Operations of zero-emission buses: Impacts of charging methods and mechanisms on costs and the level of service

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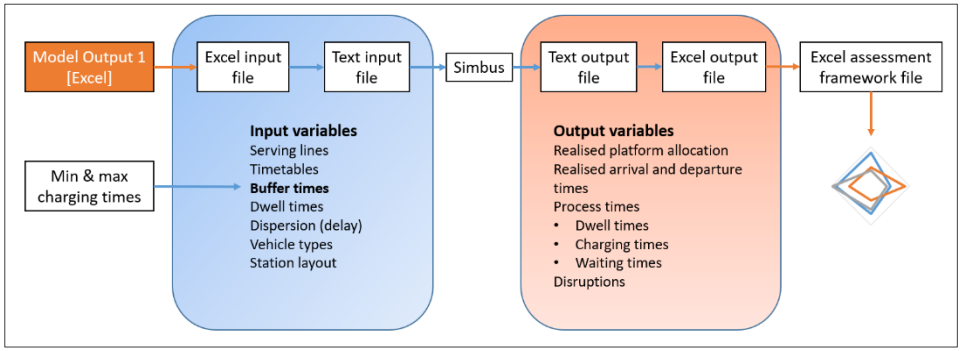
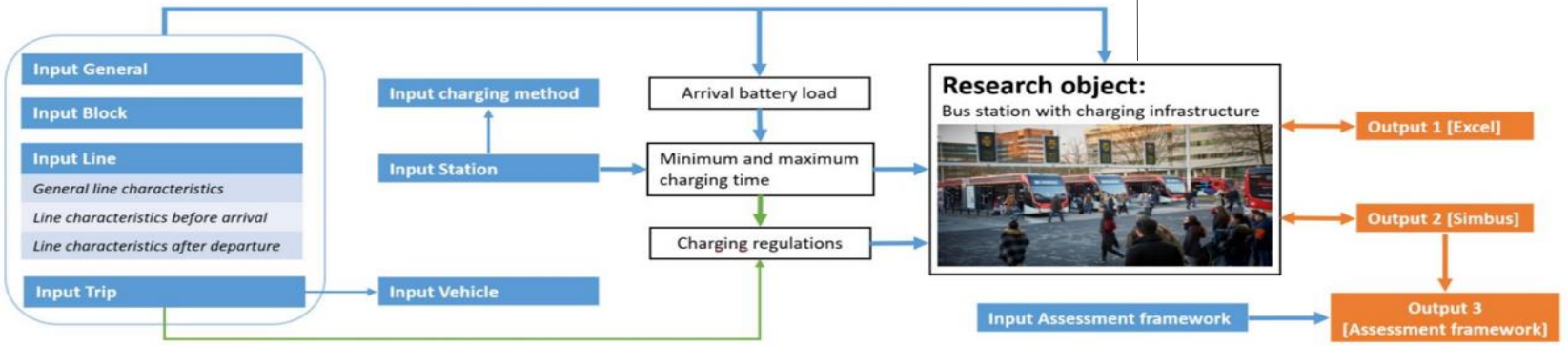
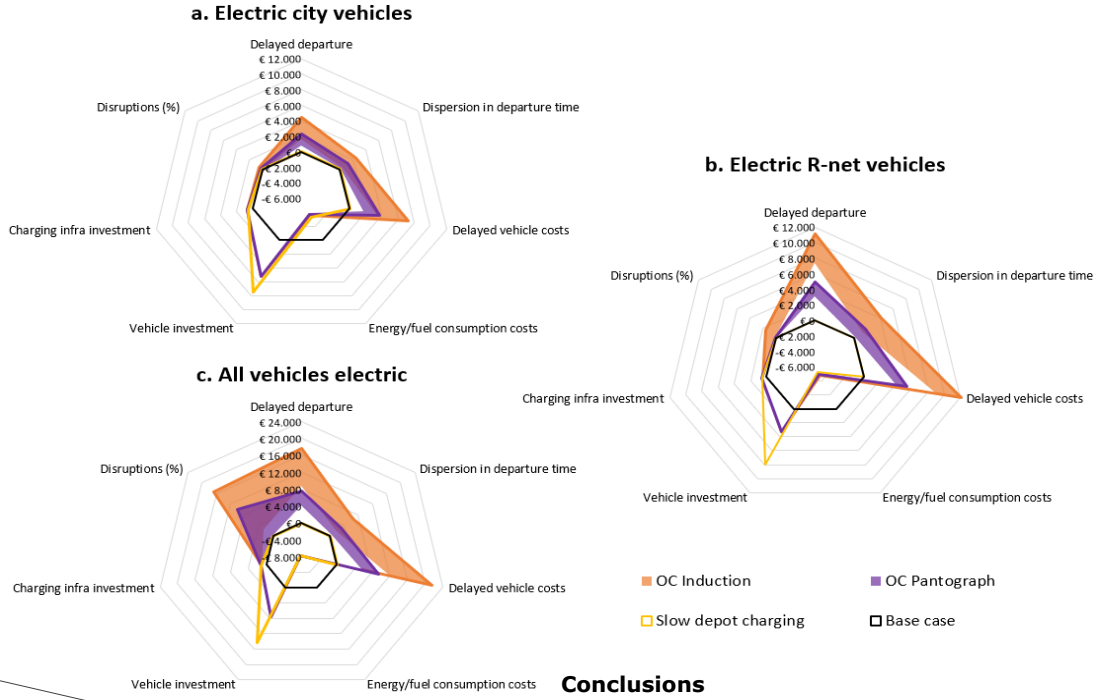
- Innovative **zero-emission buses** are on the rise all around the world.
- For now, only **trolley, battery and fuel-cell electric** vehicles can be classified as (on the pipe) zero-emission vehicles.
- **Different charging methods**, including different charging systems and power, are available to charge battery electric vehicles.
- However, scientific literature focused on the **operation and charging scheduling of electric buses** is scarce.
- In this study, a comparison of **different applied charging methods** for electric buses is obtained.
- A new **ZE-bus station simulation method** is developed to assess charging methods and charging regulations with regard to their **impacts on costs and level of service**.

Modelling approach





Results: impacts electrification of bus fleet and charging types on level of service and costs (case study Schiphol)



Conclusions

- The shift to zero emission bus transport is involved with higher costs and passenger disturbances.
- Benefits of electric operations, including vehicle propulsion cost savings up to 70 percent, are not able to compensate the high investments.
- (Slow) depot charging offers opportunities for operations on short distance lines.
- To prevent fleet overcapacity, vehicles should be recharged with high charging power along the line, preferably at combined bus stations and terminals in order to prevent charging related delays.