The importance of the GSR for the future of vehicle safety

Results of the Impact Assessment study

Richard Cuerden

6 June 2018

Vision

World leader in creating the future of transport and mobility, using evidence-based solutions and innovative thinking

Mission

Challenge and influence our chosen markets, driving sustained reductions (ultimately to zero) in:

- fatalities and serious injuries
- harmful emissions
- barriers to inclusive mobility
- unforeseen delays
- cost inefficiencies

…enabling world-class transport and mobility solutions that underpin the needs of tomorrow's economy and society

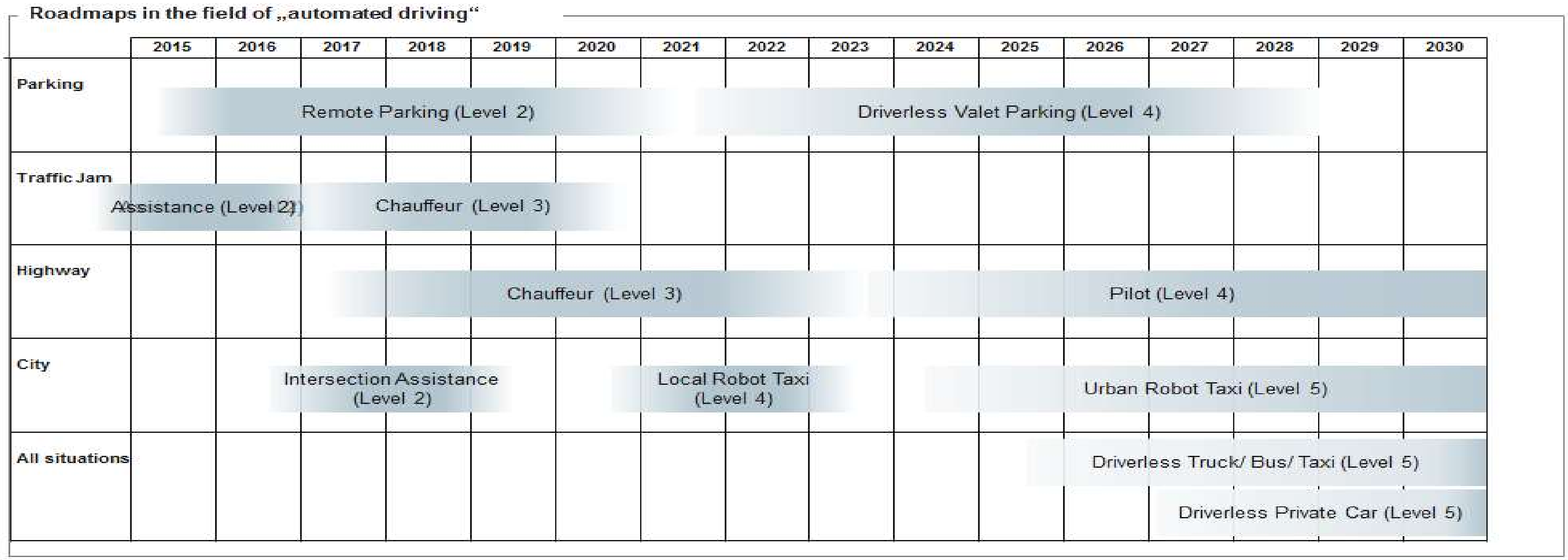
Brand Values

Inquisitive | Progressive | Trusted | Relentless

Google Car

Changing world: Connected and Automated Vehicles

Consolidation of automated driving roadmaps



CEDR
Conférence Européenne des Directeurs des Routes
Conference of European Directors of Roads

Cost-effectiveness analysis of Policy Options for the mandatory implementation of different sets of vehicle safety measures – Review of the GSR and PSR

Objective:

To **calculate** concrete **cost-effectiveness indicators and numbers of future casualties that could be prevented at an EU-28 level** for three sets of safety measures proposed by the European Commission and considered for **mandatory implementation in new vehicles starting from 2021.**

Methodology and Scope

The European Commission defined **three Policy Options**, **sets of safety measures to be implemented on a mandatory basis**:

- **PO1**: State-of-the-art and widely available package of safety solutions that are not yet mandatory in EU; their fitment varies from around 5–90%
- **PO2**: As PO1 with added safety solutions that focus on vulnerable road user protection and on ensuring driver attention to the driving task
- **PO3**: As PO2 with safety solutions that are either feasible or already exist in the marketplace, but that have a low fitment rate and market uptake, that maximises overall casualty savings and can boost safety solutions‘ innovation

The policy options are each studied for their **cost-effectiveness compared to a baseline scenario (PO0)**, where none of the measures are implemented on a mandatory basis, but voluntary uptake would continue.

Policy Options M1

Measure	Baseline	PO1 (M1)	PO2 (M1)	PO3 (M1)
AEB-VEH	–	A	A	A
AEB-PCD	–	–	B	B
ALC	–	A	A	A
DDR-DAD	–	–	A	A
DDR-ADR	–	–	–	B
EDR	–	A	A	A
ESS	–	A	A	A
FFW-137	–	A	A	A
FFW-THO	–	–	A	A
HED-MGI	–	–	B	B
ISA-VOL	–	–	A	A
LKA-ELK	–	A	A	A
PSI	–	A	A	A
REV	–	–	–	A

A = 01/09/2021 new approved types, 1/09/2023 new vehs

B = 01/09/2023 new approved types, 1/09/2025 new vehs

C = 01/09/2025, no mandatory introduction for new vehs

Policy Options M2&M3

Measure	Baseline	PO1 (M2&M3)	PO2 (M2&M3)	PO3 (M2&M3)
ALC	–	A	A	A
DDR-DAD	–	–	A	A
DDR-ADR	–	–	–	B
ESS	–	A	A	A
ISA-VOL	–	–	A	A
REV	–	–	–	A
TPM	–	–	–	A
VIS-DET	–	–	A	A
VIS-DIV	–	–	C	C

A = 01/09/2021 new approved types, 1/09/2023 new vehs

B = 01/09/2023 new approved types, 1/09/2025 new vehs

C = 01/09/2025, no mandatory introduction for new vehs

Policy Options N1

Measure	Baseline	PO1 (N1)	PO2 (N1)	PO3 (N1)
AEB-VEH	–	A	A	A
AEB-PCD	–	–	B	B
ALC	–	A	A	A
DDR-DAD	–	–	A	A
DDR-ADR	–	–	–	B
EDR	–	A	A	A
ESS	–	A	A	A
FFW-137	–	–	–	A
FFW-THO	–	–	–	A
HED-MGI	–	–	B	B
ISA-VOL	–	–	–	A
LKA-ELK	–	A	A	A
PSI	–	–	–	A
REV	–	–	–	A
TPM	–	–	–	A

A = 01/09/2021 new approved types, 1/09/2023 new vehs

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C = 01/09/2025, no mandatory introduction for new vehs

Policy Options N2&N3

Measure	Baseline	PO1 (N2&N3)	PO2 (N2&N3)	PO3 (N2&N3)
ALC	–	A	A	A
DDR-DAD	–	–	A	A
DDR-ADR	–	–	–	B
ESS	–	A	A	A
ISA-VOL	–	–	A	A
REV	–	–	–	A
TPM	–	–	–	A
VIS-DET	–	–	A	A
VIS-DIV	–	–	C	C

A = 01/09/2021 new approved types, 1/09/2023 new vehs

B = 01/09/2023 new approved types, 1/09/2025 new vehs

C = 01/09/2025, no mandatory introduction for new vehs

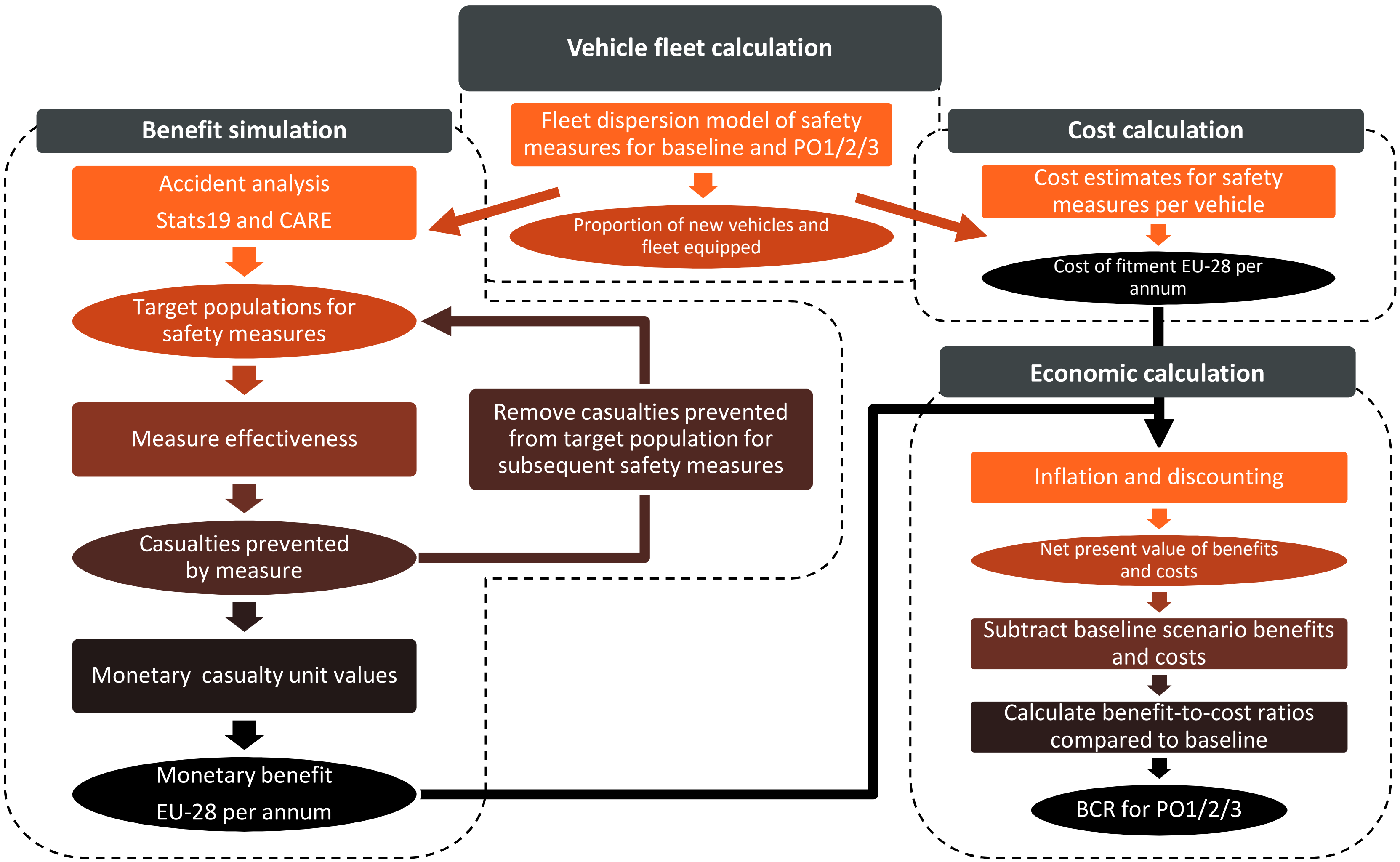
Simulation and Calculation Model

The scope of the cost-effectiveness evaluation was:

- **Geographic scope**: EU-28
- **Vehicle categories covered**: M1, M2&M3, N1, N2&N3
- **Evaluation period**: 2021–2037
- **Baseline scenario**: No further policy intervention in the transport sector, but voluntary improvements and effects of already implemented policies continue. Continued dispersion of mandatory vehicle safety measures into the legacy fleet and continued voluntary uptake of the safety measures under consideration.

Simulation and Calculation Model

- **Evaluated scenarios**: Three sets of safety measures (PO1, PO2 and PO3) implemented on a mandatory basis
- **Benefits considered**: Monetary values of casualties prevented by safety measures
- **Costs considered**: Cost to vehicle manufacturers of fitment of safety measures to new vehicles
- **Treatment of uncertainty**: Interval analysis and scenario analysis
- **Results**: Benefit-to-cost ratios (BCRs), based on present monetary values and casualties prevented, compared to the baseline scenario over the entire evaluation period



Vehicle fleet calculation
Fleet dispersion model of safety measures for baseline and PO1/2/3
Proportion of new vehicles and fleet equipped
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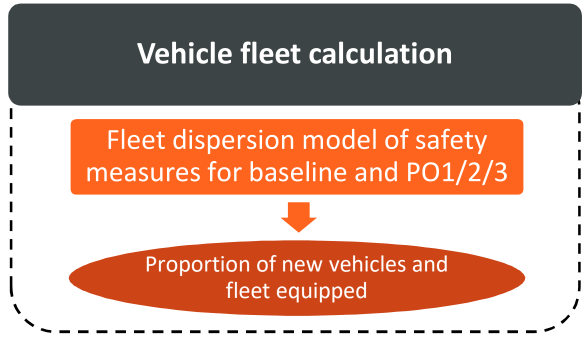
Calculate benefit-to-cost ratios compared to baseline
BCR for PO1/2/3

Simulation and Calculation Model

Note that the model takes into account:

- The **interactions of all measures when implemented together** (to avoid double-counting of casualties prevented by different measures), and
- The **effects of already existing mandatory measures** (AEB-VEH and LDW for M2&M3 and N2&N3, ESC for all categories) that are still dispersing into the fleet on the European casualty target populations.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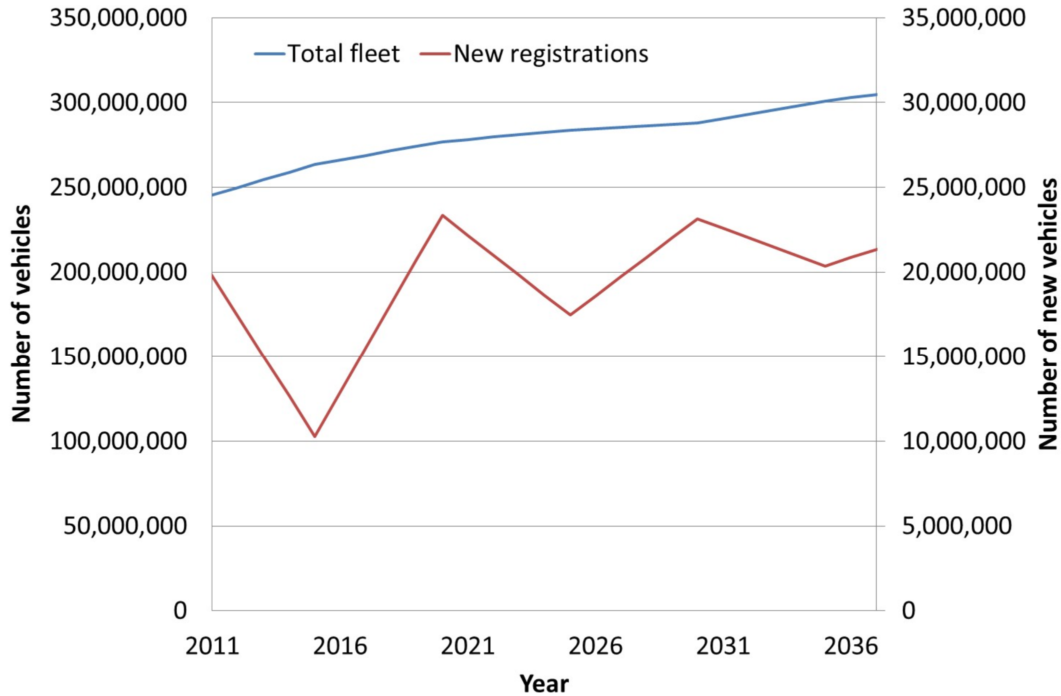
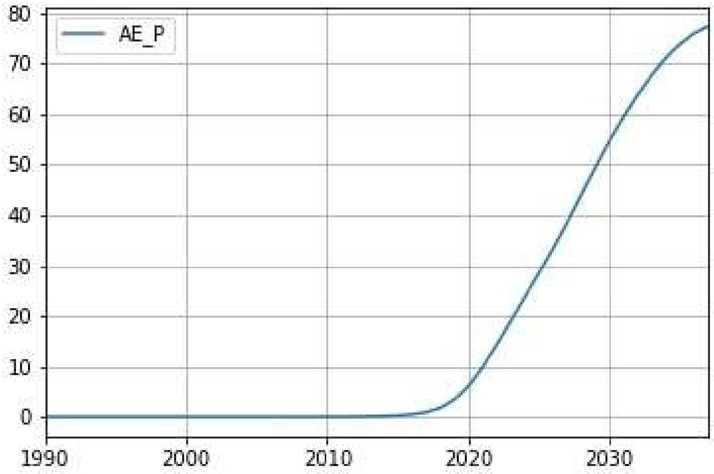
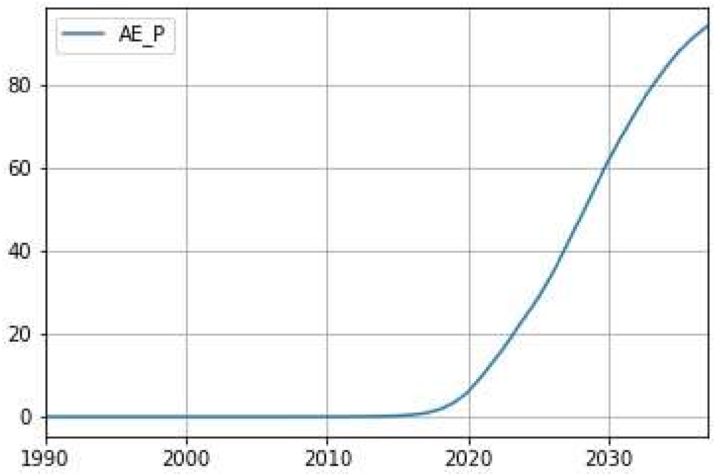
Vehicle fleet size



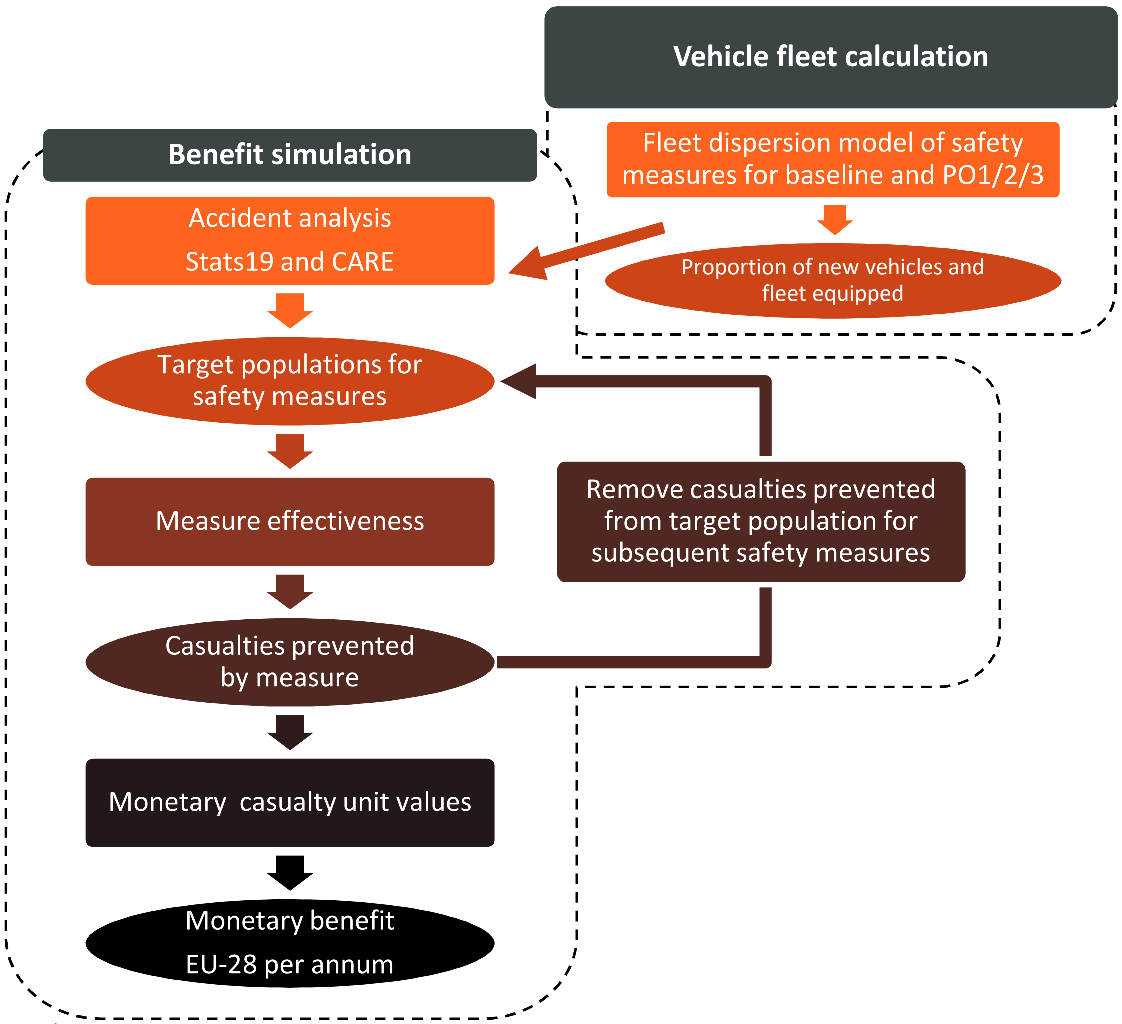
Fleet dispersion of safety measures



Percentage of all cars within the vehicle fleet equipped with pedestrian-capable AEB in voluntary uptake scenario



Percentage of all cars within the vehicle fleet equipped with pedestrian-capable AEB in mandatory implementation scenario (new approved types from 2023, all new cars from 2025)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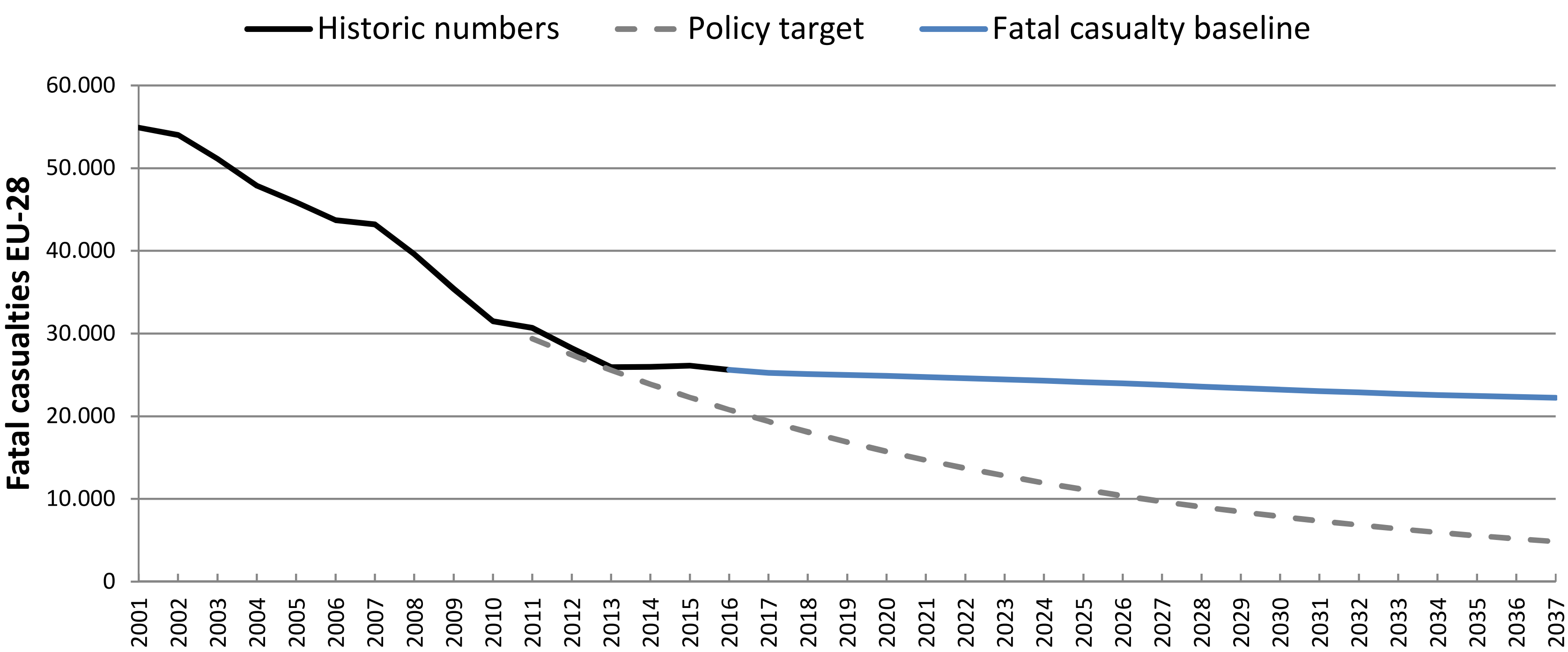
Casualty baseline



Target population estimates, EU-28 Casualty typology

Vehicle category		Collisions	Casualties (Vehicle 1)			Casualties (Vehicle 2)		
Vehicle 1	Vehicle 2		Fatal	Serious	Slight	Fatal	Serious	Slight
M1	***none***	127,635	5,405	33,198	129,912	*n/a*	*n/a*	*n/a*
M2M3	***none***	5,313	50	818	6,625	*n/a*	*n/a*	*n/a*
N1	***none***	7,475	338	1,687	7,305	*n/a*	*n/a*	*n/a*
N2N3	***none***	4,456	222	1,209	3,578	*n/a*	*n/a*	*n/a*
PTW	***none***	52,552	1,667	16,652	38,205	*n/a*	*n/a*	*n/a*
Cyclist	***none***	25,686	335	7,662	17,848	*n/a*	*n/a*	*n/a*
Other	***none***	4,301	317	1,560	3,239	*n/a*	*n/a*	*n/a*
M1	**M1**	252,173	2,900	37,283	367,874	*n/a*	*n/a*	*n/a*
M1	**M2M3**	8,986	194	808	5,254	13	580	8,823
M1	**N1**	32,931	552	3,720	30,590	111	1,320	13,459
M1	**N2N3**	23,967	1,456	4,583	22,809	35	483	3,522
M1	**PTW**	130,523	35	731	8,797	1,939	30,768	106,274
M1	**Pedestrian**	109,876	17	206	1,980	3,600	27,549	83,758
M1	**Cyclist**	103,824	7	123	1,581	1,005	16,833	86,001
M1	**Other**	13,203	331	1,469	9,247	114	1,246	5,628
……	……	…	…	…	…	…	…	…
……	**……**	…	…	…	…	…	…	…

Safety measure effectiveness

For each safety measure …

Casualty target population x Effectiveness value = Predicted casualty population

- **‘Avoidance’** describes a situation where casualties would remain entirely uninjured after application of the effective safety measure
- **‘Mitigation’** describes a situation where casualties would sustain injuries of a lower severity level (fatal turned to serious casualty, or serious to slight casualty)
    - An effective passive safety measure prevents the most severe injuries, or
    - An active safety measure reduces the impact speed.
- Measures have been assigned **separate values for effectiveness of avoidance and mitigation at all injury severity levels**.
- It should be noted that **effectiveness values for avoidance and mitigation are additive in this model**. ‘Mitigated’ casualties are subsequently added to the target population of the next lower injury severity level for other measures.

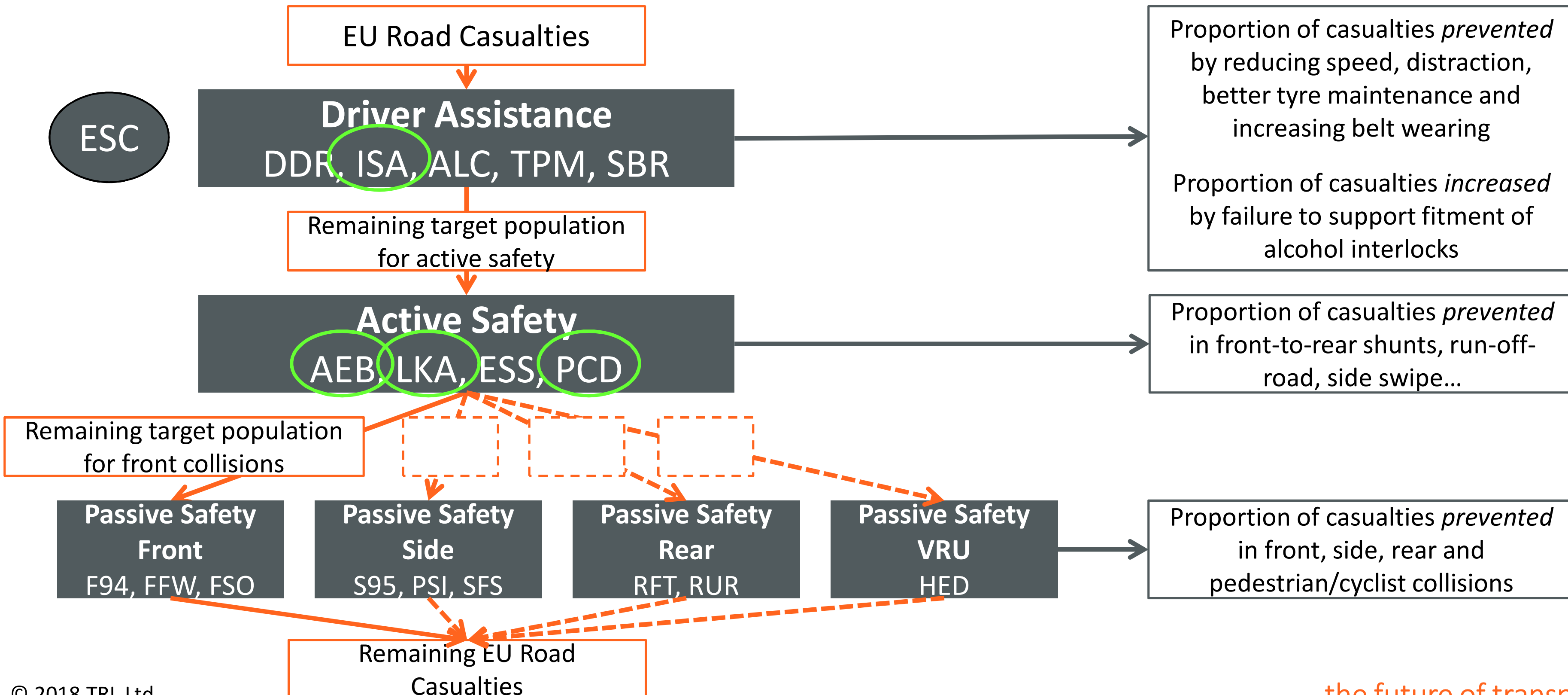
Safety measure effectiveness

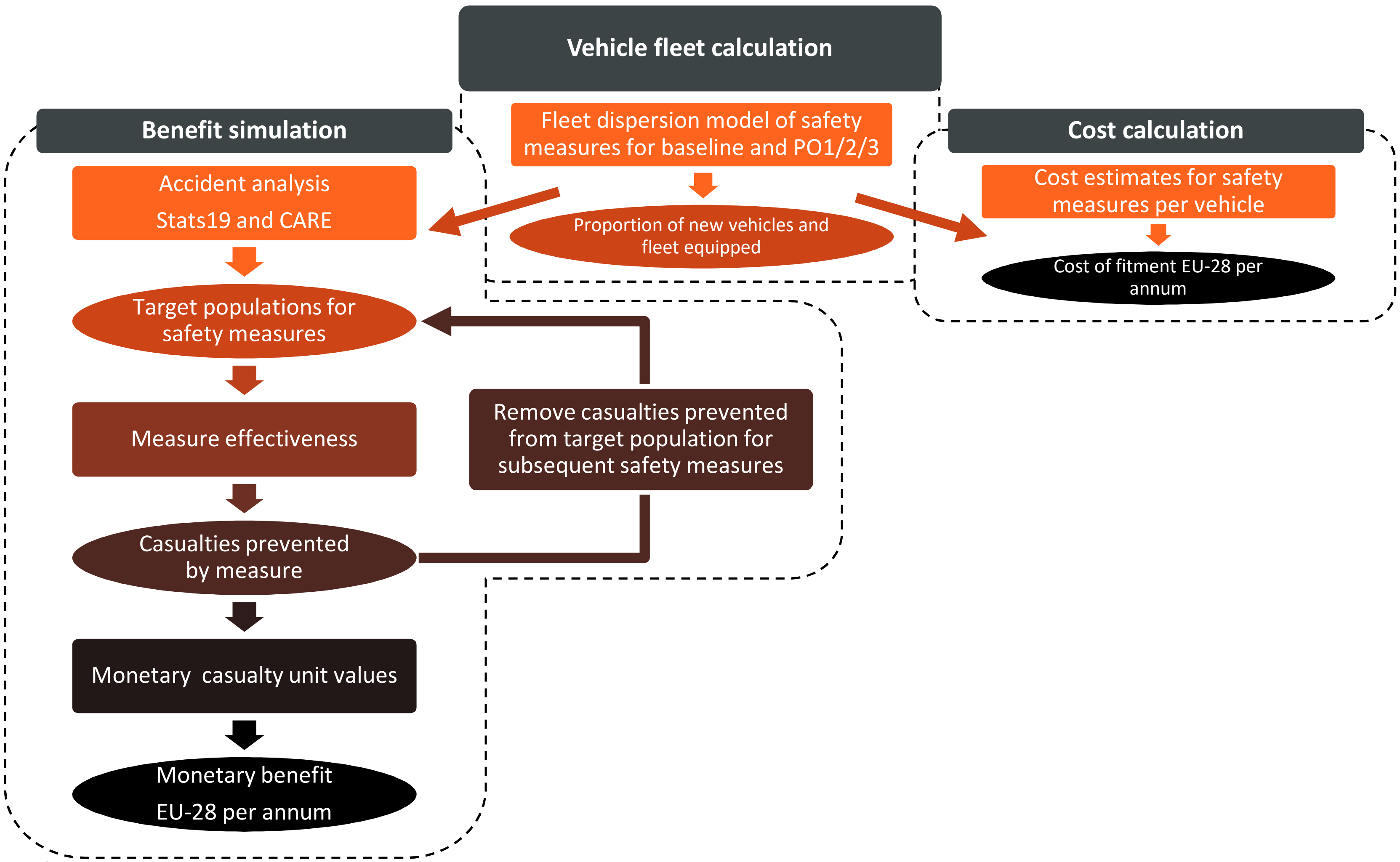
- The **effectiveness values were based on the values determined by TRL** (Seidl, et al., 2017) in preparation of this study (extracted from research studies and stakeholder input).
- Where no values could be identified during the course of this review and **where no stakeholder input was provided**, a road safety expert panel at **TRL determined best estimates from the available evidence**
- For the interval and scenario analysis, **effectiveness values were assigned a confidence level** (high or low depending on the quality of the source) and the best estimates were varied as follows in order to determine the upper and lower estimates:
  - **Plus/minus 10% for high confidence estimates**

    (for example, a value of 40% would be varied ±4 percentage points, i.e. 36% to 44%)
  - **Plus/minus 20% for low confidence estimates**

Avoidance of double-counting of casualties prevented

Clustering Levels – Example for Cars

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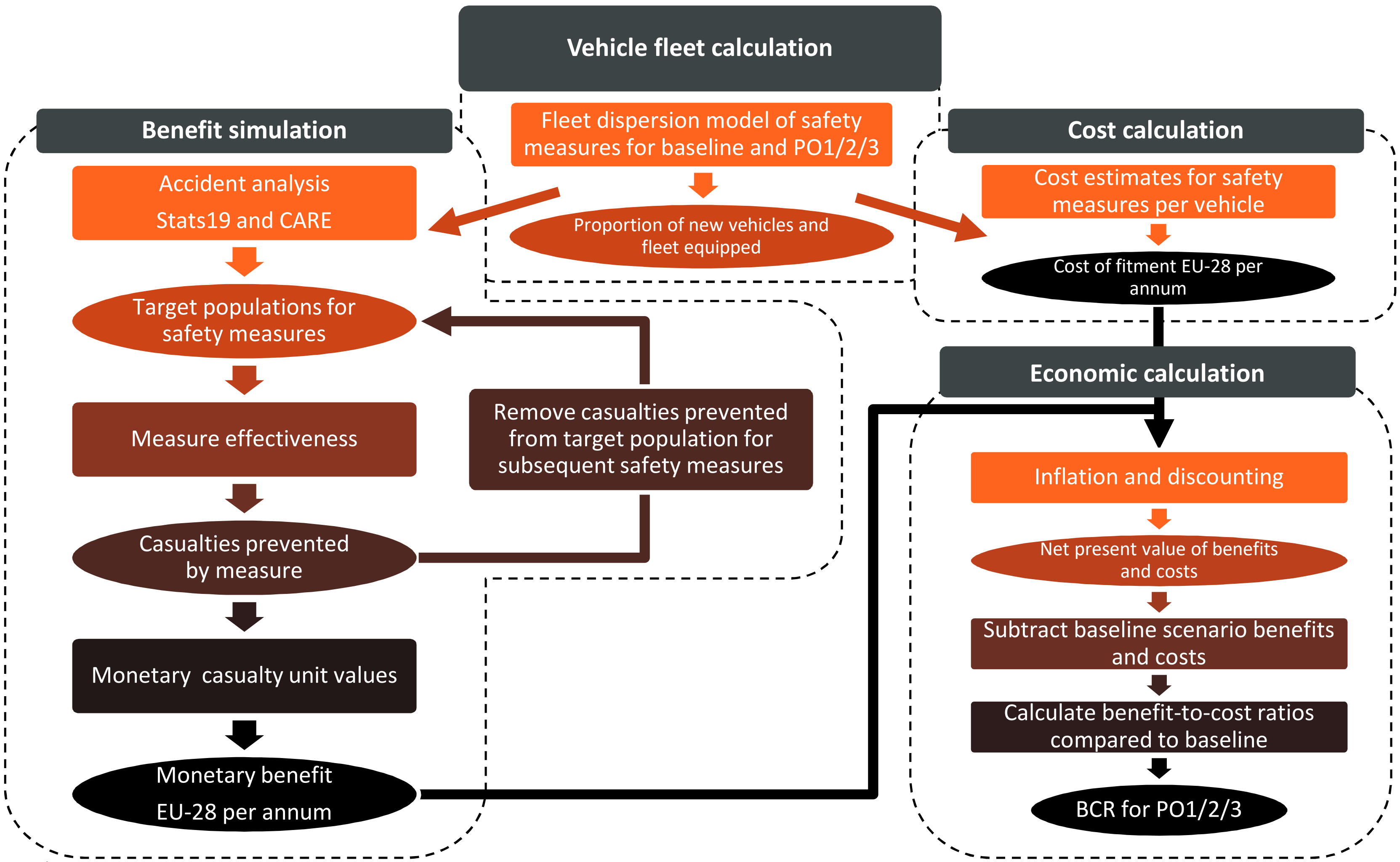
Monetisation of casualties prevented & Safety measure costs

Casualty severity	Social unit cost
Fatal	€1,870,000
Serious	€243,100
Slight	€18,700

Initial cost per vehicle	PO1	PO2	PO3
Passenger cars (M1)	€201	€360	€516
Buses and coaches (M2&M3)	€6	€607	€970
Vans (N1)	€131	€206	€521
Trucks (N2&N3)	€6	€607	€1,013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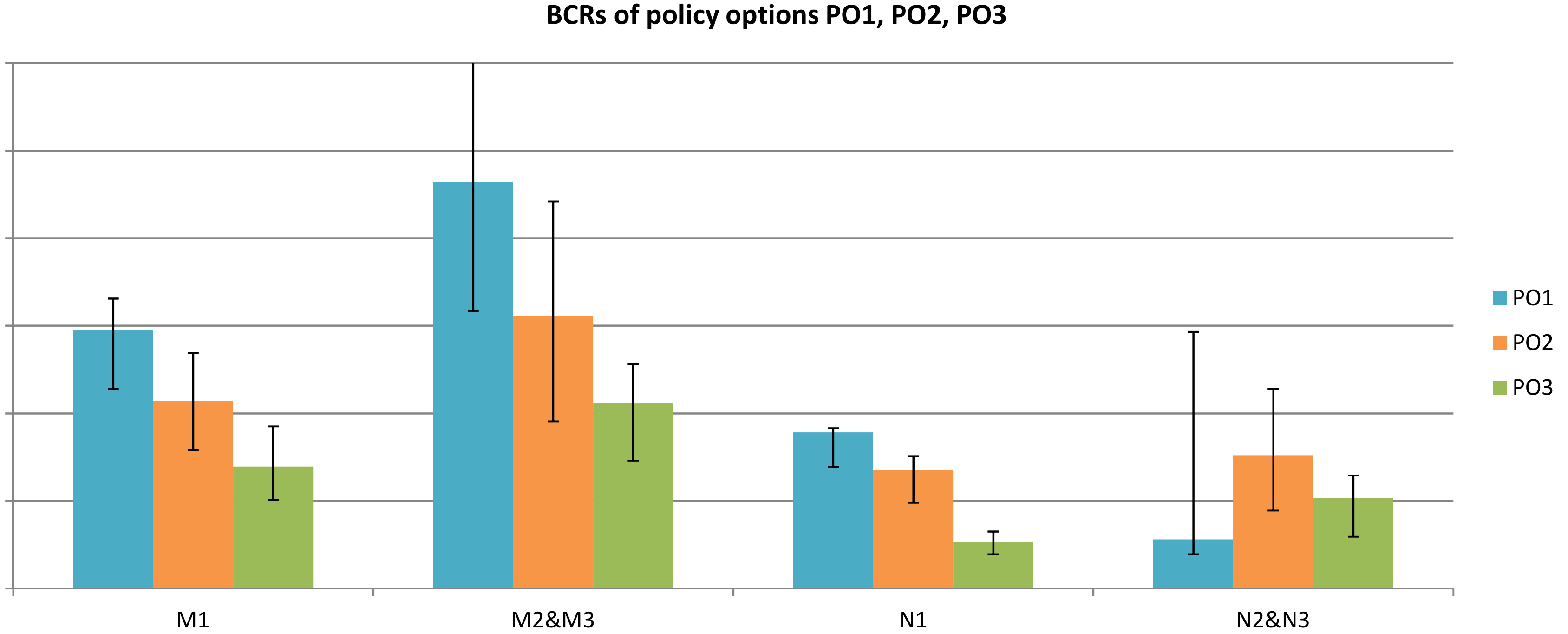
Economic Calculation

Simulation and Calculation model included ….

- Impact of additional safety measures on vehicle prices and sales numbers
  - **Cars have become cheaper in real terms in every year of the last reported decade**, despite this being a period in which technical development to meet new and **more demanding environmental and safety standards increased**
  - **However, we assumed costs would increase based on the TRL** (Seidl, et al., 2017) **study**
- Discounting of costs and benefits
  - A 'social discount rate' is applied to reflect the fact that **benefits and costs further ahead in the future are valued lower than present benefits and costs**
- Inflation of monetary values
- Sensitivity analysis
  - To quantify the range uncertainty around the best estimate BCR values, two sensitivity analysis techniques common in cost-benefit evaluations were applied (Bickel, et al., 2006a): **Interval analysis and Scenario analysis.**
- **Data sources and stakeholder validation**

Key Results



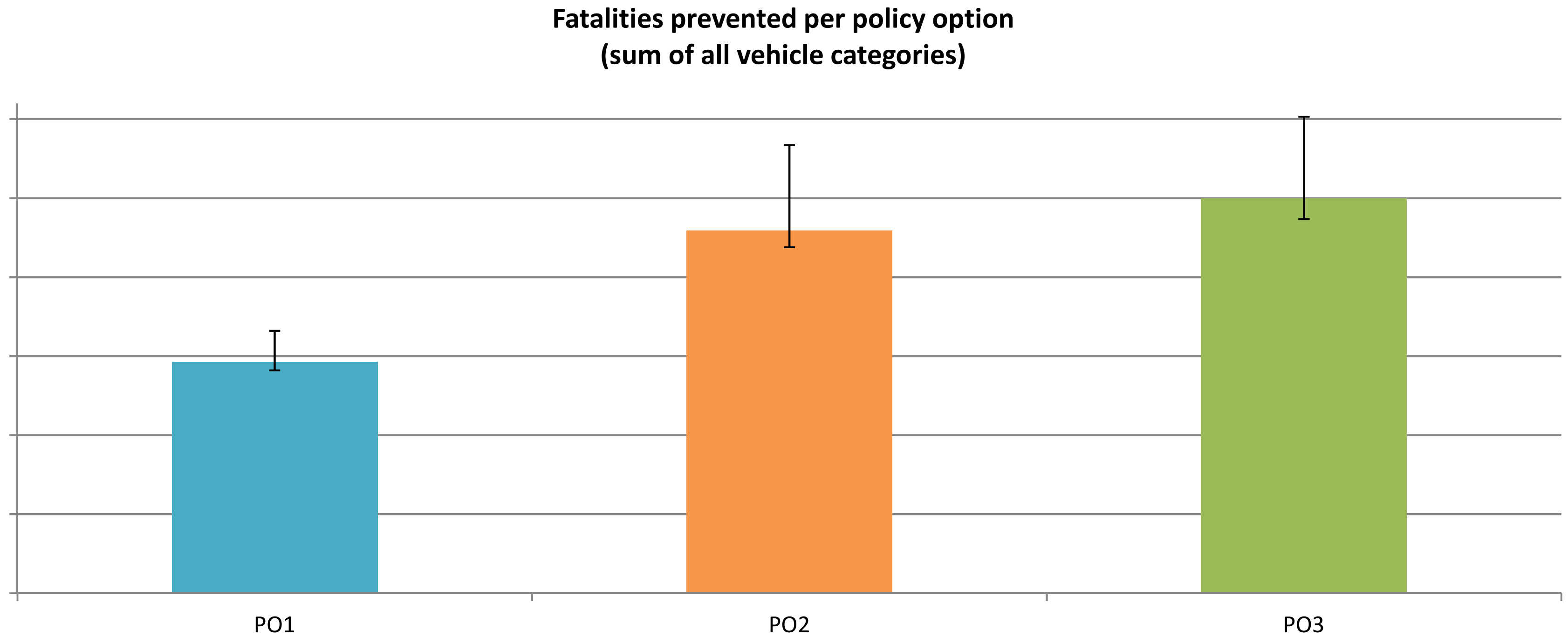
Values > 1 indicate that the benefits are greater than the costs

Key Results

Total sum of casualties prevented by safety measures across all vehicle categories over the evaluation period 2021–2037 across EU-28 compared to the baseline scenario (best estimate)

All categories	PO1	PO2	PO3
Fatalities prevented	14,639	22,951	24,794
Serious casualties prevented	67,647	118,933	140,740
Slight casualties prevented	288,293	421,562	515,681

Key Results


Fatalities prevented per policy option
(sum of all vehicle categories)
PO1
PO2
PO3

Conclusions

- Overall **PO1 offers favourable cost-effectiveness ratios** in most vehicle categories, but these are achieved with **only a small impact on both the costs and the casualty benefits** compared to the baseline scenario of continued voluntary uptake.
- The **impacts of PO2 and PO3 are larger**, with numbers of **fatalities prevented exceeding those of PO1 by a considerable margin**, but this is accompanied by **a greater cost**.
- Where PO2 or PO3 exceed the threshold to cost-effectiveness (BCR>1), the **considerably greater number of casualties prevented is a compelling reason to implement PO2 or PO3**.
- **PO3 represents the**:
  - Most ambitious option to reduce the number of deaths and injuries on EU-28 roads
  - Most relevant option to address future road casualty trends
  - Most technologically advanced – helping the EU Industry to remain competitive with regard to the challenges of developing Automated vehicles, because it includes measures such as **Advanced Driver Distraction Recognition** and **Reverse Camera Systems**.

Richard Cuerden, TRL Academy Director
Email: rcuerden@trl.co.uk
Twitter: @rcuerden_trl

THE FUTURE OF TRANSPORT

Crowthorne House | Nine Mile Ride | Wokingham |Berkshire | RG40 3GA | UK

Thank you