Future of Automotive Lightweighting Day

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Support Tools
Full vehicle assessment model

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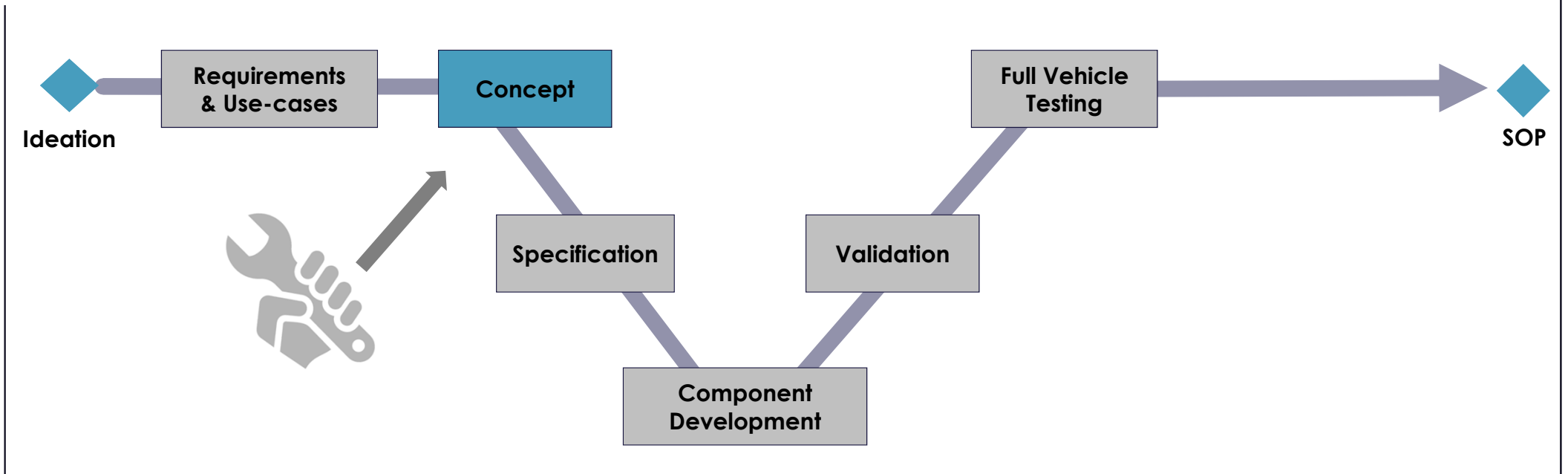
Motivation

- **During the last years a lot of developments have been carried out in the field of light weighting (material and manufacturing technologies)**

- **The large number of technologies makes it difficult to choose the right technology at the right place**

- **Uncertainty of technological impact is high in the early concept phase of the vehicle development process**

- **Light weighting is not limited to achieving the highest weight reduction, it is rather a multidisciplinary approach considering:**

  - **Structural efficiency**

  - **Economical impact**

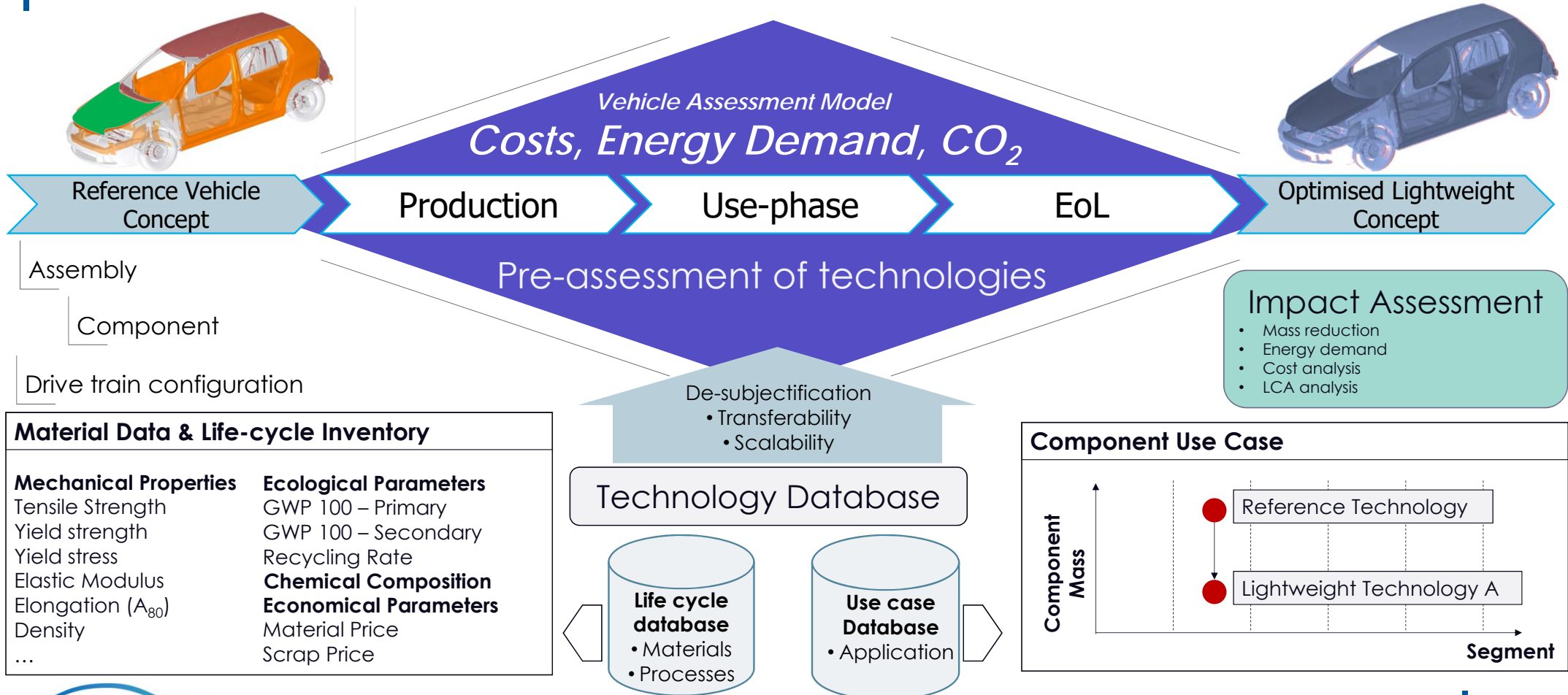 - **Environmental impact**

  - **Secondary reduction potential**

  - **etc.**

↓ **21-33% Weight**

< 3€/Kg Saved

-6 % GWP

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Development Target

Vehicle development process

Ideation → Requirements & Use-cases → Concept → Specification → Component Development → Validation → Full Vehicle Testing → SOP
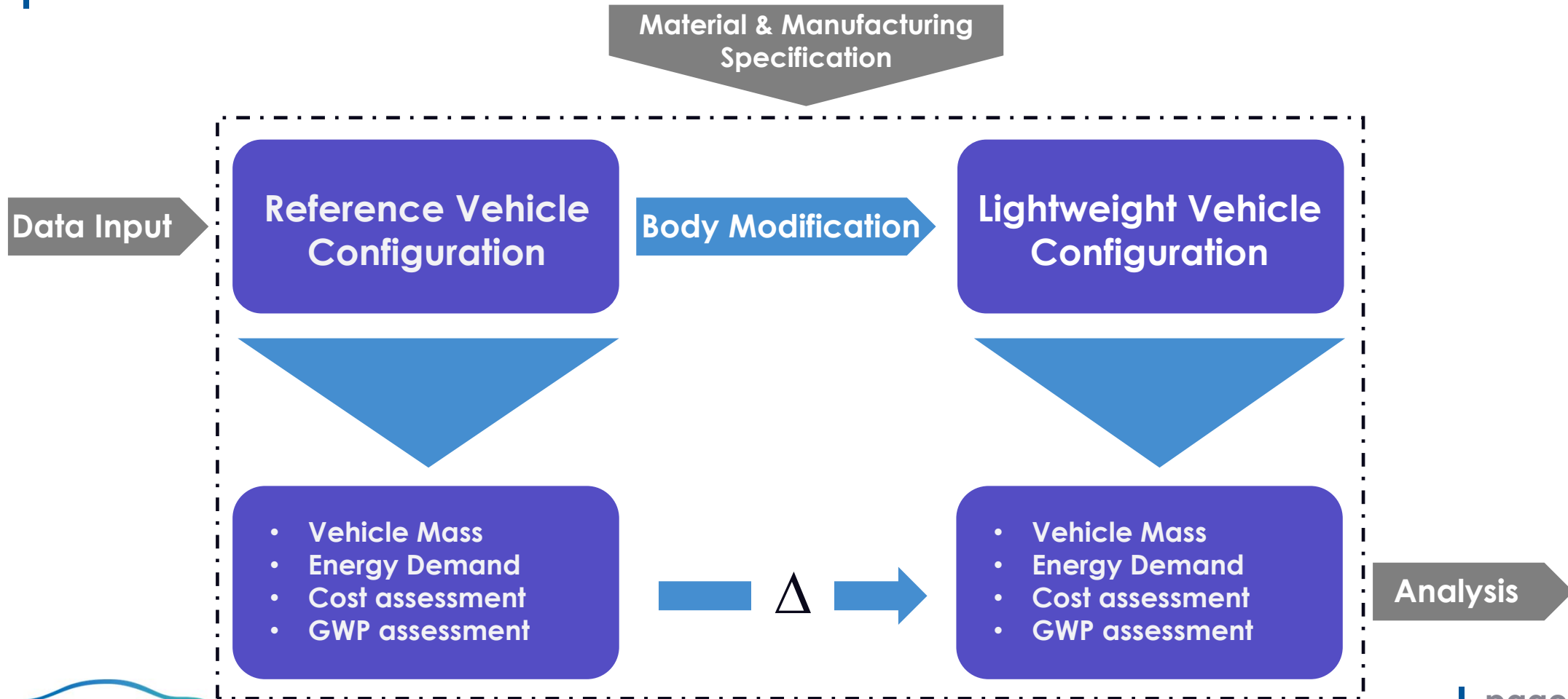
▶ Holistic method to assess lightweight technologies from a life-cycle perspective at an early concept stage
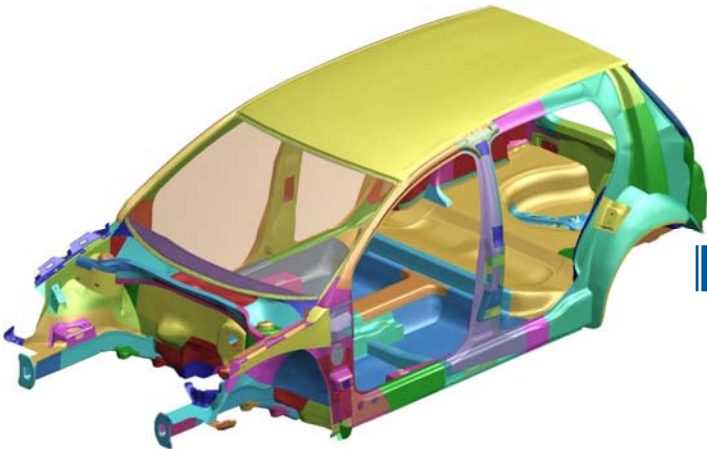
Concept of the Full Vehicle Assessment Model

Reference Vehicle Concept → Production → Use-phase → EoL → Optimised Lightweight Concept

Vehicle Assessment Model
Costs, Energy Demand, CO_2

Pre-assessment of technologies

Assembly
Component
Drive train configuration

De-subjectification
• Transferability
• Scalability

Impact Assessment
• Mass reduction
• Energy demand
• Cost analysis
• LCA analysis

Material Data & Life-cycle Inventory

Mechanical Properties	Ecological Parameters
Tensile Strength	GWP 100 – Primary
Yield strength	GWP 100 – Secondary
Yield stress	Recycling Rate
Elastic Modulus	**Chemical Composition**
Elongation (A_{80})	**Economical Parameters**
Density	Material Price
…	Scrap Price

Technology Database

Life cycle database
• Materials
• Processes

Use case Database
• Application

Component Use Case

Component Mass

Reference Technology

Lightweight Technology A

Segment

Modeling Approach

Material & Manufacturing Specification

Data Input

Reference Vehicle Configuration

Body Modification

Lightweight Vehicle Configuration

- Vehicle Mass
- Energy Demand
- Cost assessment
- GWP assessment

Δ

- Vehicle Mass
- Energy Demand
- Cost assessment
- GWP assessment

Analysis

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Results of a Typical Use Case

ALLIANCE ICEV Reference Variant

ALLIANCE ICEV Lightweight Variant
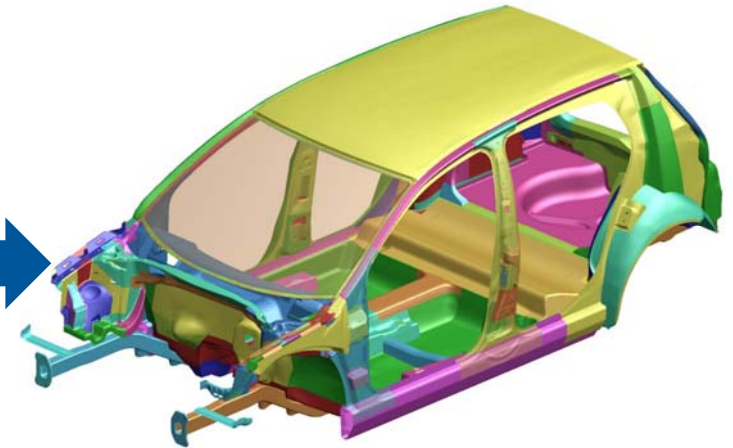
Definition of potential concept
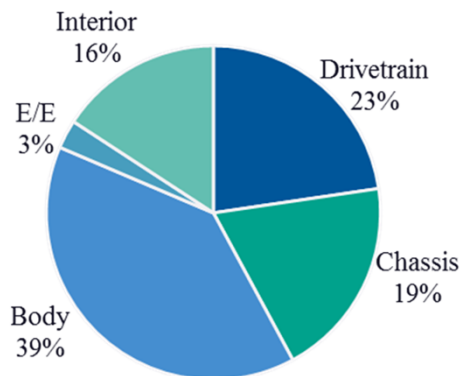
Pre-assessment with model
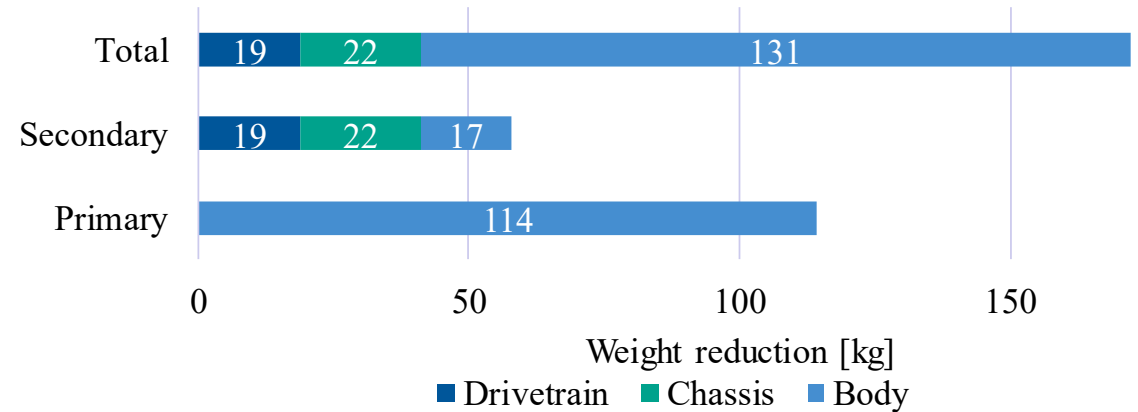
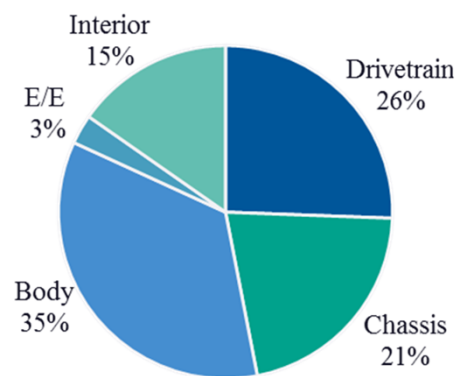Actual layout of vehicle

Validation of results

Results of a Typical Use Case – Weight Reduction

	Reference Variant	Lightweight Variant	Δ	
	[kg]	[kg]	[kg]	[%]
Drivetrain	284.7	265.7	19.0	-6.7
Chassis	244.2	221.9	22.3	-9.1
Body	493.5	362.6	130.9	-26.5
E/E*	34.9	29.7	5.2	-15.0
Interior*	198.4	158.7	39.7	-20.0
Sum	1255.7	1038.6	217.1	-17.3

Reference Vehicle m = 1255.7 kg

Interior 16%
E/E 3%
Drivetrain 23%
Chassis 19%
Body 39%

Lightweight Vehicle m = 1038.6 kg

Interior 15%
E/E 3%
Drivetrain 26%
Chassis 21%
Body 35%

Total: 19 | 22 | 131
Secondary: 19 | 22 | 17
Primary: 114

Weight reduction [kg]
■ Drivetrain ■ Chassis ■ Body

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Results of a Typical Use Case – Environmental Impact
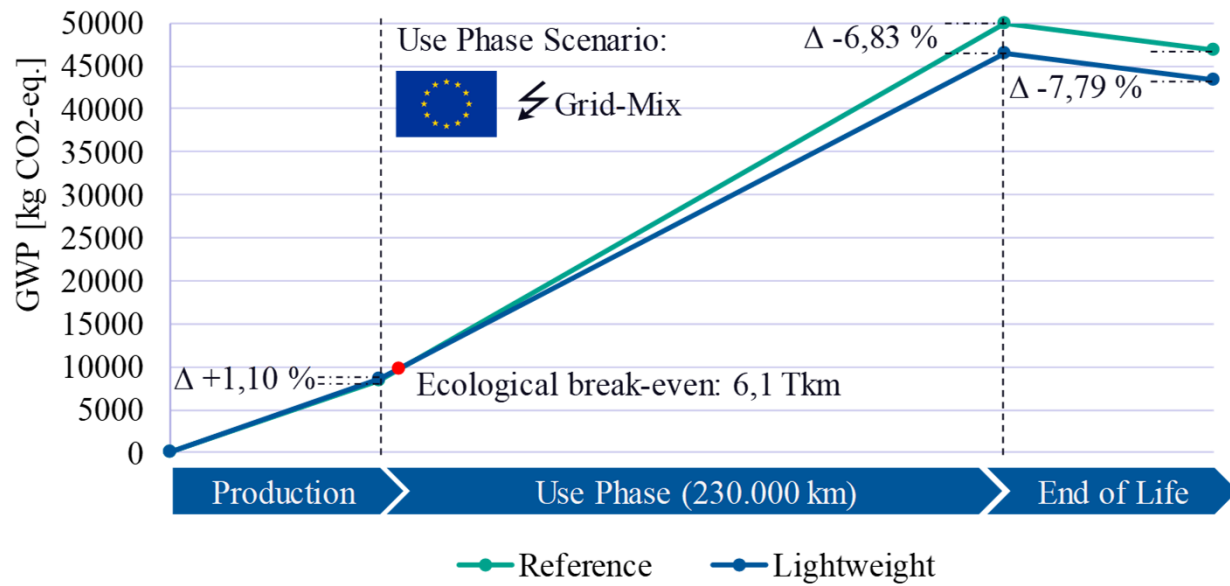
	Reference Variant	Lightweight Variant*	Δ
	[GWP]	[GWP]	[%]
Production	8469	8562	+1.10
Use	41428	37925	-8.46
End of life	-2976	-3219	-8.17
Sum	46921	43268	-7.79

Results of a Typical Use Case – Economical Impact
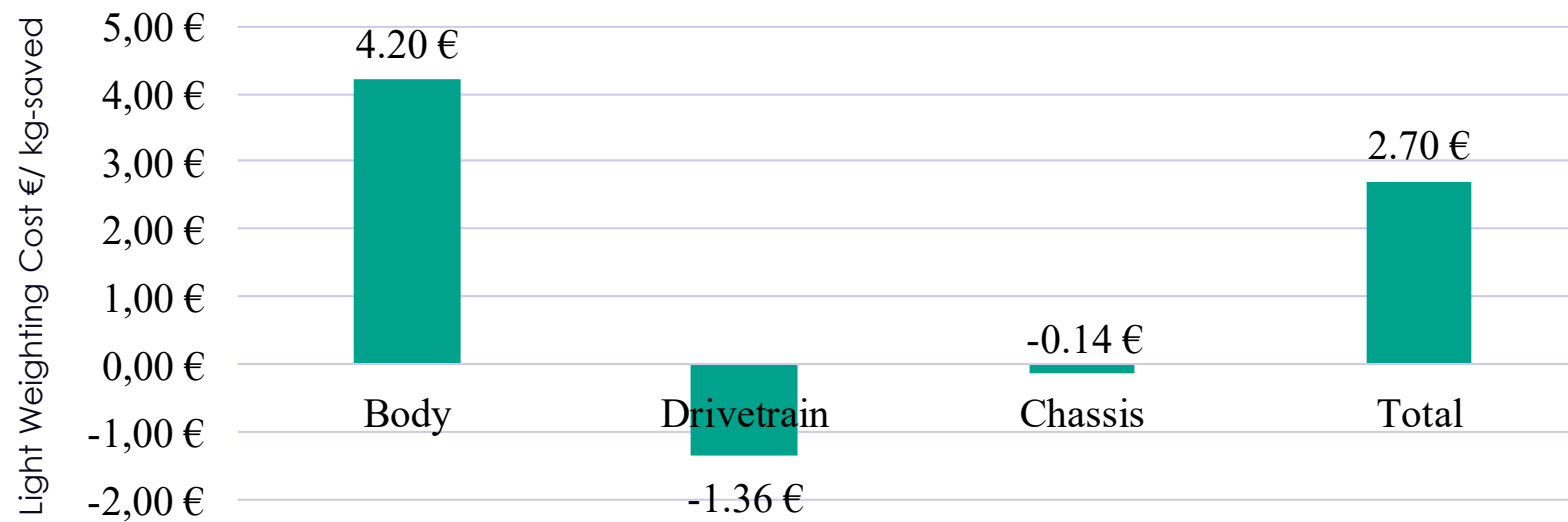
Summary & Lessons learned

- Holistic, multi-parametric assessment methodology is required to fully evaluate the impact of light weighting technologies

- Full vehicle assessment model is a tool to perform a pre-assessment of light weighting technologies at a early concept stage

- The accuracy of the model depends on:

    1. The available data in the life cycle data base

    2. The maturity of the analysed technology (use case database)

- Validation of results required by actual layout of the light weighting technology → if necessary continuous adaption of model

Thank you very much for your attention!