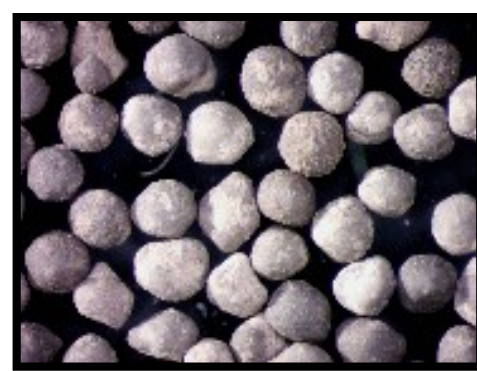




NEW MATERIAL SOLUTIONS FROM SAINT-GOBAIN FOR THERMAL ENERGY STORAGE

An overview of thermal energy storage media manufactured by Saint-Gobain for CSP, ACAES and sensible heat applications




➤ Particles currently investigated and main properties:

Particle type (0.6-1.2 mm size)	Sintered Bauxite media	« Granulated » media	« Fused » media
Appearance			
Color			
Chemistry	Al2O3 rich	Fe2O3 rich	Complex oxide system
Loose packed density	1.85 g/cc	2.8 g/cc	2.08 g/cc
Bulk Density	3.3 g/cc	4.7 g/cc	3.47 g/cc
Cp [1000°C][J/kg/K]	1276	884	1198
ρ.Cp [kJ/m³.K]	2360	2475	2498
Hardness (Vickers)	911 Hv 0.1	636 Hv 0.1	1170 Hv 0.025
Softening temperature	882°C	990°C	1110°C
Estimated price (weight cost of particles)	Reference point	x1-1,5 vs reference	x3 vs reference
	Price can be lower depending on volumes and size needed	Working on lower price with cheap recycled raw material feeds	Wider size distribution + recycled raw materials would decrease price

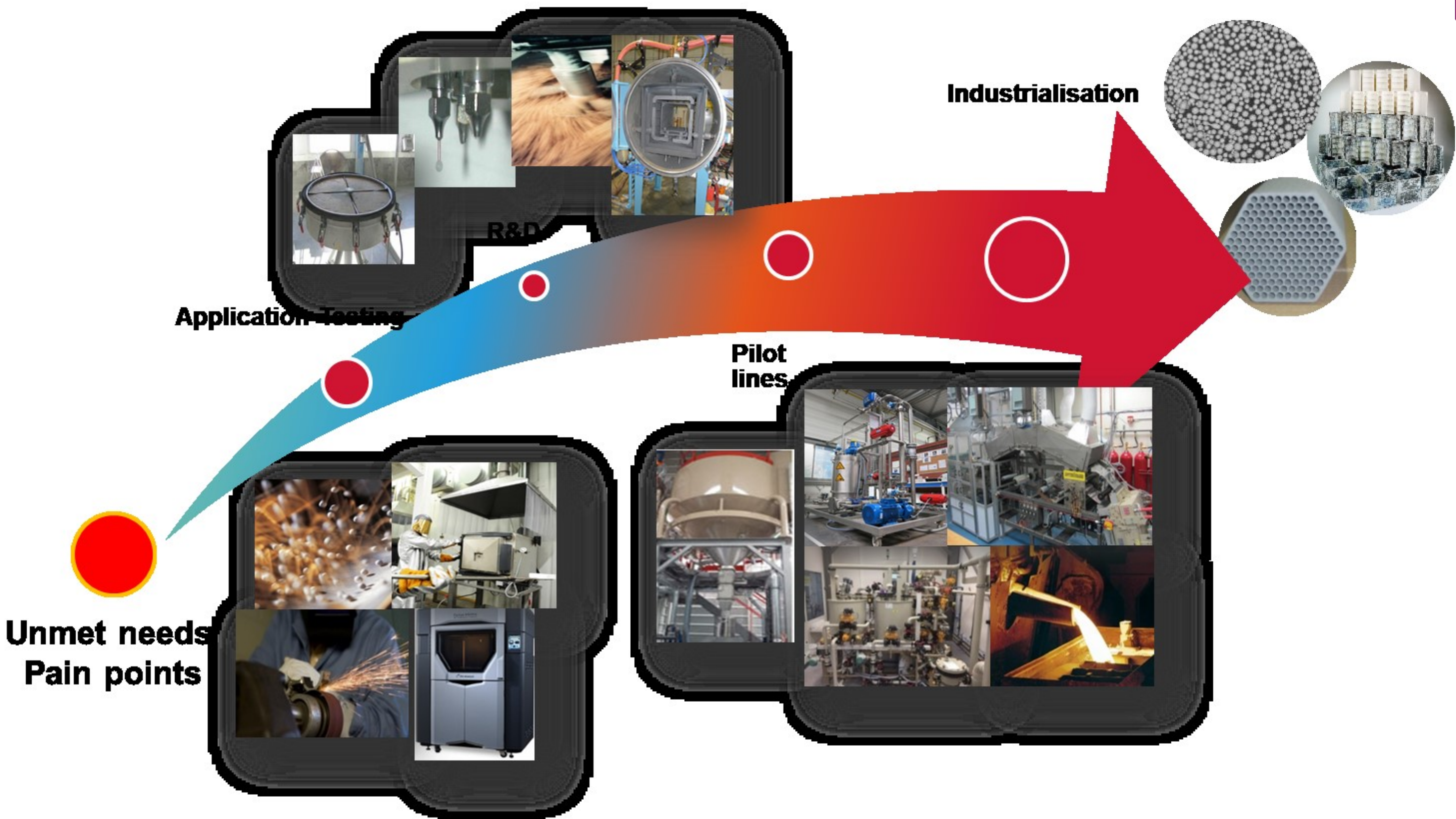
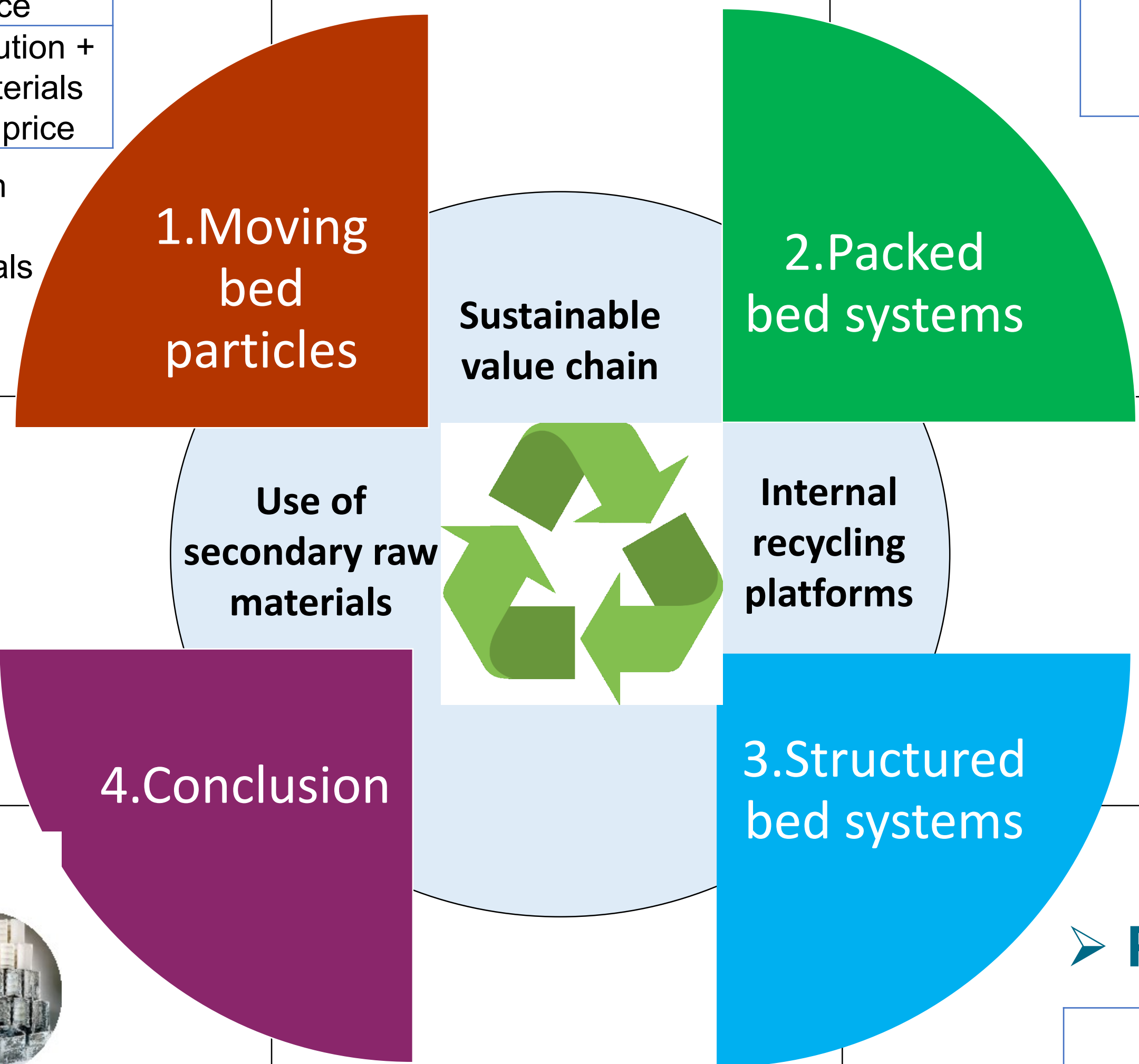


- Several particles developed in the frame of the [COMPASsCO2 project](#), funded from the European Union's Horizon 2020 Research and Innovation Action (RIA) under grant agreement No. 958418
- Current particle cost at stake → investigating cheaper and maximum use of secondary raw materials
- Other mechanical characterizations in conditions representative to the CSP application available on request thanks to unique in-house equipment

➤ Solutions currently investigated and main properties:


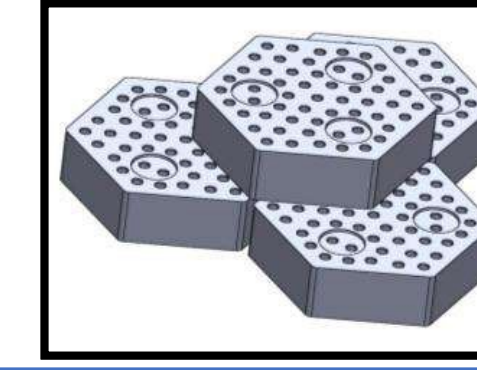
Particle type (5-20 mm size)	« Granulated » media	«Granulated» media	Sintered alumina media
Appearance			
Chemistry	AZS	Fe2O3	Al2O3
Bulk Density	2.9 g/cc	4.6 g/cc	3.95 g/cc
Cp [1000°C][J/kg/K]	930	1100	1100
ρ.Cp [kJ/m³.K]	2700	5060	4350
Estimated price	Reference point	Reference point	2 to 3 x vs Reference point
	Low price with cheap recycled raw material feeds	Low price with cheap recycled raw material feeds/ critical supply	Lower price with cheap recycled raw material feeds

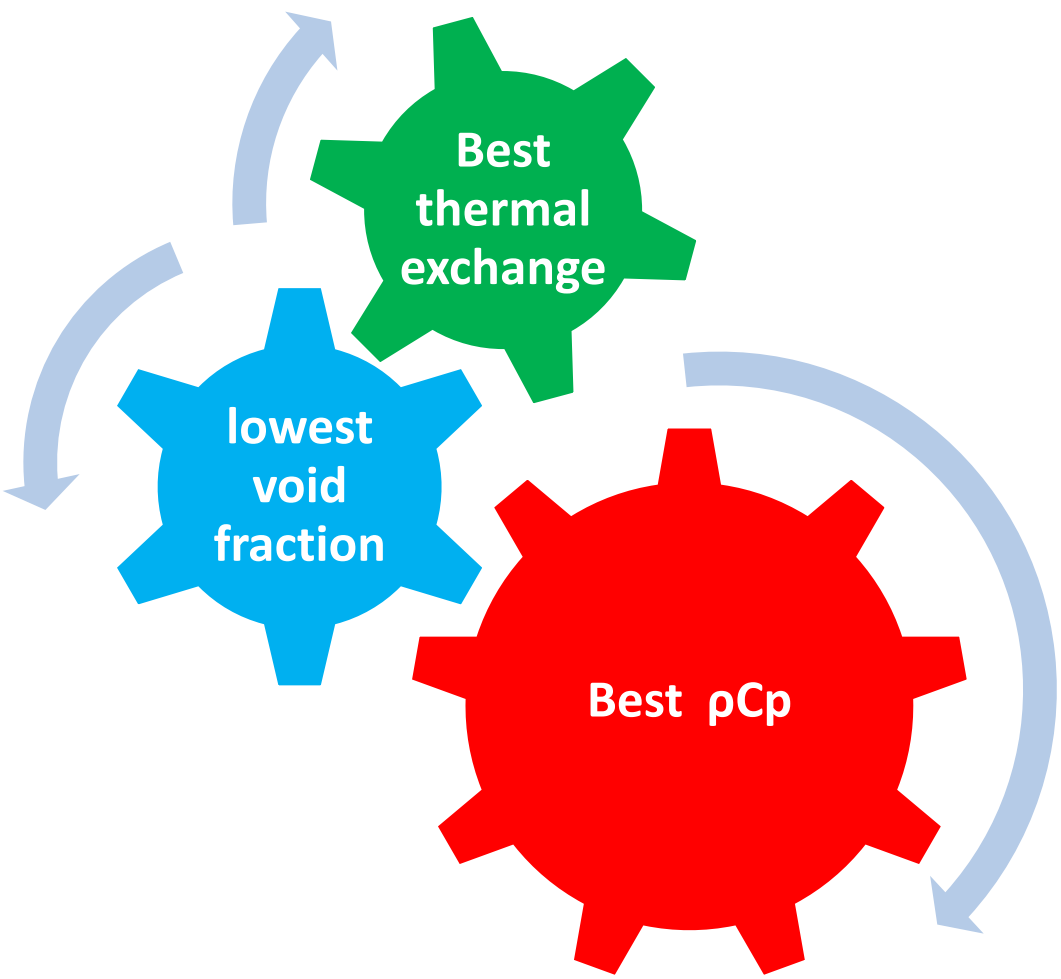
- 5 to 20 mm beads developed for sensible heat applications, for example: industrial furnaces fumes
- High thermal resistance and chemical corrosion (alumina rich products)
- High storage capacity (iron rich products)
- Other compositions or mix of different compositions also available



- Saint-Gobain extensive expertise in ceramic material science and access to several manufacturing platforms allow us to develop on request thermal energy storage media solutions to meet most demanding needs
- Customers are our main driver

➤ Past solutions investigated and main properties:

Material	Sintered Fe2O3 bricks/Gen1	Sintered Fe2O3 bricks/Gen2
Appearance		
Chemistry	Fe2O3 rich	Fe2O3
Bulk Density	2.7 g/cc	3.6 g/cc
Cp [1000°C][J/kg/K]	1100	1100
ρ.Cp [kJ/m³.K]	2970	3960
Estimated price	Reference point	x3 vs reference
	Price can be lower depending on volumes and size needed	Working on lower price with cheap recycled raw material feeds



- Development of a high performance storage media: two generations of brick shaped TES media to minimize the cost (higher efficiency for a given volume/or lower volumes for a given efficiency)
- Refractory like structure that allows high thermal shock & corrosion resistance (CSP, ACAES applications)
- Versatile process that allows use of tailored compositions
- Use of recycled materials for cost reduction