A SOCIOECONOMIC ANALYSIS TO EXPLAIN GREENHOUSE GAS EMISSIONS DUE TO INDIVIDUAL MOBILITIES

A JOINT ANALYSIS OF LOCAL AND LONG DISTANCE MOBILITIES OF CO2 HIGH EMITTERS IN FRANCE

Jean-Pierre NICOLAS, Laboratoire d'Economie des Transports, ENTPE, Université de Lyon, rue M. Audin, 69518 Vaulx-en-Velin, France,
email : jean-pierre.nicolas@entpe.fr

Damien VERRY, Centre d'Etudes sur les Réseaux, les Transports, l'Urbanisme et les constructions publiques, 2 rue Antoine Charial, 69426 Lyon cedex 03, France ;
email : damien.verry@developpement-durable.gouv.fr

ABSTRACT

This communication specifies the socioeconomic factors which affect the contribution of the CO_2 emissions of individual mobility. To do so, it uses the last 2008 French National Trransport Survey, and the focus has been laid on the 20 % highest emitters, who represent 60 % of the whole population emissions. A logit modelling has been used to highlight and to analyse the main variables explaining the membership of this category of population. Besides, the local trips are more linked to daily life, when long distance trips are more exceptional and do not require the same modes nor lay on the same motivations. These two types of mobility have then been separated, leading to the analysis of three subgroups of high CO2 emitters, with high emissions due to their local mobility, their long distance mobility and both of them.
It shows that among the top quintile of emitters, frequent travelers, with a high level of long distance mobility, are discriminated by their high level of education and income. The "great commuters", with a strong local mobility, are characterized by their high level of employment, residence location and car availability. Last the "hypermobiles" can be seen as a combination of great commuters and frequent travelers.

Keywords : CO_2 emissions socioeconomic analysis, French National Trip Survey, individual mobilities, local mobility, long distance mobility.

INTRODUCTION

The Kyoto protocol or the "factor 4" commitment at the European level are example of actions testifying of an increasing will on behalf of States to limit carbon dioxide emissions (CO_2) and impacts of the human activity on the greenhouse effect. Transport is one of the most important sources of CO_2 emissions. For example in 2004, this sector was responsible for approximately 23 % of the human greenhouse gas emissions at the world level (GIEC, 2007). In France, because of a strong proportion of nuclear energy supply, the part of transport amounted that same year to 26 % (distributed in 2/3 from individual mobilities and 1/3 from good traffics, Citepa, 2010). And, more worryingly still, the trend is always for the growth as well as in France than at the global level, although slowdowns are observed in western countries since the beginning of 2000s with the sharp increase of oil and fuel prices (Citepa, 2010; Besson, 2008).
To be able to regulate this sector in a efficient way while avoiding creating new social disparities on the pretext of environmental stakes, it is important to analyze precisely the social and economic logics and trends underlying beyond the traffics and their emissions: who emits what, and why? To answer this question, this article concentrates on the individual mobilities and wonders more particularly about the socioeconomic factors characterizing the most emissive people. It uses the 2008 French National Transport Survey (Armoogum and al., 2010), which gives a precise image of the mobility of the residents of the French territory. It allows then to estimate CO_2 emissions for every collected trips (Longuar and al., 2012)
More specifically, we tried to specify the socioeconomic factors which affect the contribution of the CO_2 emissions of individual mobility. To do so, the focus has been laid on the 20 % highest emitters, who represent 60 % of the whole population emissions according to estimations from the National Transport Survey. A logit modelling has been used to highlight and to analyse the main variables explaining the membership of this category of population. Besides, the local trips are more linked to daily life, when long distance trips are more exceptional and do not require the same modes nor lay on the same motivations. These two types of mobility have then been separated, leading to the analysis of three subgroups of high CO2 emitters, with high emissions due to their local mobility, their long distance mobility and, last but not least, both of them.

1 – METHODOLOGY: FROM THE TRIP EMISSION ESTIMATION TO THE ANALYSIS OF 3 SUBGROUPS OF HIGH EMITTERS

The 2008 French National Transport Survey

The 2008 French National Transport Survey has been carried on 20 178 households. It provides an image of the local and long-distance mobility of the people living on the French territory (mainland France and Corsica) (Armoogum et al., 2010). The information collected is grouped into a number of files of different types. Of particular interest here are :

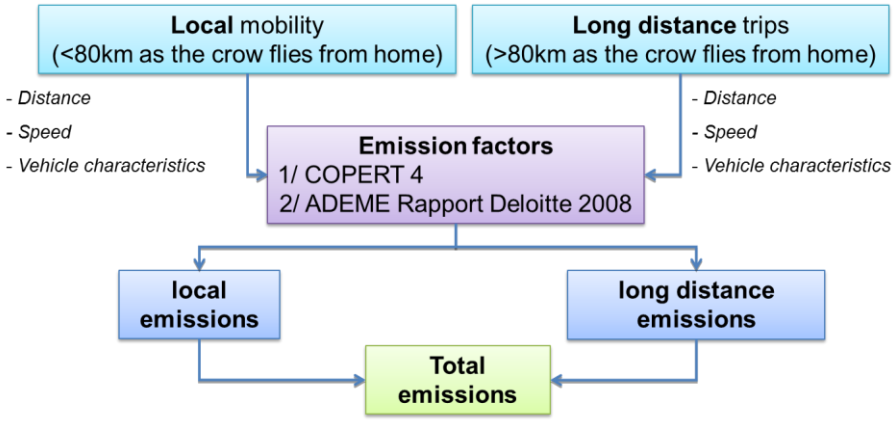
- ✓ a record, in the form of a logbook, of all car journeys made by household members 1 over a week-long period;

- ✓ a record of the journeys made the previous day and the previous weekend by one person (selected at random from all the household members aged over six at the time of the survey); 126 476 journeys have been collected here;
- ✓ a record of all long-distance journeys (i.e. more than 80 km (50 miles) from the household as the crow flies) made during the three months before the survey; 18 718 journeys are gathered in the corresponding file.

All journeys – private and work-related – are taken into account. Work-related travel information is omitted only for people whose job requires extensive travel (HGV drivers, delivery personnel, taxi drivers, etc.). The socio-economic characteristics of the household and individual respondents are also recorded during the survey. Similarly, detailed descriptions of the household's vehicles are noted.

Estimating CO_2 emissions

Every journey recorded in the survey is characterized by a number of variables that enable the amount of emissions generated to be estimated, starting with the finest level of data, corresponding to journeys, which provides a great amount of flexibility for future analyses. The results can then be re-aggregated at the desired level of analysis: by mode, by journey type or – of particular interest in this article – by type of respondent.
The CO_2 emission calculations are based on the methodology used in the European COPERT 4 program (Ntziachristos et al., 2009), complemented by data from the French Environment and Energy Management Agency (Deloitte, 2008). The detail of the calculation methodology and hypothesis is presented in Longuar et al. (2012).



Source : Longuar et al., 2012

Figure 1: The databases used for the CO_2 emission estimations

The principles adopted for the various modes of transport are presented briefly below.

Car use is predominant, as well as for local as long distance mobility, and it represents 71.9% of the total distance traveled. For this mode, COPERT 4 provides emissions functions based on the average speed of travel for a given journey, engine capacity, the emissions standard followed and the type of fuel system for the vehicle in question. The French

National Transport Survey provides information about this final characteristic directly. The emission standard can be deduced from the age of the vehicle at the time of the survey. Furthermore, the engine capacity can be inferred by cross-referencing information in the Parc Auto IFSTTAR/TNS Sofres survey, regarding taxable horse power, age and fuel system of the vehicle concerned (Gallez, Hivert, 1998).
For each journey, the distance traveled on the various road networks (urban roads, main roads, motorways) was established. Estimates of distances and speeds differ according to the type of journey.
For very short journeys (within a given zone), the distances and journey times selected correspond to declared data; for other journeys, a GIS calculation based on ViaMichelin distance tables is made. The selected journey times are declared for journeys less than 80 km (50 miles) from the household, and based on an average speed by network type for journeys more than 80 km from the household. Average speeds ranged from 10 km/h (6 mph) to 130 km/h (81 mph).
Finally, the CO_2 emissions calculated are attributed to the appropriate respondent(s) on a pro-rata basis according to the number of occupants in the vehicle, which is also specified in the survey.

Other transport modes appeared more marginal in terms of distance traveled (expressed as a proportion of the total), including air travel (12.0%), rail (5.6%), urban public transport (5.7%), walking/cycling (1.7%); and all other modes (3.0%). Unitary emissions were established for each of these modes on the basis of the results of the Deloitte report (2008). Here, too, the distances traveled were estimated on the basis of journey start and end points using GIS tools.

Table 1: average CO_2 emissions for different modes (g/pers.km)

	Unitary Emissions (g/pass.km)
Local trips	
Car	173
Urban Public Transport	42
Walk and bicycle	0
Long distance trips	
Car	103
Train	10
Plane	128

The emissions calculated as part of this article take into account only direct energy consumption, and not the primary energy source used (e.g. thermal energy to produce electricity) or emissions generated by the production and transport of fuel (refining, distribution, etc.); the figures calculated therefore correspond to "tank-to-wheel" emissions. Also, it should be remembered that the national transport survey takes account of all journeys made by individuals residing in mainland France and Corsica.

Local and long distance trips: two very different individual mobilities

A part of the National Transport Survey is built on the distinction between local and long distance mobilities. The modalities of realization of these two types of mobility appear

extremely different, as well as in their motivations as in the modes of transport required. It seems however useful to justify this choice which complicates the analysis and the presentation of the results: this is the aim of these paragraphs are dedicated to this.

If we refer to the literature on the subject, the local mobility corresponds at first to daily life mobility. The obliged commuting trips to go to work or to study remain there important and very structuring (Orfeuil, 2002). Local household trip surveys show that, even if their number tends to decrease, these obliged trips still remain dominant in terms of travelled distance because of their average length; they are also structuring, because besides their weight in distance, they have strong temporal constraints and the other daily activities get organized around them. In opposite, the long distance mobility is occasional, and corresponds to less strict trips, such as the holidays either visits to friends or family. The budgetary constraint becomes sensitive for this mobility, and the level of income constitutes the first split factor (Paulo, 2006; Grimal, 2010).

In the National Transport Survey, the distinction between local and long distance mobility is based on a criterion of distance of 80 kilometers from the place of residence. Inside this perimeter, the trips are considered as being “local”, beyond, they are at “long distance”. In spite of the arbitrary part of this type of definition, it allows to observe enough differences to be justified. The analysis of the survey shows that long distance trips are realized in 80 % for personal motives. They are limited to 14.1 trips per year and per person, even if they represent 5 910 km. The local mobility represents on average 22 trips and 176 kilometers per person and per week, approximately 8 295 kilometers a year. 23 % of this distance is linked to home-to-work or home-to-study trips. So, as the local mobility corresponds to 99 **%** of the trips for 59 **%** of the travelled distances, the long distance mobility constitutes respectively 1 % of the trips for 41 % of the distances. The car use remains predominant for local as for long distance mobility, but between these two segments it falls from 86 to 51 % of the travelled kilometers, in the profit of the plane and the train which represent respectively 30 and 14 % of the long distance kilometers (Table 2).

Table 2: Modal share of travelled distances for local and long distance mobilities

Local Mobility	
Travelled distance (billion pass.km/year)	500
Car	*85,5%*
Public Transport	*9,8%*
Walk	*2,8%*
Other modes	*2,0%*
Long Distance Mobility	
Travelled distance (billion pass.km/year)	331
Car	*51,2%*
Plane	*30,1%*
Train	*14,1%*
Other modes	*4,6%*
Global Mobility (billion pass.km/year)	**828**

Estimation LET-Certu, with the 2008 French National Transport Survey (SOeS – Insee-Inrets)

These local and long distance mobilities thus seem very different regarding their frequencies, motives and modal shares. As a consequence, the CO_2 emissions cannot be explained in the same way. We will also see in the next part, that their respective logics are not identical: there are few common socioeconomic factors explaining the differences between individual

mobilities, expressed in number of travels and in travelled distance. So, the interpretation of the individual levels of CO_2 emissions requires to well distinguish these types of mobility.

For the analysis, three groups of individuals have been established for each of these two mobilities: the 20 % of the higher emitters, those who did not emit because they did not move over the surveyed period, and finally the last group of the mobile but weakly or averagely emitters. Nine subgroups of people are obtained from the crossing of these 3x3 groups. Their size and their emission volume are synthesized in the following table:

Table 3: Distribution of the total population, according to the local and long distance emissions of the individuals

Local mobility ⇨ ⇩Long distance mob.	No emission	Average emissions	Highest emitters (20%)	All
No emission	10,3%	29,5%	7,8%	47,5%
Average emissions	3,5%	21,8%	7,1%	32,4%
Highest emitters (20%)	2,0%	12,9%	5,1%	20,0%
All	15,8%	64,2%	20,0%	100%

Table 4: Distribution of the total volume of CO_2 emissions, according to the local and long distance mobilities of the individuals

Local mobility ⇨ ⇩Long distance mob.	No emission	Average emissions	Highest emitters (20%)	All
No emission	0,0%	12,7%	16,1%	28,8%
Average emissions	0,1%	10,4%	15,8%	26,3%
Highest emitters (20%)	2,2%	23,8%	18,9%	44,8%
All	2,3%	46,9%	50,8%	100%

The weight of the local mobility can immediately be underlined: it still represents the most important part of the distance travelled (passenger.kilometers) and of the CO_2 emissions of the residents of the French territory.

As our questioning in this article concerns more specifically the analysis of the socioeconomic factors which favour strong rates of CO_2 emissions, we have been focused on the 20 % highest emitters, all mobilities included. These 20 % highest emitters represent 60 % of the emissions and are logically located in the extreme column and the line of the tables:

Table 5: Distribution of the 20 % highest emitters of the population, according to their local and long distance emissions

Local mobility ⇨ ⇩Long distance mob.	No emission	Average emissions	Highest emitters (20%)	All
No emission	0,0%	0,0%	6,9%	6,9%
Average emissions	0,0%	0,0%	6,5%	6,5%
Highest emitters (20%)	0,1%	1,6%	5,0%	6,7%
All	0,1%	1,6%	18,4%	20%

Table 6: Distribution of the CO_2 emissions of the 20 % highest emitters of the population, according to their local and long distance emissions

Local mobility ⇨ ⇩Long distance mob.	No emission	Average emissions	Highest emitters (20%)	All

No emission	0,0%	0,0%	14,9%	14,9%
Average emissions	0,0%	0,0%	14,9%	14,9%
Highest emitters (20%)	0,5%	9,9%	18,8%	29,1%
All	0,5%	9,9%	48,6%	59%

Our analysis has been led on this population of high emitters, with a four logit modelling process. To begin with, a first model has been built on the whole high emitter population. But as we saw that the explaining factors are not the same, another model concentrates on the high emitters linked to their local mobility while a third focuses on long distance high emitters. The last model has been built with the 5% of the individuals who are high emitters because of their high mobility on both local and long distance.

2 – WHICH FACTORS ARE SIGNIFICANTS TO EXPLAIN HIGH CO2 EMISSIONS ?

Previous studies highlight the main factors explaining individual mobility which have served here as an analysis grid for emission results (Orfeuil, 2000; Kaufman et Flamm, 2002; Hjorthol, 2003; Paulo, 2006; Nicolas et David, 2009; Dupuy, 2010; Ewing et Cervero, 2010). Some of them emerge in particular and are included in the French NHTS:

- ✓ Occupation (school pupil, student, working, unemployed, at home or retired), largely matching up with age and life cycle, and influencing the activities which structure and give rhythm to daily life.
- ✓ Household income level, given in terms of consumption units1, is divided here into 6 equal categories. Household income level always facilitates access to private cars for people of driving age, even though car use is widespread today; it also opens up wide possibilities for long distance leisure travel.
- ✓ Education (diploma) is related to income but has his own effect in mobility: people with higher degree have more capacity and habits to travel.
- ✓ Household residence location (town centre, suburbs, peri-urban, rural, school and shop location) affects the distances travelled daily and plays, as a consequence, a role in the transport modes used.
- ✓ Transport offer (transit distance, bus frequency) is linked with modal choice..

The difference of level of CO2 emissions associated with the different type of mobility confirms the main effects of this factors (table 6). The highest emitters are male, rich, well-educated, live in a family with 1 or 2 children in rural or suburbs area far from transit, school and shops, work and own cars. Results show that for most of French people emissions from local mobility are higher than those from long-distance mobility, except for the people with the highest diploma (BAC+5) who emit less for local trips but far more for long distance travels.

[1] Due to the economies of scale within the household, INSEE proposes counting the first person as 1, then all other adults as 0.5 and children under 15 as 0.3.

The descriptive analysis confirm also (see appendix 1) the existence of different groups among high emitters. We call those with high emissions for long-distance mobility and low for local mobility the “frequent travelers”, those with high emissions for local mobility and low for long-distance mobility the “great commuters”, and those with high emissions for local mobility and long-distance mobility the “hypermobile”. To determine the significant factors discriminating these subgroups, we use a four logit models with a stepwise procedure with all the variables described in the table 6.

Table 6 Descriptive analysis: Individual CO2 emission associated with mobilities by socio-economics variables

		Population %	Global mobility emissions (kg/pers)	Local mobility Emissions (kg/pers)	Long-distance mobility Emissions (kg/pers)
Quintile of income per consumption unit	0 Poor	23,0%	1 018	805	213
	1	22,2%	1 442	1 146	296
	2	21,0%	1 905	1 491	415
	3	18,4%	2 065	1 507	558
	4 Rich	15,4%	2 789	1 603	1 185
Education	No diploma	44,3%	1 026	756	270
	BEP CAP	24,5%	2 066	1 696	370
	BAC	9,7%	2 121	1 590	531
	BAC+2	15,5%	2 565	1 787	778
	BAC+5	6,0%	3 329	1 592	1 737
Household composition	One adult	15,5%	1 560	1 095	465
	Childless couple	25,8%	1 887	1 292	596
	Single-parent family	8,5%	1 274	1 027	247
	Family 1 or 2 children	33,9%	2 030	1 498	533
	Family 3 children and +	12,6%	1 475	1 105	370
	Other	3,7%	1 422	1 074	348
Shops < 1 km	No	28,5%	1 944	1 552	392
	Yes	71,5%	1 692	1 168	524
School < 1 km	No	31,2%	1 898	1 487	411
	Yes	68,8%	1 702	1 182	521
Transit <1 km	No	24,4%	1 921	1 550	371
	Yes	75,6%	1 713	1 189	524
Bus frequency (+ 10 bus/day)	No	56,2%	1 935	1 493	442
	Yes	43,8%	1 544	1 000	544
Work status	Employed	44,8%	2 543	1 895	648
	Other situation	1,9%	887	729	158
	Schoolchildren	17,0%	739	474	264
	Student	4,1%	1 571	1 120	451
	Unemployed	8,3%	1 399	890	509
	Retired < 75 years	7,0%	1 561	1 085	476
	Retired > 75 years	16,9%	537	431	107
Motorisation	No	32,8%	670	436	234
	Yes	67,2%	2 297	1 687	610
Gender	Female	51,6%	1 516	1 122	394
	Male	48,4%	2 027	1 441	586
Residence Location	Center	30,8%	1 480	870	610
	Suburbs	30,1%	1 873	1 384	489
	Periurban	39,1%	1 903	1 516	387
All		100,0%	1 764	1 277	487

Table 1 Descriptive analysis: Individual CO2 emission associated with mobilities by socio-economics variables

The first model concerns the “high emitter”, the top quintile of respondents. The factor the most significant is by far the work status. The probability to be a high emitter for a worker is twice of an unemployed. Car availability and residence location have also an important impact. The resulting odd ratios for the residence location indicate that the resident of rural or periruban areas are about twice likely to be high emitters than central areas inhabitants. The model did not take into account the presence of shops or school at less than 1 km (the effect must be included in the residence location).

Table 7 Results of logistic regression for being in the 20 % highest emitters

		Values	Ods ratio	Pr > Khi-2
Intercept		-1,1877		<.0001
Gender	Female	Ref		
	Male	0,3353	1,398	<.0001
Education	No diploma	Ref		
	BEP,	0,4226	1,526	<.0001
	BAC	0,4906	1,633	<.0001
	BAC+2	0,5556	1,743	<.0001
	BAC+5	0,6292	1,876	<.0001
Household composition	One adult	Ref		
	Childless couple	-0,088	0,916	n.s
	Single-parent family	-0,00706	0,993	n.s
	Family 1 or 2 children	0,0114	1,011	n.s
	Family 3 children	0,1892	1,208	0,0252
	Other	-0,1254	0,882	n.s
Income	Low	Ref		
	Medium	0,29	1,336	<.0001
	High	0,6513	1,918	<.0001
Work status	Workers	Ref		
	Schoolchildren	-0,8891	0,411	<.0001
	Student	-0,353	0,703	0,0012
	Unemployed	-0,6874	0,503	<.0001
	Retired > 75 years	-2,2794	0,102	<.0001
	Retired< 75 years	-0,7485	0,473	<.0001
	Other	-0,7741	0,461	<.0001
Car availability	Yes	Ref		
	No	-1,8929	0,151	<.0001
PT accessibility	No	Ref		
	Yes	-0,1116	0,894	0,0337
Bus frequency	No	Ref		
	Yes	-0,1387	0,87	0,0199
Residence location	Periurban	Ref		
	Suburbs	-0,0403	0,961	n.s
	Center	-0,6633	0,515	<.0001

N= 18 632 n.s not significant Model fit : R^2 (adjusted)=0.26 Correct prediction : 76.5%

Table 2 Results of 3 logistic regressions for each subgroup of emitters

Model		The Frequent travelers		The great commuters		The "Hypermobiles"	
Variables		Ods ratio	Pr > Khi-2	Ods ratio	Pr > Khi-2	Ods ratio	Pr > Khi-2
	Intercept		<.0001		<.0001		<.0001
Gender	Female	Ref					
	Male	1,697	<.0001	1,185	0,0003	1,534	<.0001
Education	No diploma	Ref					
	BEP,	0,621	0,013	1,647	<.0001	1,309	0,0147
	BAC	*1,115*	n.s	1,632	<.0001	1,434	0,0091
	BAC+2	*1,248*	n.s	1,474	<.0001	2,064	<.0001
	BAC+5	2,031	0,0005	1,39	0,0013	2,061	<.0001
Household composition	One adult	Ref					
	Childless couple	.	.	0,871	0,0813	.	.
	Single-parent family	.	.	*0,956*	n.s	.	.
	Family 1 or 2 children	.	.	*1,066*	n.s	.	.
	Family 3 children	.	.	1,354	0,0012	.	.
	Other	.	.	*0,885*	n.s	.	.
Income	Low	Ref					
	Medium	2,211	0,0006	.	.	2,327	<.0001
	High	4,52	<.0001	.	.	4,124	<.0001
Work status	Worker	Ref					
	Schoolchildren	*0,754*	n.s	0,429	<.0001	0,312	0,0023
	Student	*1,135*	n.s	0,586	<.0001	*1,157*	n.s
	Unemployed	2,172	<.0001	0,356	<.0001	*0,847*	n.s
	Retired > 75 years	0,166	0,0024	0,122	<.0001	0,125	<.0001
	Retired < 75 years	*1,176*	n.s	0,423	<.0001	0,743	0,0023
	Other	*0,013*	n.s	0,463	0,0004	*0,809*	n.s
Car availability	Yes	Ref					
	No	0,322	<.0001	0,145	<.0001	0,186	<.0001
PT accessibility	No	Ref					
	Yes	.	.	.	.	.	.
Bus frequency	No	Ref					
	Yes	.	.	0,87	0,0353		
Residence location	Periurban	Ref					
	Suburbs	.	.	0,917	n.s	0,906	n.s
	Center	.	.	0,454	<.0001	0,59	<.0001

Variables not included into the models, n.s not significant. N= 18632. All coefficient are significant at $p<0.05$. R^2 (adjusted)=0.1 Correct prediction : 71%, R^2 (adjusted)=0.21 Correct prediction : 75%, R^2 (adjusted)=0.15 Correct prediction :74%

The second model concerns the three subgroups of highest emitters.

For the “frequent travelers”, the factors the most significant are the level of education and incomes. The probability to be frequent traveler for a people with a Bac+5 is twice of those without a diploma. The estimates imply also that people in the highest income group have four times more chance to be in this subgroup than those in the lowest group of income. In terms of work status, unemployed are more likely to be frequent travelers: they don’t need to go to work, their emission related for local mobility are low, and as they have a high level of

life they can travel a lot. The model didn't take into account the residence location, it seems that in our model long-distance mobility is independent of home location.
For the "great commuters", the factors the most significant are the work status, by far, car availability and residence location. The probability to be great commuters for working people is tree times more of those without a job. The estimates imply also that people who live in central area have twice less chance to be in this subgroup than those in rural or periurban areas. In terms of household composition, unemployed are more likely to be frequent travelers: they don't need to go to work, their emissions related for local mobility are low, and as they have a high level of life they can travel a lot. The model didn't take into account the level of income; it seems that in our model, local mobility is independent of level of income as soon as car availability is considered.

For the "hypermobiles", the most significant factors seem to be a combination of those seen in the two previous model: high education, car availability, incomes explain the fact to be in this subgroup. The probability to be "hypermobile" for a people with a Bac+5 is twice of those without a diploma. The estimates imply also that people in the highest income group have four times more chance to be in this subgroup than those in the lowest group of income. In terms of car availability, non motorized respondents are about 80% less likely to hypermobiles than those with a car. The model didn't take into account the household structure or transport offer: what really matter for this subgroup is wealth and education.

CONCLUSION

The analysis of CO2 emissions finds significant different factors to explain the variety of mobility behaviors among high emitters. Among the top quintile of emitters, frequent travelers are discriminated by their high level of education and income, the "great commuters" by their high level of employment, residence location and car availability. The "hypermobiles" can be seen as a combination of great commuters and frequent travelers. At a time when French government is envisaging the introduction of a carbon tax with effect from 2014, this result could help to estimate the consequences on household expenditures and contribute to define policies more fair and effective. The policies to regulate local and long-distance mobility should be differentiated. As such, the debate on urban sprawl, type of urbanism and location of economic and residential activities is a real challenge on a local level; this remaining the area where the highest levels of emissions are generated. However, an increase in the cost of car use (higher taxes or price increase of petrol), will impact the most modest households much more than more affluent ones, especially working people for whom cars are a necessary tool these days to travel between work and home. Plus the high increase of property prices leaves, at this level, little chance of adjusting via residential mobility. A price increase for long distance mobility seems to generate less inequality than the previous case, as long distance travel is less necessary and mainly affects the most educated members of the population. It can have a considerable impact when we observe the strong link it has with income growth.

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APPENDIX

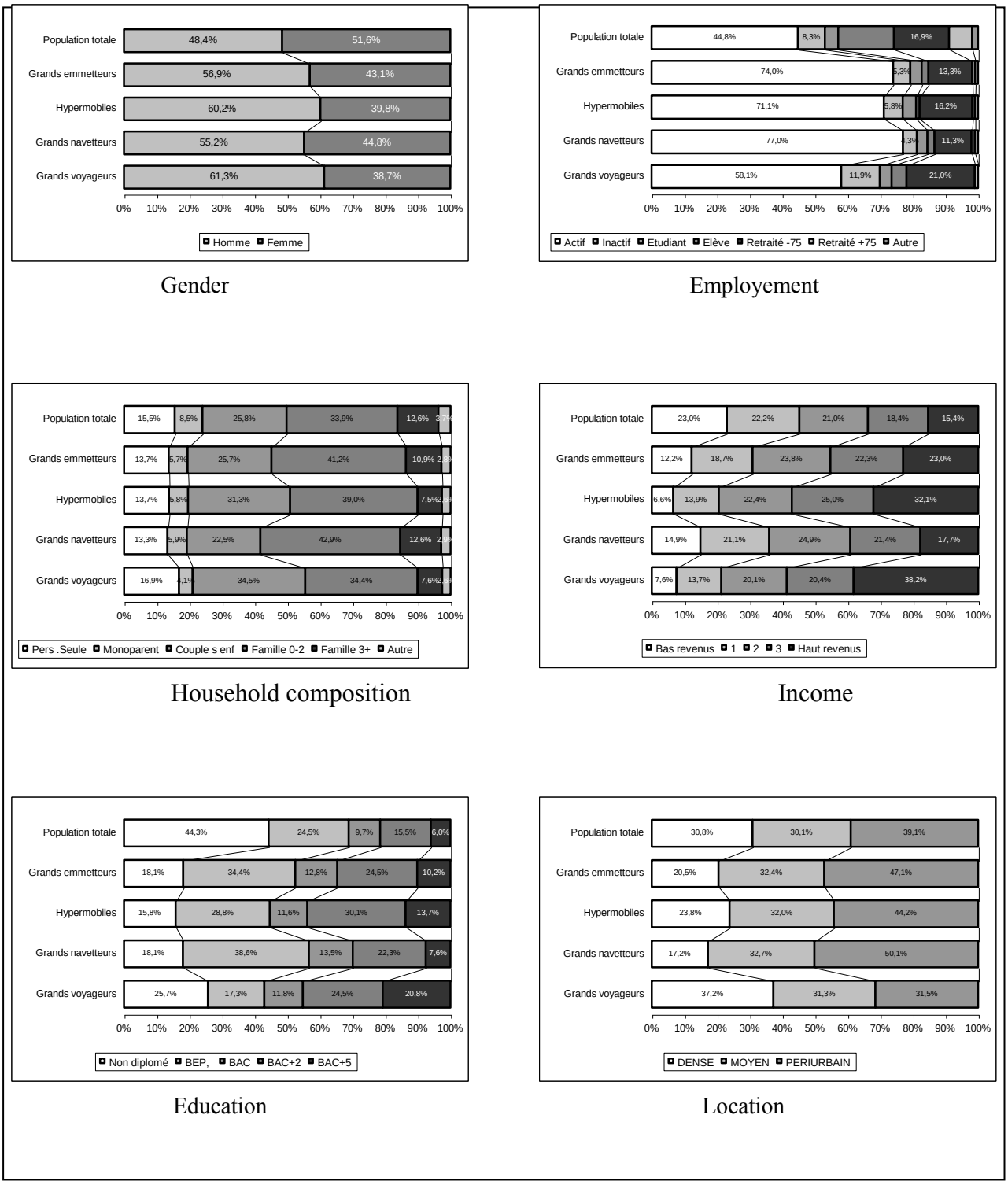

Figure 1. Characterization of the different groups of high emitters compared to their socio-economic composition. Reading the "Frequent travellers" are 20.8% to have a diploma BAC +5 (or more) against 6.8% for the general population.