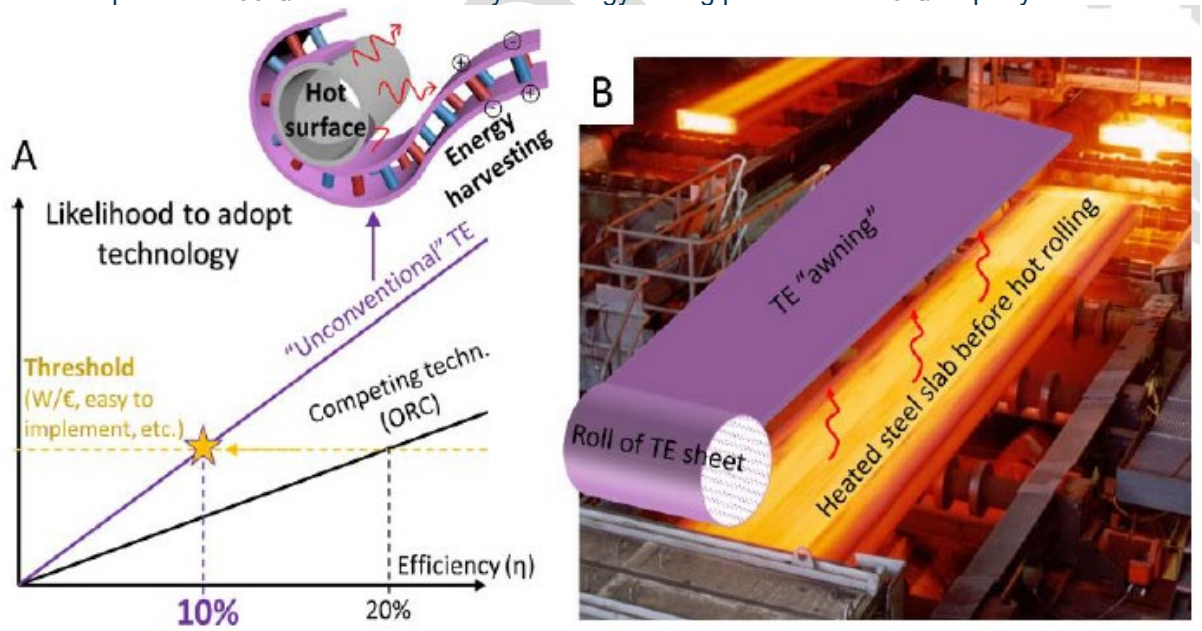
Abstract FLEXTEG

Flexible 3D printed thermoelectric generators for energy harvesting, full cSBO with a proposed starting date on 1 January 2022 and a proposed duration of 48 months, with partners KU Leuven and VITO.

Thermoelectric materials (TEMs) are perfect candidates to harvest waste heat because they can transform it directly into electrical energy. **Compared to competing technologies such as Stirling or Organic Rankine Cycle (ORC), TEs have similar cost, i.e. ~3.5 €/W**, but they present competitive **advantages related to their solid-state nature** by virtue of the absence of any moving parts or working fluids: **compactness**, **lightweight, portability**, and **superior lifetime** and **reliability** with **zero maintenance**. Until now, the widespread use of TEs for large-scale energy harvesting has been precluded by 3 hurdles: **1)** their efficiency remains lower than competing technologies; **2)** their fabrication process is cost-inefficient; and **3)** their traditional form factor is limited to small and rigid devices.

With our proposed 3D printing (3DP) technology using proven TEMs, we address these challenges in the following way: **1)** 3DP allows microstructure optimization and thus potential **efficiency increase**; we target an efficiency of 12%, 2) 3DP will **reduce production costs** by material usage minimization and efficient fabrication, enabling a 1-step deposition / patterning / integration process, 3) 3DP allows to produce **large-area TE modules on a flexible and/or rollable substrate**, which increases the application potential enormously. Our targeted TE modules can be integrated in any industrial process and on any flat or curved surface where heat is wasted, e.g. in the steel and cement production, chemical or food industry, but also in combination with solar panels, heating systems or phase change materials. It is this **combined benefit of lower costs and tremendous versatility** of the application range that shall provide a competitive edge of TEs over existing solutions. At the same time, ubiquitous and uninterrupted energy harvesting on a large scale will offer a substantial energy saving potential, and thus CO_2 reduction potential, for the companies that apply it. For a representative ΔT of 40 K, we estimate the CO_2 emission reduction to be ~1/4 ton per year and m_2. Assuming a price of 3.5 €/W of installed TEs, the estimated priced of 438 €/m² is balanced by an energy saving potential of 219 €/m² per year.



Efficiency alone is not enough to evaluate the suitability of a technology. Other factors such as installation and maintenance costs, adaptability or durability are equally important. Hence, unconventional (printed and flexible)TEs can compete with more efficient technologies, such as ORC, which involves bulky, expensive, and hard-to-maintain equipment. These unconventional TEs will enable heat recuperation by adapting to hot curved surfaces(like pipes)or be installed above hot surfaces like awnings, adapting optimally to the thermal gradient.

For substantive questions about this project proposal, please contact MOT4 representative Jeroen van Walsem (jvanwalsem@catalisti.be; +32 497 731 175).