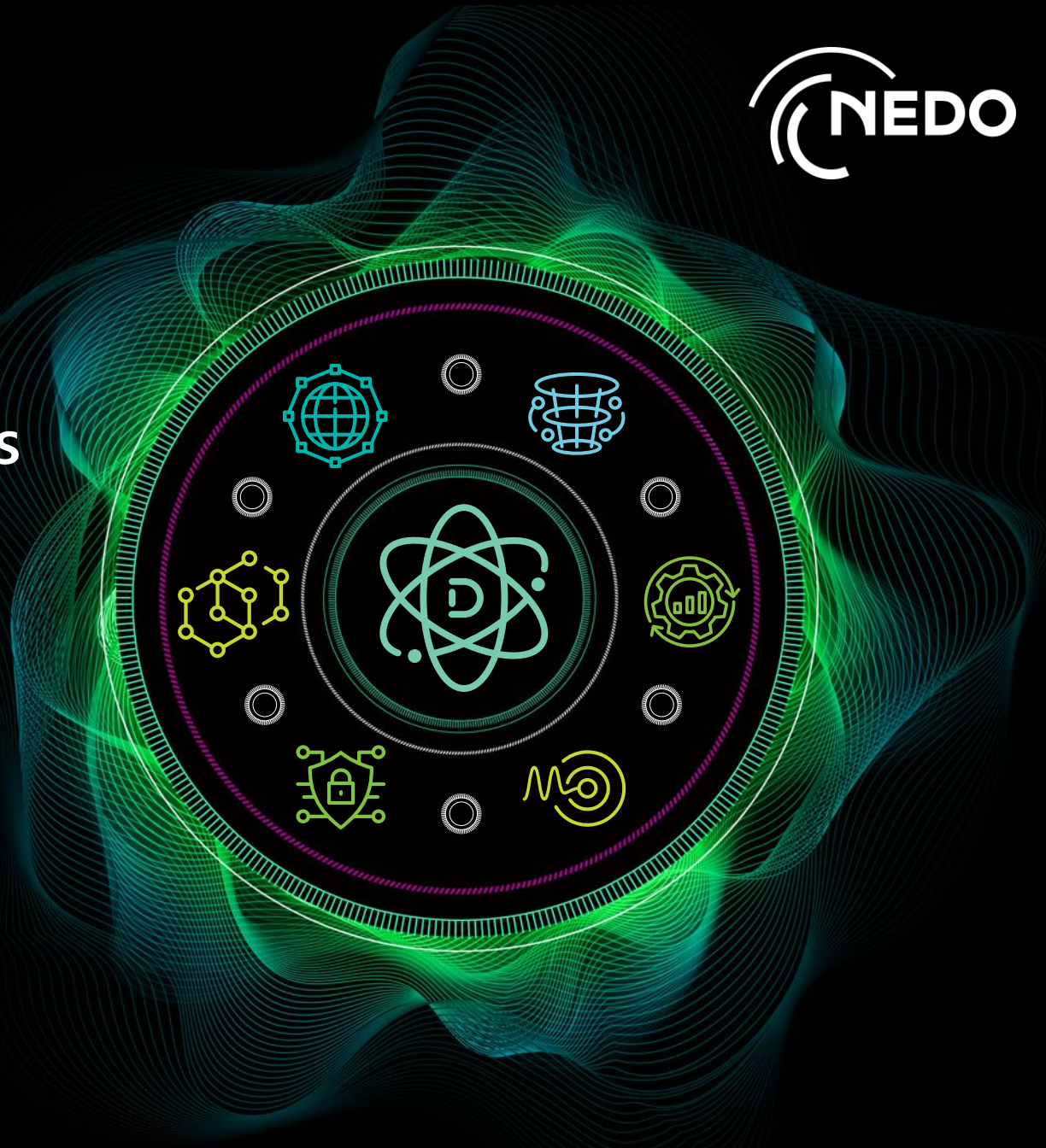
Quantum Computing Use Cases

Optimizing facility operation plans to reduce power consumption at data centers

NRI



New Energy and Industrial Technology Development Organization (NEDO)

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Validation

Industry	Energy
Process	Retailers and customers
Method	combinatorial optimization
Category	Ising*

Background

- NRI is conducting technical verification and research and development to clarify how quantum computing technology can be used to solve various social issues, including global environmental problems.
- **With the trend toward decarbonization and rising electricity prices, the reduction of electricity consumption is drawing attention.**
- NRI's business requires **highly power-efficient facility operation plans for data centers, which account for approximately 80% of electricity consumption**

Issues and motivation to be solved

- For the heat source facilities used for air conditioning and other operations at NRI's Tokyo Data Center 1, we conducted **Demonstration Tests for Optimal Operation Planning Using Quantum Computers** from April to September 2022 in order to create highly power-efficient facility operation plans
- This demonstration experiment was carried out **in collaboration with Ozeki Laboratory of Tohoku University** which is advancing the applied research of quantum computer.

Problem setting as a quantum computer

- **Analyzed data affecting power consumption at data center heat sources and built mathematical models** using a mathematical planning approach to formulating business challenges
- Using the constructed mathematical model, **the operation plan of the heat source facility that minimizes electric power consumption was calculated**.
  - ✓ As a precondition, **considering that the amount of cooling heat required in the data center will increase by 30% in the future** against the background that the equipment operated in the data center is increasing year by year
- The machine uses **D-wave Advantage, a quantum computer with quantum annealing.**
  - ✓ In order to perform the calculations on the quantum computer, the **Fixstars Amplify SDK from Fixstars Amplify** was used.

Reference: NRI"Nomura Research Institute conducts demonstration tests using quantum computers to reduce power consumption in data centers" (https://www.nri.com/jp/news/info/cc/lst/2022/1206_1)
*Ising: A computing approach, mainly associated with quantum annealers and simulators specialized for the Ising model, in which a problem is first formulated as an Ising model and then solved computationally. It is particularly well suited to problems that involve finding the optimal combination from a vast number of possibilities.

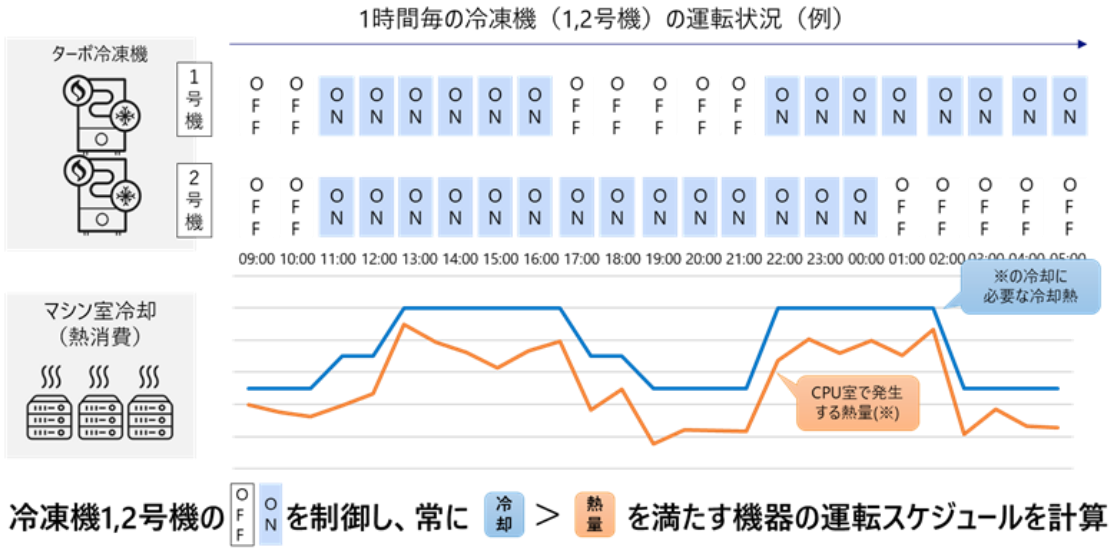
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Expected business benefits

- If the heat source facilities are operated according to the operation plan, **electricity consumption is estimated to be reduced by up to 10%** in the spring and autumn seasons when the outside temperature is around 20 degrees Celsius.
- The mathematical model used for optimization in this demonstration experiment is not specific to NRI's data center and **can be applied to general building heat source equipment.**



Calculated operation plan image of the refrigerator in the heat source facility

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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)
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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".