High Power Density Electric Motors for Large-scale Transport

Rod Badcock[1], James Storey[1], Kent Hamilton[1], Zhenan Jiang[1], Huub Weijers[1], Duleepa Thrimawithana[2], and Sangkwon Jeong[3]

[1]Victoria University of Wellington, NZ
[2]University of Auckland, NZ
[3]Korea Advanced Institute of Science and Technology, South Korea

Email: rod.badcock@vuw.ac.nz

***Abstract*— The world needs to cut its greenhouse gas emissions to limit the impact of global warming. New Zealand has set itself a challenging target, to be net zero carbon by 2050. Not counting agriculture, transportation is the largest source of our greenhouse gas emissions. Our tourism sector depends on flying; while our exports depend on shipping. To stop using fossil fuels, we need to start using electricity. Fortunately, New Zealand has an advantage – over 80% of our energy is generated from renewable sources, and we have plenty of scope to increase it to 100% using wind, solar, and geothermal. The biggest technological challenge is to electrify aviation, followed by heavy transport: rail, shipping, and heavy trucks. Electric planes are still in their infancy. But superconducting machines offer two advantages for electric aircraft: they are small and light, relative to their power output. New Zealand has been working on superconductors since the 1980s, has teamed up with NZ's leading researchers in power electronics and cryogenics systems and formed strategic international research partnerships. The research in this NZ national programme looks at how to make superconducting machines for aircraft using novel technology such as flux pump exciters, low ac-loss windings, wide bandgap electronics, and integrated cryogenic systems. We will present an overview of the technology development, its implications, and how this research is globally relevant.**

***Keywords (Index Terms)* — Net Zero Carbon, electric aircraft, superconducting motor, flux pump, wideband gap electronics, cryogenic system.**

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