MEMAN

INTEGRAL MATERIAL AND ENERGY FLOW MANAGEMENT IN MANUFACTURING METAL MECHANIC SECTOR

Seizing the opportunities of circular economy in manufacturing

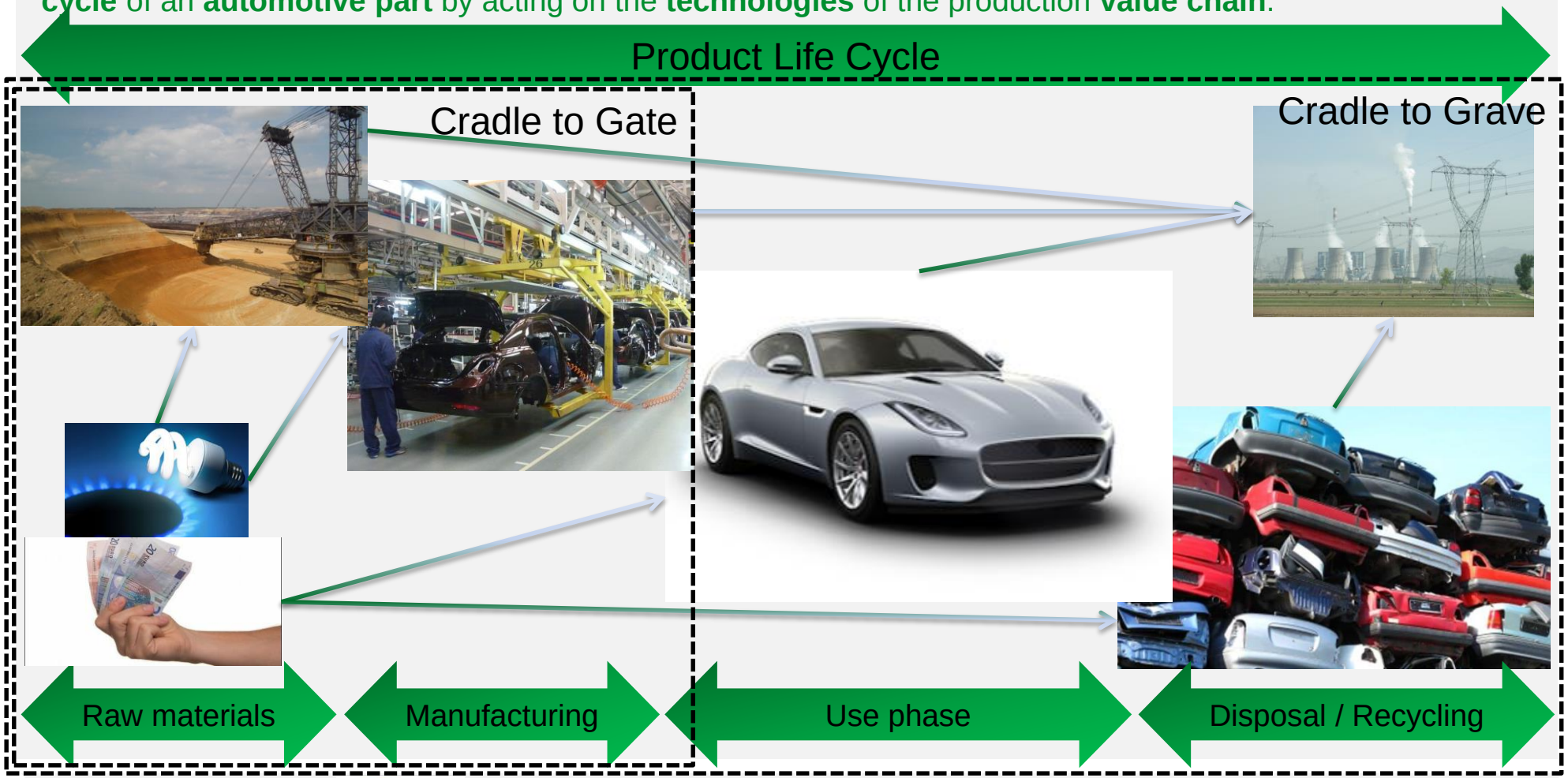
The case study on Casting

Jaio Manzanedo Gabilondo, Energy Storage and Management, IK4-IKERLAN

MEMAN stands for “Integral Material and Energy flow MANagement in MANufacturing metal mechanic sector”. This project has received funding from the European Union’s Horizon 2020 Programme under grant agreement no. 636926.

Casting Cluster – Use Case 1: HOLLOW KNUCKLE – Overall goal

Demonstrate significant **reduction** in **energy** consumption, **environmental impact** and **cost** during **life cycle** of an **automotive part** by acting on the **technologies** of the production **value chain**.



Main Partners:

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Casting Cluster - Use Case 1: HOLLOW KNUCKLE – Partners

MEMAN Casting cluster		MAIN ROLE IN THE PROJECT
IK4 IKERLAN Research Alliance	IKERLAN	Co-ordination of the casting cluster
fagor ederlan taldea	EDERLAN	Automotive parts manufacturer
EDERTEK technology centre	EDERTEK	Design of automotive parts
Loramendi	LORAMENDI	Sand core process supplier
insertec Furnaces & Refractories	INSERTEC	Industrial furnace developer
aurrenak	AURRENAK	Mould manufacturer
msi grupo	MSI	IT solutions developer
acciona Infrastructure	ACCIONA	LCA expert

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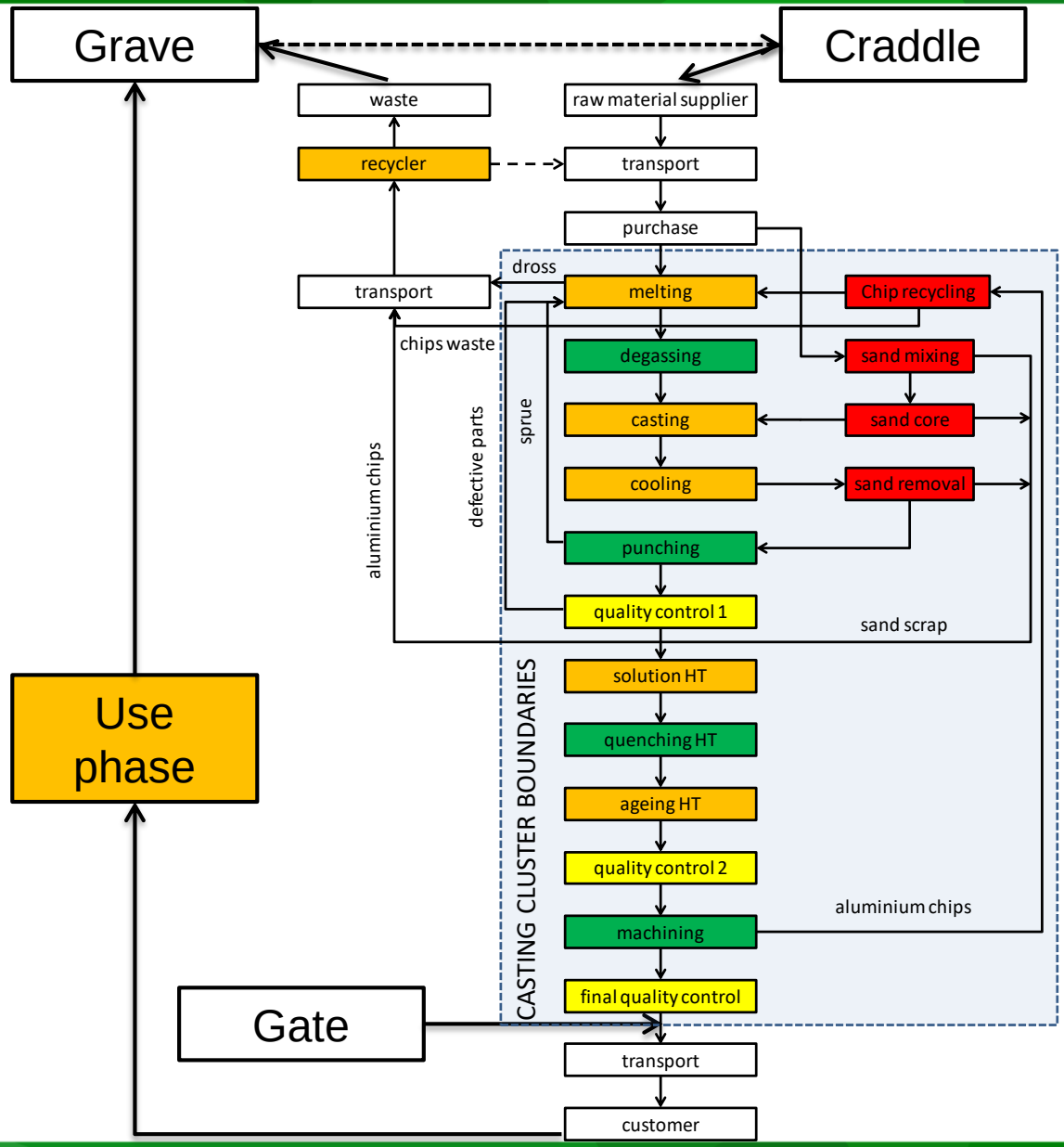
Casting Cluster - Use Case 1: HOLLOW KNUCKLE – Value chain structure



Processes colour code	
	Non modified
	Modified/impacted
	Added
	Non addressed

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Casting Cluster - Use Case 1: HOLLOW KNUCKLE – Value chain actions

Initial Situation & Targets

- current part: main contributions to **life cycle GWP** from **raw materials** (35%) and **vehicle use phase** (62%).
- **weight reduction** of > 20% in final part reduces life cycle GWP by acting on both impact origins:
  - Lighter part → less raw materials
  - Less weight → lower vehicle fuel consumption
- Requires **additional machines and processes**

Solution Elements & Innovations

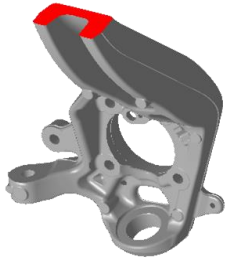
a. new **hollow part** with **same performance** but with significant **weight reduction.**

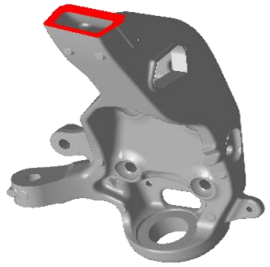
b. new **sand core making machine** with **reduced energy consumption.**

c. new **in-house aluminum chips recovery** system

d. energy efficiency actions in **value chain** processes

Solid U section (5.2 kg)





Hollow tubular section (4.1 kg)

Benefits & Achievements

	cradle to gate	cradle to grave (life cycle)
energy	**- 23 %**	**- 22 %**
CO_2	**- 24 %**	**- 22 %**
costs	**- 22 %**	**- 21 %**

Transfer Potentials

- knuckles for mid-sized and premium cars
- Potentially 6 mio. Large sized cars = 24 mio parts per year only in Europe
- total reduction potential: **1.2 mio t. CO_2 per year** (0.03% of 2015 EU emissions from all sources)

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Casting Cluster - Use Case 1: HOLLOW KNUCKLE - Innovations

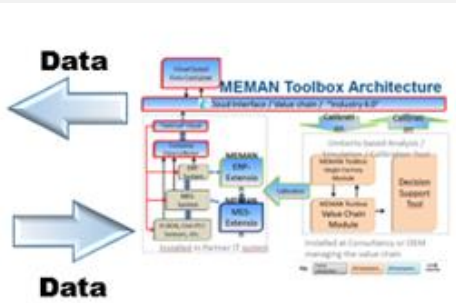
Innovation a. DEVELOPMENT OF A LIGHT HOLLOW KNUCKLE AND THE PROCESS NEEDED.

- Lighter automotive part with a competitive manufacturing process.
- Development of an hollow part and its process in LPDC (low pressure die casting):
  - **20 % of reduction** in part final weight.
  - **Optimal process** in term of energy and raw materials **savings.**
  - Additional **investment** on equipment **required.**
- **OEM's interest** required for **widespread production** of automotive parts with this approach.
- Some **OEM's** have been **approached**.

Main Partners: EDERTEK technology centre, aurrenak

Innovation b. ULTRAPRECISE AND EFFICIENT CORE MAKING DEVICE

- Disruptive development in the inorganic core making process.
- Innovation in motion system, heating system, drying gas heating, gas pressurized gas generation and sand blowing system:
  - **70 % of reduction** in energy used in motion.
  - **25 % reduction** in blowing gas pressure.
  - **Near to ZERO** error in positioning / exact repeteability.
  - **More than 50%** of reduction in tooling heating energy.
- Higher development & construction costs.
- **Needed changes in regulations** in order to certificate foundry machines with energy consumption standards.



Main Partners: Loramendi

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Casting Cluster - Use Case 1: HOLLOW KNUCKLE - Innovations

Innovation c. ALUMINIUM CHIPS IN-HOUSE RECOVERY SYSTEM

- Hollow knuckle process generates more aluminium scrap → recycling within process saves raw materials and energy.
- Development of a new in-house delaquering line for cleaning and preheating of aluminium scrap:
  - **Clean material** at T > 250ºC ready to be fed to melting, **reducing dross** formation.
  - **98% material recovery and 20% energy savings.**
  - Allows **wide range** of **scraps** as input → wide choice and **reduced cost of materials** for parts manufacturing.
  - **Avoids transport** and **selling** of external remelting.
- **Parts manufacturing** companies' **interest** required for wide imple

Innovation d. ENERGY EFFICIENCY ACTIONS IN PRODUCTION VALUE CHAIN

- Local (gate to gate) energy consumption increase due to new processes and equipment and more material melting required per part. Additional effort for increasing energy efficiency in manufacturing processes.
- Compressed air for LPDC cooling:
  - responsible of > 15% of gate to gate electricity consumption
  - Change of cooling method resulting in **45% savings** of process step electricity. Partially validated in some lines → requires mould design change for widespread implementation
- Thermal treatments:
  - account for 36% of gate to gate gas consumption. Stack gases still have significant energy content.
  - Heat recovery and re-use in heat treatment furnaces with potential of **15% savings** of process step natural gas.
  - Additional R&D&i effort required → new H2020 project ongoing

Main Partners: insertec Furnaces & Refractories

Main Partners: fagorederlan caldea IK4 IKERLAN Research Alliance

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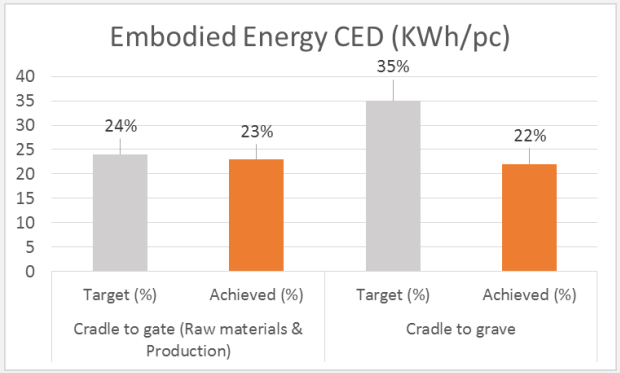
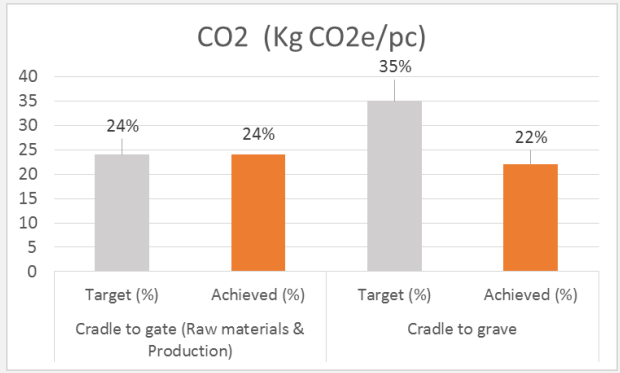
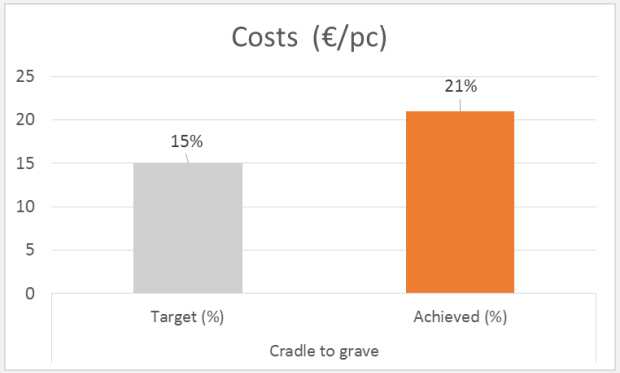
Casting Cluster - Use Case 1: HOLLOW KNUCKLE – KPIs achievements







CONTRIBUTIONS TO KPI ACHIEVEMENTS:

- Main contribution from **raw materials** use **reduction**: less material in final part + higher recycled aluminium use
- High weight of **use and disposal phases** contribution sets a limit to the relative improvement in cradle to grave → but **high absolute reductions** still achieved. As example for GWP:
  - Cradle to gate improvement: 23 kg CO2-eq./part, 24% relative improvement from present value chain.
  - Cradle to grave improvement: 50 kg CO2-eq./part, 22% relative improvement from present value chain.
- Significant **local** (gate to gate) **improvements** also achieved:
  - 9% Direct energy use
  - 5% costs

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Thank you for your attention!

Jaio Manzanedo Gabilondo
Energy Storage and Management
IK4-IKERLAN
jmanzanedo@ikerlan.es
+34 943 712 400
(Casting Cluster Co-ordinator)

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