



**FORMForum**

**FUTURE OF ROAD MOBILITY 2016**

# EARPA FORMForum 2016

## Winning the CO<sub>2</sub> Challenge Optimisation of OEM Product Portfolios by Market Modelling

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# The European CO<sub>2</sub> legislation bears high economical risks for OEMs and suppliers due to necessary investments with unknown customer acceptance at the same time.

## Status-quo

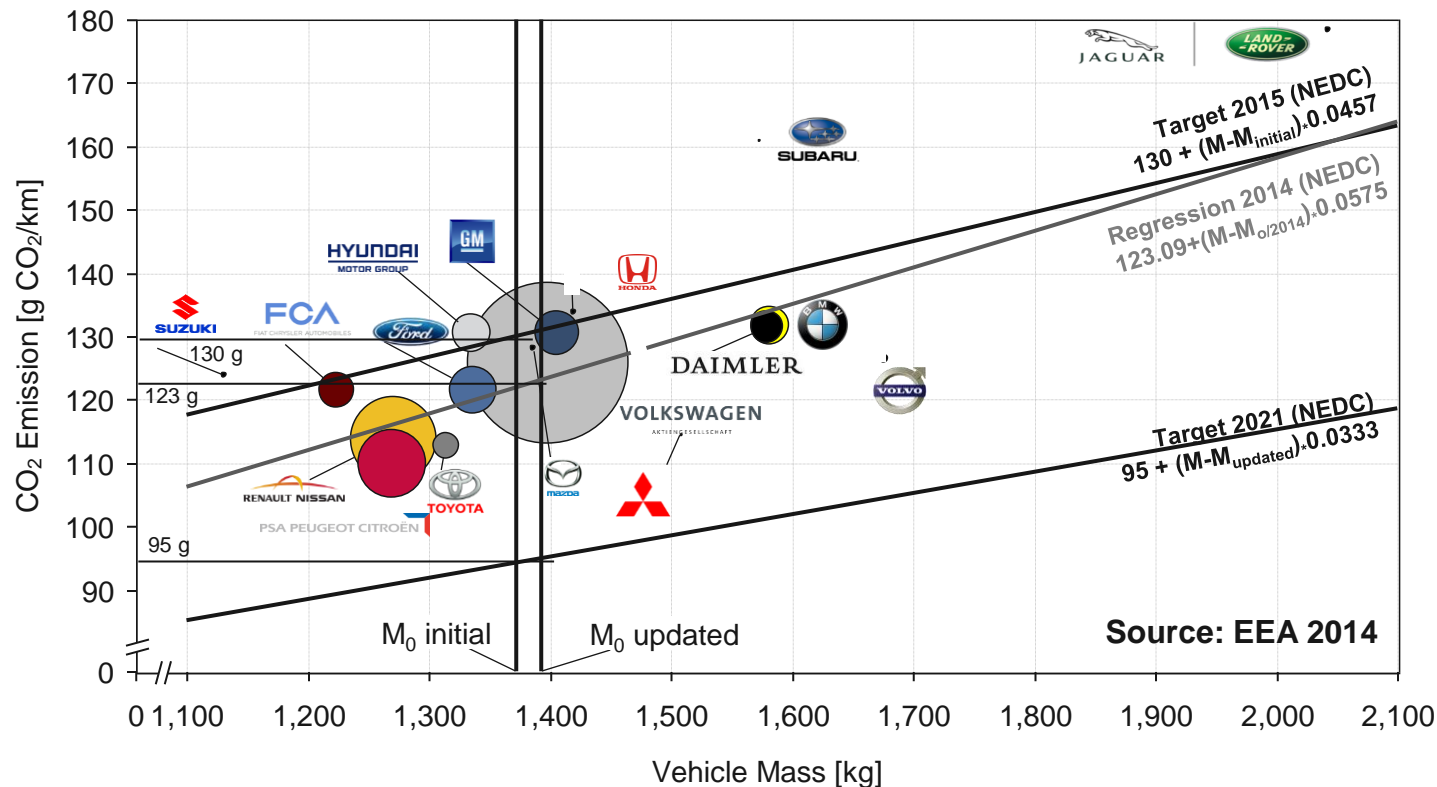
- The **framework** for the EU automotive industry is **changing drastically**.
  - Introduction of stringent **CO<sub>2</sub> reduction** legislation
  - Highly **volatile and increasing fuel prices** (in the long term)
- OEMs and suppliers react by establishing **technologies for higher efficiency** and introduction of **electrified vehicle concepts**.
  - **Very high investments** are necessary for each technology.
- Future **consumer demand** for respective technologies is highly **uncertain**.
- **The framework conditions bear high economical risks for OEM and suppliers.**
  - **Cost-driven approaches are insufficient** since customers determine fleet composition.



## Market modelling as a solution

- A **reliable picture of future customer demands** is the key for market success of OEMs and suppliers in Europe.
- Holistic market modelling is **able to provide this information** and helps OEMs and suppliers to meet the challenges arising from the European CO<sub>2</sub> legislation.

# All OEMs face a major challenge in complying with future CO<sub>2</sub> fleet emission targets. However, their initial situation is very different.



## Pooling

**VW Group:** Audi, Porsche, Seat, Skoda, Volkswagen, Bugatti, Bentley, Lamborghini

**OEM Group:** OEM, Mini, Rolls Royce

**Daimler:** Mercedes-Benz, Smart

**FCA:** Fiat, Alfa Romeo, Chrysler, Dodge, Ferrari, Jeep, Lancia, Maserati

**GM:** Opel, Vauxhall, Chevrolet, Buick, Cadillac

**Hyundai Kia Automotive Group:** Hyundai, Kia

**Renault Pool:** Nissan, Renault, Infiniti, Dacia, Lada

**PSA:** Peugeot, Citroen

**Tata Motors, Jaguar, Landrover**

**Toyota-Daihatsu Group:** Toyota, Daihatsu, Lexus

Future indicative target range: 2025: 65 - 80 g/km (NEDC eq.) - 2030: 50 - 70 g/km (NEDC eq.)

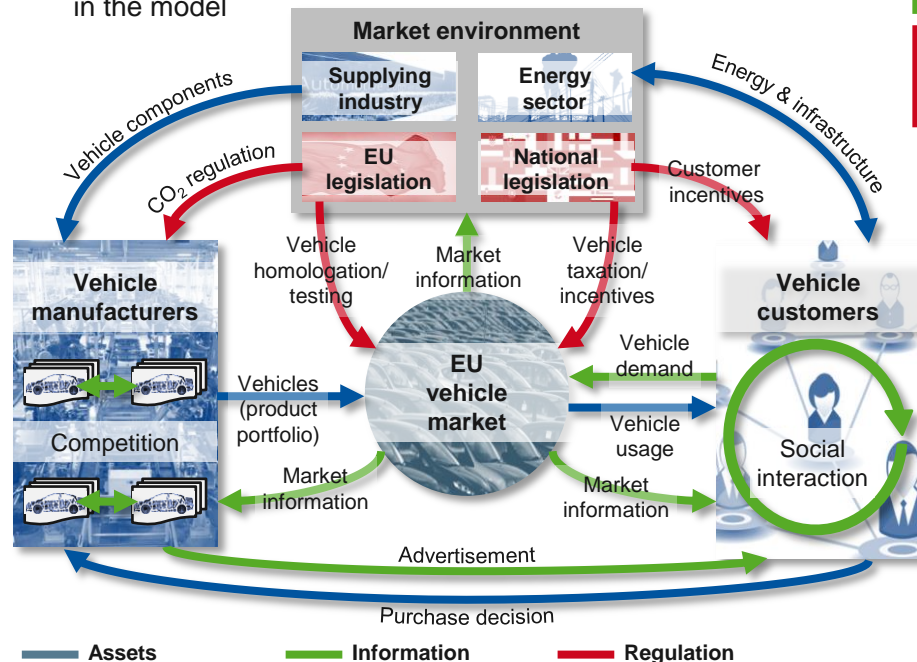
# Agenda

1. Motivation
2. Methodological Approach
3. Exemplary Results
4. Summary

# The methodological approach is a holistic market model that is capable of simulating OEM performance and hence improving product strategies in different environmental conditions.

## Complete Model Structure

- The complete model structure represents the complex interactions in the market
- All relevant actors and interdependencies have been integrated in the model



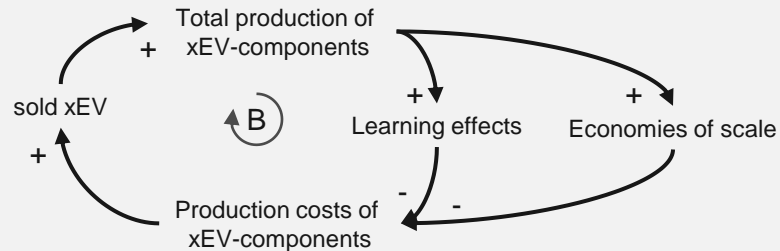
- **Three types of actors** with direct or indirect connections
- Actors exchange different **assets**
- Various **information is exchanged** by market actors **internally** and **externally**
- OEM, customers and the market are **regulated by the EU and national governments**
  - Main effects are **CO<sub>2</sub> regulation, taxation and incentives**
- Model represents a **complete description of the relevant interactions** within the EU new vehicle market
- Full integration of interaction requires **high effort towards model setup and parameterization**, e.g.
  - **Socio-demographics** of customers
  - National (vehicle) **taxation schemes** of EU member countries
- All interactions except the product portfolio variable are transferred in model algorithms and scenario-based assumptions
- The product portfolio remains as the single model command variable
- Various performance indicators can be defined e.g.
  - Compliance with CO<sub>2</sub> legislation
  - Operating profit / margins

# The model structure requires a hybrid approach of macro and micro modelling with an integrated system dynamics and agent-based modelling structure.

## Hybrid modelling

### Macro-modelling: System Dynamics (SD)

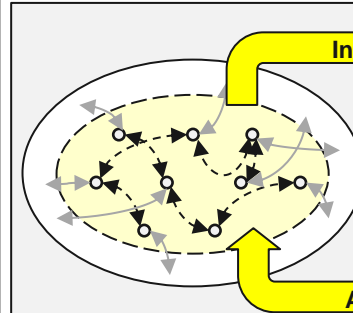
#### System environment (example)



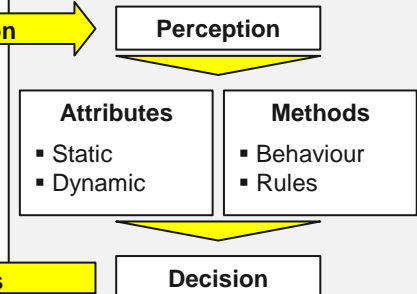
- **Causal-loop-chains** model self-reinforcing or self-regulating effects (analogy to closed loop control)
- Sources and abatements as interface towards environment
  - + Reproduction of **complex systems** with only a few components
  - + Analysis of influences of **exogenous factors** on the environment
  - Detailed **comprehension of system** necessary
  - Effects on **micro-level** not visible

### Micro-modelling: agent based modelling (ABM)

#### Environment



#### Agent



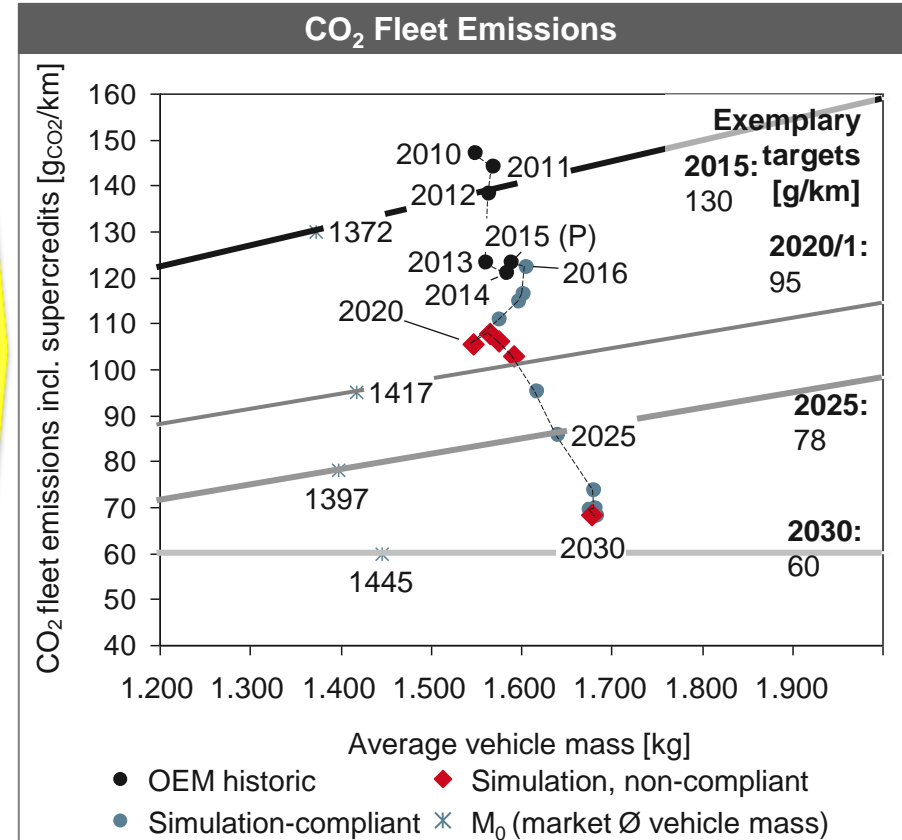
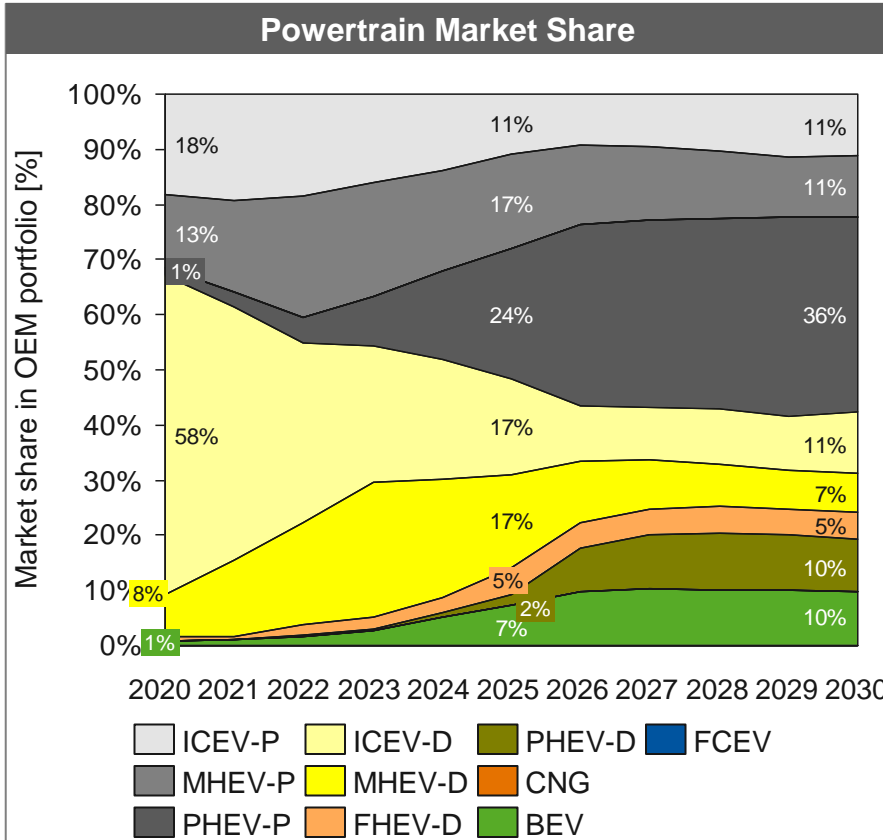
- Developments of systems can be traced back to **microscopic effects** (emergence)
  - + **System-coherencies** must not be known a priori
  - + high **level of detail**, as every agent possesses a limited amount of proprietary methods
  - High **computational effort**
  - **Exogenous parameters** cannot be stated

# Agenda

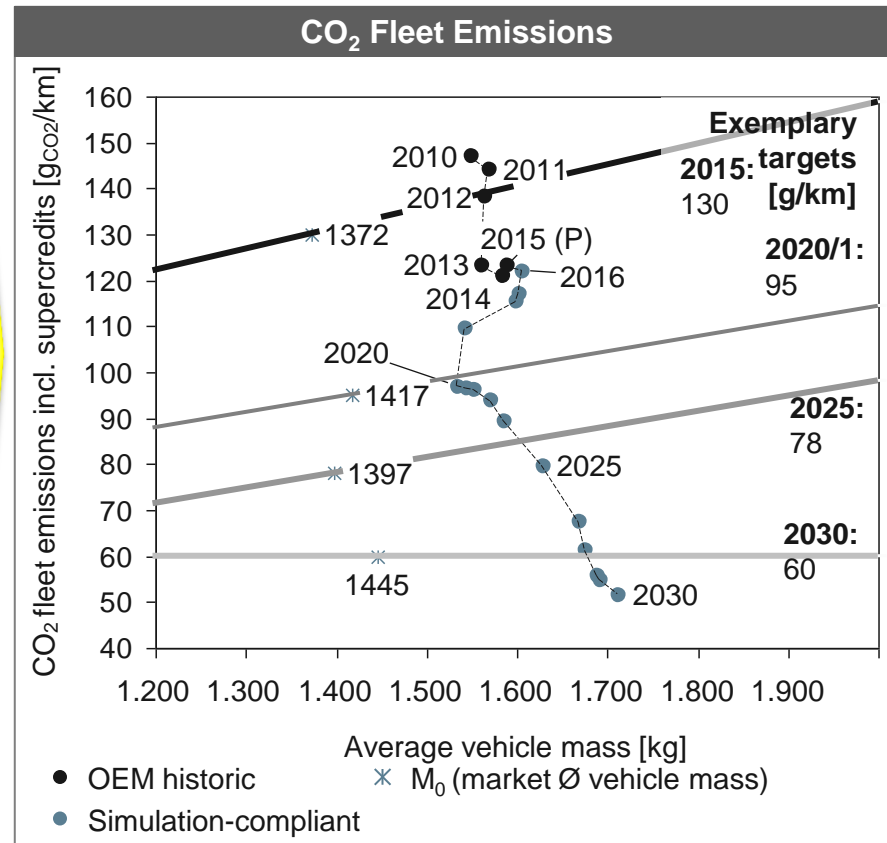
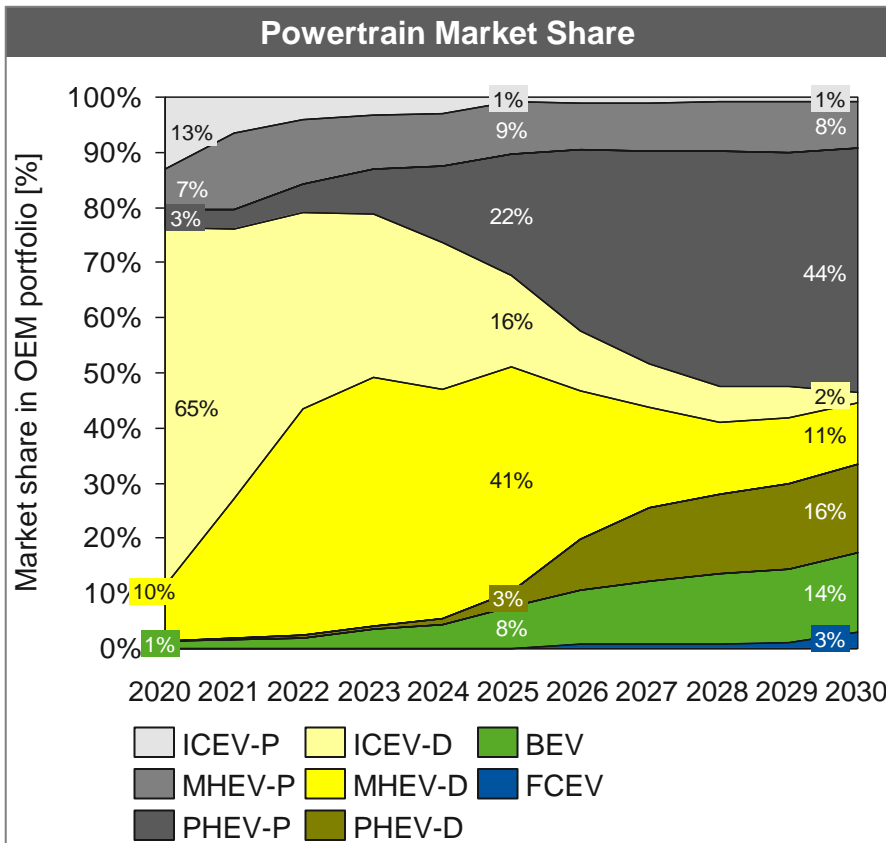
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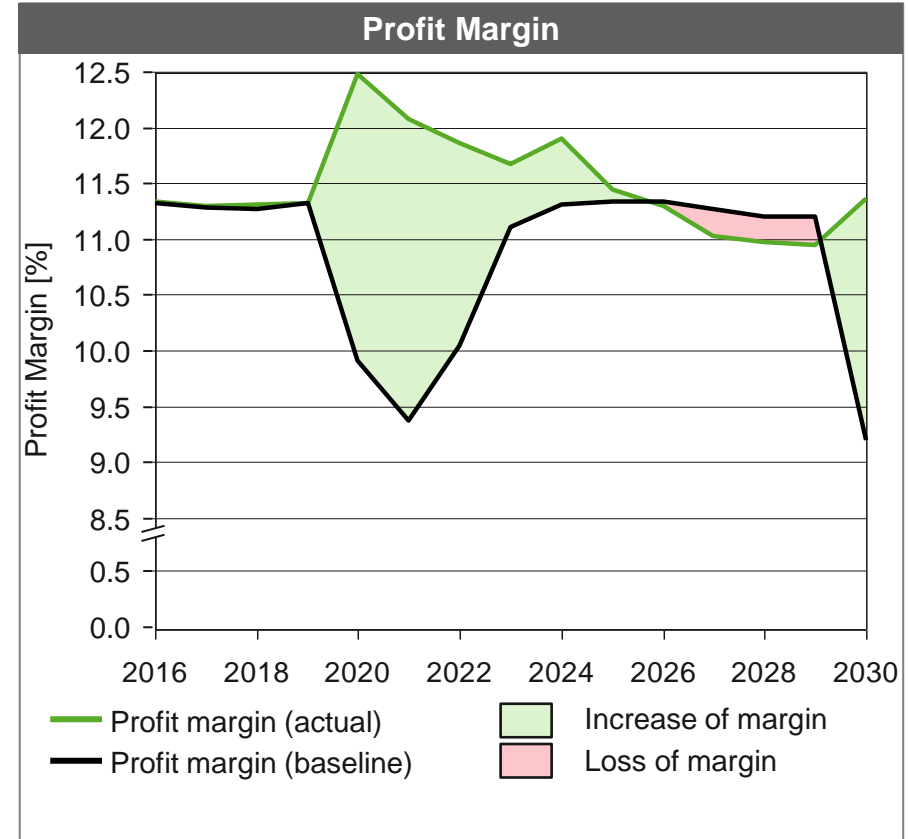
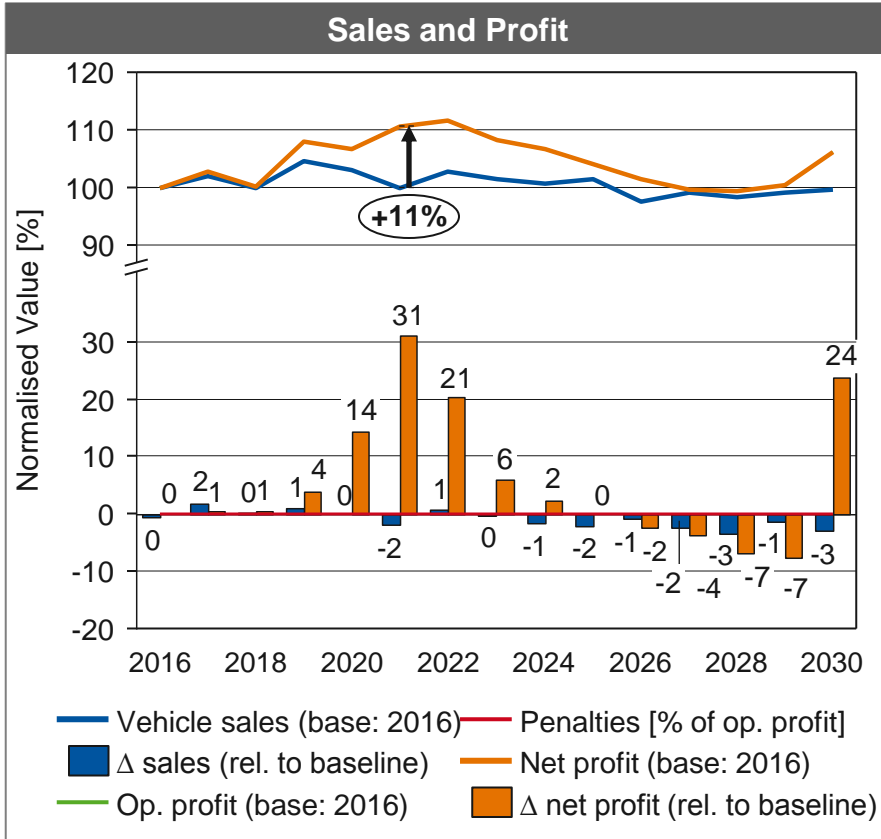
The assumed baseline strategy for the investigated OEM fails to meet the target limits from 2020-2023 and again in 2030, implying high penalty payments and reputational damage.



# PHEV-focused strategy leads to full target compliance even with significantly decreasing diesel shares. The fleet emissions curve has a safety reserve in 2025 and 2030.



Penalty payments are completely avoided while sales and turnover are even slightly increased with significantly improved profit margins compared to baseline strategy.



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# Contact

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