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# Editorial
# Special Section on COVID-19 Impact on Electrical Grid Operation: Analysis and Mitigation

COVID-19-RELATED shutdowns have significantly impacted the electrical grid operation worldwide, as governments put strict measures in place to manage the global pandemic. The global electrical demand plummeted around the planet in March, April, and May 2020, with countries such as Spain and Italy experiencing more than 20% decrease in their usual electric consumption. On the other hand, countries like Canada experienced unusually high summer peaks due to the increase in demand for the residential HVAC systems. Electricity network operators are facing unprecedented challenges in scheduling energy resources; for example, energy forecasting systems struggle to provide an accurate demand prediction given massive changes in patterns of electricity consumption induced by COVID-19 restrictions.

A competition titled ''Day-Ahead Electricity Demand Forecasting: Post-COVID Paradigm'' was hosted on the IEEE DataPort to call for strategies to mitigate the impact on day-ahead forecasting techniques' performance from December 2020 to May 2021 (https://ieee-dataport.org/competitions/day-ahead-electricity-demand-forecasting-post-covid-paradigm). This competition focused on day-ahead prediction of city-wide demand under changing COVID restrictions and attracted researchers and engineers around the world to participate. More detailed information (e.g., data, winning teams, and top-performing methods) can be referred to [A1] in this Special Section.

Winners of this competition were invited to submit articles to this Special Section describing their methods. In [A2], the first-place winner of the competition applied state-space models to adapt the aforementioned forecasters, including standard statistical and machine learning models. The final predictions were improved by leveraging the diversity of the set of obtained forecasters to achieve the right compromise between the two extremes. In [A3], the third-place winner of the competition proposed a novel online forecast combination called smoothed Bernstein Online Aggregation for multiple point prediction models. This flexible approach could quickly adjust to new energy system situations as they occur during and after COVID-19 shutdowns.

Besides the winners of the data competition, the Special Section was open to public submissions. In [A4], it was discovered that mobility-related changes like non-pharmaceutical interventions are significant for load forecasting. In [A5], Lakshminarayana *et al.* examined how an attacker could cause unsafe grid operating conditions by executing load-altering attacks targeted at compromising hundreds of thousands of IoT-connected high-wattage loads in low-inertia power systems. In [A6], a decomposition-residuals deep neural network was proposed to provide more accurate electricity demand predictions than single models within the COVID-19 era. In addition, model interpretability is improved by indicating which endogenous or exogenous inputs contribute the most to specific hour-ahead forecasts.

COVID-19 is still affecting societies around the world and continues to be a source of uncertainty for both electricity consumption patterns and grid operation policies. In fact, the future electrical grid, a cyber-physical-social system, will face various uncertainties induced by natural disasters and pandemics. We hope that these six articles in this Special Section serve as significant references for future research to mitigate the impact of such uncertainties on the electrical grid stability, reliability, and efficiency.

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## APPENDIX: RELATED ARTICLES

[A1] M. Farrokhabadi, J. Browell, Y. Wang, S. Makonin, W. Su, and H. Zareipour, "Day-ahead electricity demand forecasting competition: Post-COVID paradigm," *IEEE Open Access J. Power Energy*, vol. 9, pp. 185–191, 2022.

[A2] J. D. Vilmarest and Y. Goude, "State-space models for online post-COVID electricity load forecasting competition," *IEEE Open Access J. Power Energy*, vol. 9, pp. 192–201, 2022.

[A3] F. Ziel, "Smoothed Bernstein online aggregation for short-term load forecasting in IEEE DataPort competition on day-ahead electricity demand forecasting: Post-COVID paradigm," *IEEE Open Access J. Power Energy*, vol. 9, pp. 202–212, 2022.

[A4] N. Zarbakhsh, M. S. Misaghian, and G. McArdle, "Human mobility-based features to analyse the impact of COVID-19 on power system operation of Ireland," *IEEE Open Access J. Power Energy*, vol. 9, pp. 213–225, 2022.

[A5] S. Lakshminarayana, J. Ospina, and C. Konstantinou, "Load-altering attacks against power grids under COVID-19 low-inertia conditions," *IEEE Open Access J. Power Energy*, vol. 9, pp. 226–240, 2022.

[A6] K. Theodorakos, O. M. Agudelo, M. Espinoza, and B. D. Moor, "Decomposition-residuals neural networks: Hybrid system identification applied to electricity demand forecasting," *IEEE Open Access J. Power Energy*, vol. 9, pp. 241–253, 2022.