

# H2020 Theme Oriented Training NMBP

## *Examples of running H2020 projects in NMBP*

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# INTEGRAL

- **“IN**itiative to bring the 2nd generation of **ThermoE**lectric **G**enerators into industrial **ReAL**ity”

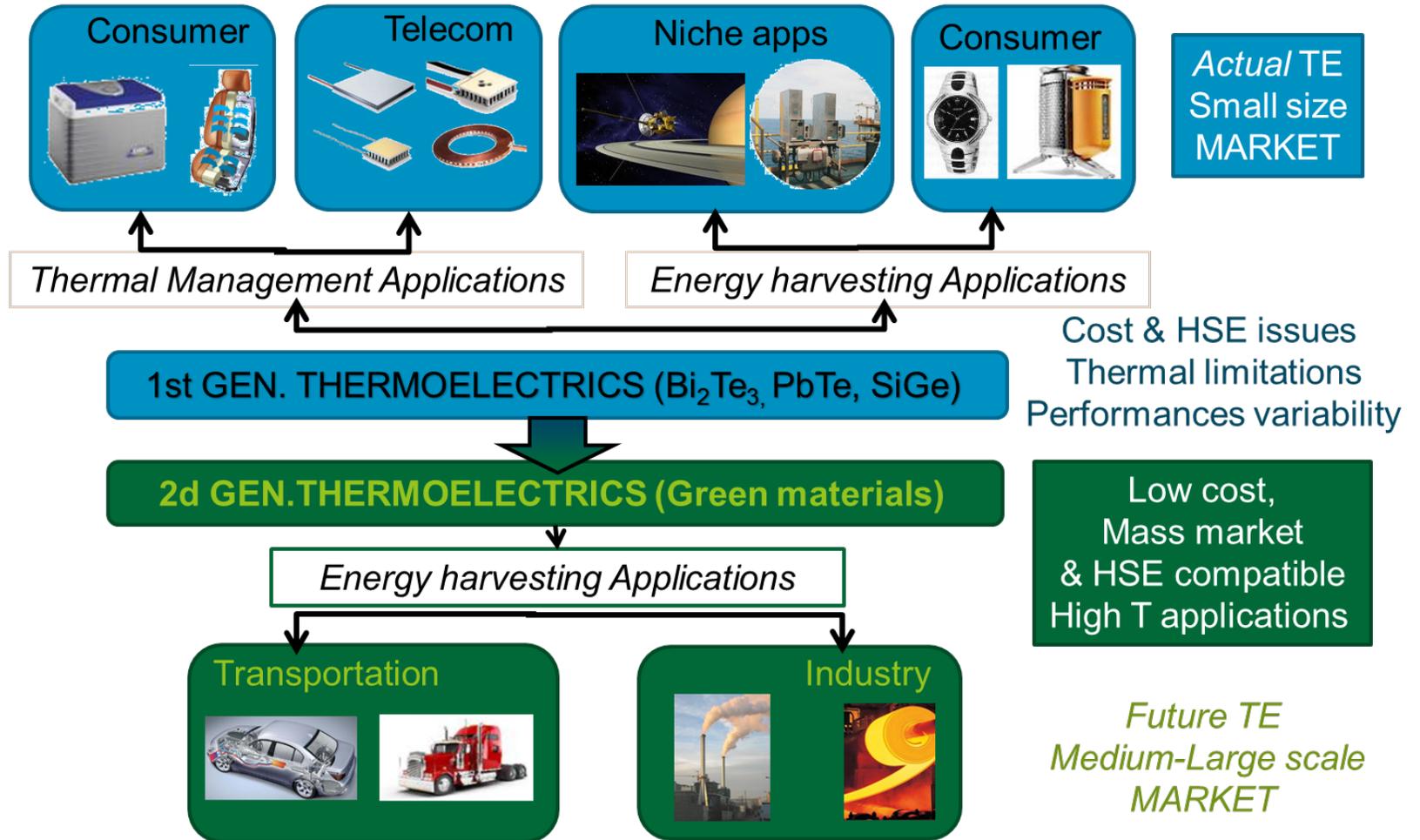


*H2020 PILOTS\_1\_ 2016: Pilot lines for manufacturing of materials with customised thermal/electrical conductivity properties*

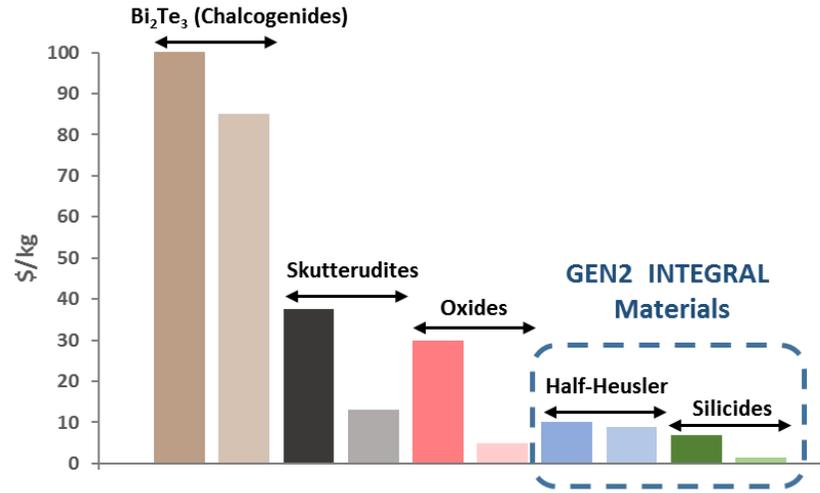


# CONTEXT AND CONCEPT

## • MARKET CONTEXT

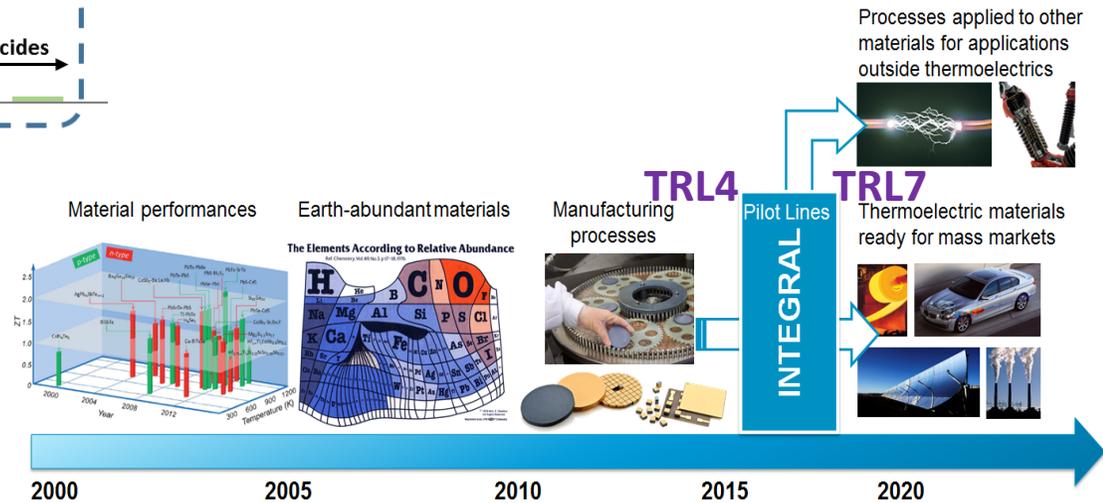


# GEN2 THERMOELECTRIC MATERIALS



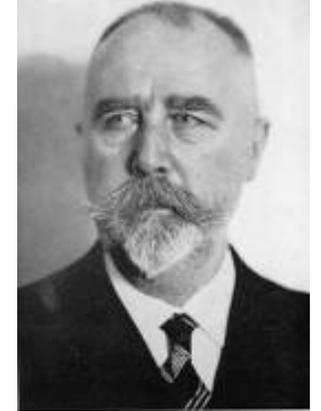
Regarding material cost **Half-Heusler** and **Silicides TE Materials** represent the best candidates for mass production for future TE market (automotive and Factory of the future) => **GEN2 TE materials !**

**INTEGRAL** is placed as the logical continuity of the previous cooperative projects funded by Europe to **increase TE material production maturity on existing pilot lines**

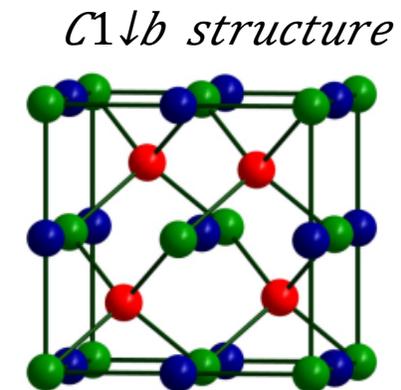


# What is a half-Heusler Material?

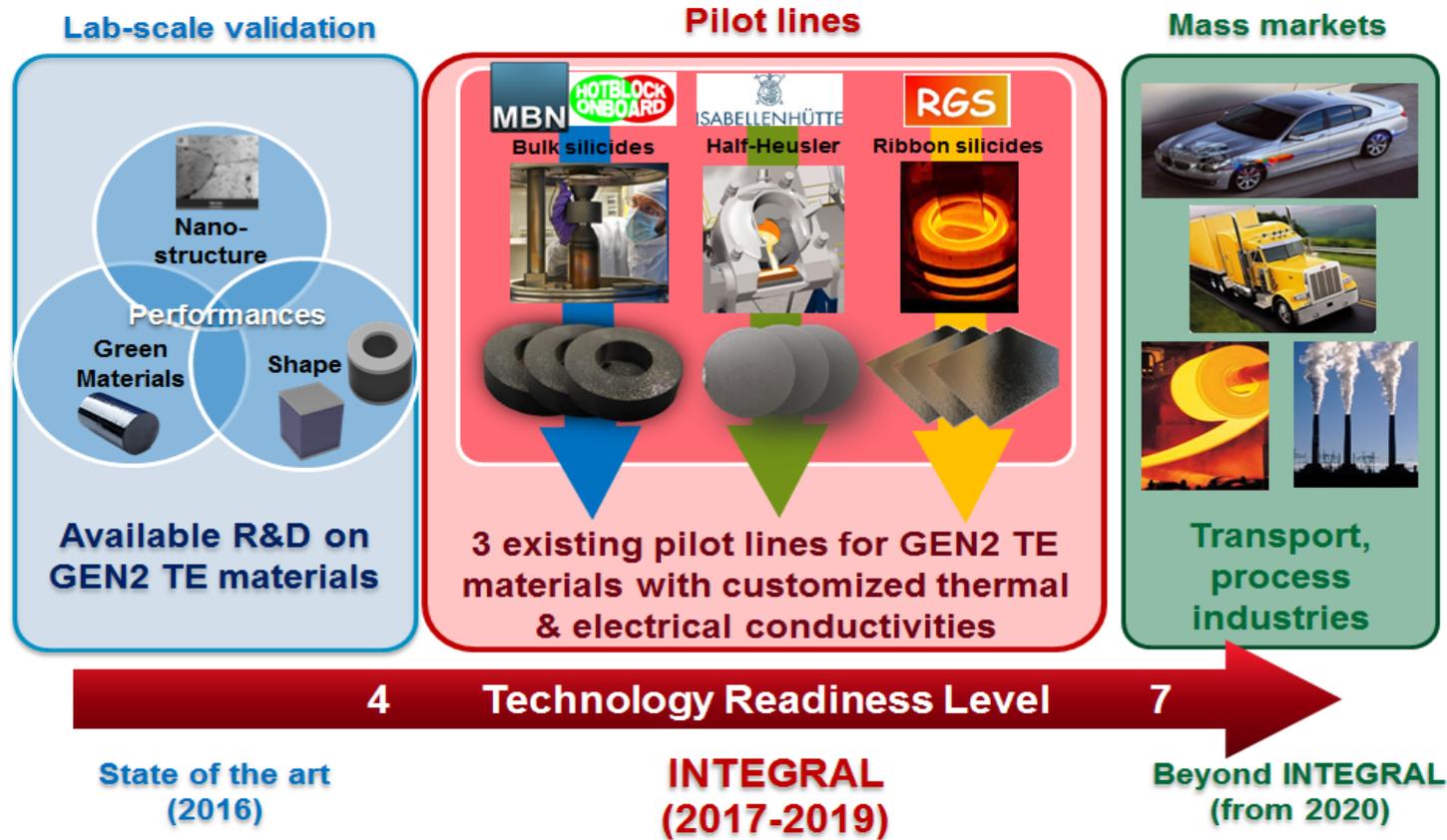
- Dr. Fr. Heusler found the material class of Heusler-Compounds in 1903 at Isabellenhütte
- Related with Heusler-Comp. are the Half-Heusler-Comp.
- Half-Heusler-Comp. are semi conducting intermetallic phases
- The chemical composition of Heusler-Comp. is **XYZ**



H																			He
Li	Be																		
Na	Mg																		
K	Ca	Sc	Ti	V	Cr	Mn	Fe	Co	Ni	Cu	Zn	Ga	Ge	As	Se	Br	Kr		
Rb	Sr	Y	Zr	Nb	Mo	Tc	Ru	Rh	Pd	Ag	Cd	In	Sn	Sb	Te	I	Xe		
Cs	Ba		Hf	Ta	W	Re	Os	Ir	Pt	Au	Hg	Tl	Pb	Bi	Po	At	Rn		
Fr	Ra																		
			La	Ce	Pr	Nd	Pm	Sm	Eu	Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu		
			Ac	Th	Pa	U	Np	Pu	Am	Cm	Bk	Cf	Es	Fm	Md	No	Lr		



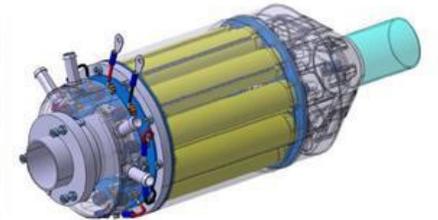
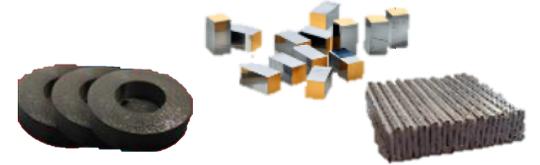
# INTEGRAL CONCEPT



The aim of the **INTEGRAL** project is to upscale the GEN2 TE material technology using existing pilot lines, in order to address mass markets (transport, process industries), and produce advanced functional materials with customized electrical and thermal conductivities

# MAIN OBJECTIVES

- Develop customized multifunctional GEN2 TE materials
- **Upscale the GEN2 TE materials fabrication processes** on existing pilot lines, from TRL 4 to TRL7
- Develop in-line real-time characterization and process control
- Demonstrate performance stability and efficiency improvement of the functionalized GEN2 TE materials
- Perform a technology transfer on the upgraded pilot lines
- Prepare the commercial deployment of new generation of advanced multifunctional materials with customized electrical and thermal properties



# CONSORTIUM

- The INTEGRAL consortium is composed of 12 complementary partners from 8 European countries with well-balanced with relevant expertise
- 3 Major GEN2 TE material providers
- 4 Industrial end-users with defined markets
- 3 RTOs focused on TE materials customization and characterization
- 1 TE powder provider
- 1 SME in innovation management

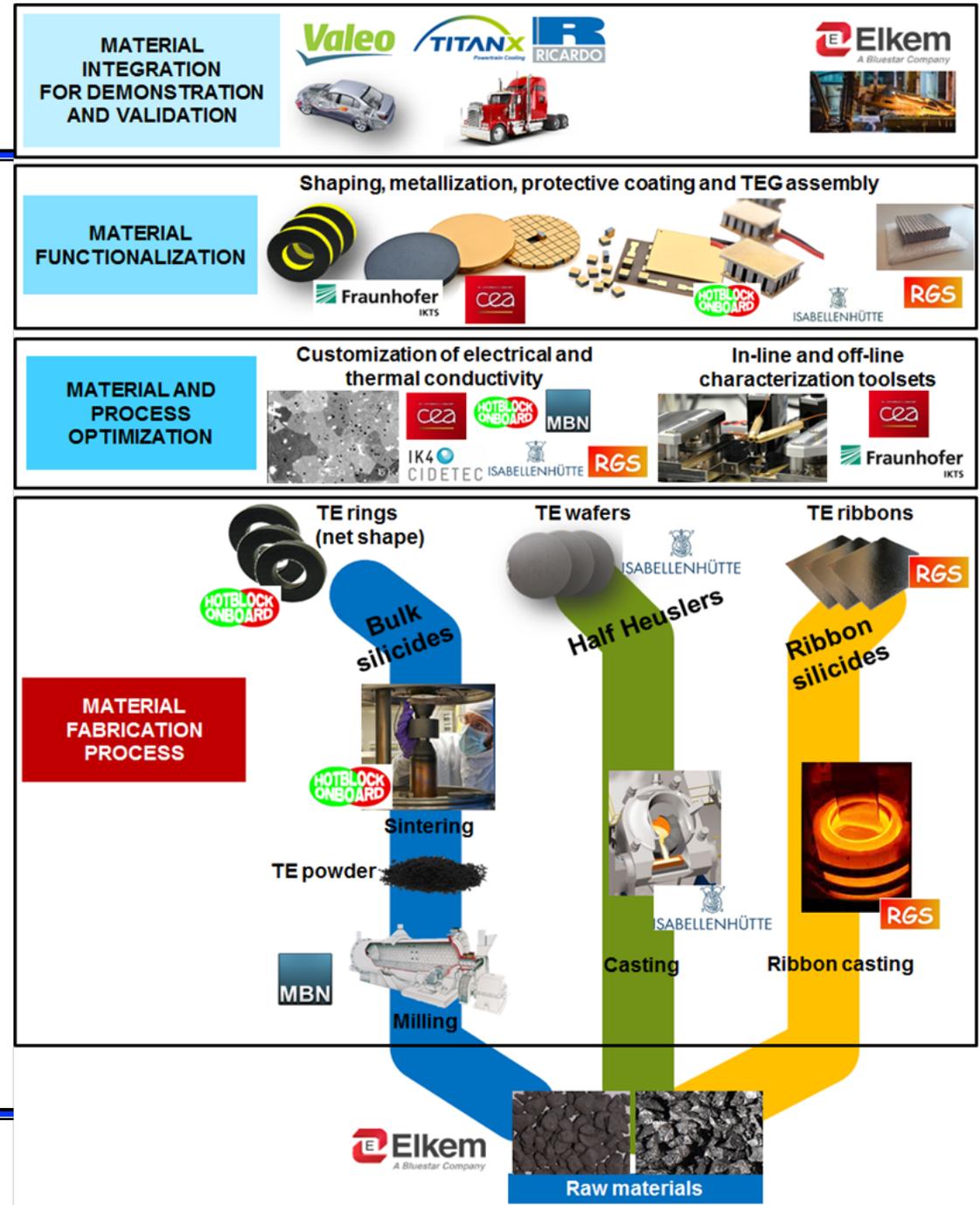


# PROJECT STRUCTURE

- INTEGRAL covers the whole value chain of thermoelectrics, from raw materials to thermoelectric generators integrated by the end-users
- Each material is dedicated to one application :

**Automotive** (VALEO-HBOB),  
**Trucks** (RICARDO-ISAB)  
**Heavy industry** (ELKEM- RGS)

- Material **customization**, **functionalisation**, off-line and in-line **characterization** are transversal to the materials/application : same strategies and common tool sets



# EXPECTED IMPACT

- **Upscale GEN 2 TE materials on existing pilot lines for massive production and mass market exploitation** – material with customized thermal and electrical properties dedicated to targeted markets (transport, process industries).
- **Production processes and process control will be improved**, lowering the loss and waste of materials at pilot lines of RGS, ISAB and HBOB - Rise up the production capability of companies in Europe and meet the potential market needs in aimed mass markets (transport, process industries).
- **Cost reduction, environmental and safety legislations** - GEN2 TE materials are based on abundant, eco-friendly and low-cost elements
- **Target applications outside of the field of thermoelectricity** - Permanent magnets, high-voltage insulators, photovoltaic, batteries, spintronic, magneto caloric => **Industrial workshops** will be held during the project to determine new potential markets

# EXPECTED GENERAL IMPACT AT EU LEVEL

- **Improving Innovation Capacities and Integration of new Knowledge**

- Transport : limit the use of alternators and dedicated ancillary diesel generators or auxiliary sets => Expected Fuel consumption reduction 3%
- Process industry: TE is a reliable solution for Industrial process harvest wasted heat to improve energy and process efficiency
- Autonomous sensors and IoT: power sources for autonomous sensors and connected devices (internet of things), for (metallurgy, process industry, power generation industry). TEG technology will replace batteries and allow long lifetime wireless device networks.

- **Environmental and Social Impacts**

- Address new mass market using green GEN2 TE material
- Applications contribute to reduce CO<sub>2</sub> emissions (Energy harvesting and improve process efficiency)

- **Regulations and Standards Framework Conditions**

- INTEGRAL will create a sustainable and green chain of TE material and process compliant with the market, compliant with REACH and RoHS
- LCA of all processes and HSE study to ensure the correct working conditions of their employees
- INTEGRAL will significantly contribute to establish standards in the TE industry



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INTEGRAL Coordinator

<http://liten.cea.fr/cea-tech/liten/Pages/actualites/Kick-off-Meeting-INTEGRAL-Project.aspx>