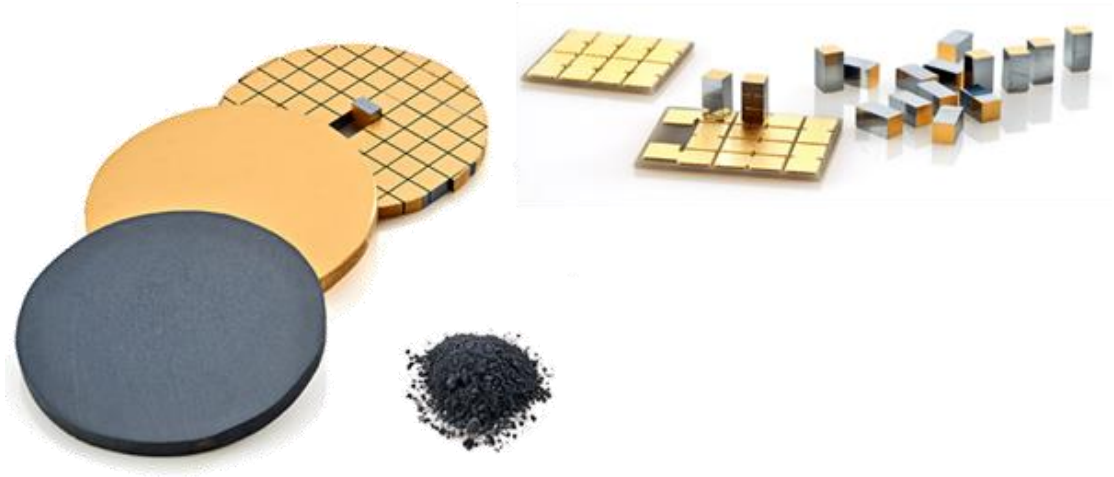
liten
cea tech



NANOMATERIAL TECHNOLOGIES DIVISION (CEA LITEN)

NANOSPAIN_2017 "Nanotechnologies and Advanced Materials Pilot Projects Test-beds for industry and private investments"

8 March 2017 *San Sebastián*

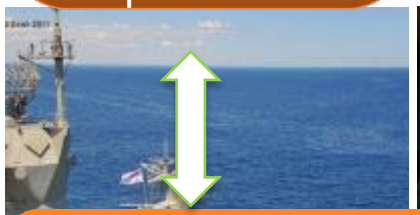
Marina Urbina/ CEA LITEN/DTNM

- **CEA AT A GLANCE:**
- **FROM ATOMIC RESEARCH TO RENEWABLE ENERGY**

TECHNOLOGY

SCIENCE

Defense Applications Division	Nuclear **Energy Division**	Technology **Research Division**
French strategic independance	French Energy **independance**	**French Competitivness**



Fundamental Research

Material Science Division/ Life Science Division

16 000 employees
4 B€ Annual Budget
580 Patents per year
120 new high tech companies since 1984

cea tech

4 500 employees
550 M€ Annual budget
500 patents/year
50 new high tech companie

- list
- leti
- liten

new energy technologies and nanomaterials

Our aim:
« Speed up technology transfer »

• A MULTIDISCIPLINARY APPROACH TO R&D: A VIRTUOUS CIRCLE

2005 - Grenoble / Chambéry

Staff 1 100 - 140M€

new energy technologies and nanomaterials

liten

Exploit Liten's extensive technological portfolio and access complementary technological solutions via CEA-tech

list

software-intensive systems

Staff 800 - 70 M€

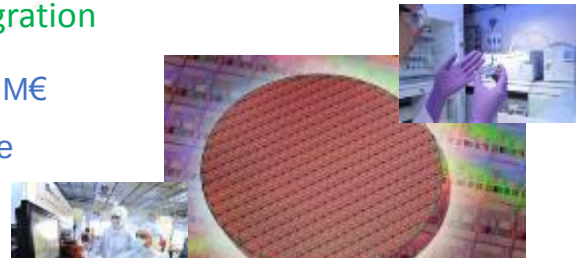
2003 - Paris Sud

leti

micro-nanotechnologies and system integration

Staff 1 800 - 240 M€

1967 - Grenoble



• LITEN MANDATE: MIXING INDUSTRIAL COMPETITIVENESS WITH ENVIRONMENTAL RESPONSIBILITY

Contribute to national and European climate Plans

Contribute to energy independency

Support industry through key enabling technologies integrated in systems

3 KEY DRIVERS

ENERGY EFFICIENCY & LOW CO2	RENEWABLE & LOW CARBON ENERGY	MATERIALS
▪ Energy harvesting ▪ Efficiency in Buildings ▪ Efficiency in Manufacturing ▪ Clean Transportation ▪ Smart grids	▪ Photovoltaics ▪ Solar thermal & thermodynamic ▪ Biomass & biogas ▪ Hydrogen	▪ Abundant & non toxic materials ▪ Low energy processes ▪ Recycling ▪ Life cycle analysis

• LITEN : KEY FIGURES

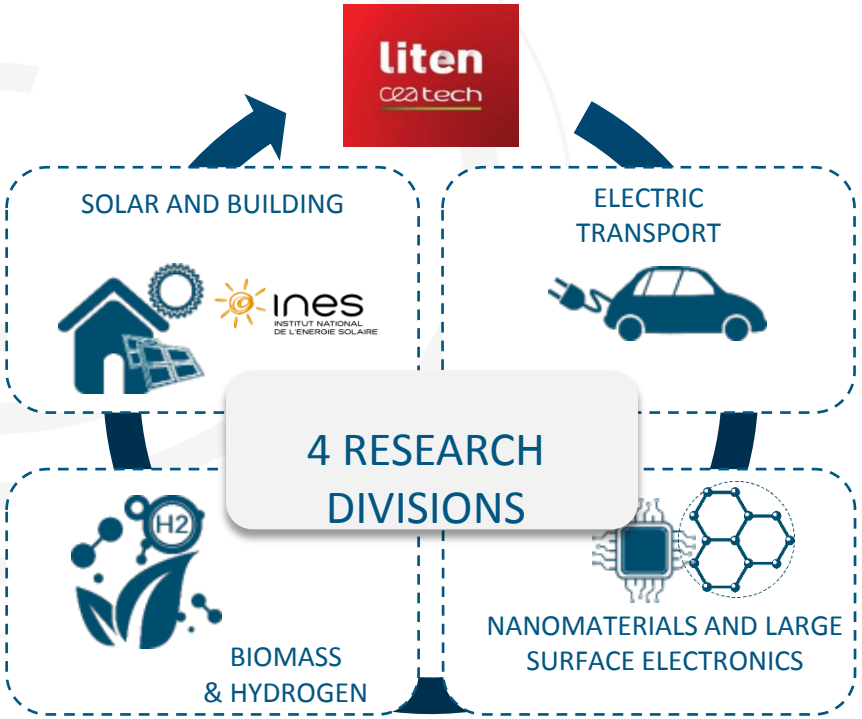
1000 researchers
- 2/3 permanents
- 30% of staff/industrial backgrounds
- 42 y old average

Almost 1300 patents
- 250 generated in 2015

> 350 industrial partners

140 M€ budget

Research contracts
- 40% Institutional
- 60% Industry



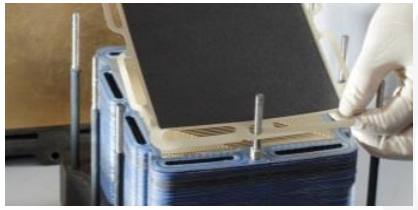
• OUR PLATFORMS

HYDROGEN PRODUCTION AND STORAGE PLATFORM 40 researchers & technicians
6 million € investment

NANO CHARACTERISATION
80 researchers & technicians
30 million € investment

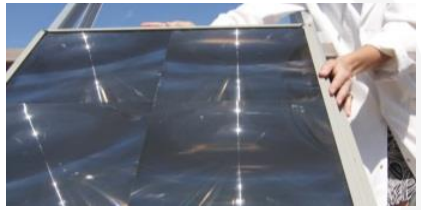
BIOMASS
40 researchers & technicians
7 million € investment

BATTERIES
200 researchers & technicians
40 million € investment



FUEL CELL PLATFORM
40 researchers & technicians
6 million € equipment

ELECTROMOBILITY
20 researchers & technicians
4 million € equipment



SOLAR PHOTOVOLTAICS
200 researchers & technicians
100 million € equipment

SMARTGRID
30 researchers & technicians
2 million € investment

THERMAL SYSTEMS
75 researchers & technicians
15 million € investment

POWDER METALLURGY
20 researchers & technicians
5 million € investment

ENERGY MICROSOURCES
40 researchers & technicians
20 million € investment

LARGE SURFACE PRINTED ELECTRONICS
50 researchers & technicians
8 million € investment

• VERTICAL INTEGRATION: THE VALUE CHAIN

FIRST INDUSTRIALIZATION

DEMONSTRATION

SYSTEM INTEGRATION

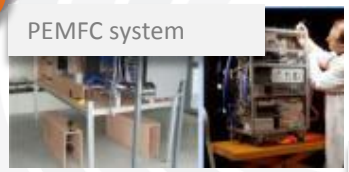
COMPONENTS

PROCESSES

MATERIALS

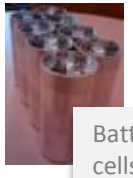
Alsolen: 500 KW Fresnel Concentrated Solar Power

Integration of CEA technologies
15 KWh Li Battery+ 25 kW PEMFC
+ 10,5 kg H2 ~350 kWh



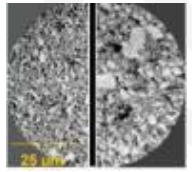
PEMFC system

Solar cells

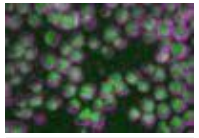


Batteries cells

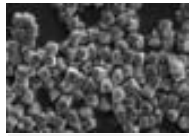
Solar charging station and micro grid



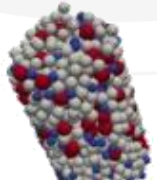
X rays Nanotomography of ceramic cells



Fuel cell catalyst



Powder for batteries



Atomic scale modelling of hybrides

NANOMATERIAL TECHNOLOGIES DIVISION: KEY FIGURES

Patents

66 new patents in 2015

More than 2 pat./M€ budget

Manpower 2015

230 people

75% permanent staff

R&D Platforms

3 Worldclass Facilities

- Powder metallurgy
- Printed Electronics
- Nano Materials synthesis

Budget 2015: 30M€

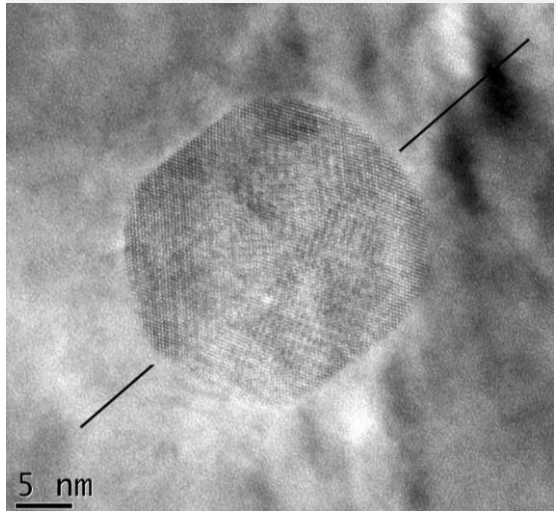
24 M€ turnover (80%)

6 M€ of CEA Funding (20%)

NANOMATERIAL TECHNOLOGIES DIVISION

A DIVISION FOCUSED ON THREE CORE AREAS

NANOMATERIAL ELABORATION



MATERIAL EFFICIENCY AND ENERGY RECOVERY

COMPONENTS FOR MOBILE DEVICES AND PRINTED ELECTRONICS

liten
cea tech

Commissariat à l'énergie atomique et aux énergies alternatives
17 rue des Martyrs | 38054 Grenoble Cedex
www-liten.cea.fr

Établissement public à caractère industriel et commercial | RCS Paris B 775 685 019

INTEGRAL

"INitiative to bring the 2nd generation of ThermoElectric Generators into industrial ReALity"

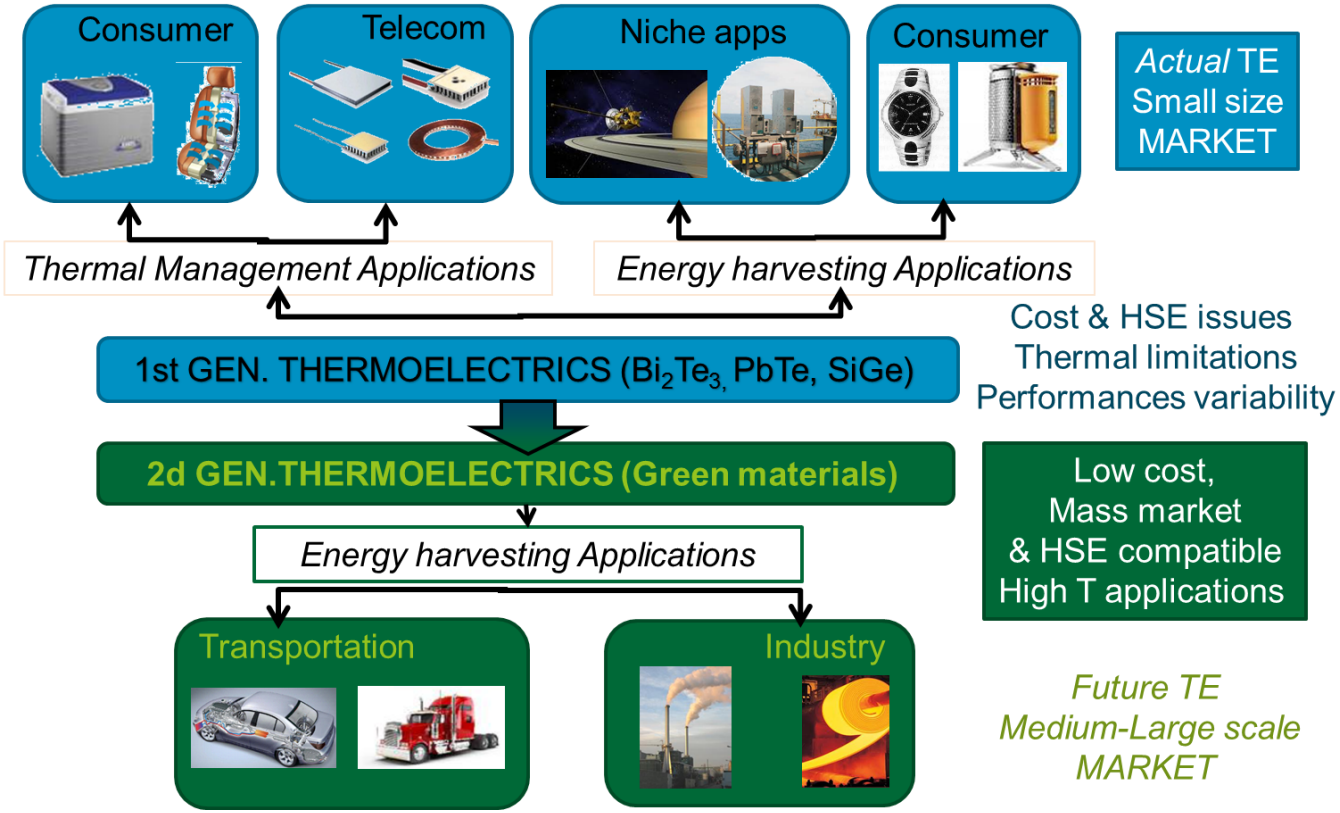
H2020 PILOTS_1_ 2016: Pilot lines for manufacturing of materials with customised thermal/electrical conductivity properties

Summary

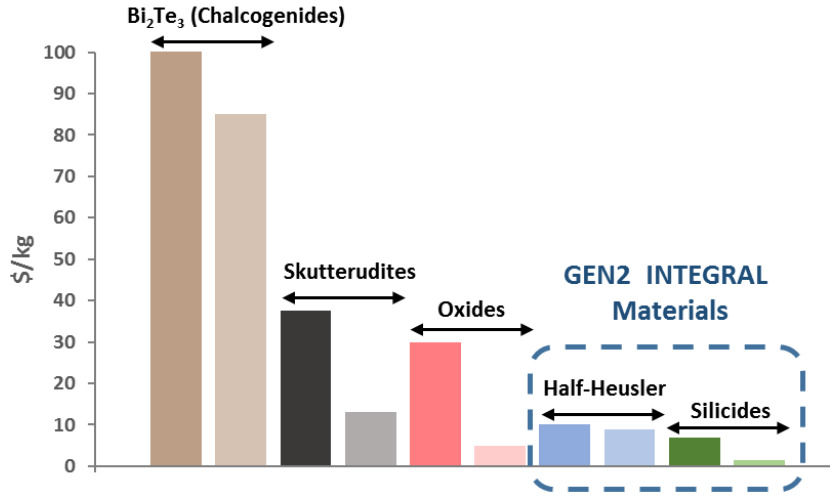
1. CONTEXT AND CONCEPT
2. MAIN OBJECTIVES
3. CONSORTIUM
4. PROJECT STRUCTURE
5. EXPECTED IMPACTS

CONTEXT AND CONCEPT

- MARKET CONTEXT

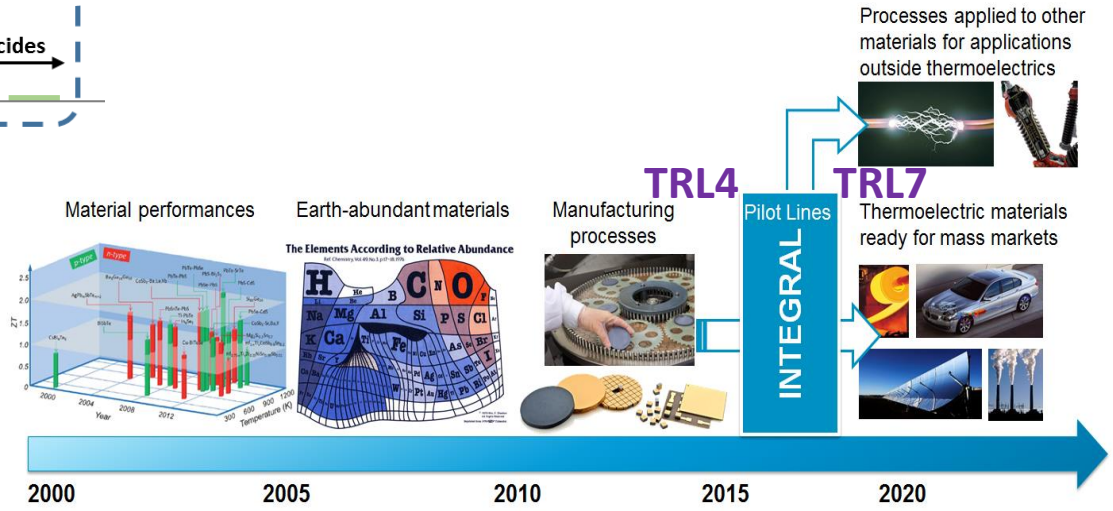


GEN2 THERMOELECTRIC MATERIALS



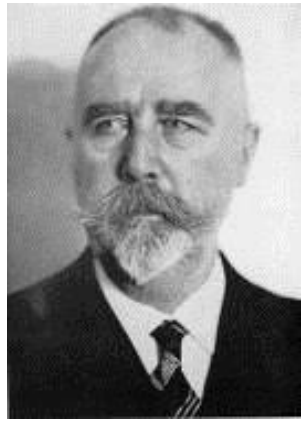
Regarding material cost **Half-Heusler** and **Silicides TE Materials** represent the best candidates for mass production for future TE market (automotive and Factory of the future) **=> GEN2 TE materials !**

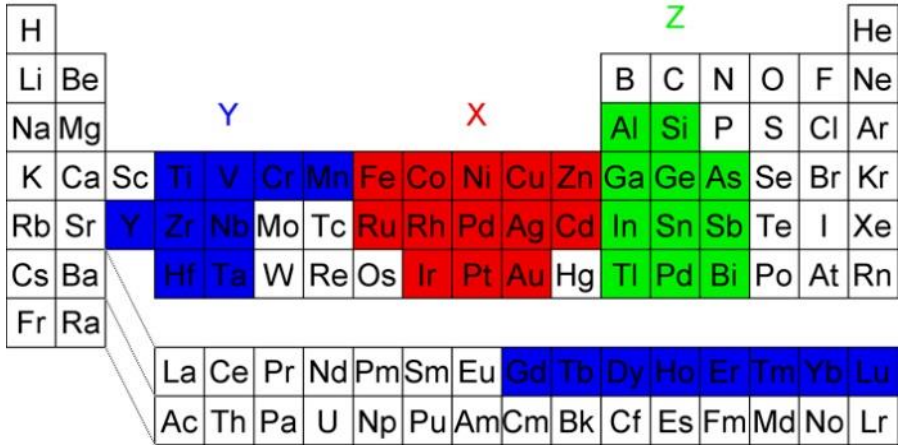
INTEGRAL is placed as the logical continuity of the previous cooperative projects funded by Europe to **increase TE material production maturity on existing pilot lines**



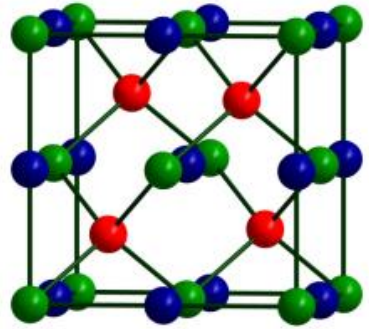
What is a half-heusler Material?

- 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 $\boldsymbol{XYZ}$

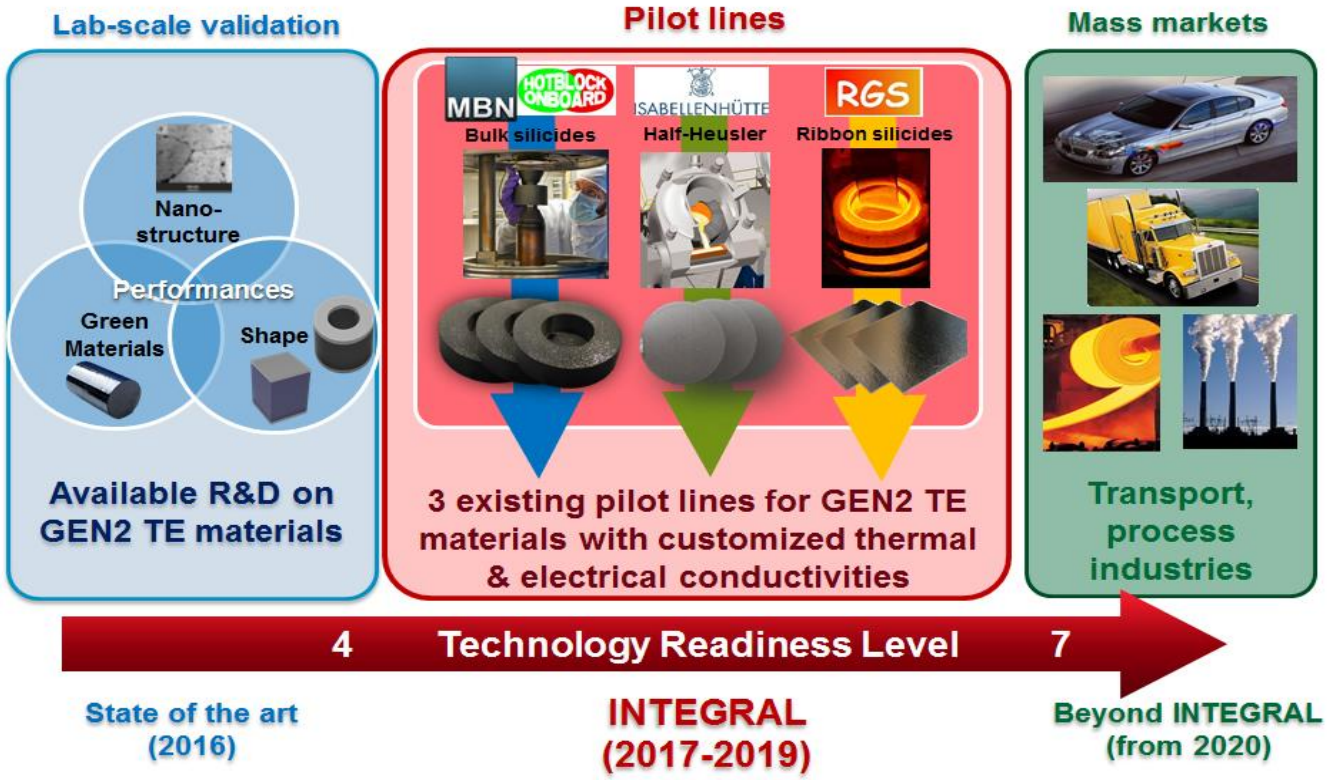




$C1_b$ *structure*



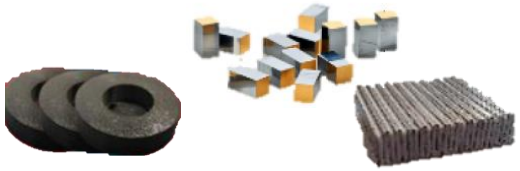
INTEGRAL CONCEPT

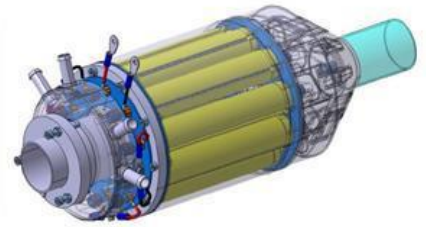


The aim of the **INTEGRAL** project is **to upscale** the GEN2 TE material technology using existing pilot lines, in order to address mass markets (transport, process industries), and produce advanced functional materials with customized electrical and thermal conductivities

MAIN OBJECTIVES

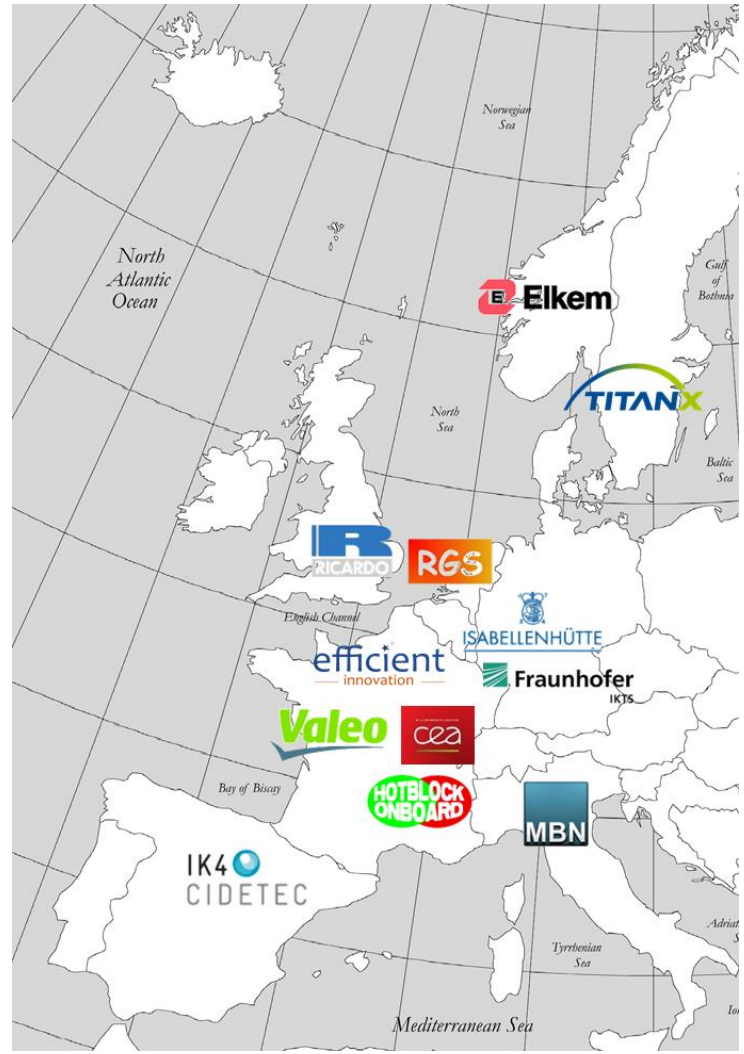
- Develop customized multifunctional GEN2 TE materials
- **Upscale the GEN2 TE materials fabrication processes** on existing pilot lines, from TRL 4 to TRL7
- Develop in-line real-time characterization and process control
- Demonstrate performance stability and efficiency improvement of the functionalized 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

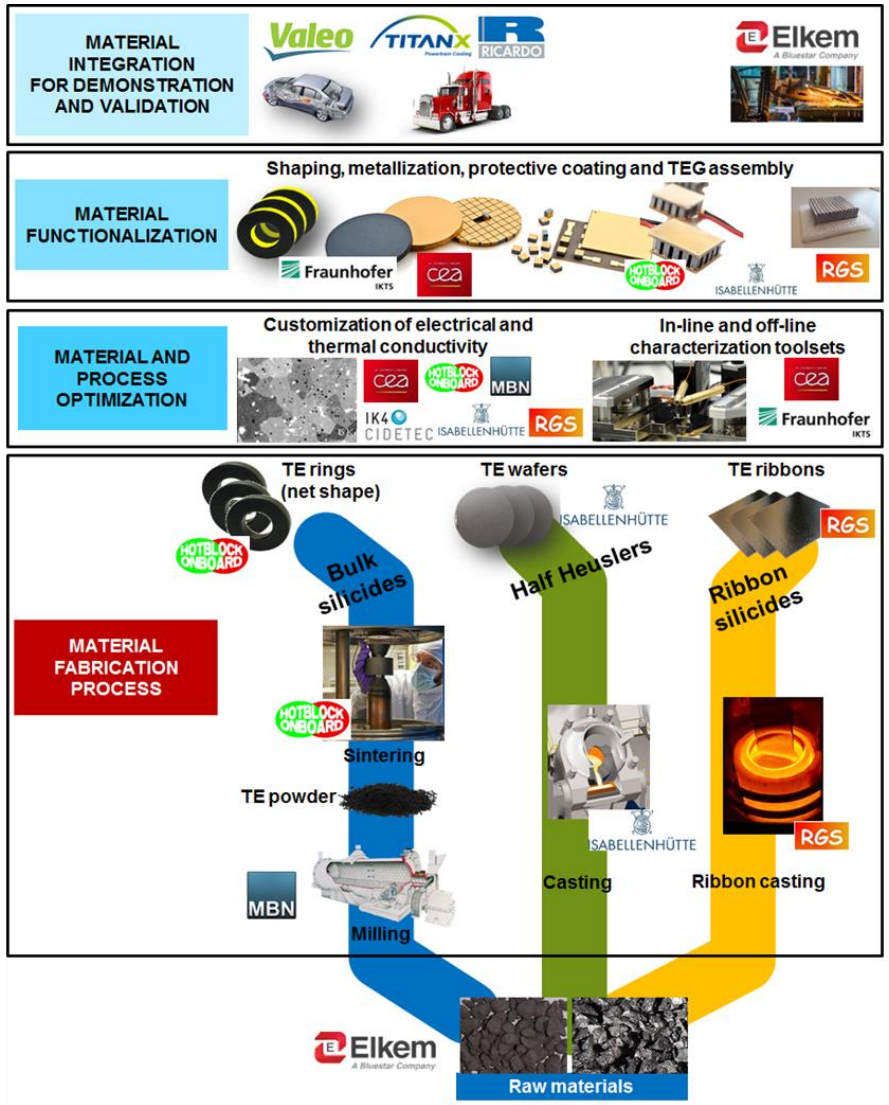


PROJECT STRUCTURE

- 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 calorie => **Industrial workshops** will held during the project to determine new potential markets

EXPECTED GENERAL IMPACT AT EU LEVEL

- **Improving Innovation Capacities and Integration of Knew 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_2 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

Thank you for your attention

For more information:

Dr. Jean-Yves Escabasse (Jean-yves.ESCABASSE@cea.fr)

INTEGRAL Coordinator

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