Concept Symposium 2016
Governing the Front-End of Major Projects

The trade-off between private and public funding of transport infrastructure

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Toll financing in Norway has a long tradition and is today an integrated part of the total financing of national and county roads. Local initiatives form the basis for planning and approval of toll road projects. The process with political commitment on several levels is probably one of the reasons for the relatively broad political consensus on the use of tolls.

However, road tolls can be more expensive than public funding through taxes, and there are trade-offs related to both the share of toll financing, the length of the toll collection period and the level of tolls. This is a complex issue and the net effects may vary according to the characteristics of each project.

In this study, transport models are used to predict the generated traffic by those who live in a given area; which destinations that are chosen; which means of transport that are being used; and finally the routes that are used to get there. For each of the areas we have statistical information about the number and types of jobs, and an overview of age, gender, car ownership and a travel patterns for different population groups. The information contained in the models gives a good starting point to calculate the road users' reaction to tools, and hence the society's gains and losses from such measures.

The study concludes as follows: High tolls in projects with relatively low traffic reduce the socio-economic profitability, compared with public funding. In some projects, there may be "thresholds" in the market that should be considered before any tolls are set. Such thresholds may be linked to choice of route and probably also to potential induced traffic. In such cases, tolls that are only marginally too high can reduce the socio-economic profitability significantly.

There may be significant distributional effects between the toll projects and operators in adjacent transport networks, which should be paid attention to in the appraisals. For example, diverted traffic could affect adjacent toll projects and ferry services.

Tolls may be desirable to public funding in projects with high traffic levels and low toll rates, especially where there are tendencies to congestion in or around the project. In such cases, the toll may also have a positive traffic regulating effect.

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Agenda

- Introduction: Toll financing in Norway
- The costs of public funds and of toll financing
- An approach to identify these costs in case studies
- Findings from 4 case studies
- Concluding remarks

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Backdrop

- Norway has had a strong economic growth, however with the credit crunch (2008) and the oil price drop (2014-) as setbacks
- A significant traffic growth causes bottlenecks to emerge, the roads are in some places not up to standard and hence there is a need for investments to ensure long term productivity and welfare (in some respects controversial; there is an ongoing discussion about the need for reduced transport for environmental reasons)
- There is also a need for optimising the use of today's transport network (less controversial)
- Access to financial resources for transport infrastructure investments may not be the main challenge, but rather to ensure that the right investments are made, and to avoid over-heating of the national economy
  - Toll funding may withdraw purchasing power from the private sector (however fiscal taxes will do the same)
  - Incentives to propose projects that relieves the public budget constraints, investments can be made earlier
  - But no 'quick fix', there are costs connected to toll funding, and the right projects, based on economic analyses, still need to be selected

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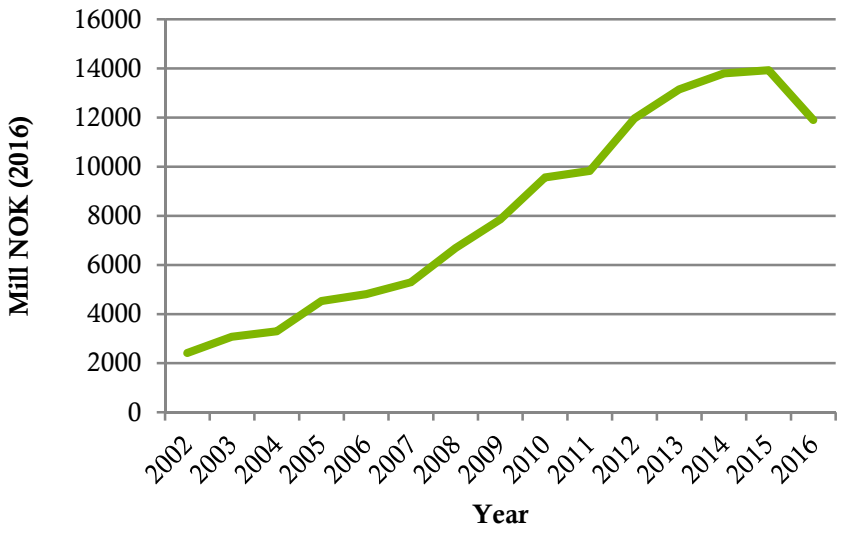
Introduction: Toll financing in Norway

- Modern toll financing in Norway roots back to the 1930's
- Currently, toll financing counts for ca. 35 % of the road investments (NTP 2014-2023)
- Toll financing grows stronger than public funding
- 80 % of the larger road investments under QA2 is wholly or partly funded by tolls



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Introduction: Toll financing in Norway

- Toll financing is evaluated and a Proposition for Toll Funding (PTF) is made to the Storting for approval
- The PTF are rarely controversial because of the nature of the preceding political/administrative process
- It is worth noting that until now, a toll funding assessment has not been demanded as a part of the Conceptual Appraisal Report (KVU)
  - Hence, the calculations of the road user benefits could become upward biased. This practice is now under revision.

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The costs of public funds and toll financing

- Cost of toll financing (CTF):
  - Allocation loss in the traffic market (dead weight loss (DWL), network effects)
    - Is likely to vary among projects
  - Toll collection costs
  - Cost of capital
- The costs of public funding (CPF)
  - Net DWL in all markets ("the fiscal tax wedge")
  - Is assumed to be 20 % for all projects in Norway, forms the basis for comparison between CTF and CPF
    - This could be discussed on the ground that fiscal taxes could (1) increase overall welfare through redistribution and (2) the project could increase the tax base.

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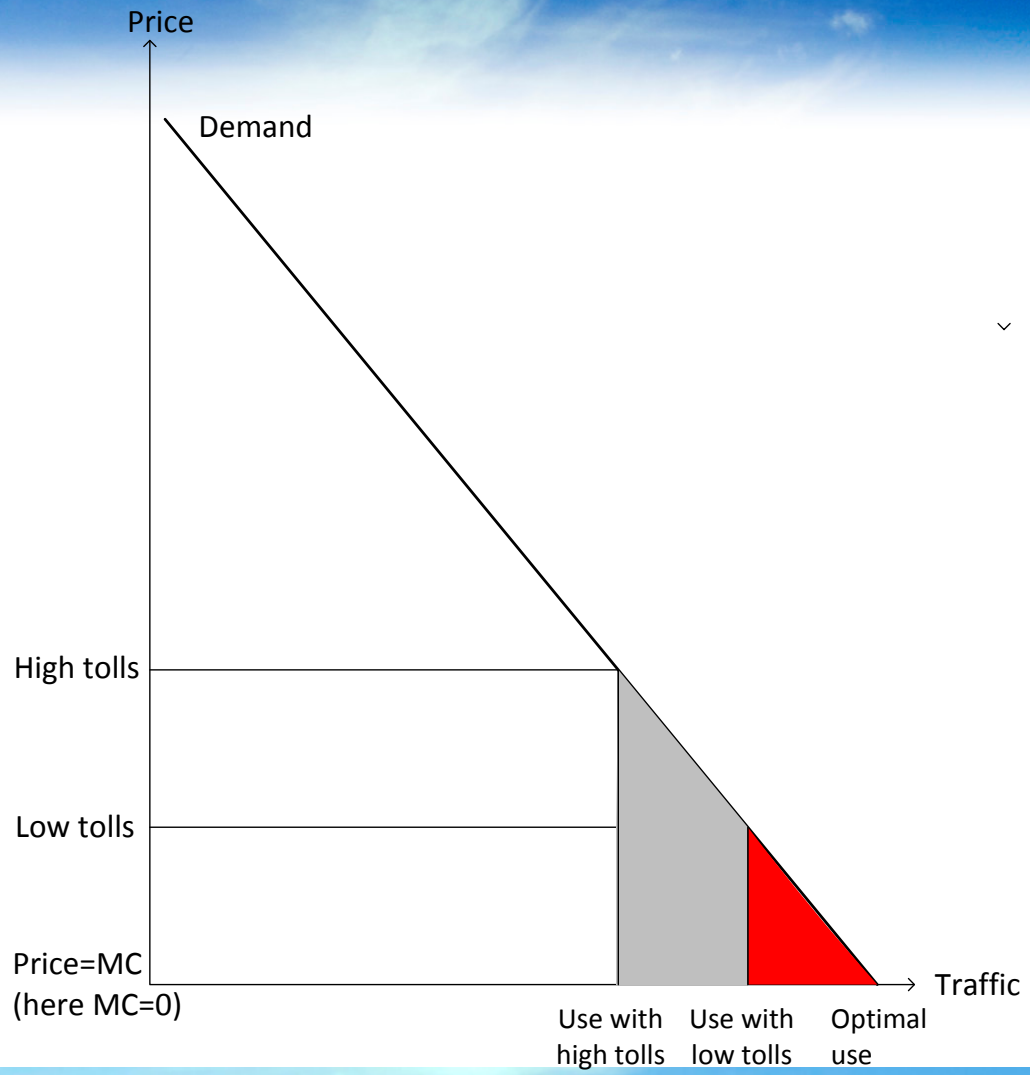
Cost of toll financing: Deadweight loss (DWL) in the traffic market

- DWL increases over-proportionate with the toll level
- DWL becomes less in inelastic markets
- Elasticities <-0.03, -2.26>, around -0.5 on average. Varies with travel purposes, trip lenghts, frequency of travel etc.



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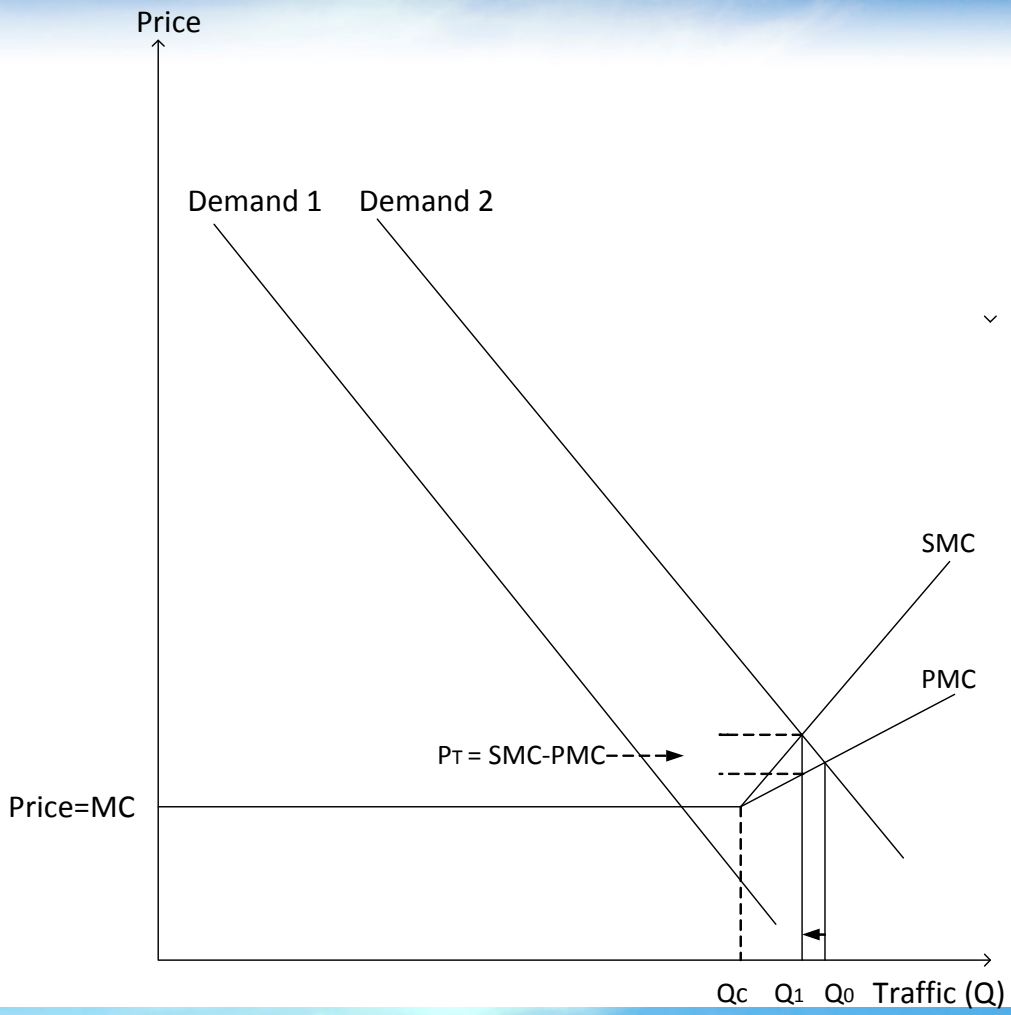
Cost of toll financing: Adjacent parts of the network may become affected

Traffic demand «elsewhere»:

- No road tolls combined with induced traffic might cause bottlenecks elsewhere (Demand 2 includes the induced traffic)
- Bottlenecks (constrained capacity) causes SMC > PMC, a toll P_T corrects this and traffic reduces from Q_0 to Q_1.
- This effect is then fed back to the project as an increase in travel cost and hence the road user benefits are (slightly) reduced.



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Costs of toll financing

Costs with toll financing $C_T = \alpha * I + (1-\alpha) * \lambda * (I-R) + DWL_a + c_i$

Where

α = share of investments with toll financing,

λ = marginal cost of public funds,

I = investment,

R = change in public sector revenues ,

DWL_a = deadweight loss

c_i = toll collection costs

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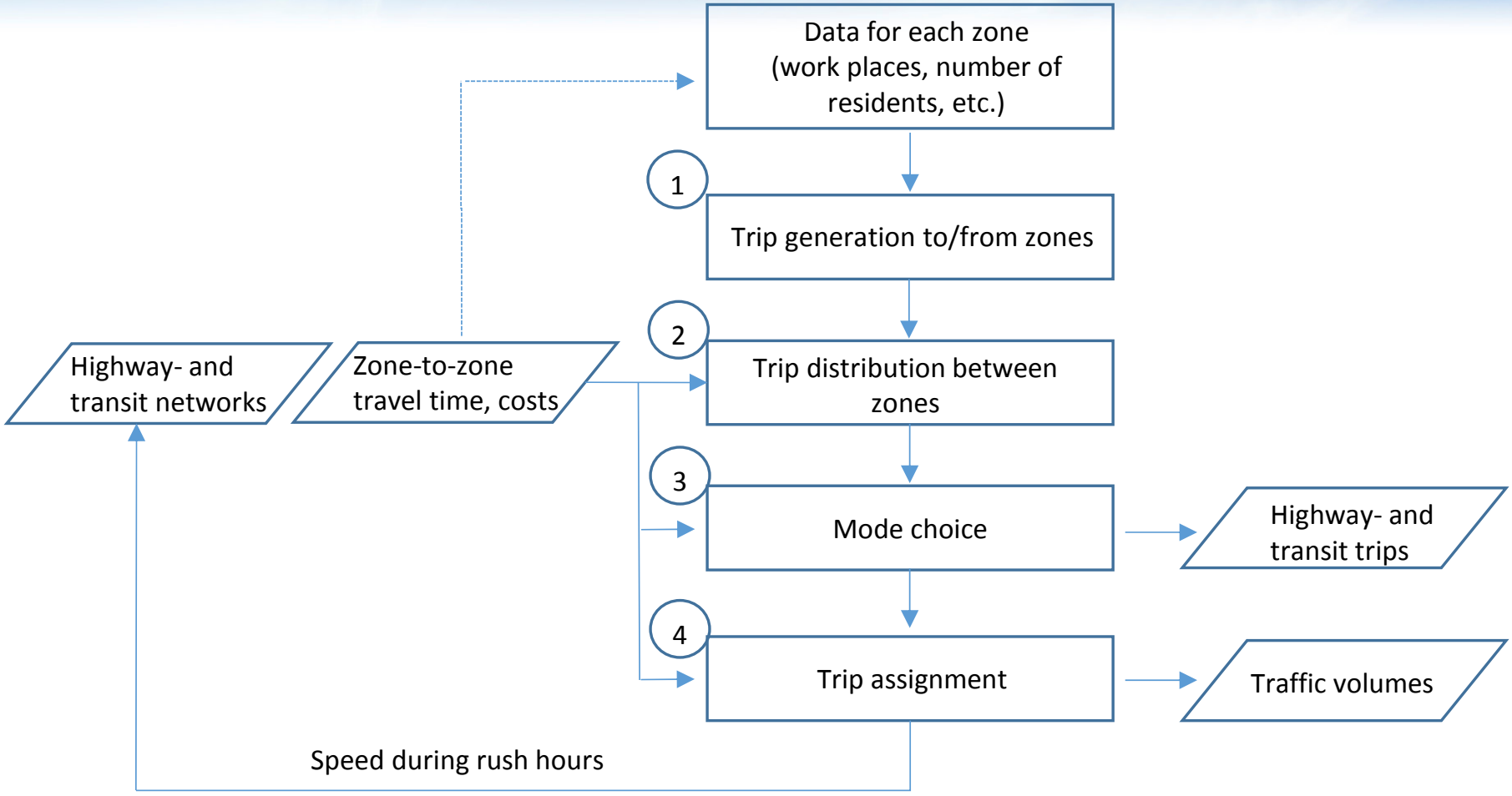
Case studies: a transport modelling approach



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Transport modelling

- Trips are modelled zone to zone for different travel purposes (Business, to/from work, leisure, other private purposes) and modes (Car, public transit, walking/cycling, air transport).
- The models exists for two geographical levels, (1) regional and urban travels, (2) long-distance travels.
- The model uses data on network distances, travel speeds and costs together with register data on workplaces, employment and households and travel survey data which gives information about travel patterns for various segments of the population
- The models should be able to reproduce the current travel behaviour (measured by traffic counts) and in such cases scenarios where network layout and various toll schemes can be simulated and assessed, including DWL calculations.

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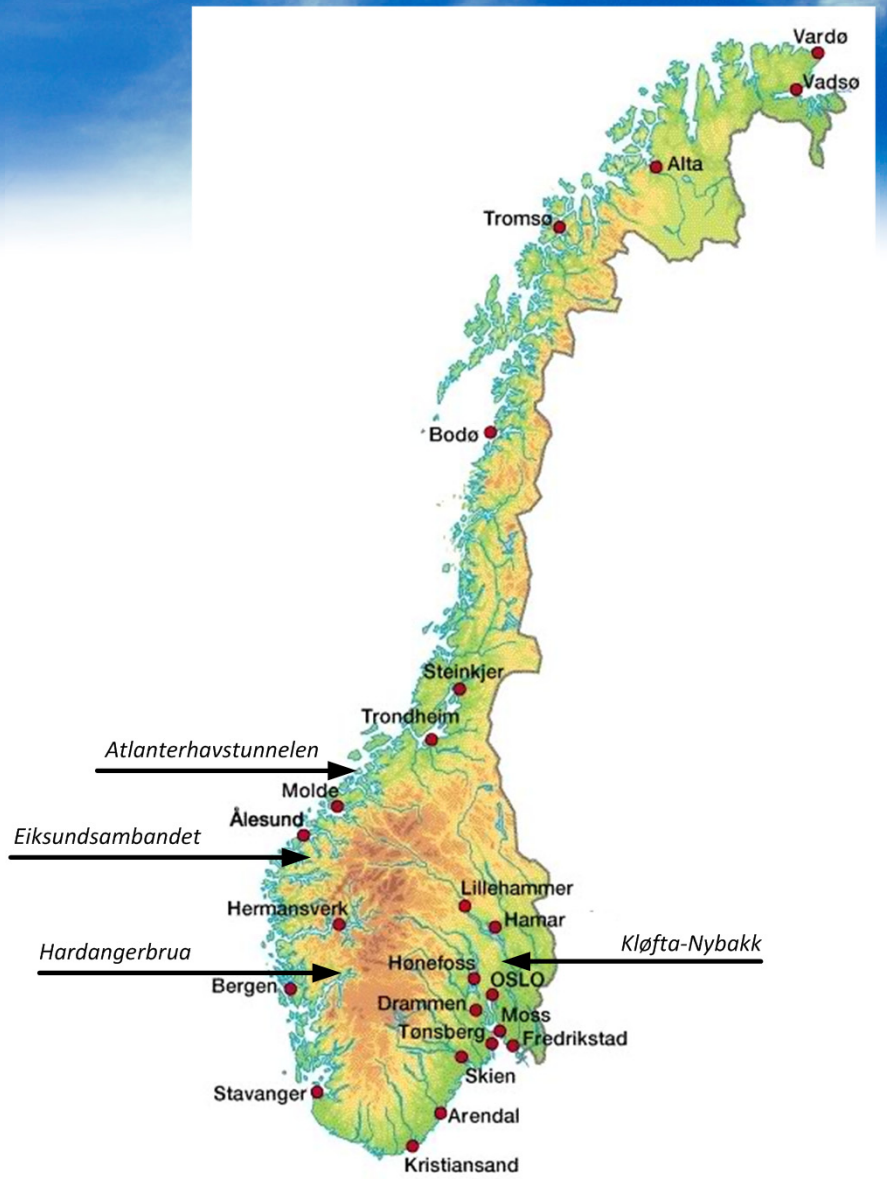
4 case studies

- *Eiksundsambandet*, a fixed fjord link (subsea tunnel) in the north-Western part of Norway, dominated by short distance trips. AADT=2500, toll=NOK 76/car. Investment MNOK 970 (2010), 18% toll funded.
- *Atlanterhavstunnelen*, a fixed fjord link (subsea tunnel) not too far from Eiksund, but closer to a city centre, dominated by short distance trips. AADT=2000, toll=NOK 85/car. Investment MNOK 880 (2010), 25 % toll funded.
- *Hardangerbrua,* a fixed fjord link (suspension bridge) connecting the east and western parts of Norway, dominated by long distance trips. AADT=1700, toll=NOK 150/car. Investment MNOK 2400 (2014), 65 % tolls and local funding.
- *E16 Kløfta-Nybakk*, a highway improvement project in a densely populated area. AADT=9300, toll=NOK 20/car. Investment MNOK 744 (2014), 60 % tolls.



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Research questions

- What are the total costs of toll financing and how does these compare with the cost of public funds?
  - One of the cases (Hardangerbrua) will be presented in some detail, together with the main results from the rest of them
- What are the optimal toll level in these four cases?
- How has toll funding been treated in the cost-benefit analyses?

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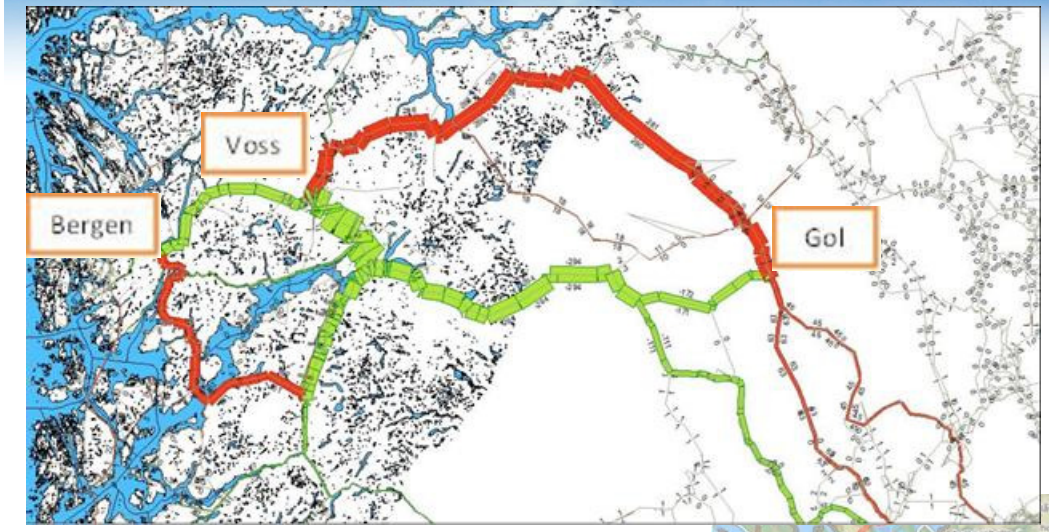
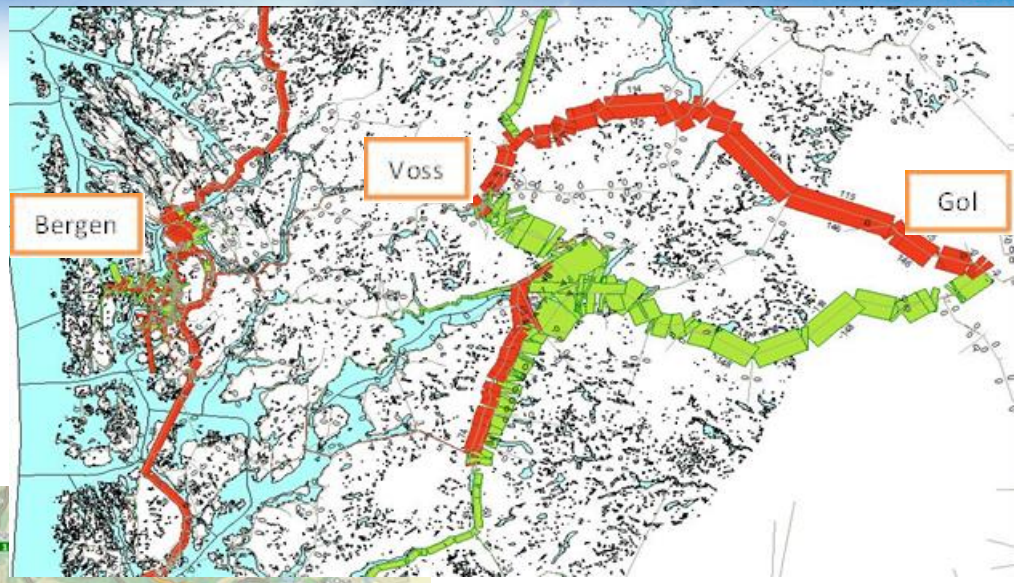
Hardangerbrua - route choice, comparison tolls=NOK 150 with no tolls

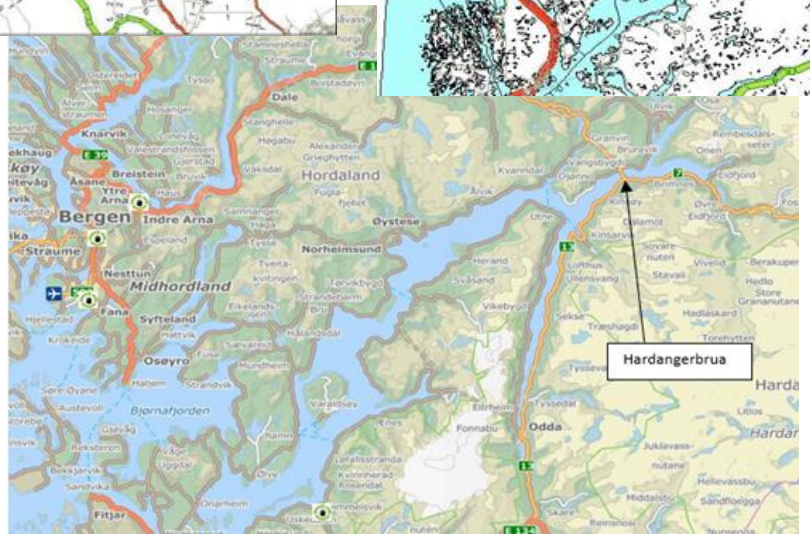


Longer trips



Shorter trips

Green=reduced traffic
Red=increased traffic



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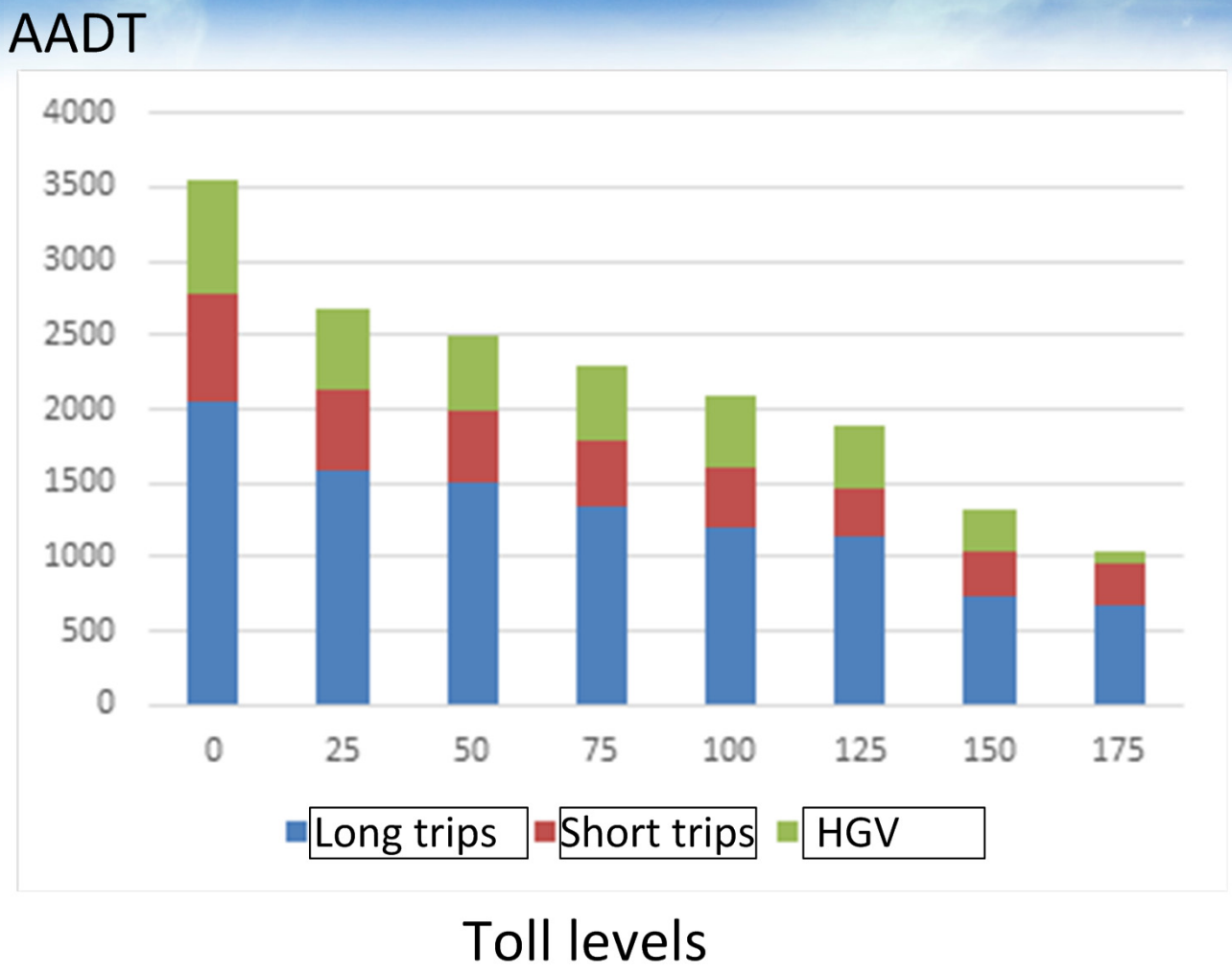
Hardangerbrua – toll levels (NOK) and traffic (AADT)



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Economic impact assessment, Hardangerbrua. MNOK, for 2014. *Relative to tolls=NOK 150*

Tolls	User benefits, short trips	User benefits, long trips	User benefits, HGVs	User benefits, total	Toll revenues, Hardangerbrua	Other network revenues (toll + ferry)	Revenues, total	20 % tax wedge	Sum socio-economics
0	23	92	72	187	- 90	-55	-145	-29	13
25	16	79	57	151	-60	-55	-115	-23	13
50	11	65	45	120	-34	-49	-83	-17	21
75	8	50	33	91	-10	-52	-62	-12	17
100	5	33	21	60	9	-42	-33	-7	20
125	2	22	10	34	20	-31	-11	-2	21
175	-2	-7	-3	-13	-27	-4	-31	-6	-50

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Hardangerbrua, comparison with today's toll level. Conclusions

- Toll revenues and economic benefits can be increased by reducing the toll level somewhat
- A stronger reduction in tolls redistributes benefits between road users and the toll company, still with economic surplus
- A reduction in tolls to NOK 125 could increase the share of toll financing from 46 % to 56 %, given a 15 years collection period
- The need for public funding (including cost of public funds) seems lowest with tolls=NOK 125.
- The economic benefits seems to be highest with tolls=NOK 50 and NOK 125.

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Main findings from the other cases: Eiksundsambandet – comparison with *ex ante* ferry service

- The road user benefits are reduced from MNOK 110 per year with tolls=0 to around MNOK 40 with the actual toll of NOK 76. This is a 65 % reduction.
- Some of this is redistribution between road users and the toll company, but some is due to reduced traffic.
- The annual economic net benefit is reduced from 50 MNOK/year (tolls=0) to 10 MNOK/year (tolls = NOK 76), which amounts to a difference of around 450-500 MNOK for a 15 years period.
- Indications of that higher tolls during a shorter time span may increase the economic net benefit

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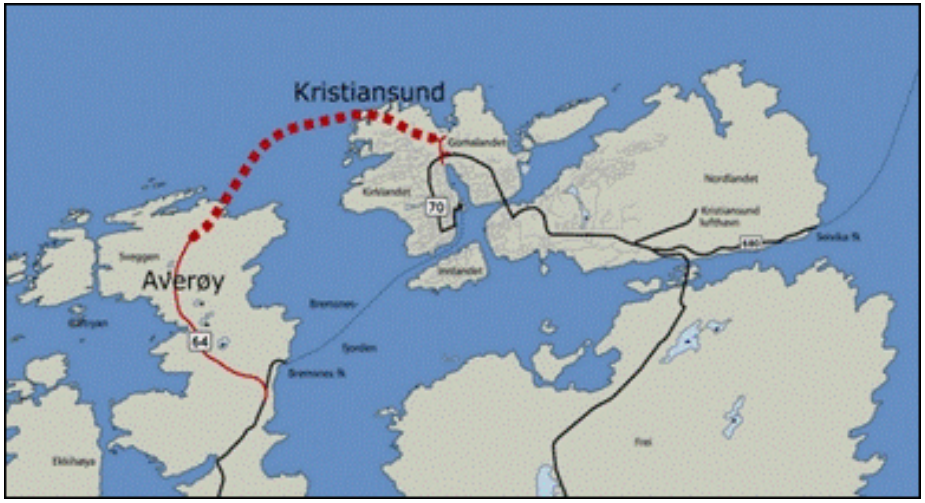
Main findings from the other cases: Atlanterhavstunnelen – comparison with *ex ante* ferry service

- The road user benefits are reduced from MNOK 145 per year with tolls=0 to around MNOK 45 with the actual toll of NOK 85. This is a 70 % reduction.
- Some of this is redistribution between road users and the toll company, but some is due to reduced traffic (from AADT 5800 to AADT 1750).
- The annual economic net benefit is reduced from 85 MNOK/year (tolls=0) to 25 MNOK/year (tolls=NOK 85), which amounts to a difference of around 650-700 MNOK for a 15 years period.
- Test with a realistic slightly congested situation in the adjacent city of Kristiansund suggest an «an optimal» toll of NOK 20 (gives highest net benefits)



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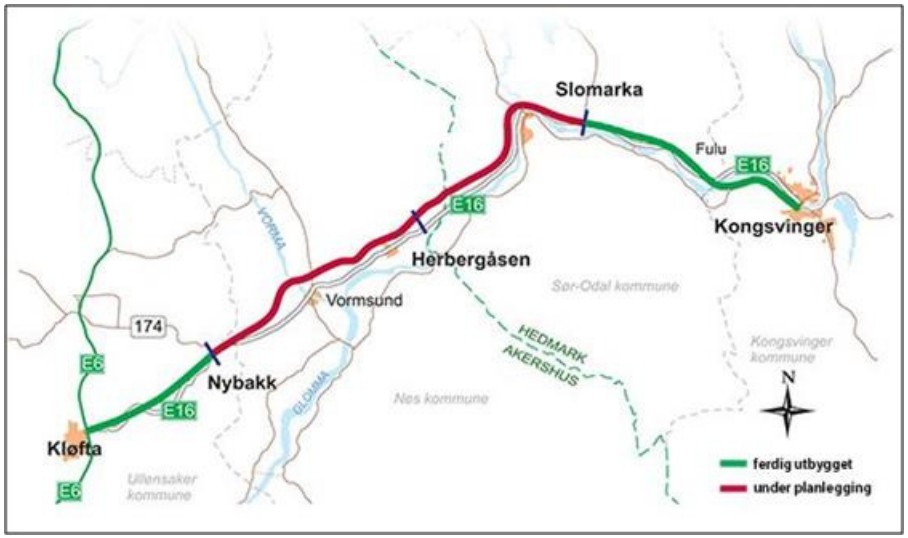
Main findings from the other cases: E16 Kløfta-Nybakk – comparison with today's toll level (NOK 20)

- The road user benefits increases with around MNOK 55 with tolls=0, with a corresponding reduction in toll revenues
- There is a redistribution between road users and the toll company, with little traffic effects
- The annual economic net benefit shows little variation with the toll levels, but a toll=0 shows a negative discounted net benefit of around NMOK 100
- Taking collection costs into consideration, the difference is small.



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Main conclusions

- High tolls in relatively thin traffic markets with short and price sensitive travels reduce the economic profitability of the projects, compared with public funding. In our cases, the loss amounts to MNOK 500-700, discounted over 15 years
- In some traffic markets, there are clear signs of «thresholds» where route choice effects and/or induced traffic come into play. One should be aware of such effects when the toll collection scheme is designed. In the case of Hardangerbrua, a slight reduction in the toll level could increase the discounted net benefit with around MNOK 250
- In denser traffic markets with lower tolls and congestion tendencies, tolls could be both an economically profitable source of funding and a means for traffic regulation
- An optimal time-varying toll may however not increase the toll revenues as compared with a fixed 24/7 toll rate.

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Main conclusions

- Tolls are affecting the road users' benefits, and they may in some cases (high tolls in thin markets) limit fulfillment of objectives with respect to regional integration/integrated labour markets. Some of the larger projects where Wider Economic Impacts are claimed, falls into this category.
- Not including user benefit effects from toll funding in the economic analyses will cause a biased Net Present Value
- A lot of resources are used on planning and QA on tolled projects, but paradoxically the economic impacts of tolling are not included in a systematic and transparent way
- The discussion about funding should not blur the discussion about selecting the good projects, and funding should indeed be a part of the economic analyses as input to the decision-making process, in the early stage as well.

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A selection of weaknesses and uncertainties

- Models are always encumbered with weaknesses:
  - The effects of larger changes (like effects of removing high tolls) may be biased
  - The models results are equilibria, it may take time to reach them and this is not counted for in the discounting
- Data are uncertain with respect to robustness and representativeness. This is a larger problem in sparsely populated areas, perhaps like roads leading to smaller islands
- In some cases, the equilibria might be unstable, like in the case of Kløfta-Nybakk