TOSA buses power up for less

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Credit: EPFL

EPFL scientists have developed a mathematical model to minimize the infrastructure and operational costs of the TOSA ultra-rapid rechargeable electric bus system.

Are electric buses that recharge themselves at bus stops the future of public transportation? For now they're part of the arsenal deployed in the name of sustainable mobility. In Geneva, ABB Sécheron and its partners (TPG, SIG and OPI) have just concluded a successful pilot operation of

their electric bus system TOSA. Instead of using overhead lines, the buses power up in just 15 seconds at specific stops and at the terminus station. How can this technology that frees trolleybuses from electric wires be integrated into the public transport network?

The project, fruit of a collaboration between ABB Sécheron, EPFL's Transportation Center and the Haute Ecole ARC; aims to answer this question. The scientists developed software that simulates the creation of a public transport line that minimizes costs as a function of operational constraints, connection with the electricity network and the route profile. It's a web interface that offers a cost-benefit analysis of a TOSA line in order to determine the least expensive technical configuration for a given network.

The innovation of the rechargeable TOSA buses is that they provide large-capacity (133 passenger), 100% electric vehicles without the use of overhead lines and with batteries that are small enough - twice the energy of an electric car battery – to ride on the roof of the bus. At certain stops, a robotic arm on the roof zips out automatically and connects, giving the batteries 15 seconds of recharging time, in a technique called "flash" charging.

This is the time it takes for passengers to disembark and embark. And it's enough time to store up the energy needed to get to a recharging station at an upcoming stop or the terminus.

From battery size to weather conditions

To measure the competitiveness of a TOSA line, many parameters must be taken into account. They are determined by price, but also by the needs of bus operators and technological constraints. The model developed by EPFL researchers takes into account infrastructure and component cost (batteries, connection to the electricity network,

recharge station placement) as well as the life expectancy of the components. It also incorporates parameters such as the bus driver's salary and the electricity rate. All told, 56 variables are taken into consideration to determine the most cost-effective and efficient system.

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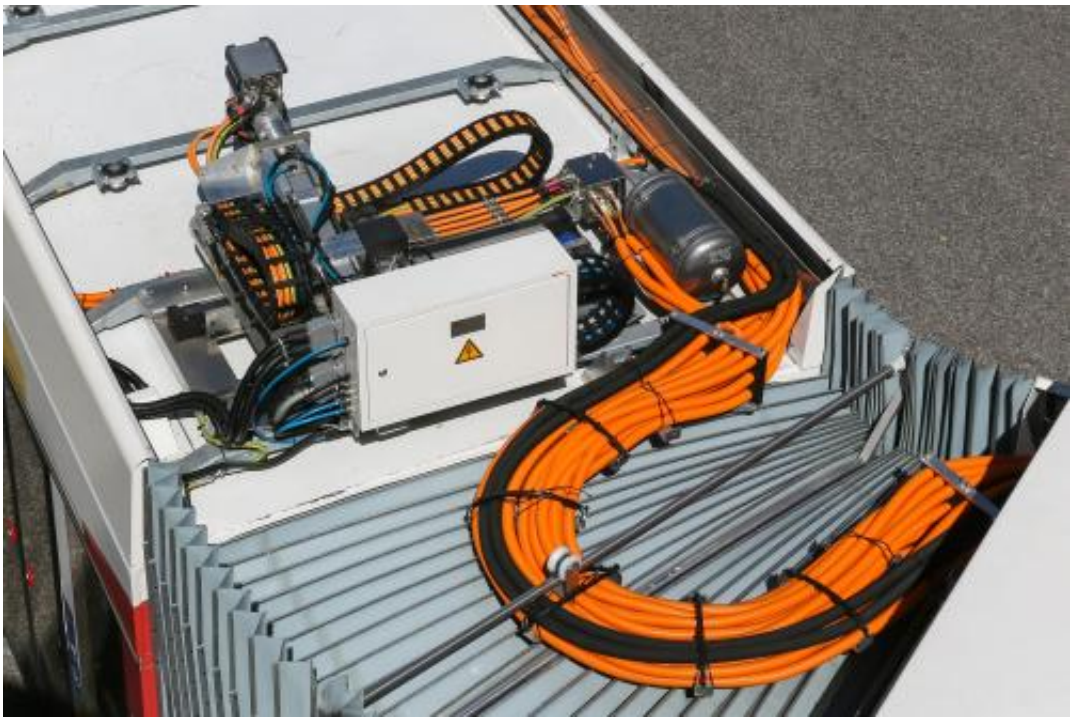
The algorithm is based on a model that the Haute Ecole ARC developed of the requirements of the buses (electric, electronic and power) and the charging stations (at the end of the line, on the route, or at the depot) as a function of route conditions. This includes variables like the number of passengers, the recuperation of braking energy, altitude, speed and even weather conditions.



Credit: EPFL

The entire modeling and cost optimization project was integrated into a web interface, making it possible to design a virtual TOSA line for a given city and estimate its cost. Many cities have expressed interest in TOSA technology, but Geneva will be the first city to adopt a regular TOSA line, somewhere around 2017. The challenge is now to optimize costs for a complex bus network that includes several TOSA lines.

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