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Top-level research and data

Energy Data Science for Forecasting, Optimization and Regional Decarbonization Assessment

(Representative papers)

1. F. Osaki, Y. Fujimoto, Y. Iino, Y. Ihara, M. Mitsuoka, Y. Hayashi "Dynamic Bus Charge Scheduling by Model Predictive Control to Maximize Local PV Surplus Power Utilization", eTransportation, 25, 100441 (2025)
2. Y. Fujimoto, M. Ohba, Y. Tanno, D. Nohara, Y. Kanno, A. Kaneko, Y. Hayashi, Y. Itoda, W. Wayama "Historical Reconstruction Dataset of Hourly Expected Wind Generation Based on Dynamically Downscaled Atmospheric Reanalysis for Assessing Spatio-Temporal Impact of On-Shore Wind in Japan", Big Earth Data, 8 (4), 732-754 (2024)
3. Y. Fujimoto, M. Inagaki, A. Kaneko, S. Minotsu, Y. Hayashi "Day-Ahead Scheduling of Wind-Hydro Balancing Group Operation to Maximize Expected Revenue Considering Wind Power Output Uncertainty", IEEE Access, 11, 119200-119218 (2023)
4. Y. Fujimoto, M. Fujita, Y. Hayashi "Deep Reservoir Architecture for Short-Term Residential Load Forecasting: An Online Learning Scheme for Edge Computing", Applied Energy, 298, 117176 (2021)
5. Y. Fujimoto, Y. Takahashi, Y. Hayashi, "Alerting to Rare Large-Scale Ramp Events in Wind Power Generation", IEEE Transactions on Sustainable Energy, 10 (1), 55-65, (2019)
6. Y. Fujimoto, H. Kikusato, S. Yoshizawa, S. Kawano, A. Yoshida, S. Wakao, N. Murata, Y. Amano, S. Tanabe, Y. Hayashi, "Distributed Energy Management for Comprehensive Utilization of Residential Photovoltaic Outputs", IEEE Transactions on Smart Grid, 9 (2), 1216-1227 (2018).

Keyword

- Energy data science
- Energy management systems
- Power and energy systems
- Machine learning
- Renewable generation and demand forecasting
- Mathematical optimization
- Distributed energy resources
- Carbon intensity
- Digital twins

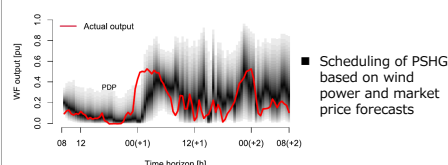
Deployment targets (sites, materials, etc.)

Power grids, local energy systems, homes, buildings, factories, renewable generation, battery storage, electric vehicles, charging infrastructure and electric fleet depots

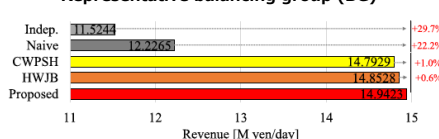
Features (implementation means, etc.)

Renewable Generation Forecasting and Uncertainty Assessment

We forecast renewable generation and its time-dependent uncertainty to optimize operations under equipment constraints, including coordinated wind and pumped-storage hydro generation (PSHG) operation.



Probabilistic wind power forecast



Example of profitability improvement through BG operation (Ref.3)

Assessing Regional Decarbonization Characteristics Using Large-Scale Electricity Data

Using smart meter data from approximately 22 million demand contracts across 424 Japanese municipalities, we assess electricity carbon intensity (CI) and its sensitivity to increasing demand. Municipalities with similar CI can exhibit different demand sensitivities. This reveals regional characteristics beyond current emission levels and supports locally tailored decarbonization strategies.

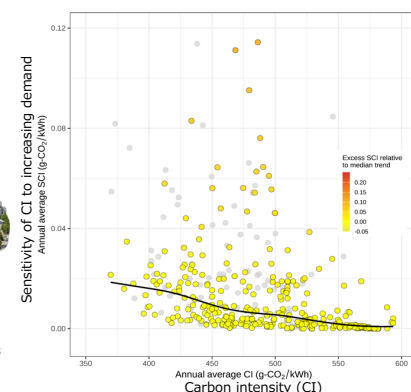


Meteorological satellite data



Generation mix by supply area

- Estimate municipal electricity demand and supply
- Compare CI and its sensitivity to demand changes



Relationship between municipal CI and its sensitivity to increasing demand

- Y. Fujimoto, S. Sugano, M. Mitsuoka, Y. Ihara, S. Shimokawa, Y. Hayashi, "Hidden Heterogeneity within Low-carbon Cities via Demand-Sensitive Carbon Intensity", Research Square (preprint), (2026) doi:10.21203/rs.3.rs-8891089/v1

Associated proprietary technologies

- Renewable generation and demand forecasting using time series analysis and machine learning
- Energy system scheduling under uncertainty and equipment constraints
- Coordinated operation of distributed energy resources and EV charging and discharging
- Energy data analysis, modeling and system simulation

Assumed outlets / applications

- Energy management for communities and facilities using renewables and battery storage
- Virtual power plants (VPPs) and demand response (DR)
- Coordinated EV charging and fleet operation
- Assessment of infrastructure deployment and operating strategies for decarbonization

Associated SDGs

