



# Socio-economic evaluation, C-ROADS Italy 2

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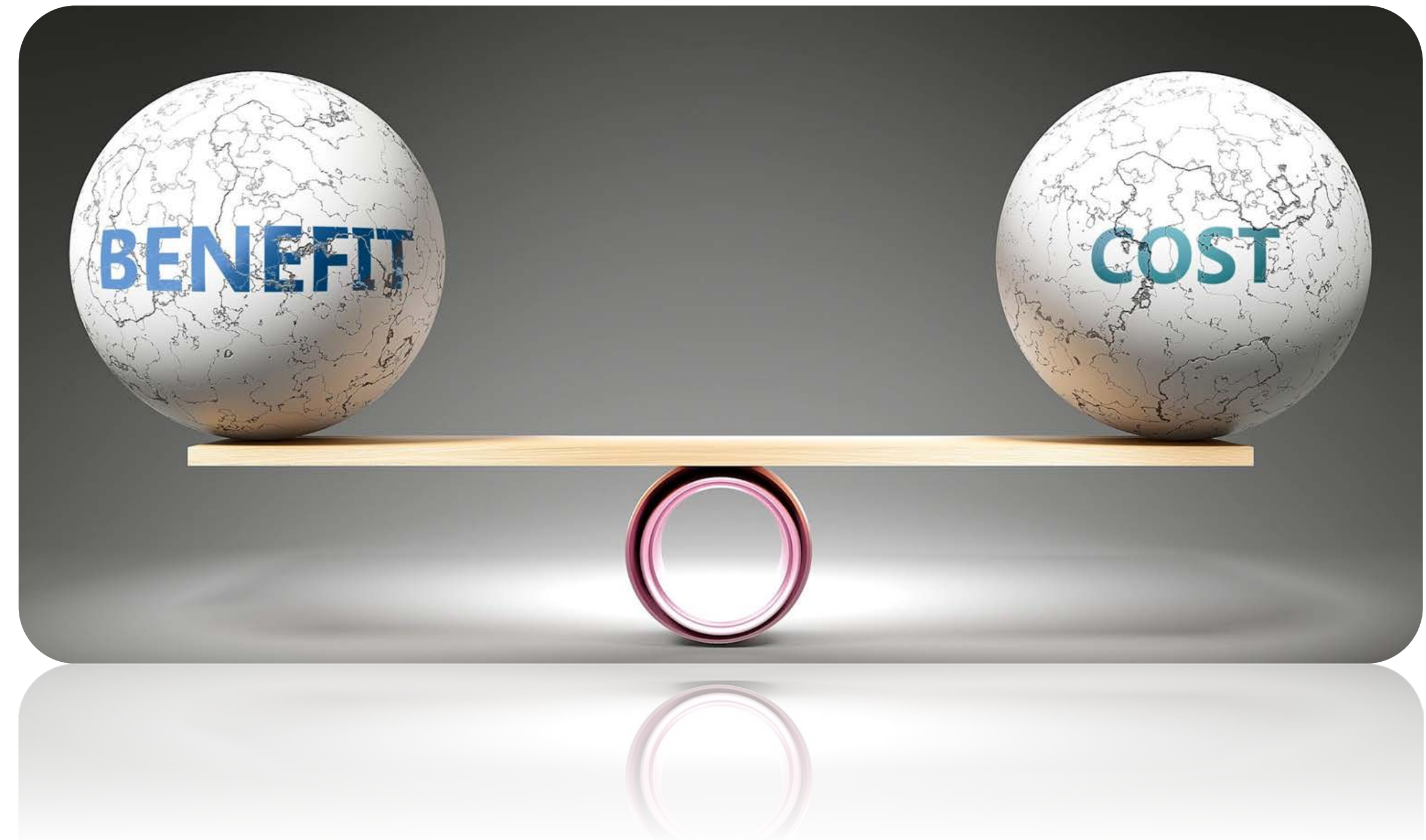
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# Agenda

- Objectives
- Methodological framework
- Ex-post simulation-based evaluation results for GLOSA/SPTI
- Concluding remarks

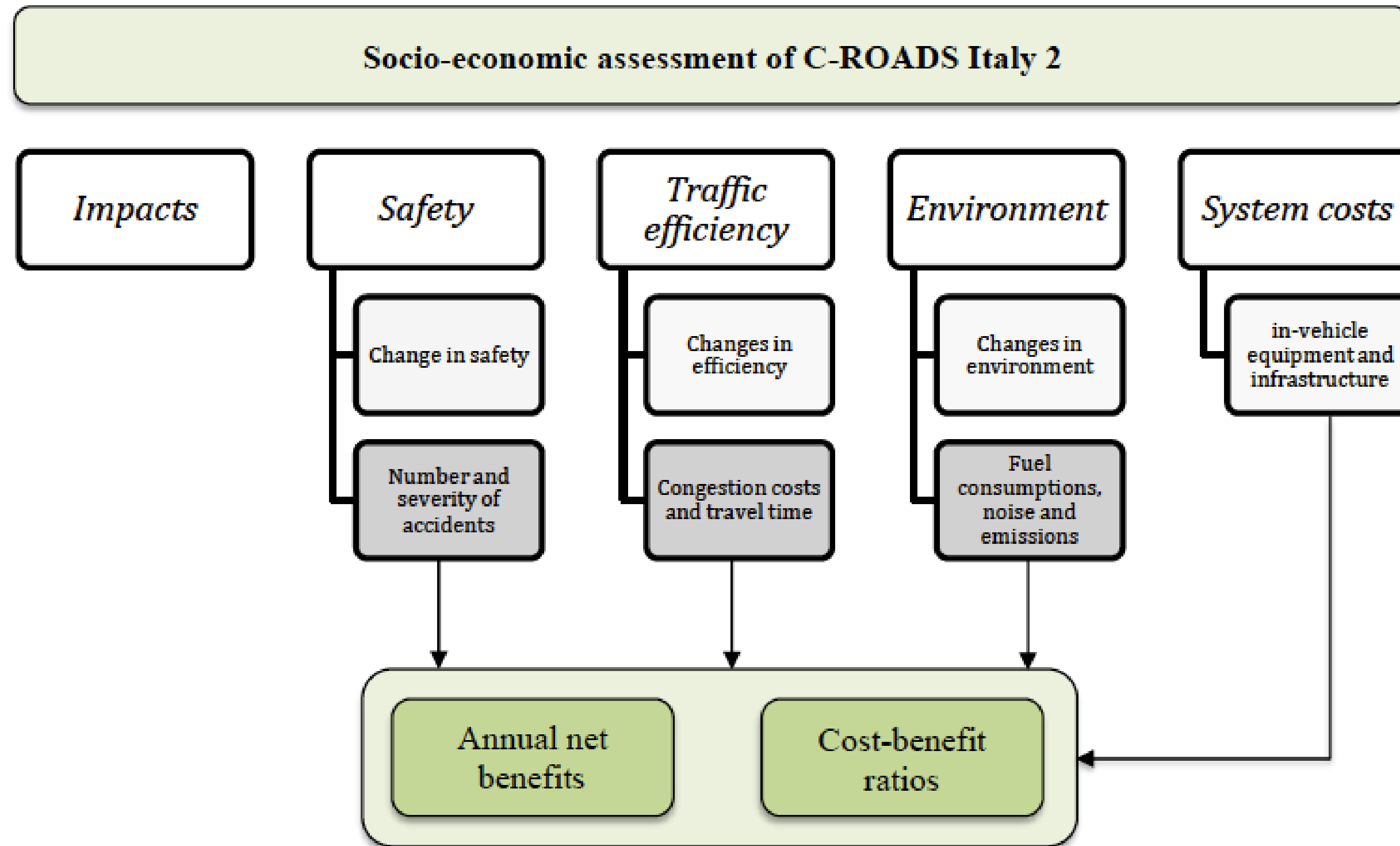
# Objectives

- To quantify in monetary values the impacts of C-ITS use cases on *safety, traffic efficiency and environment*, and compare to cost through a CBA framework
- **CBA known limitations:** failing to capture the wider picture for large-scale transport projects, conducted early on in the decision process, inability to capture eg. job creation, quality of life, economic development effects
- However, CBA allows to present **results in a more understandable format** that aids in assessing **whether the economic and social costs of a project outweigh its benefits**





# Methodological framework



$$NPV = \sum PV(B) - \sum PV(C)$$

$$BCR = \frac{\sum PV(B)}{\sum PV(C)}$$

- Field tests effects on users (incl. non-travellers):
  - **road congestion**, intended as "pure traffic disutility"
  - **road accidents**
  - **polluting emissions**, i.e. those harmful to human health and deriving from energy consumption attributable to users
  - **noise pollution**, which determines social impacts depending on the location, the duration of exposure and the type of vehicle and its characteristics
  - emissions of gases that contribute to **global warming**
- Benefits & system costs to be quantified and discounted to present year
- The evaluation methodology is based on: C-ROADS Evaluation and Assessment Plan, National and European Commission's Guide to Cost-Benefit Analysis of Investment Projects, previous literature on economic/financial appraisals for ITS projects

# Methodological framework

## ASSUMPTIONS

- Use cases evaluated through a **snapshot approach** - baseline vs operational scenarios and **in isolation** rather than as bundles
- Selection of use cases depending on data volume and quality
- Comparing **NPV and CBRs** per use cases and by penetration rates

## METHODOLOGICAL STEPS

### Evaluation scenarios

Select C-ITS use cases

Define evaluation approach & target assessment years

Identify data sources & collection methods

### Penetration rates

In terms of fleet and infrastructure

Define penetration rates by target years and use cases

### Scaling up of impact data

Simulation data needed for varying penetration rates and user behaviours

Definition of scaling up variables and external data requirements per use case

### Benefit monetisation & cost estimates

Identify KPI that can be monetised

Research and use of EU-wide and/or National parameters

### Socio-economic KPIs

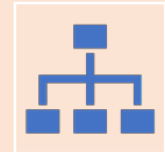
Research on **cost variance** depending on deployment conditions and market situation

Estimation of **KPIs: NPV, CBR**

## USE CASES

				Trento	Torino	Verona	VR-Auto BSPD	Auto BSPD
IVS In Vehicle Signage	DSLI	Dynamic Speed Limit Information	IVS - DSLI				X	
	EVFT	Embedded VMS "Free Text"	IVS - EVFT		X			
	OSI	Other Signage Information	IVS - OSI	X	X			
HLN Hazardous Locations	TJA	Traffic Jam Ahead	HLN - TJA		X		X	
	SV	Stationary Vehicle	HLN - SV		X			
	WCW	Weather Condition Warning	HLN - WCW		X			X
	APR	Animal or Person on the Road	HLN - APR		X			
	OR	Obstacle on the Road	HLN - OR		X			
	EVA	Emergency Vehicle Approaching	HLN - EVA			X		
RWW Road Works	LC	Lane Closure	RWW - LC		X			
	RC	Road Closure	RWW - RC		X		X	
	WM	Winter Maintenance	RWW - WM					X
SI Signalized Intersections	GLOSA	Green Light Optimal Speed Advisory	SI - GLOSA	X	X	X		
	TLP	Traffic Light Prioritisation	SI - TLP	X	X	X		
	SPTI	Signal Phase and Timing Information	SI - SPTI	X	X	X		
	ISVW	Imminent Signal Violation Warning	SI - ISVW	X				
PVD Probe Veicle Data	VDC	Vehicle Data Collection	PVD - VDC		X		X	
	EDC	Event Data Collection	PVD - EDC		X			
DAY 1.5 services		Traffic Information and smart routing			X			
		On Street Park Management & Information		X				
		Connected & Cooperative navigation in/out city			X			

# GLOSA/SPTI ex-post evaluation – methodological building blocks



Scenario-based evaluation via a CBA framework relying on **simulated impact data (micro-modelling)**



Use of simulated impact on test routes, i.e. average queue length, **average delay and average fuel consumption at peak hours**



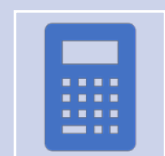
**Conversion of impacts** (improvements to travel time and fuel consumptions) **in annual economic gains**



GLOSA-specific **annual investment & operating cost survey** to Cities



Costs and benefits discounted to **current market values** and assessment year of **15 years**



Calculation of **ENPV and BCR**

Scenario	Low Uptake (2025)	Medium Uptake (2030)	High Uptake (2035)	Full Uptake (2038)
<i>Vehicle Uptake</i>	35%	50%	75%	100%
<i>Infrastructure Uptake</i>	50%	100%	100%	100%

Vehicle Uptake: MP of vehicles equipped with OBU  
Infrastructure Uptake: traffic lights equipped ITS-G5

## Cost category considered

*Investment*

*Operation & maintenance*

Centralised ITS sub-system, Vehicle ITS sub-system, Roadside ITS sub-system (only RSU, Personnel, Back office for Trento and Turin)



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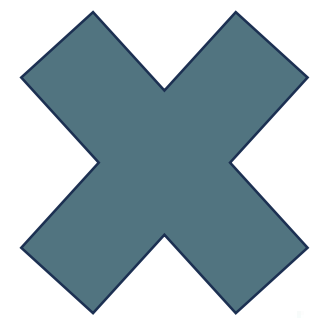


# GLOSA/SPTI ex-post evaluation: *from impact data to economic gains*

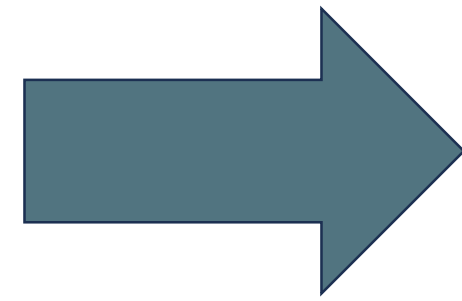


# GLOSA/SPTI ex-post evaluation – average delay cost

Average vehicle delay  
(per MP rate and intersection)



Typical cost factor (value of time) for  
urban/peri-urban trips and  
home to work



Torino (18 jnc)



Trento (13 jnc)



## Change in average delay cost – Torino

	Baseline	Low uptake	Medium uptake	High uptake	Full uptake
<b>Total</b>	5.916	-320	-993	-1.339	-1.707
<b>% change</b>		-5%	-17%	-23%	-29%

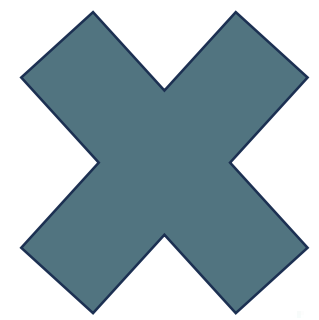
## Change in average delay cost – Trento

	Baseline	Low uptake	Medium uptake	High uptake	Full uptake
<b>Total</b>	705	-100	-157	-221	-293
<b>% change</b>		-14%	-22%	-31%	-42%

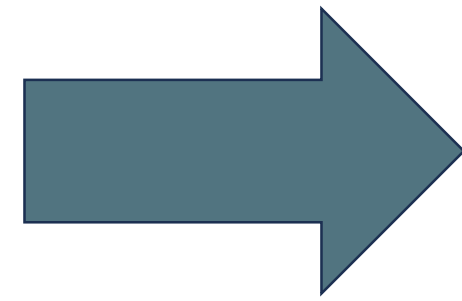


# GLOSA/SPTI ex-post evaluation – average fuel consumption cost

Average fuel consumption  
(per MP rate and intersection)



Typical cost factor per ton of  
CO2 emitted



Torino



## Change in average fuel consumption cost – Torino

	Baseline	Low uptake	Medium uptake	High uptake	Full uptake
<b>Total</b>	896	96	27	8	-36
<b>% change</b>		11%	3%	1%	-4%

Trento



## Change in average fuel consumption cost – Trento

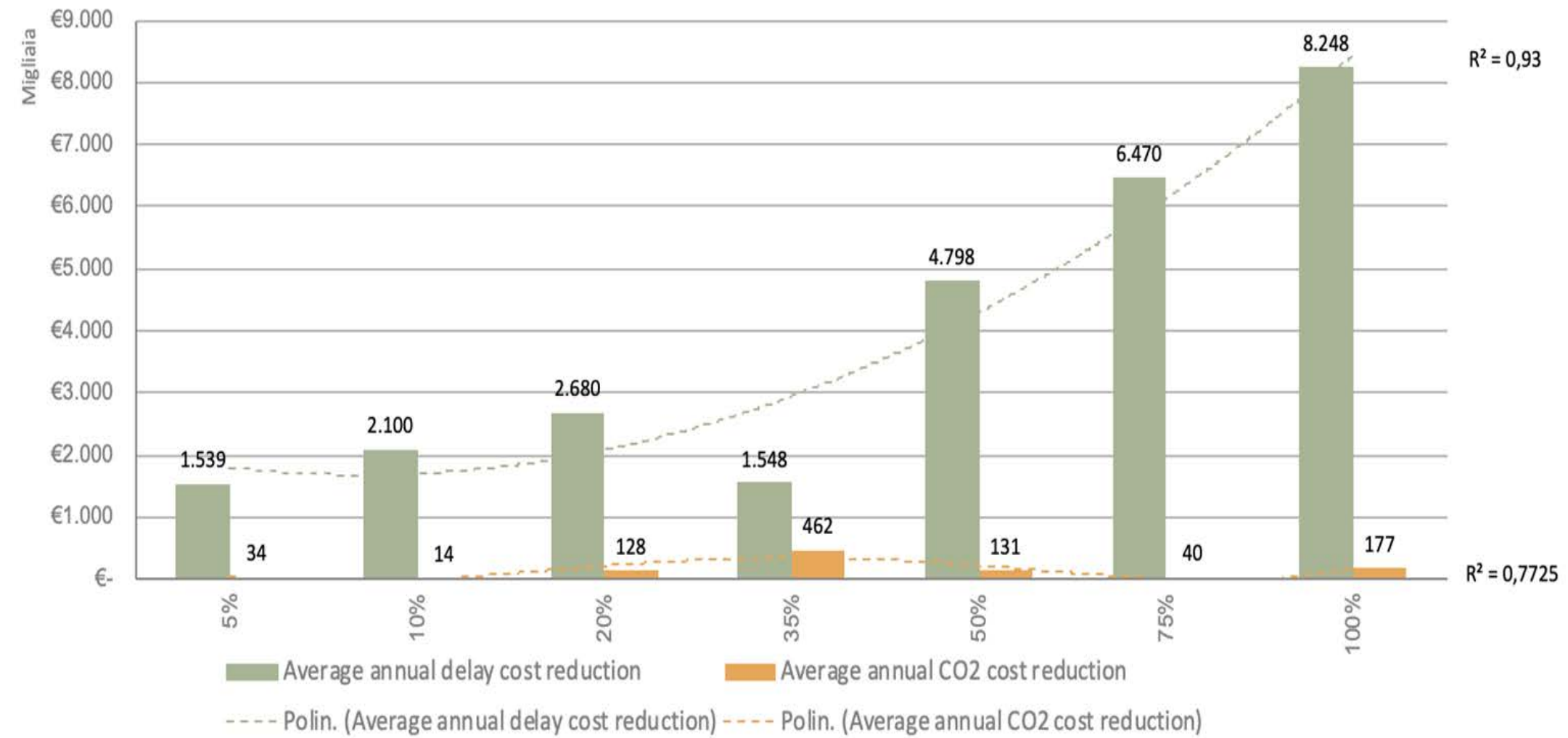
	Baseline	Low uptake	Medium uptake	High uptake	Full uptake
<b>Total</b>	310	-8	-14	-21	-27
<b>% change</b>		-3%	-5%	-7%	-9%



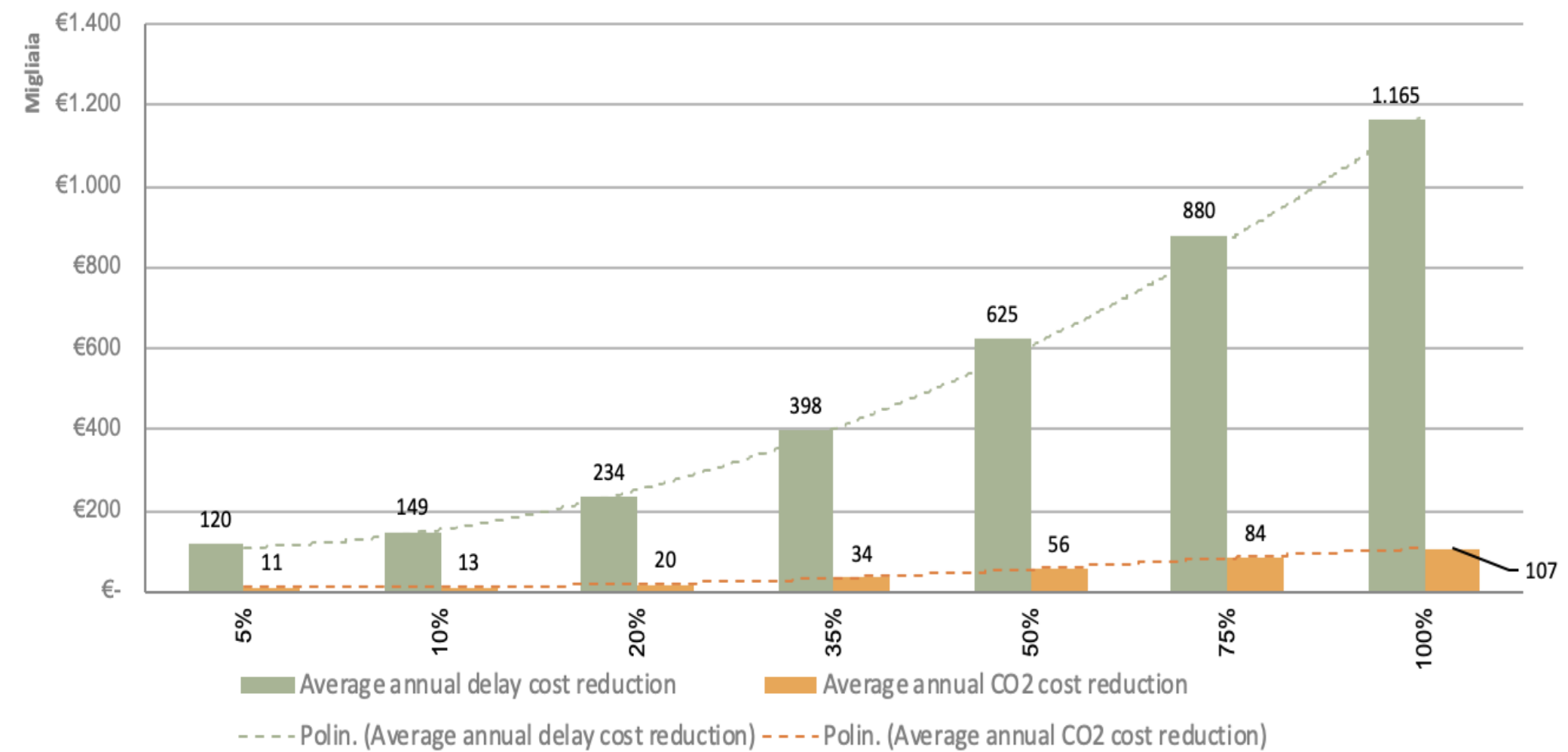
# GLOSA/SPTI ex-post evaluation – annual cost reduction by penetration rate



With GLOSA/SPTI annual cost reduction by penetration rate

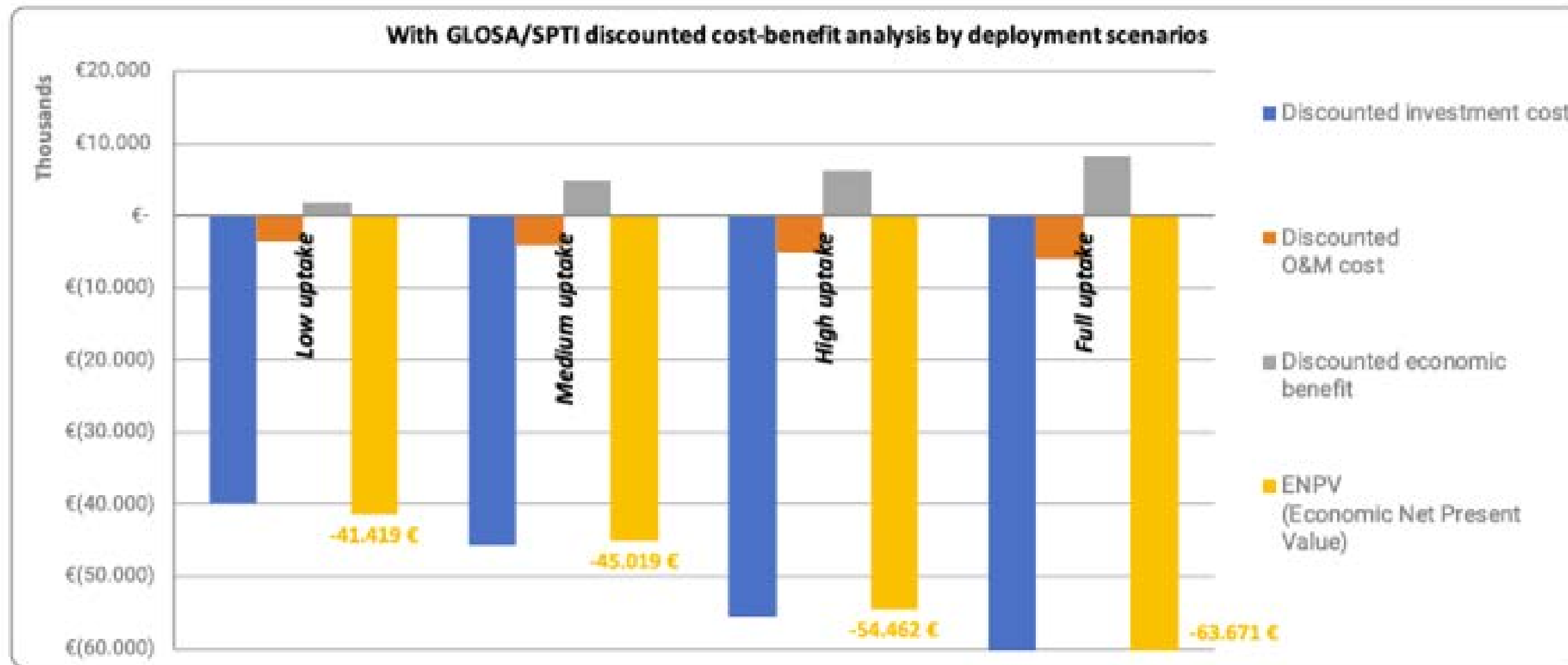


With GLOSA/SPTI annual cost reduction by penetration rate



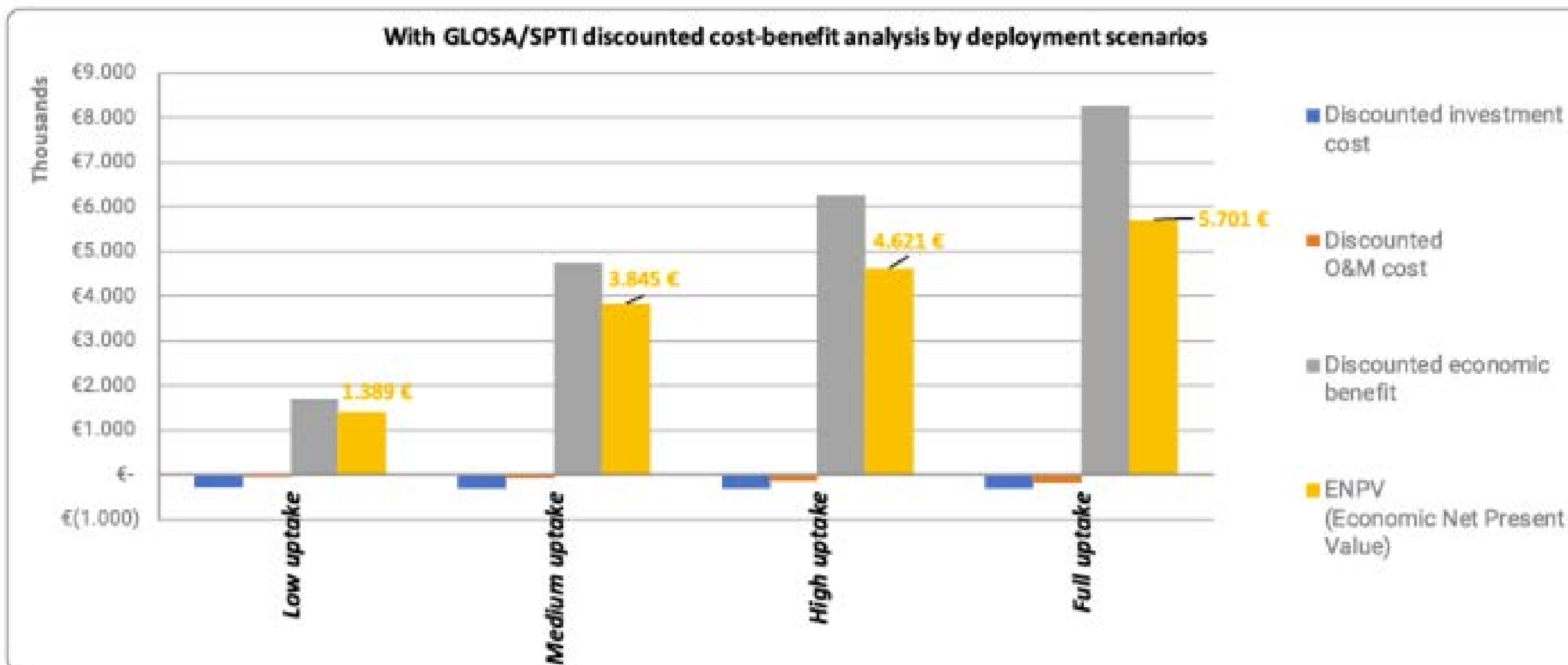


# GLOSA/SPTI ex-post evaluation – CBA results for Torino



<b>BCR – Torino</b>	
Low Uptake	0,04
Medium Uptake	0,10
High Uptake	0,11
Full Uptake	0,12

*with OBU cost*

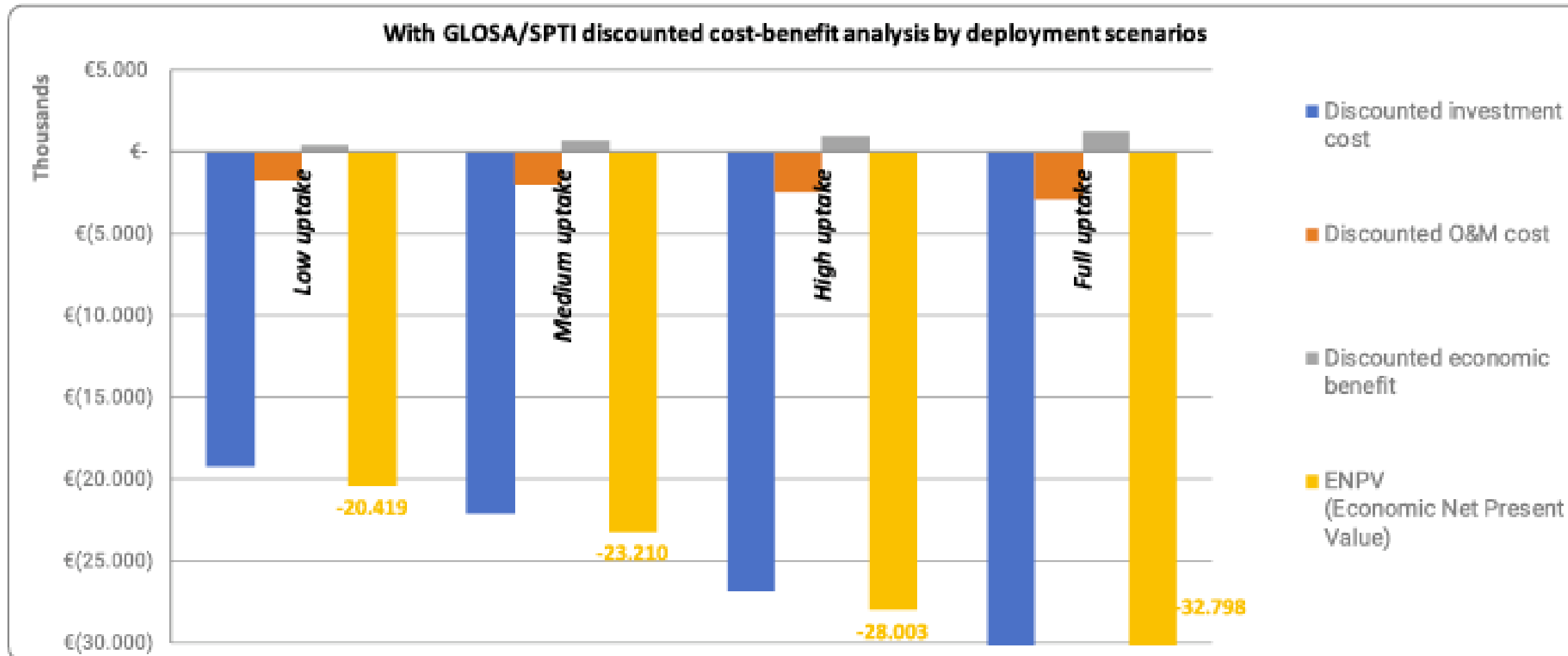


<b>BCR – Torino</b>	
Low Uptake	5,95
Medium Uptake	13,08
High Uptake	15,21
Full Uptake	18,94

*without OBU cost*

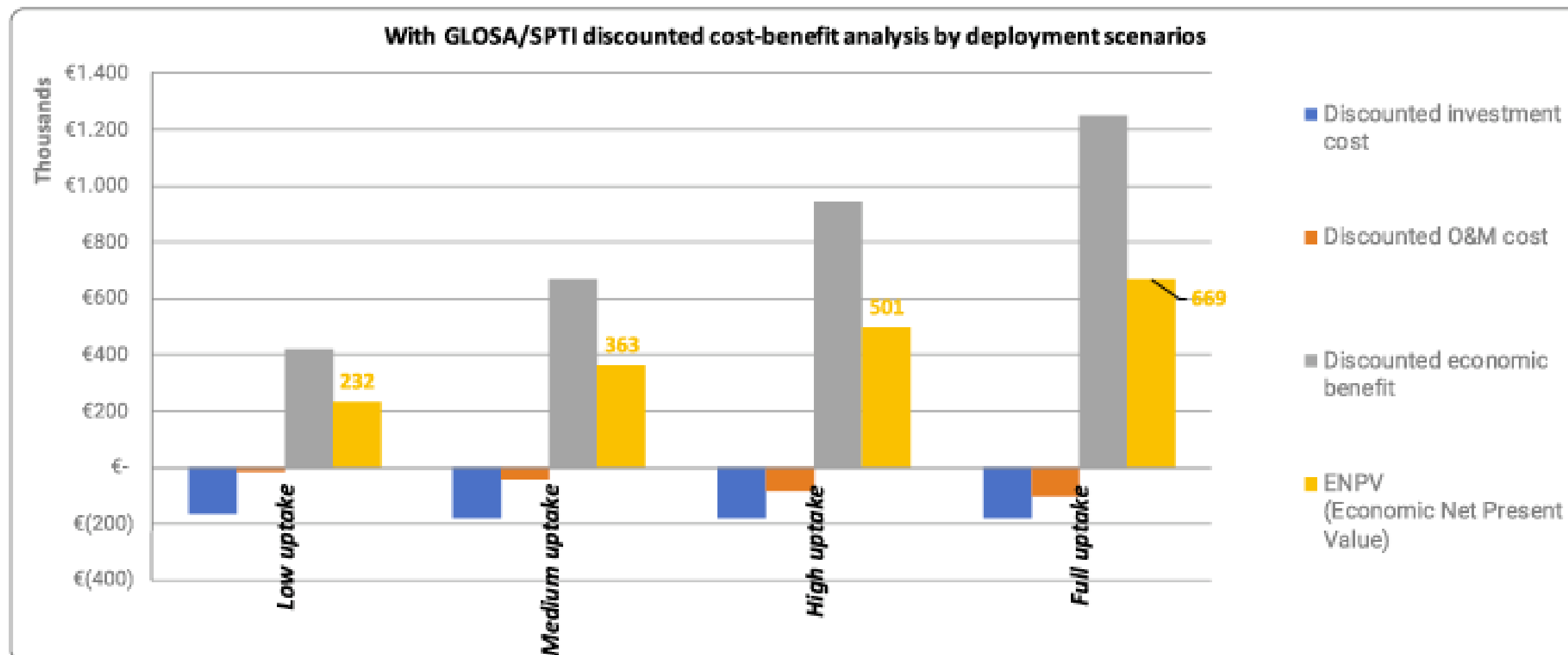
*safety-based and ITS-G5 communication will have been integrated in all new passenger cars by 2025*

# GLOSA/SPTI ex-post evaluation – CBA results for Trento



<b>BCR – Trento</b>	
Low Uptake	0,02
Medium Uptake	0,03
High Uptake	0,03
Full Uptake	0,04

*with OBU cost*



<b>BCR – Trento</b>	
Low Uptake	2,43
Medium Uptake	3,06
High Uptake	3,86
Full Uptake	4,84

*without OBU cost*



# Concluding remarks

## Findings:

- **Investment is not worthwhile for any of the uptake scenarios**, if all system costs are to be considered
- By taking **OBU purchase costs off** the analysis, the future deployment scenarios become all **worthwhile starting from 2025** where the **vehicle penetration and the infrastructure uptake are at respectively at 35% and 50%** (higher impact for Turin with CBR at 5,95 vs 2,43)

## Limitations:

- **Granularity of evaluation data** – in addition to MP rates, simulated impact data could consider **gradual infrastructure uptakes**
- **Limited environmental effects** – so far fuel consumption effects and CO2 considered, with e.g. **global warming, noise effects excluded**
- **Small scale testing** - socio-economic analysis relied on the effects estimated at test-site level; impact KPIs will have to gathered under **real-life traffic conditions and extrapolated** to a higher territorial level



**THANK YOU!**



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