

Superconductors and the energy sector: the perfect match?

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By carrying very high direct current densities without losses, superconductors offer a lot of opportunities in the field of energy. A fusion reaction provides the huge energy of the sun. So fusion is one of the extremely promising way for energy production in the future with abundant fuel resources. A viable fusion machine inevitably uses superconductors to magnetically confine the plasma. In the field of electric networks, a critical infrastructure in our societies, superconductors bring a breakthrough, the fault current limitation, which enhances the supply security and the voltage quality, two real today needs and demands. Superconducting cables bring large opportunities for the electricity supply of metropolis thanks to their increased power capacity compared to conventional cables. A superconducting cable can be favourably coupled to liquid hydrogen transportation. Furthermore the absence of Joule losses in superconductors makes them natural materials for sustainable development, CO₂ emission reductions and energy savings.

However superconductors should meet some requirements in order that superconducting applications become real products. The most severe constraint to use superconductors is to keep them at low temperatures: otherwise they show Joule losses. The high critical temperature superconductors (HTS) have the main characteristic to possibly operate at much higher temperatures compared to the superconductors used at present. So the HTS have removed the cryogenic bottleneck even if cryogenics still remain often an issue in term of investment cost. The main challenge is now to provide a high performance low cost HTS wire. Present developments around the YBaCuO coated conductors are very encouraging.

The state of the art of the superconductors and their application in the energy sector will be presented.