

Socio-economic assessment of C-ITS services in Nordic countries

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Road networks

- DK 1
- FI 6
- NO 3
- SE 4
- Tunnels, motorways, 2-lane roads, urban streets

Characteristics of national networks included in assessment	Denmark	Finland	Norway	Sweden
Lenght (km)	3820	14166	55807	16116
Vehicle kilometres driven (million/year)	29331	31687	39619	48360
Share of heavy vehicles (%)	6,7	9,9	1,8	15,8
Vehicle hours driven (million/year)	391,6	421,8	831,5	516,5
Vehicle hours spent in congestion (M/year)	19,9	14,9	28,2	12,7
Fatal accidents (number/year)	55,5	97,5	72,0	63,1
Non-fatal injury accidents (number/year)	476	1241	2370	2764
Property damage only acc. (number/year)	1677	5587	11850	20139
CO2 emissions (million tonnes/year)	4,8	6,9	4,6	8,1

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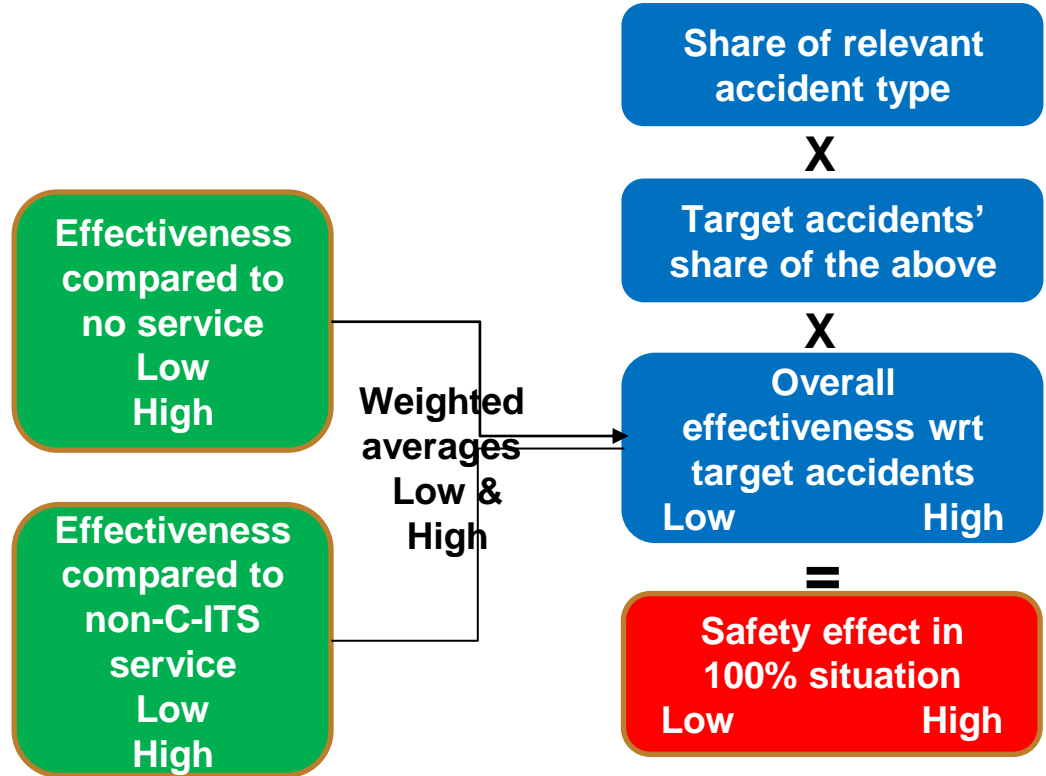


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Direct safety effects – i.e. the "intended" effects

- Estimated for each service in each network
- Aim to calculate effect in full coverage situation i.e. full network coverage, full vehicle penetration, full event coverage



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Indirect safety effects

- Specific effects that can vary between networks
- Effects on exposure, crash risk and crash consequence
- Often effects may compensate each other
- M3 and part of M6 calculated over all services

Safety impact mechanisms

M1. Direct in-vehicle modification of the driving task

M2. Direct influence by roadside systems

M3. Indirect modification of user behaviour

M4. Indirect modification of non-user behaviour

M5. Modification of interaction between road users

M6. Modification of exposure

M7. Modification of modal choice

M8. Modification of route choice

M9. Modification of accident consequences only

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Mobility and efficiency effects

Changes of vehicle km and hours driven

- Route guidance type of services – fuel & charging information, on-street parking information, traffic information, smart routing
- Warning services may lead to detours
- All C-ITS services may make car driving a bit more attractive

Change in vehicle hours driven

- Decreased speeds mean increased vehicle hours driven

Change in modal split

- Public transport priorities

Reduction of crash-related congestion if safety is improved

- Share of crash-related out of all congestion is highest on low volume roads

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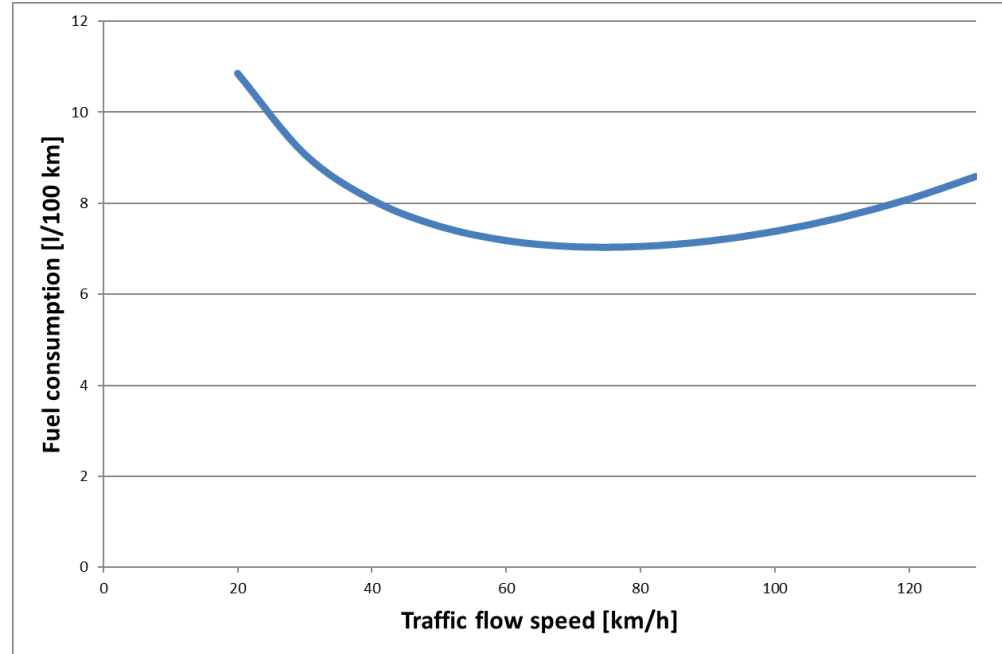
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CO2 effects

- Change in modal split - only on urban networks
- Change in vehicle km driven - proportional to emission change
- Change in vehicle speeds - according to generic diagram



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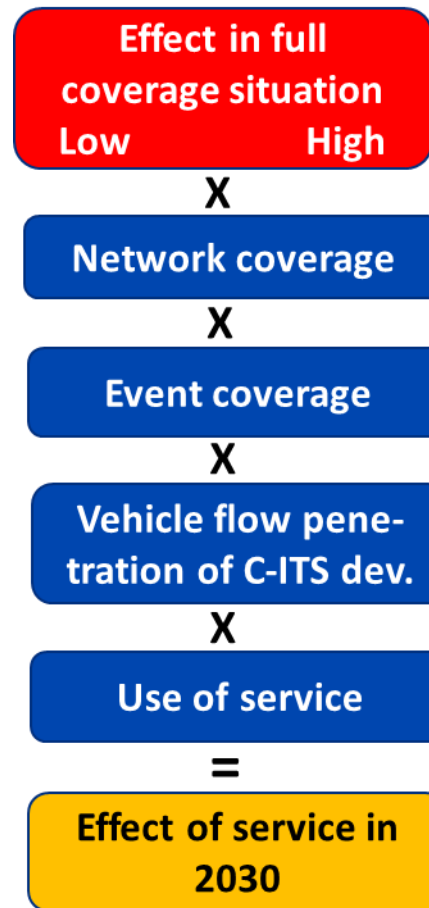
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Scaling up effects

- Carried out for each service in each network
- Done for each type of effect
 - safety
 - mobility
 - efficiency
 - CO₂ emissions
- National effects summed up



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Benefits in 2030 %

LOW EFFECTIVENESS SCENARIO	DENMARK	FINLAND	NORWAY	SWEDEN
Vehicle hours driven (million/year)	-0.04%	-0.01%	-0.04%	-0.02%
Vehicle hours spent in congestion (M/year)	-0.004%	-0.002%	-0.003%	-0.0002%
Fatal accidents (number/year)	-3.3%	-1.2%	-4.8%	-3.9%
Non-fatal injury accidents (number/year)	-1.6%	-0.9%	-2.0%	-1.7%
Property damage only accidents (number/year)	-1.6%	-1.0%	-2.0%	-1.7%
CO ₂ emissions (million tonnes/year)	-0.05%	-0.01%	-0.07%	-0.02%
HIGH EFFECTIVENESS SCENARIO	DENMARK	FINLAND	NORWAY	SWEDEN
Vehicle hours driven (million/year)	-0.10%	-0.02%	-0.10%	-0.02%
Vehicle hours spent in congestion (M/year)	-0.9%	-0.02%	-0.5%	-1.8%
Fatal accidents (number/year)	-4.5%	-1.7%	-6.3%	-5.2%
Non-fatal injury accidents (number/year)	-2.7%	-1.5%	-3.5%	-2.9%
Property damage only accidents (number/year)	-2.7%	-1.6%	-3.5%	-2.9%
CO ₂ emissions (million tonnes/year)	-0.07%	-0.07%	-0.10%	-0.03%

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Costs – example Norway

NORWAY COST ELEMENTS	NUMBER	INVESTMENT COST €	O&M COST/YEAR €
C-ITS UNITS			
In-vehicle units	740 697	133 325 533	11 851 158
Roadside units, new	1 850	24 975 000	1 073 000
Roadside units, upgraded	0	0	0
Mobile V2I stations	600	2 700 000	480 000
BACK-OFFICE			
TMC		6 000 000	200 000
Data management		1 000 000	200 000
SERVICE PROVISION			
Personnel incl. Procurement			300 000
Equipment (HW+SW)			200 000
Telecommunications			200 000
Service purchase			0
TOTAL			
Sum of the costs above		168 000 533	14 504 158
Sum of costs excluding in-vehicle costs		34 675 000	2 653 000

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Benefits and costs

Costs and benefits (€)	Denmark	Finland	Norway	Sweden
Vehicle unit costs				
Investment 2021-2030	118 087 200	141 381 000	133 325 533	352 944 000
Operation & maintenance 2030	10 496 640	12 567 200	11 851 158	31 372 800
Road operator costs				
Investment 2021-2030	5 312 500	3 672 000	34 675 000	73 500 000
Operation & maintenance 2030	486 000	2 062 960	2 653 000	5 900 000
Benefits				
Low effectiveness scenario 2030	22 741 967	10 475 197	41 087 119	68 239 294
High effectiveness scenario 2030	44 806 980	16 318 268	68 377 214	123 663 528

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Concluding remarks

- Socio-economically feasible C-ITS services
- The results depend on assumptions
 - We need more empirical results about C-ITS service use and impacts on mobility and driving behaviour
- Importance of safety impacts diminishes as vehicle safety keeps on improving while efficiency impacts keep a major role
- Start deployment with high traffic volume main roads
- High network and event coverage of C-ITS services is essential for impacts

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- Full report and other information available at:
www.nordicway.net
- Report's direct link: https://uploads-ssl.webflow.com/5c487d8f7febe4125879c2d8/5fdb176c20c0a29823b40c68_NordicWay%20%20Evaluation%20Report_FINAL.pdf

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