rés	Sorties	Loisirs proximité	TLD	LD	Bi-rés	Sorties	Loisirs proximité		
1	Démographie	10	0	0	10	10	0	Route par train 12%	Route par train 8%	Route par train 10%	Route par train 10%	64 millions	2,1, qui se répartit suivant les différents patterns
1.1	Croissance démographique	0	0	0	0	0	0	0	0	0	0	64 millions	0
1.2	Vieillessement	0	0	0	0	0	0	Route par train 12%	Route par train 8%	Route par train 10%	Route par train 10%	0	0
1.3	Effets générationnels	10	0	0	10	10	0	0	0	0	0	0	0
1.4	Structure famille	0	0	0	0	0	0	0	0	0	0	0	2,1, qui se répartit suivant les différents patterns
2	Conditions économiques	0	0	0	0	50% gr voyageurs, 40% autres	0	0	0	0	0	0	0
2.1	Croissance économique	0	0	0	0	30% gd voyageur, +20% autres	0	0	0	0	0	0	0
2.2	Chômage inégalités	0	0	0	0	0	0	0	0	0	0	0	0
2.3	Temps travail	0	0	0	0	20%	0	0	0	0	0	0	0
3	Sécurité internationale	0	0	0	0	0	0	0	0	0	0	0	0
4	Transports	-30%	-10%	-10%	-10%	-10%	air par train : 30%	air par train : 75%; route par train: 40%	route par train : 40%	route par train : 25%; route par bus et autres : 10%	route par train bus et autres : 35%	0	0
4.1	Technologie	0	0	0	0	0	0	0	0	0	0	0	0
4.2	Infrastructures	0	0	0	0	0	air par train 15%	air par train : 35%; route par train : 20%	route par train 20%	route par train 10%; route par bus et autres 5%	route par train, bus et autres : 15%	0	0
4.3	Tarifcation	-30%	-10%	-10%	-10%	-10%	air par train 15%	air par train : 40%; route par train : 20%	route par train 20%	route par train 15%; route par bus et autres 5%	route par train, bus et autres : 20%	0	0
5	Marché du tourisme	0%	0%	0%	0%	0%	0	0	0	0	0	0	0
6	Société et styles de vie	0	0	0	0	20%	0	0	0	0	0	0	0
6.1	Logement	0	0	0	0	10%	0	0	0	0	0	0	0
6.2	Changement culturel[8]	0	0	0	0	10%	0	0	0	0	0	0	0
	Total	-20%	-10%	-10%	0%	80% gr voyageurs, 70% autres	air par train 30%	air par train 75%; route par train 52%	route par train et autres 48%	Route par train 35%; route par bus et autres 10%	route par train bus et autres : 45%	64 millions	2,1, qui se répartit suivant les différents patterns

2.3 DISCUSSION

A) EVOLUTION OF HOUSEHOLD TOURISM/ LEISURE MOBILITY

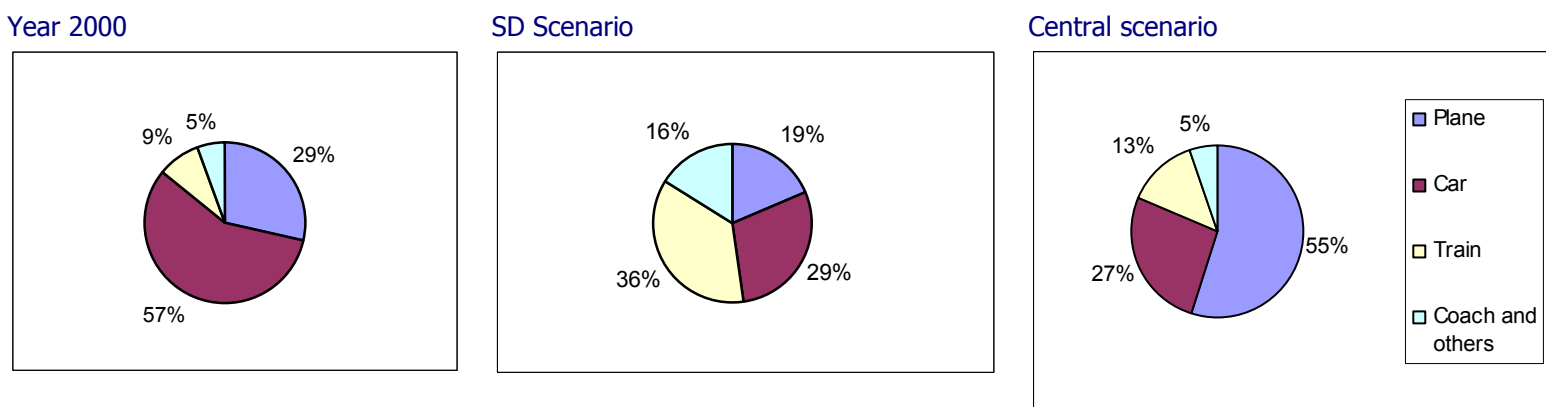
The SD scenario leads to 291 billions of passenger.km traveled for tourism and leisure purposes in 2050, which is 34% more than in 2000, but is to compare with the central scenario for 2050, which would have lead to 742 billions passenger.km.

The trips allowed per person amount to 4553 km (+12% than 2000 situation). The breakdown of this mobility between the different types of trips evolves :

- very long distance mobility (air transport overseas) remains almost at the same level as in 2000 (0,1 trips per individuals and per year), but its repartition is fairer (less frequent trips for more people). The average distance per trip decreases by 20% (8000 km), due to an increase in travel prices;
- long distance mobility decreases, with 0,67 trips per year and per person (1,2 in 2000), which translates a decline in the attractivity of some mass destinations (Languedoc Atlantic shore) felt as less exotic than overseas trips. The average distance per trip though decreases by 10%;
- this loss in long distance mobility is compensated by an increase in outings (3,7 per person against 1,99 in 2000);
- bi-residential mobility remains more or less the same, with 0,38 trips against 0,32 in 2000. The average distance per trip falls by 10%;
- short distance leisure mobility (near the home) is another way to compensate the lower access to long distance mobility : it doubles in 2050, with 36 km per person and per week, against 18 km in 2000.

The main factor making the sustainability of this scenario possible is the evolution of modal split (Figure 2). Compared to year 2000 situation, where train and coach were only reaching 14% of market share, these two modes of transport amount to 51% in 2050. The share of plane, by far the most polluting mode of transport with regards to GHG, is limited to 19%.

Figure 2 :Modal split of passenger.km – All tourism and leisure trips



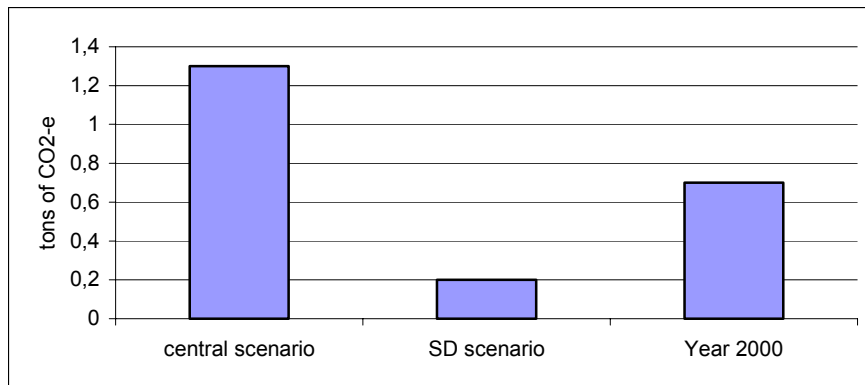
B) IS THE SCENARIO REALLY SUSTAINABLE ?

We now come back to the seven objectives for sustainable mobility, and check the compliance of the scenario.

Climate change

The GHG emissions related to tourism and leisure reach in the SD scenario 13 MT CO₂-e (-66% compared to the year 2000 situation), which fulfils the objectives. The central scenario would have led to 80 MT (+106%). Emissions per person decrease by 71%, to 0,2 T CO₂-e.

Figure 3 Emissions of CO₂-e per person



Access to leisure and travel

The departure rate reaches 71% (against 68% in 2000), which is not the maximum that could be attained, but is a serious social progress, if one considers the ageing of population: those who can travel do, and most of financial and professional constraints to mobility are offset.

Beyond a possibility of mobility maintained at the level of 2000 but more equally distributed, this scenario tries, to improve the access to leisure and travel, to restore the experience of travel, i.e to improve the content of well-being of a typical tourism trip. The environmental constraints however imply some limits to mobility, compared, for instance, with the central scenario. This can not be only obtained by positive measures, such as infrastructure investment, but also implies some constraints, taxes (transport pricing....).

Noise and congestion

The evolution of passenger.km by mode (Figure 4) yields elements to analyse the impacts of the scenario on noise and congestion.

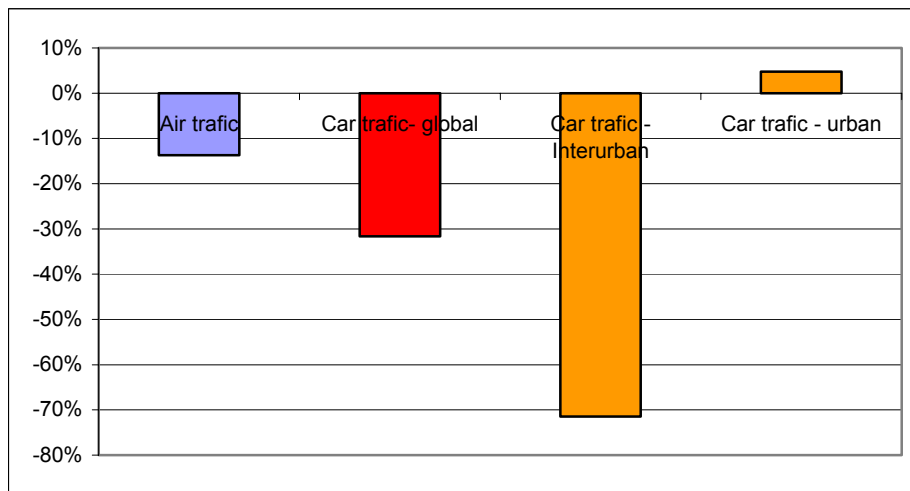
As the scenario relies on a diminution of the modal shares of plane and car, its effect on air and road (interurban) congestion and noise are very positive.

The same can not be said for the development of train traffic, which increases by 250% on interurban connection, and by 987% on regional and local connections in the SD scenario. This pose several problems :

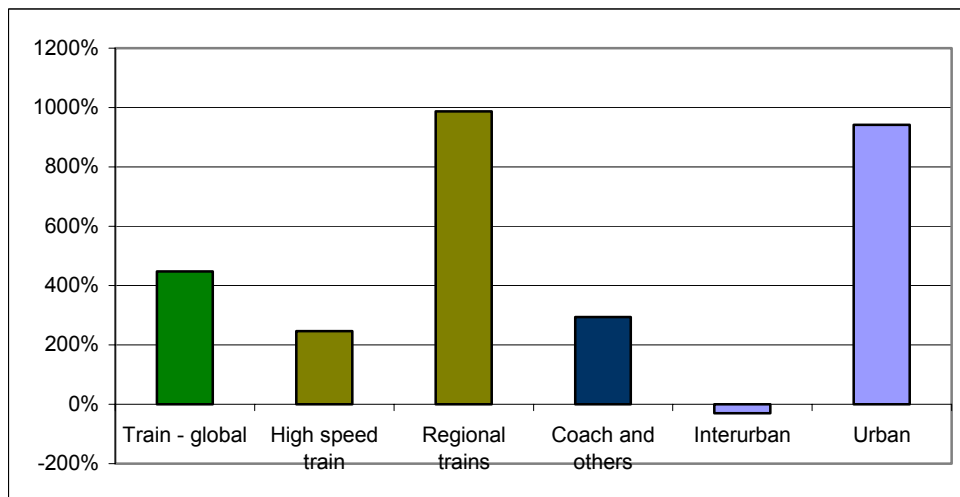
- noise;
- space consumption in urban area, with the need to find available space for new railways and tramways, in a context in which the urban car traffic does not diminish (+5% between 2000 and 2050).

Figure 4 : Evolution 2000-2050 of passenger.km by transport mode and type of traffic – SD Scenario

Plane and car



Train and coach



Conventional pollutants

The scenario clearly favours means of transport relying on electricity : train and tramways. This would likely lead to a development of nuclear energy, which does not emit GHG nor conventional air pollutants (but poses other problems...). The diminution of road traffic (-32%), together with the improvement of energy efficiency of engines goes in the same sense.

Security of transport

The diminution of road transport, and specific measures such as lower speed limits on highways favour the security of driving, so do the limitation of air traffic and the focus on train.

Other issues could be dealt with, such as the fragmentation of natural habitats following rail infrastructure development, the pressure on periurban natural spaces following the development of short distance leisure mobility.

CONCLUSION

Building scenarios is a way to do with the impossibility to predict. The environmental issues that have arisen since the seventies have pointed out the complexity of the world and the uncertainties under which decisions have to be taken and strategies built. This has, if not given birth, at least fostered new methods of thinking, marginal and disregarded by the scientific community at the beginning, but which thirty years after are the core of the work of one of the most organized scientific communities worldwide: the IPCC.

Basically, scenarios deal with uncertainty and are built on data that reflect it. They are of course supposed to use the best data at hand; nevertheless this kind of work is often confronted with rather poor quality or unreliable data, with which one must do if the scenario is to be built. The best that can be done is to be clear about the origin of assumptions: literature, "guesstimates"... So there can be a discussion on the assumptions we make, and the model can be fed with other assumptions; in other words the scenario we present is not the only sustainable development scenario that can be imagined.

Trying to be rigorous does not in itself determine the scenario you will build; other factors such as the cultural or philosophical background of the author(s) play a role. In the case of this scenario, the outlook on technological progress and its potential is crucial.

If one adds the most optimistic forecasts for each new technology, it is possible to build for 2050 a future in which planes are powered by hydrogen from carbon neutral resources, cars by fuel cells etc. and give that way major answers to sustainability issues. This type of thinking is not totally illegitimate; it has proven right at least in one case in the past decades: the current state of technology and of its use in the fields of computers and telecommunications is far beyond what could have been reasonably expected at the end of the seventies.

Nevertheless what we have seen for transport technologies in the last decades (e.g. the difficulties in the implementation of electric cars) does not suggest we should rely only on major technological breakthroughs. It could well prove unrealistic: for example a typical backcasting scenario relying basically on technology and built a few years ago forecasts for 2005 urban electric and hybrid vehicles at 10% of the market each; we are far from it. (ENERDATA 1999 p.38)

This is why we think building a scenario must deal with the demand for tourism and leisure-related transport, the more as its volume is significant and growing fast. In this respect, we are conscious that most of the features of the scenario we build contradict current trends (longer distances, shorter stays, more frequent departures, the increasing use of air transport etc.) which in fact are not sustainable and will have to be coped with some day.

The scenario shows that under sustainability constraints, there is still a future for tourism, which is not an obvious conclusion at the first glance when one starts by looking at the contribution of tourism to GHG emissions and the trends of demand. With this scenario more people take holidays than now but for longer stays and less often. A more significant part of the population can go to exotic destinations, but it is now an exceptional experience in one's lifetime: there are still possibilities to discover other regions of the world but through longer

stays and slower travel. In short the hyper mobile minority must refrain from traveling as much as it desires (but they still manage to travel), the majority of the population has to change some of their habits, but to a large extent gains in local leisure can compensate less long and very long distance tourism, and the lower income people are rather better off as regards tourism.

In our sense this is far from being the end of tourism.

REFERENCES

Brutel, C. (2001). "Projections de population à 2050. Un vieillissement inéluctable." Insee première(762).

Brutel, C. a. O., L (2003). "Projections démographiques pour la France, ses régions et ses départements." Insee Résultats- Société.(16): 40.

Ceron, J. P. D., G. (2005). "More mobility means more impact on climate change : prospects for household leisure mobility in France." Belgeo **1-2**: 103-120.

Cristofari, M. F. a. L., G (2001). "Recensement de la population 1999. Des ménages de plus en plus petits." Insee première **789**.

Dubois, G., Ceron, JP (2005). "Exploring Tourism/ Leisure GHG Emissions in 2050 : the Case of France." Journal of sustainable tourism **in press**(Special issue).

Dubois, G. C., JP. (2005). Greenhouse gas emissions from tourism under the light of equity issues. Tourism , recreation and climate change. C. M. Hall. Clevedon, Channel View Publications.

ENERDATA (1999). Transport, énergie et contraintes environnementales en France à l'horizon 2030: apports de l'approche "backcasting" à la formulation des stratégies technologiques et organisationnelles. Grenoble: 60p.

Gössling, S., Peeters, P., Ceron, J.-P., Dubois, G., Patterson, T., and Richardson, R. (2005). "The Eco-efficiency of Tourism." Ecological economics **online-publication available at www.elsevier.com**.

IPCC (2001). Climate change 2001. Synthesis report. Cambridge, Cambridge University Press.

Larrère, C. L., R (1997). Du bon usage de la nature. Pour une philosophie de l'environnement. Paris, Aubier.

Meadows, D. L. (1972). The limits to growth. New York, Universe Books.

MIES (2004). Plan Climat 2004. Paris, Ministère de l'écologie et du développement durable: 88.

Peeters, P. (2003). The Tourist, the Trip and the Earth. Creating a Fascinating World. N. M. a. C. Departments. Breda, NHTV: 1-8.

Radanne, P. (2004). La division par 4 des émissions de carbone en France d'ici 2050. Paris, Mission interministérielle de l'effet de serre: 35p.

Sachs, I. (1972). Development and environment. Report and working papers of a panel of experts. Paris, La Hague, Mouton.

WBCSD (2004). Mobility 2030: Meeting the challenge to sustainability. Conches, Genève, World Business Council for Sustainable Development: 175.