Solution to electrify the entire city bus traffic in Lund city using dynamic charging.

In a future world where electric buses operate the city of Lund; can dynamic charging from electric roads be the perfect solution? What should it look like and can it be competitive with the current solution?

An algorithm has been written to evaluate the possibilities of introducing an electric road system (ERS) in Lund city. With a desired end station dwelling time of 300 seconds (5 minutes) and a charging power of 180 kW, an ERS could become reality for the whole bus system using only 2-3 kilometres electric road and some additional stationary charging locations. Parts of the city around Lund central station should preferably see electric road installation in an optimized scenario (as in Figure 1).

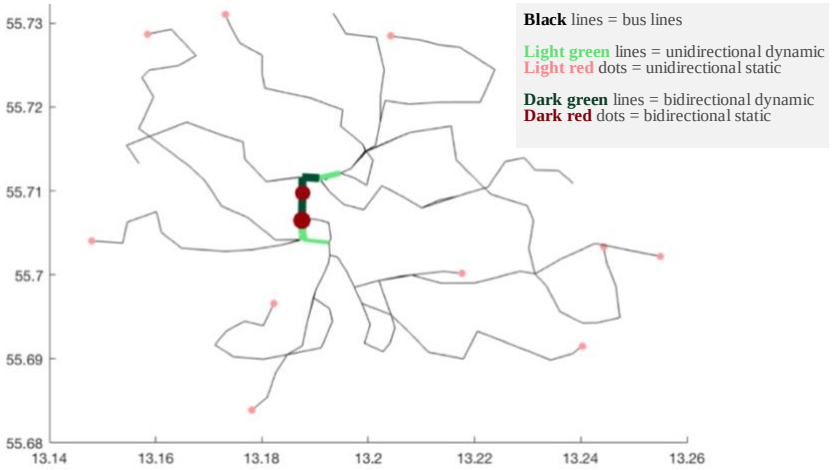

Figure 1 ERS of a possible scenario with 5 minutes end station dwell time. The colors represent unidirectional or bidirectional charging (described in the box). Thicker lines or dots mean that more bus-lines utilize those locations.

If vehicle investments are disregarded, a system like this could cost significantly less to operate than the current one using natural/bio gas (25 MSEK/year compared to 28.5 MSEK/year). However, the electric bus cost of today is about 50 % higher than for conventional buses, resulting in a cost comparison where the electric option annually becomes 8 MSEK more expensive. The high-volume production of electric buses is at an early stage today and it is likely that a more mature production process will render in cheaper vehicles.

An ERS like the one used in this report has many positive sides. Charging while driving enables smaller batteries since the vehicle is fuelled during the trip and not before or after as in the case with stationary charging. Furthermore, the recharge waiting times can be partly eliminated if the system is not as dependent on stationary charging. This creates flexibility which is important to bus operators who do not want to risk their vehicles being stranded due to empty batteries. The algorithm enables testing of flexibility by modification of stop times and driving velocities to analyse the effects of such situations. Results show that a more flexible system should contain more dynamic charging, but annual costs could increase up to 20% depending on the magnitude of modifications (~20% for an extreme case with zero seconds of end station time).

New techniques like this are needed because of the raising importance of electrification of the transport system. In Sweden, where the climate goals are amongst the most aggressive in the world, and with its transport sector relying on fossil fuels to more than 70%, the focus is now high on new, sustainable transportation solutions. The national climate goals of zero net emissions of greenhouse gases by the year of 2045 might seem like a distant issue but changing the whole transportation system is a very big undertaking that takes long time. It is therefore important that efficient and cost-effective techniques are put to test within the upcoming years so that a sustainable transportation can be achieved within the time scope.