A Cost-Benefit Approach to Public Transport Priority to Road access
Snorre Lægran, Senior Engineer, Norwegian Public Roads Administration
Thredbo 7 27th June 2001

1 Introduction

In Norway we have quite a lot of bus lanes. We have no statistic, but I guess it is about 50-70 km. Mostly, of course, in and towards Oslo.

During the peak hour public transport have a modal split of 70% for trips to work to inner Oslo city. This includes train, metro, tram and bus. Bus play a significant rule in Norwegian public transport, it is only in Oslo railbound transport is quite big. Because of environmental aspects, the politicians in Oslo dislike buses downtown, they prefer railbound transport. Some will stop the buses near the cityborder so the passengers have to change. I fear that a lot of these then will change to their Opel or Volvo instead.

From the western part of Oslo one bus lane, two general-purpose lanes and the railway all carry about 3.500 persons to Oslo Centrum in the morning peak hour.

In Bergen they soon will start building bus lanes in both directions to and from the concentrated working area Sandsli and Kokstad, near the airport 15 km south of the city.

But, the bus lanes are under some pressure. In the National transport plan 2002-2011 it is decided to start demonstration projects with HOV lanes, that means convert bus lanes to HOV lanes. Therefore, I will concentrate this paper on HOV lanes.

Empty automobile seats are one of the most under-utilised resources in the urban transportation sector. I Norway the average vehicle occupancy is 1,8, for trips to and from work it is 1,1-1,2. The utilization is a bit more than 20%.

HOV lanes are one attempt to increase the utilization. Carpooling and vanpooling is another. Carpooling and vanpooling is common in North America, but not in Europe and Scandinavia. On the other hand public transport is more common in Europe and Scandinavia. Both rail bound transport, and buses.

2 Why HOV?

2.1 General

HOV lanes and other demand attempt in USA were organized in larger scale in the 70-ties, and the oil-crises were one factor. Since then some lanes have failed, and some have had success, and some are in critical light. In USA there are now nearly 2.000 lanekilometers HOV lanes. (Compared to 12 in Madrid, 9 in Stockholm, 1,5 in Leeds and 0,8 in Trondheim).

The incitements are among

- Increase the person capacity of the road
- Delay, or prevent, increasing of capacity – savings for the State
- To affect the modal split

- Reduce the total amount of traffic – savings for the environment
- Reduce time in traffic – savings for the users - if lane conversion is the method we have to expect increased delay for non-HOV's, but hopefully the sum will be saving.
- More predictable transport

The findings are that HOV lanes and carpooling is most popular among commuters with quite a long distance. The savings must on a certain level, 5 – 15 – 20 minutes, to compensate for the time spent picking up others en route.

HOV lanes may be more suitable in USA than Scandinavia because of the lack of public transport. For many Europeans the bus or tram leave for every 15 minutes, but the neighbour / husband / colleague leave only once. The relative high standard of public transport applies for destinations in Centrum. The spreading land use, also among offices and other workplaces, often result in change of bus / train / tram. In such cases carpooling can be better than bus, with or without HOV lanes.

In such cases it is important to emphasize that we are talking about moving people, not cars. In transport vocabulary we often talk about the number of cars per time unit. In public transport sector, and aviation, there are focuses on patronage.

2.2 Oslo

In Oslo there has been made an EIA for new motorway from Asker to Oslo, the west corridor, some more than 10 km. Today it is 6 lanes, 3 in each direction. Inbound one lane is a bus lane, as I mentioned initially. The recommended alternative is a 6-lane motorway in tunnel, and the existing road will be converted to local road inclusive bus lanes, total 4 lanes. Because of big timesaving the project are calculated to have a positive cost/benefit. That seems reasonable. But, perhaps other solutions are even better.

From 1997 to 2010 they expect 35% increase in traffic, (read cars), the increase in persons is 23%. The difference because of increased car-ownership, so saying reduced occupancy. In the peak hour today there are 3.900 persons in 3.700 cars, in 2 lanes, occupancy 1,17 (assume 10% trucks). (And there are 3.700 persons in 100 buses in the bus lane). In 2010 there will be demand for 4.800 persons. If the occupancy increase to 1,44 the number of cars in 2000 can carry the number of persons of 2010, with similar congestion as today. The recommended alternative will carry the same number of persons in 4.500 cars, with similar congestion as to day, but in a tunnel.

Is occupancy of 1,44 impossible? Maybe. On the A 647 in Leeds, one year after HOV lane was implemented; car occupancy had increased from 1,35 to 1,43. And, a lot that is a result of traffic transfers.

I hope I will get an opportunity to calculate HOV lane in the new tunnel. That seems to be a quite reasonable solution. Then the local public transport can use the bus lane on ground, and the express buses can use the HOV lane. And may be the best thing; you will not got the same congestion as today. At least some of the citizens can get into town with car in predictable time.

There have been calculations of conversion of the existing bus lane to an HOV lane. This was not recommended because of to much interference from the crossings. The crossings are to many pr km. The public transport would have got too bad conditions.

2.3 Succeed factors

The ultimate measure of success of an HOV lane as an additional lane is its effect on the average occupancy of the entire highway. In cases with conversion of an existing lane the critical measure of success might be that average travel times do not increase irrespective of occupancy.

There are very few cases where it has been shown that this has occurred, notwithstanding that some authorities claim success, in traffic management terms. One contention, as in Trondheim, is that an HOV lane can assist public transport where a conventional bus lane would prove difficult to introduce.

In Leeds they emphasised that they gave priority to 1) existing bus passengers, 2) existing HOV's, and finally to them who changed mode, either to bus or to HOV.

3 Experiences

3.1 Point of departure

The point of departure is important. We have three:

- Conversion of a general purpose lane
- Conversion of a bus lane
- Building of new lane

In Trondheim and Leeds they have converted general-purpose lanes. In Stockholm they have converted bus lane. In Trondheim there are urban conditions, in Leeds semi-urban, and in Stockholm the road are on the countryside.

3.2 Leeds

Conversion of a general-purpose lane to an HOV lane, 1,5 km, arterial road, inbound between Bradford and Leeds. Traffic levels have increased on average 2,2% per annum 1986-1996. This led to congestion problems. The Leeds Transport Strategy does not permit increase in radial capacity, which would result in a further increase in traffic levels. It was important to seek ways of making more efficient use of the existing road network. The savings is about 4-5 minutes.

3.3 Stockholm

In Stockholm there were about 1.200 vehicles in the peak hour towards city, and about 1.500 people. In the bus lane there were additional 30 buses with about 1.000 passengers. 25 cars in the general-purpose lane had 3 or more passengers, which means 2% of the vehicles. The savings in the bus lane was up to 8 minutes.

They have retained their target to increase the 3+ to 4% during 2000 (4 month). A critical moment was the possible delay of the public transport, which means the bus passengers.

The surveys up to now have showed that so has not happened. For 2001 their target is 6% 3+, that means a change of travel mode for 150 people in the peak hour.

3.4 Trondheim

The first Norwegian carpooling lane opened in Trondheim on the 9th of May 2001. The right hand lane on a four lane arterial with a median was converted to a lane for buses, taxis and carpools with 2 or more occupants (HOV 2+). The project is located on Elgeseter gate between the intersections to Valøyvegen and Abels gate. The lane is only an 850 M section of one of the two downtown bound lanes. It is that short because of a left hand turn to the hospital, but this is the part with heaviest traffic.

The before situation was characterized by unstable conditions for all traffic, that also made the public transport very unpredictable. The main rational for this one-year demonstration project is a better utilization of the road capacity.

Some objectives for the project were set:

- A change in travel speed from app 20 km/hour in both lanes to 30 km/hour in the carpooling lane.
- 5% reduction of all vehicles in the arterial and at a minimum just as many persons transported as before.
- 5% reduction in total travel time for the people transported.

In Elgeseter road there were about 1.500 vehicles included 70 buses in the morning peak hour. The 70 buses carried 60% of the people (2450), and the cars 40% (1660). 2% of the cars had 3+ and 25% had 2+, and more than 70% only the driver, similar to Stockholm.

The transport model showed great delays for the remaining vehicles with 3+, and the model could not show great difference with 2+. The local council wished 3+, but the road authority and police recommended 2+. The agreement is 2+ from May to October, and 3+ from October.

A car passenger count was done during the morning rush on May 22-23. I emphasise that this findings not yet is official, they are preliminary and have to be controlled.

This figure shows the travel time in the HOV lane. As we see the peak before eight o clock is gone, but we also se that the savings is less than two minutes.

The next figure shows the travel time in the remaining left lane. As we see the situation is quite similar.

The next figure shows the occupancy before and after. As we see the first findings show that the occupancy has increased, but the results must be worked up some more before they are official.

The share of 2+ has increased by approx 5%. The survey was limited to the road where the HOV-lane has been implemented. Hence it does not tell if car-poolers being attracted from other roads can explain this. As the travel time before and after it is not big differences, that indicate little transferred traffic.

Counts of bus passengers are not available yet. In the HOV lane there are now some more than 500 vehicles in the HOV lane, of which 70 buses. I suggest that their conditions are better than before, and almost as good as an ordinary bus lane. A bus lane they tried to get, but did not succeed.

The Public Roads Administration through a plan for new signing and marking introduced the HOV-lane for the 2+ requirements. The plan was sent to the police and the municipality of Trondheim according to usual procedures. The administration in the municipality decided to present the plan to the Executive committee of local council due to an earlier resolution in the City Council in 1995. At that time a carpooling lane for 3+ was approved, however without saying where it should be implemented. The Executive committee sticked to the former resolution in the City Council for a 3+ requirement.

As a result the Public Roads Administration decided to go for a project in two phases. From medio November the occupancy level will be raised to 3+. If so will happen, we don't know. The 2+ situations seems to work quite perfect...

3.5 2+ or 3+

2+

- As an initial project
- Conversion of a general-purpose lane
- I forstadsområder ved få / ingen alternative ruter
- Where the traffic amount beyond that not reach minimum of public acceptance level
- Under 20 buses / hour
- Reasonable conditions for buses
- Only limited congestion

3+

- Conversion of bus lane
- More than 50 buses /hour
- Congestions
- Corridor with increasing demand
- In arterial roads with alternative routes available

Some thumb rules

- 2+ result in 20-30% of the vehicles can use it on day one, this may result in good public acceptanse
- If there will be congestion in 2+ lane, there are indicia that public transport have to little share.
- 3+ practically work as a bus lane
- It is easier to change from 3+ to 2+ than opposite
- the most efficient will be a huge number of 3+ vehicles, but results show that the best utilization occur with 2+, under the assumption of good conditions for the buses
- Enforcement may be easier with 2+ than 3+, but there are fewer vehicles to control with 3+.

Conversion of general-purpose lanes has been controversial. In arterial areas this conversion have been more pain free. There is understanding that it is not possible to increase capacity in urban areas. One argument is that best effect of HOV lane occur whit conversion of general-purpose lane.

4 Objections

4.1 Bus lane conditions

There are a lot of objections against HOV.

The Norwegian National transport plan emphasise the absolute condition that there must not be disadvantages for the buses, this is actual with conversion of bus lanes. But there are still two opportunities; 1) The present situation will continue 2) The condition of the bus lane can be repaired, and then convert to HOV lane. Now both the bus passengers and the 3+ passengers may get better condition.

If conversion of a bus lane to HOV lane result in 30 sec delay for 100 buses with 40 passengers during a peak hour, this summarize to 2.000 minutes delay, or 33 hour .

But, even in situation as in Trondheim where we make a “bus lane light”, some “publictransportfriends” are negative; they fear that this will be starting of the end of bus lanes.

This is also an argument, which can be used the other way around. In my opinion there have up to now in Norway been quite strict regulations of traffic. With more traffic, and less road space, some more gradations can be reasonable. In Norway all bus lanes, and HOV lane, are in operation 24 hours a day, 365 days a year. That is not necessary for the buses, but the regulations are like this. Perhaps it can be easier to get HOV lanes if they work only in the peak.

4.2 Empty lane

In USA there are focus on the “empty lane syndrome”. In California an HOV lane may have to assure 750-800 vehicles per hour. This is for to prevent the empty lane syndrome. Otherwise they think it is under utilization of road capacity. An analogous recommendation is that there have to a vehicle every 15 second, that mean about 250 vehicles per hour.

Many HOV lanes in USA may be abolished, partly because of the empty lane syndrome.

This is not a subject in Norway, we have bus lanes with 12 buses / peak hour, and that is really empty.

A frequently heard argument against HOV infrastructure in the USA is that these roads are built on public land and financed with public tax money, therefore they have to be equally accessible to everyone. The money from which infrastructure is built can be an important issue for political planning decisions, but probably not in Scandinavia.

4.3 Transferred traffic

An HOV lane is a restrictive measure, which is likely to encourage some single occupant drivers to consider alternative routes. This may be a negative effect if there is re-assignment to residential routes. Opposite some HOV's may come from parallel routes to the new HOV lane.

One fear is that of a modal shift, from public transport to car-pooling if strong incentives for car-pooling are offered. In short-term this may not be negative for the bus operators; in the peak hour they usually do not have unoccupied capacity. In long-term this may led to more vehicles.

Latent and induced traffic is also themes, as they are in Braes paradox and Downs syndrome, which more or less can occur with road enlargement.

If the basis is two general-purpose lanes with traffic flow just upon the capacity limit, this will be efficient. Maybe this will be more efficient than an HOV lane. But, when the capacity limit is reached, the flow is converted to congestion. In this case there may be time for HOV lane to give gains to some of the road-users. And, as done in Trondheim, you may introduce HOV early so the negative impacts of the solo drivers not are too big.

4.4 Who shall get the favours?

In socio-economic mind the vehicle with highest value of time shall get the favour. After buses this may lead to businessmen to and from meetings, delivery vans, I don't know. The problem may be to identify these cars. Other good purposes are electric or gas vehicles.

At least it is quite easy to point out vehicles with 2+, and the signs are quite simple.

The project leader in Leeds emphasised that the HOV lane is primary for the bus passengers, secondly for they who already drove together, and in third place to those who changed mode. The success factor is not to convert drivers to passengers.

5 Transport of tomorrow

In Norway, and in other countries, traffic conditions are both of technical and political interests. I have pointed out that HOV lanes can differentiate among the solutions of to day.

When you enlarge an ordinary two-lane road (one in each direction) to a four-lane road you increase the road capacity more than twice. This occurs because of easier overtaking, and also because of crossings in two levels. Enlarging to six lanes will give more

capacity, but not pass any threshold. In this case the threshold can be reached if the third lane can be an HOV-lane.

A few HOV lanes in USA are combined with HOT lane, that means you can pay a toll to get the advantages. (Houston Katy Freeway is one) The toll varies; small congestions and little use of the HOV lane give small toll, heavy use of HOV lane result in high toll. HOT lanes have made HOV facilities more or less fail-safe. If a 2+ lane are over utilized, it can easily been converted to a 3+. And if 3+ are under-utilised, it can be combined as a HOT lane. The key is to be adaptable.

In Norway we have a border between public transport and private transport. The state is funding the infrastructure, both for roads and public transport. The key for good socio-economic public transport is funding of operation cost. In quite big cities a rule of thumb is 50% grant and 50% from the passengers. In Oslo the grant is about 30%, and Bergen and Trondheim about 5-10%. One problem is that the grant is coming from the county authorities, which are poor compared to the state, and may be the biggest problem; the grant is unpredictable.

May be HOV lanes can conduce to reduce the border between moving cars and moving buses; the main thing is moving people.

I hope I can contribute to get a more adaptable use of road space in Norway. I hope we can get a mixture with bus lanes, HOV lanes 2+, 3+ in the peak hours, general-purpose lanes, and may be HOT lanes in addition to the toll rings we have in our three biggest cities.