Sustainability.
Exploring the road ahead for car mobility

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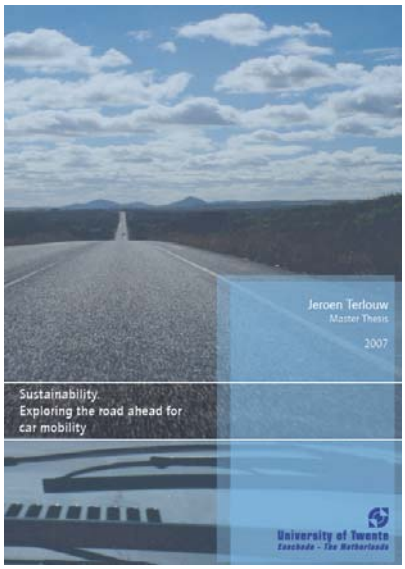

Mobility has an important societal function. It can be seen as the motor of our society. However, mobility and its growth have external effects on welfare as well, such as, depletion of natural resources, air pollution, noise and smell nuisance, traffic un-safety, and congestion. The car has both positive and negative effects on mobility and therefore an important influence on welfare. This study strives to gain an insight into the possibilities to improve positive effects and at the same time minimise negative effects of car mobility. In order to have a reference, the concept of 'sustainable development' is applied to mobility.

'Sustainability' includes economic, social, and environmental aspects. A translation of this concept to mobility resulted in five pillars on which sustainable mobility rests: i) accessibility representing the economical conditions, ii) transport equity, iii) traffic safety, and iv) liveability representing the social conditions and v) nature and environment representing the environmental conditions. In addition, targets were linked to these sustainable mobility pillars. These targets are 'zero lost vehicle hours', 'no rise of pro rata household expenditures on mobility, 'zero traffic casualties', 'no road traffic noise nuisance' and 'zero emissions from cars'.

'Development' is the other angle of the concept. The objective of this study is to find realistic combinations of measures and technical possibilities for 2050 that might lead to the sustainable target values of car mobility referred to above. Improvements that approach these target figures are considered an important contribution to developing sustainable car mobility, since both approachability and achievability are considered important for decision-making.

Instead of forecasting, the extrapolation of current trends, the backcasting approach is used. This method describes desirable futures that focus on solving societal problems. In addition, it analyses consequences and conditions to arrive at these futures.

In this study the WLO scenario 'Global Economy (GE)', a scenario with strong growing economy, was used as a reference to address the maximum required effort for achieving the sustainable mobility targets. Comparing the GE scenario in 2050 with the sustainable mobility targets, illustrates a policy discrepancy. According to the GE scenario and in comparison with the current situation, the lost vehicle hours will double, the number of fatalities in traffic remains equal, the area with noise nuisance shows a little increase and CO2 emissions almost double.

Expressing these gaps in costs for society resulted in 1.7 billion euro for accessibility, 6.4 – 8.0 billion euro for traffic safety, 3.3 – 4.4 billion euro for liveability, and 2.6 – 5.7 billion euro for nature and environment.

Three scenarios (or combinations of measures and technical possibilities) for the year 2050, were constructed of which it is expected to increase the degree to which the sustainable mobility targets are achieved. These scenarios were intended to decrease the social costs. The three scenarios were constructed within the 'Global Economy' scenario. 'Technology Take-over (TT)' is the first scenario and is driven by emerging technologies. Autonomous driving on a highway is supposed to reduce lost vehicle hours and traffic casualties and battery electric vehicles (BEV) are expected to minimise emissions to a minimum. A second scenario, 'Conscious Consumer (CC)', presumes people becoming aware of sustainability striving to it. Minimising social costs should be realised by changing the perception of lost vehicle hours. Infrastructure that invites for desired usage that should reduce traffic casualties. People adopting the fuel cell electric vehicle as their transport means is expected to minimise the emissions. In the third scenario 'Exploiting Conventional Technologies (ECT)', conventional technologies and measures are used, and optimised. A kilometre and emission based charge for vehicles should minimise lost vehicle hours, an event recording system is expected to improve traffic safety and an optimised conventional combustion vehicle in combination with the usage of biofuels are used in this scenario to minimise social costs related to the environment. Equal in all three scenarios are the usage of silent tires and silent asphalt to tackle the noise nuisance problem.

An analysis of the costs and benefits is carried out to examine if the measures are successful, in the sense of achieving or approaching the targets for sustainable mobility coupled to a favourable social cost benefit ratio. This analysis resulted in the following findings and recommendations:

1. A broad look makes sustainable development for mobility achievable;

   • All three scenarios show a positive net balance. Before this study, striving for sustainable mobility seemed ambitious. This was mainly inspired by the ecological aspect of sustainability. However, when the other aspects of sustainability (social development and accessibility) are taken into account as well, sustainable development for car mobility seems to be feasible based on costs and benefits.

   • Based on these findings, it is recommended to use sustainability integrally. This means, considering economical, social and environmental aspects.

   • When comparing the scenarios, 'Conscious Consumer' shows the best results. This is mainly due to the positive effects of the traffic safety measures because of sustainable safe adaptations on infrastructure. Not considering this aspect shows that it does not matter which road to sustainable mobility will be taken, since they have equal cost benefit ratios and equal effects.

2. Sustainable safe infrastructure and noise abatement measures have priority;

- Traffic safety can make a sustainable development; however, the targets (no serious traffic casualties) are not achieved. Selected measures do have a positive net benefit. Especially the sustainable safe infrastructure in combination with some intelligent transport systems showed good results.

Noise nuisance of car mobility can be reduced to a minimum by implementing silent tires and silent asphalt; in addition, these measures have a very positive net benefit.

- In striving for sustainable development for car mobility under a favourable societal cost benefit ratio, it is recommended to give priority to the design of sustainable safe infrastructure in combination with specific intelligent transport systems and noise abatement measures.

3. For sustainable development of nature and environment there is no need to change our current infrastructure to battery or hydrogen vehicles, since optimising the conventional car can be sufficient as well. However, the measures belonging to this pillar depend on development of the oil price, the value of an avoided tonne of CO_2, and the development of specific engine technologies in order to realise a positive net balance;

- Damage to nature and environment by emissions can be reduced heavily. In all three scenarios, emissions can be minimised to almost zero. However, this can only be done at net costs to the society. The extend to which these cost may vary in future can even result in a benefit to society. Future oil price is uncertain and has a direct impact on feasibility. The value of one tonne avoided CO_2 emission has great impact on the benefits and has wide range in literature. Uncertainty about the development of specific engine technologies and related costs are high. These uncertainties indicate that an even further increasing oil price, higher CO_2 emission reduction targets, or improvements in one of the related engine technologies could give positive net benefits.

- Further research is required to reduce the uncertainties and narrow the bandwidth of the three above aspects: oil price, CO_2 emission value and additional car technology costs.

- From the various vehicle technologies, BEV, FCEV, and the optimised biofuel ICEV none stand out on costs and benefits, whatever emission value or oil price, consequently no policy conclusions can be drawn on this aspect. Difference in development of on the vehicle technologies might lead to a distinguishing cost benefit ratio.

- Because a decision in relation to nature and environment cannot be made based on costs and benefits, other factors that play a role in decision-making become increasingly important. The road towards the sketched scenarios becomes vital. Although the BEV and the FCEV show higher efficiency rates and higher flexibility in fuel choice, they still need to overcome some technical barriers and require considerable changes in infrastructure. For exploiting conventional car technologies this is not required, and thus seems to have an easier transition path. So why should the Netherlands (and other countries) shift towards to other infrastructures, while optimising current technologies lead to the same results? Therefore it is recommended that policies emphasise on optimising ICEVs and on increasing there efficiency, not ignoring other new vehicle technologies.

At the same time, the possible negative effects of using biofuels like sugarcane ethanol on food competition should be studied in more detail. If the negative effects of sugar cane ethanol are manageable, this is an easy sustainable road ahead. If they are not manageable, the achieved efficiency improvements can also be beneficial for a transition towards BEVs or FCEVs. Especially weight, rolling resistance, and drag reduction are favourable for all roads to sustainability.

4. And what about accessibility?

- Accessibility is much debated because it affects people directly and personally by increasing travel times. However, nature and environment, traffic safety and noise nuisance have much higher social costs and thus higher potential benefits. These are less debated since they do not affect people so much on a personal level. It is therefore recommended to make people more aware of this discrepancy by internalising externalities.
- The accessibility measures have a positive net balance although smaller then safety and liveability measures. Accessibility cannot be improved in the highest economic growth scenario (GE), but without the selected measures and technologies, the accessibility would aggravate. Moreover, the positive net benefit is mainly achieved by minimising external effects. The ‘kilometre and emission based charge’, and the ‘automated highway system’ reveal the highest net benefits. It is expected that in the other three WLO scenario’s (with lower economic and population growth), the selected measures would result in improved accessibility.
- Accessibility is the only sustainable mobility aspect that aggravates in the three sketched scenarios compared to the current situation, at least when lost vehicle hours is used as an indicator. This would mean more and other measures are required to improve this pillar. On the other hand, it has to be noted that accessibility has relative low costs to society. With the arrival of ‘intelligent transport systems’ it is plausible that the perception of lost hours changes and other indicators like reliability of travel time

become more important. Using other indicators for accessibility seems advisable.

5. Only additional car costs prevent indiscriminate access to car mobility.
   - Transport equity, equal access to mobility, could be a problem due to high additional car costs. This can be compensated by subsidies.
   - In addition, lower usage costs can be expected for fuel because in all scenarios the energy efficiency of the vehicles is improved.

Keywords:

Sustainable mobility, Sustainable transport, Accessibility, Transport equity, Traffic Safety, Liveability, Nature and environment, Backcasting, Cost Benefit Analysis