Flow refuelling problems in e-mobility
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models and solutions

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For a reduction in environmental pollution and dependency on petroleum, *electric vehicles* (*EV*) present an advantageous alternative to traditionally fossil-fuel powered automobiles. Rapid growth in the number of EVs requires an urgent need to develop an adequate *charging station* infrastructure to stimulate and facilitate their usage. Due to restricted investments in the development of a sufficient infrastructure, locations have to be chosen deliberately.

In this paper several extensions considering different objectives and various constraints to the *deterministic flow refuelling location problem* (*DFRLP*), described by de Vries and Duijzer [1], are introduced, described and implemented. Furthermore, the model extensions are analysed using randomly generated problem instances. The research shows that, when considering *location-dependent costs*, results heavily depend on the relation of said cost differences. Tests for different cost scenarios are carried out and policy implications are discussed.

The basic DFRLP, which is proven to be strongly $\mathcal{NP}$-hard, assumes that the availability of a single charging station is sufficient to refuel all flows using it, regardless of the EVs number, which wants to be refuelled there and their distance travelled since the last refuelling process. Furthermore, increasing acceptance of EVs requires the consideration of *restricted capacity* at charging stations. Capacity is defined by calculating the energy demand at a charging station for each EV and therefore simultaneously taking decisions concerning the placement and size of stations. We also discuss the influence of *failure probabilities* at potential facility locations while deploying an infrastructure in order to guarantee a minimum path reliability for a certain number of EVs.

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References

[1] H. de Vries and E. Duijzer, Incorporating driving range variability in network design for refueling facilities, *Omega* **69**, 102–114, 2017.