To what extent can supporting carpooling reduce road congestion?

A policy mix of "stick" measures (generalised distance based road charge) and "carrot" measures (supporting carpooling) could induce an increase in the occupation rate of cars in Belgium from 1.44 to 1.50. This relatively modest increase can be explained by the relatively small share of trips for which an increase in the occupation rate is a realistic option, and by the inconveniences linked to the organisation of carpooling. Nevertheless, this policy mix can induce a notable improvement in the traffic situation during the peak periods in the regions that currently suffer the most from congestion.

What policy measures are available to promote carpooling?

To respond to increasing congestion and pollutant emissions, policy makers target to decrease overall travel by car; one way to contribute to this objective is to increase the average occupancy rate of cars[1], this is the ratio between the transport demand (passenger-kilometres) and the supplied vehicle kilometres. In Belgium, the Brussels Capital Region targets an increase in the occupancy rates of cars from 1.3 to 1.35 through a promotion of carpooling, while the Walloon Region targets an increase in the occupancy rates of cars from 1.3 to 1.8.

Most measures proposed in the Belgian integrated energy and climate plan have in common that they intend to encourage carpooling (they are "carrot" measures) rather than to discourage driving on one's own (what we could label as "stick" measures).

Usually, "carrot" measures refer to highway lanes that are reserved to cars with more than one occupant, or to the building of carpool parkings near highways. However, it is also possible to subsidize commuters who travel together, or to provide public support for apps that facilitate the matching of participants.

A typical "stick" measure is road pricing: even if it is not focused on the promotion of carpooling, carpooling spreads the cost of road pricing over a higher number of travellers. Focused measures also exist, such as so-called High Occupancy Toll ("HOT") lanes, which are lanes that are available without charge to vehicles with more than one occupant (or to other exempt vehicles) - all other vehicles need to pay a fee for using the lane.

What does an analysis for Belgium tell us?

What is the impact of such measures in Belgium?

An analysis with the Belgian national transport demand model, PLANET, shows that an occupancy rate of 1.5 can be obtained with a combination of carrot and sticks encompassing a flat road charge of 4 EURO cent per km combined with support measures for carpool that reduce the variable costs of carpooling[2] to work by almost 50%. We estimate that such policy mix would result in around 2 billion EURO of additional government revenues per year.

Pure (support) "carrot" schemes that lead to similar results in terms of occupancy rate, would come at a net cost to the government budget of around 1 billion EURO on an annual base.

Even if this constitutes an improvement compared to the current situation (i.e. a national average occupancy rate of 1.44), an occupancy rate of 1.5 falls short of the regional policy targets in Belgium listed above. This means that other (types of) measures need to be implemented to achieve the targets.

What explains these results?

Several interrelated causes are identified that could explain the rather limited increase in the occupancy rate of cars.

A first reason can be found in Table 1, which splits the projected annual travel in Belgium in 2025 (expressed as passenger kilometres) according to the travel motive and the

[1] Fostering teleworking can also contribute to a reduction in car travel. The impact of this specific measure on travel demand was analyzed recently by the Federal Planning Bureau (see https://www.plan.be/uploaded/documents/202011191356220.WP_2006_12245.pdf).

[2] This refers to the fuel costs per person kilometer but also to the opportunity cost of the time spent carpooling.

transport mode used. Maybe surprisingly, most travel is not undertaken for professional motives (commuting to and from work, business travel). Around 60% of travel in Belgium is undertaken for 'other' motives (e.g., shopping, leisure, family visits, walking around).

Clearly, the potential for increased car-pooling for those motives is more limited: the occupancy rate for family related trips, for instance, is intrinsic to those trips.

Table 1 - Shares in total passenger kilometer
Percentages per mode(column) and travel motive (and rows)

Motive	Total per motive	bus	carpool	car solo	metro	moto	walking and cycling	train	tram
Business	7.1	0.1	0.9	5.9	0.0	0.2	0.1	0.0	0.0
Others	60.8	2.3	29.8	21.8	0.4	0.4	3.3	2	0.8
School and students	5.5	1.3	1.5	0.3	0	0	0.4	1.7	0.1
Work	26.6	0.7	2.1	20.0	0.1	0.3	0.4	2.9	0.1
Total per mode	100.0	4.4	34.3	48.0	0.5	0.9	4.1	6.6	1.1

Source: PLANET

Second, Table 1 also shows that carpooling represents less than 10% of the passenger kilometres for the motive "work". However, this is not due to a cost disadvantage of carpooling compared to other modes, far from it.

To see this, we need to use the concept of "generalised cost of travel": the sum of the monetary cost of travel, and of the opportunity cost of the time spent travelling. Table 2 summarizes the generalised and the monetary cost for all passenger modes for the travel motive "work" (again, these are the projected costs for 2025).

Only travelling by train has a lower generalised cost than carpooling. In other words, if only generalised costs would matter for travellers, one would expect very high modal shares for carpooling.

Taking together with the statistics on modal shares, those figures imply that, in the perception of users, carpooling has some intrinsic disadvantages that are not captured in the generalised costs.

Table 2 - Costs for travel motive "work"
EUR per pkm

CostType	Period	walking and cycling	moto	car solo	car pool	train	bus	tram	metro
Generalised cost	Off peak	0.69	0.71	0.57	0.34	0.31	0.36	0.64	0.71
Monetary cost	Off peak	0.00	0.56	0.08	0.03	0.03	0.01	0.02	0.01
Generalised cost	Peak	0.73	0.78	0.62	0.39	0.33	0.42	0.79	0.85
Monetary cost	Peak	0.00	0.56	0.08	0.03	0.03	0.01	0.02	0.01

Source: PLANET

It is not too difficult to think of such disadvantages: the need to coordinate work and leisure schedules with other travellers, the detour to a carpool parking, the risk of vandalism and theft when a car is left at a carpool parking, the risk that other travellers meet delays, etc. This explains why the potential of pure "carrot" measures to promote carpooling is rather limited, unless a lot of resources are devoted to counterbalance those disadvantages.

Averages can hide a lot…

Even if the overall effect of analysed measures to promote carpooling remains limited, we should bear in mind that congestion is often concentrated in time and space. In areas where congestion is very high, even limited increases in carpooling can have non-negligible local effects.

For instance, in the metropolitan area surrounding Brussels, the combined "carrot and sticks" measures result in a decrease in car travel by 13% during peak hours, and an increase in average speed levels by 27% (from a current value of around 60 km/hour). In the area surrounding Antwerp, car travel decreases by 20% during peak hour, and speed increases by 18% (starting also from around 60 km/hour).

For the sake of comparison, the results for Belgium are: a decrease in car travel during peak hours by around 16%, and an increase in average speed levels by 7% (from a current value of around 68 km/hour). Outside the peak hours, the average speed lies around 80 km/ hour, car travel would decrease by around 14% and speed would increase by around 2.5%.

In a nutshell….

Carpooling for home-work commuting can indeed be encouraged with "carrot" measures, but this comes at a high cost for public finances. A "stick" measure such as a flat road charge has as main advantage that it also encourages shifts away from driving by car in general, to public transport modes and actives modes: carpooling is just one of the alternatives to driving alone. Combining "carrot" and "stick" measures combines the strong incentive effects of a flat road

charge with measures that make carpooling more attractive, and thus sweeten the pill. Moreover, the combination of "carrots" and "sticks" results in net government revenues.

Even if the impact of the measures analysed here falls short of current policy targets, the local impacts on congestion are far from negligible.

It should be emphasized that the current analysis is not meant to propose a specific course of action, but to illustrate the impact of the different measures to favour carpooling. There is no implication that the specific values chosen for the parameters are policy-driven or otherwise recommended.