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THE EFFECTS OF MAJOR TOLL-ROAD FINANCED INVESTMENTS IN PRIVATE AND PUBLIC TRANSPORT INFRASTRUCTURE ON PUBLIC TRANSPORT

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BACKGROUND AND OBJECTIVE

When the toll ring around Oslo was established in 1990 it was part of a major scheme to speed up investments on the primary road network in and around Oslo, called the "Oslo Package 1". A condition for the scheme was that twenty percent of the revenue be allocated to public transport investments, specifically bus, tram and metro services, in the Greater Oslo area. Further, a parliamentary bill stated that strong emphasis should be placed on public transport even in relation with other road investments that are part of the Package.

Norway has more than 70 years of experience in using road toll payment as a financial instrument for building bridges and tunnels. Up to 1980, less than 5 percent of the total road investments came from toll revenues. Today about one third of the national road investment budget is based on toll fees. The urban toll rings are important contributors to this budget.

This tolling tradition was one background for the toll ring in Oslo. More important, however, was the congestion problem and the fact that increased car ownership, urban growth and a national road investment profile that benefited rural areas contributed to a common

understanding among planners and local politicians that urban infrastructure investments had to be sped up.

The toll ring is located 5-8 km from the city centre. All car drivers must pass the toll ring when they drive from one part of the city to another. Only motorists driving into the city area are tolled, and toll is payable 24 hours a day, all days. The toll ring offers electronic toll collection with the use of on-board units. The share of manual and coin box collection in Oslo has decreased from 40 percent in 1991 to app. 20 percent today. From 2004 electronic toll collection was harmonised throughout Norway. Every toll road now uses the "Autopass" system.

Toll revenues cover 55 percent of the total investments of Oslo package 1, while central government co-funding covers the remaining 45 percent. For the period 1990-2001 the total road investment scheme in Oslo was initially estimated at 13 billion NOK. This figure has doubled due i.a. to demand for higher standards, cost overruns and environmental issues. Table 1 provides some relevant key data.

Table 1: Key figures for Oslo toll ring. Exchange rate: €1 = app. NOK 8

	1990	Current
Population (1000), municipality	461	529
Population (1000), region	880	1024
12 year investment (bn 199-NOK)	13	27
Toll fee, single trip in private car, NOK	10	20
Number of passing cars daily (1000), app.	201	245

The population was negative to the toll ring before it opened, but the opposition is reduced over the years. Two thirds of the population is now in favour of a new toll ring where a substantial part of the income will be dedicated to public transport.

The Norwegian Public Road Administration assigned Institute of Transport Economics to perform an evaluation of the effects of the main road investments in the two biggest cites in Norway – Oslo and Bergen – during the 1990s and up until 2001. The study deals with several aspects (traffic, public transport, safety, environment, urban sprawl, transport industry satisfaction etc). This paper focuses especially on impacts on public transport in Oslo, resulting from Oslo package 1 investments. A paper by Lian (2005a) describes the impacts on traffic and travel behaviour in both cities. Parts of the background material presented here is similar to that of Lian's.

The objective of the present study is to separate out the effects on public transport that are attributable to the Oslo Package 1. When the developments in some key statistics, like total demand, modal shares etc are presented, they must be corrected for the effects of other factors

than Oslo package 1 that affect them. In addition to presenting developments of key statistics and analyses of econometric modelling, representatives of the two main public transport organising bodies in the region have been approached and given the opportunity to present their views of and experiences with the investment scheme. They are Oslo Metro (OS) and Greater Oslo Local Public Transport (SL). But firstly, some main features of the investment scheme are presented.

INVESTMENT PROJECTS WITHIN OSLO PACKAGE 1

The investment programme covered the period 1990 to 2001 and had initially a total budget of around NOK 13bn including financial costs. A strategy which was kept throughout the period was to start with the inner or more central areas. A larger share of planned projects were implemented here than e.g. the outer southern and western corridors. Annex 1 is a map where the projects within Oslo are shown.

Important aspects of the investment scheme were increased road standard and raised speed limits. In Oslo, a new road tunnel close to the CBD now connects the western and southern/ eastern part of the city. There are also new tunnels from north and east into the city. Other main investments were large improvements on the outer ring road (Ring 3) and some road projects in the county of Akershus which surrounds Oslo.

The single most important public transport investment project inside Oslo was the linking of 4 eastbound metro lines with another 4 westbound lines. These were previously not linked, but originated in two distant parts of the city centre. The new connection is regarded as a particularly important quality improvement of the public transport network. Other important public transport schemes were the extension of a metro line and a tram line, a new tram line, bus lanes and new terminals at major interchanges.

In Akershus county, which surrounds Oslo, all public transport investments were either related to interchanges or to bus lanes. The interchange projects include bus-bus, park and ride, train-bus and metro-bus relations.

Oslo package 1 investments in public transport in Oslo and Akershus are illustrated in Annexes 2 and 3.

EFFECTS OF OSLO PACKAGE 1

Competition between public and private transport

As a rule of thumb, public transport can only compete effectively with the car if its door-to-door travel time is less than twice that of the car. Spørck and Johnsen (1999) analysed this general rule. Figure 1 is taken from their study and shows clearly that relative travel time plays an important role in determining modal shares. The relative travel times are quite favourable for public transport because of the relatively long distance into the city centre, long sections with bus lanes and good train connections. The figure also shows the importance of the interchange penalty.

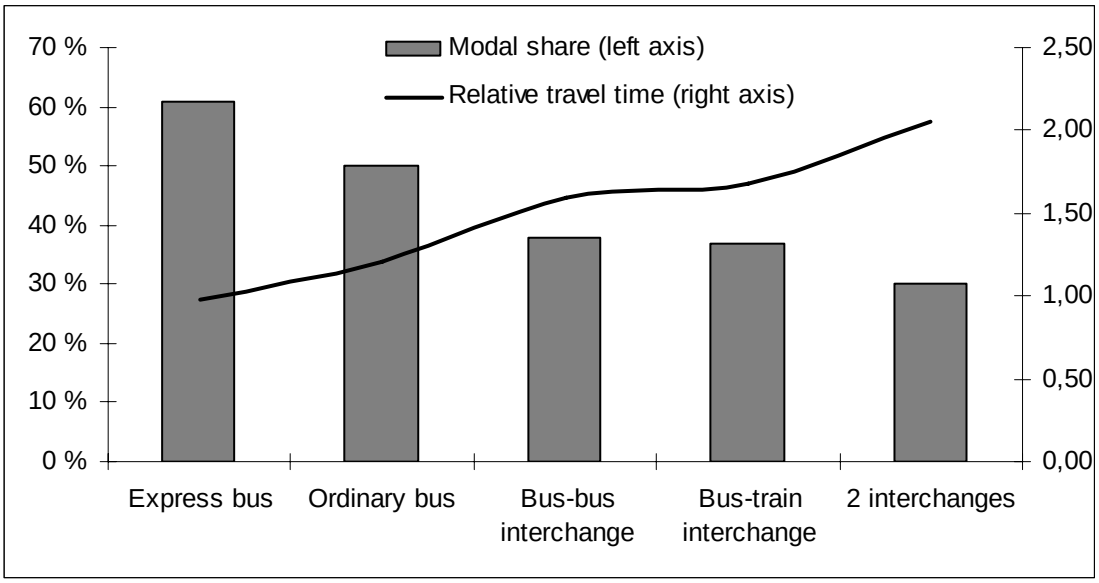

Figure 1: Relationship between modal share and relative travel times. Morning commuting trips. Case: Corridor from west into Oslo. Source: Spørck and Johnsen (1999)

The question then arises: To what extent has Oslo package 1 altered relative travel times? The answer is not clear. On the one hand, the massive investments in tunnels, bridges and dual carriageways have sped up car travel times, leaving public transport less competitive. On the other hand public transport speeds have also increased as there is now less traffic on the secondary road network, which is mainly used by buses. Metro lines that serve local suburbs are probably the losers in this battle. Much of the road network which serves these areas has been upgraded and offers superior travel times.

Reduced congestion was a main goal of the investment package. In Oslo, car travel times have been measured on a yearly basis on 18 routes since 1990. Over time there are only minor

changes in travel times and delays. In total, there is a small improvement in average speed during the morning rush hour, but no significant changes in the afternoon. The continuous struggle between traffic growth driven by urban and economic growth, and road capacity is illustrated by figure 2. By 1995 many larger road projects were finished. In the years 1995-1997 there was a period of strong traffic increase driven by an economic upswing. Around 2000 a new bulk of projects was finished, improving the situation for a short while.

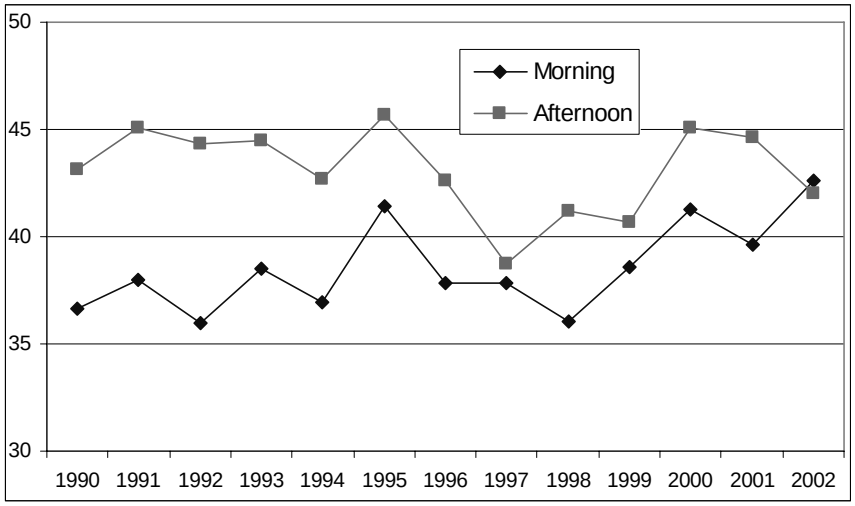

Figure 2: Average travel speed (km/h) for peak traffic in Oslo. 1990-2002.

Travel time improvements have occurred along the outer ring road (Ring 3). To the north, average travel speeds are also relatively high. To the south, delays have increased due to population growth. To the west, the situation is relatively unchanged. Delays here are still the largest in the region. A peak-hour round trip from west has in total an average of 30-40 minutes delay, depending on the route.

The numerous measures for higher driving speeds have improved the condition in particular for the ¾ of the traffic which runs outside rush hours. Car travel is now perceived as more convenient and predictable. In Oslo, off-peak travel time along the outer ring road (Ring 3, 18 km) has been reduced from 18 to 14 minutes.

Modal shares

Travel surveys are available for different years of toll ring operations. A postal survey was undertaken in 1989 just before the opening of the toll ring. A national telephone survey with an extra sample for Oslo was carried out 2001. Walking and cycling is excluded from the analysis since there seems to be a considerable amount of underreporting of such trips in the 1989 postal survey. Looking just at motorised transport, there is a small shift towards more car travel. The public transport share in the region is reduced from 27 percent to 23 percent.

These figures correspond almost exactly with traffic statistics on the city border. See figure 3. Although the number of passengers has increased, public transport modal share has fallen steadily due to faster growth in car use.

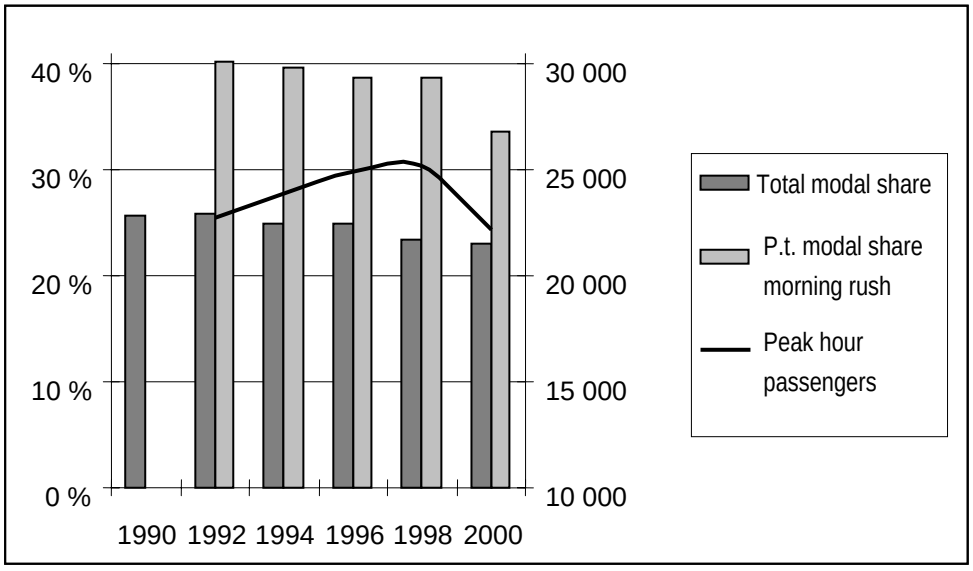

Figure 3: Public transport modal share

There seems to be no clear link between where road investments take place, and where changes in public transport market share occur. However, the car clearly seems to get increasing importance in the outer parts of the city. See figure 4. Further, the share of trips within the outer parts of the region (outside the toll ring), is greater than before (from 45 percent to 55 percent of all motorised trips). Thus, urban sprawl seems to act as a structural change that leads to increased car travel. To what extent road investments contribute to speed up urban sprawl is difficult to tell.

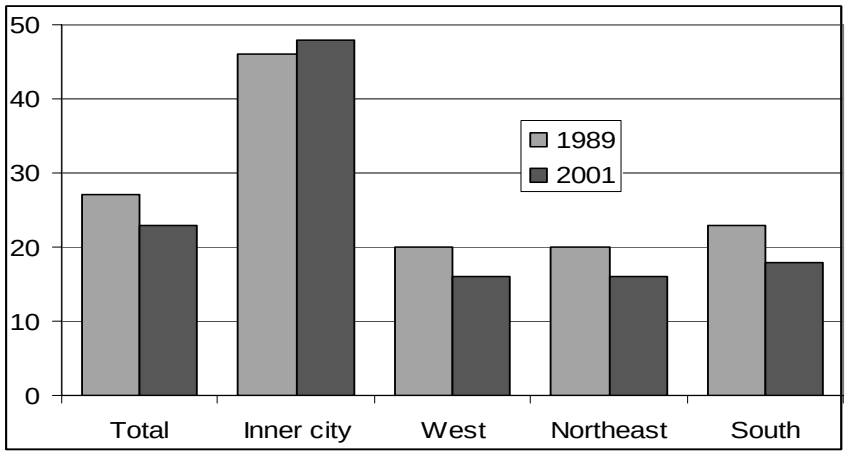

Figure 4: Public transport in Oslo region by area, 1989 and 2001. Percent of total motorised transport.

Car traffic growth

Early studies of the traffic impacts of the toll rings indicate about 3-5 percent traffic reduction (Ramjerdi 1995). During the 1990s the Oslo region experienced car traffic growth in line with national growth rates (+ 1.9 percent per year) despite a much stronger increase in main drivers of mobility, like population, employment and income (Lian, 2005a). See Table 2. This leaves, according to Lian, little support for induced traffic effects of road investments, even though Oslo's share of national road investments increased from 11 percent before the investment package to 23 percent after. His interpretation is that the total volume of car traffic only to a minor extent is influenced by the investment programme.

Table 2 Growth in traffic, population and employment in the Oslo region, 1990-2002. Percent. Source: Lian (2005a)

	Greater Oslo	Norway
Population	13.7	7.1
Employment	15.4	10.4
Private cars	21.4	17.8
Traffic (vehicle kilometres)	40.0	44.0

Looking at different parts of the city, traffic growth in outer parts of Oslo was stronger than in the inner parts. The surrounding county Akershus experienced a traffic growth of 2.5 percent per year in the period 1990-2002, whereas Oslo had a growth of only 1.1 percent per year. However, due to urban sprawl Akershus experienced a much stronger increase than Oslo in the drivers of mobility, such as jobs and population. Especially the number of jobs in Akershus grew fast during the period 1990-2002.

Patronage growth

During the 1990s demand for public transport was relatively stable in most Norwegian cities. In Oslo, however, this period was one of sustained patronage growth. See figure 4. The 1990s was also a period of patronage growth in Akershus, although with some more fluctuation

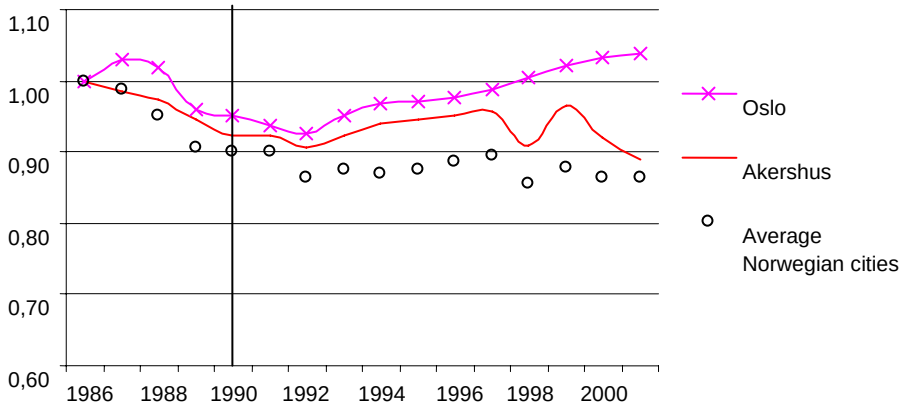

Figure 4: Development in public transport demand in Oslo, Akershus county and average for Norwegian cities. 1986=1.00. Note: strike in 1998.

Fearnley and Carlquist (2001) developed a demand model in which public transport patronage is explained by changes in income, petrol prices, fare levels and service levels. The model explains variation in patronage relatively well for most Norwegian cities, but this is not the case in Oslo. This is shown in figure 5. During the 1990s there is considerable discrepancy between modelled and actual patronage. The model under-estimates demand levels for most of the 1990s. This means that there must be a positive demand effect of omitted variables during the 1990s. Lian (2005b) has suggested with considerable strength that the unexplained growth is attributable to the public transport quality improvements, which were parts of Oslo package 1. In particular, the linking of the eastern and western metro lines, the new tram lines and the extensive network of bus lanes represent major quality improvements that are not included in the model. The public transport investment schemes of Oslo package 1 have, in conclusion, generated substantial new demand for public transport.

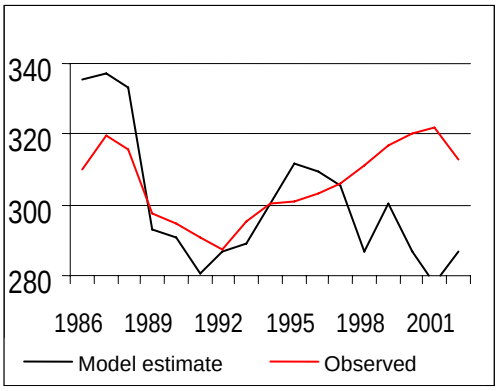

Figure 5: Comparison of modelled and observed demand in Oslo based on the Fearnley and Carlquist (2001) model. Trips per capita

Operating costs

Improvements in the principal road network in general, and bus priority measures in particular, have given rise to higher bus operating speeds. This has again paved the way for new regional express bus lanes. As an example, the Greater Oslo operator, SL, reports that they were able save one or two buses on one single express route from West into Oslo.

In central Oslo, car traffic growth has outweighed the benefits of infrastructure developments. This is especially true for rush hour traffic. On the other hand, peak operating speeds would have deteriorated to even worse levels without the investments, so the net effect is probably an improvement. Operating speeds are, however, generally higher or unchanged outside the peaks.

Inside Oslo, the growth in metro train mileage was higher than the increase in bus and tram production. This is probably a result of the infrastructure improvements. The cost of metro operations is higher than that for bus. For this reason the developments in operating costs in Oslo are not as favourable in Oslo as they are in Akershus. See figure 6, which shows that operating costs in Akershus fell early in the period and remained stable until they increased again in year 2000.

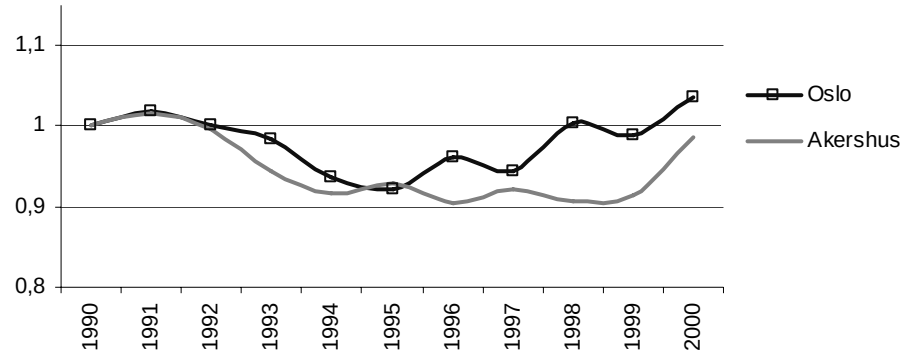

Figure 6: Developments in operating costs per vehicle kilometre. 1990=1.00

CONCLUSIONS

The toll road financed investment scheme in Oslo during the 1990s has affected public transport performance and patronage in several ways:

- The introduction of the toll ring led to an immediate 3-5 percent reduction in car traffic.
- Growth in car use is regarded as modest in light of the major improvements of the primary road network and the strong growth in drivers of demand for car (income, employment etc.). There is as such little evidence in our data of induced traffic
- Operating speeds have increased for both buses and cars. The ratio of travel times between bus and car during off peak periods has not been favourable for public transport.
- Public transport modal shares have fallen steadily during the 1990s despite sustained public transport patronage growth in the period. Car use has increased even more rapidly than public transport.
- Road infrastructure improvements have reduced operating costs, particularly in outer Oslo. Metro infrastructure improvements in Oslo have led to increased metro operations, which again have increased total operating costs in Oslo.

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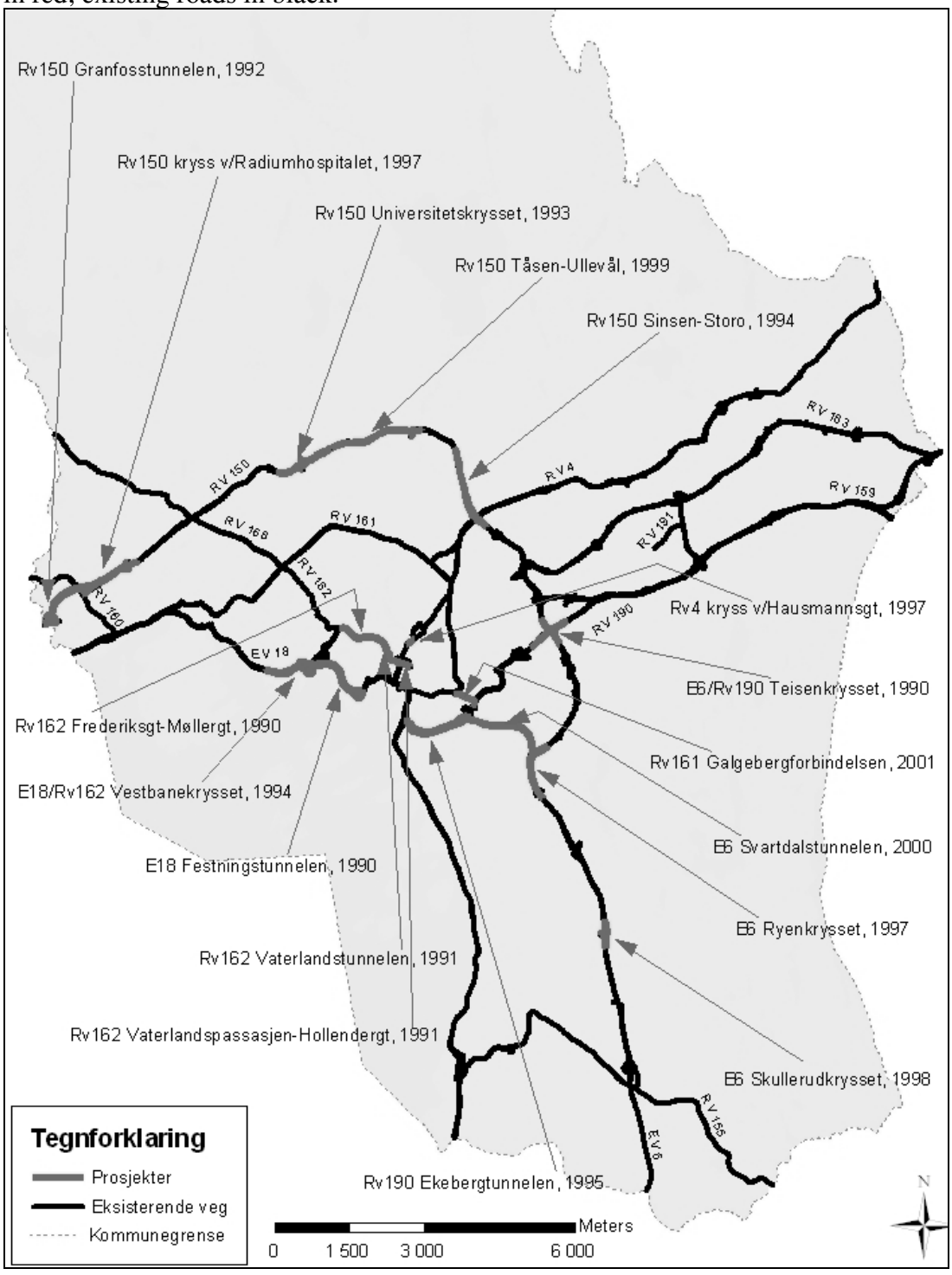
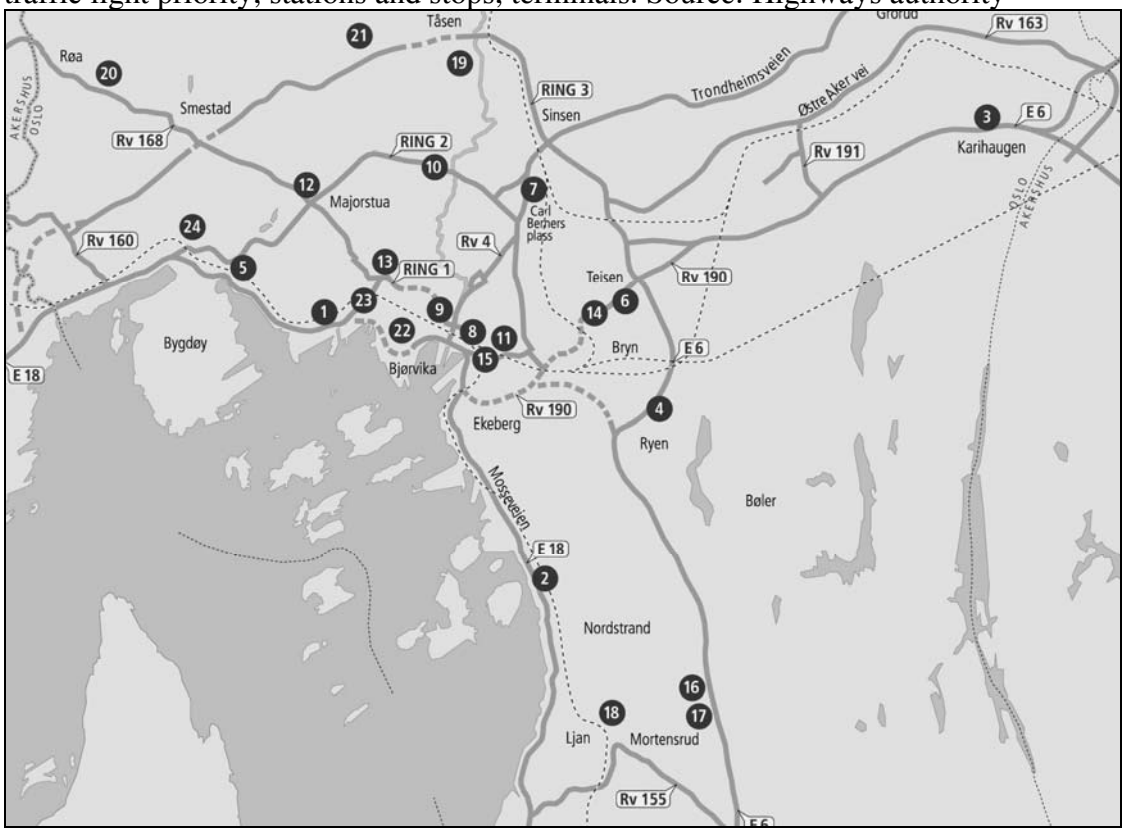
ANNEX 1

Road investments in Oslo within Oslo package 1, and year of completion. Projects are marked in red; existing roads in black.



ANNEX 2

Public transport investments in Oslo within Oslo package 1. The projects include bus lanes, traffic light priority, stations and stops, terminals. Source: Highways authority



ANNEX 3

Public transport investments in Akershus county within Oslo package 1. The projects include bus lanes and interchanges. Source: Highways authority