Stress tests for a sustainable mobility: an accessibility approach

Synthesis

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The project called "stress-tests for a sustainable mobility: an accessibility approach" aims to develop stress-tests to propose a sustainable mobility analysis. First, comparing the Lyon Urban Area and the Munich metropolitan Region, municipalities are tested regarding their susceptibility to sharp increases in mobility costs by means of the Vulnerability Assessment. The concept is in this research adapted to regional vulnerability in the case of dramatic increases in mobility costs. Vulnerability can be divided into the following three dimensions:

- **Exposure** is the contact between system and stress.
- **Sensitivity** is the degree to which something/someone is affected by exposure to stress
- **Resilience** is the ability of something/someone to absorb perturbations without changes in its fundamental structure.

This vulnerability analysis is coupled with a "stress-tests" approach at a household's level. Stress-tests implement shocks on fuel prices and CO2 emission. It highlights shocks impact on different household's daily mobility and location choices. We consider a *ceteris paribus* approach. Stress-test scenarios are implemented using the following assumptions. First, shocks on mobility appear suddenly and therefore are not planed by households. Second shocks alternatives depend only on households. Public authority cannot answer these shocks. Then no public measure such as a tax decrease or fuel voucher is implemented to absorb, even partially, the shocks. Stress-test n°1 is a crude oil price at a level of $200/barrel. Stress-test n°2 considers the tripling of fuel prices at the gas station triples. Stress-test n°3 proposes a quantity regulation. We assume an oil shortage and rationing of fossil energy resources. It rations fossil fuel resources by translating a limited fuel supply into a maximum number of kilometers traveled per month. It asks the following question: what would happen if a "monthly car travel distance of 42 km maximum" was imposed to each individual for daily mobility? Would households react to this situation by changing their daily activity program or mobility behavior? In France, CO2 consumption is estimated to be between 8 and 9 tons per person per year (see ADEME). Among them 2 tons are used for mobility (Longuar et al., 2010). In this stress-test, the purpose is to reduce CO2 consumption to 500 kg per year, among them 200 kg for mobility. This yearly emission budget of 200kg corresponds to 120 liters of fuel per year, 500 kilometers (with a consumption of 5l per 100 km) and 42 monthly kilometers.

Different conclusions can be drawn from vulnerability and stress-tests approaches. In terms of methodology the benchmarking between Lyon and Munich Regions aims to highlights similarities but also differences between the two case study areas. The first issue refers to the administrative perimeter to consider for comparisons. It appears that the most pertinent perimeters to consider are the Grand Lyon and the Munich Region (MVV), mainly according to

available data. In this context, it is not really possible to strictly compare the two "regions" but only to have parallel analysis.

At a municipal level, results highlight the importance of public transports supply. A zone served by public transports is less vulnerable than a rich area. Indeed, transport demand supply impacts the daily car trips (exposure level) and a possible mode change (resilience impact) while income only impacts sensibility level. Therefore, it's not surprising to observe the city centers are less vulnerable than suburban ones.

At the individual level, the stress-test analysis highlights households' difficulties whatever their location. If a fuel price based on $200 per barrel has only limited change on short-term mobility behaviors, tripling the price at the gas station is a drastic shock, especially for the most vulnerable households. Three main reasons are proposed to explain household vulnerability. Vulnerability increases with the household size and children mainly if the two parents are working. Moreover a peripheral location coupled with low income level increase sensitivity to shocks. These three vulnerability determinants can be detailed as follow:

- Number of children can impact number of trips. Children related trips are mainly made by car in trips chains with parents. It's more bi-activity of parents than number of children which favor vulnerability. First because, it increases home-to-work trips distances. Then because these trips are often constraint in time or destination zones.
- Vulnerability for bi-active families is strengthened when they live on peripheral zones, not served by public transports. For these families, car is necessary for most of trips. Facing mobility shocks, a re-location near the working place of one of workers is not sufficient to limit the impact of higher costs on household budget.
- Then the level of household income seems to be the main cause of vulnerability. Taking the example of a young student living in the city of Lyon. In spite his low transport budget; this household lives with less than monthly €200 when housing and transport expenditures paid. Therefore he can be seen as "vulnerable". On the contrary, the retired household is not vulnerable in spite of a car oriented mobility. This household has a high income level and can support a fuel price increase. Even if an Co2 emission constraint is imposed, this household will change its vehicle for an electric one for trip lower than 200 kilometers. This new vehicle will allow to keep the same car-mobility behavior and in the same time reducing the Co2 emission.

More than individual life choice determining location and mobility choices, comparing mobility and housing costs, this the uncertainty on shocks witch can increase vulnerability. Uncertainty prevent households from forecasting price variations. In this context, the issue of public decision maker choice and is crucial.