

# **Synergies of electric urban transport systems and distributed energy resources in smart cities**

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**Abstract—** Transport systems and buildings are among the bigger energy users inside cities. Abundant research has been developed about these systems (facilities and transport). However, synergies among them are commonly overlooked, not taking advantage of the possible benefits of their joint coordination and management. This paper presents a linear programming model to find the optimal operation and planning of distributed energy resources (DER) in a residential district, while considering electric private and public transport systems, in particular electric vehicles and metro. Hence, the main contribution of this paper is the analysis of synergies of such an interconnected scheme. It has been assumed that part of the metro regenerative braking energy can be stored into electric vehicles' (EVs') batteries, so that it can be used later for other trains or for the EV itself. Several case studies have been proposed using data from a residential district and a metro line in Madrid. The obtained results show important cost savings in the overall system, especially a significant power cost reduction for the metro system.

**Index Terms—** Demand response, distributed energy resources, electric vehicle, energy management, public transport systems, smart city.

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