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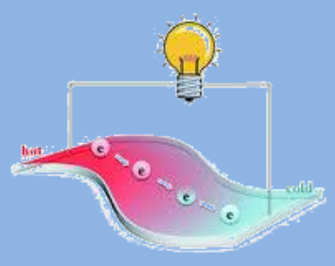

Waste heat recovery with thermoelectrics

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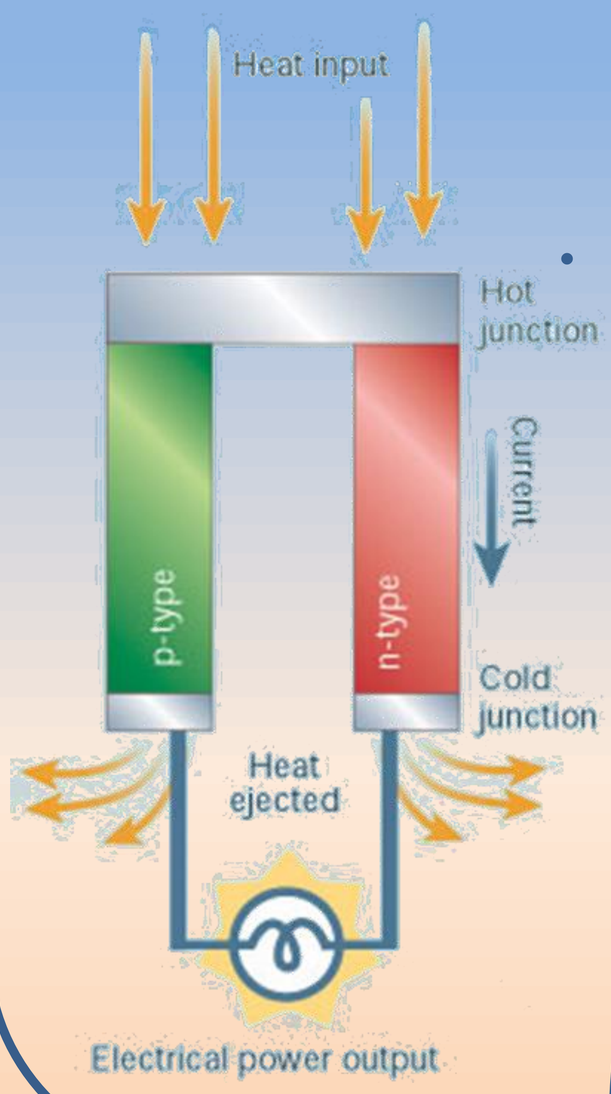
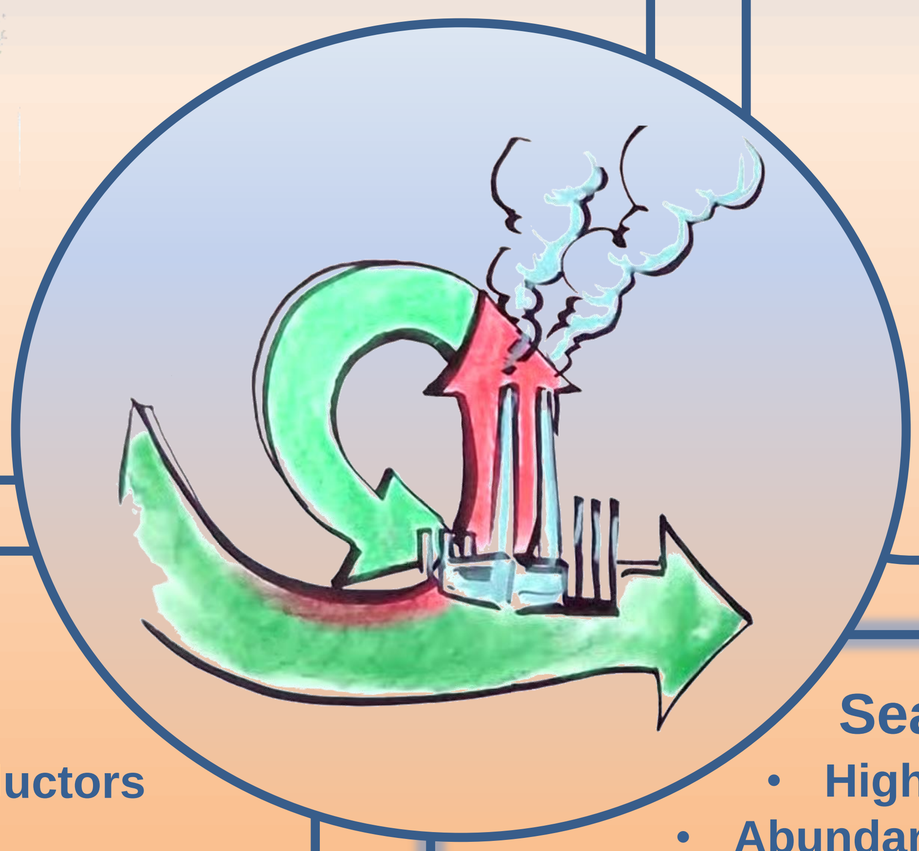
Overview

Everyday a huge fraction of the heat we produce for power generation, energy conversion or heaters is emitted into the atmosphere as waste heat and irrevocably lost. Utilization of waste heat is seen to strongly boost overall efficiency of many energy conversion technologies and provide cleaner forms of energy. Thermoelectric generators (TEGs) are able to directly convert heat into electric energy without the need of moving parts or maintenance.

The principle:

- A thermo electric material will built up a voltage when exposed to a temperature gradient
- N- and p-type thermoelectric materials are connected electrically in series and thermally in parallel



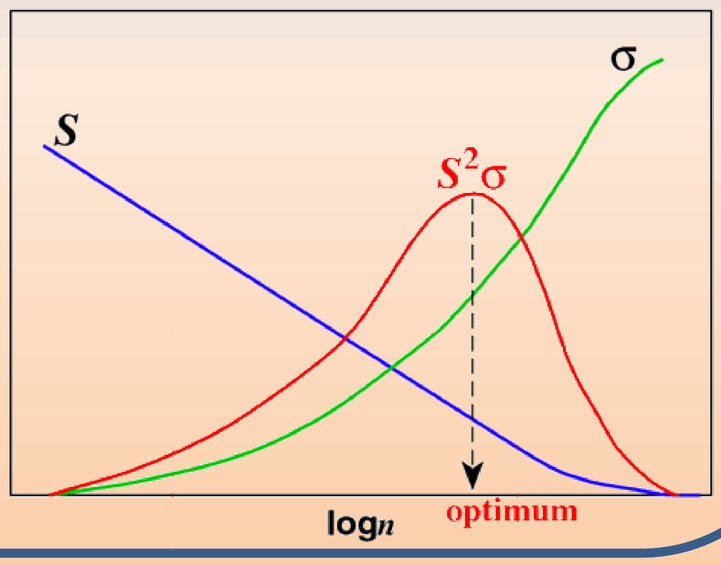


What is a good thermoelectric material?

- High seebeck coefficient (Voltage per temperature difference) (S)
- High electrical conductivity (σ)
- Low thermal conductivity (K)

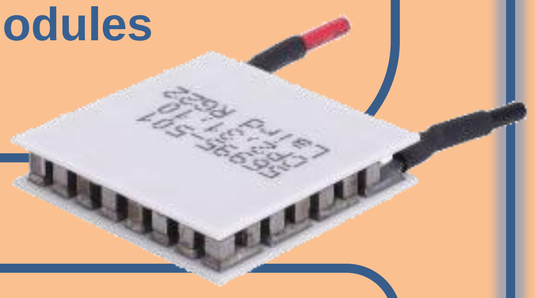
➢ Maximize the figure of merit

$$ZT = \frac{\sigma S^2 T}{K}$$



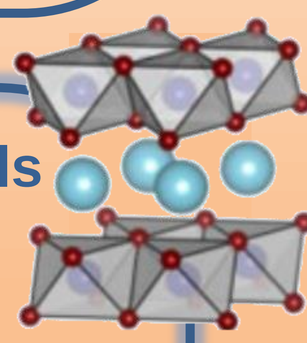
State of the art:

- Intermetallic semiconductors
- Toxic materials
- Expensive
- Low temperature stability
- Only rectangular modules

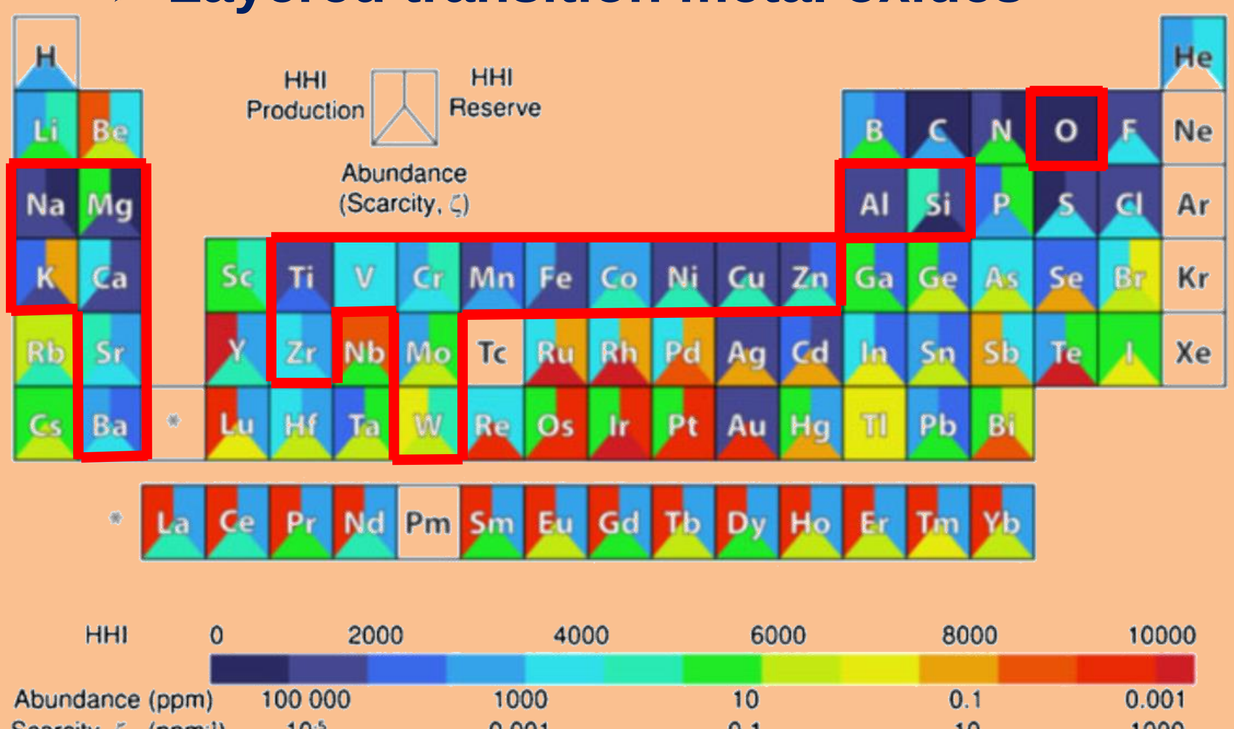


Searching for new materials

- High temperature stability
- Abundant and cheap



➢ Layered transition metal oxides



- Kieslich, Gregor, et al. "A chemists view: Metal oxides with adaptive structures for thermoelectric applications." *physica status solidi (a)* (2016).
- Ohtaki, Michitaka. "Oxide Thermoelectric materials for heat-to-electricity direct energy conversion." *Kyushu University Global COE Program Novel Carbon Resources Sciences Newsletter* 3 (2010).

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