Processes, vol.12, no.9, pp.1816-1-1816-22, September, 2024.

A novel optimal planning and operation of smart cities by simultaneously considering electric vehicles, photovoltaics, heat pumps, and batteries

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Abstract-

A smart city (SC) includes different systems that are highly interconnected. Transportation and energy systems are two of the most important ones that must be operated and planned in a coordinated framework. In this paper, with the complete implementation of the SC, the performance of each of the network elements has been fully analyzed; hence, a nonlinear model has been presented to solve the operation and planning of the SC model. In the literature, water treatment issues, as well as energy hubs, subway systems (SWSs), and transportation systems have been investigated independently and separately. A new method of subway and electric vehicle (EV) interaction has resulted from stored energy obtained from subway braking and EV parking. Hence, considering an SC that simultaneously includes renewable energy, transportation systems such as the subway and EVs, as well as the energy required for water purification and energy hubs, is a new and unsolved challenge. In order to solve the problem, in this paper, by presenting a new system of the SC, the necessary planning to minimize the cost of the system is presented. This model includes an SWS along with plug-in EVs (PEVs) and different distributed energy resources (DERs) such as Photovoltaics (PVs), Heat Pumps (HPs), and stationary batteries. An improved grey wolf optimizer has been utilized to solve the nonlinear optimization problem. Moreover, four scenarios have been evaluated to assess the impact of the interconnection between SWSs and PEVs and the presence of DER technologies in the system. Finally, results were obtained and analyzed to determine the benefits of the proposed model and the solution algorithm.

Index Terms- grey wolf optimization algorithm; optimal planning and operation; regenerative braking energy; smart city

Citation:
Dehghani, M.; Javidi, G.; Niknam, T.; Pourbehzadi, M.; Sarvarizadeh, M.; Sheybani, E.; Shokri, M. "A novel optimal planning and operation of smart cities by simultaneously considering electric vehicles, photovoltaics, heat pumps, and batteries", Processes, vol.12, no.9, pp.1816-1-1816-22, September, 2024.