

LET'S
PRINT THE
QUANTUM
APPLICATIONS
CARD GAME.



PRINT & EXPLORE THE WORLD OF QUANTUM

A century ago, brilliant scientists laid the foundation for Quantum Mechanics – the laws of physics at the very small scale, where phenomena behave differently than in our everyday experience. Today, we stand on the verge of quantum technologies making real-world impact. Quantum computers, networks, and sensors are entering the market with tremendous promise for our future.

This card set contains over one hundred cards illustrating future applications of quantum computing, communication, and sensing. Some applications are approaching commercial availability, while others may take years to develop.

The Centre for Quantum & Society created this card game to help you explore potential quantum applications in an engaging, playful manner.

GAME PREPARATIONS

COMPONENTS IN THIS DOCUMENT: 1 card set (110 cards) with 14 Quantum for Healthcare Cards, 8 Quantum for Infrastructure Cards, 12 Quantum for Energy Cards, 9 Quantum for Water cards, 8 Quantum for Military Cards, 12 Quantum Sensing Cards, 15 Quantum Computing Cards, 10 Quantum Communication & Security Cards, 9 Critical Materials for Quantum, 4 Policy | Alignment Strategies Cards, 6 Policy | Acceleration Factor Cards and 3 Policy | Collaborations.

CUT AROUND
OUTER EDGES

STEPS: Cut out each card. Cut neatly around the outer edges of the images.

ACKNOWLEDGEMENTS

Thanks to our early playtesters at the Quantum Policy Academy, Alliander, the Policymakers and Designers user tests, TU Delft's Industrial Design Engineering faculty, Centre for Quantum and Society team day, Centre for Future Generations Flagship Event, the Government Trainees Programme Day, and everyone else who helped refine the earliest versions of the game.

We extend our special gratitude to the creators of Sushi Go!, whose game mechanics inspired the Quantum Applications Card Game.

CREDITS AND LICENSE

The Quantum Applications Card Game was created by Juwe van Vliet and Deborah Nas. The content brings together insights from academic research, white papers, and Centre for Quantum and Society projects. Graphic design by Juwe van Vliet, with images by Willem van Aken (CSIRO), Matthew ten Bruggencate (via Unsplash), Rose Galloway Green (via Unsplash), JC Gellidon (via Unsplash), Marieke de Lorijn, QDNL, and Juwe van Vliet.

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CENTRE FOR QUANTUM AND SOCIETY



QUANTUM FOR HEALTHCARE

Improving Exoskeletons

Achieve greater precision, adaptability, and user control with a combination of quantum computing and quantum sensing.

MOST #CARDS +6 OR +3



QUANTUM FOR HEALTHCARE

Innovating Protein Structures

Model protein structures to develop targeted therapies and engineered biomolecules with quantum computing and quantum sensing.

MOST #CARDS +6 OR +3



QUANTUM FOR HEALTHCARE

Enhancing Blood Diagnostics

Analyse blood biomarkers for rapid, accurate disease detection, organ function assessment, and evaluation of physiological states with quantum computing.

MOST #CARDS +6 OR +3



QUANTUM FOR HEALTHCARE

Monitoring Health Continuously

Enable early detection of health anomalies, enabling timely interventions and personalised care by tracking vital signs with quantum sensing.

MOST #CARDS +6 OR +3



QUANTUM FOR HEALTHCARE

Mapping Brain Activity

Measure neural activity non-invasively for predicting epileptic seizures or neurological disorders like Alzheimer's and Parkinson's disease with quantum sensing.

MOST #CARDS +6 OR +3



QUANTUM FOR HEALTHCARE

Designing Immunotherapies

Simulate immune system interactions at the molecular level to optimise personalised immunotherapies with quantum sensing and quantum computing.

MOST #CARDS +6 OR +3



QUANTUM FOR HEALTHCARE

Detecting Genetic Mutations

Enhance genetic research by rapidly identifying disease-associated mutations with quantum computing.

MOST #CARDS +6 OR +3



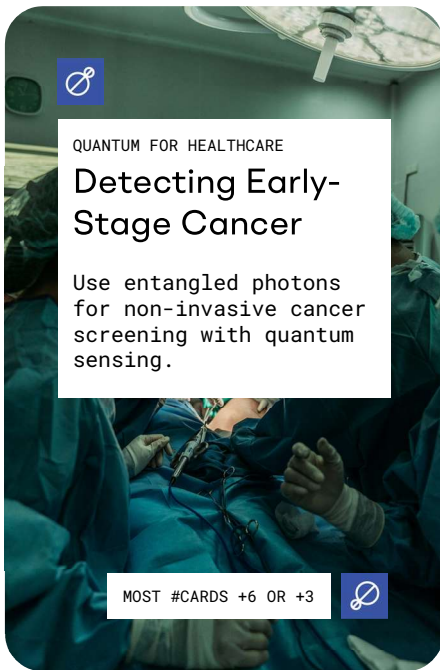
QUANTUM FOR HEALTHCARE

Mapping Metabolic Pathways

Simulate complex biochemical reactions to understand metabolism and its role in disease with quantum computing.

MOST #CARDS +6 OR +3





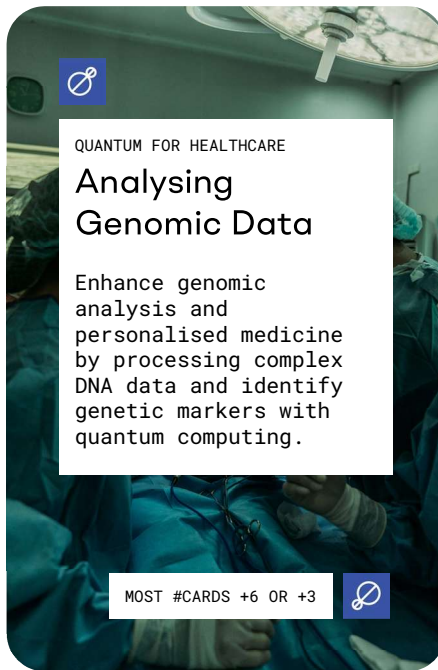


QUANTUM FOR HEALTHCARE

Detecting Early-Stage Cancer

Use entangled photons for non-invasive cancer screening with quantum sensing.

MOST #CARDS +6 OR +3 



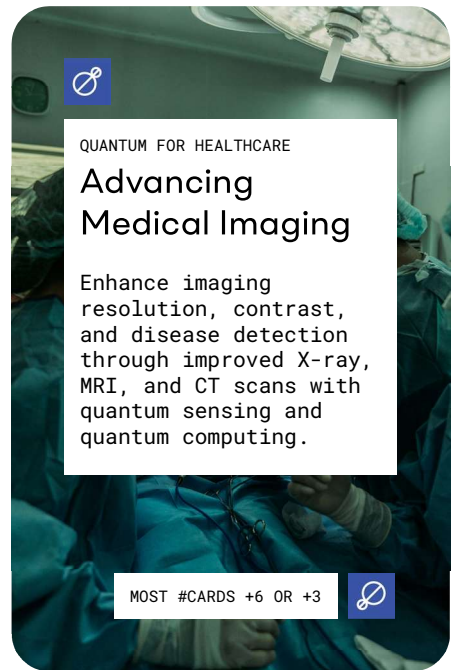


QUANTUM FOR HEALTHCARE

Analysing Genomic Data

Enhance genomic analysis and personalised medicine by processing complex DNA data and identify genetic markers with quantum computing.

MOST #CARDS +6 OR +3 



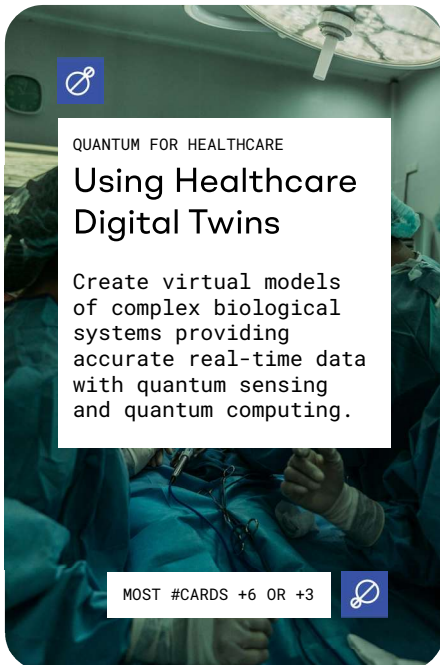


QUANTUM FOR HEALTHCARE

Advancing Medical Imaging

Enhance imaging resolution, contrast, and disease detection through improved X-ray, MRI, and CT scans with quantum sensing and quantum computing.

MOST #CARDS +6 OR +3 





QUANTUM FOR HEALTHCARE

Using Healthcare Digital Twins

Create virtual models of complex biological systems providing accurate real-time data with quantum sensing and quantum computing.

MOST #CARDS +6 OR +3 



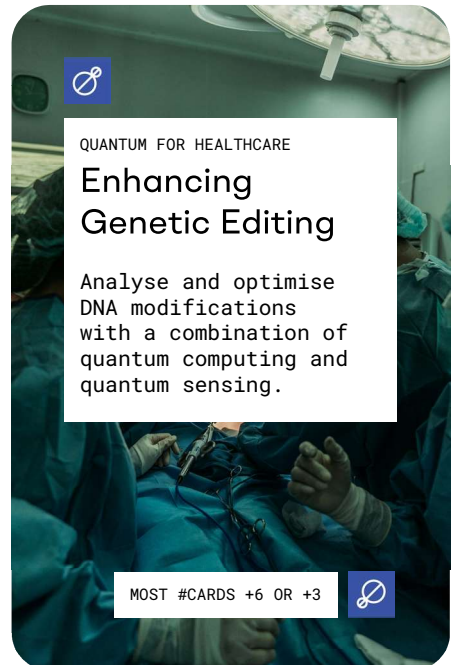


QUANTUM FOR HEALTHCARE

Developing New Medicine

Accelerate the design, testing, and optimisation of new medicines and vaccines with quantum computing.

MOST #CARDS +6 OR +3 



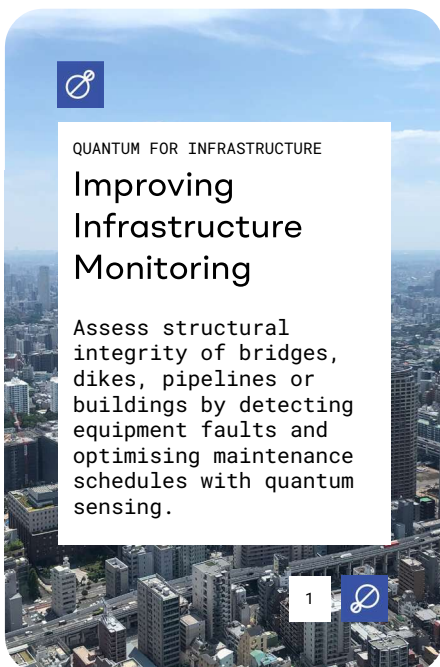


QUANTUM FOR HEALTHCARE

Enhancing Genetic Editing

Analyse and optimise DNA modifications with a combination of quantum computing and quantum sensing.

MOST #CARDS +6 OR +3 



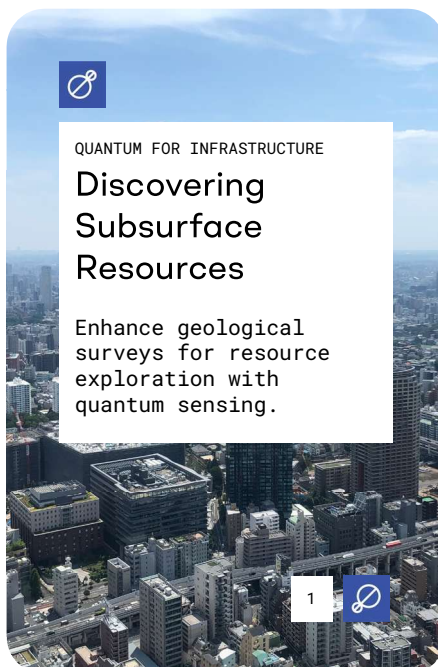


QUANTUM FOR INFRASTRUCTURE

Improving Infrastructure Monitoring

Assess structural integrity of bridges, dikes, pipelines or buildings by detecting equipment faults and optimising maintenance schedules with quantum sensing.

1 





QUANTUM FOR INFRASTRUCTURE

Discovering Subsurface Resources

Enhance geological surveys for resource exploration with quantum sensing.

1 



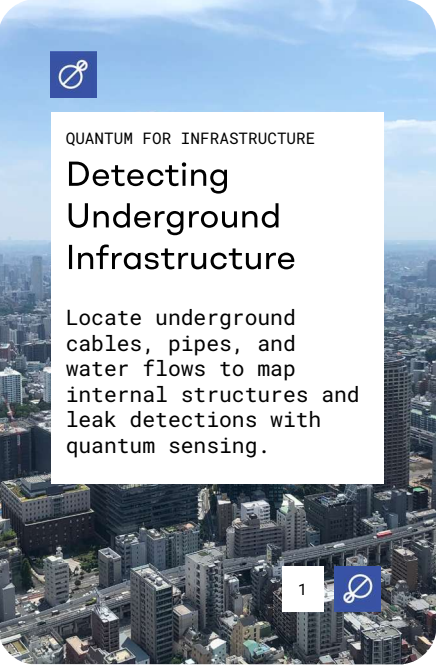


QUANTUM FOR INFRASTRUCTURE

Improving Land Management

Assess soil health, measure soil moisture, and optimise water usage and agricultural practices with quantum sensing.

1 





QUANTUM FOR INFRASTRUCTURE

Detecting Underground Infrastructure

Locate underground cables, pipes, and water flows to map internal structures and leak detections with quantum sensing.

1 



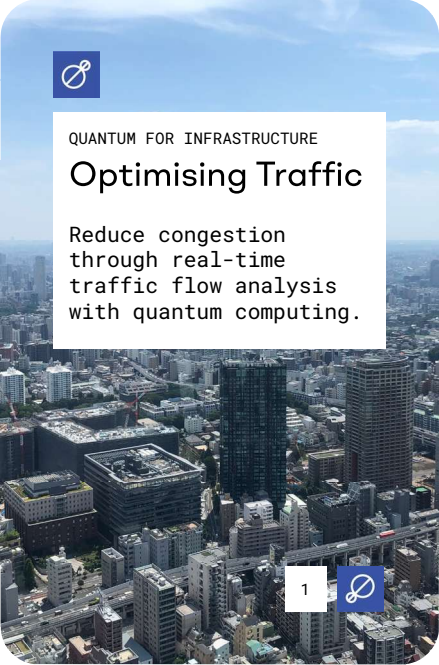


QUANTUM FOR INFRASTRUCTURE

Optimising Disaster Response

Enhance real-time monitoring and early disaster warning systems with quantum sensing.

1 



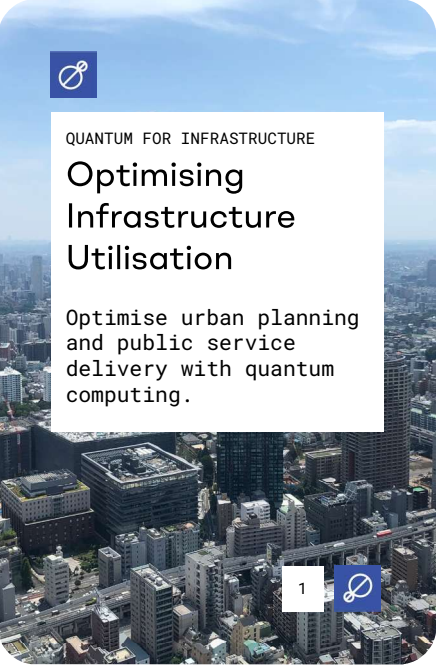


QUANTUM FOR INFRASTRUCTURE

Optimising Traffic

Reduce congestion through real-time traffic flow analysis with quantum computing.

1 



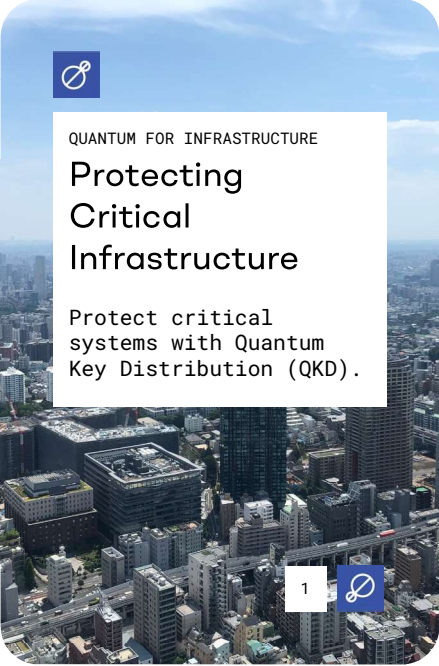


QUANTUM FOR INFRASTRUCTURE

Optimising Infrastructure Utilisation

Optimise urban planning and public service delivery with quantum computing.

1 



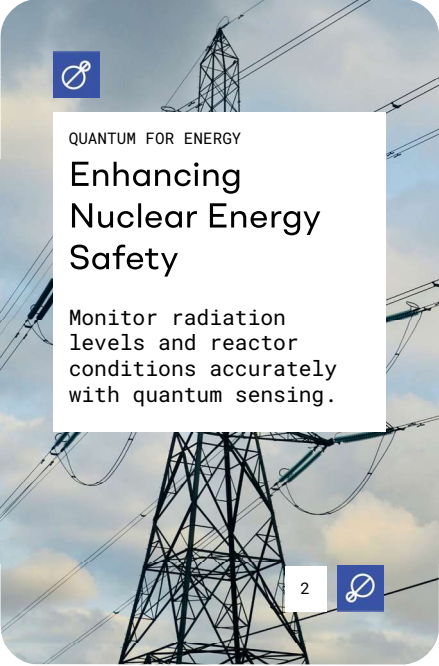


QUANTUM FOR INFRASTRUCTURE

Protecting Critical Infrastructure

Protect critical systems with Quantum Key Distribution (QKD).

1 



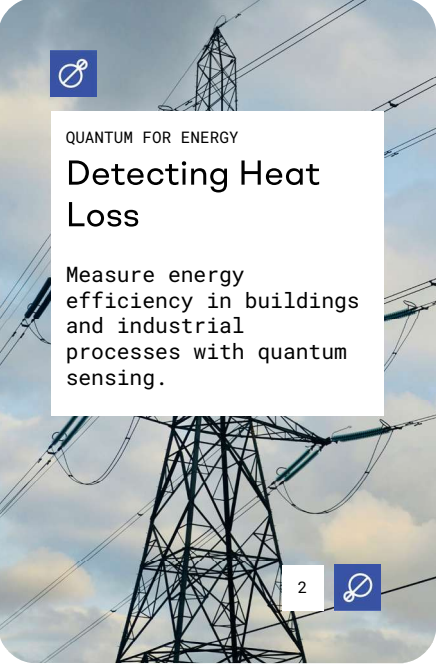


QUANTUM FOR ENERGY

Enhancing Nuclear Energy Safety

Monitor radiation levels and reactor conditions accurately with quantum sensing.

2 



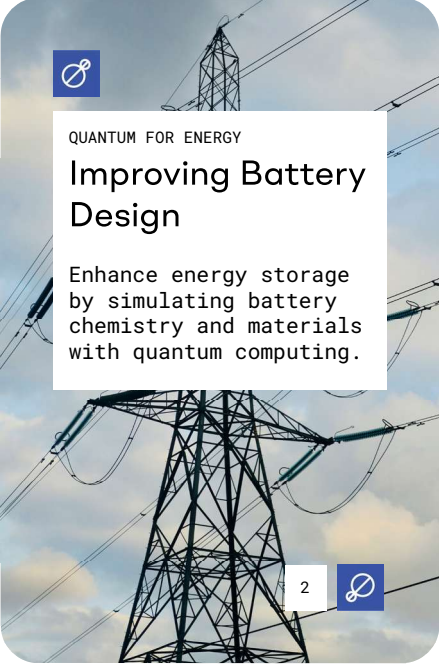


QUANTUM FOR ENERGY

Detecting Heat Loss

Measure energy efficiency in buildings and industrial processes with quantum sensing.

2 



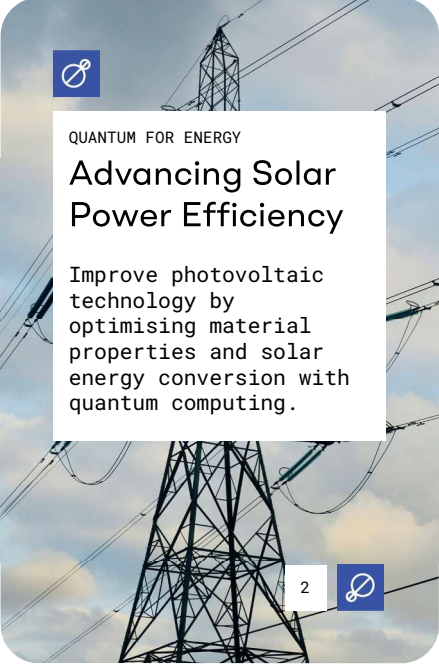


QUANTUM FOR ENERGY

Improving Battery Design

Enhance energy storage by simulating battery chemistry and materials with quantum computing.

2 



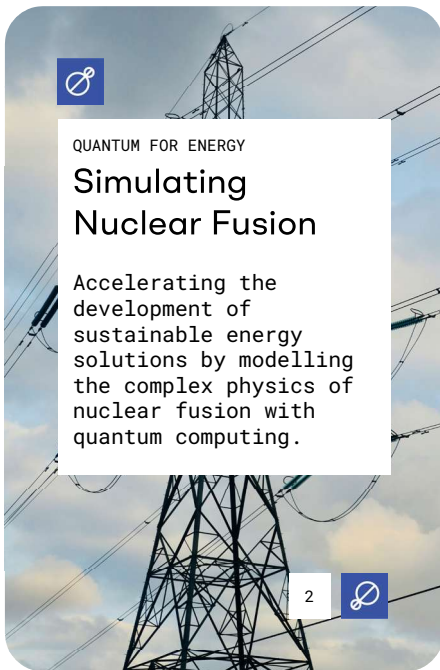


QUANTUM FOR ENERGY

Advancing Solar Power Efficiency

Improve photovoltaic technology by optimising material properties and solar energy conversion with quantum computing.

2 



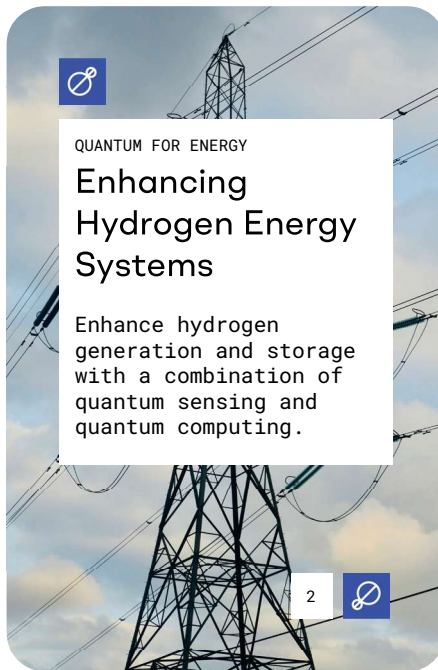


QUANTUM FOR ENERGY

Simulating Nuclear Fusion

Accelerating the development of sustainable energy solutions by modelling the complex physics of nuclear fusion with quantum computing.

2 



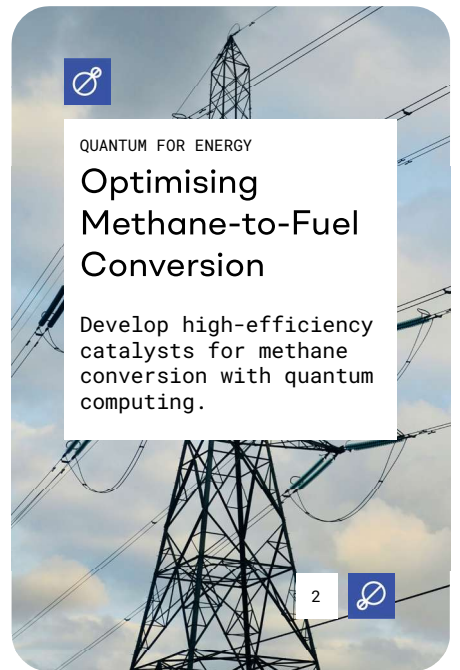


QUANTUM FOR ENERGY

Enhancing Hydrogen Energy Systems

Enhance hydrogen generation and storage with a combination of quantum sensing and quantum computing.

2 



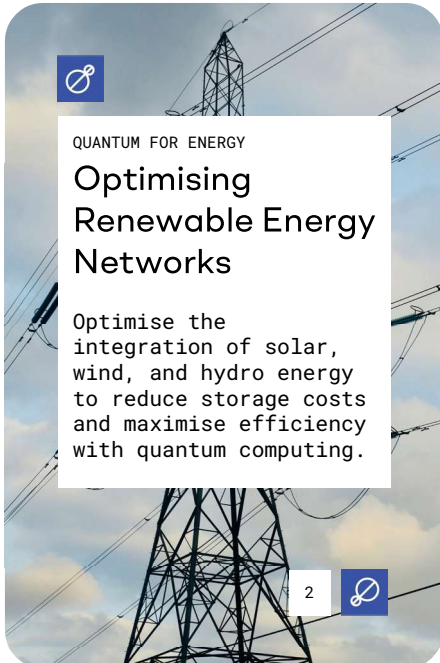


QUANTUM FOR ENERGY

Optimising Methane-to-Fuel Conversion

Develop high-efficiency catalysts for methane conversion with quantum computing.

2 



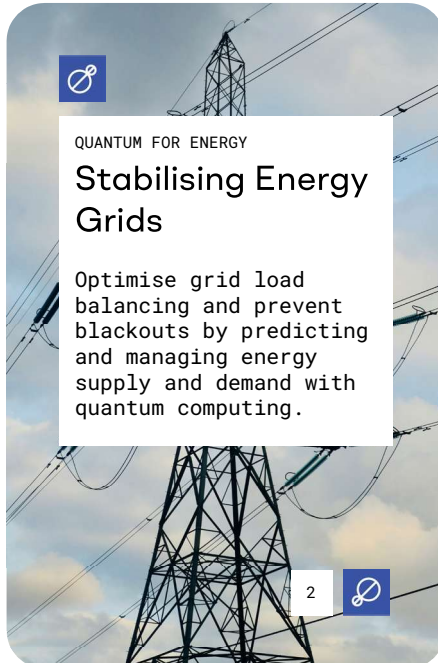


QUANTUM FOR ENERGY

Optimising Renewable Energy Networks

Optimise the integration of solar, wind, and hydro energy to reduce storage costs and maximise efficiency with quantum computing.

2 



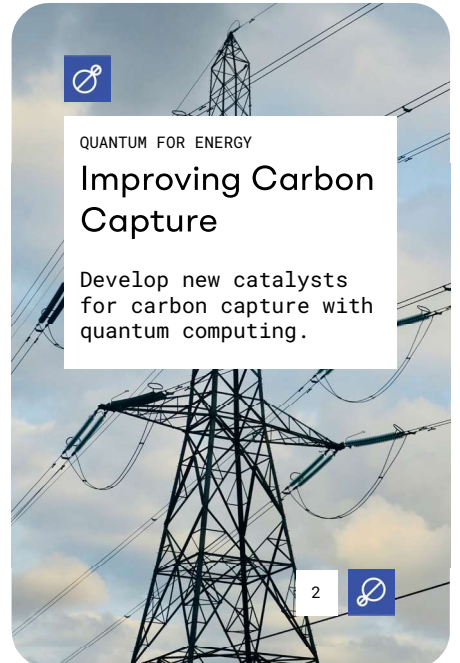


QUANTUM FOR ENERGY

Stabilising Energy Grids

Optimise grid load balancing and prevent blackouts by predicting and managing energy supply and demand with quantum computing.

2 



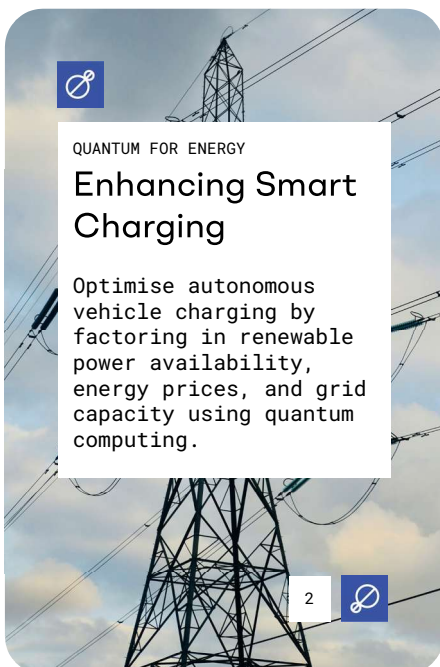


QUANTUM FOR ENERGY

Improving Carbon Capture

Develop new catalysts for carbon capture with quantum computing.

2 



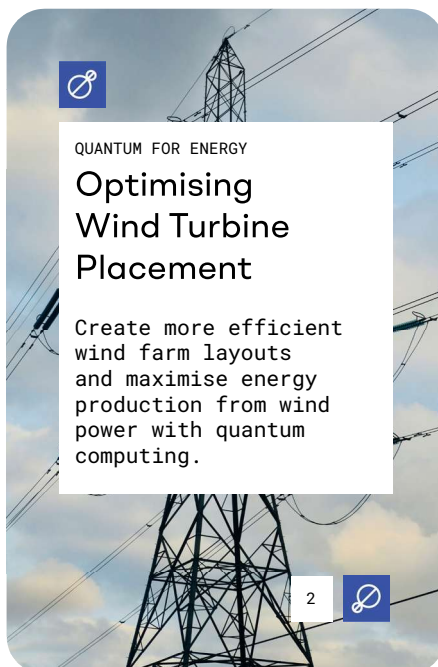


QUANTUM FOR ENERGY

Enhancing Smart Charging

Optimise autonomous vehicle charging by factoring in renewable power availability, energy prices, and grid capacity using quantum computing.

2 



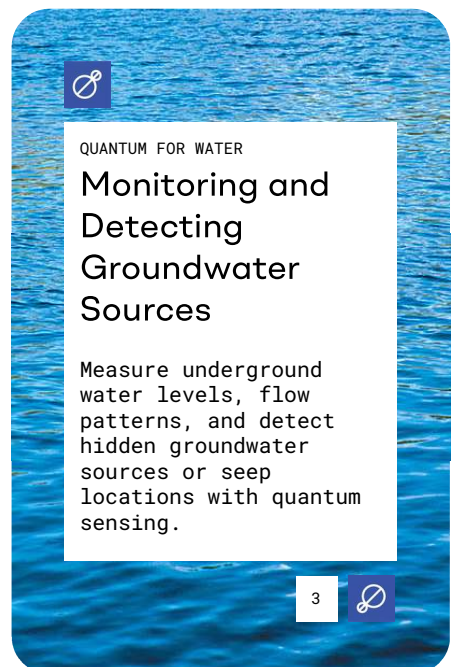


QUANTUM FOR ENERGY

Optimising Wind Turbine Placement

Create more efficient wind farm layouts and maximise energy production from wind power with quantum computing.

2 





QUANTUM FOR WATER

Monitoring and Detecting Groundwater Sources

Measure underground water levels, flow patterns, and detect hidden groundwater sources or seep locations with quantum sensing.

3 



QUANTUM FOR WATER

Simulating Hydrological Flows

Model river systems, groundwater, and water interactions, such as precipitation, evaporation, infiltration, and runoff, with quantum computing.

3





QUANTUM FOR WATER

Detecting Early Coastal Erosion

Enhance Earth’s surface observations and monitor environmental changes of coastlines with quantum sensing.

3





QUANTUM FOR WATER

Optimising Lock Management

Ensure optimal water levels by efficiently planning and managing water flows through locks in rivers, canals, and lakes with quantum computing.

3





QUANTUM FOR WATER

Improving Real-Time Water Safety

Monitor real-time water retention, pH levels, chlorophyll, and nutrient concentrations using quantum sensing, and predict contamination events with quantum computing.

3





QUANTUM FOR WATER

Optimising Water Purification and Desalination

Optimise wastewater treatment processes, break down persistent pollutants as PFAS, and advance desalination membranes with a combination of quantum computing and quantum sensing.

3





QUANTUM FOR WATER

Improving Ocean and Marine Research

Study ocean currents, salinity, and marine ecosystems through high-resolution monitoring of underwater environments and ocean dynamics with quantum sensing.

3





QUANTUM FOR WATER

Sizing Rainwater Harvesting Systems

Optimise the size of rainwater harvesting systems, balancing cost, supply reliability, and water quality in diverse infrastructures with quantum computing.

3





QUANTUM FOR WATER

Improving Climate Data Collection

Detect ice and water mass changes, water movement and ocean circulation with quantum sensing.

3





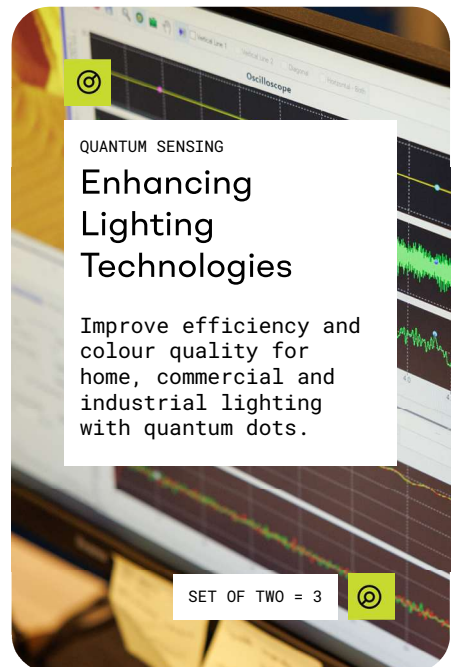
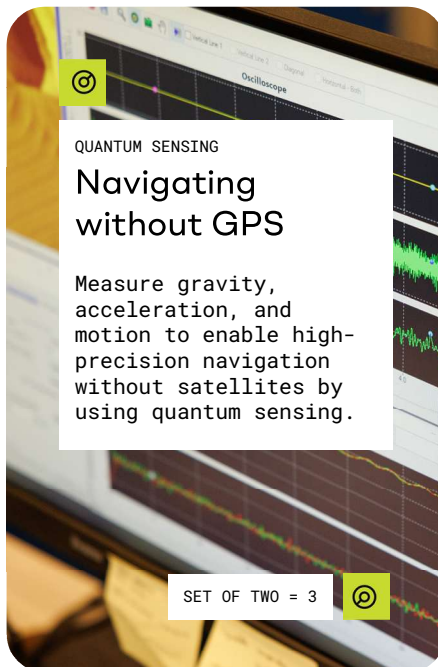
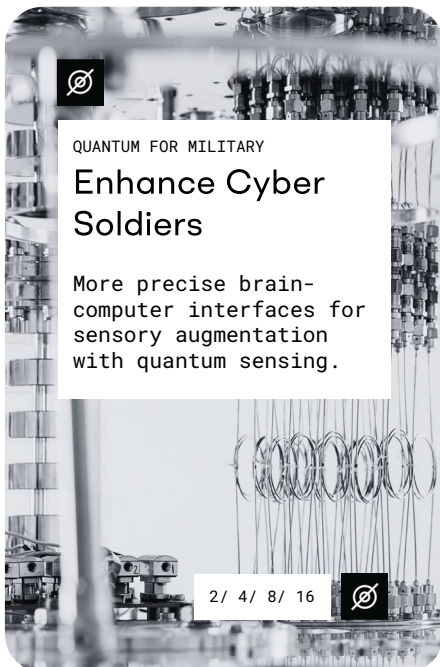
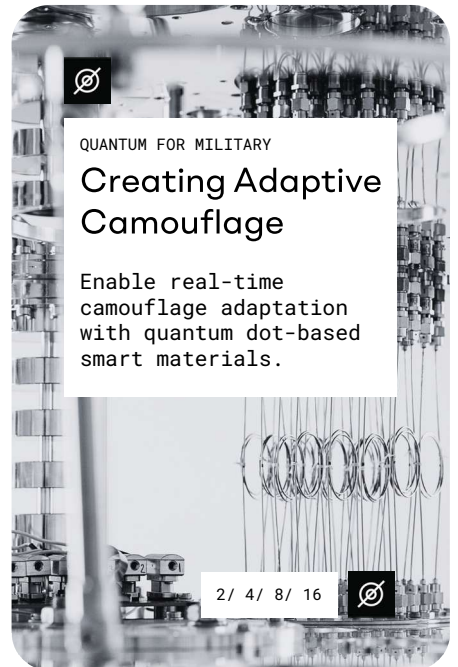
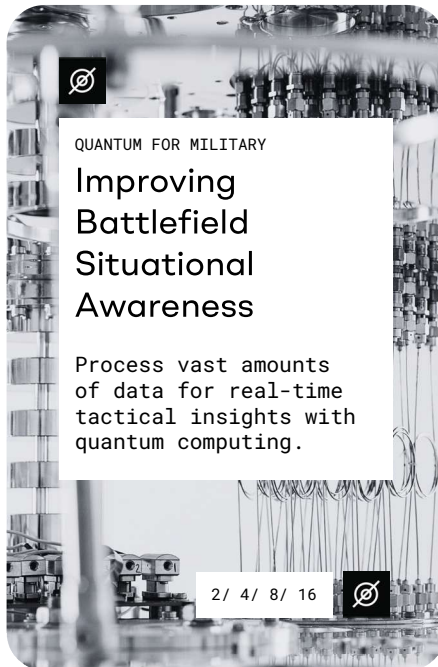
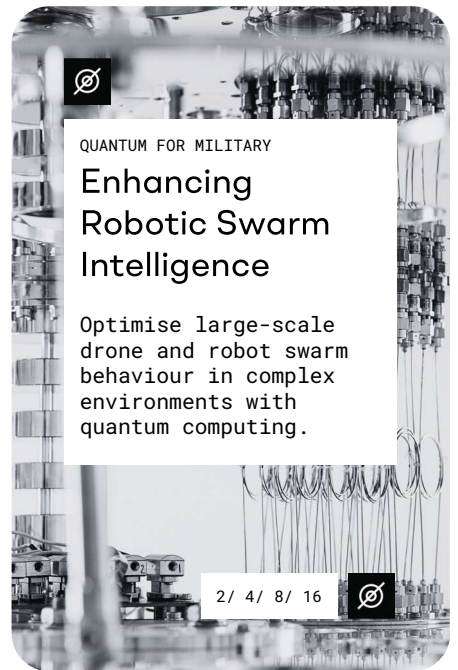
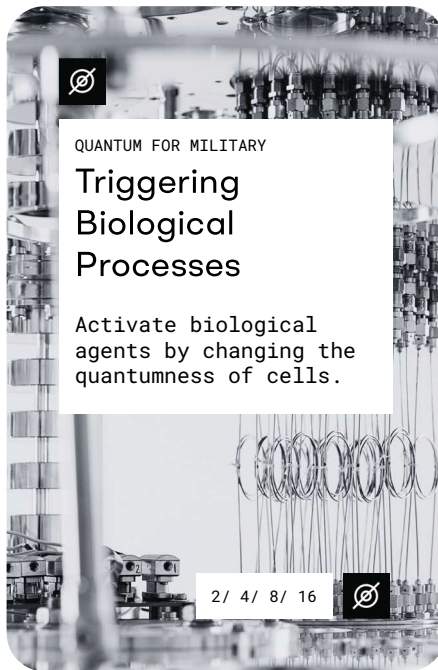
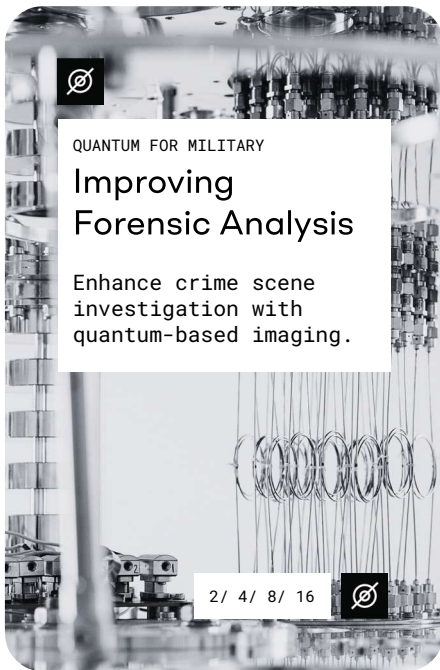
QUANTUM FOR MILITARY

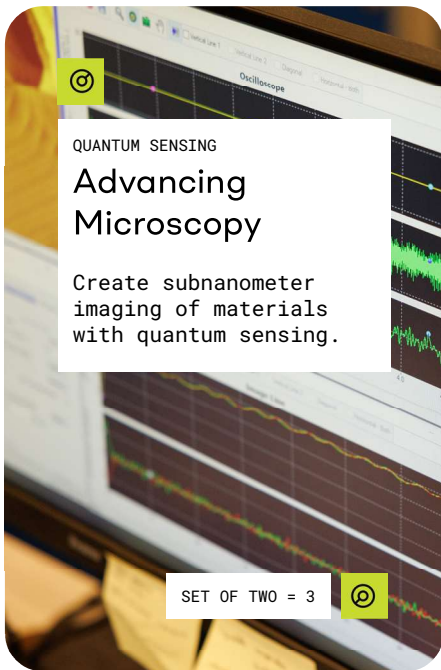
Enhancing Surveillance Systems

Improve pattern recognition in video footage with quantum computing.

2 / 4 / 8 / 16





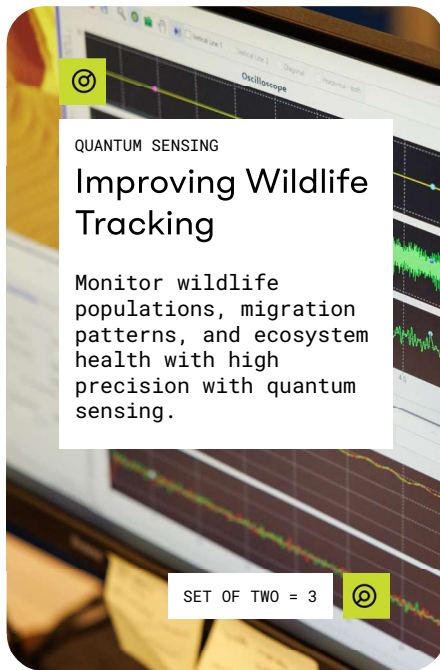


QUANTUM SENSING

Advancing Microscopy

Create subnanometer imaging of materials with quantum sensing.

SET OF TWO = 3

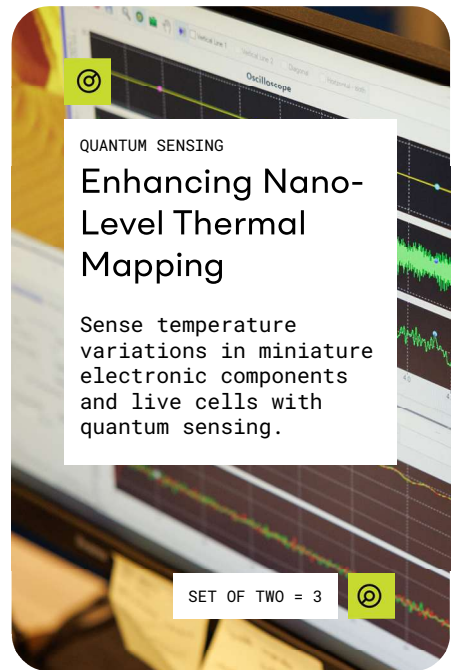


QUANTUM SENSING

Improving Wildlife Tracking

Monitor wildlife populations, migration patterns, and ecosystem health with high precision with quantum sensing.

SET OF TWO = 3



QUANTUM SENSING

Enhancing Nano-Level Thermal Mapping

Sense temperature variations in miniature electronic components and live cells with quantum sensing.

SET OF TWO = 3

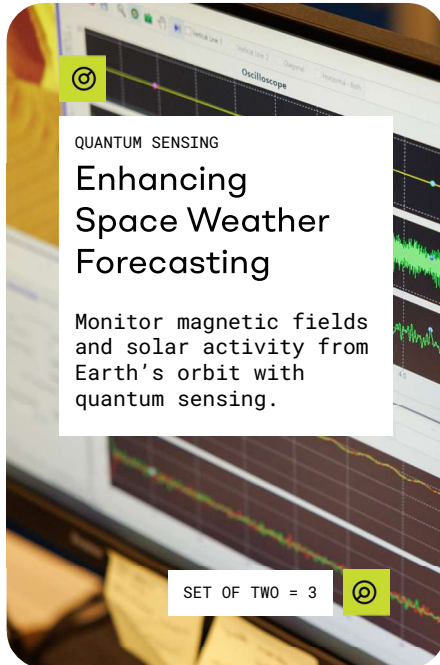


QUANTUM SENSING

Measuring Air Quality

Enhance pollutant detection with quantum sensing.

SET OF TWO = 3

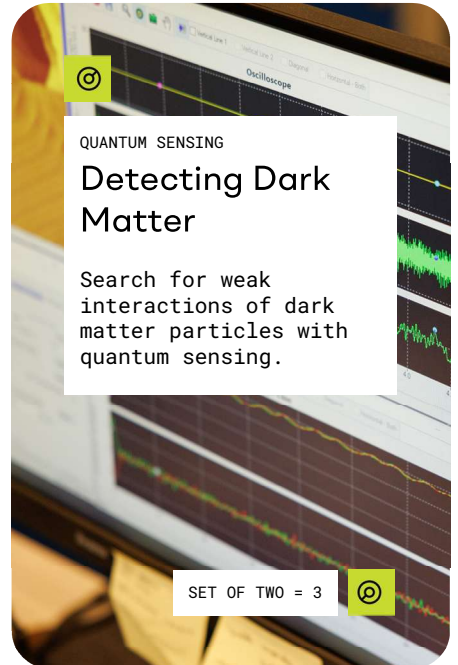


QUANTUM SENSING

Enhancing Space Weather Forecasting

Monitor magnetic fields and solar activity from Earth's orbit with quantum sensing.

SET OF TWO = 3

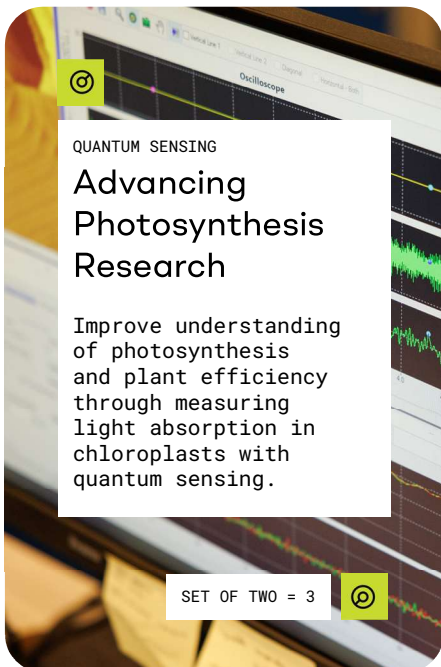


QUANTUM SENSING

Detecting Dark Matter

Search for weak interactions of dark matter particles with quantum sensing.

SET OF TWO = 3

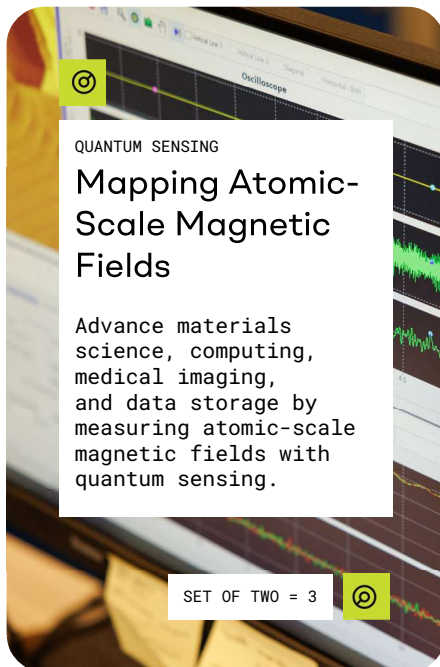


QUANTUM SENSING

Advancing Photosynthesis Research

Improve understanding of photosynthesis and plant efficiency through measuring light absorption in chloroplasts with quantum sensing.

SET OF TWO = 3

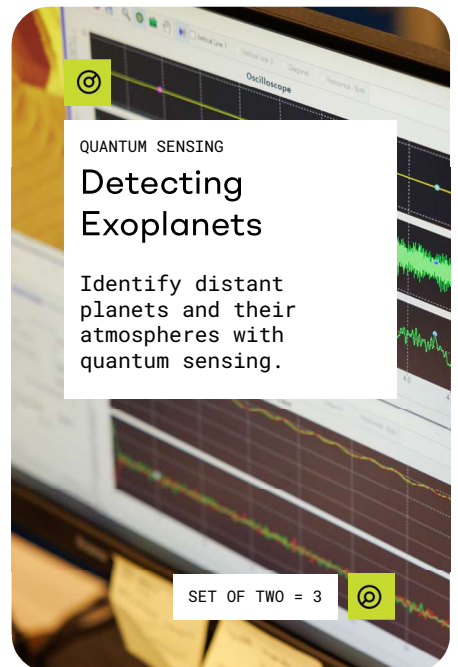


QUANTUM SENSING

Mapping Atomic-Scale Magnetic Fields

Advance materials science, computing, medical imaging, and data storage by measuring atomic-scale magnetic fields with quantum sensing.

SET OF TWO = 3

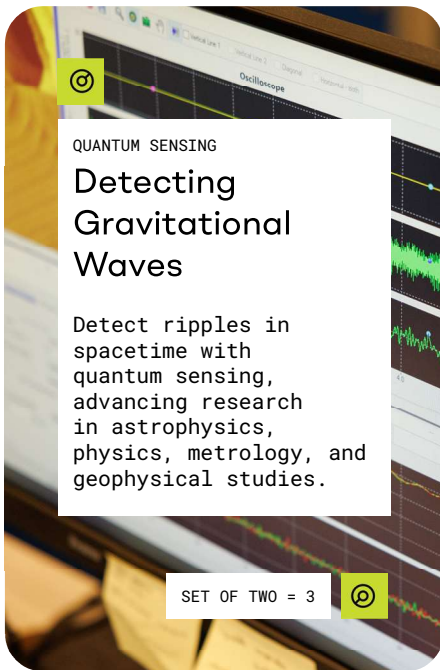


QUANTUM SENSING

Detecting Exoplanets

Identify distant planets and their atmospheres with quantum sensing.

SET OF TWO = 3

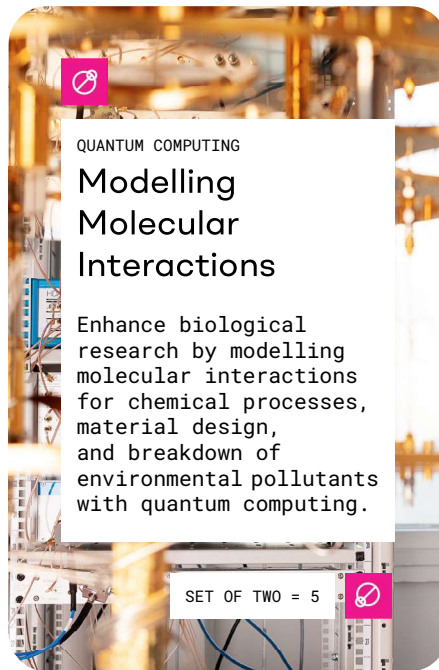


QUANTUM SENSING

Detecting Gravitational Waves

Detect ripples in spacetime with quantum sensing, advancing research in astrophysics, physics, metrology, and geophysical studies.

SET OF TWO = 3

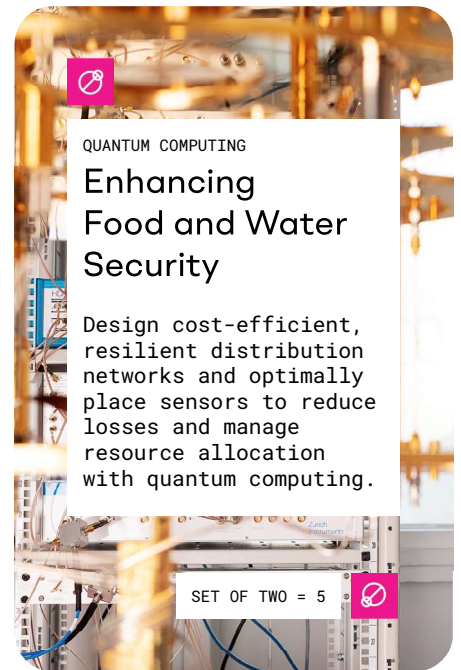


QUANTUM COMPUTING

Modelling Molecular Interactions

Enhance biological research by modelling molecular interactions for chemical processes, material design, and breakdown of environmental pollutants with quantum computing.

SET OF TWO = 5

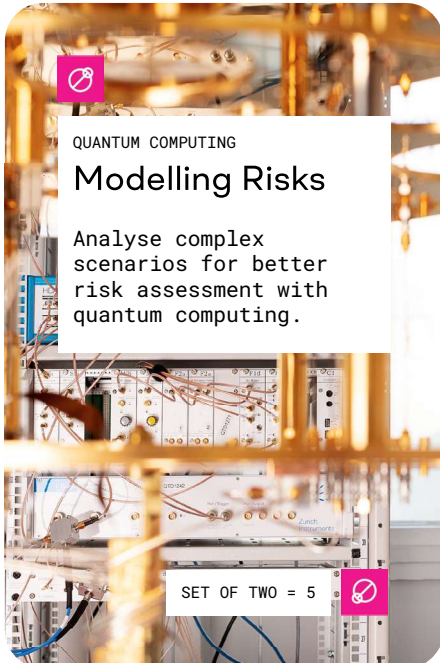


QUANTUM COMPUTING

Enhancing Food and Water Security

Design cost-efficient, resilient distribution networks and optimally place sensors to reduce losses and manage resource allocation with quantum computing.

SET OF TWO = 5

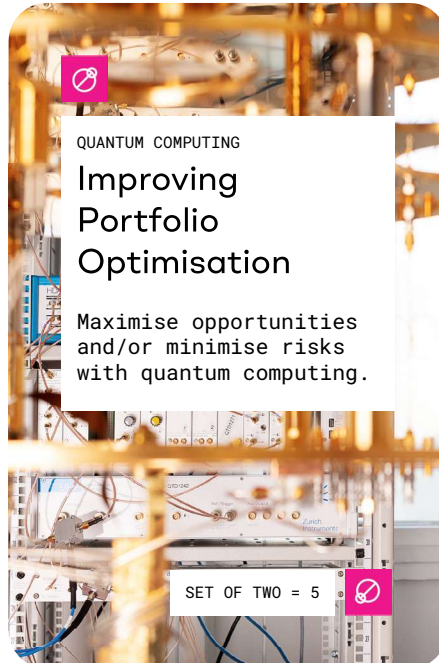


QUANTUM COMPUTING

Modelling Risks

Analyse complex scenarios for better risk assessment with quantum computing.

SET OF TWO = 5



QUANTUM COMPUTING

Improving Portfolio Optimisation

Maximise opportunities and/or minimise risks with quantum computing.

SET OF TWO = 5

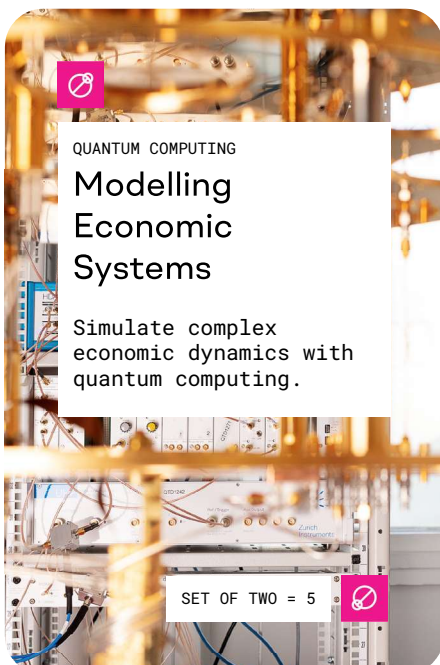


QUANTUM COMPUTING

Developing New Materials

Simulate molecular structures for advanced material design with quantum computing.

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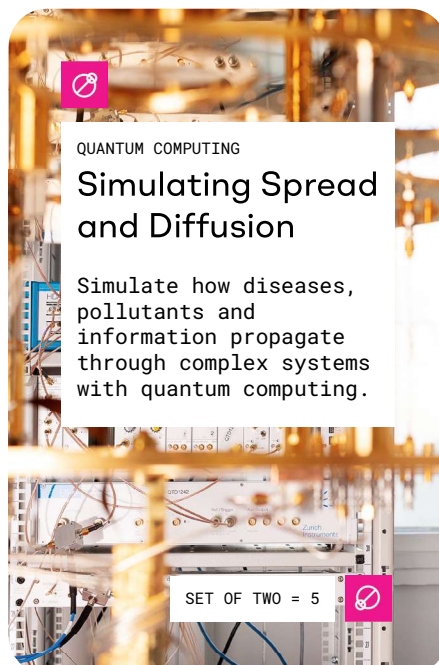


QUANTUM COMPUTING

Modelling Economic Systems

Simulate complex economic dynamics with quantum computing.

SET OF TWO = 5

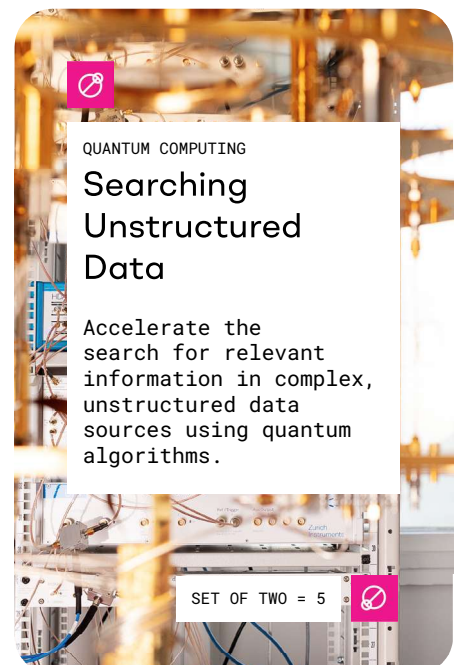


QUANTUM COMPUTING

Simulating Spread and Diffusion

Simulate how diseases, pollutants and information propagate through complex systems with quantum computing.

SET OF TWO = 5

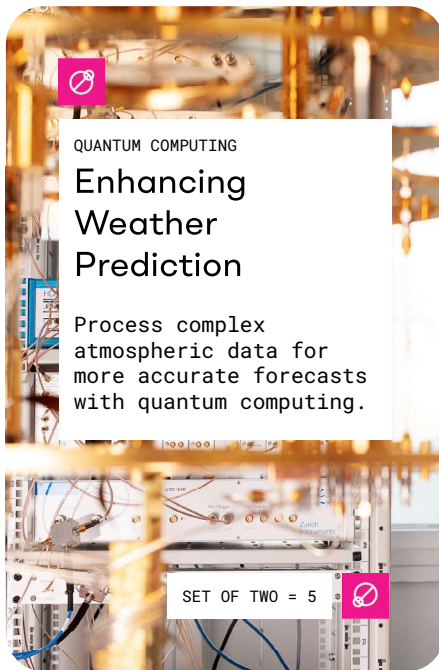


QUANTUM COMPUTING

Searching Unstructured Data

Accelerate the search for relevant information in complex, unstructured data sources using quantum algorithms.

SET OF TWO = 5

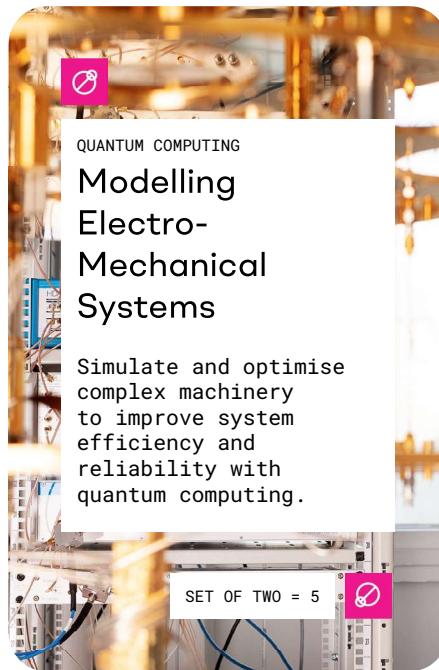


 QUANTUM COMPUTING

Enhancing Weather Prediction

Process complex atmospheric data for more accurate forecasts with quantum computing.

SET OF TWO = 5 

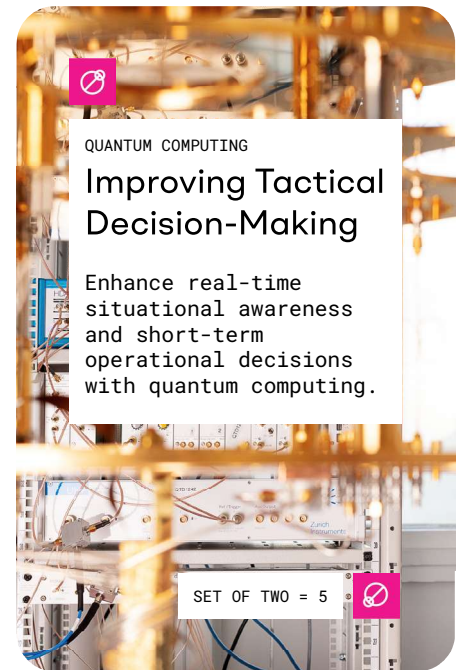


 QUANTUM COMPUTING

Modelling Electro-Mechanical Systems

Simulate and optimise complex machinery to improve system efficiency and reliability with quantum computing.

SET OF TWO = 5 

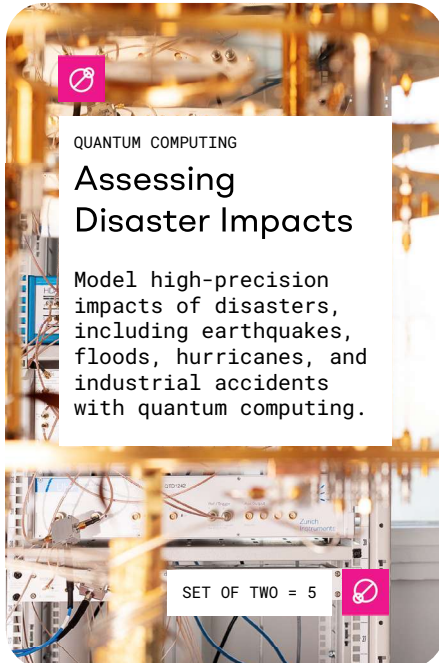


 QUANTUM COMPUTING

Improving Tactical Decision-Making

Enhance real-time situational awareness and short-term operational decisions with quantum computing.

SET OF TWO = 5 

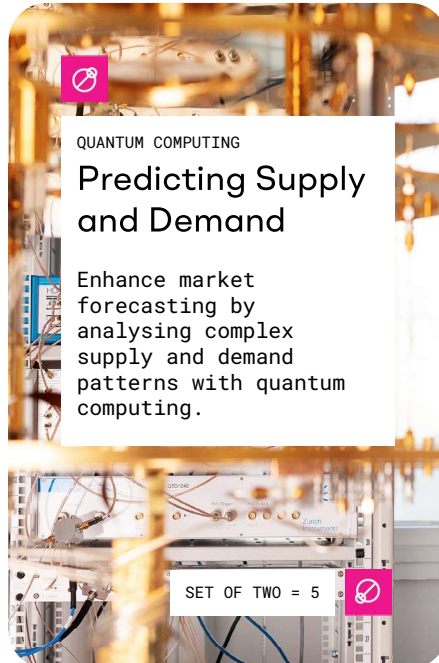


 QUANTUM COMPUTING

Assessing Disaster Impacts

Model high-precision impacts of disasters, including earthquakes, floods, hurricanes, and industrial accidents with quantum computing.

SET OF TWO = 5 

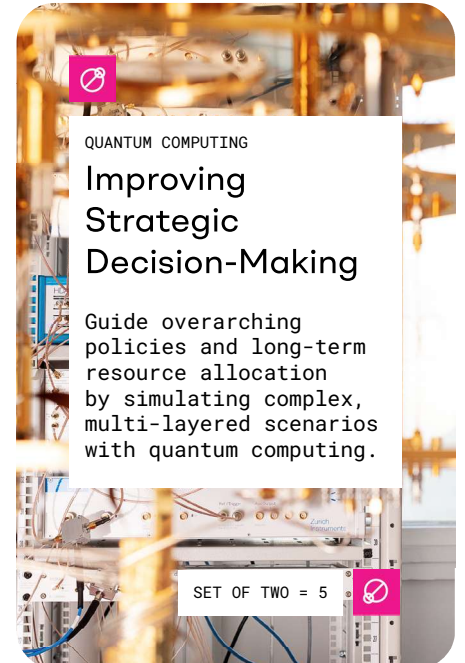


 QUANTUM COMPUTING

Predicting Supply and Demand

Enhance market forecasting by analysing complex supply and demand patterns with quantum computing.

SET OF TWO = 5 

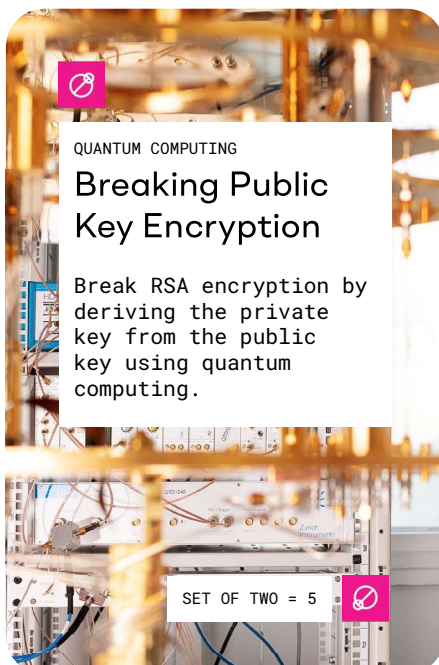


 QUANTUM COMPUTING

Improving Strategic Decision-Making

Guide overarching policies and long-term resource allocation by simulating complex, multi-layered scenarios with quantum computing.

SET OF TWO = 5 

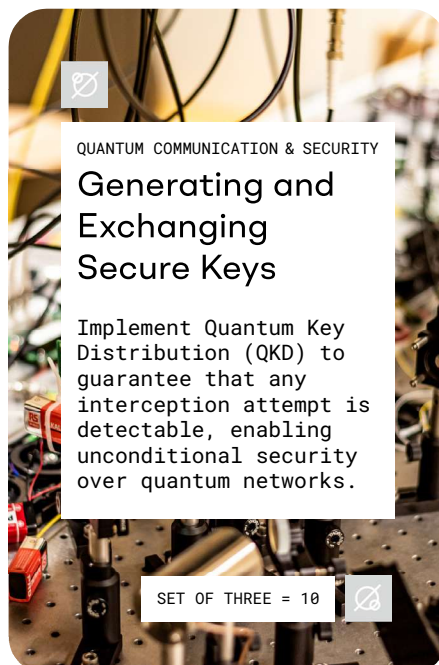


 QUANTUM COMPUTING

Breaking Public Key Encryption

Break RSA encryption by deriving the private key from the public key using quantum computing.

SET OF TWO = 5 



 QUANTUM COMMUNICATION & SECURITY

Generating and Exchanging Secure Keys

Implement Quantum Key Distribution (QKD) to guarantee that any interception attempt is detectable, enabling unconditional security over quantum networks.

SET OF THREE = 10 

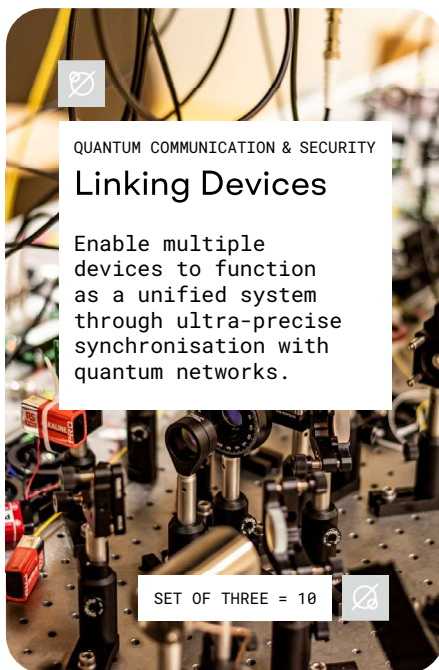


 QUANTUM COMMUNICATION & SECURITY

Verifying Sender's Location

Validate a sender's location and prevent spoofing with Quantum Position Verification.

SET OF THREE = 10 

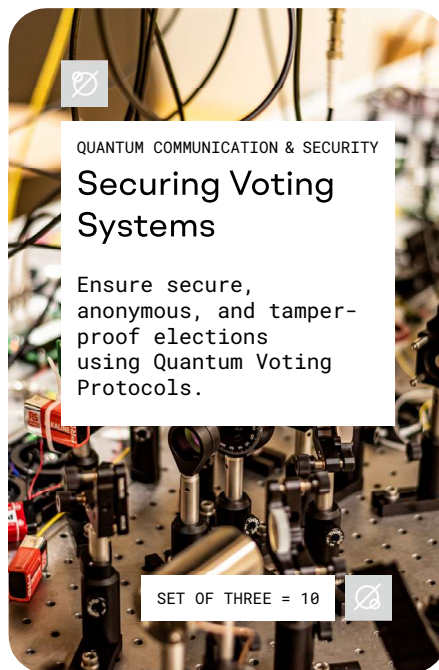


QUANTUM COMMUNICATION & SECURITY

Linking Devices

Enable multiple devices to function as a unified system through ultra-precise synchronisation with quantum networks.

SET OF THREE = 10

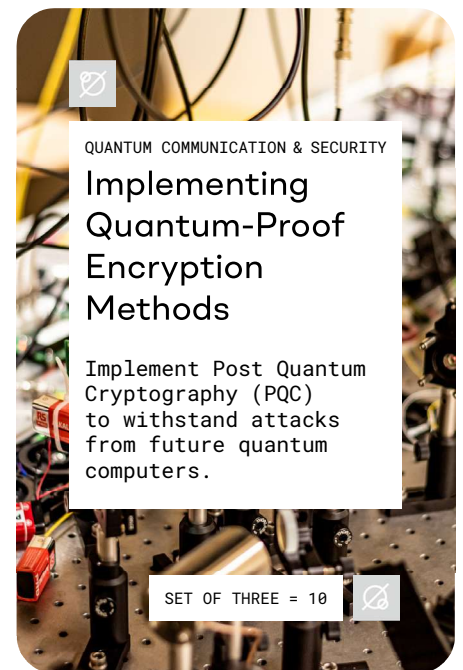


QUANTUM COMMUNICATION & SECURITY

Securing Voting Systems

Ensure secure, anonymous, and tamper-proof elections using Quantum Voting Protocols.

SET OF THREE = 10

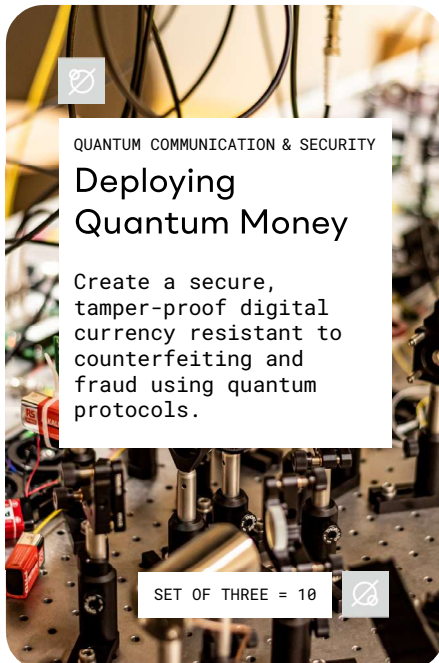


QUANTUM COMMUNICATION & SECURITY

Implementing Quantum-Proof Encryption Methods

Implement Post Quantum Cryptography (PQC) to withstand attacks from future quantum computers.

SET OF THREE = 10



QUANTUM COMMUNICATION & SECURITY

Deploying Quantum Money

Create a secure, tamper-proof digital currency resistant to counterfeiting and fraud using quantum protocols.

SET OF THREE = 10

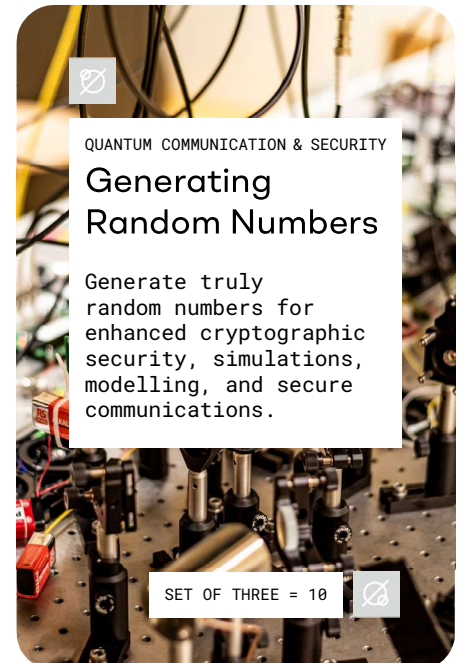


QUANTUM COMMUNICATION & SECURITY

Enhancing Digital Signatures

Create tamper-proof, unforgeable digital signatures for secure authentication and document verification using quantum protocols.

SET OF THREE = 10

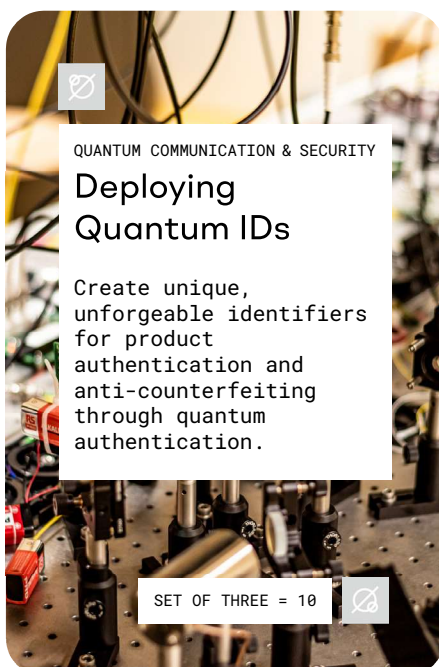


QUANTUM COMMUNICATION & SECURITY

Generating Random Numbers

Generate truly random numbers for enhanced cryptographic security, simulations, modelling, and secure communications.

SET OF THREE = 10



QUANTUM COMMUNICATION & SECURITY

Deploying Quantum IDs

Create unique, unforgeable identifiers for product authentication and anti-counterfeiting through quantum authentication.

SET OF THREE = 10



QUANTUM COMMUNICATION & SECURITY

Boost Cyber Capabilities

Enhance both cyberattacks and network protection by rapidly scanning for vulnerabilities with quantum computing.

SET OF THREE = 10



CRITICAL MATERIALS FOR QUANTUM

Superconducting Processors

Requires niobium titanium nitride (NbTiN) and aluminium oxide (Al_2O_3).

MOST/LEAST CARDS +6/-6



CRITICAL MATERIALS FOR QUANTUM

Semiconductor Processors

Requires germanium-73 (Ge-73) and silicon-28 (Si-28).

MOST/LEAST CARDS +6/-6



CRITICAL MATERIALS FOR QUANTUM

Cold Atom Processors and Memory

Requires rubidium-87 (Rb-87), cesium-133 (Cs-133), and strontium-87 (Sr-87).

MOST/LEAST CARDS +6/-6



CRITICAL MATERIALS FOR QUANTUM

Photonic Processors and Memory

Requires lithium niobate (LiNbO_3), silicon nitride (SiN), and barium titanate (BaTiO_3).

MOST/LEAST CARDS +6/-6



CRITICAL MATERIALS FOR QUANTUM

Colour Centre Memory

Requires diamond (C), silicon carbide (SiC), and silicon-28 (Si-28).

MOST/LEAST CARDS +6/-6



CRITICAL MATERIALS FOR QUANTUM

Topological Processors

Requires niobium diselenide (NbSe_2), niobium titanium nitride (NbTiN), and indium antimonide (InSb) to create superconducting topological states for Majorana-based qubits.

MOST/LEAST CARDS +6/-6



CRITICAL MATERIALS FOR QUANTUM

Photonic Components

Requires silicon nitride (SiN), gallium arsenide (GaAs), indium phosphide (InP), lithium niobate (LiNbO_3), and indium gallium arsenide (InGaAs).

MOST/LEAST CARDS +6/-6



CRITICAL MATERIALS FOR QUANTUM

Electronic Components

Requires silicon carbide (SiC), indium gallium arsenide (InGaAs), gallium arsenide (GaAs), indium antimonide (InSb), indium phosphide (InP), and aluminium oxide (Al_2O_3).

MOST/LEAST CARDS +6/-6



CRITICAL MATERIALS FOR QUANTUM

Cryogenic Components

Requires cupronickel (CuNi), gallium arsenide (GaAs), and helium-3 (He-3).

MOST/LEAST CARDS +6/-6



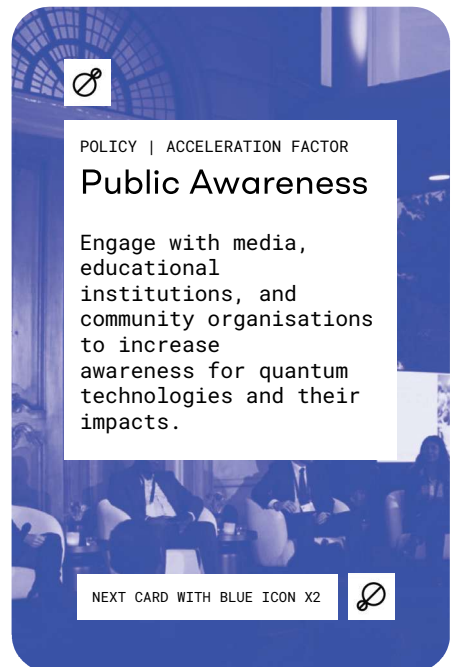
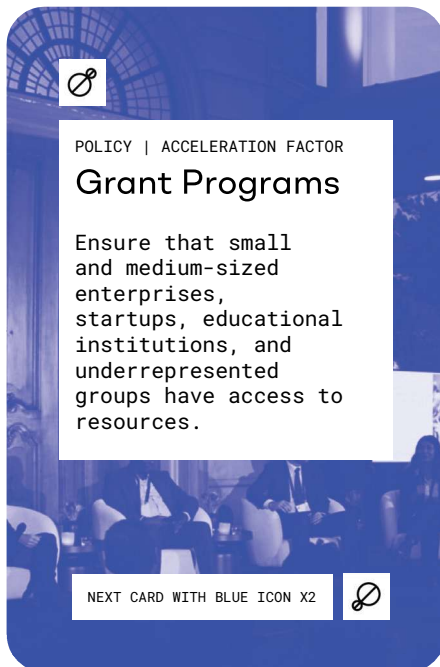
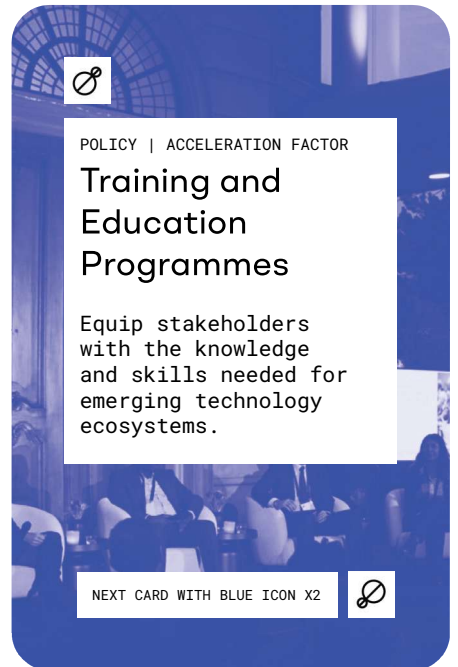
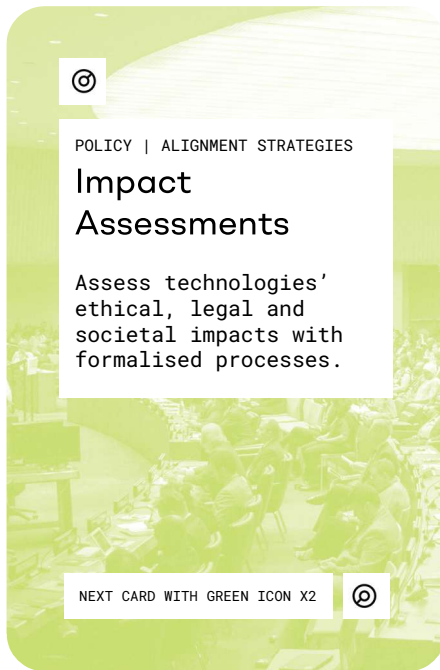
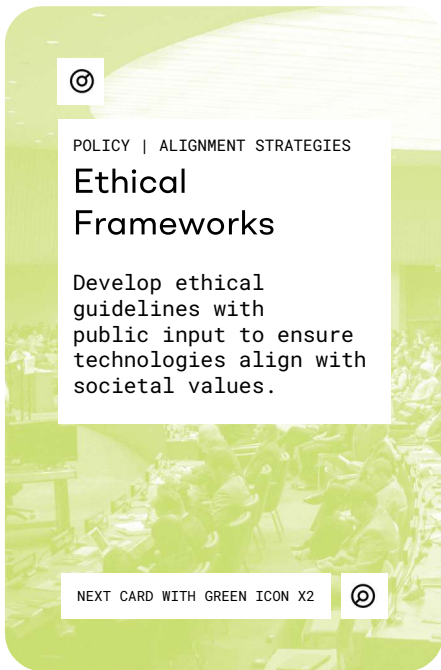
POLICY | ALIGNMENT STRATEGIES

Adaptive Regulatory Frameworks

Have built-in mechanisms for regular review and updates based on stakeholder feedback and technological advancements.

NEXT CARD WITH GREEN ICON X2







POLICY | COLLABORATIONS

Public-Private Collaborations

Forge partnerships between governments, industry, and academia to guide responsible technology development.

NEXT CARD WITH PINK ICON X2





POLICY | COLLABORATIONS

Global Collaborations on Standards

Participate in international bodies to harmonise technology standards.

NEXT CARD WITH PINK ICON X2





POLICY | COLLABORATIONS

Cross-Sector Partnerships

Ensure that technology providers, industry sectors, regulators, and community organisations align their goals with public values.

NEXT CARD WITH PINK ICON X2

