S-in motion Overview

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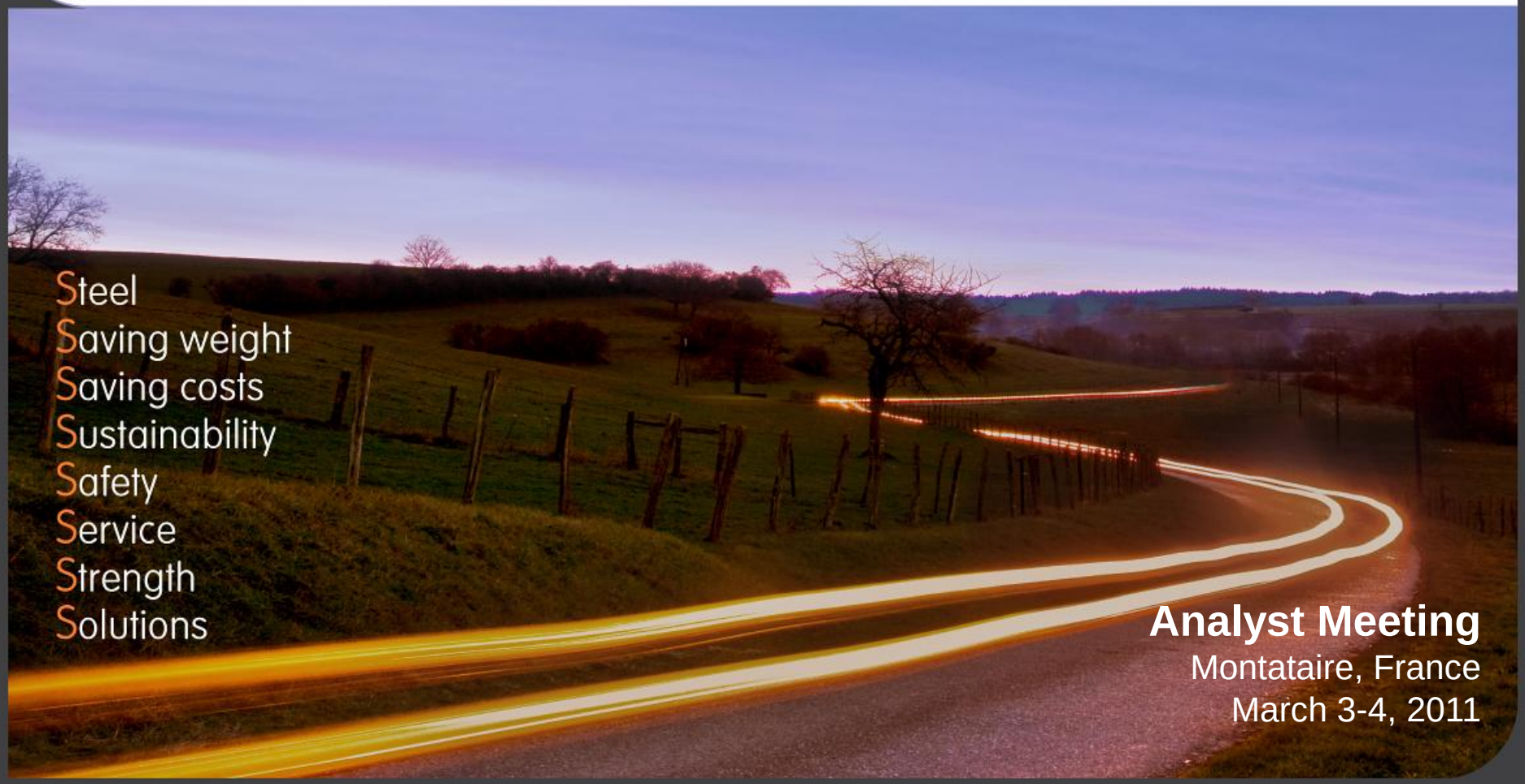
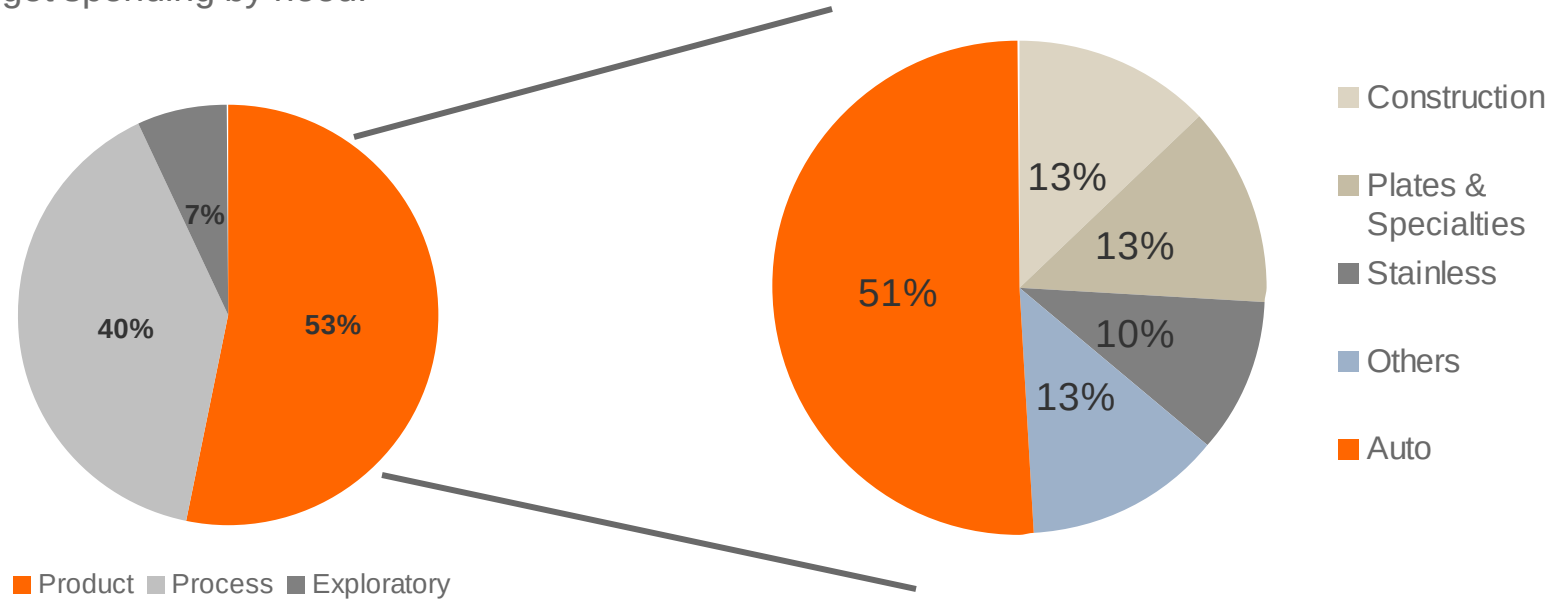


Analyst Meeting
Montataire, France
March 3-4, 2011

Global R&D Key Facts and Figures

- Over 1,400 full time researchers
- Working on all process and development needs
- Expanding worldwide network of laboratories (currently 11 labs in Europe, North America, and South America)
- Budget spending by need:

- Key challenges fully aligned with the group strategy: geography, value chain, product differentiation



6 Labs Dedicated to the Automotive Market

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US Lab – East Chicago

200 Engineers and Technicians

- Product development and improvement
- Knowledge building
- Sheet product applications
- Customer manufacturing technology
- Structural design and CAE analysis

Auto Products – Maizières

170 Engineers and Technicians

- Development of new steels
- Improvement of steels' in-use properties
- Anti-corrosion solutions
- Breakthrough products
- Technical service to customers

Isbergues – Stainless steels

60 Engineers and Technicians

- Development of new steels
- Improvement of steels' in-use properties
- Knowledge building
- Technical service to customers

Canada Lab – Hamilton

53 Engineers and Technicians

- New product development and improvement
- Sheet product application
- Tube applications
- Structural design and CAE analysis

Auto Applications – Montataire

100 Engineers and Technicians

- Forming & design of components
- Conception & design of steel solutions
- Assembling, welding, adhesive bonding
- Multi-materials & other laminates
- Multi-thickness Blanks (LWB, Patch,…)

Gandrange – Long Carbon

40 Engineers and Technicians

- Development of new steels and applications
- Manufacturing and service property qualification
- Technical service to customers

S-in motion Project

S-in motion

- **Objectives:**
  - Lightest vehicle with currently available Advanced High Strength Steels (AHSS) grades relative to a modern, C-class baseline vehicle
  - Build a catalogue of worldwide solutions for each sub-module
  - Including worldwide crash and stiffness requirements & performance ratings
  - At the lowest possible cost

- **Scope**
  - Body-in-White (BIW), hang-on parts, and chassis

- **Worldwide ArcelorMittal R&D teams** involving:
  - Automotive suppliers (engineering offices, diemakers, prototypes)
  - Industrial partners (Gestamp and Magnetto Automotive)

Steel

Use of Worldwide-Available ArcelorMittal Products:

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→ Solutions ready for implementation on new vehicle projects

Flat carbon products: Advanced High Strength Steels

Essentially grades > 780MPa

- Dual Phase family
- Complex Phase family
- Usibor® 1500P
- Tailored welded blanks (especially Usibor® 1500P /Ductibor® 500P)
- Trip 780
- Martensitic family

And also

- FF 280 DP 0.6 mm for closures

Chart for AHSS

(Tensile strength values)

- PHS ≥1300MPa
- AHSS ≥1180MPa
- AHSS ≥ 900MPa
- AHSS ≥ 780MPa
- AHSS ≥ 590MPa
- AHSS ≥ 450MPa
- HSS
- Mild steel

Integration of all other ArcelorMittal products

- Stainless for Body-In-White (BIW): 17.7 C950
- Tubular products for chassis
- Stainless for exhaust system: K44X, Laser Welded Blanks (LWB), tubes
- Long products for spring (2050 MPa), steering knuckle (Forged SOLAM™ B1100)

Safety

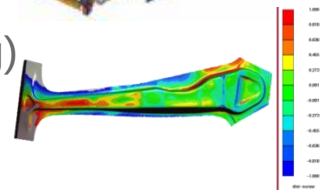
Steel Solutions Optimization

All automotive requirements were verified for each solution:

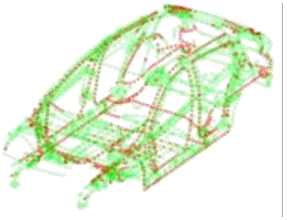
- Crash assessment
  - Euro and US NCAP, Rear Crash, AZT Danner, Roof Crush, Door Crash..

- Stiffness assessment
  - Static Stiffness (torsion & flexion), Modal Analysis, Door sagging…

- Forming feasibility
  - Finite Element simulation for formability assessment (cold - hot stamping)



- Assembly feasibility
  - Risk analysis of welding combinations and tests on critical assemblies



- Industrial validation
  - Industrial forming and assembly sequences
  - Cost assessment

Solutions

Generic Baseline Model Set-up

Two versions → **A European version**
→ **An adapted version for North American market**

- Representing typical architecture, mass, material distribution and functional requirements for a 2010 C-segment car

- Implementation of benchmark data on our previous ArcelorMittal vehicle
  - Computer-Aided Design (CAD) modification and meshing to get a complete finite element model

- Model optimization for fulfilling all load cases and mass requirements
  - Crashworthiness, stiffness, forming and assembly validation

ArcelorMittal vehicle

Benchmark Information:

materials, architecture

S-in motion EU baseline

Adaptation to 2010 NA crash requirements

materials, architecture

S-in motion NA baseline

Saving Weight

Methodology

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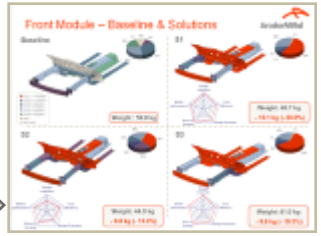
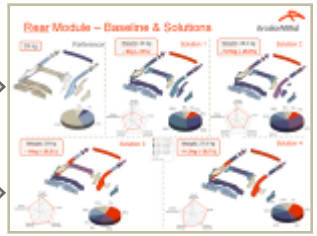
Baseline Meshing
Baseline Set-up

Baseline

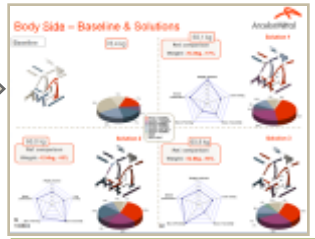
Innovative Design Proposal
Sub-module approach



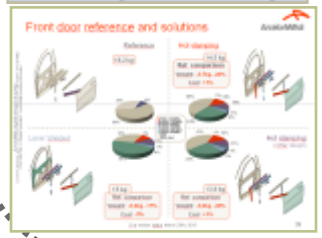
3 Solutions
Front Module
(-10.1 kg)



4 Solutions
Rear Module
(-11.2 kg)



3 Solutions
Body Side
(-13.3 kg)



3 Solutions
Door Module
(-3.7 kg)

Weight Saving Optimization

Lightest vehicle

Constraints:

- 5* Euro NCAP
- Benchmark level NVH performance

S-in motion Lightest Vehicle: 57 kg weight saving

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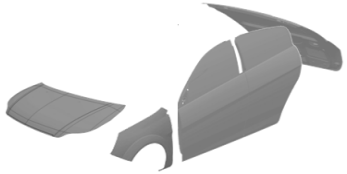
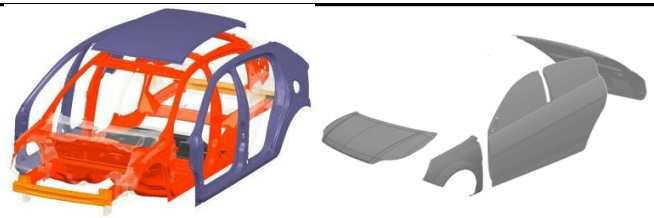
		Baseline	Weight saving	
BIW +CMS	All (including optimized in baseline)	300	41 kg	14%
	Structural parts	179	35 kg	20%
	Roof Panel and body sides	36	5 kg	14%
	Bumper System	10	1 kg	10%
Hang on parts 	All	94	16 kg	17%
	Doors (x4)	61	11 kg	18%
Total		394	57 kg	14%

20% of weight saving on 62% of BIW (structural parts)

BIW + Bumpers

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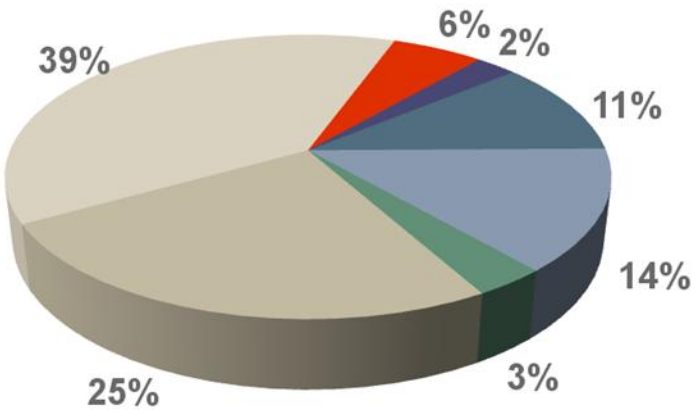
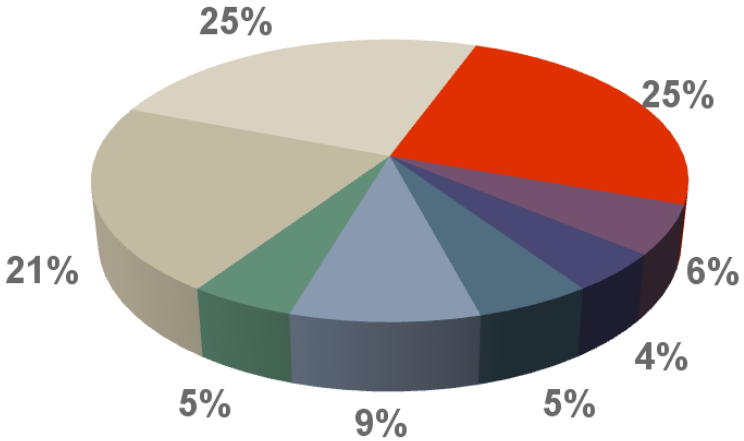
Baseline Weight Breakdown



Final Weight Breakdown



36% AHSS

Processes

- Hot stamping 4 parts
- Stamping of LWB 8 parts
- Roll forming 1 part

- PHS ≥1300MPa
- AHSS ≥1180MPa
- AHSS ≥ 900MPa
- AHSS ≥ 780MPa
- AHSS ≥ 590MPa
- AHSS ≥ 450MPa
- HSS
- Mild steel

Tensile strength values

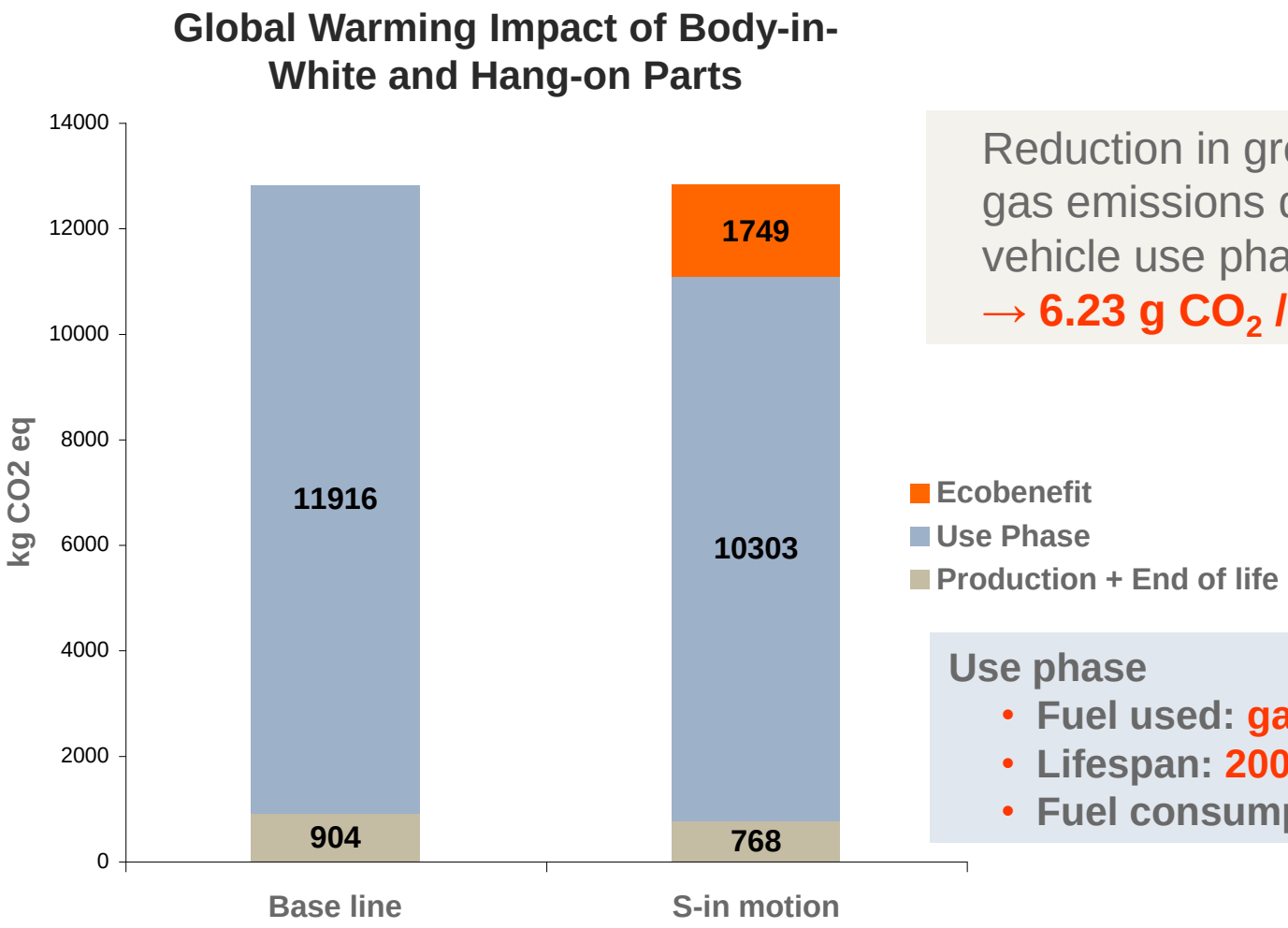
54% AHSS

Processes

- Hot stamping 29 parts
- Stamping of LWB 16 parts
- Roll forming 2 parts

Sustainability

Life Cycle Analysis Results



Reduction in greenhouse gas emissions during the vehicle use phase
→ **6.23 g CO_2 / km**

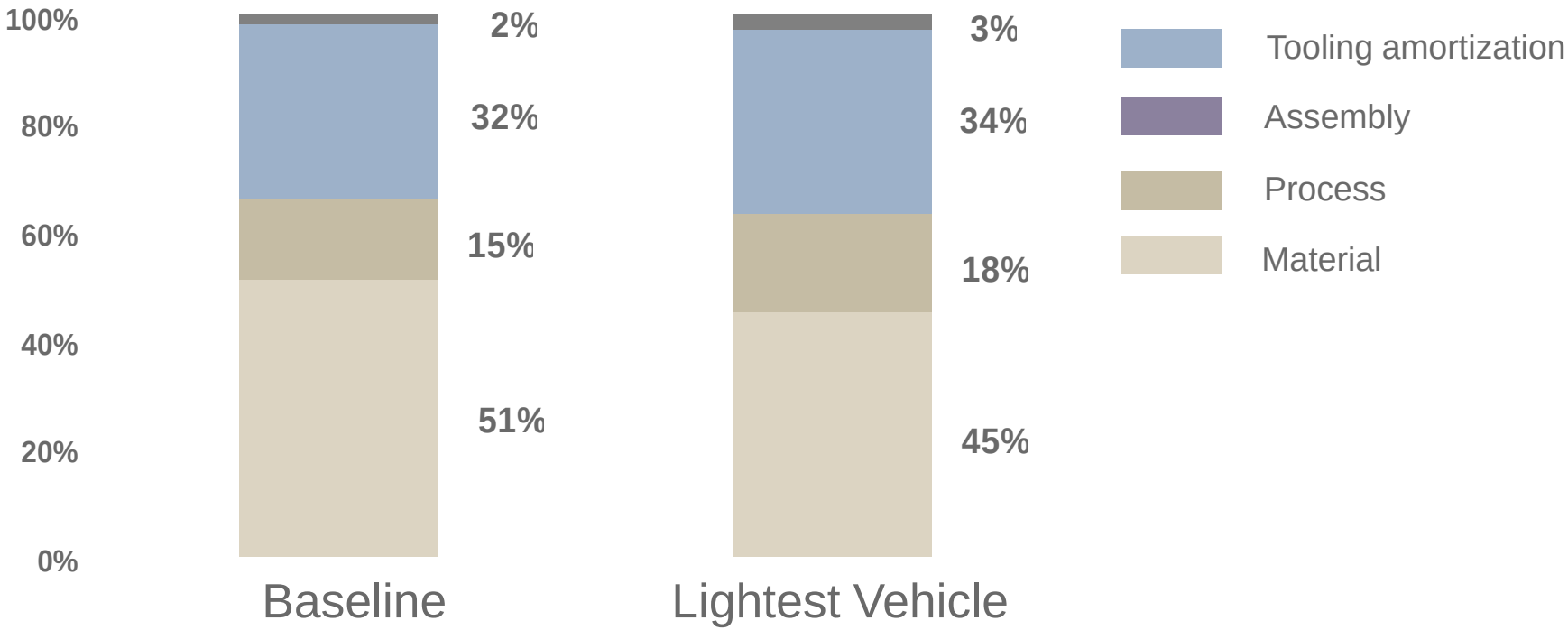
Use phase

- **Fuel used: gasoline**
- **Lifespan: 200 000 km**
- **Fuel consumption: 6.6 l/100 km**

Saving Costs

Lightest BIW: Cost Summary

Weight saving is achieved at neutral cost



Conclusions and Next Steps

- **S-in motion will be rolled out globally to all customers** through ArcelorMittal worldwide customer teams starting in November 2010

- Beyond S-in motion, innovation in the Automotive market requires:
  - Intensive effort on the unique requirements of **electric vehicles** (body structure, electric motors)
  - Innovative, **cost effective coatings**
  - **Breakthrough products** (next generation Hot Stamping materials, High Strength + High Formability, etc.)

- Next step will likely be an S-in motion project embracing Breakthrough products currently being developed by ArcelorMittal
  - First promising assessment: **additional weight saving of 29 kg**

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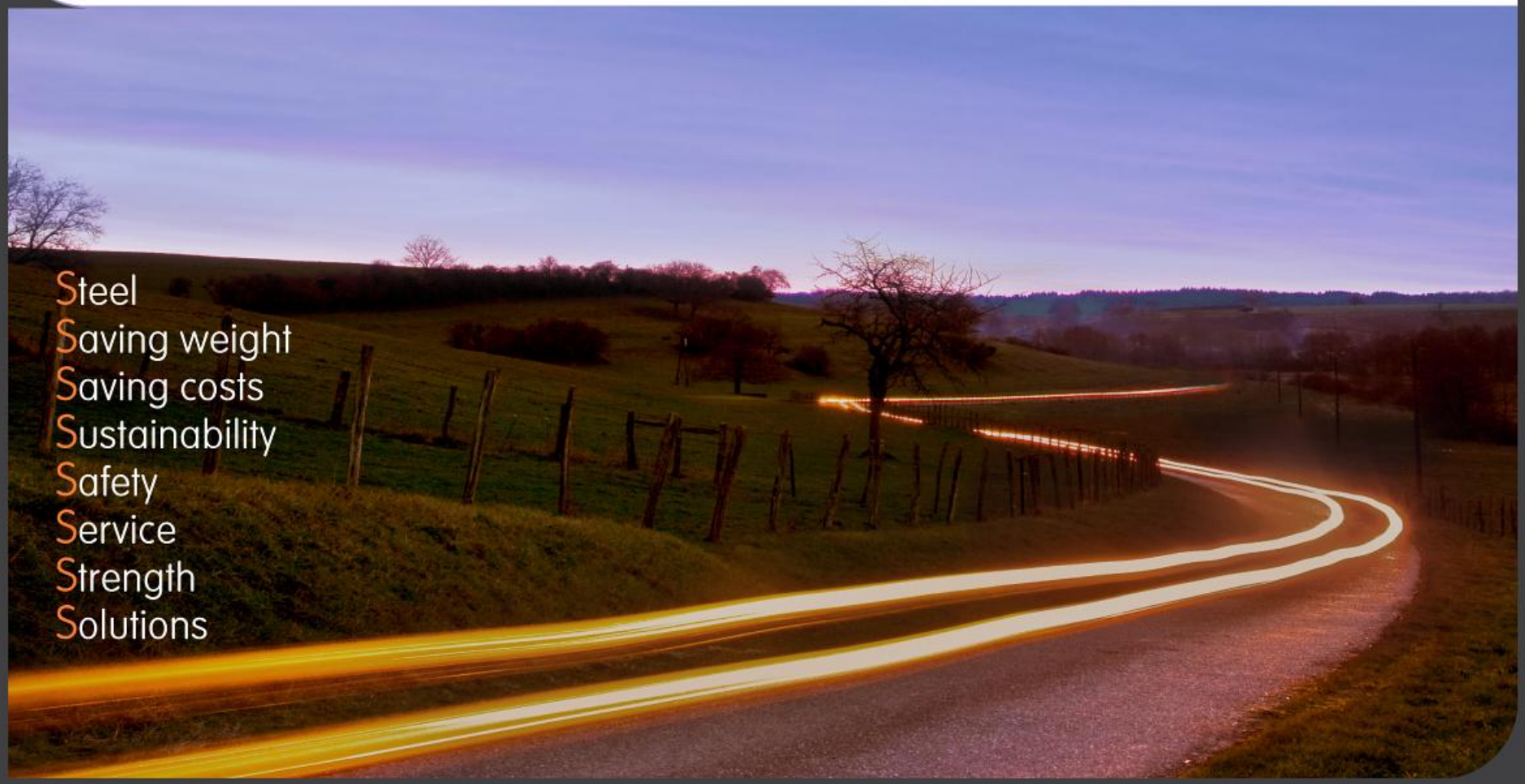
S-in motion