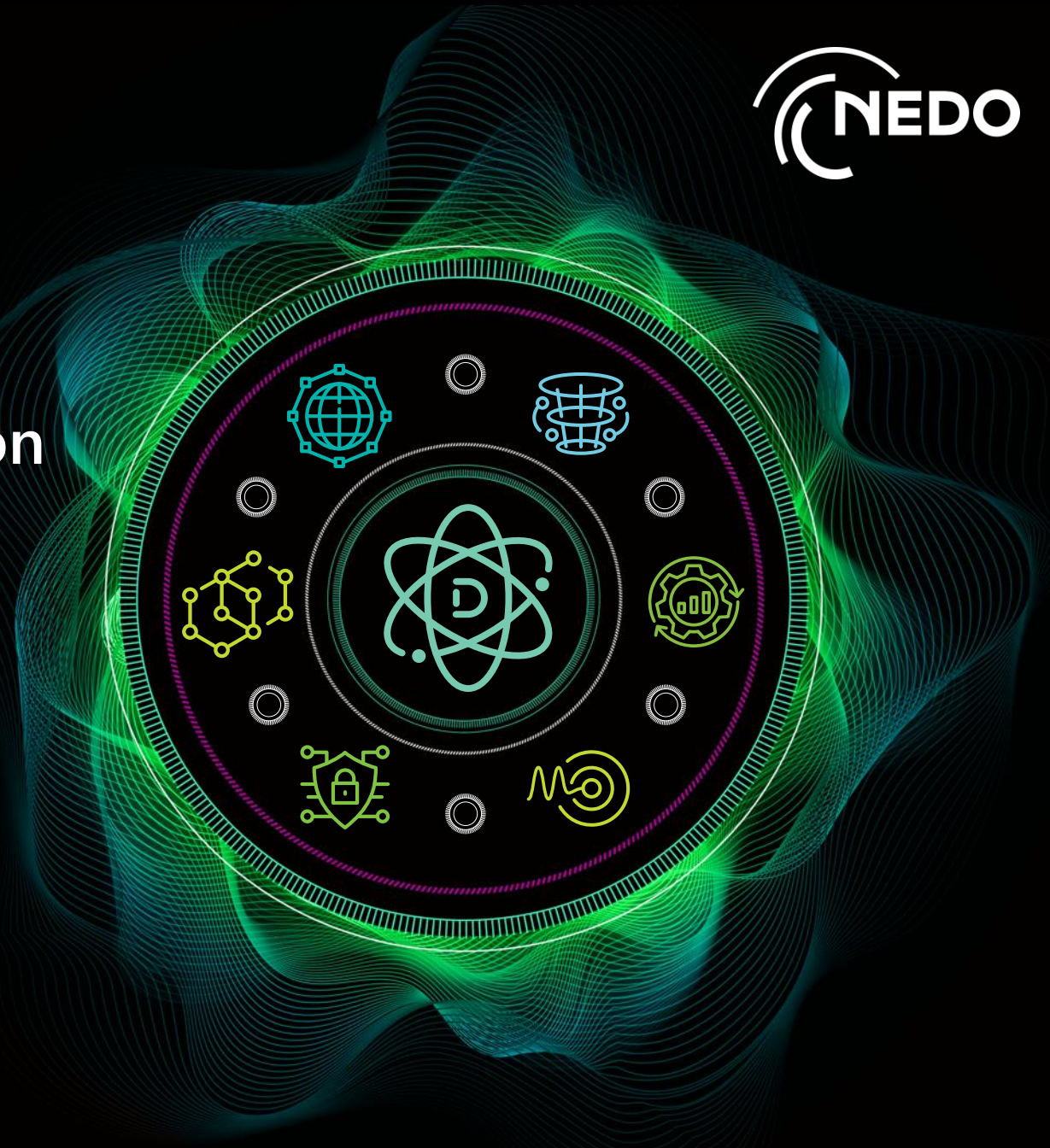
Quantum Computing Use Cases

Optimization of resource allocation for electricity demand

TIS, The University of Osaka



New Energy and Industrial Technology Development Organization (NEDO)

TIS, The University of Osaka: Optimization of resource allocation for electricity demand [2025/5] 1/2

Validation

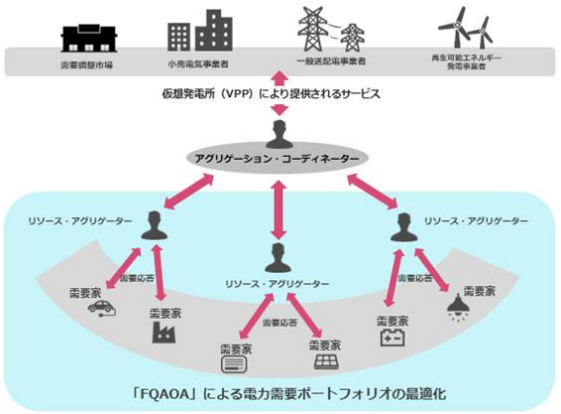
Industry	Energy
Process	transmission and distribution
Method	combinatorial optimization
Category	Gate*

Background

- The proliferation of renewable energy is leading to a shift from the traditional centralized supply of large power plants to a model that **leverages distributed energy resources.**
- Resource aggregation business, in which distributed resources are bundled to adjust supply and demand, is attracting attention. In this field, two entities, **aggregation coordinators** that optimize the supply and demand balance and **resource aggregators** that supply the desired amount of electricity through demand suppression, play important roles by constructing virtual power plants (VPP).
- Resource aggregators **need to achieve stable power procurement even in highly volatile environments by appropriately combining demand suppression amounts provided by multiple customers.**
- **The introduction of quantum optimization algorithms is expected to play an important role in power demand portfolio optimization** in the resource aggregation business.

Issues and motivation to be solved

- In the resource aggregation business, both securing procurement volume and stability are required.
- The problem is that conventional quantum optimization algorithms have difficulty in satisfying procurement plans due to limitations in calculation accuracy, and there is a discrepancy between the actual demand suppression amount and the expected electricity amount.



Power Demand Portfolio Optimization Image

See Also: TIS: "TIS and the Quantum Information and Quantum Life Research Center at The University of Osaka Develop a New Quantum Algorithm "FQAOA" ~ Achieved an approximately 10 fold increase in calculation accuracy for optimizing resource allocation in relation to electricity demand as a first step toward reducing environmental impact ~" (https://www.tis.co.jp/news/2025/tis_news/20250507_1.html)
*Gate（gate-based）: A computing approach in which operations are applied sequentially to qubits to perform calculations. Similar in concept to logic circuits in classical computers, it can address a wide range of problems.

TIS, The University of Osaka: Optimization of resource allocation for electricity demand [2025/5] 2/2

Validation

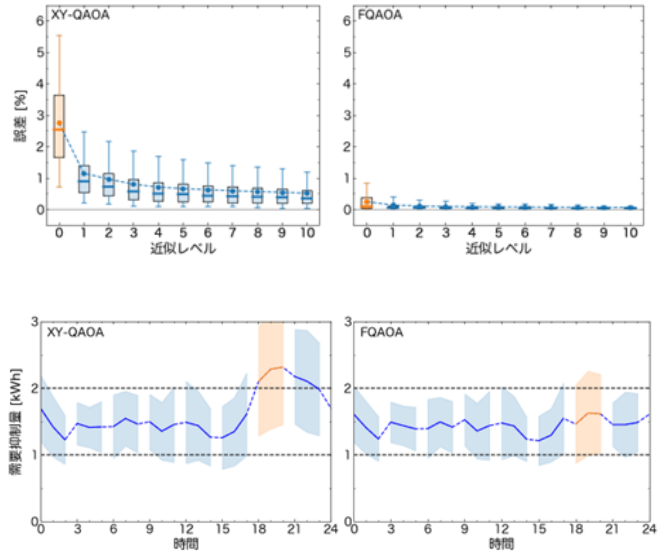
Industry	Energy
Process	transmission and distribution
Method	combinatorial optimization
Category	Gate*

Problem setting as a quantum computer

- TIS and The University of Osaka improved the jointly developed algorithm "FQAOA" and applied it to a power demand portfolio optimization problem.
- By adopting a new optimization approach that properly takes into account the balance conditions for aggregating the demand suppression amount that matches the desired procurement amount, **FQAOA** achieves a significant improvement in calculation accuracy compared to the conventional method.
  - With the conventional method, the error from the optimal solution was 27.6%, but by introducing "FQAOA," the error was reduced to 2.5%.
  - When the desired amount of electricity to be procured is set to 1 kWh to 2 kWh for all time zones, the calculation result shows that the amount of electricity obtained by the conventional method is 2.23±0.858 kWh for the time zone between 18:00 and 21:00, whereas the amount obtained by using "FQAOA" is 1.57±0.604 kWh, which makes it possible to procure electricity with higher accuracy.

Expected business benefits

Quantum optimization algorithms **are expected to be applied not only to improve energy efficiency but also to reduce environmental impact** in the energy field.



Comparison of Results between Conventional Calculation and "FQAOA"

See Also: TIS: "TIS and the Quantum Information and Quantum Life Research Center at The University of Osaka Develop a New Quantum Algorithm "FQAOA" ~ Achieved an approximately 10 fold increase in calculation accuracy for optimizing resource allocation in relation to electricity demand as a first step toward reducing environmental impact ~" (https://www.tis.co.jp/news/2025/tis_news/20250507_1.html)

*Gate（gate-based）: A computing approach in which operations are applied sequentially to qubits to perform calculations. Similar in concept to logic circuits in classical computers, it can address a wide range of problems.

More use cases are available on our website. We invite you to explore them.
https://www.quantum-computing-use-cases.nedo.go.jp/english/

More Use Cases

New Energy and Industrial Technology Development Organization (NEDO)
AI and Robotics Department (e-mail: quantum_ai@ml.nedo.go.jp)

This collection of use cases was obtained as a result of the work commissioned by the New Energy and Industrial Technology Development Organization (NEDO) "Cyber-Physical Development Business of Quantum/Classical Hybrid Technology/Study of Use Case of Quantum Technology" and the "Post-5G Information and Communications System Infrastructure Reinforcement R & D Project (Quantum Industrialization)/Comprehensive Study for Promoting the Industrialization of Quantum Computers".