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## **An old problem could stop the U.S. from leading on quantum computers**

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In 1984, three physicists proved it was possible to manufacture the building blocks of quantum computers. In November, after four decades and discoveries by many others in the field, [they were awarded a Nobel Prize](#) for it. Today, quantum computing is turning the corner from scientific puzzle to engineering challenge: how to build systems big and reliable enough to be useful. But like so many other advanced technologies, the supply chains that feed this technology are brittle and too often reliant on components sourced from Asia. As quantum computing begins to scale up, government and companies should be creating a quantum supply chain that avoids chokepoints abroad.

It can be hard for most people to get their heads around what’s different about quantum computers. Whereas traditional computers calculate with “bits” that are either 1 or 0, quantum computers use “qubits” that, bizarrely, can be 0, 1 or a mix of both. This lets them conduct certain hyper-complex calculations at speeds that far surpass even today’s supercomputers, which could dramatically accelerate computations in fields like materials science and chemistry.

That’s why big tech companies like Google, Microsoft and IBM, which have already built working quantum computers at very small scale, are investing heavily in quantum

capabilities. Quantum start-ups have attracted billions in investment as well. These companies are not investing for the sake of science alone — they believe they can soon demonstrate commercially relevant quantum computers.

The U.S. government agrees. The Defense Advanced Research Projects Agency, the Defense Department's research and development unit, [has set a target of 2033](#) to achieve utility-scale quantum computing. Some companies have even more ambitious timelines, though these may be overly optimistic. These systems still must scale from hundreds of working qubits to millions. There is also substantial uncertainty about which qubit technology will prove most reliable and cost effective. Nonetheless, the progress is rapid enough that we must start planning for the arrival of quantum computing — and consider the long-run risks if we don't.

Are American supply chains ready for quantum computing's scale-up? We don't think so. AI's highly concentrated supply chains illustrate the problem. Most of the world's artificial intelligence chips are manufactured by a single company in Taiwan. Rare earth materials used in their manufacture are monopolized by China. Many other chemicals, printed circuit boards, wiring and other components required by AI datacenters are predominantly or exclusively manufactured in East Asia.

With [its rare earth controls last year](#), Beijing demonstrated how it can weaponize the U.S.'s dependence to its advantage, but that's not the only threat. Supply chains that are concentrated are also often brittle. The covid pandemic showed that critical chip supplies can run short. The construction of AI datacenters has been limited by shortages of packaging capacity and substrate material. We've also faced deficits of electrical transformers and gas turbines needed to power data centers.

In hindsight, we'd have been better off if, five years before the launch of ChatGPT, we began building more chip manufacturing and power generation capacity. A lesson of the past decade is that the best way to avoid painful supply chain snarls is to plan around them far in advance.

The stakes are enormous. It's already well understood that quantum computing could be immensely important in accelerating R&D in drug discovery, battery chemistry and materials science. The consulting firm [BCG estimates](#) that quantum computing could create up to \$850 billion of value by 2040. And the national security stakes are

especially significant, given that a sufficiently large quantum computer could crack most commonly used encryption.

Right now, it's difficult to definitively say which country is leading quantum computing development. The United States has multiple serious players, but China is spending heavily, and Australia, Japan, Britain and several European countries also have serious quantum computing efforts underway. All we can say with certainty is that once a company builds the first real, commercially viable quantum computer, there will be a race to build many more. The winner of that stage will be determined more by supply chain scale-up than any other factor.

What components do we know we'll need? Most quantum systems require intense cooling. Today, the dilution refrigerators that are needed to cool many types of quantum computers are largely produced by a few small companies in the U.S., Britain and Finland. [Chinese media](#) recently announced mass production of a homegrown dilution refrigerator. Beijing is not leaving this to chance.

Quantum chip production poses another supply-chain challenge. Many companies outsource quantum chip production to the same semiconductor foundries, concentrated in East Asia, that make traditional semiconductors. The printed circuit boards, wiring and cabling, and other components used in quantum systems are usually sourced from traditional tech supply chains — and so are heavily dependent on China and Taiwan.

Finally, quantum computing will require greater use of certain exotic materials. The risks of relying on China for rare earths and critical minerals, many of which are required for quantum systems, have become clear. Depending on which specific quantum technologies mature, we may need more of the critical mineral niobium, which today is found almost exclusively in Brazil. China's [already begun](#) buying up niobium mines. Tantalum, another important material for some quantum systems, is largely produced in Nigeria, Rwanda and the Democratic Republic of the Congo, and mostly [processed in China](#).

Congress and the Trump administration recognize these challenges. The National Quantum Initiative supports R&D efforts and is likely to be reauthorized this year. It may include measures to assess supply-chain risk and build flexible domestic manufacturing capabilities. Senior Trump administration officials like Deputy

Commerce Secretary Paul Dabbar [have previously backed](#) establishing a “quantum foundry” to address some of these concerns.

Quantum computing may still sound like science fiction, but the scale-up phase is approaching. The race is now about supply chains as much as science and engineering. The United States spent the past decade trying to rectify the naive supply-chain errors that resulted in our dependence on adversaries for critical tech components. It can't make those same errors again.