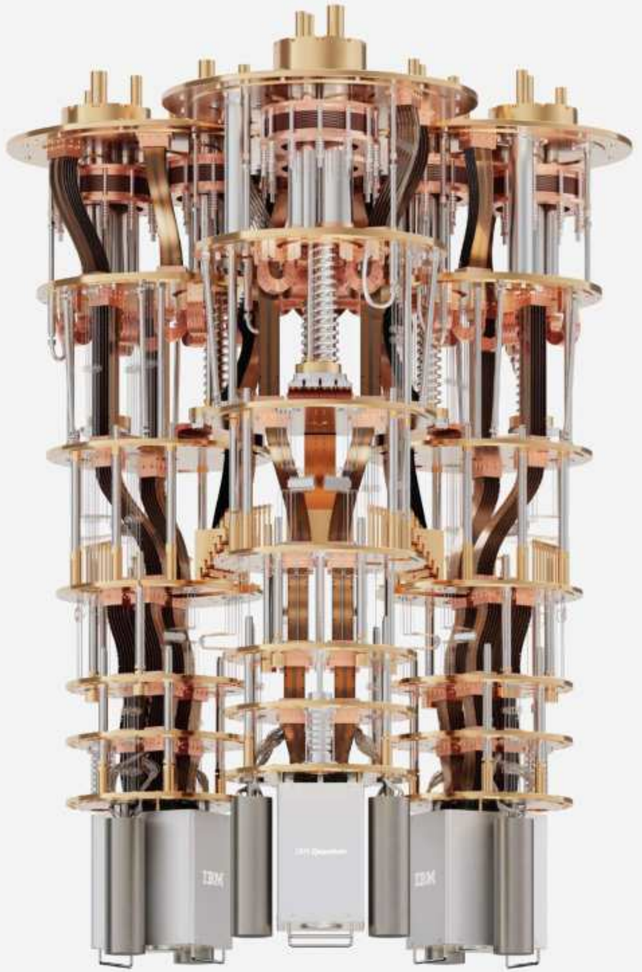
Building a Quantum Economy

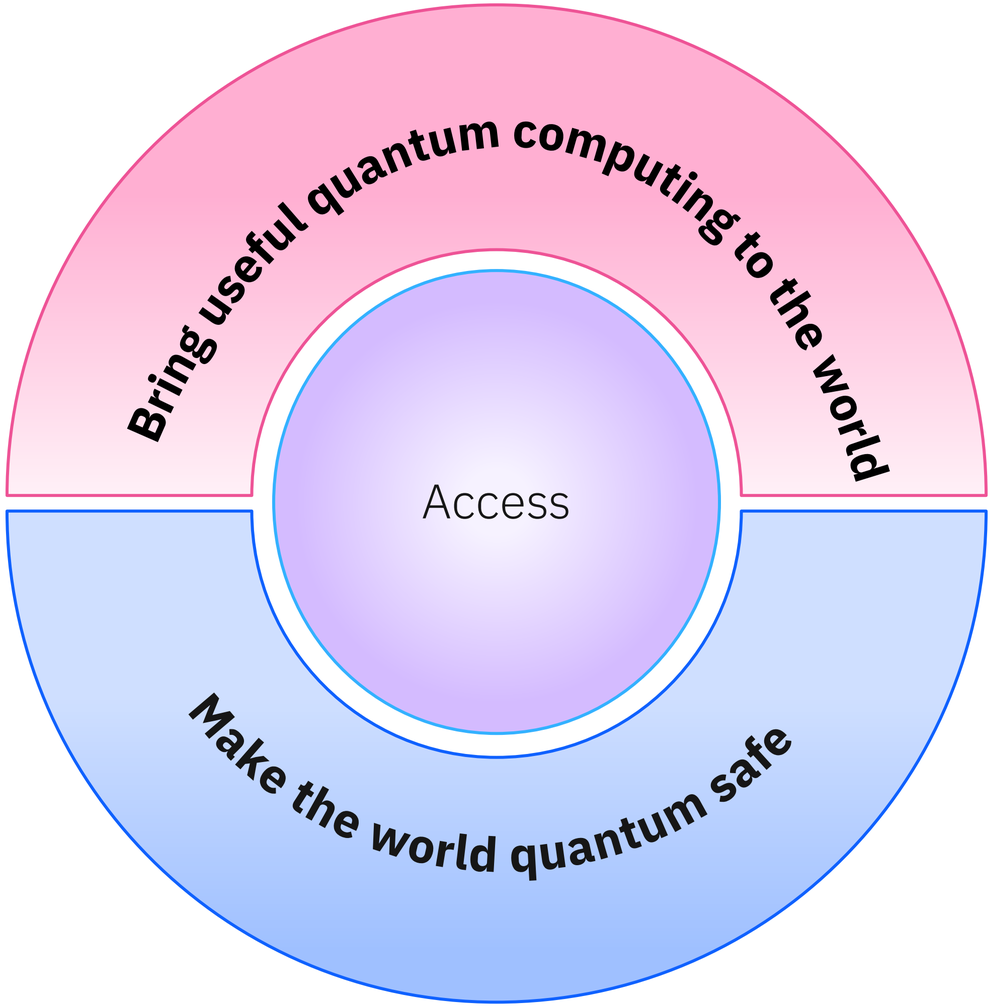


Petra Florizoone
IBM Quantum Global Business Director
IBM Quantum Distinguished Ambassador

IBM **Quantum**

IBM

Our Mission


Bring useful quantum computing to the world
Access
Make the world quantum safe

The new wave of computing

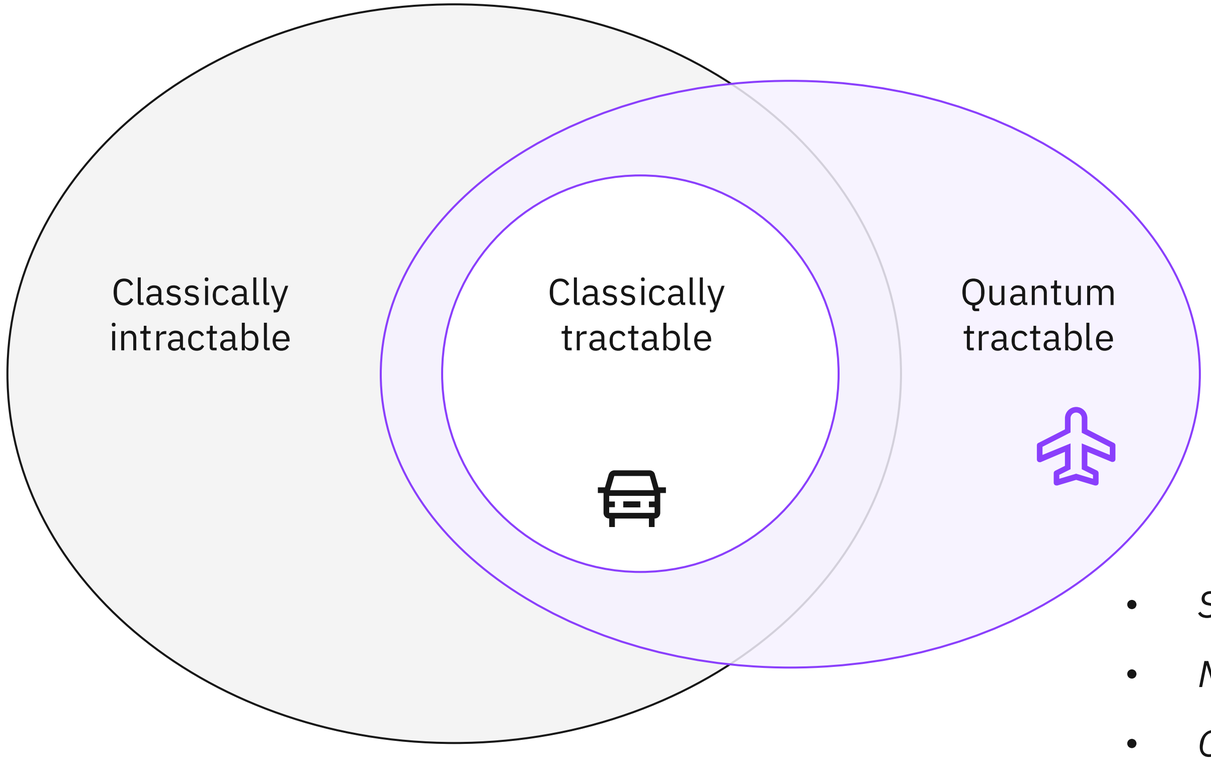
Classical computer
Well suited for many problems

Quantum computer
Unlock classically intractable problems

Unlock discovery with quantum computing

Harnesses the capacity to advance conceptual and tools-based discovery

Quantum computers are exponentially more powerful than classical computers



1. A new way of computing
   New paradigm of problem-solving and thinking
2. Solving new problems
   Unlock classically unsolvable problems, cutting computation time down from hours to minutes
3. Discovery of new use cases
   Expand discovery into new computational spaces

- *Simulating Nature*
- *Machine Learning*
- *Optimization*

Source: https://matt-rickard.com/dyson-tool-driven-scientific-revolutions

What are these problems?

Modeling molecules, atoms, electrons, and quarks with unprecedented accuracy

Developing lighter, longer-lasting batteries for electric vehicles, electronics, and energy grid storage

Designing lighter, stronger materials to allow planes to be more efficient and to need less maintenance

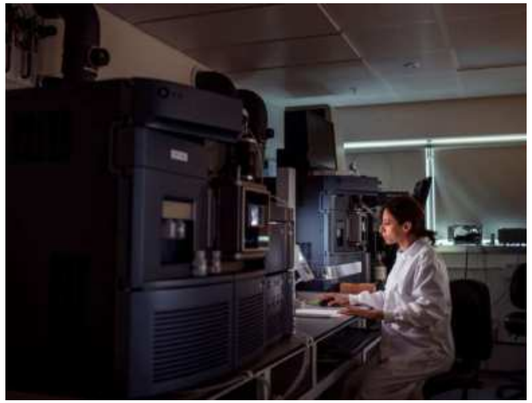
Discovering new classes of antibiotics to counter the emergence of multidrug-resistant bacterial strains

Designing optimal superconductors for MRI, electromobility, and renewable energies

What are these problems?

Solving algebra in [exponential] spaces.
Finding hidden patterns in structured problems.

Improving anomaly detection, as for rare events detection and fraud detection



Improving patient outcomes by designing optimal cell-centric therapeutics

Strengthening risk management through better time series and sequence prediction

Optimizing vehicle routing and scheduling for large-scale logistics networks

Quantum computing is expected to have impact across industries

Example use cases

Nearer Term

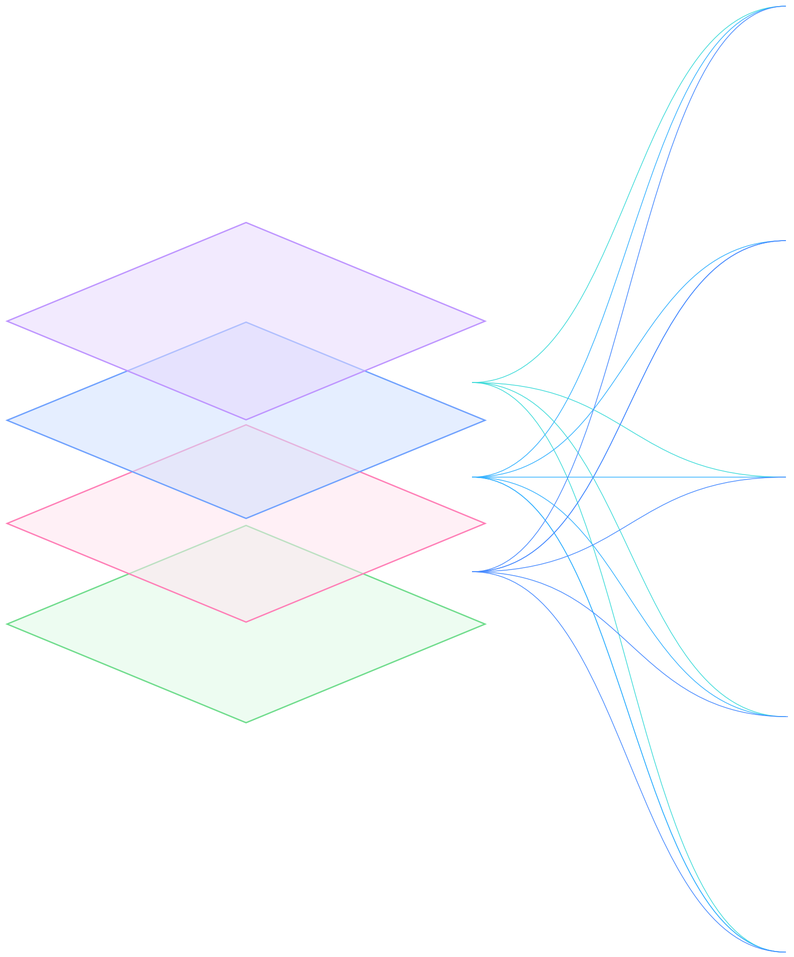
Longer Term

Chemistry & materials

Optimization & Search

Machine Learning/AI

Numerical simulation



Aerospace	• High strength-to-weight materials development • Wing ply-composite design optimization • Aircraft computational fluid dynamics
Automotive	• Advanced batteries • Multi-objective vehicle routing optimization • Auto design and simulation
Chemicals	• Lower energy fertilizer manufacturing • Efficient Catalysts • Accelerated product development
Electronics & semiconductors	• Placement and routing optimization • Deposition/etch process modeling • Multi-domain simulation
Energy	• Grid management • Grid optimization with EV's • Carbon Sequestration
Financial Services	• Portfolio optimization • Derivatives/options pricing • Antti-Money laundering
Health Care & Life Sciences	• Drug discovery and drug design optimization • mRNA & protein structure predictions • Disease target & biomarker discovery

So, when will this happen?

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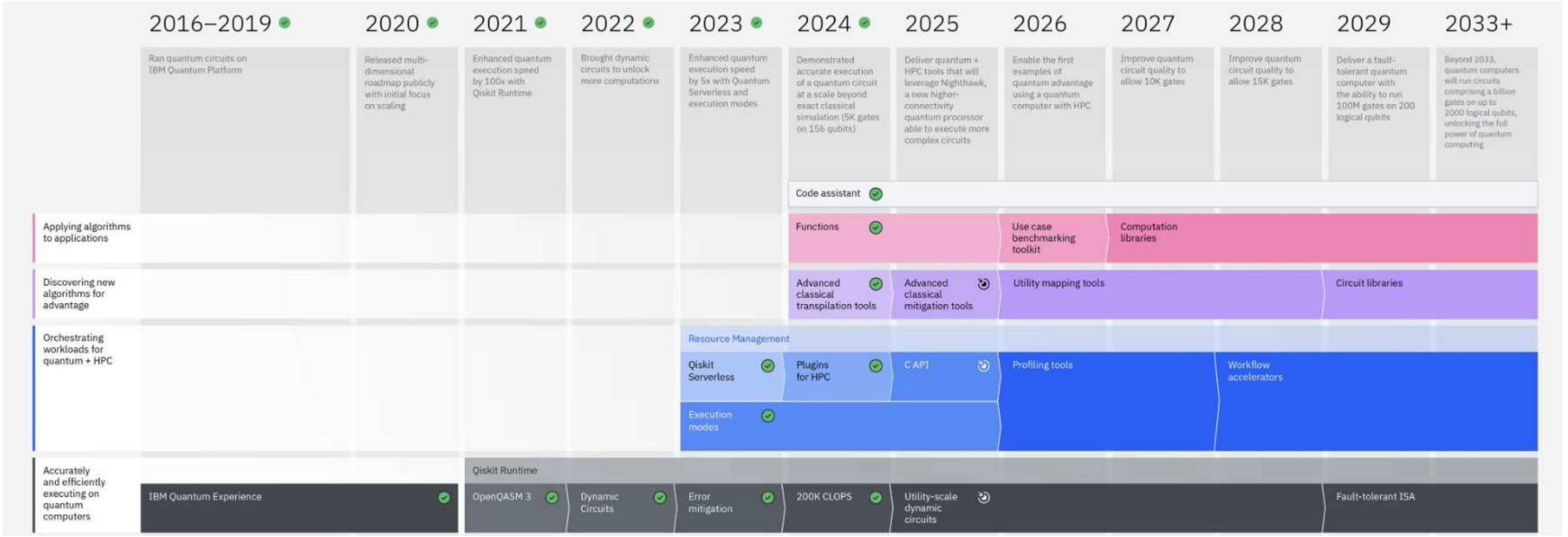
Actually, it has already started.

When our quantum computing is fully developed, we will have our GenAI moment.

Quantum computing will become mainstream, seemingly overnight.

Our roadmap has this starting in 4 years.

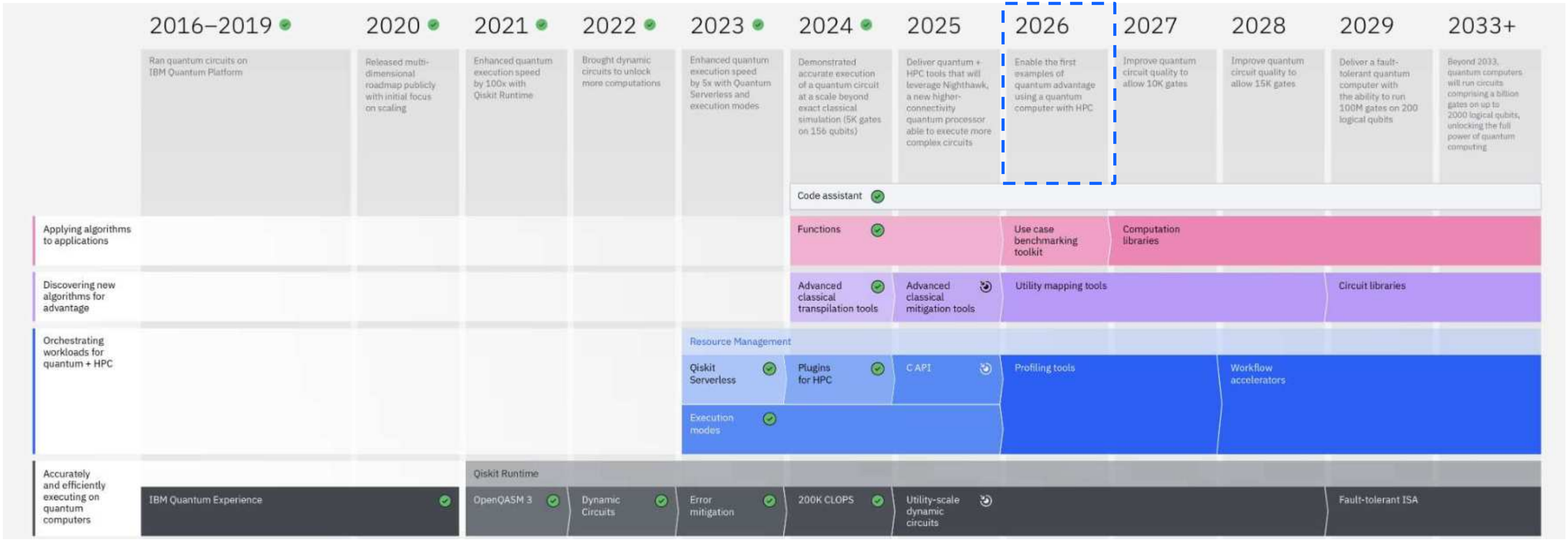


The problem is, by this point it will be too late.

The problem is, by this point it will be too late.

- Organizations that invested early will have already developed expertise, algorithms, and IP.
- They will be poised to dominate their sectors.
- Those that didn’t invest or hoped to fast-follow will be at a major quantum disadvantage.

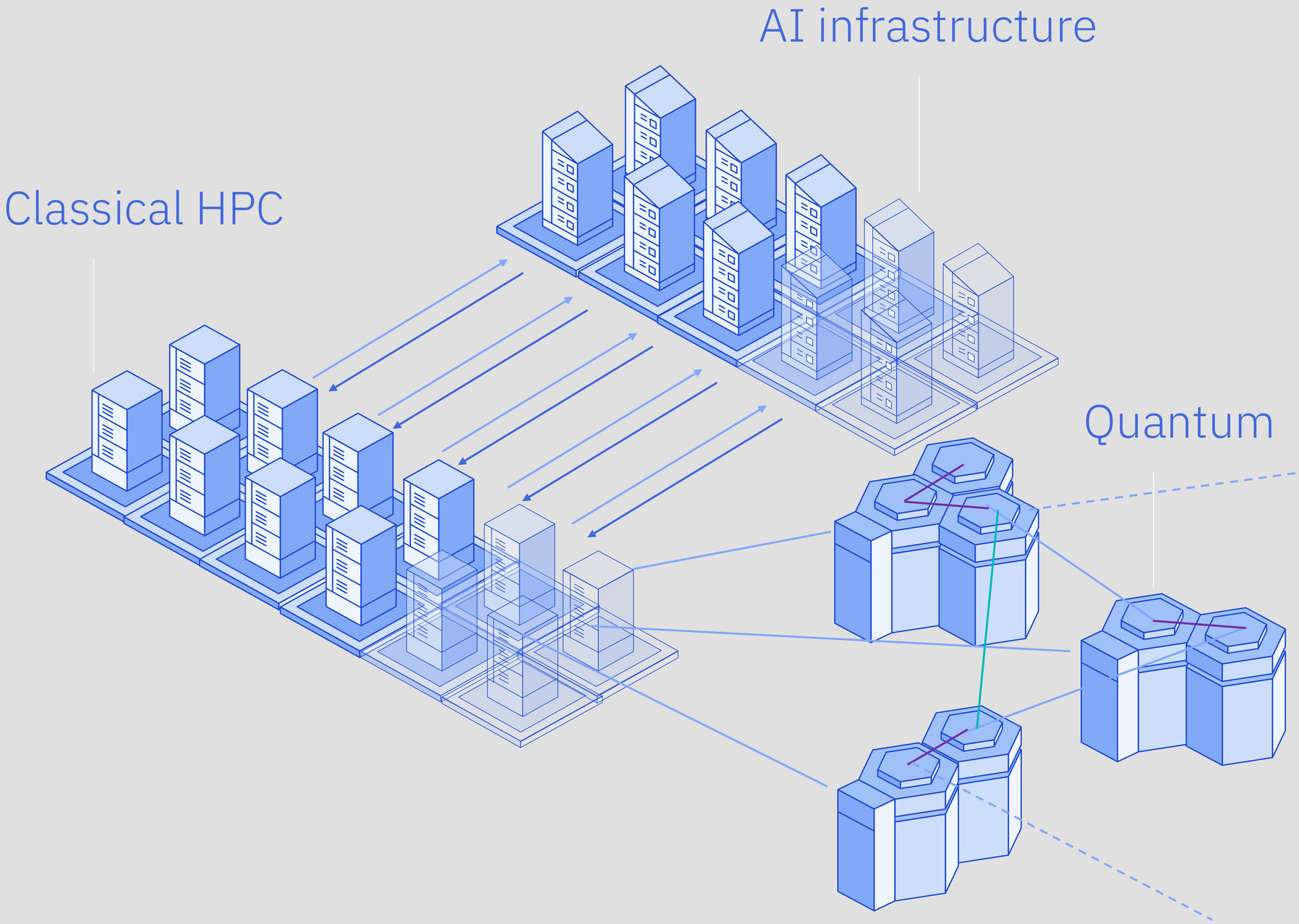
Our users are sowing the seeds of quantum advantage.
And we're confident that we'll see demonstrations of quantum advantage in the next year.



Quantum is a component in the future of advanced computing

In the future, quantum will integrate with other components, including AI, to enhance the overall capability of our computational tools.

Each tool is best suited for certain types of tasks, and all will work together to solve the hardest problems that face society today.



Early adopters are projected to gain substantial competitive advantage

↓

Estimated 90% value capture by early adopters

Source: Boston Consulting Group (“Quantum Computing Is Becoming Business Ready,” 2023)

IBM Quantum in numbers

The IBM Quantum ecosystem is a thriving, rich community driving innovation.

275+

IBM Quantum Network members
The largest ecosystem

600K+

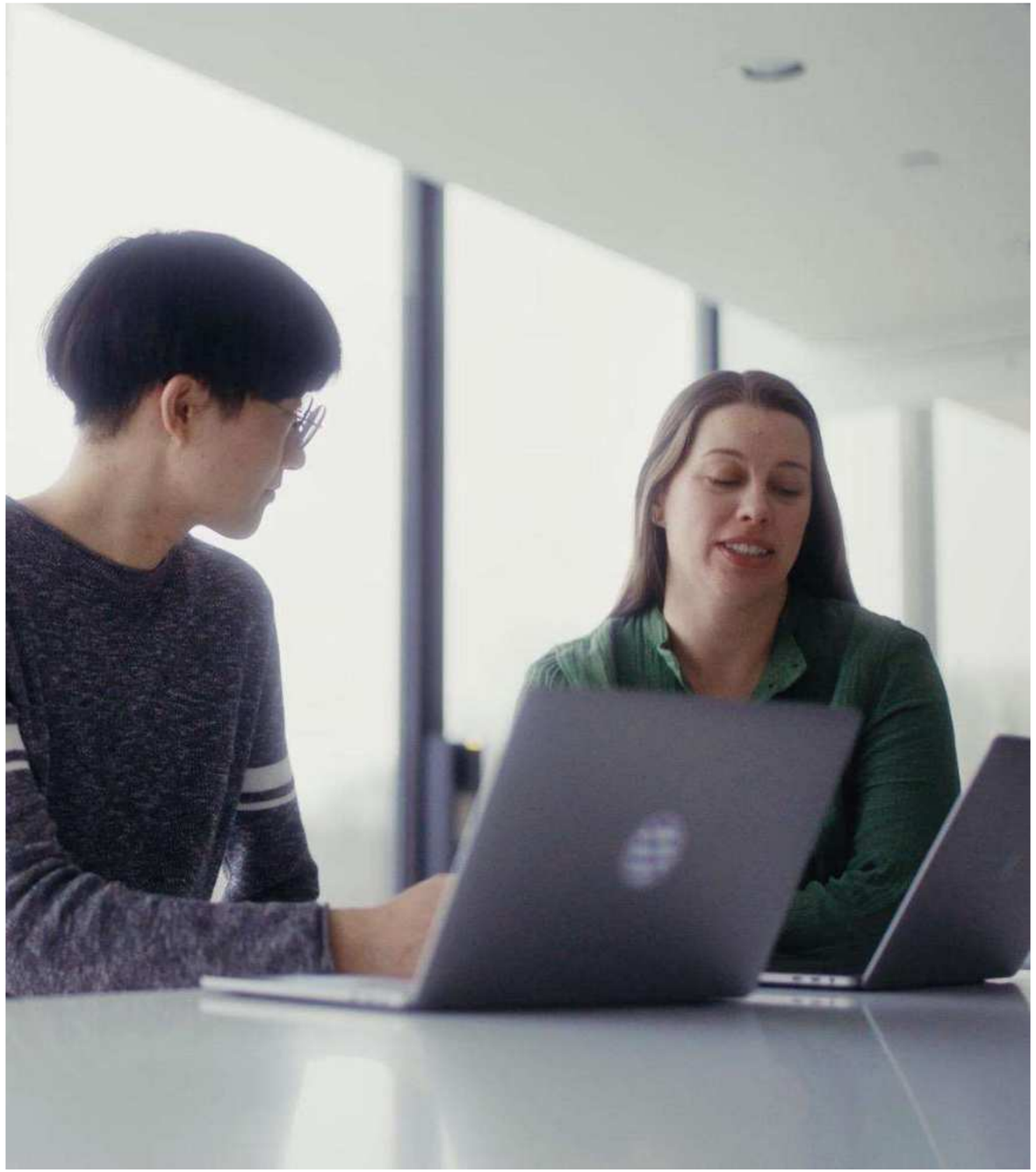
Users
The largest user base

3,000+

Papers
The most innovative ecosystem

10+

Quantum computers
The largest fleet



Workforce development and education

For every three quantum technology job openings today, the United States has only one qualified candidate—and by 2025, McKinsey analysts predict, more than half of the country's quantum jobs will go unfilled.

700+

Courses created over the last 7 years

9M+

Content viewers globally

1.1K+

Certified developers

4K+

Badges earned

Ecosystem

IBM Quantum Platform hosts the strongest ecosystem advancing quantum computing

The IBM Quantum Network has 275+ members

Industry members	50+
Commercial partners and startups	55+
Academic and research institutions	170+

IBM Quantum community

IBM Quantum Learning

An online platform for learning the basics of quantum computing, and how to use IBM Quantum services and systems to solve real-world problems.

IBM Quantum Challenge

An annual coding challenge focused on teaching the world how quantum computational scientists use Qiskit.

Qiskit Global Summer School

An annual event featuring online lectures delivered by various IBM Quantum experts, as well as live Q&A sessions.

Qiskit YouTube channel

The Qiskit YouTube channel hosts hundreds of useful videos on quantum computing.

Qiskit Developer Certification

The world's first ever developer certification for programming a quantum computer, setting the benchmark for quantum developer skills.

Qiskit Advocates

A global program that provides support to individuals who actively contribute to the Qiskit community. There are hundreds of Qiskit advocates representing many countries who contribute to the Qiskit community.

Quantum Innovation Centers

Strategic partners developing regional and national leadership in quantum computing by leveraging IBM Quantum capabilities and expertise

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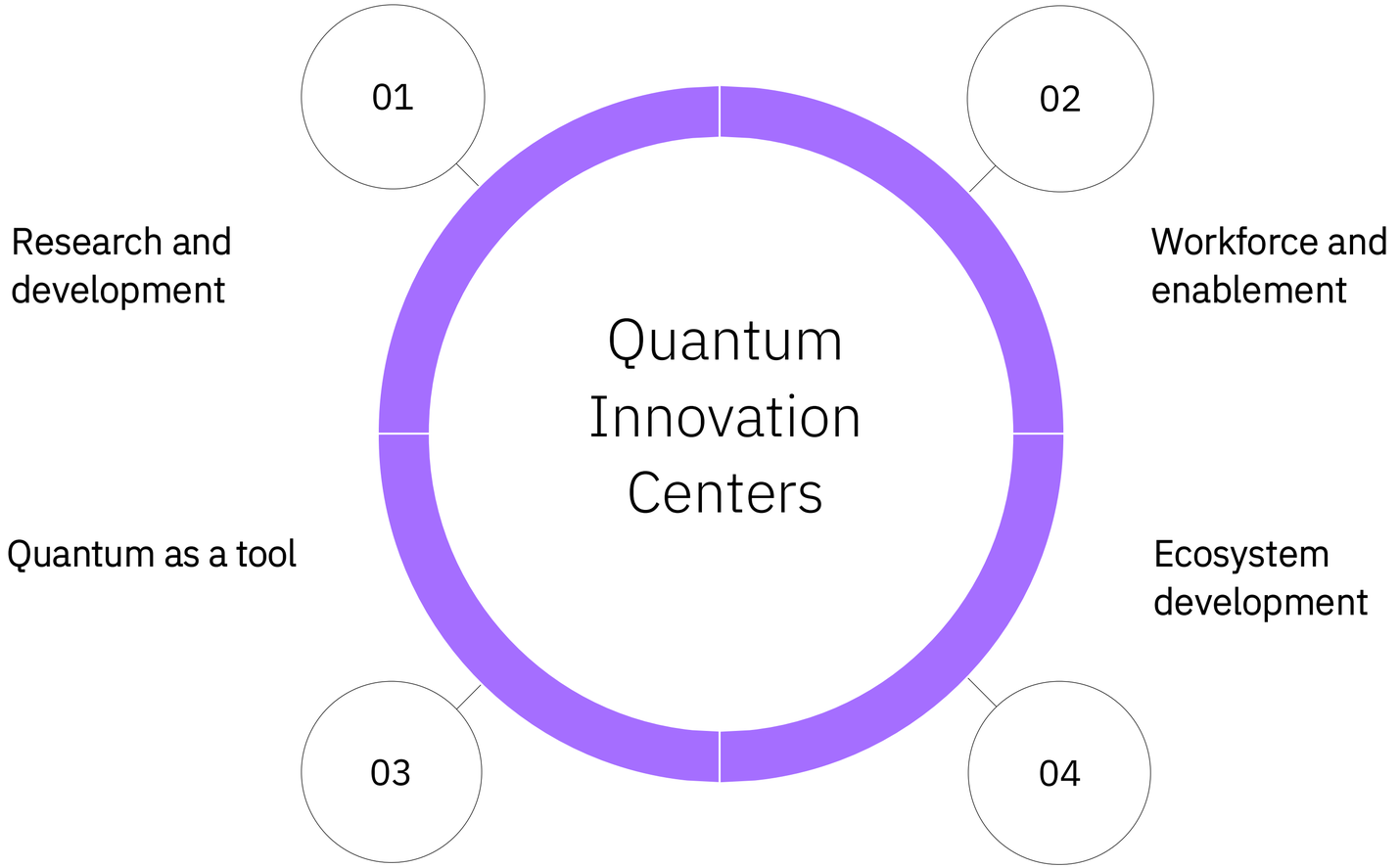
Join the 40+ other institutes with QICs, including...

BasQ (Ikerbasque)
Brookhaven National Lab
Cleveland Clinic Foundation
Keio University
Oak Ridge National Lab
PINQ^2
QuantumBasel
Rensselaer Polytechnic University
RIKEN
University of Southern California
University of Tokyo
Yonsei University



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Quantum Computational Centers Announced

Quantum Computational Center
University of Tokyo

Shin-Kawasaki, Japan
June 2021

Discovery Accelerator
Cleveland Clinic

Ohio, USA
March 2023

Discovery Accelerator
PINQ [2]

Bromont, Canada
September 2023

Quantum Computational Center
Rensselaer Polytechnic

Troy, New York
April 2024

Quantum Computational Center
Yonsei University

Seoul, South Korea
September 2024

JHPC-quantum Riken

Kobe, Japan
May 2025

IBM-Euskadi Quantum Computational Center

San Sebastián, Spain
Projected 2H25

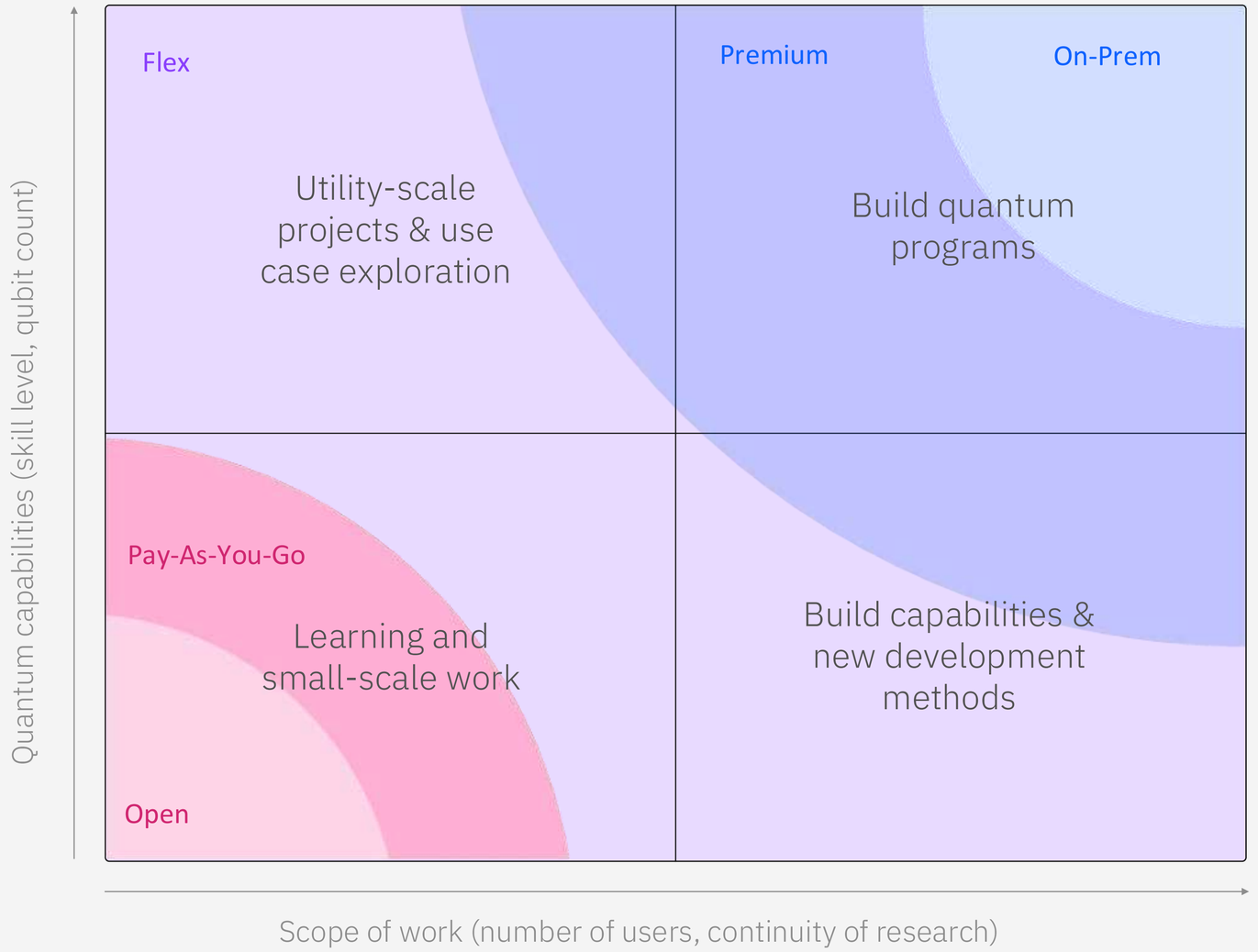
National Quantum Algorithm Center

Chicago, USA
Projected 4Q25

Quantum Valley Tech Park

Andhra Pradesh, India
Projected 1Q 2026

IBM Quantum offerings to suit your quantum goals and needs



Our mission

→ Bring useful quantum computing to the world

→ Make the world quantum safe

Today’s classical security protocols will be obsolete tomorrow

Prime factors

= p x q

2048-bit composite integer

```
25195908475657893494027183240048398571429282126204032027777137836043662020707595556264018525880784406918290641249515082189298559149176184502808489120072844992687392807287776735971418347270261896375014971824691165077613379859095700097330459748808428401797429100642458691817195118746121515172654632282216869987549182422433637259085141865462043576798423387184774447920739934236584823824281198163815010674810451660377306056201619676256133844143603833904414952634432190114657544454178424020924616515723350778707749817125772467962926386356373289912154831438167899885040445364023527381951378636564392120103971228221207203570
```

Expected computation time

The most powerful computer today:

Millions of years

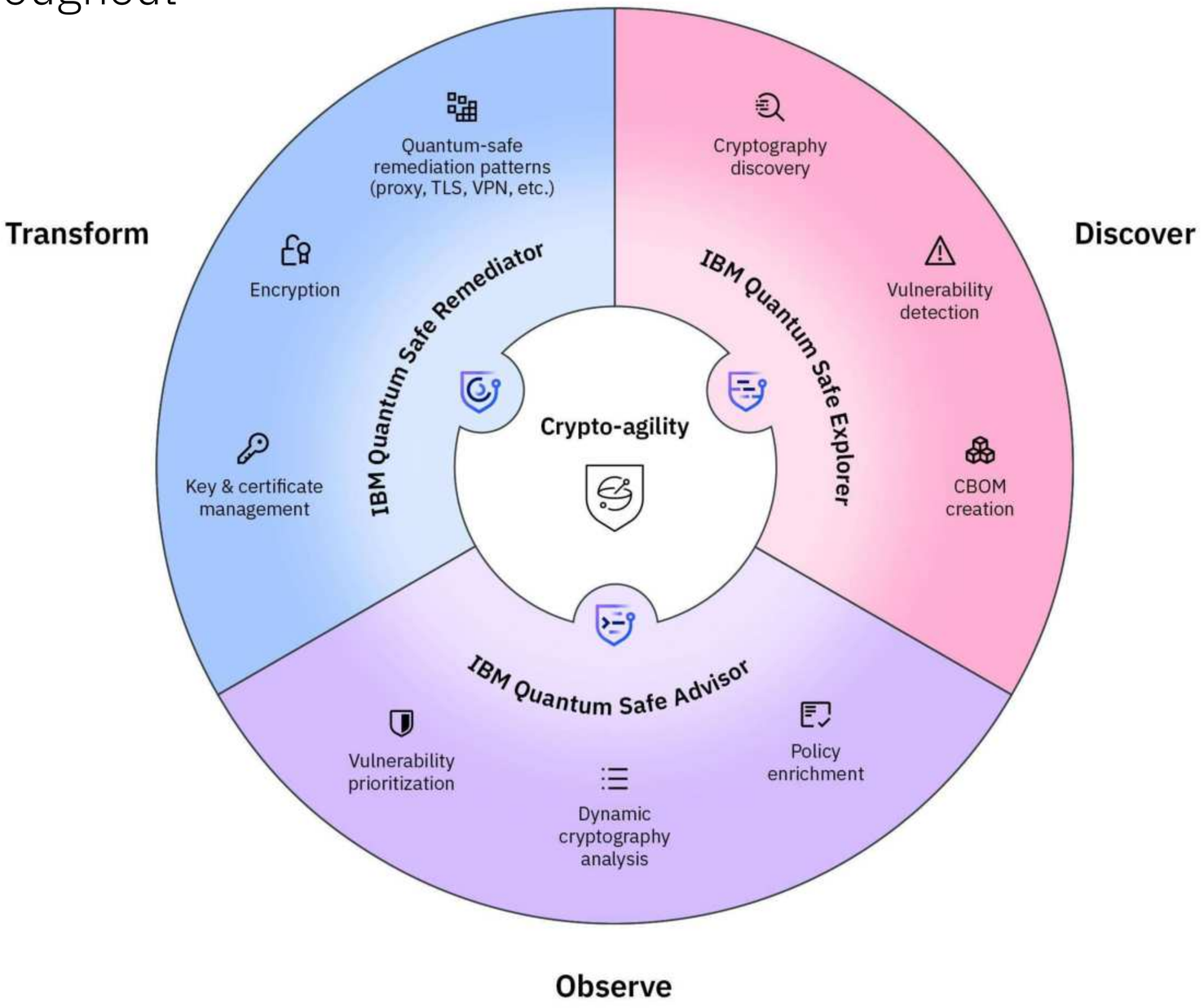
Shor’s quantum algorithm:

Hours

Public key encryption • Digital signatures • Key exchange algorithms

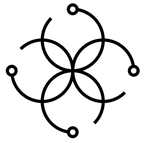
RSA • DSA • ECC • ECDSA • DH

IBM technology helping clients throughout their quantum-safe journey



Get ready *now*

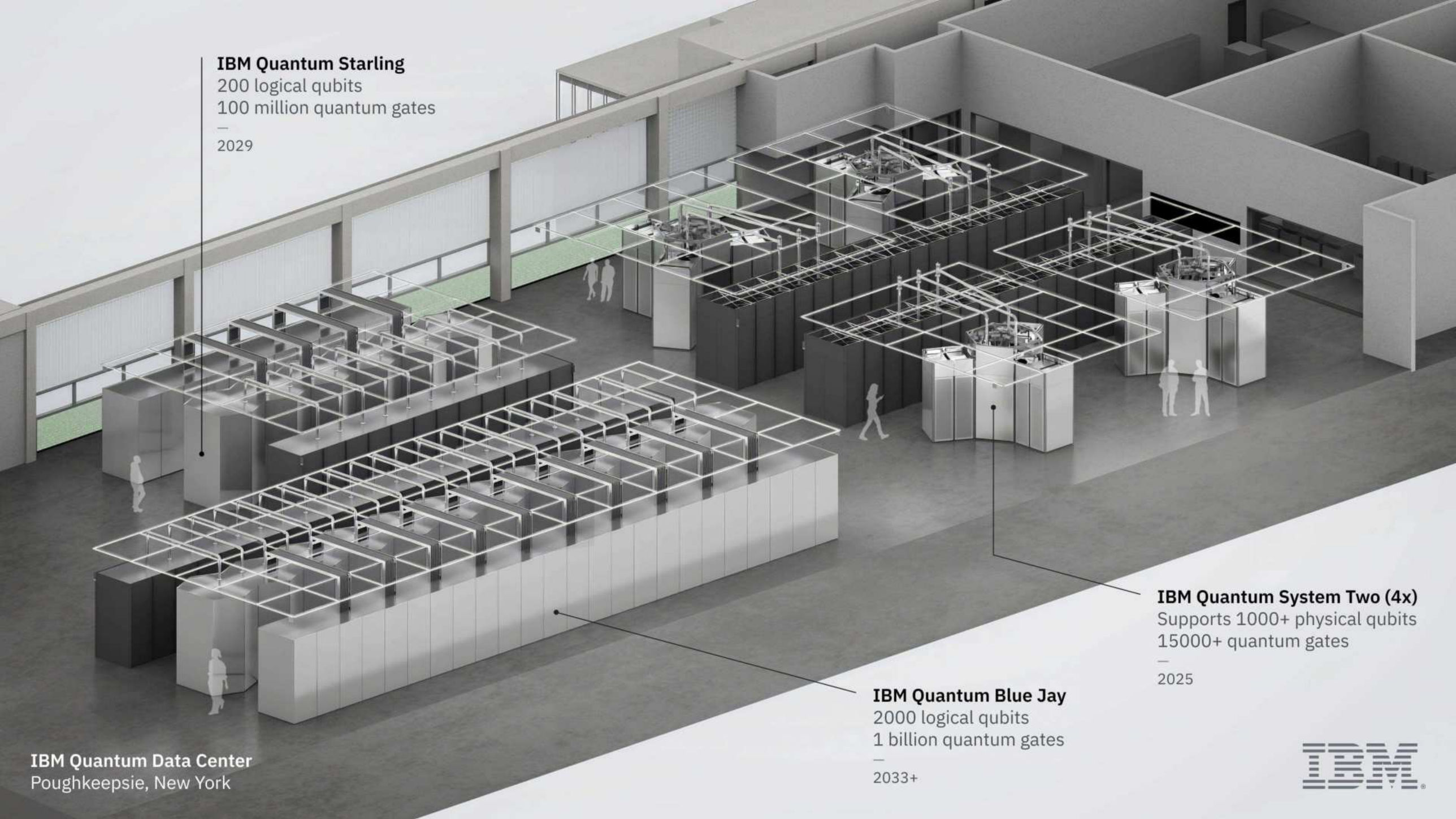
Upskill in quantum



Engage in the global quantum ecosystem

Begin your journey to quantum safe

Launch the IBM Quantum Platform


IBM Quantum Starling
200 logical qubits
100 million quantum gates
—
2029
IBM Quantum System Two (4x)
Supports 1000+ physical qubits
15000+ quantum gates
—
2025
IBM Quantum Blue Jay
2000 logical qubits
1 billion quantum gates
—
2033+
IBM Quantum Data Center
Poughkeepsie, New York

Let’s create the future of quantum computing *together*

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