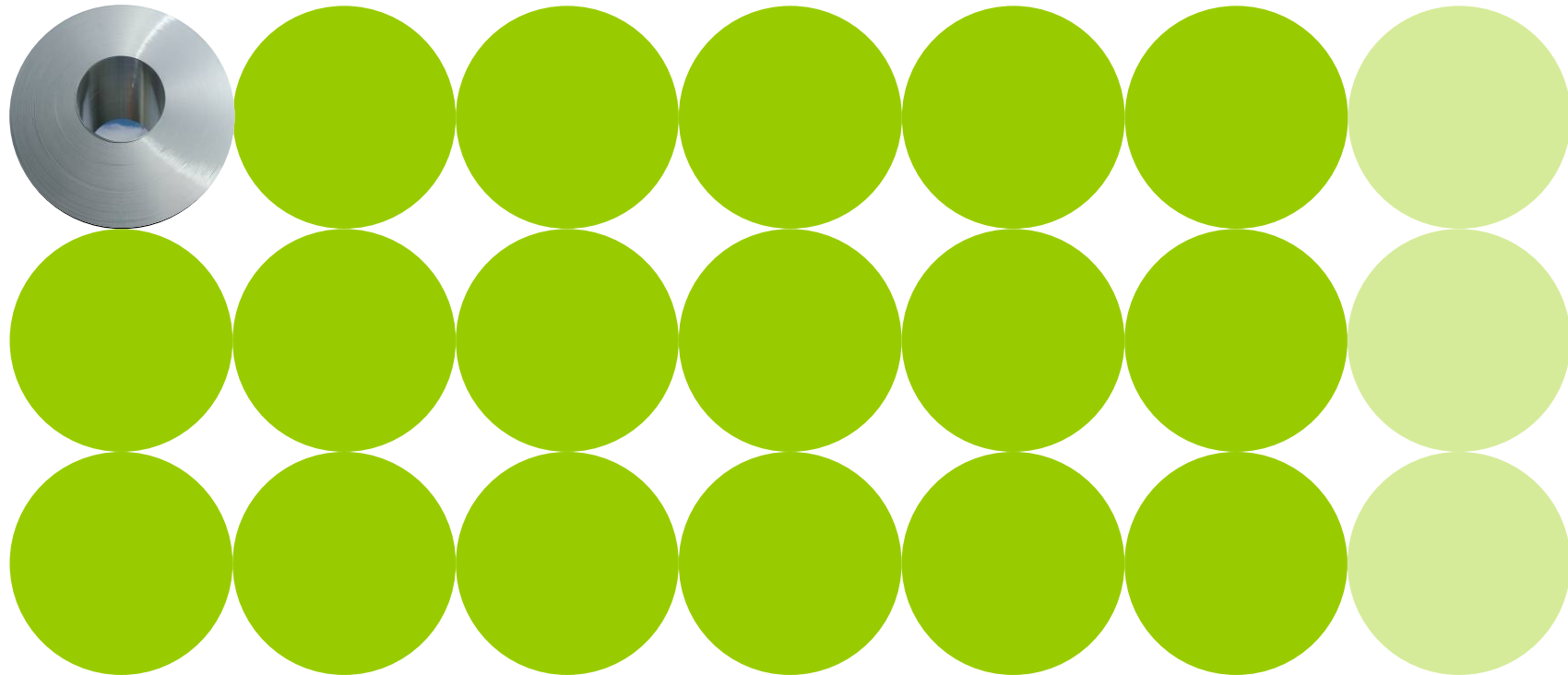


AluMag Roadshow 2011

Hydro Aluminium Rolled Products ; PG Automotive Sheet



10.10.2011 BMW München ; 11.10.2011 AUDI Ingolstadt ; 12.10.2011 Daimler Sindelfingen ; 13.10.2011 Opel Rüsselsheim ; 14.10.2011 ZF Stemmweide

Hydro's perceptive; Aluminium is the metal of the future



- **Lightweight**
 - 1/3 the density of steel
- **Recyclability**
 - 5% of original energy consumption
 - 75% of all aluminium produced still in use
- **Corrosion resistant**
 - Oxide layer
- **Formability**
 - Extrusion, rolling, casting
 - Low melting point vs. steel
- **Excellent conductivity**
 - Thermal – electrical
- **Alloying technology**
 - Gives a wide range of physical properties

Properties lead to increased market share

- Aluminium-intensive urbanization and infrastructure
- Climate challenge – aluminium as part of the solution
- Recyclability more important with high energy prices

Are we alone with this perceptive?

- Super Light Car – Multidisciplinary Research Consortium
- Multi material approach

OEM

Design & Engineering

Simulation

Steels

Material testing

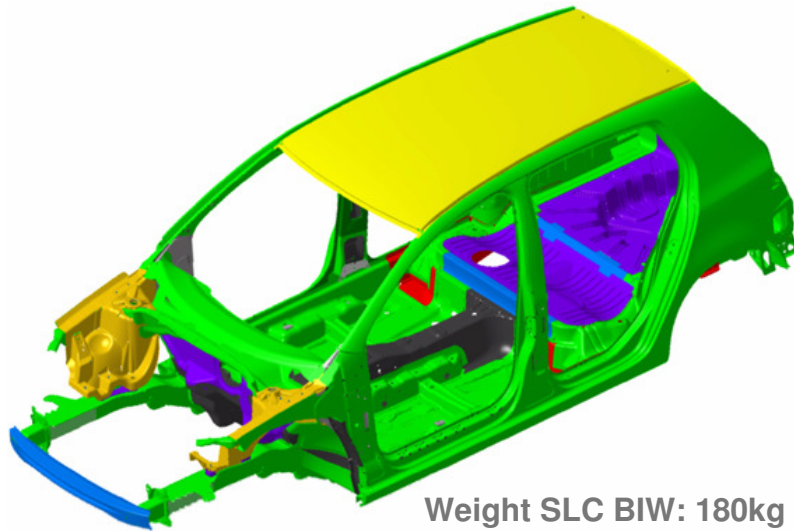
Light metals

Sustainability

Plastics

Logos include: Volkswagen, Renault, Volvo, Daimler, Porsche Engineering, Ika RWTH Aachen, ARUP, IVM Automotive, Ricardo, Alstom, Stuttgart DLR, ESI Group, Engineering Research AB, Arcelor, University of Ancona, LBF, Institut Betriebsfestigkeit, merl, Západočeská univerzita v Plzni, Dieffenbacher, Alcan, Dow, University Perugia, Polytec Group, Institut Chemische Technologie, Advanced Processes and Systems, TU Delft, Technische Universitat Darmstadt, PE Europe GmbH, TNO, and Hydro.

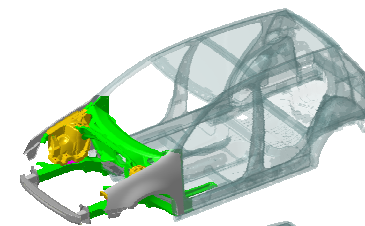
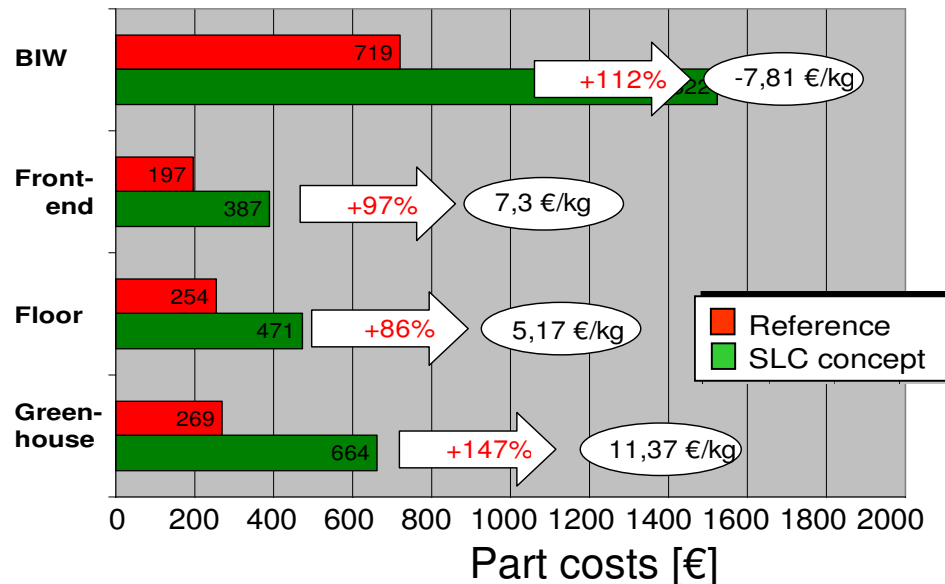
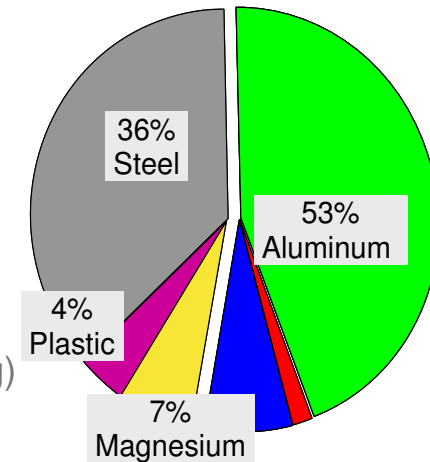
Results ; final SLC body concept



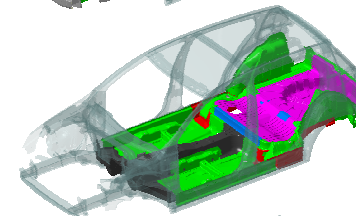
Weight SLC BIW: 180kg (Δm -101kg)

Applied Materials

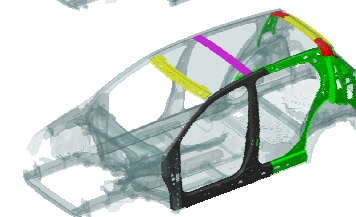
- Aluminium sheet (80kg)
- Aluminium cast (13kg)
- Aluminium extrusion (3kg)
- Steel (66kg)
- Magnesium (11kg)
- Fibre reinforced plastic (7kg)



Frontend

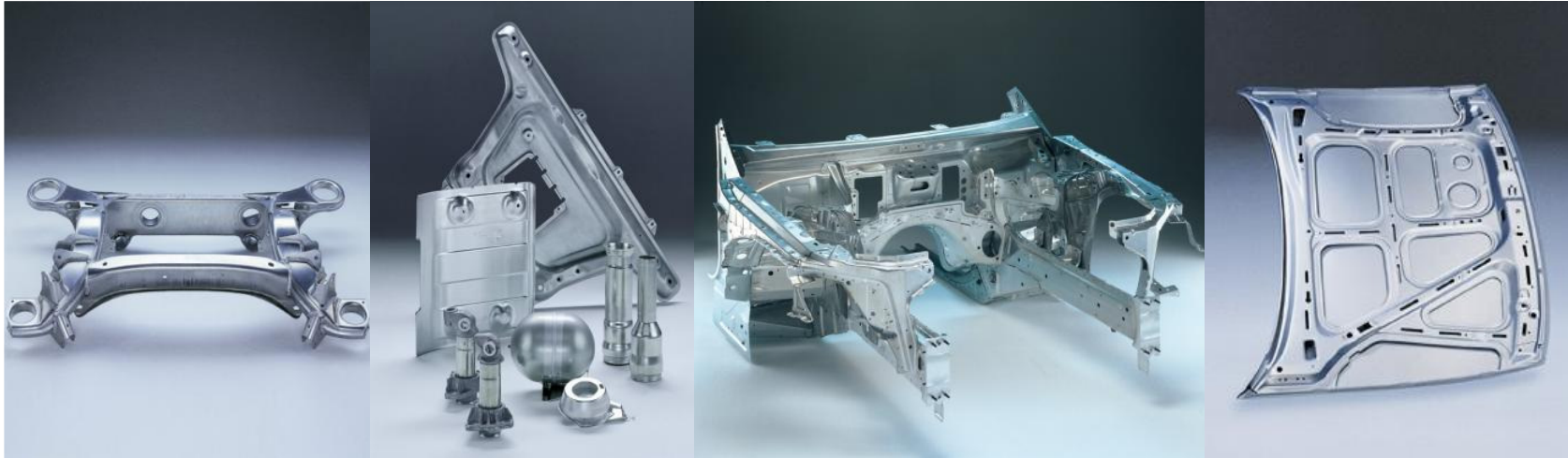


Floor



Greenhouse

Hydro Aluminium Automotive Sheet Typical Applications

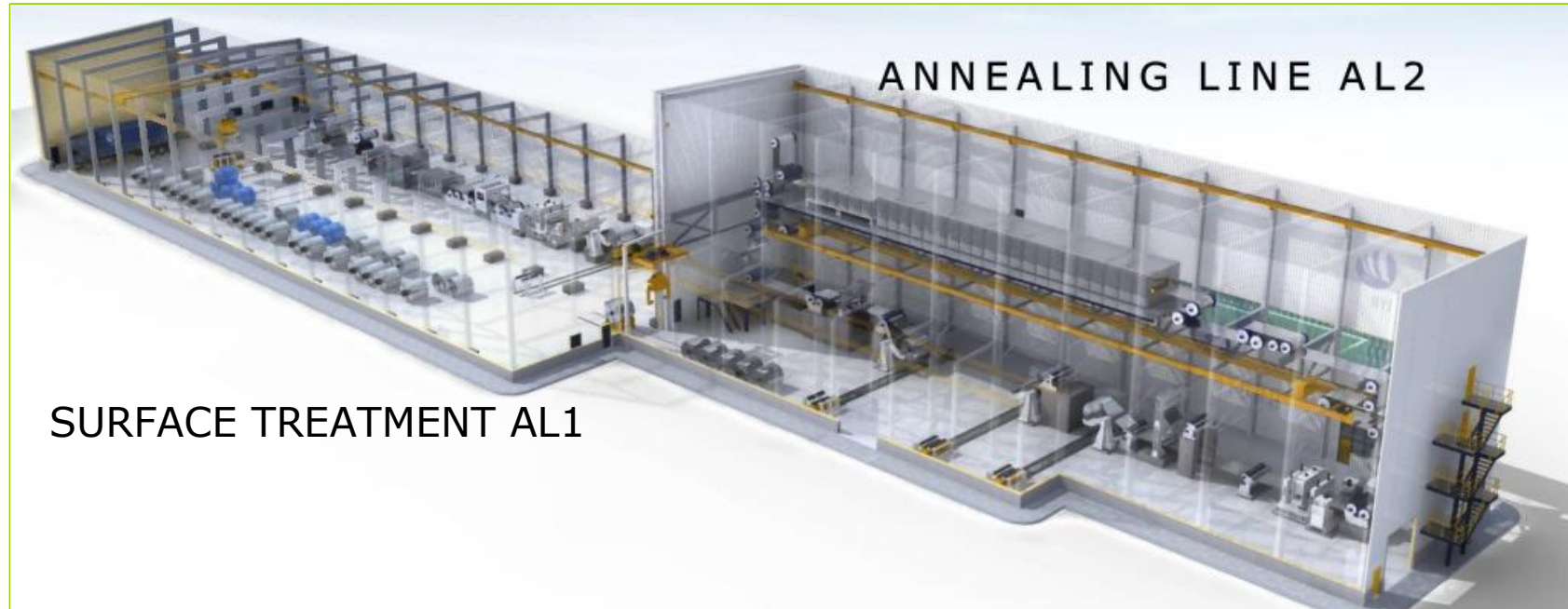


Chassis
Hydro is
market leader

Components Structure
Hydro in strong position

6xxx-Body
Hydro upgrades
market position

- Hydro is with 80.000 tpy second largest aluminium sheet supplier in Europe



- 2 production lines tailor made and optimized for surface critical automotive products like car body sheet and truck fuel tanks
- Full strip width capability up to 2130mm
- Innovative process technologies with high flexibility and efficiency aligned to Hydro's future automotive product mix
 - line speed for annealing and surface treatment independently adjustable

Hydro Aluminium Automotive Sheet Development Strategy

„The major growth potential for aluminium sheets for automotive applications is in the high volume car segment“ (voice of market)

Hydro`s Target:

- Penetration of high volume car segment with aluminium sheet solutions

Prerequisites

- cost competitive solutions (customer)
- with ability for efficient recycling (society & environment)



Hydro Aluminium Automotive Sheet Development Emphasis

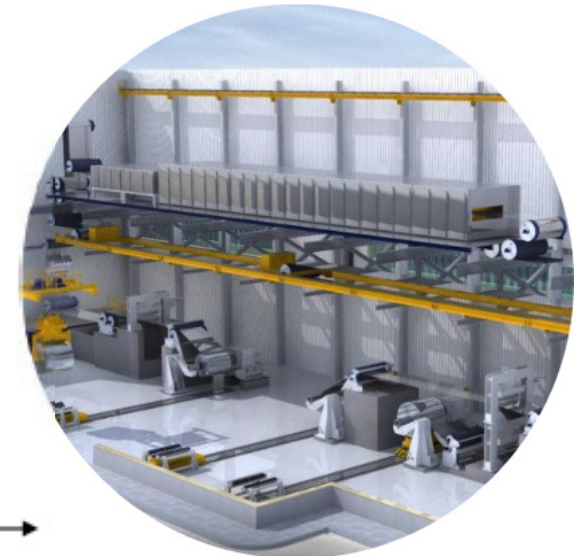
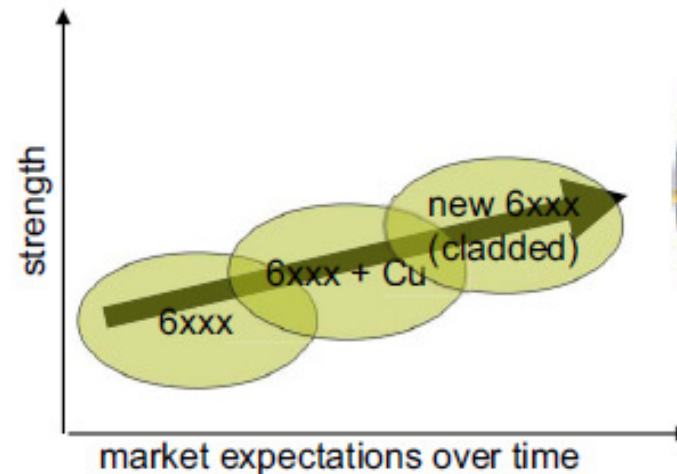
- Alloy concepts with balanced property optimisation and recycling efficiency
 - 2 directions for property optimisation: strength & formability
- Added value surface
- Recycling and remelting technology

Hydro's Alloy Concepts

„For the high volume car segment, the property optimisation within existing and established 5xxx and 6xxx alloy systems allows a good balance with recycling efficiency“ (Hydro's perception)

Roadmap for strength optimisation:

- brand new continuous annealing line for 6xxx automotive alloys
- today's requirements:
typical 6xxx
- future requirements:
6xxx with Cu
novel 6xxx
(optionally clad)

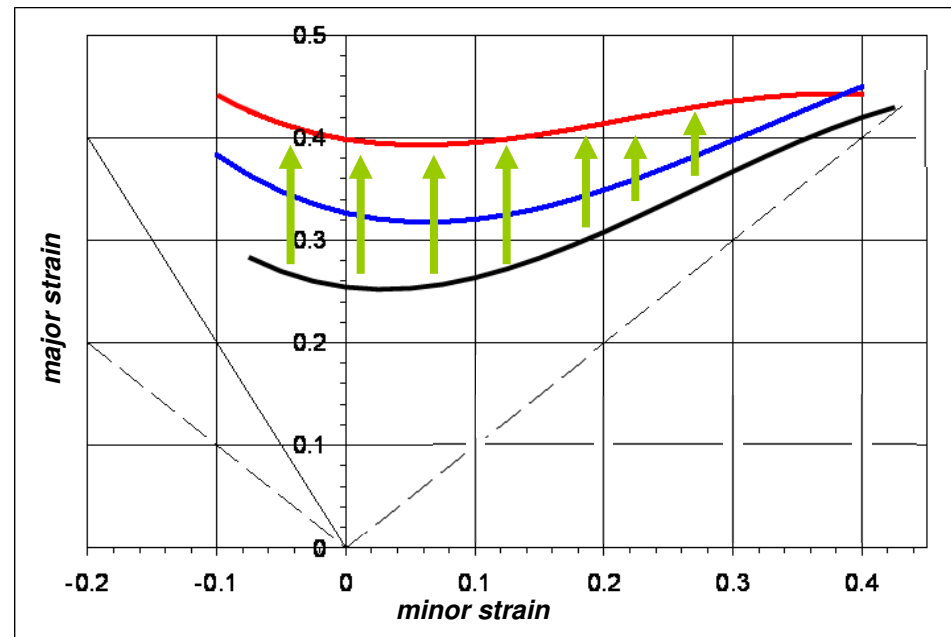


Hydro's Alloy Concepts

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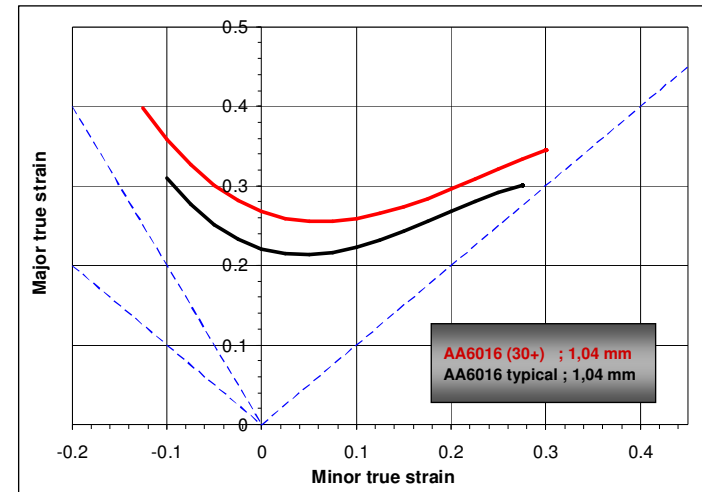
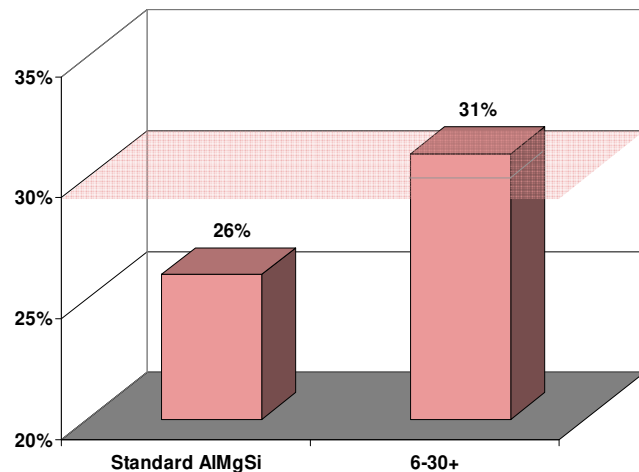
Roadmap for forming optimisation:

- 5xxx alloy system
forming optimised AA5182
high-Mg alloys (**AlMg5+**)
- 6xxx alloy system
6/30+



Hydro's Innovation "6/30+"

- 6xxx alloy for parts with highest requirements on formability (today: for car body inner parts only)
- Elongation values in condition T4 :
 - $A_{80\text{mm}}$ exceeding **30%** in all directions
 - A_g exceeding **25%** in all directions



Hydro's Innovation "6/30+" further key characteristics

- alloy composition within the established AA6016
=> allows uni-alloy concept with car body outer panels
- typical paint bake response
=> in-service strength similar to standard AA6016 alloys
- compatible with all OEM processes
=> in particular joining operations like adhesive bonding



DC-casting

hot-rolling



*continuous
coil annealing*

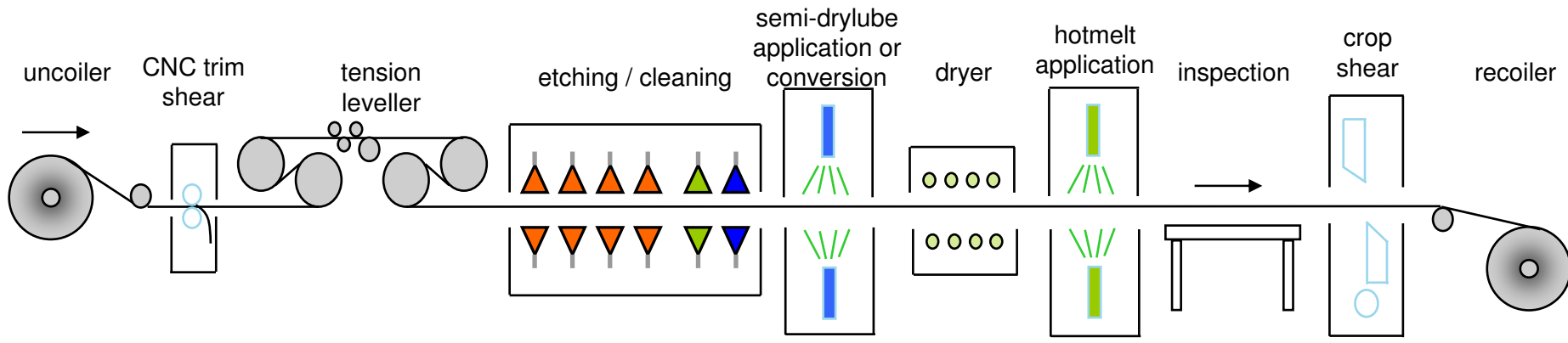
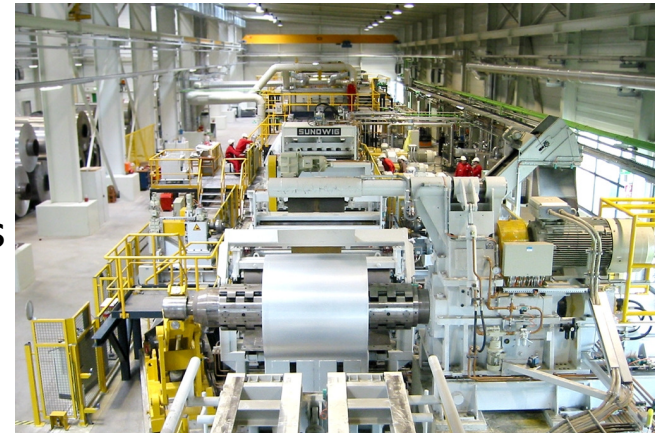


Hydro's Added Value Surface

„Surface treatments & lubrication systems are OEM specific, no unified specification expected“ (voice of market)

Hydro's Strategy:

- surface coating line optimised for **flexibility**
- preferred partner for surface related developments with OEM's & chemical suppliers



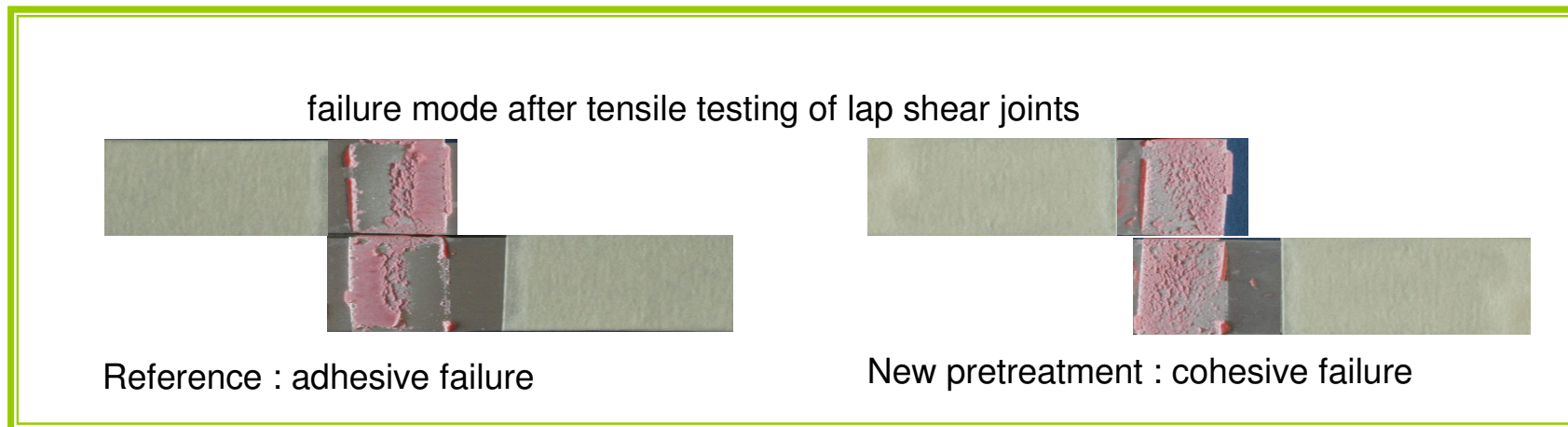
Hydro's Added Value Surface

„coil passivation is more cost efficient than lot passivation“ (voice of customer)

Development example:

coil passivation for high strength structural joints by adhesive bonding

- cost efficient & environmentally friendly (compatible with VOC guidelines)
- better durability than Ti/Zr



Recycling and Remelting Technology

"End-of-life recycling back into products favourable for CO2 footprint, and requested by customers and other stakeholders" (voice of market)

Hydro's Commitment:

- investment in 3 new recycling furnaces in Germany in the last 3 years (Rheinwerk, Hamburg, AluNorf)



- => 150.000 tonnes state-of-the-art recycling capacity in Germany

Hydro aims to be Europe's leading supplier of casthouse products and semis – produced from primary, scrap, and end-of-life materials




Summary

Hydro's Perception
aluminium is the ideal material for sustainable lightweighting

Hydro's Strategy
penetration of high volume car segment with alu sheets solutions

Hydro's Focus
cost effectiveness // compatibility with efficient high volume recycling concepts

Hydro's Emphasis
5xxx & 6xxx alloys // added value surface // recycling technology



Aluminium is the
metal of the future,
Hydro's future is in
aluminium.

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where people make the difference

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