

Lujien terästen käyttö autojen korirakenteissa

OHUTLEVYPÄIVÄT 2024

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Olli Oja





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Product development engineer

CR&MC Product Development, Hämeenlinna, Finland

SSAB Career

2009 Started as a trainee in Product Development, Raahe

2010 - 2014 Product development engineer, Hot rolled strip products, Raahe

2014 - today Product development engineer, Cold rolled & Metal coated products, Hämeenlinna

“My current responsibilities involve, for example, the development of advanced high-strength steels, which were the topic of my doctoral thesis, and the R&D work of Zero and Fossil Free steels as hot-dip galvanized products.”

I’m currently interested on the possibilities of using different modelling methods in product development.”

Education

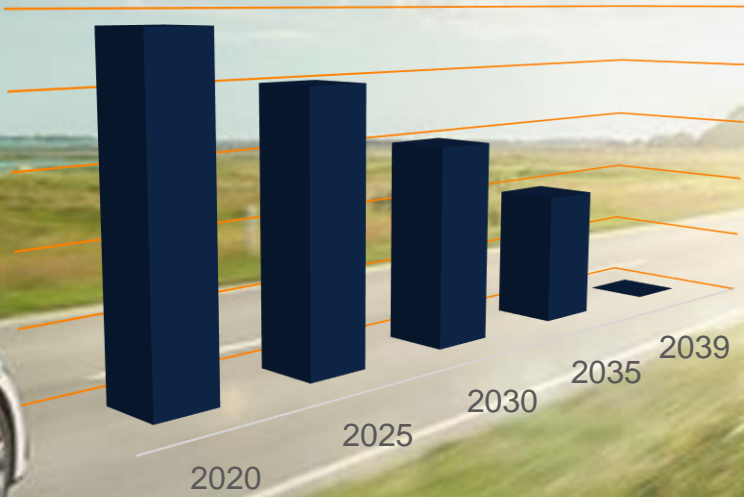
MSc (Tech), Mechanical Engineering, University of Oulu, 2010

DSc (Tech), Materials Science and Engineering, Tampere University, 2022

Content

1. Motivation
2. Different steel types in modern cars
3. Heat treatment and application examples of advanced steels










The Mobility industry have started the transformation towards Carbon neutral



Mercedes-Benz "Ambition 2039" – carbon neutral in 2039

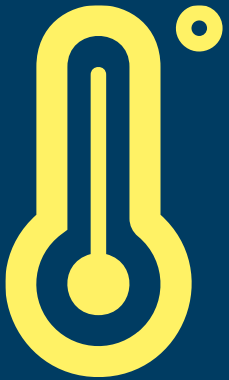
Electric propulsion is the future



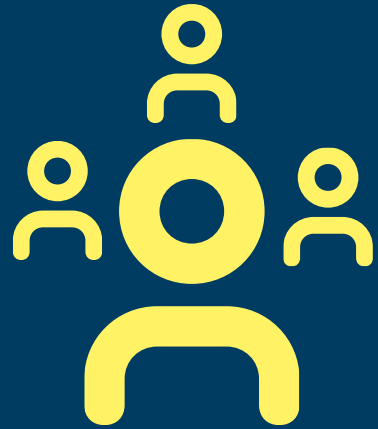
 ... 50% electric by 2030	 ... 100% electric by 2030	 ... 100% electric by 2035 in Europe	 ... 100% electric by 2035 in Europe
 ... 100 new EV models by 2025	 ... 100% electric by 2035	 ... 100% electric by 2040 in Europe	 ... 90% electric by 2030
 Fast-growing Chinese pure EV players (100% electric fleets)		 ... 100% electric by 2030 in Europe	 ... 80% electric by 2030
		 ... only EV and hybrids sales from 2022 in Europe; globally 100% electric by 2040	

The world has some challenges

Climate
change



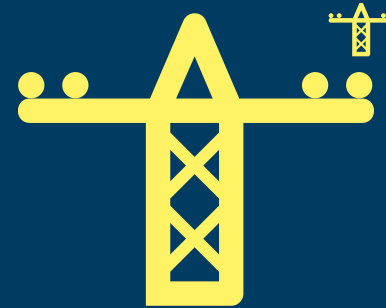
Growing
world
population



Urbanization



Demand
for new
infrastructure



Resource
scarcity

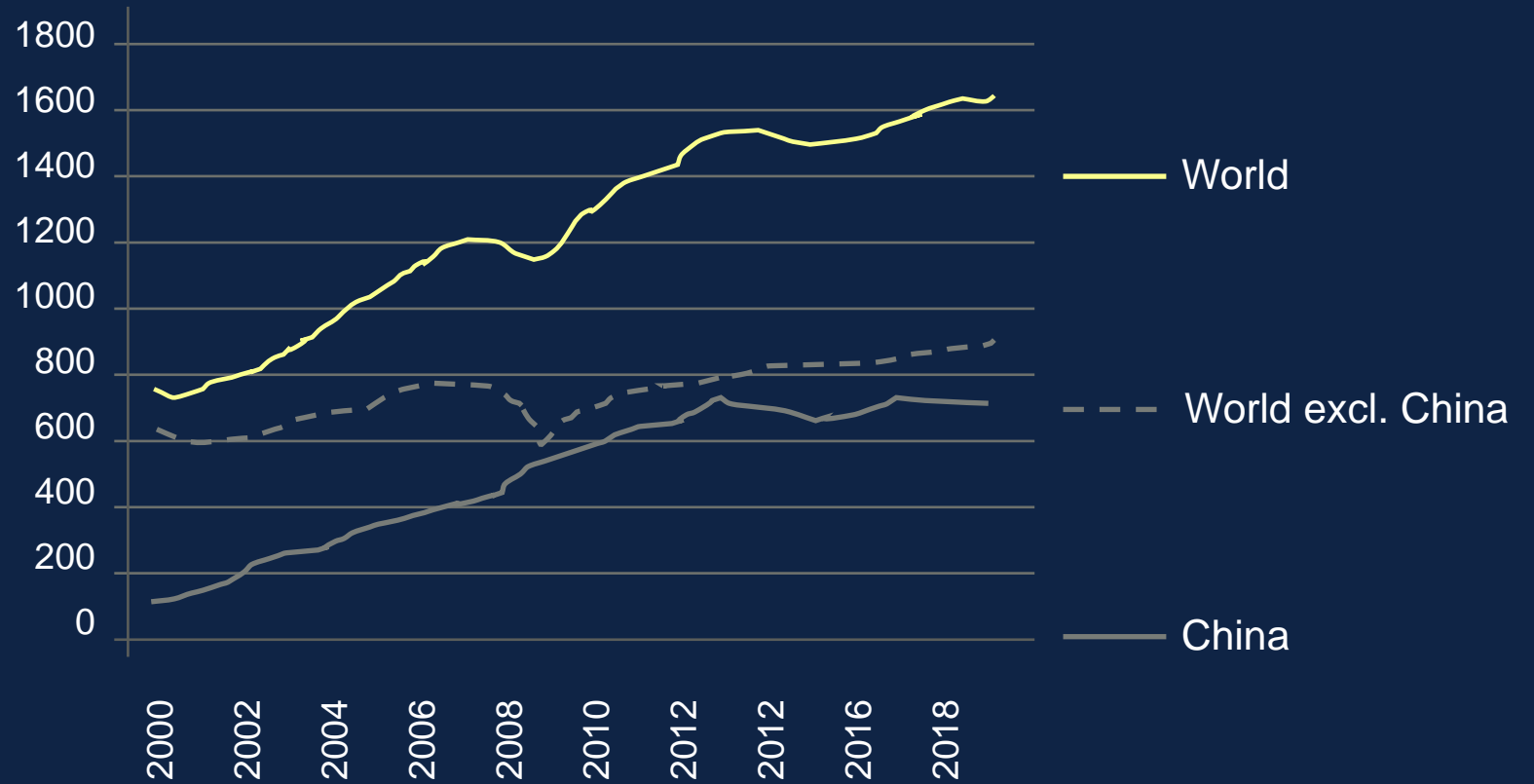


World steel consumption

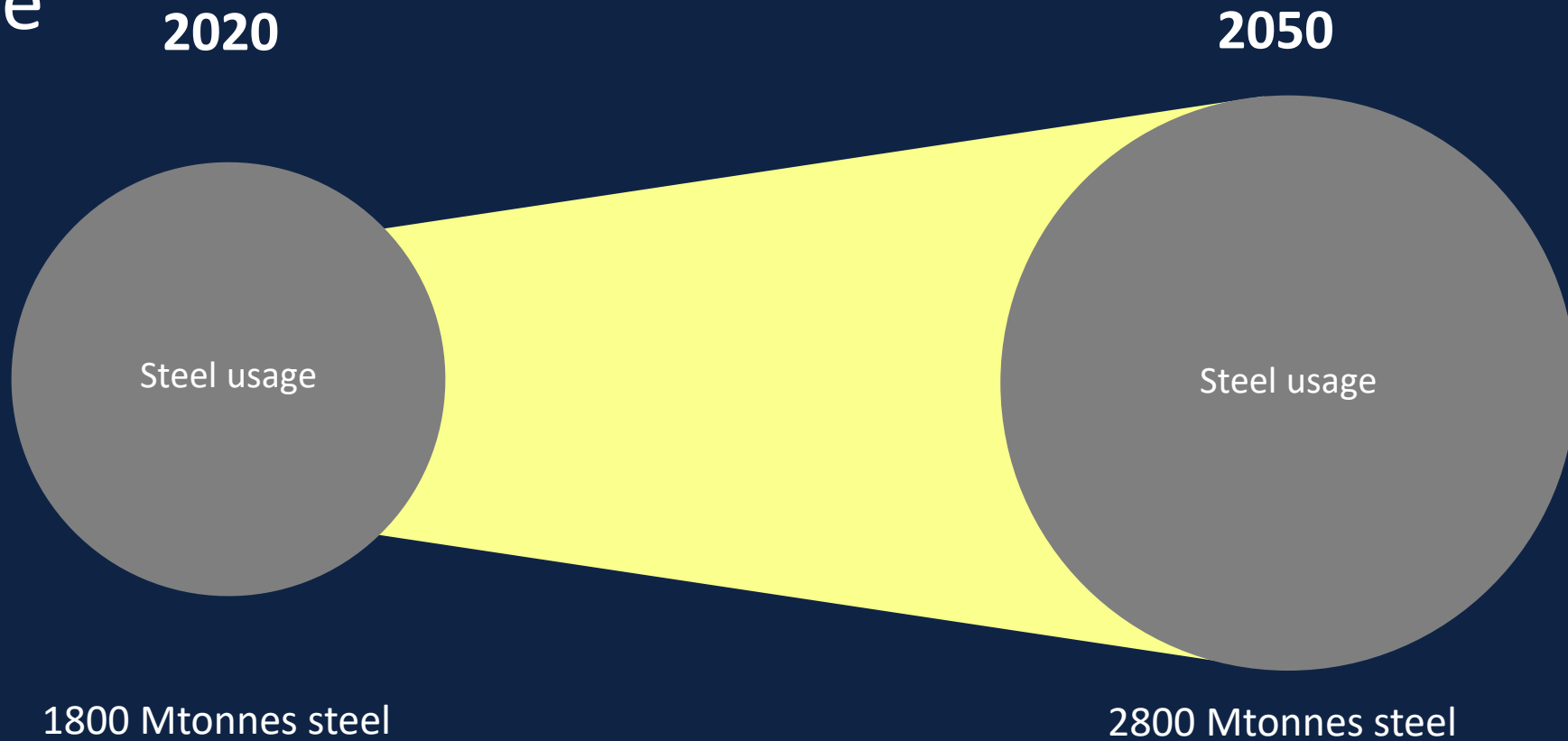
Standard of living

Urbanisation and infrastructure

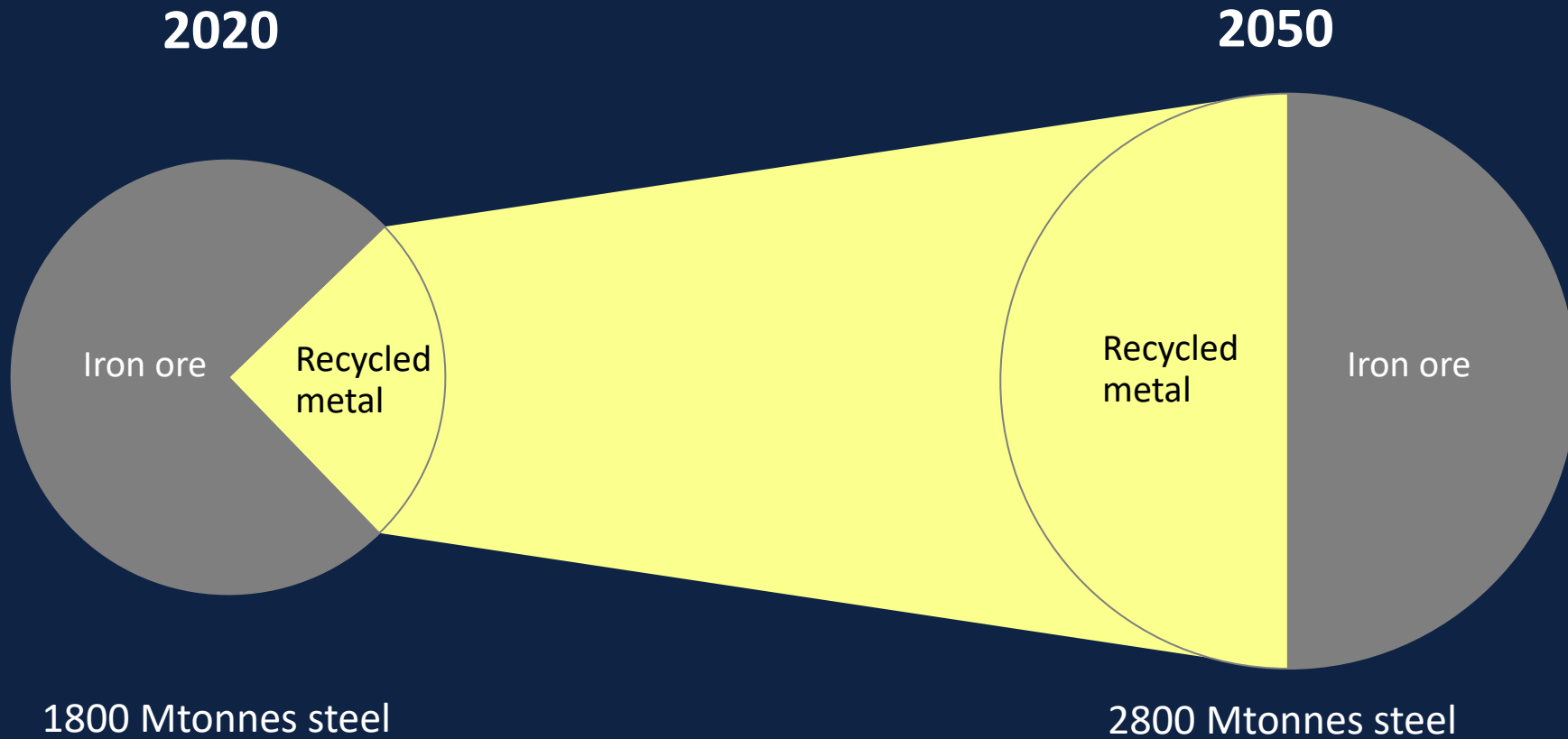
Transportation and production



Steel usage will continue to increase



Recycling will not be enough



[Source: Swedish iron and steel producers' association, Jernkontoret]



Carbon emission in operations including purchased energy (scope 1-2):

0.0

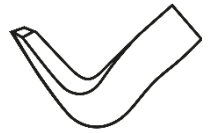
kg CO₂e emissions per kg steel (target).



Carbon emission in operations including purchased energy and iron ore (scope 1-2 and iron ore of scope 3 upstream):

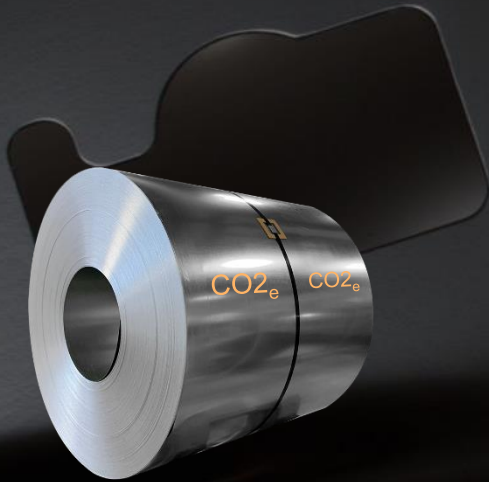
0.0

kg CO₂e emissions per kg steel (target).



SWEDISH
STEEL PRIZE

How else can you affect the carbon footprint?



Low CO2e
Material



Material
Efficiency

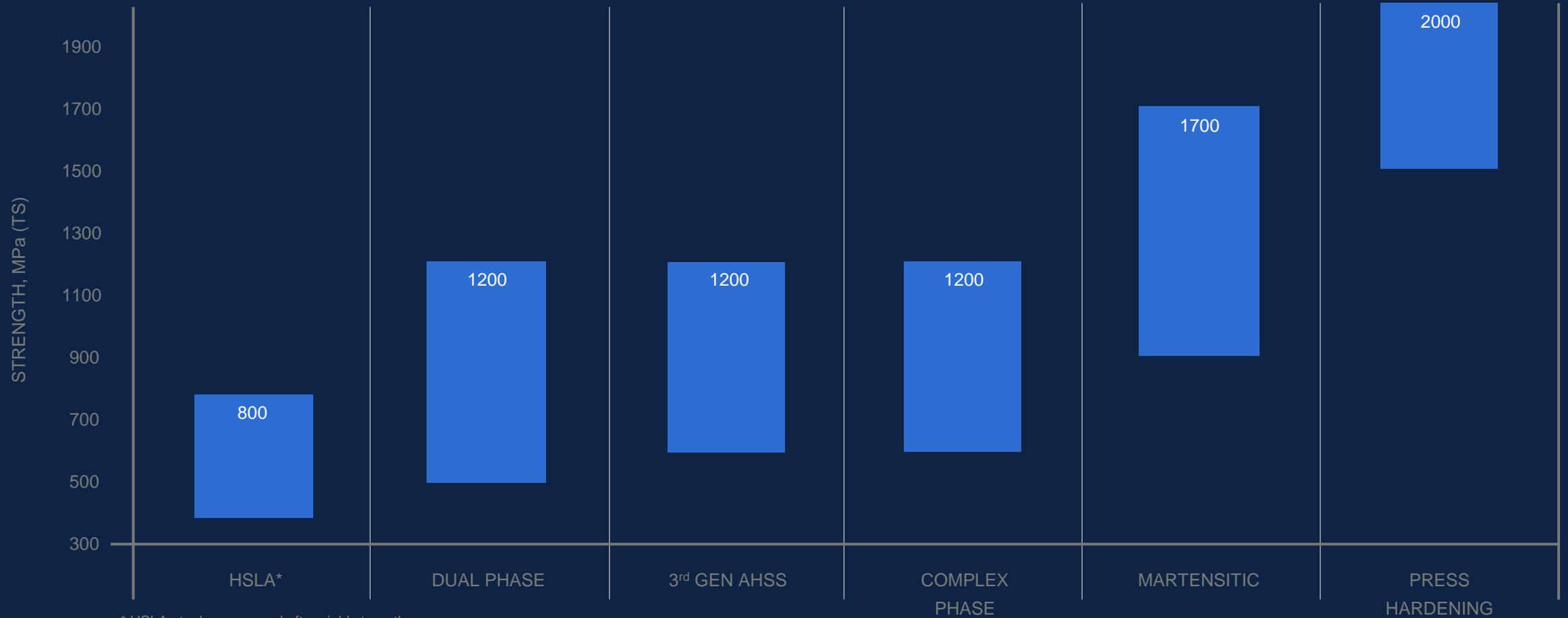


Material
Utilization



Energy
Consumption

Docol® product families



Different steel types in modern cars

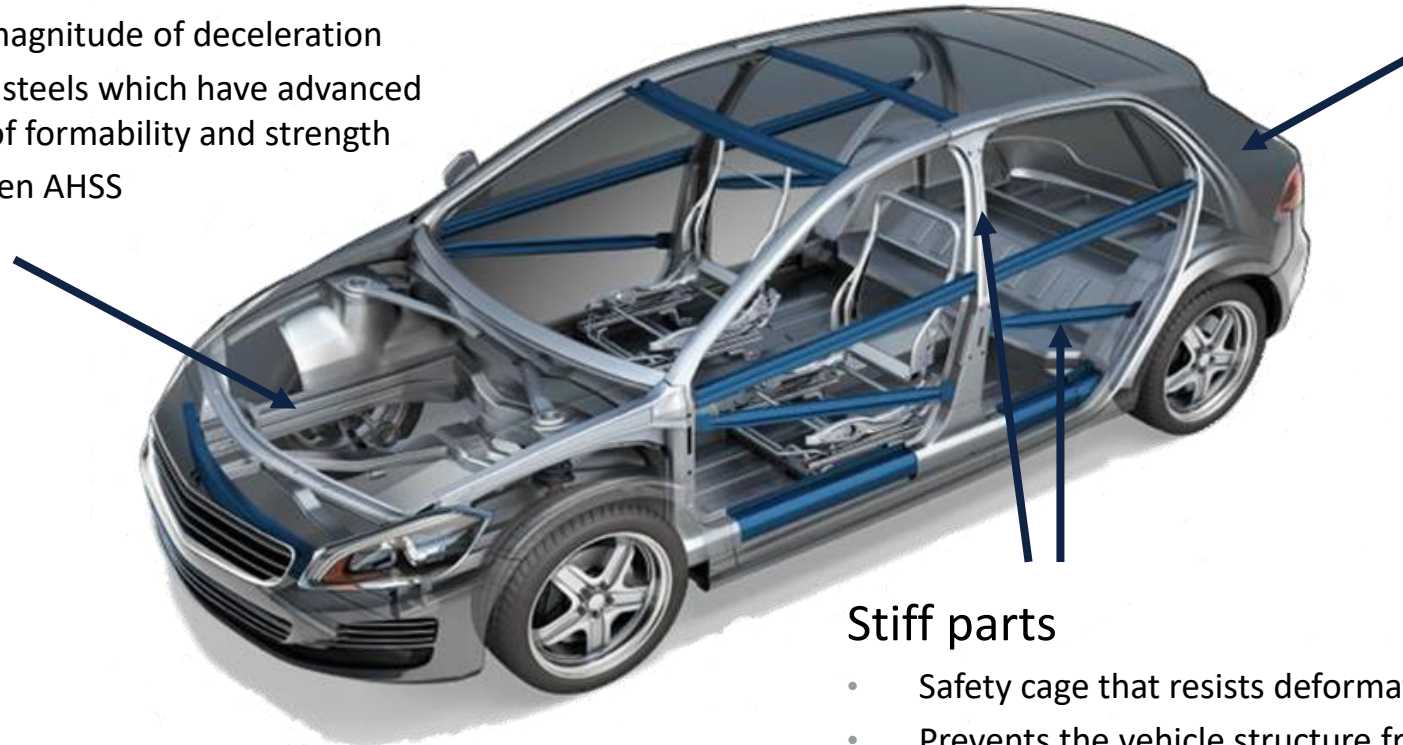
Steel types and their use in typical passenger car

Energy absorption parts

- Crumple zone that absorbs the kinetic energy during the event of crash
- Controls the magnitude of deceleration
- High-strength steels which have advanced combination of formability and strength
- DP/CP and 3Gen AHSS

Outer body panels

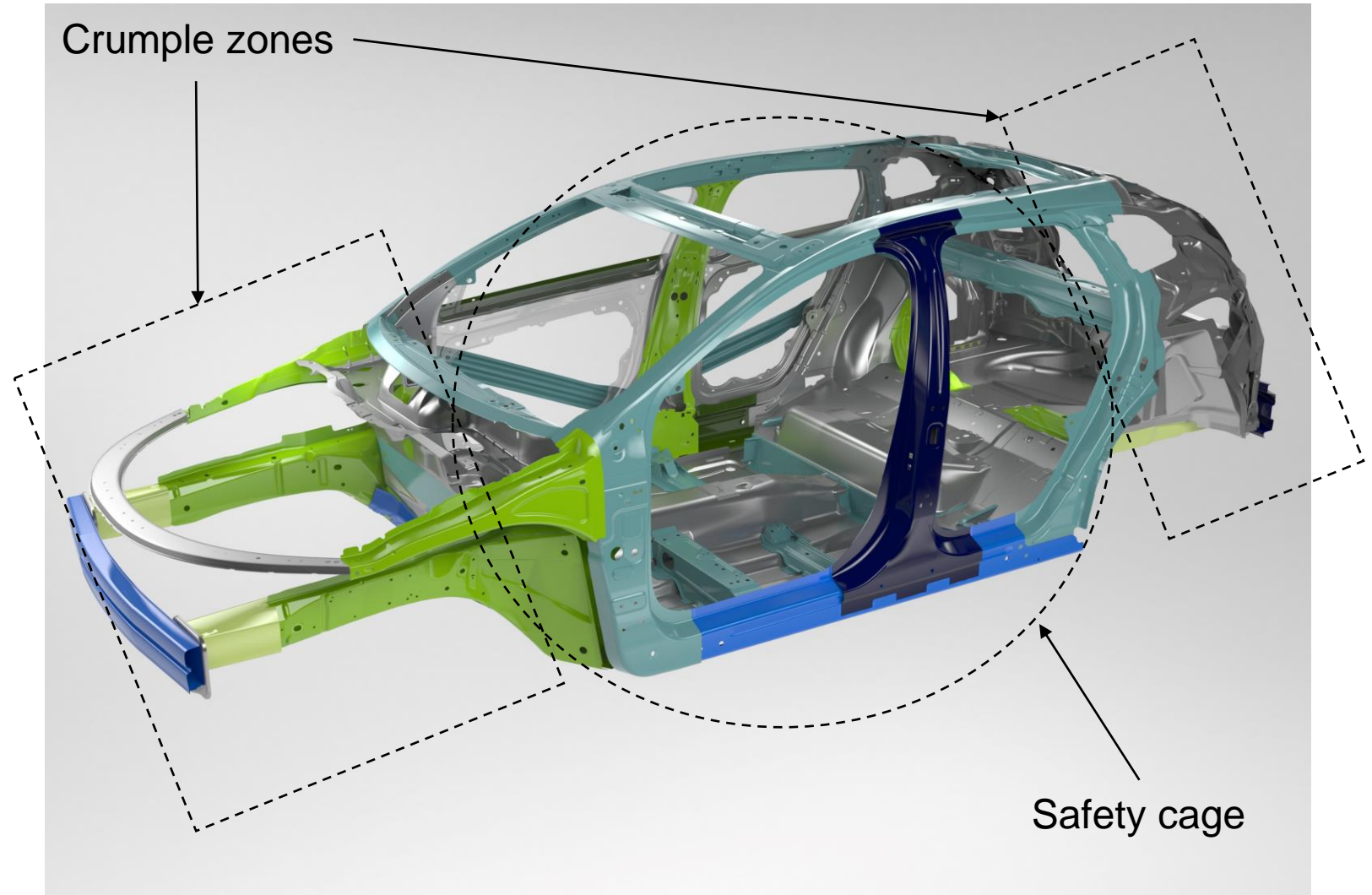
- Dent resistance after painting
- E.g. Bake hardening steels



Stiff parts

- Safety cage that resists deformation
- Prevents the vehicle structure from impacting occupant during the event of crash
- High yield strength, ultra-high tensile strength
- $R_m > 980 \text{ MPa}$ (DP/CP, M, PHS)

Protective sections in the typical body-in-white



Protective sections in the typical body-in-white

Low-strength structural steels (LSS)

High-strength steels (HSS)

Aluminum

Advanced high-strength steels (AHSS)

Plastics

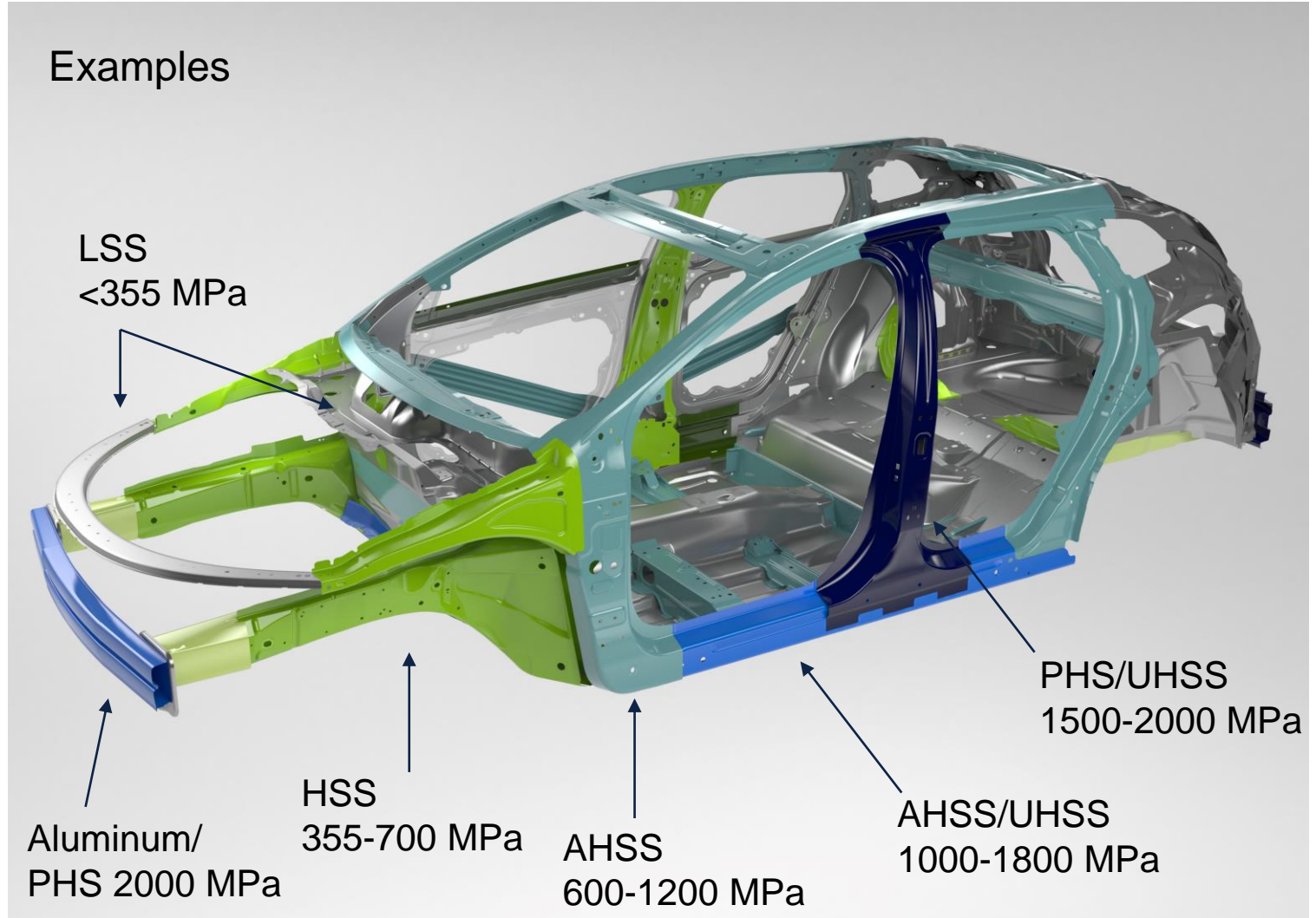
Press-hardening steels (PHS)

Ultra-high strength steels (UHSS)

Others

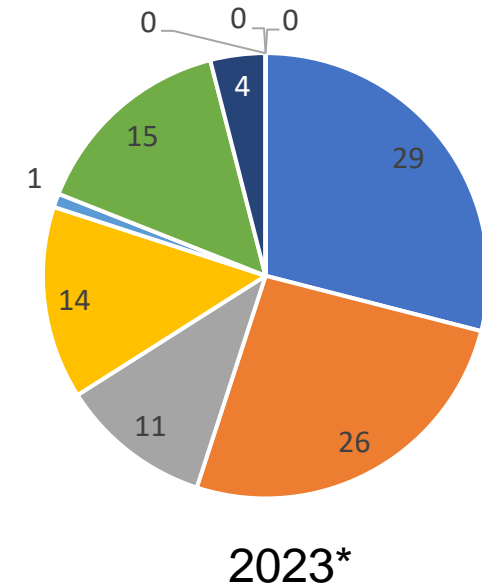
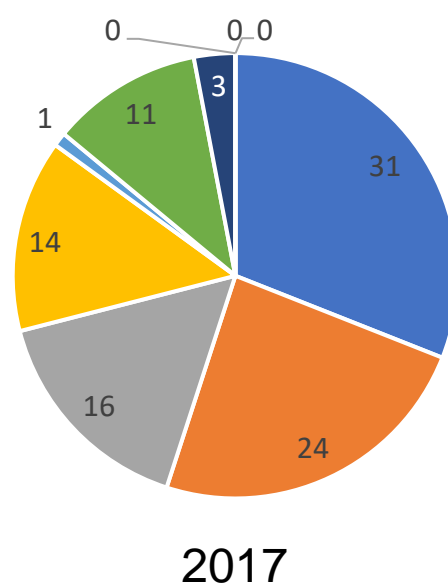
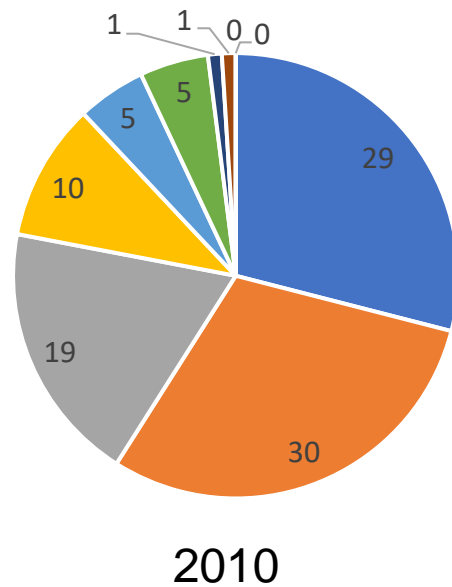
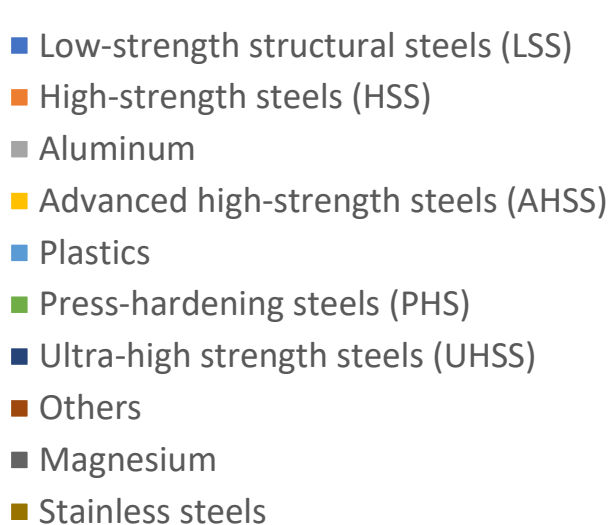
Magnesium

Stainless steels



Steel types in the vehicles presented at EuroCarBody conference in 2010, 2017 and 2023

- Material distribution in the vehicle body including closures
- High-strength steels (incl. HSS, AHSS, UHSS and PHS) have increased whereas aluminum and plastics have decreased



*2023 electric cars, for example, Ford E-Transit, Peugeot 3008, Volvo EX90 and VW ID.7

Battery protection

– Inspiration example



EV-concept for cars

Energy absorbing and load transfer

Protecting the battery cells

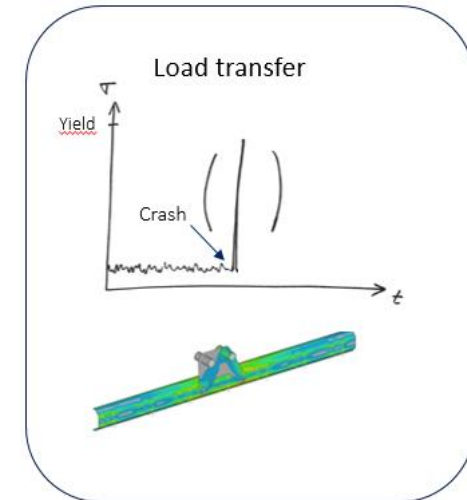
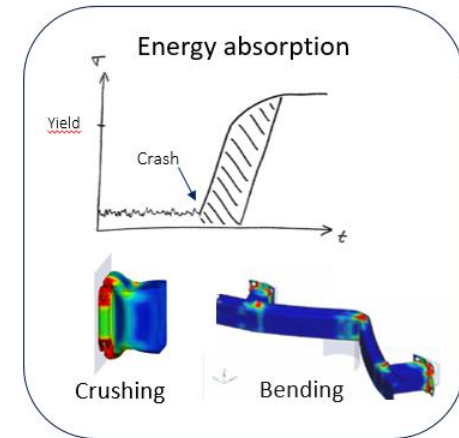
Highest strength with lowest weight and cost

Adoptable for fuel cell technology

Battery protection – Inspiration example

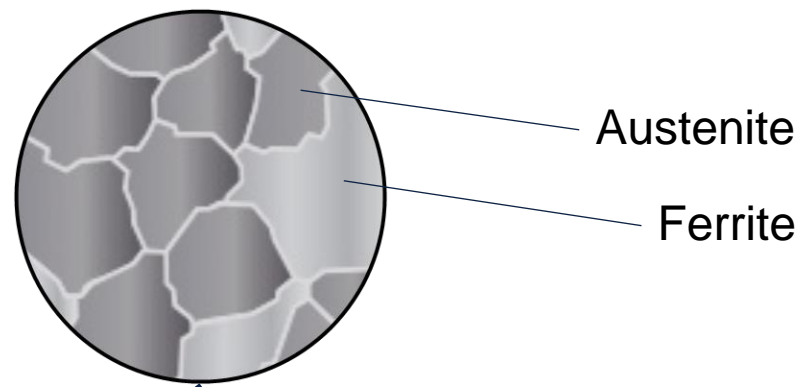
Seat cross beam

e.g.
PHS1900 (MPa)
roll-formed in
VW ID.7

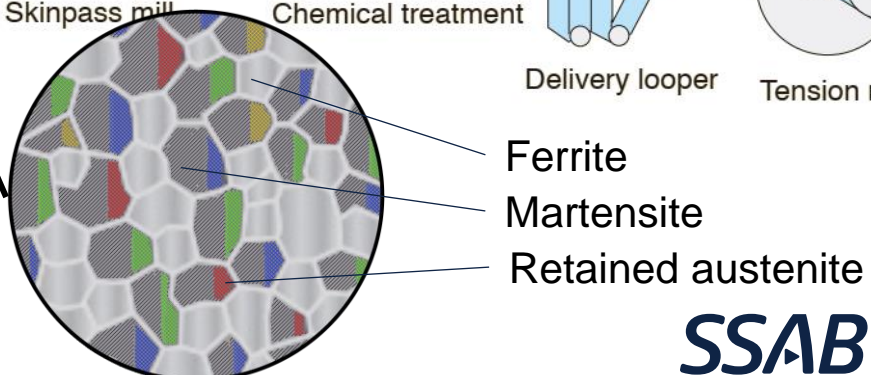
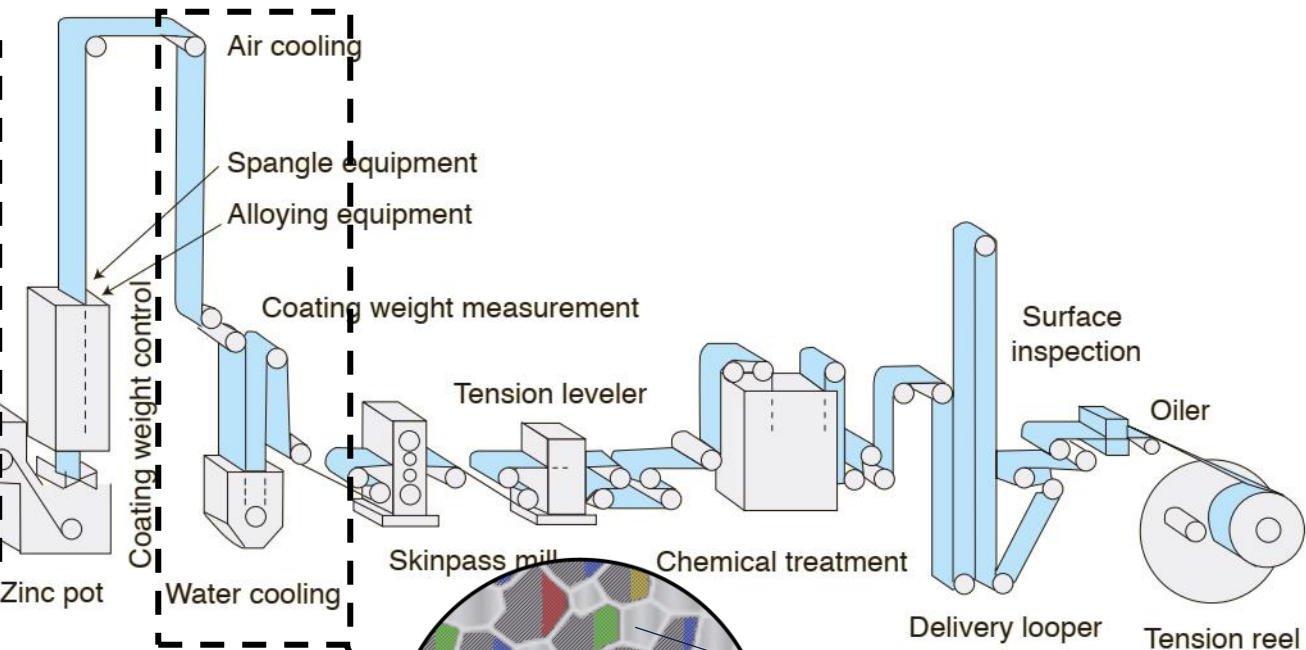
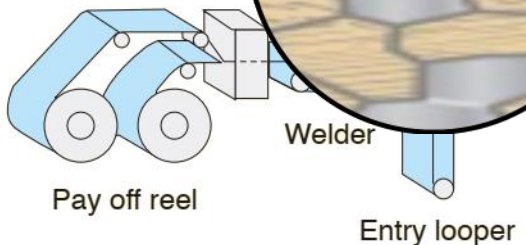
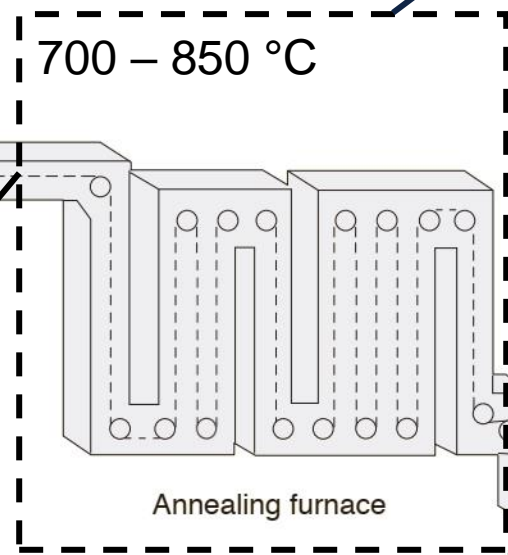
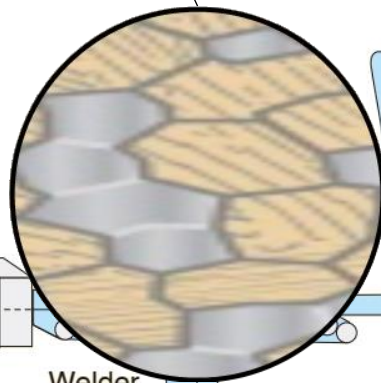


Heat treatment and application examples of advanced steels

Production of AHSS in continuous hot-dip galvanizing line



Ferritic-pearlitic



SSAB

[Courtesy of WorldAutoSteel / Adapted from Teräskirja (Metallinjalostajat ry, 2014)]

Use examples

- Side impact beam and waistline reinforcement



Production of advanced steels at continuous annealing line before cold forming or batch annealing before press hardening process

Starting material

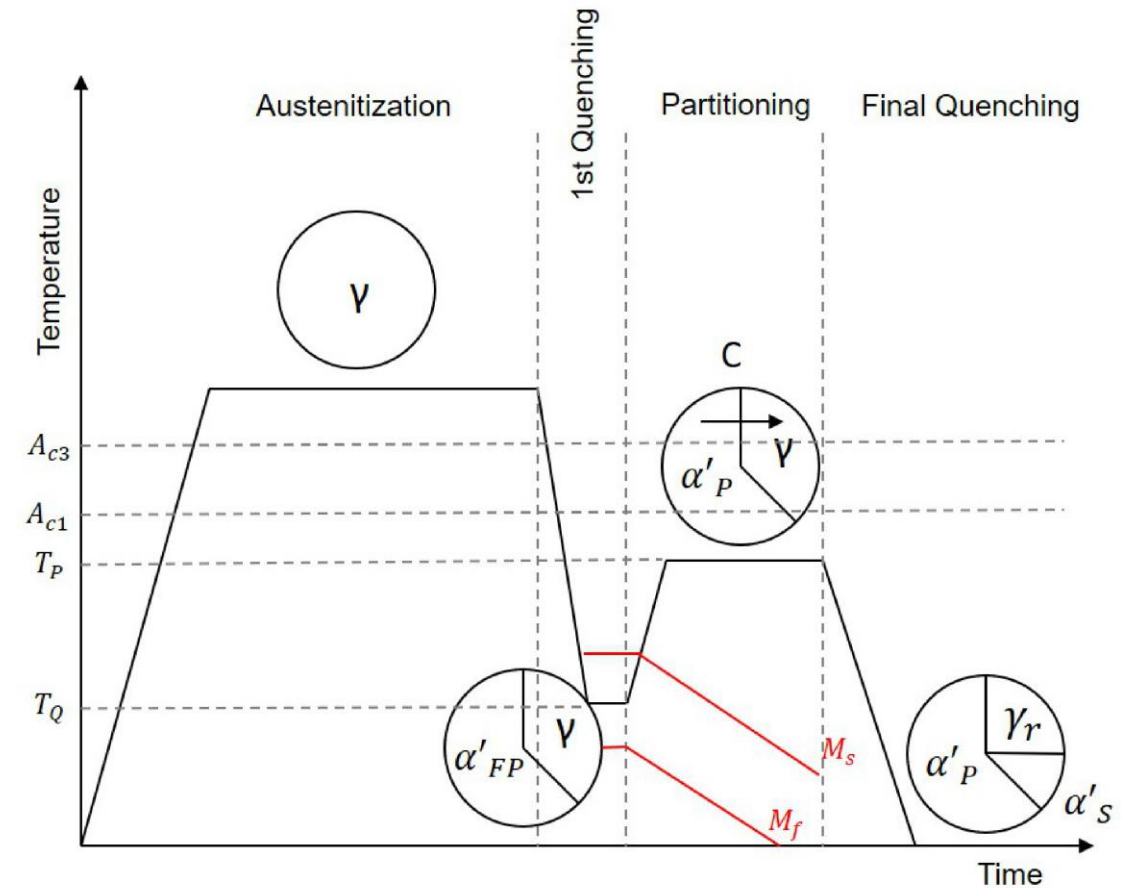
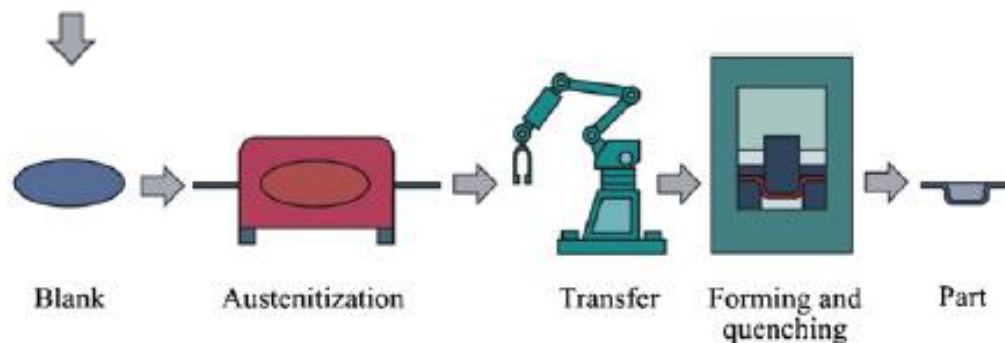
- Cold-rolled, full-hard strip

Continuous annealing

- Annealing step, austenitizing
- Rapid cooling, quenching
- Low-temperature tempering → cold forming by the steel user

Batch annealing in bell furnace

- Annealing step, intercritical annealing
- Slow cooling to produce lower strength compared to continuous annealing, press hardening done by the steel user



[Influence of Quenching and Partitioning Parameters on Phase Transformations and Mechanical Properties of Medium Manganese Steel for Press-Hardening Application, Blankart et al. (Metals, 2021)]

Use examples – Continuously annealed

- Side impact beams and bumper reinforcement



Use example – Press hardened

- Tailor-made bumper solution



SSAB

Kiitos mielenkiinnosta!