Big Data Analytics and Machine Learning for Smart Grid and Integrated Energy Systems

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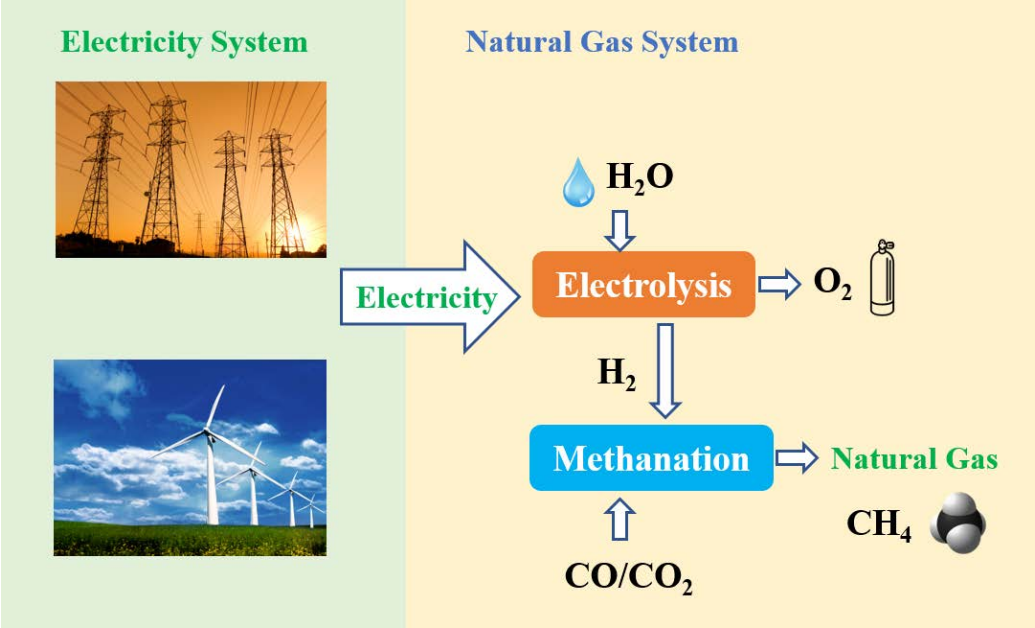
The concept of smart grid has gained considerable attention from both academia and industries. With the increasing penetration of renewable wind energy in electric power systems, the balance between electricity supply and demand is challenging. The emerging power-to-gas technology effectively converts the excessive electricity into natural gas. The manufactured natural gas can be sold to the market or used by gas-fired units. Power-to-gas technology could support a deep penetration of wind energy. However, the uncertainty in wind power generation and dynamics in natural gas system pose a great challenge to the coordination of electric power systems and natural gas systems.



In this project, we aim to leverage the power of big data analytics and statistical machine learning to extract useful uncertainty information from historical wind data, and organically integrate it into the robust optimization model for scheduling of power generating units, power-to-gas facilities and natural gas production wells. The model formulation includes both the power system part and the natural gas system part. The case study will be based on the IEEE-118 bus power system and 12-node gas system. The electric power system has 7 wind farms, which has a total capacity of 720MW. There are 12 gas nodes, 3 gas wells and 12 pipelines in the natural gas system.