High Temperature Superconductivity Application Readiness Map – Energy Delivery

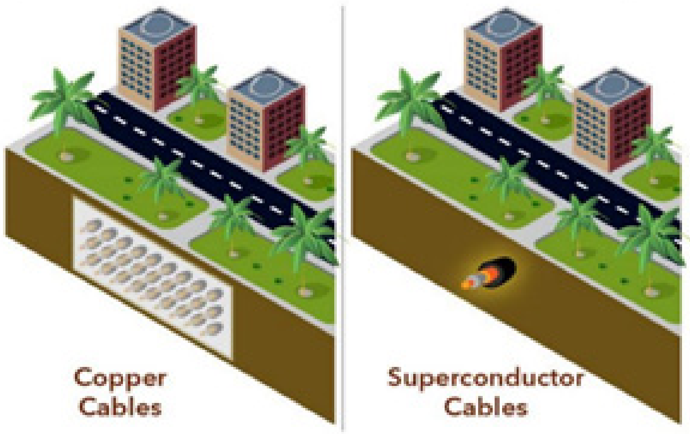
The International Energy Agency's High Temperature Superconductivity Technology Collaborative Program (IEA HTS TCP) analyzed energy delivery applications for HTS. The product was a Readiness Map that illustrates the Technology Readiness Levels (TRL) over time of HTS applications.

The dependence on the electric power system is becoming more important than ever to supply our residential, commercial and industrial sectors. To this end, new technologies and tools are being developed to provide a more reliable, flexible, resilient and secure generation, transmission, and distribution system. High temperature superconductivity (HTS) is one of the technologies that has the potential to do this.

Superconductivity is a phenomenon that causes certain materials, at low temperatures, to lose resistance to the flow of electricity. The lack of resistance enables a range of technology applications such as high-capacity power cables, fault current limiters, high-efficiency generators for offshore wind turbines, and innovative energy storage and transformer solutions. Not only do superconductor-based devices provide improvements over conventional electric grid technologies, but they also offer unique alternatives to system challenges that cannot be addressed utilizing conventional solutions.

Examples of these HTS benefits include:

- HTS cables can carry much larger levels of power than conventional cables for the same underground cross-section and right-of-way.
- Many of the world's utilities are coping with increasing fault (short-circuit) currents, possibly requiring new substation circuit breakers. An HTS fault current limiter (FCL) can help manage increasing fault currents more cost-effectively and reduce losses by at least 50% in solid-state FCLs and at least 90% in fault-current-limiting reactors.
- Energy storage can increase the utilization of renewable resources and improve power quality. Superconducting Magnetic Energy Storage (SMES) has several advantages over other storage technologies, including rapid response times, nearly infinite charge/discharge cycles without degradation, and very high round trip efficiency.



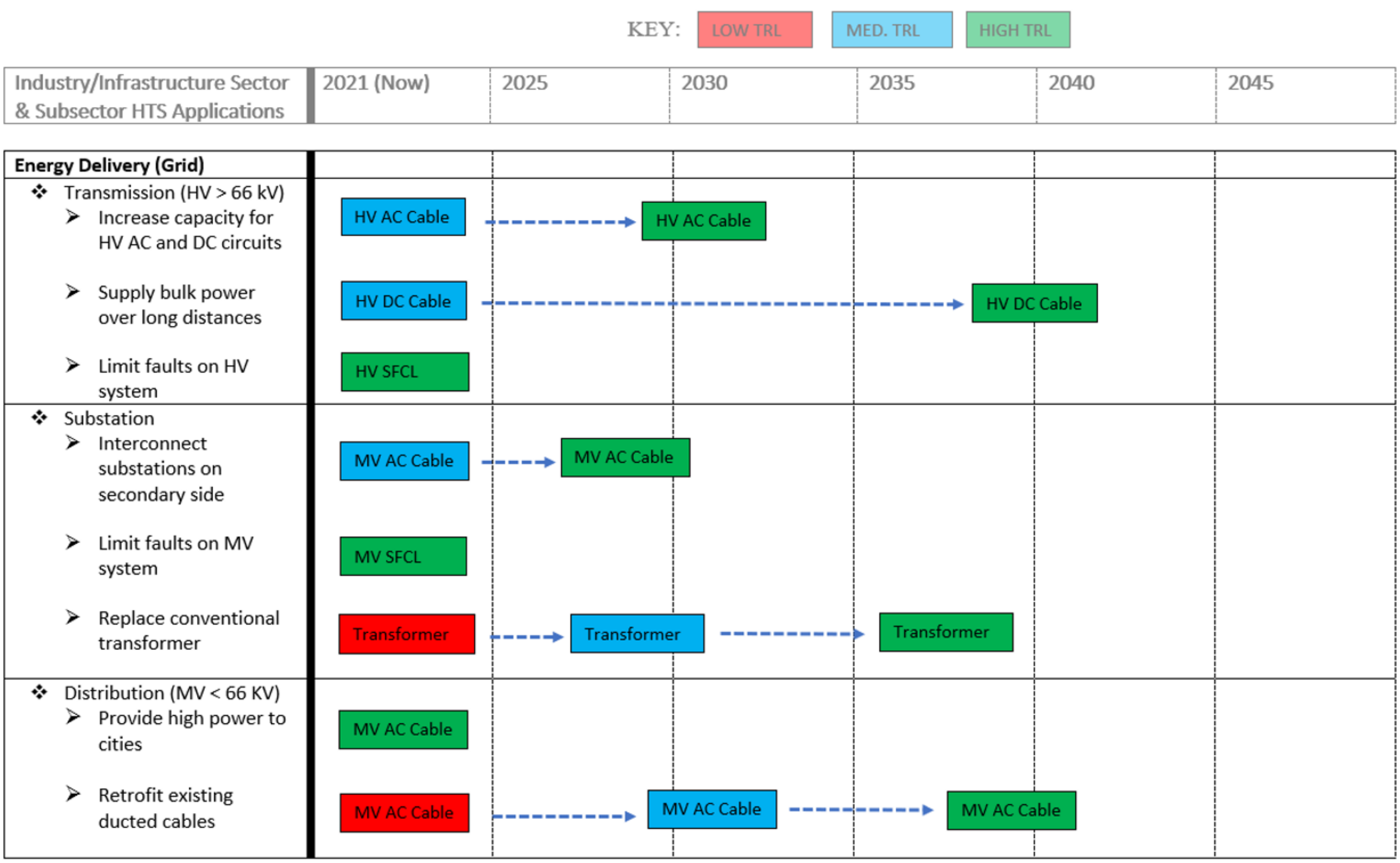
Superconducting cables can replace many conventional cables and transfer transmission power at distribution voltages

A link to the entire Technology Readiness Map document and more information about the IEA HTS TCP can be found at www.ieahts.org

Definitions of the TRL levels are found in the figure on the right.

The figure below shows the TRL levels of various transmission, substation and distribution applications in the energy delivery sector. For each of the applications, the TRL for today and future were determined by using the input of industry experts. Factors influencing technology readiness include:

- Underlying scientific/engineering maturity (e.g., HTS wire design; cabling technology)
- Potential for ongoing R&D of component technologies (e.g., existing or planned research activities; institutional support; etc.)
- Specific application readiness (e.g., maturity of HTS AC cable design; user need for non-conventional solutions)



HTS cables and fault current limiters have a very high TRL level and are available for purchase in the market. HTS based transformers are still in the research and development phase.