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EV CHARGING PLANNING FOR MICRO DISTRICTS

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In the 2014, under the guidance of the Riga Energy Agency (municipal agency REA) in collaboration with the main stakeholders "Riga Smart City Sustainable Energy Action Plan for 2014 – 2020" has been developed and approved by the Riga City Council. Its purpose is the reduction of the CO_2 emissions by use new technology, such as, the use of electric vehicles. Certainly, the growth in the number of electric vehicles will increase the demand for electricity and the profile of daily load curve to change, what will have influence on the work of local distribution networks. Subsequently, a need arises to create the optimal planning of electricity supply distribution for the all consumers. The aim of this study is to assess the increase of demand for electricity under the conditions of daily electric vehicles charging and of the possible locations of slow and fast charging stations (points) for a single district of Riga. The study considers only two groups of electricity consumers - the private citizens and the service companies (in the context of EU co-financing programme).

For the case study of a single urban microdistrict's consumption of electricity were used: a model of distribution network, from the substation capacity of 2 x 25 MVA (TR 110/20/10 kV) and transformer substations MV/LV –TR 10/0.4 kV; the average daily load schedules of electricity consumers (the private citizens and the service companies) in the working day.

The estimation of electricity consumption was performed in the two stages.

Stage 1: a time period of maximum and minimum daily electricity consumption for each group of consumers, as well as the load factor and load curve irregularity factor were determined.

Stage 2: the total daily electricity consumption was calculated.

As a result, it is concluded that the largest maximum demand for electricity in the microdistrict is observed from 16:00 to 23:00, whereas from 23:00 to 07:00 the minimum demand is observed.

Having looked at consumption without EVs, were added EVs to the urban microdistrict's consumption.

Consequently, to further analyse the results it was defined the number of vehicles that could be integrated in the energy distribution network of the said microdistrict on the daily basis. In microdistrict, the number of passenger cars using fossil fuels is 6,764. Was assumed that from the estimated number of passenger cars, 5% would be represented by EVs, which in turn were divided into three groups: EVs that are owned by private persons (residents of the said microdistrict; single and multi-family houses consumers); EVs that are owned by legal persons – of the said microdistrict service buildings consumers; EVs that are owned by non-residents of the said microdistrict.

To estimate the increase in demand for electricity under conditions of daily charging of electric vehicles, as well as to observe the changes in the profiles of peak daily load curve and planning the location of slow and fast charging stations (points) for a single district of Riga, the following two scenarios were proposed:

Scenario 1 allows charging the service buildings' vehicles near service buildings and multi-family houses on parking lots.

Scenario 2, includes the service buildings' vehicles and the possible non-residents vehicles of the district, enlarges the analysed period of time.

During all scenarios, the slow-charging for all consumer groups happens from 23:00 to 7:00, and the stations are located near of the defined sectors. Fast-charging is relevant for the legal persons and non-residents.

Having analysed the scenarios, it was determined that the Scenario 2 shows the most high electricity consumption. The load factors and load curve irregularity factor are closer to 1.0 than in Scenario 1, making it the optimal choice from the considered scenarios.

As a result, the case study allowed making the following conclusions:

- The existing urban power networks can provide with electricity a substantial number of EVs if the slow charging happens during the periods of low electricity demands.
- Scenario 2 is the optimum for improving of the load irregularity graphic network.
- Using of the Electric Vehicles allows reduce CO_2 emissions by 5.1%.