Power transformers can drastically reduce energy loss compared to conventional transformers

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A transformer developed by the Robinson Research Institute, currently in factory testing in Christchurch, has successfully handled top current capacity—1390 amps—and measurements show the energy losses were half that of a conventional transformer.

This demonstrated efficiency and reliability of HTS systems means they are an attractive alternative to current technologies, says Robinson's HTS transformer science leader Dr Mike Staines.

"The world's shift from fossil fuels to renewable generation, the need for greater control of power flow and customer needs are driving the new electricity technologies. Some of these new technologies will be HTS based, an area in which New Zealand has developed a significant competitive edge".

HTS transformers use superconducting wire instead of copper wire and liquid nitrogen for cooling and insulation instead of transformer oil, eliminating fire and environmental hazards. The wire is much narrower but can still carry the required current, making HTS transformers smaller and lighter.

The key to the transformers' success is a new type of HTS cable, designed and manufactured in New Zealand by GCS Ltd. Called Roebel cable, it is based on a design invented in 1912 by Ludwig Roebel.

"This cable has multiple strands of wire wound together, which is similar to copper cables used in conventional transformers, but has significantly great power density. It also enables the transmission of electricity in power systems with less resistance or loss of energy", says Nick Long, a senior principal scientist with the Robinson Research Institute.

"GCS Ltd, the world's sole supplier, has manufactured its own unique HTS Roebel cable that is attracting international attention for numerous applications".

The transformer is undergoing further testing to mimic a real world loading profile for an extended period.

Professor Bob Buckley, Director of the Robinson Research Institute, says the close working relationship with a number of industry partners has been vital to the success of the project.

"These domestic partnerships meant we've been able to rapidly overcome the technical hurdles before others around the world, and stay at the forefront of the race to develop HTS technologies for manufacturers and the electricity industry."

With funding from the Ministry for Business, Employment and Innovation and the project partners, Robinson Research Institute researchers teamed up Callaghan Innovation which managed the engineering, assembly and testing, Fabrum Solutions for the cryostat engineering, local utility companies Vector and Northpower, Wilson Transformer Company, ETEL Transformers and GCS. The delivery team used significant expertise and experience from HTS-110, Powerlab, Parsons Brinckerhoff and the Institute for Electrical Engineering in Slovakia.

"Together we've shown that HTS transformers are a commercially

attractive solution and will reduce energy losses, increase safety and increase power density within switch yards, which is critical within high population density cities," says Callaghan Innovation project leader Dr Neil Glasson.

Wilson Transformer Company, based in Melbourne, contributed design and manufacturing expertise to the project and constructed the transformer's steel core.

"It's been exciting to be part of this development which has demonstrated the potential of superconducting transformers to deliver real value in transmission grids. We're looking forward to helping in further advancement", says Strategic Technology Officer Mohinder Pannu.

The researchers are now looking to assemble a team for the next phase of the project, which will develop the first commercial prototype transformer.

"Ongoing development work will ensure New Zealand maintains its position as a global leader in the application of HTS to advance electricity networks", says Managing Director of Fabrum Solutions Christopher Boyle. "The transformer's world-leading composite cryostat—designed and built by a New Zealand owned and based manufacturer—is attracting significant international interest."

The technology demonstrated in this transformer has cemented the world class reputation of New Zealand in this area and is attracting commercial attention from major overseas corporations that paves the way for the supply of high-value technology-intensive exports into these markets.

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