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IET International Travel Award Report

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The IET international travel award recently afforded me the opportunity to travel to Stellenbosch University in South Africa, from Aug 1-21, to work closely with the MTN Mobile Intelligence Lab on paratransit electrification projects.

Paratransit vehicles, in particular the minibus taxi, are ubiquitous throughout sub-Saharan Africa. Between 50-100% of daily commutes in many major cities (e.g. Johannesburg, Cape Town, Harare, Kigali, Nairobi, Addis Ababa, and more) the region are serviced by minibus taxi. However, the vehicles tend to be old, inefficient, and highly pollutant, issues that electrification could help ameliorate. Along with moving sub-Saharan Africa's dominant transport industry away from the alarmingly high and increasing price of diesel fuel, which is a heavy financial burden on the taxi industry and commuters, transitioning to electric versions of these vehicles will greatly reduce greenhouse gas emissions and air pollution. In a highly capital- and energy-constrained context, our research involves developing technical solutions and in-depth planning and analysis to ensure safe and effective transitions of fleets around the sub-continent.

The first, and most exciting, portion of our research, is the minibus taxi EV retrofit. Demonstrating proof-of-concept of the electric taxi retrofit is first major step in unlocking a "retrification" economy for paratransit. In general, sub-Saharan African countries do not have the capital or materials to mass produce new electric minibuses in the near future. Relying on imports is not an ideal solution, as it places these countries at an even further financial disadvantage while developing a dependency and doing nothing for local labor forces. Innovative solutions like the retrofit that rely on local labor force and establish supply chains for the requisite parts could boost local economies and upskill labor forces while these countries develop and prepare them for mass electrification of other vehicle types in the future.

During the visit, we completed the very first minibus taxi EV retrofit which Oxford, Stellenbosch, and industrial partner Rham Equipment have collectively been working on for two years. This proof-of-concept generated lots of media buzz including several news articles and blog posts. We travelled to Rham Equipment's headquarters to present the completed retrofitted taxi to the South African National Development Institute (SANEDI). The presentation was successful, and SANEDI will be funding more work on the project.

As the electrification of paratransit and development of charging infrastructure in South Africa provides many business opportunities, the trip gave me the opportunity to network with entrepreneurs creating exciting start-ups in the field, discuss the future of the industry, and

learn about building both hardware and software businesses. In addition to traveling to Rham Equipment, I met with Zero Carbon Charge (ZCC) and Zimi Charge, two up and coming charge point installers in the region. With both ZCC and Zimi, I had the opportunity to present some modelling I have done for my PhD, on optimally designing solar and storage systems for charging stations and assessing whether fleets of their clients are technically and economically viable for electrification. The feedback I got was invaluable for my PhD research and for my own edification in how to build models that are useful for business applications.

The meetings with ZCC and Zimi, as well as several brainstorming sessions with members of the MTN Mobile Intelligence Lab lead to ideas on how to include load shedding into the models, which is absolutely critical for them to be useful in this context. Load shedding refers to the rolling blackouts in the region that are caused by a lack of sufficient electricity supply relative to demand. It is a daily, pervasive problem in South Africa, often occurring up to several hours or more a day. Electric vehicles rely on electricity to charge, so load shedding must be taken into account when planning for their integration into local transport systems. It is not a problem that has been faced by EVs in the developed world so far (electricity is almost always available), so this research is critical for effective planning by local fleet owners and charge point operators.

Lastly, due to the media buzz the electric taxi retrofit generated, we also had the chance to meet with UK Foreign Commonwealth Development Office (FCDO) representative Nicholas Brooks to present our research and open the door for further funding opportunities.

I am extremely grateful to the IET for supporting my travel with the International Travel Award. Living and working closely with the MTN Mobile Intelligence Lab at Stellenbosch University in South Africa for three weeks was an incredible and unique opportunity to further my PhD research in the appropriate context and learn from/network in person with individuals in the same field.

