# GKN Powder Metallurgy

„On the industrial view on technology developed in Supreme“

Sebastian Blümer

Development Engineer Additive Manufacturing

# GKN Powder Metallurgy – The metal shape solution provider

## GKN Hoeganaes
Metal Powders

**£0.3bn (40% internal)**

**> 300.000 tons / year**

## GKN Sinter Metals
Product Solutions

**£1.0bn**

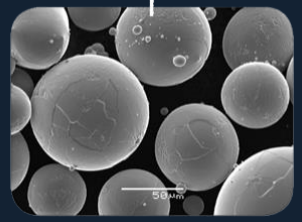
**> 13m pieces / day**

## GKN Additive
Additive Solutions

We provide high precision metal solutions for automotive and industrial applications.

# Already Positioned to Lead the Market

## Materials



- From high purity to high productivity Advanced AM materials
- Aero and Auto certified

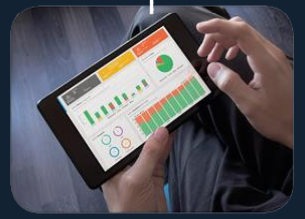
## Design

- Design to function
- Fatigue and topology optimization
- Identifying value @ AM Experience Days

## AM Process

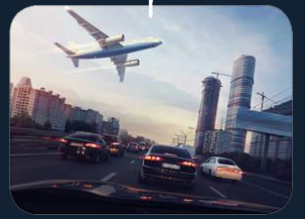
- From high performance Laser to high productivity Binder
- Full range of materials

## Operational Excellence



- Global footprint
- World class production system
- IATF 16949 certified AM plant

## Markets



- Automotive (OEMs & tiers)
- Industrial

We have the whole value chain!

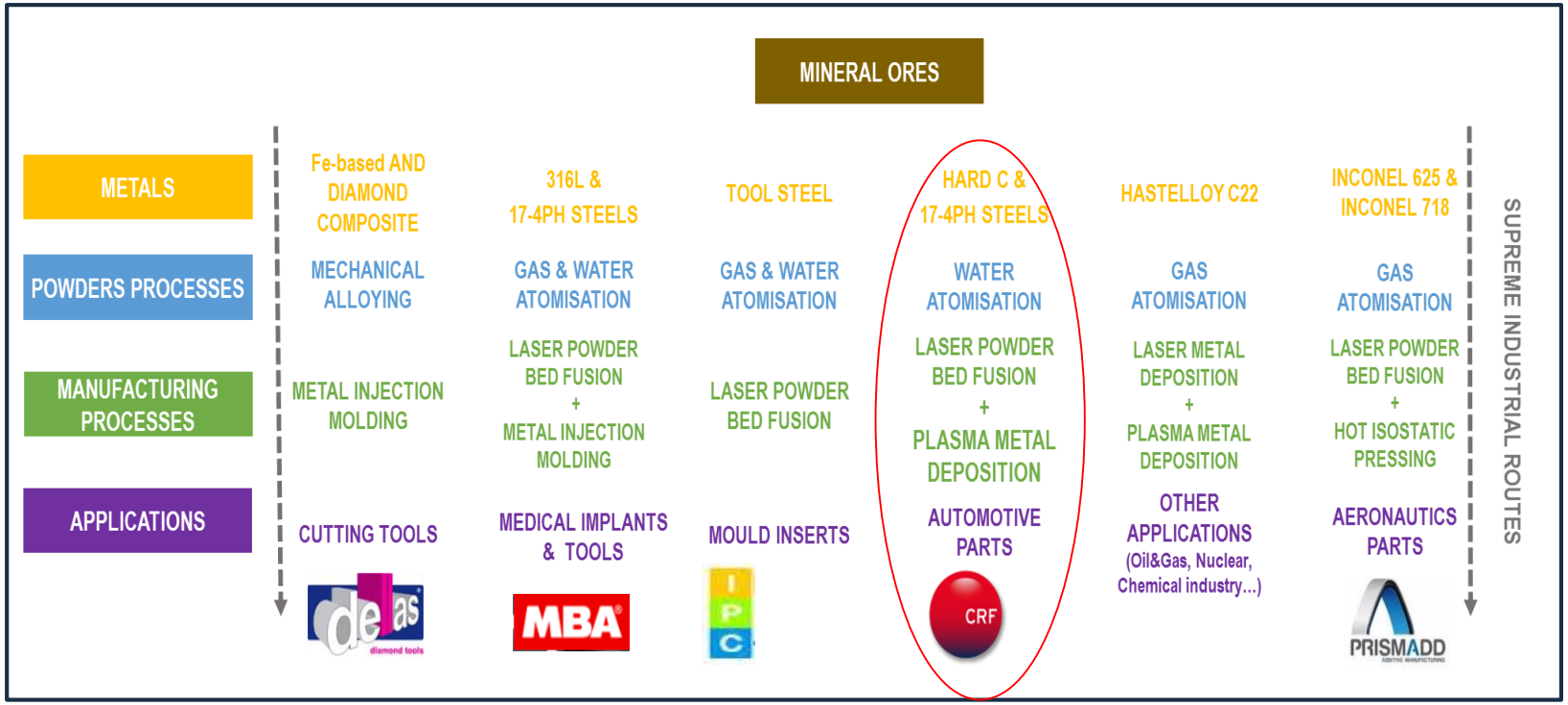
# Supreme

1. Overall project concept
2. Development of High C steel for LPBF process
3. Demonstrator in automotive

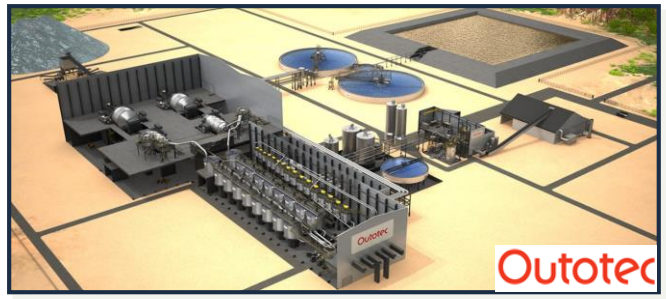
# Overall project concept

## Project consortium

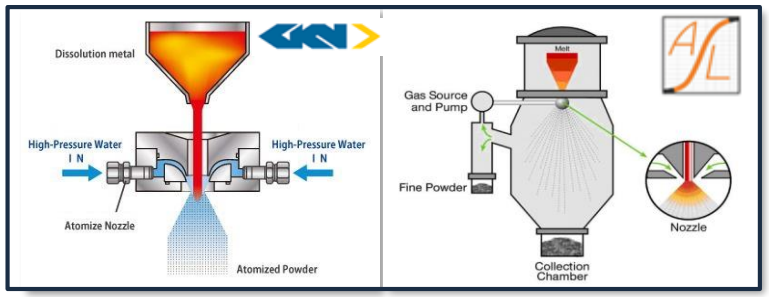

## Production routes



# Overall project concept




Minerals

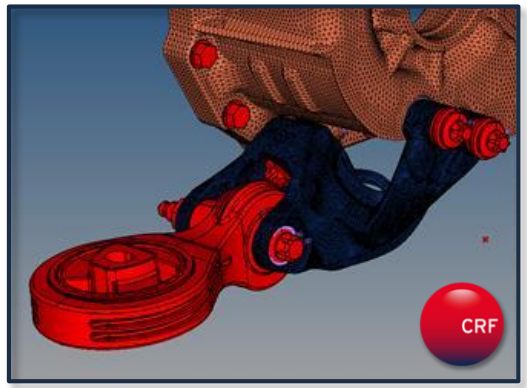



Powders


LPBF Process

## Project objectives

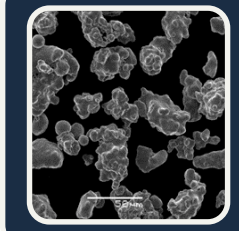
| Improvement | | Reduction | |
|---|---|---|---|
| >10% | Energy efficiency | >30% | $CO_2$ emissions |
| >25% | Raw material resource efficiency | | |
| >10% | Production rate | | |




Application

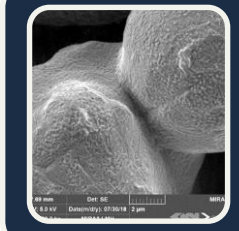
# Development of High C steel for LPBF process

## Process Development



### Material selection

- Material alloy
- Gas atomized powders
- Water atomized powders



### Powder characterization

- Particle size distribution
- Chemical element distribution
- Flowability

### Investigation of processability

- System preconditions
- Parameter studies
- Evaluation of mechanical properties

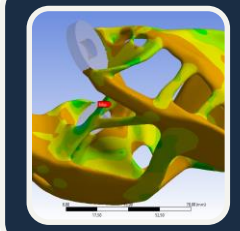
## Application Development

### Evaluation conventional design

- Design Constraints
- Mechanical Properties
- Application

### AM-Potential

- Mass reduction (lightweight approach)
- Stress optimization
- Cost efficiency

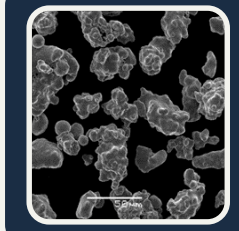


### Design for AM

- Topology optimization
- FEM Simulation
- Evaluation of mechanical properties

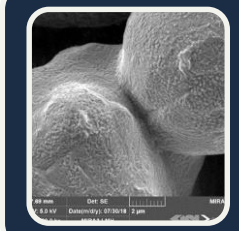
# Development of High C steel for LPBF process

## Process Development



### Material selection

- Material alloy
- Gas atomized powders
- Water atomized powders



### Powder characterization

- Particle size distribution
- Chemical element distribution
- Flowability

### Investigation of processability

- System preconditions
- Parameter studies
- Evaluation of mechanical properties

## Supreme

### Material selection

- Anchorsteel 4600 V low alloy steel
- Carbon level: up to 0,6%
- Water atomized powders

### Powder Characterization

- 10-68 µm
- Chemical distribution: oxygen content (0,09%)
- Carney method, Hall flow method, Avalanche angle

### Investigation of processability

- Pre-heating up to 500 °C
- Volume parameter, support parameter
- Internal stresses, tensile strength, elongation

# Demonstration in automotive

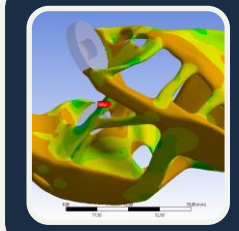
## Application Development

### Evaluation conventional design

- Design Constraints
- Mechanical Properties
- Application

### AM-Potential

- Mass reduction (lightweight approach)
- Stress optimization
- Cost efficiency

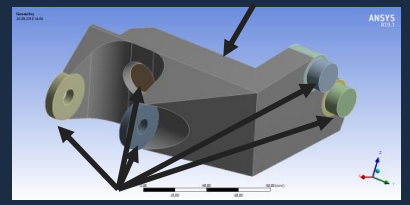


### Design for AM

- Topology optimization
- FEM Simulation
- Evaluation of mechanical properties

## Supreme

### Evaluation conventional design



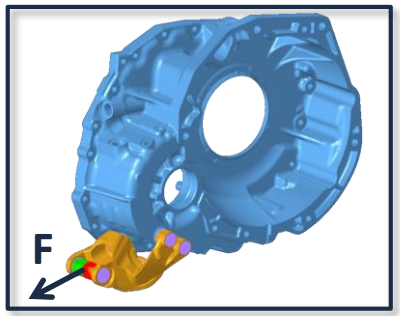

### Potential

- Mass reduction: 50% (achievable goal)
- Cost efficiency: high priority

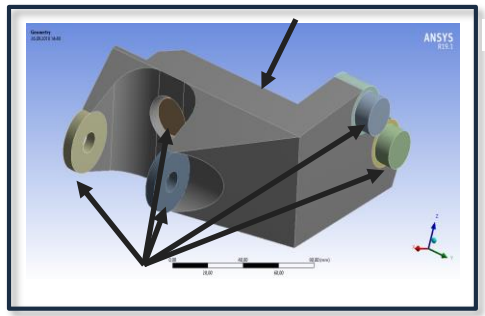
### Design for AM

- Topology Optimization: design suitable for LPBF process
- FEM-Simulation: tension and compression
- Evaluation of mechanical properties: tensile strength, yield strength, elongation, hardness

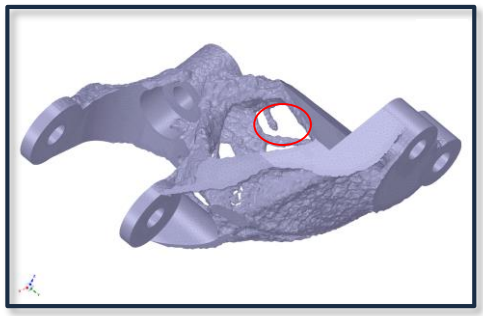
# Demonstration in automotive



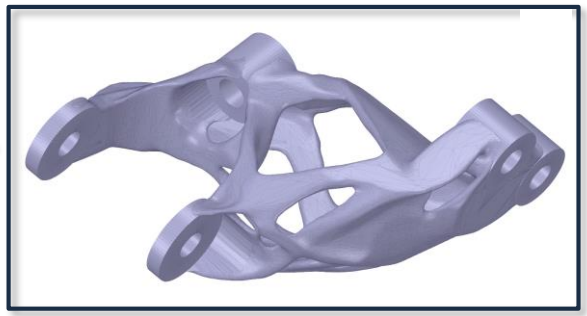

Current application



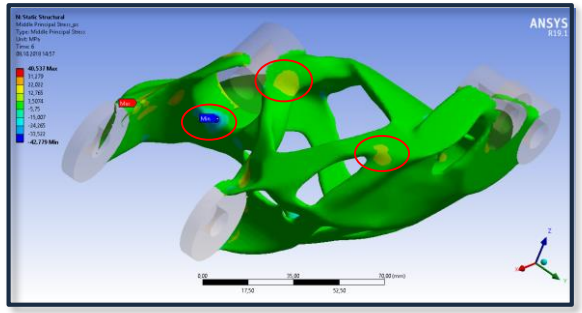
Boundary conditions



Topology optimization



Design for AM



FEM-Simulation

**Results in Supreme:**

- First draft of topology optimized design finished
- Current mechanical properties fulfills the requirement of engine mounts
- First draft design weight reduction: approx. 33%
- Requirements for second draft: Lifecycle analysis and dynamic mechanical properties
- Achievable goal: 50%

# Summary and Outlook

**Summary:**

- LPBF-Processability of water atomized High C steel powders achieved
- First parameter studies with 0,6% carbon level performed
- Material density higher than 99% could be reached
- First draft of topology optimization achieved a weight reduction of 33%

**Outlook:**

- Further parameter studies with different carbon levels planned
- Development of quality and performance parameter set
- Internal stress analysis with modified LPBF system pre-conditions
- Second draft of topology optimized design → achievable goal: weight reduction of 50%
- Energy and cost analysis together with CRF

# THANK YOU FOR YOUR ATTENTION!

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