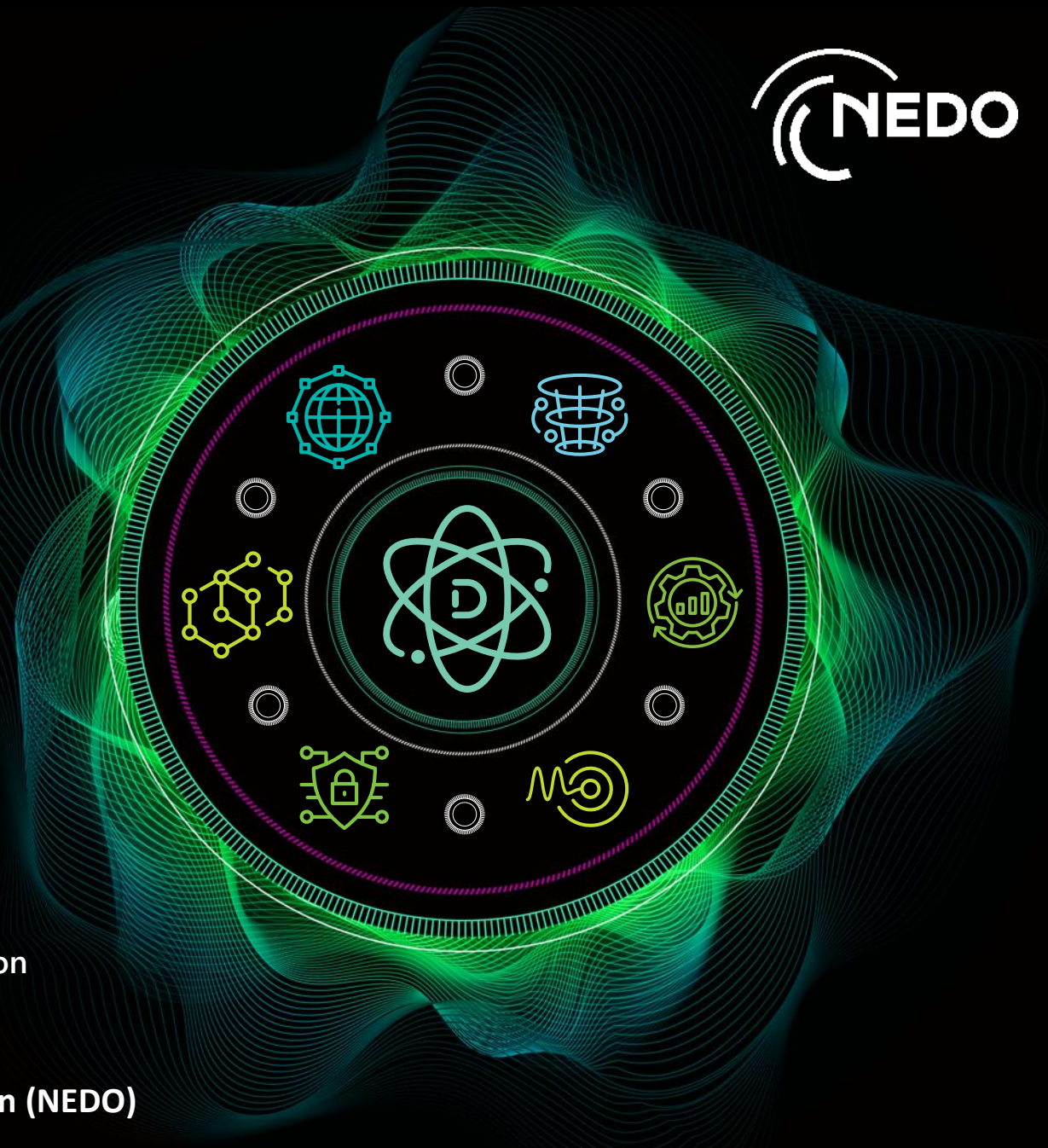
Quantum Computing Use Cases

Large-scale traffic simulation



Promotion of SDGs with Quantum Technology

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New Energy and Industrial Technology Development Organization (NEDO)

大規模交通シミュレーション
Large-scale traffic simulation



ユースケース概要 **Use Case Overview**	渋滞による余剰エネルギーの発生を最適な経路・信号制御により抑制 Suppressing the generation of excess energy due to traffic congestion through optimal route and signal control.
解決できる課題と効果 **Issues to be addressed and their effects**	街の渋滞状態を改善し、移動のストレスや無駄なエネルギー消費を低減 Improve the traffic conditions in the city to reduce travel stress and unnecessary energy consumption.
量子技術の貢献 **Contributions of quantum technology**	既存の大規模交通モデルの精緻化およびシミュレーション Refinement and simulation of existing large-scale traffic models.

実現予想時期 **Expected realization period**	(Year)2040～2050
産業分類 **Industry classification**	運輸・交通 Transportation
関連するQRAMI階層 **Related QRAMI layers**	インタフェース層 Interface layer
関連する量子技術 **Related quantum technologies**	量子アニーリング Quantum Annealing

新規性 **Novelty**	既存の模倣 Existing imitation
達成難易度 **Difficulty of achievement**	困難 Difficult
社会貢献度 **Social contribution level**	幅広い業種に貢献 Contributions to a wide range of industries
市場規模 **Market size**	1,000億～1兆円 100B～1T¥

Detail

Large-scale traffic simulation

- Large-scale, real-time traffic simulation and optimization of routes and signal control will greatly reduce travel inconvenience and environmental impact.



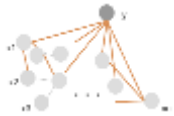
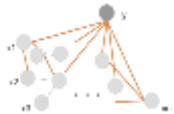
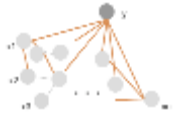
17%
Reduction in energy consumption concerning transportation

Currently, traffic congestion prolongs travel time and energy consumption of travelers. Traffic simulation and route/signal control using QC can alleviate traffic congestion and reduce energy consumption by 17%.

Potential contribution of computational technology	Feasible ultimate world	Supportable SDG goals
Traffic-flow simulation	Reducing traffic congestion reduces stress involved in people's travel and reduces wasteful energy consumption	3 すべての人に健康と福祉を
Proposals for optimizing means of transportation	Energy supply and demand within the grid can be controlled to some extent by proposing transportation methods	7 エネルギーをみんなにそしてクリーンに
Proposals for optimizing route and signal control	Improved efficiency of logistics and labor saving	9 産業と技術革新の基盤をつくろう
Proposals for optimizing crowd accident prevention and evacuation during large-scale disasters	Minimizing damage during disasters increases safety and security in the city	11 住み続けられるまちづくりを

Roadmap

Large-scale traffic simulation

Process		Necessary R&D and business development	Quantum-computer scope of contribution and future development issues	
Large-scale, real-time traffic simulation	Establishing traffic model	■ Validating existing traffic modeling such as “agent-based” models and construction of new models (inputting large amounts of measured data and formulating traffic flow through linear-regression analysis)		■ Expanding the scope of quantum computing for statistical analysis, e.g., linear-regression analysis (i.e., developing methods with a wider range of applications than current algorithms)
	Real-time, large-scale simulation	■ Establishing calculation technology that incorporates the real-time nature of cars and people	Solve forward problems in causal models 	■ Identifying computational tasks with/via the model that are difficult to solve using classical approaches ■ Developing algorithms to efficiently solve the tasks
Optimizing mobility	Establishing optimization model for people and goods movement	■ Constructing a mobility-optimization model that addresses factors such as time, cost, individual health status, and energy supply-and-demand balance within the grid		■ Expanding the scope of quantum computing for statistical analysis, e.g., linear-regression analysis (i.e., developing methods with a wider range of applications than current algorithms)
	Calculation and optimal proposal	■ Proposing optimal means of transportation for people and goods (cars, public transportation, walking, drones, etc.), and optimal routes	Solve the inverse problem in causal models 	■ Accelerating the search for—and expanding the scope of—optimal solutions (developing methods with a wider range of applications than current algorithms)
Optimizing route and signal control	Establishing methodology for determining countermeasures based on the simulation results	■ Constructing a social system for decision-making at local and national levels		■ Expanding the scope of quantum computing for statistical analysis, e.g., linear-regression analysis (i.e., developing methods with a wider range of applications than current algorithms)
	Signal and vehicle control based on the methodology	■ Optimizing control of traffic signals and cars based on methodology ■ Proposing optimization of crowd-accident prevention and crowd evacuation during large-scale disasters	Solve the inverse problem in causal models 	■ Accelerating the search for—and expanding the scope of—optimal solutions (developing methods with a wider range of application than current algorithms)

Roadmap

Large-scale traffic simulation

Process		Necessary steps	Items related to quantum computers	2024	2025-2030	2030-2040	Beyond 2040
Large-scale, real-time traffic simulation	Establishing traffic model	■ Collecting and analyzing existing traffic-flow models					
		■ Expanding the scope of quantum computing for statistical analysis, e.g., linear-regression analysis	■				
		■ Input a large amount of measured data and refine the traffic-flow model using quantum linear-regression analysis	■				
	Real-time, large-scale simulation	■ Within those models, identify computational tasks difficult to solve by a classical approach	■				
		■ Verifying the possibility and business feasibility of accelerating calculations with quantum computers	■				
		■ Establishing quantum algorithms for real-time prediction of traffic flow	■				
Optimizing mobility	Establishing optimization model for people and goods movement	■ Expanding the scope of quantum computing for statistical analysis, e.g., linear-regression analysis	■				
		■ Refining transportation models that incorporate local energy supply and demand, personal preferences, health conditions, etc.	■				
		■ Developing a scheme to obtain data sets of information on transportation, energy, and personal characteristics in real time					
	Calculation and optimal proposal	■ Verifying the possibility and business feasibility of accelerating calculations with quantum computers	■				
		■ Accelerating the search for—and expanding the scope of—optimal solutions	■				
		■ Establishing quantum algorithms for proposing optimal means and routes for the movement of people and goods	■				
Optimizing route and signal control	Establishing methodology for determining countermeasures based on the simulation results	■ Expanding the scope of quantum computing for statistical analysis, e.g., linear-regression analysis	■				
		■ Constructing a social system for decision-making at local and national levels					
	Signal and vehicle control based on the methodology	■ Accelerating the search for—and expanding the scope of—optimal solutions	■				
		■ Establishing signal and vehicle optimization algorithm based on methodology	■				
		■ Establishing signal optimization and control technology					
		■ Formulating algorithms for predicting traffic flow during crowd-related accidents and large-scale disasters on the basis of past case studies.	■				
		■ Establishing quantum algorithms for optimizing evacuation routes and shelters	■				

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 ”.