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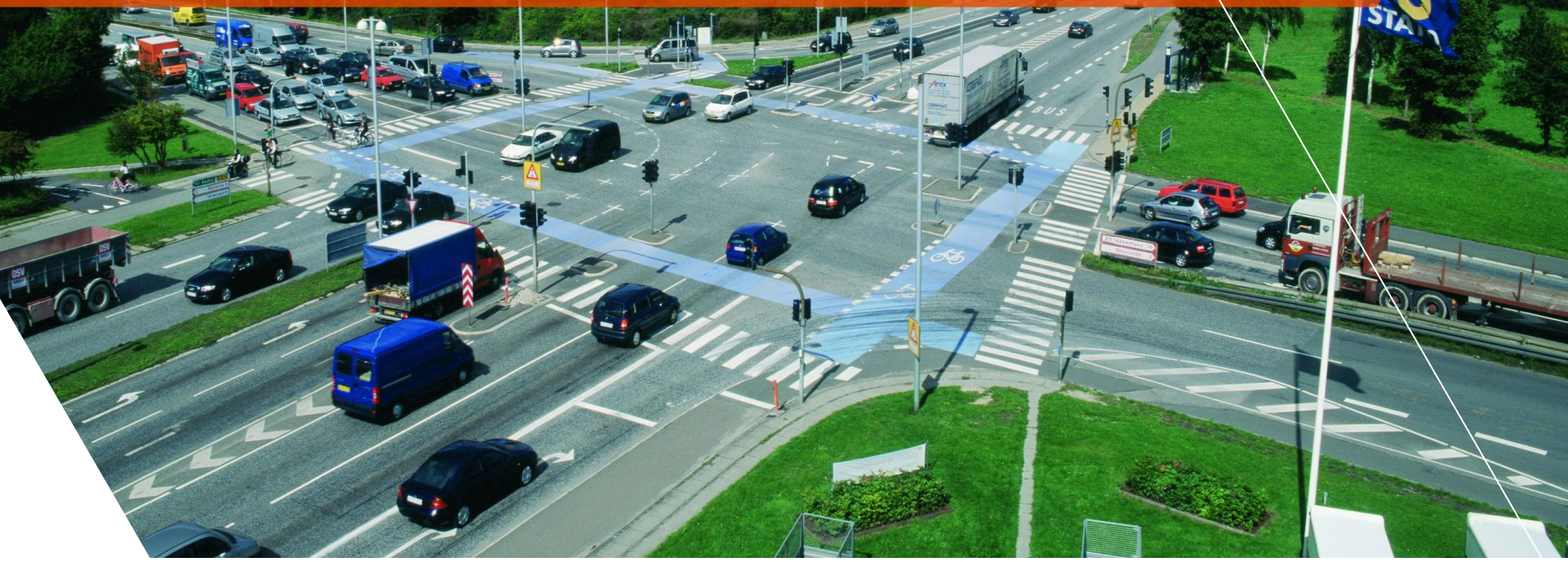
Traffic signals
Socio-economic effects and CO2-emissions

Steen Lauritzen, Vejdirektoratet

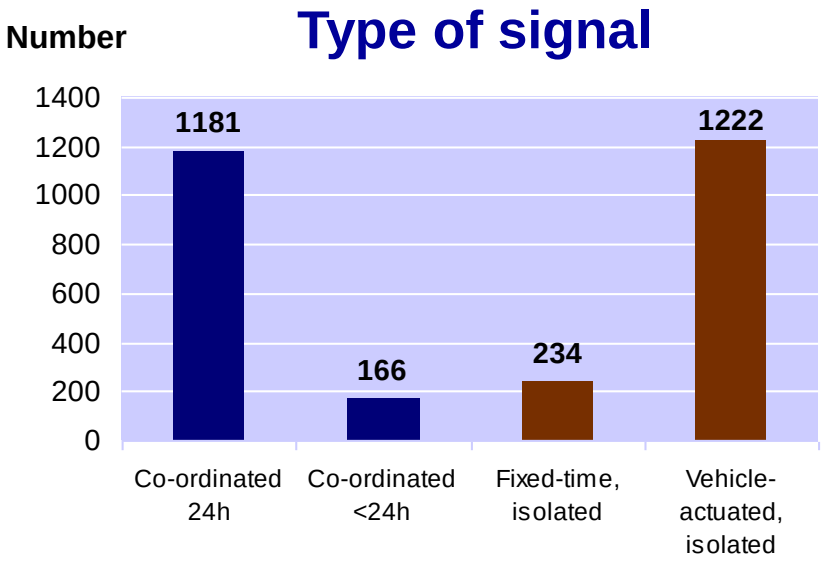


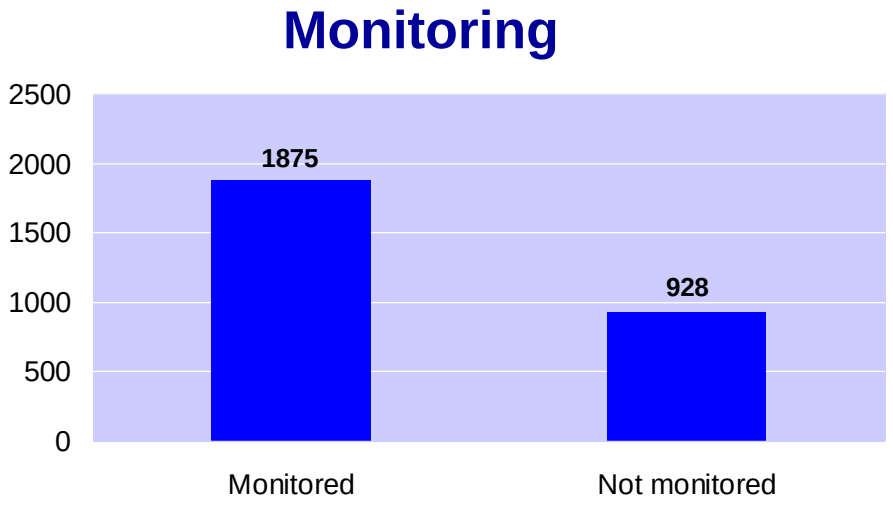
Outline

- Traffic signals in Denmark
- Yearly costs of traffic signals
- Some projects from Denmark and Sweden
- Potential for CO_2-reductions
- Conclusion

Traffic Signals in Denmark

Ca. 2.800 installations





Costs per year (a rough estimate) (DKK)

	Per junction	2,800 junctions
➢ Delays	3,4 mill. kr.	9,5 bill. kr.
➢ No. of stops	*(2,9 mill.)*	*(8,1 bill.)*
➢ Accidents	0,9 mill. kr.	2,4 bill. kr.
➢ Fuel	0,6 mill. kr.	1,8 bill. kr.
➢ Maintenance	0,025 mill. kr.	0,07 bill. kr
Total	**4,9 mill. kr.**	**13,8 bill. kr.**

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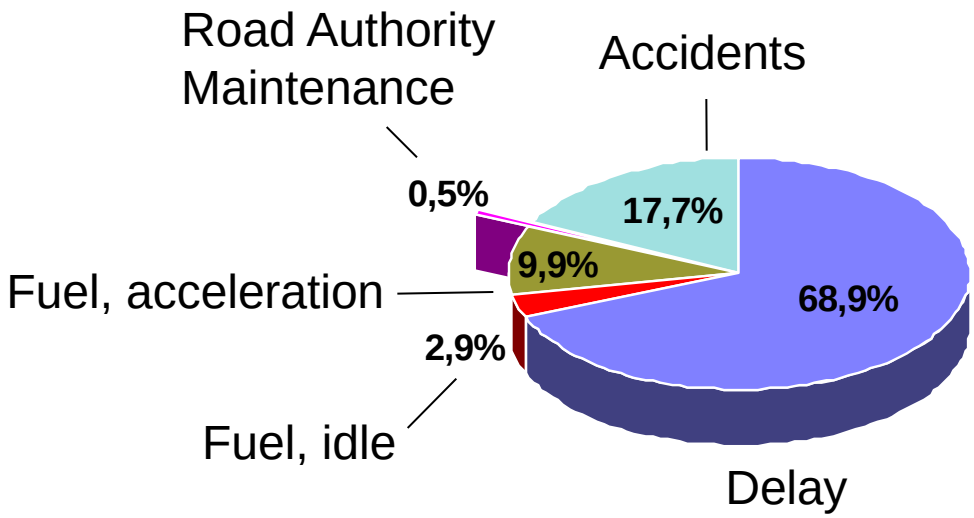
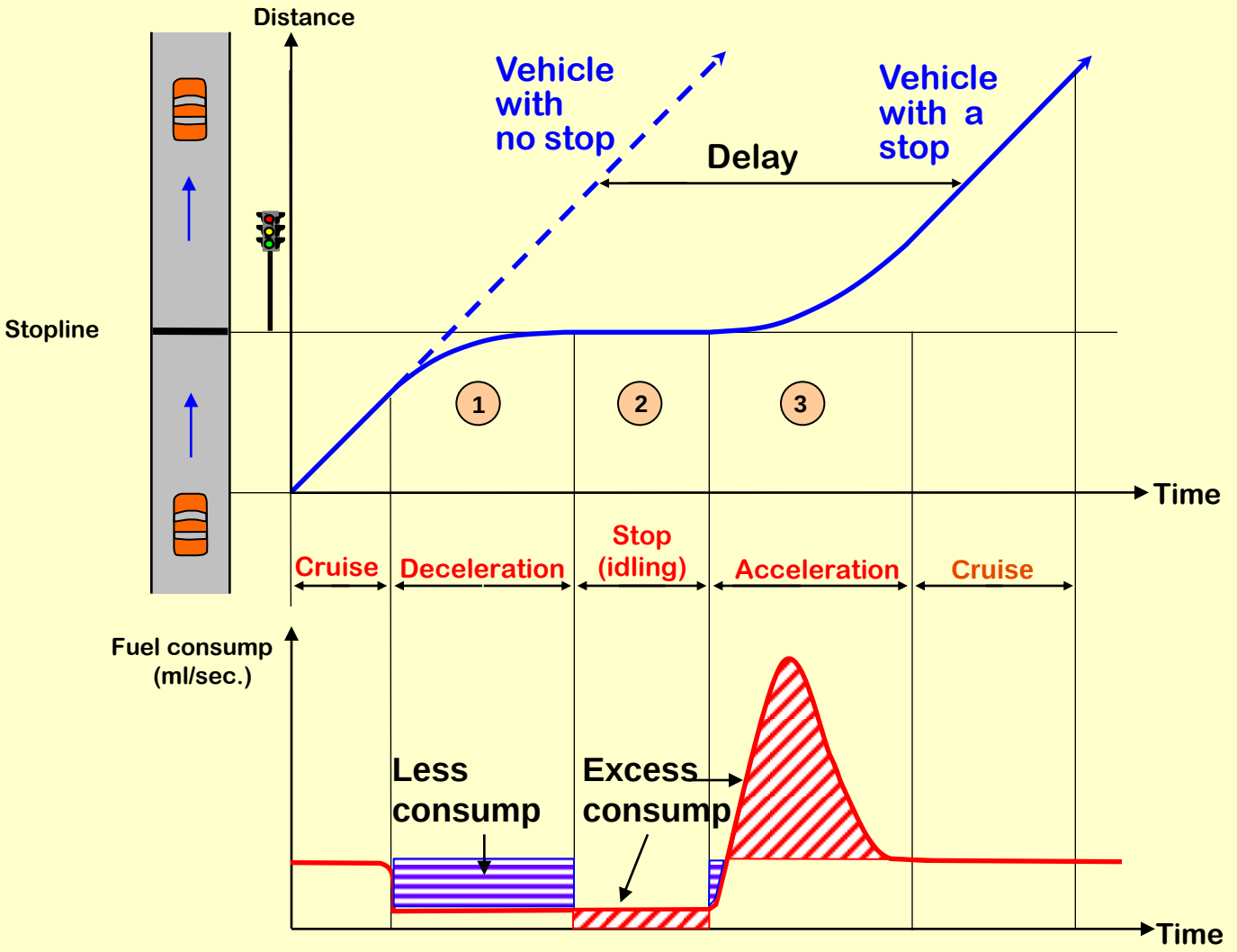
Distribution of costs

Costs per year for one traffic signal: 4,9 million DKK (€ 0,7)

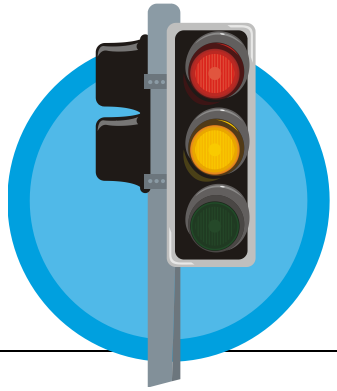


Stops are expensive !



Fuel consumption and red light

- Idling (car): 0,8-1,0 liter/hour
- One stop (car): 0,02 liter extra fuel
- One stop (truck 10 t): 0,20 liter extra fuel
- One stop (truck 40 t): 0,50 liter extra fuel
- 40 % af the fuel consumption in a signalised network is caused by traffic signals according to traffic models



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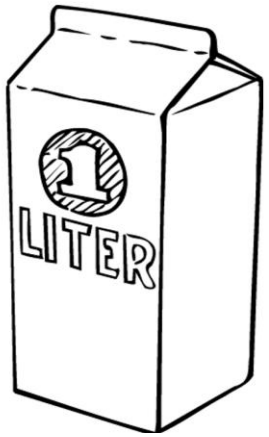
Fuel consumption and CO2-emission



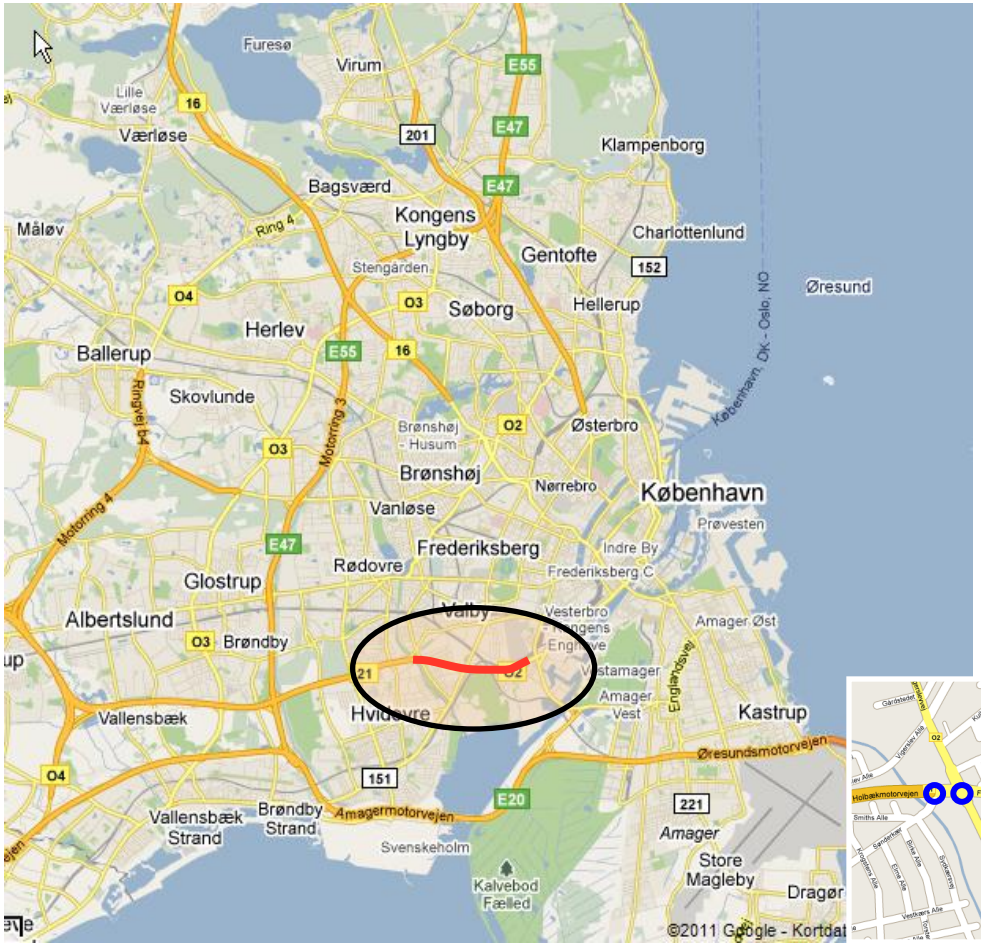
750 g

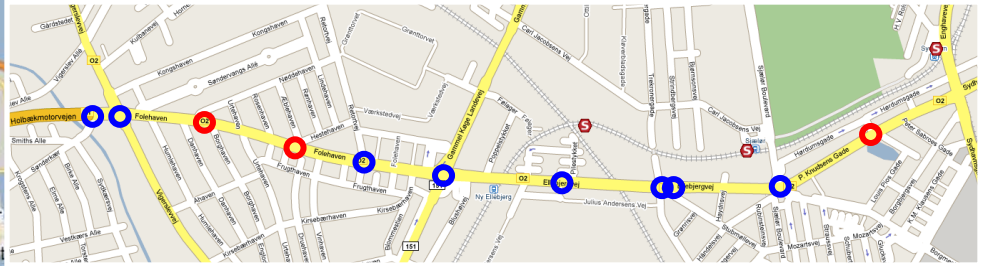
Gasoline → 2,3 kg CO_2

Diesel → 2,7 kg CO_2

Master thesis, DTU

(Morten Hedelund, Jakob Tønnesen (2009)





- 11 traffic signals
  - 8 junctions
  - 3 pedestrian crossing
- Dayly Traffic Volume: 38000

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Results – arterial in Copenhagen

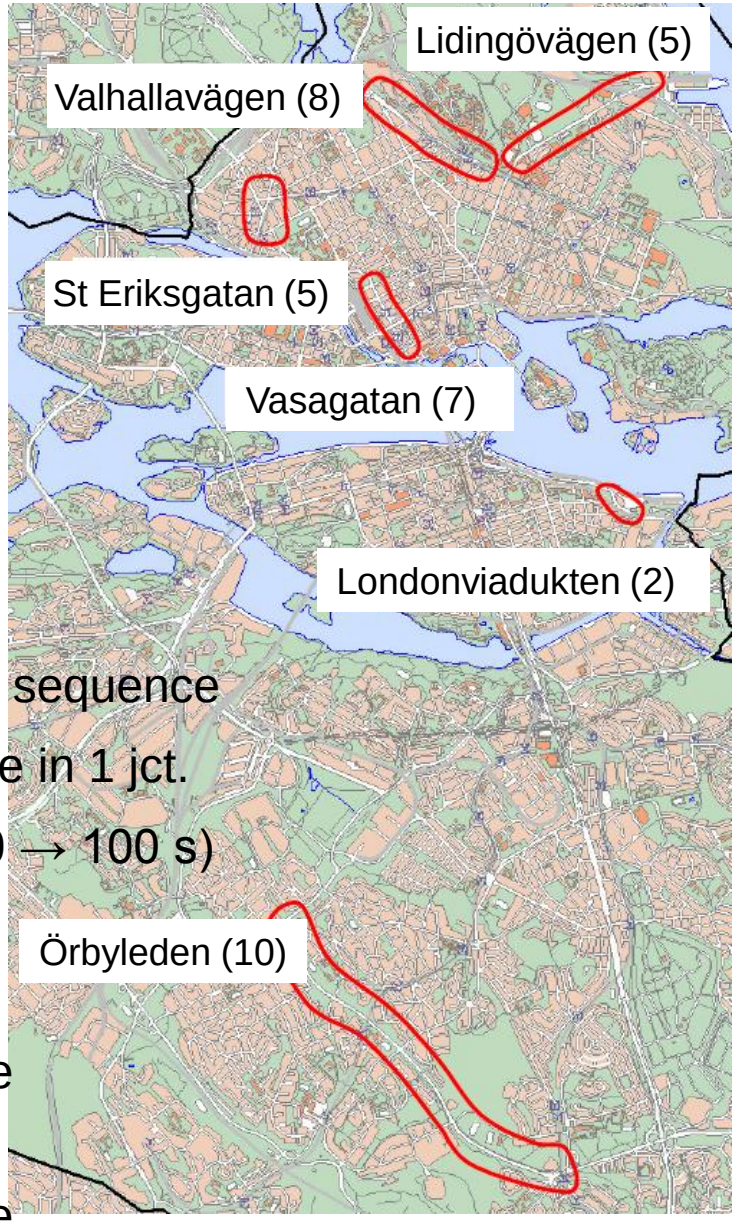
Offset optimisation:

- Results based on simulations (VISSIM)
- Confirmed by GPS floating car data

	Morgen (7-9)			Dag (11-13)			Eftermiddag (15-17)		
	Basis	Opt.	Ændring	Basis	Opt.	Ændring	Basis	Opt.	Ændring
Antal stop	34.985	26.301	-25 %	16.608	13.558	-18 %	25.109	22.083	-12 %
Brændstof (liter)	6.337	6.040	-5 %	4.633	4.563	-2 %	6.330	6.258	-1 %
Forsinkelse (timer)	384	276	-28 %	144	120	-17 %	257	231	-10 %

MATSIS-project (S)

Aim: Reduce CO_2-emission by fine tuning signal co-ordinations



- Londonviadukten: Linking + changed stage sequence
- Lidingövägen: Changed stage sequence in 1 jct.
- S:t Eriksplanområdet: Cycle time increased (90 → 100 s)
- Vasagatan: 1 arrow signal
- Örbyleden: All signals co-ordinated, changed stage sequence
- Valhallavägen: All signals co-ordinated, changed stage sequence

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Questions?

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MATSIS-project (S)

Benefits of optimising 6 co-ordinated systems in Stockholm:

Delay:	– 19 %
CO_2-emission:	– 7 %
Benefits per year:	118 mill. SEK
Payback time:	1 month
Benefit/cost:	12:1

	Ton CO2	No. Junct.	Ton/jct.
Londonviadukten	350	2	175
Lidingövägen	355	5	71
S:t Eriksgatan	720	5	144
Vasagatan	105	7	15
Örbyleden	460	10	46
Valhallavägen	875	8	109
Total	**2865**	**37**	**77**

Savings per junction per year:
77 ton CO2 = 30,000 litres of fuel = 420,000 SEK

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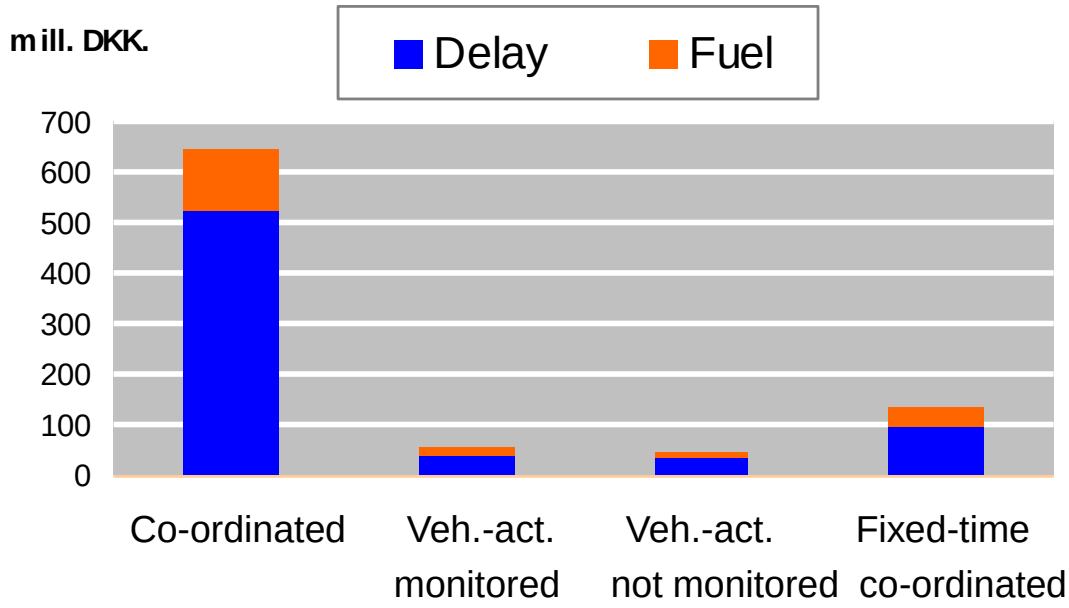
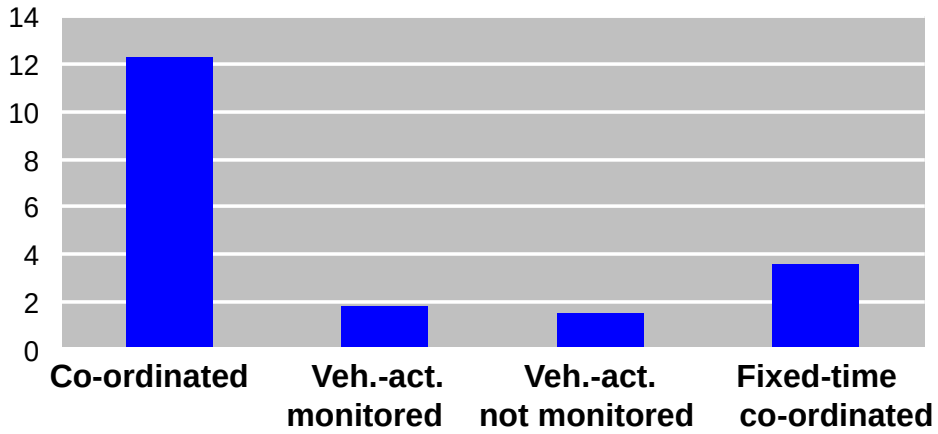
Potential for each type of signal



Full potential (fuel + delay savings): 900 million DKK (€120 million)

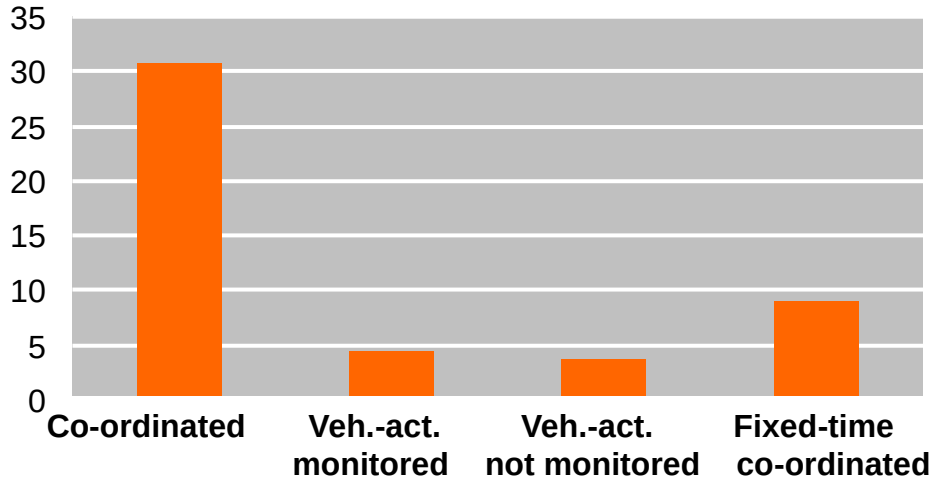
Potential savings per year

Fuel (millions litres)



Total 19 million litres)

CO_2 (1,000 tonnes)



Total 47,000 tonnes

Savings of 0,5-1 percent of the emission from road transportation

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Conclusions

- Stopping traffic is ”expensive” for drivers
- Optimising traffic signals is a useful method of saving CO_2 and reducing congestion
- Annual savings of 19 million fuel or 50,000 tonnes of CO_2 is possible. (0,5-1 pct. of CO_2-emission from road transportation)
- Keep focus on co-ordinated traffic signals (offset optimisation)