Future Architecture of the Network
TE WHATUNGA HIKO

Case study: Demonstration DC House

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About FAN

Electricity and electrification are seen as the significant enablers for decarbonisation of our nation. The Future Architecture of the Network (FAN) | Te Whatunga Hiko programme aspires to meet the challenges the electrical power system will face as we journey towards sustainable decarbonisation.

Our vision is to provide an infrastructure paradigm through a hybrid AC/DC transmission and distribution system that meets the needs of tomorrow's efficient, low-carbon, reliable and resilient electrical power system.

With a brief unconstrained by the present technical and economic limitations, and a horizon of 2050 and beyond, the programme is ambitious in its goals to deliver significant knowledge and capability development; transition pathways; new technologies; and input into design processes, standards and regulations.

Funded as part of the New Zealand Government's Strategic Science Investment Fund (SSIF) on Advanced Energy Technology Platform (AETP), the research team is investigating what the future electrical power system might look like. The main hypothesis is that high penetration of DC transmission and distribution (conveyance) into the AC grid will provide many benefits to transition to a low-carbon power system. The major research challenge is to determine the future architecture, topology and a transition pathway.

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Disclaimer

The report has been developed for specific cases, defined in the report, and accordingly some assumptions have been made. FAN takes no responsibility for any errors or omissions in, or for the correctness of, the information contained in the report.

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Case study

This programme seeks to investigate many aspects of increasing the level of DC penetration into our electricity network. Many of these investigations have produced real devices, such as protection systems, control systems, power conversion systems, etc. The number and type of devices will continue to grow as the programme advances. There are also investigations into the application of DC to existing infrastructure and equipment, such as cables and wiring, appliances etc.

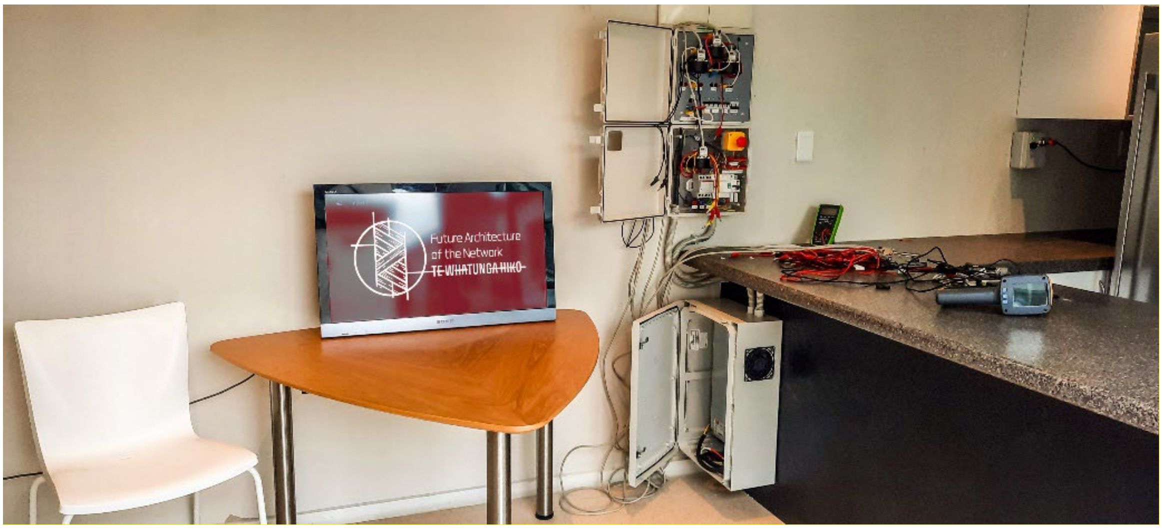
In order to both demonstrate the advances made, and to provide a real-world laboratory environment to test the new devices, and the application of DC within existing infrastructure, a 'DC house' concept was developed and actioned.

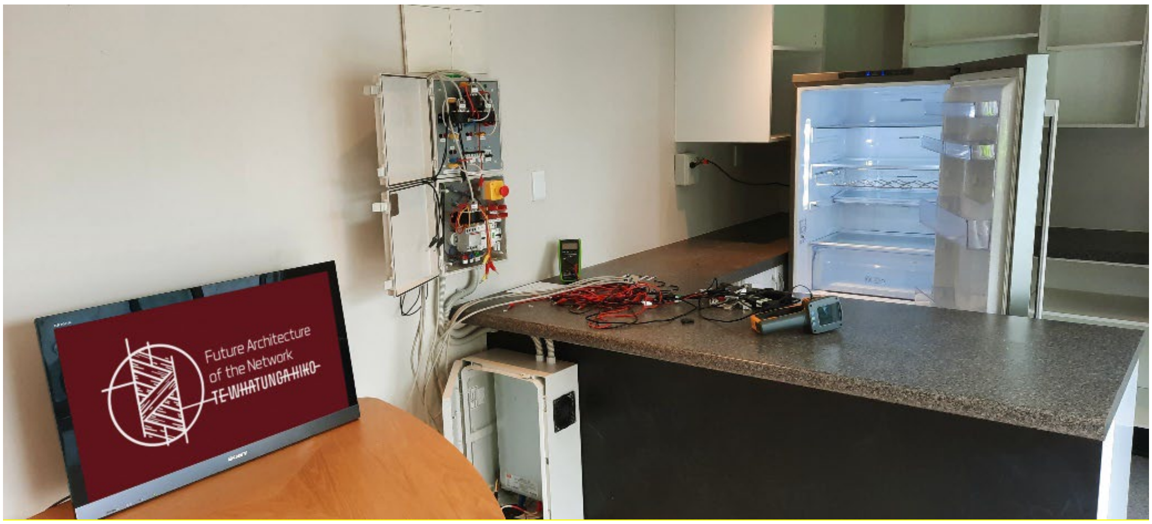
While the 'DC house' provides a vehicle to showcase the advances made, the more critical purpose is to provide an environment where multiple systems/devices can be integrated and extensively tested when working together. This is very important requirement, as it allows the interaction between component systems to be measured and quantified, and potential benefits or issues identified and learned from. This marks this development as a unique facility, with very few equivalent facilities in place internationally.

The 'DC house' is based around a small hospitality facility that was acquired on the University of Canterbury campus and has been converted to run entirely on a DC supply. Having a kitchen facility as well as a relaxation space, it is a good analogy to a domestic environment typical in Aotearoa New Zealand. The design brief included heating (heat-pump technology), hot water, refrigeration, entertainment, and both low-power (USB-C) and high-power general-purpose power outlets.

Extensive monitoring points were installed, both within the DC circuits of the house, and on the AC feed prior to the AC/DC conversion point. This work was completed with the assistance of summer research students.

Because the 'DC house' is a unique test facility, it has attracted international interest. Since commissioning, one of our collaborators from TU Dresden (Germany) has visited for four weeks with the sole purpose of taking power quality measurements within the facility, and a follow up visit is planned for additional tests by another researcher from TU Dresden.

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