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Evaluation of Regulations 443/2009 and 510/2011 on the reduction of CO_2 emissions from light-duty vehicles

Sujith Kollamthodi (Ricardo-AEA)

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Study aims and objectives

- **Study evaluates Regulation 443/2009 (Passenger car CO_2 Regulation) and Regulation 510/2011 (LCV CO_2 Regulation)**

- **Evaluates all elements of the Regulations in terms of:**
  - Relevance
  - Efficiency
  - Effectiveness
  - Coherence
  - EU added-value

- **Assesses positive and/or negative impacts of the Regulations in terms of ensuring:**
  - A high level of environmental protection
  - Supporting competitiveness, innovation and employment
  - Social equity

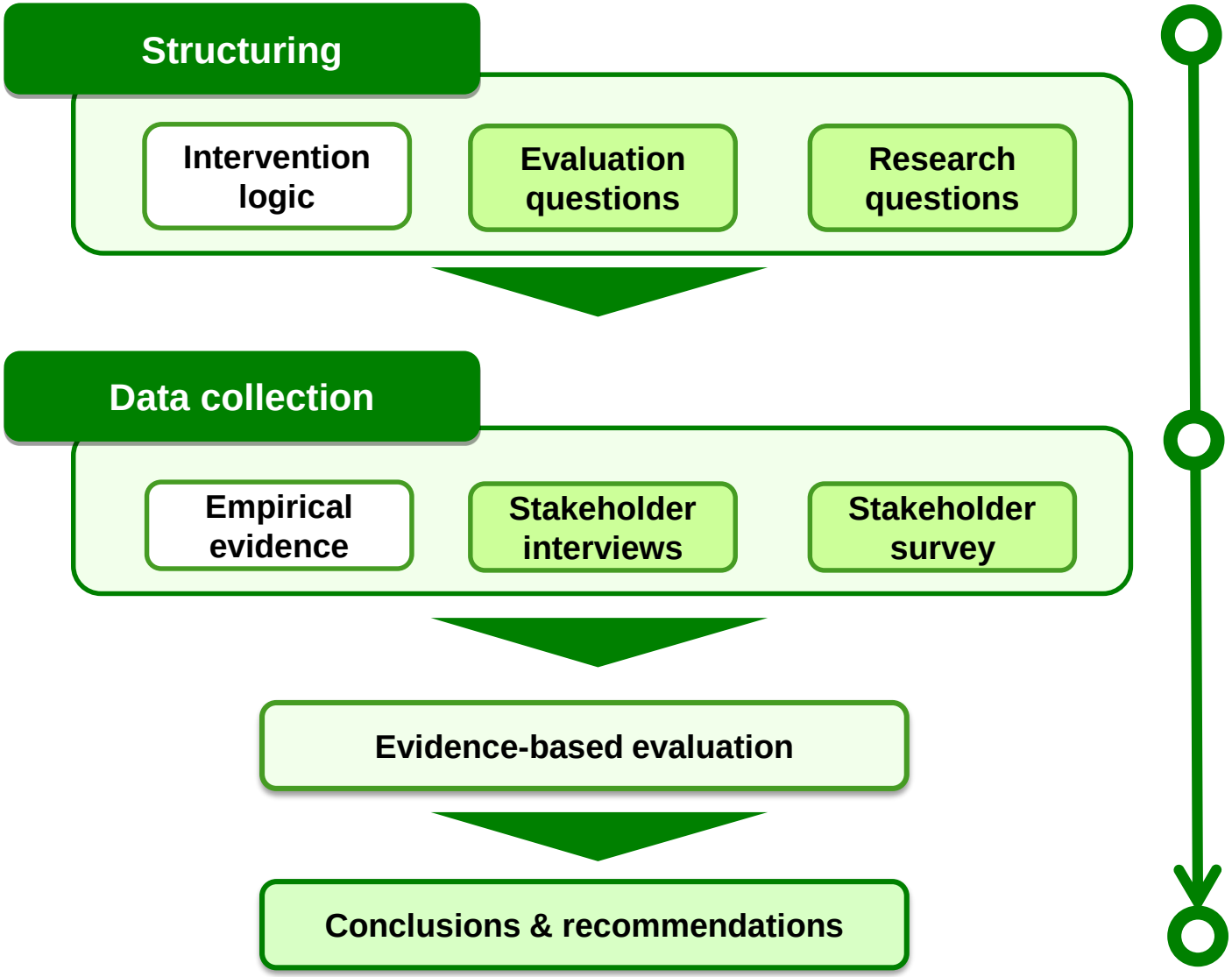
Study aims and objectives

- **The aims are to better understand:**
  - Areas that are causing inefficiencies due to issues relating to **design / implementation** and the relative importance of these different aspects;
  - Areas that could be affecting **competitiveness or social equity** for different areas of the automotive market; and
  - To make recommendations on whether the current legislative framework needs to be adapted in light of future technological developments in the automotive sector

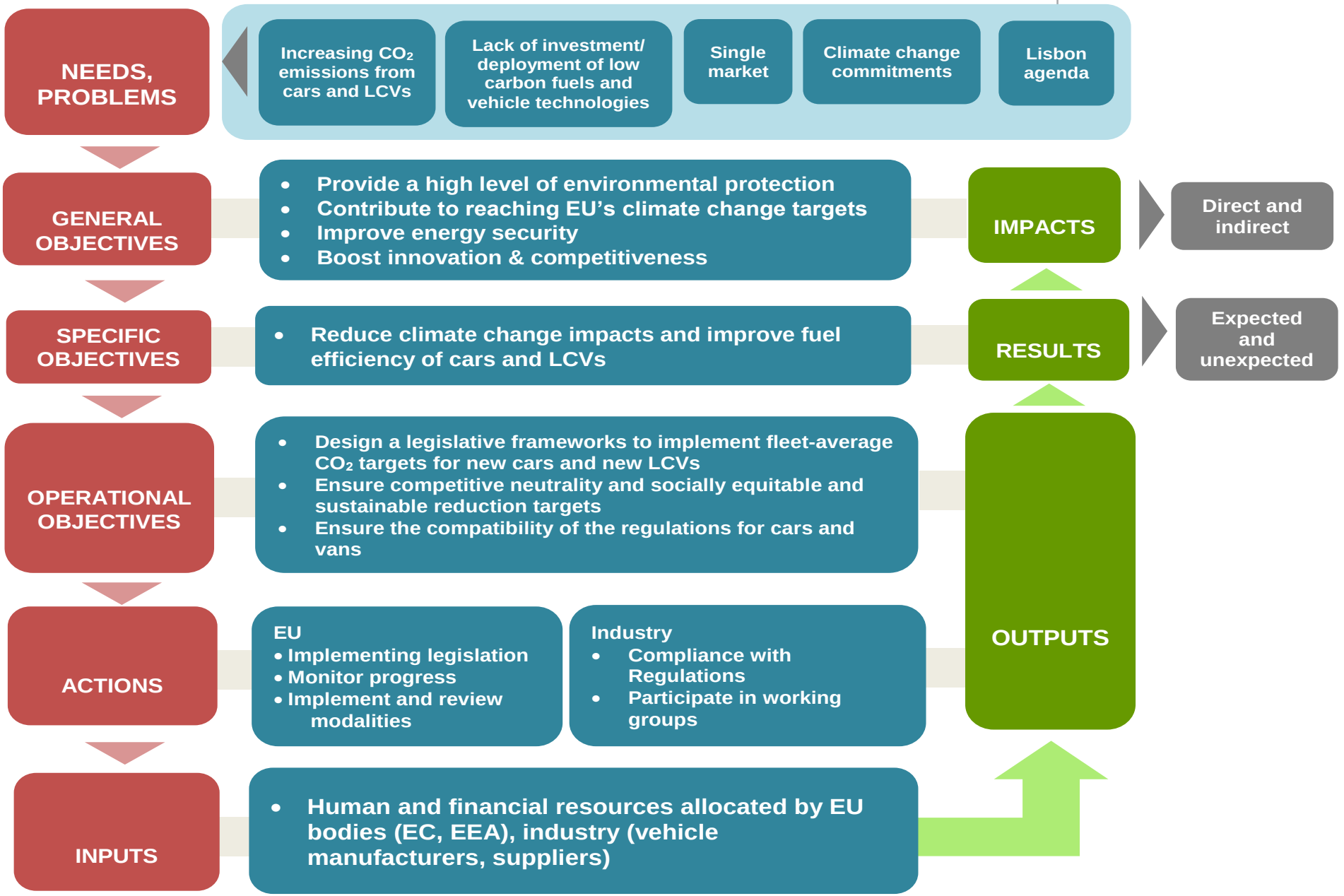
- **The study is NOT:**
  - An impact assessment of future Regulations. The scope focuses on **looking backwards** at the results compared to what was expected at the time the Regulations were being developed.

- **The findings will be used outside of this study to support the future development of the Regulations for the period post 2020/21**

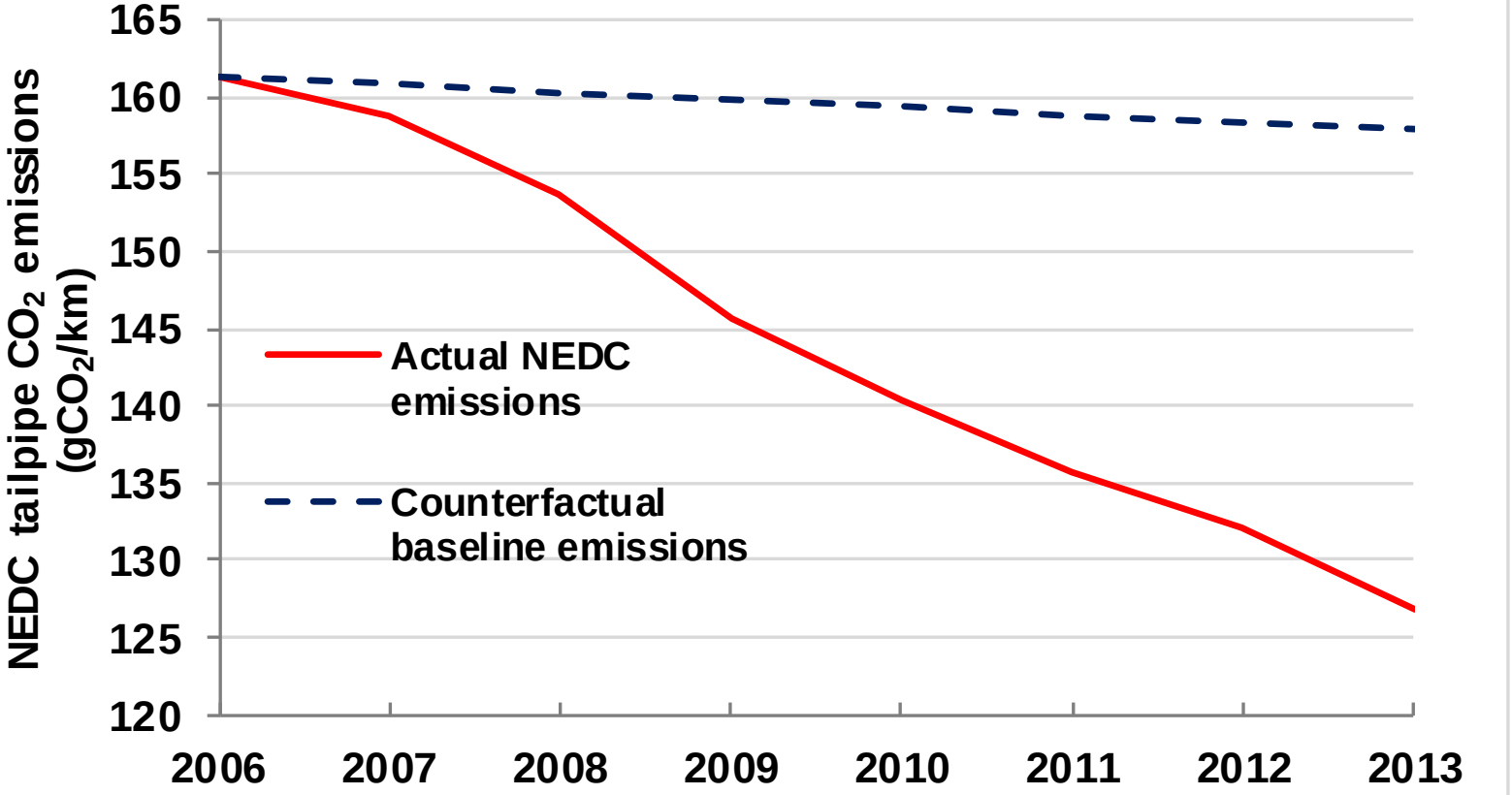
Study methodology



Intervention logic

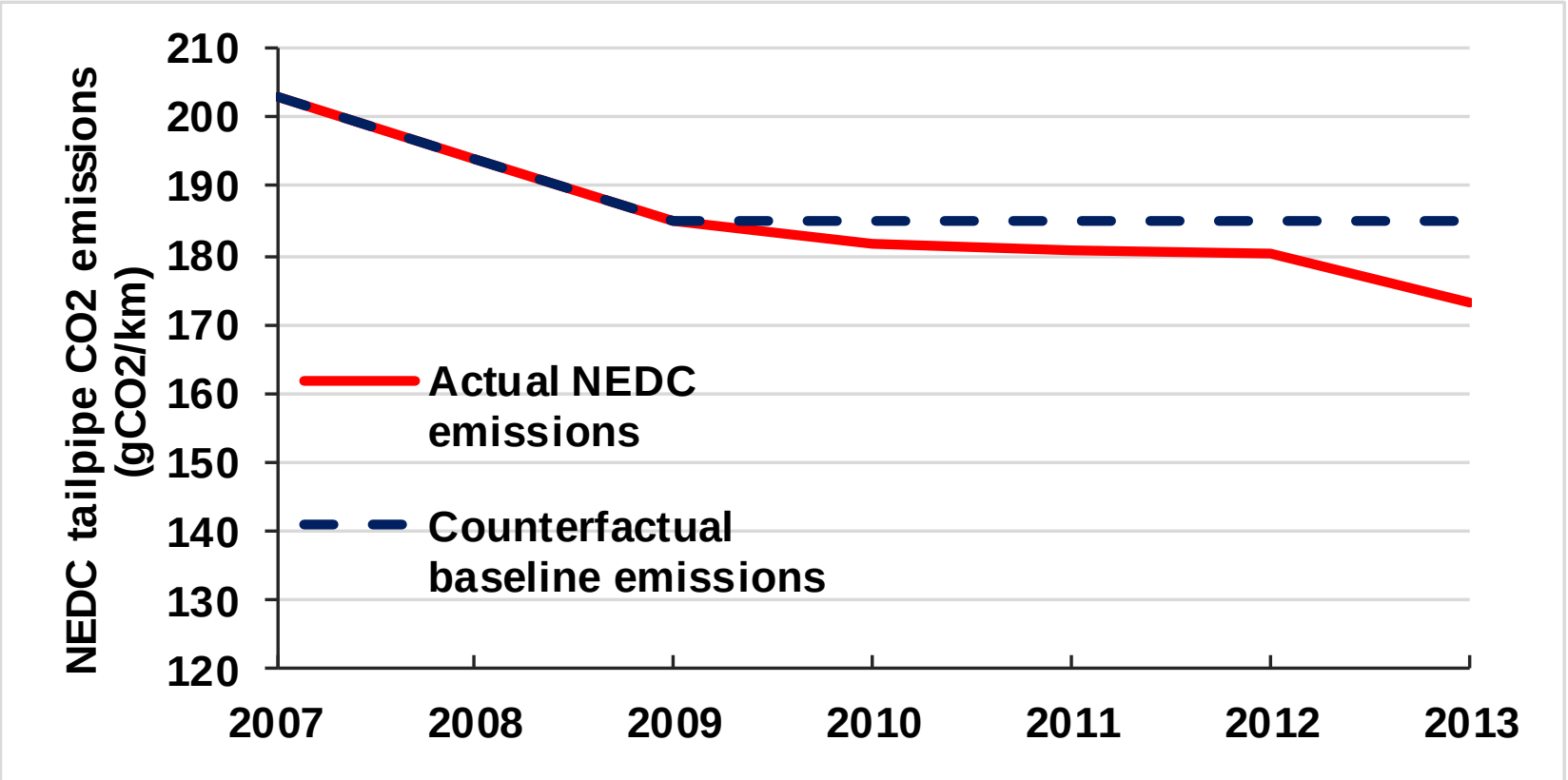


Baseline scenario - cars



- Baseline scenario represents what would have happened in the absence of the Regulation
- For passenger cars, 0.5 gCO_2/km annual improvement assumed (takes into account any residual impacts of the voluntary agreement)

Baseline scenario - LCVs



- **Baseline scenario for LCVs assumes that emissions remain flat from 2009 onwards (year the Regulation was announced)**

Relevance – to what extent do the objectives of the Regulations still respond to the needs?

- Low Carbon Economy Roadmap and Transport White Paper demonstrated that the transport sector will have to achieve GHG reductions of ~60% by 2050 to be consistent with economy-wide targets
- Hence, significant improvements in the CO_2 performance of light duty vehicles were, and still are, needed
- Current annual average rate of emissions reductions are around 3.5% for cars and 2.1% for LCVs.
- In order to be consistent with the 60% reduction **the rate of annual emissions reductions needs to increase** – potentially to 5.2% per year for cars and 3.2% per year for LCVs.
- Evidence suggests that **without regulatory measures, average fuel consumption does not decline at a sufficiently fast rate** – and can even increase
- Furthermore, even though car use has started to decline in some countries, this will not be sufficient to meet the scale of the challenge
- All of these factors indicate that the Regulations are still relevant in the context of needing to cut CO_2 emissions from cars and LCVs

Effectiveness of the Regulations

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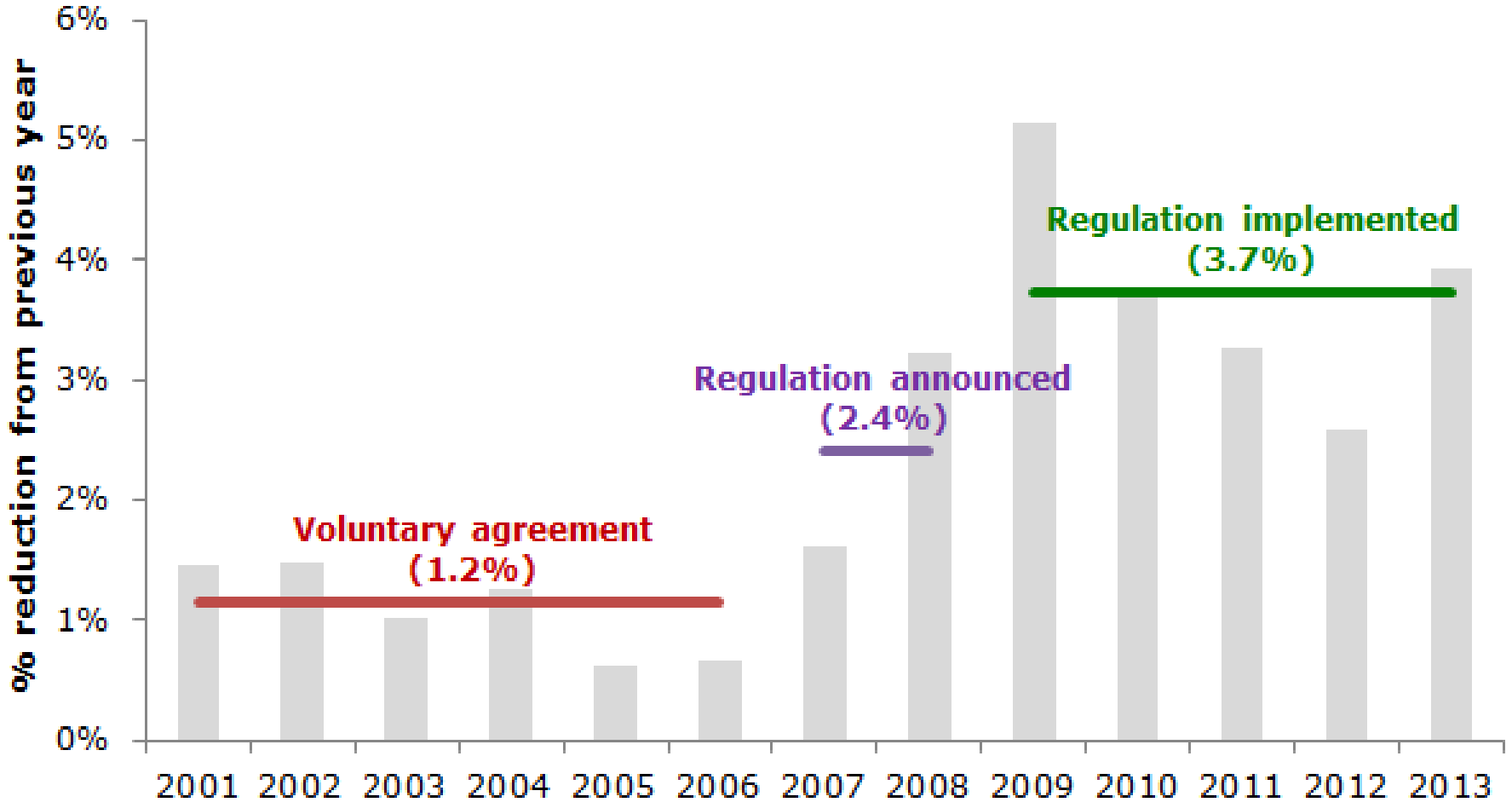
- **Achieved reductions in tailpipe CO_2 emissions**
  - Average NEDC tailpipe emissions in 2013 were **126.6 gCO_2/km for cars** and **173.3 gCO_2/km for LCVs.** In both cases, regulatory targets have been met early (2015 targets for cars and 2017 target for LCVs).
  - For passenger cars, 72 manufacturers out of 84 met their 2013 manufacturer-specific targets in 2013. All but two met their targets through joining pools.
  - For LCVs, 12 out of 13 manufacturers met their indicative 2013 targets in 2013
  - **All larger car manufacturers are on track to meet their 2015 targets** (15 have already met these targets and six already have average emissions below 120 gCO_2/km)
  - Five LCV manufacturers (48% of the market) already have average emissions below 175 gCO_2/km
  - **Percentage of new LCVs registered with emissions below 140 g/km has increased** (32% in 2013 compared to 27% in 2012)

Effectiveness of the Regulations

- **Extent to which the Regulations have contributed to reductions in emissions – passenger cars**



Effectiveness of the Regulations

- **Extent to which the Regulations have contributed to reductions in emissions – passenger cars**
  - High-level data suggests that the Regulation has been effective in reducing car CO_2 emissions
  - However, many other factors have also affected tailpipe CO_2 emissions over the same time period
  - Regression analysis was carried out in this study to investigate the contribution of the Regulation to CO_2 reductions compared to other influencing factors
  - The findings suggest that the Regulations were responsible for **at least two thirds of the emissions reductions achieved**
  - The factors responsible for the remaining one third are likely to include national policies, shifts in consumer preferences, investments made to meet the voluntary agreement target and autonomous improvements in vehicle fuel efficiency

Effectiveness of the Regulations

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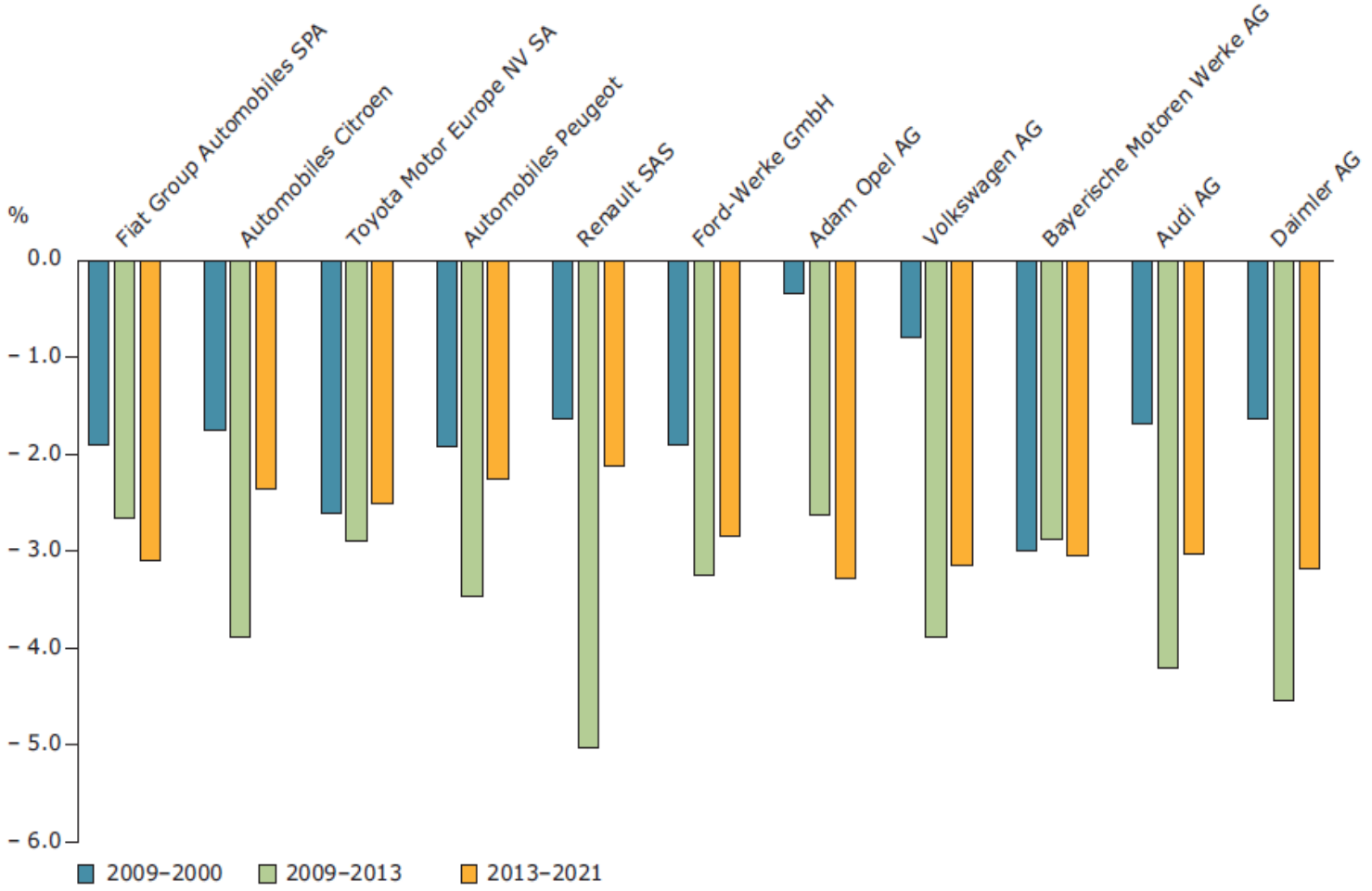
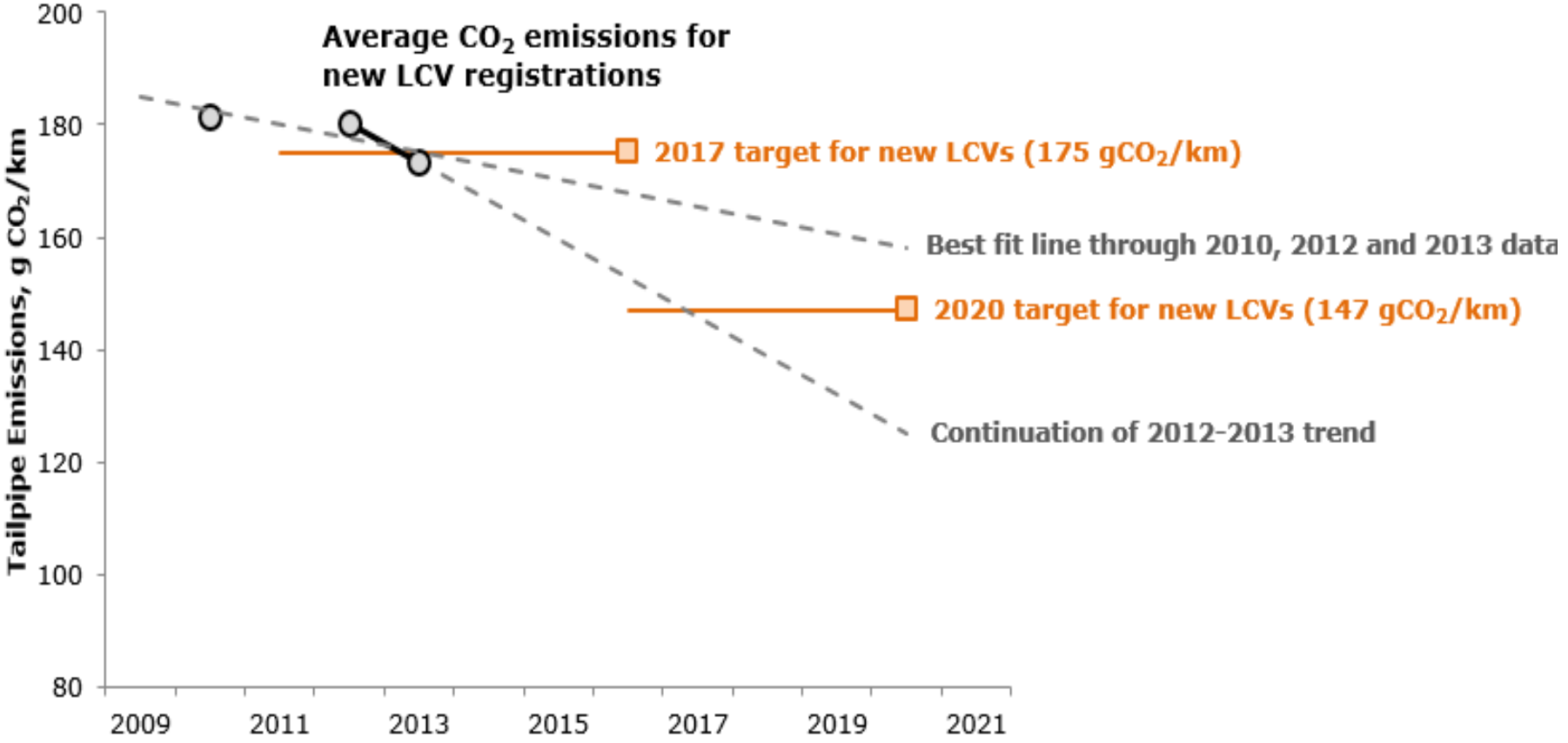
- **Passenger cars: are manufacturers on track to meet future targets?**
  - For the largest car manufacturers, the rate of progress required to meet their 2021 targets is generally lower than the rates of reductions achieved since 2009



Effectiveness of the Regulations

- **LCVs: are manufacturers on track to meet future targets?**
  - Best-fit line through 2010, 2012 and 2013 data indicates that LCV manufacturers would miss their targets
  - However, if 2012-2013 trends continue, LCV manufacturers will over-achieve against their target by 2020



Effectiveness of the Regulations

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- **Weaknesses of the Regulations**
  - **Test cycle emissions -** not representative of real-world emissions
  - **Use of super-credits** – but in practice, these were not needed to meet the target
  - **Use of mass as the utility parameter** – potentially disincentivises mass reduction as an abatement option
  - **Phase-in period** – however in practice this only weakened the target by 1.7% for cars because manufacturers complied early
  - **Small volume and niche derogations** – very limited impacts – worst-case scenario is that the target could have been weakened by a fraction of 1%
  - **Use of Tank-to-Wheel (TTW) emissions-based metric** – Regulations incentivise vehicles with low TTW emissions that may have higher Well-To-Tank (WTT) emissions. WTT emissions are not covered by the Regulations
  - **Embedded emissions** – Regulations incentivise vehicles with higher embedded emissions but these emissions are not covered by the Regulations

Effectiveness of the Regulations

- **Competitiveness and innovation**
  - Impacts appear to be positive as there is some evidence that fuel economy standards induce R&D spending
  - Patent application trends indicate that the European automotive industry has been increasingly focused on researching hybrid and electric vehicles
- **Social equity**
  - Overall impacts likely to be positive – analysis did not identify any impacts on retail prices of new vehicles
  - Fuel efficiency benefits of vehicles affected by the Regulations will benefit consumers in all income groups once vehicles pass to the second-hand market
- **Environmental protection**
  - Current focus of Regulation on tailpipe emissions to the exclusion of WTW and embedded emissions has so far not been problematic – but this may change in future if alternative powertrains become more prevalent
  - In most cases the technologies and fuels with the greatest reductions in life-cycle GHG emissions also have the greatest potential to reduce NOx and PM emissions

Efficiency of the Regulations – passenger cars

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- **Cost effectiveness to society**
  - Comparing ex-ante estimates costs and benefits with actual outcomes indicates that the **car CO_2 Regulation is highly cost-effective to society as a whole**

	Ex-ante impact assessment	Ex-post evaluation
Costs to society (NPV 2006-2020)	€21 billion	-
Costs to society (NPV lifetime costs for new cars registered between 2006 and 2013)	-	-€37 billion
CO_2 savings – all new cars 2006 to 2020	-636 $MtCO_2$	-
Lifetime CO_2 savings - new cars registered between 2006 to 2013	-	-375 $MtCO_2$
Cost effectiveness (€/tCO_2)	+€33/tCO_2	-€101/tCO_2

  - Figures indicate there have been **net economic benefits to society**
  - Main reasons for better than expected cost effectiveness are because:
    - Fuel prices were higher than originally anticipated between 2006 and 2013
    - Costs of deploying technologies for new vehicles have been lower than anticipated
  - Note that cumulative emissions benefits and economic benefits will increase in future years

Efficiency of the Regulations – passenger cars

- **Costs to manufacturers of complying with the Regulations**

	Technology costs per vehicle	Estimated total costs to industry
Ex-ante estimate: TNO (2006)	€620	€58 billion
Ex-ante estimate: IEEP (2007)	€730 to €1670	€69 billion to €157 billion
Ex-post analysis (this study)	€202	€19 billion

- Costs to industry have been much lower than anticipated
- Market penetration of different technologies has been analysed and cross-referenced against technology cost estimates from vehicle teardown studies
- Level of effort (i.e. emissions reductions required) to meet the 130 g/km target also greater than anticipated (e.g. TNO (2006) cost estimate based on reducing emissions from 140 g/km in 2008 to 130 g/km in 2012
- Regulation has been much more cost efficient in achieving emissions reductions than expected

Efficiency of the Regulations – passenger cars

- **Changes in consumer fuel expenditure**

	Ex-ante predicted estimate	Ex-post outturn
Lifetime savings in fuel expenditure per vehicle	€2,693	€3,692

– Savings in fuel expenditure greater than expected due to:

  - Over-achievement against the 2015 target
  - Higher actual fuel prices than assumed in the original Impact Assessment
  - Higher than expected deviation between test-cycle and real-world fuel consumption performance

Efficiency of the Regulations – LCVs

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- **Cost effectiveness to society**

	Ex-ante impact assessment	Ex-post evaluation
Costs to society (NPV 2010-2020)	-€3.9 billion	-
Costs to society (NPV lifetime costs for new LCVs registered between 2010 and 2013)	-	-€1.6 billion
CO_2 savings – all new LCVs 2010 to 2020	-60 $MtCO_2$	-
Lifetime CO_2 savings - new LCVs registered between 2010 and 2013	-	-9.4 $MtCO_2$
Cost effectiveness (€/tCO_2)	-€39 to -€33/tCO_2	-€166/tCO_2

- LCV CO_2 Regulation is highly cost effective
- Ex-ante analysis assumed baseline starting point of 203 gCO_2/km – but more recent data indicates that average LCV emissions were around 185 gCO_2/km in 2010
- Hence emissions benefits in the impact assessment may have been overestimated
- However, significant emissions benefits already realised and even if new LCV emissions performance does not improve beyond 2013 levels, a further 20 $MtCO_2$ in emissions savings would be realised (compared to baseline) by 2020 from new vehicles entering the fleet.

Efficiency of the Regulations – LCVs

- **Costs to manufacturers of complying with the Regulations**

	Technology costs per vehicle	Estimated total costs to industry
Ex-ante estimate	€1798	€12.9 billion
Ex-post analysis (this study)	€114	€0.8 billion

– Costs to industry have been much lower than anticipated

– This is mainly due to lower level of effort (emissions reductions) needed (i.e. reducing average emissions from 185 gCO_2/km to 173.3 gCO_2/km)

Efficiency of the Regulations – LCVs

- **Changes in consumer fuel expenditure**

	Ex-ante predicted estimate	Ex-post outturn
Savings in fuel expenditure (2010 to 2020)	-€16.4 billion	-
Savings in fuel expenditure (lifetime savings for new vehicles registered 2010-2013)		-€1.6 billion

- Fuel savings cannot be compared on like-for-like basis at this point in time
- Fuel savings likely to have been over-estimated in ex-ante analysis due to assumed baseline performance of 203 gCO_2/km
- However, savings to date equate to €1,570 over the lifetime of each new LCV
- Even if fuel efficiency of new LCVs did not increase beyond 2013 levels, a further €3.4 billion in lifetime fuel savings could be realised from new vehicles entering the EU fleet between 2014 and 2020, compared to the baseline scenario

Coherence: how the Regulations fit with other policy objectives

- **To what extent are the Regulations aligned with other EU interventions**
  - The Regulations are coherent with demand-side EU measures such as the Car CO_2 Labelling Directive and the Clean Vehicle Directive
  - Member States also use CO_2 based vehicle taxation policies to influence vehicle purchasing behaviour
  - Various EU Directives on fuels, energy carriers and energy infrastructure are also in place and these work together with the Regulations to reduce GHG emissions from light duty vehicles
  - The requirements of the Euro emissions standards and the targets in the CO_2 Regulations may lead to trade-offs between vehicle air pollutant emissions performance and CO_2 emissions performance
  - There are no explicit conflicts between safety requirements and the CO_2 Regulations

EU added value

- Automotive industry requires as much regulatory certainty as possible given the high macro-levels of investment required to comply with target
- Only EU-level action can achieve the level of certainty required
- High risk that it would not be possible to co-ordinate action at the Member State level to achieve the same levels of effectiveness and efficiency as has been achieved with EU-level action
- Currently, there are widely varying break points employed in differentiation of taxes, fiscal incentives and fuel economy labels developed by different Member States
- These policies are subject to national sovereignty and hence it seems unlikely that national policy measures would create a level playing field

Conclusions

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- The Regulations are still highly **relevant** in the context of needing to reduce emissions from the transport sector in line with economy-wide CO_2 reduction targets
- They have been **effective** in ensuring that emissions reductions have been achieved and in increasing the rate of reductions.
- It is also clear that a Regulatory measure for car CO_2 emissions has been significantly more effective than the previous voluntary agreement
- A key weakness relates to the use of NEDC test cycle emissions to measure performance as this is not representative of real-world emissions performance
- The car CO_2 Regulation has been significantly **more cost-effective** than originally anticipated, primarily due to lower than expected technology costs and higher than expected fuel prices. This has resulted in **net economic benefits** to society
- The Regulations are broadly coherent with other EU policy measures, and in many cases, they work together with these other measures to reduce CO_2 emissions from road transport
- There is clear added value associated with EU-level action that is unlikely to be achieved through action at the Member State level

QUESTIONS?

Sujith Kollamthodi
Practice Director – Sustainable Transport

Ricardo-AEA Ltd
Gemini Building,
Fermi Avenue,
Harwell, Didcot,
Oxfordshire,
OX11 0QR

T: +44 (0)1235 753526
E: sujith.kollamthodi@ricardo-aea.com
W: www.ricardo-aea.com