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"Disrupter Series: Quantum Computing"

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Chairman Latta, Ranking Member Schakowsky, Members of this Subcommittee,

Thank you for the invitation to participate in today's hearing to discuss the opportunities and challenges presented by this incredible technology, quantum computing.

My name is Michael Brett. I am the CEO of QxBranch, an advanced data analytics company based here in Washington DC, with teams in Australia and the United Kingdom.

QxBranch is an advanced data analytics company we started about four years ago. We are a fast-growing team of data scientists, software engineers and machine learning specialists who design algorithms for challenging data problems.

We are at the cutting edge of creating algorithms that find patterns, detect anomalies and uncover other business insights that help our customers reduce costs, improve their understanding of risk, and serve their customers better.

Data analytics is already a rapidly-advancing technology area delivering benefits to people all over the world, and we're particularly excited about what quantum computing can contribute to our business.

Quantum computers are not just a faster computer. They enable an entirely different approach to performing calculations – an approach that asks the question, what if we go beyond limit of "classical" computers and into the subatomic, or quantum realm, to perform computational work? It turns out that this is possible, and there are some incredible and surprising phenomena like superposition and entanglement that allow us to solve some interesting - and practically unsolvable - problems like simulating the interactions among molecules as the grow in size, since the exhibit exponential growth in complexity.

Our friends who build quantum computing hardware are in the process of creating machines that allow us to take advantage of these unique phenomena. You will hear a great example of this from Dr Chris Monroe at IonQ, next. These machines allow software developers like us to solve difficult problems using a different kind of mathematics – quantum math – much more efficiently than we ever could using classical computers.

At QxBranch we are harnessing this new approach to computing to create algorithms and applications we couldn't create with today's computers. Even with all the advanced cloud and high-

performance computing available to us, there are still problems that are practically impossible to solve.

Our ambition is simple – quantum computers will allow us to solve some of the most intractable and most valuable computational problems around today. These new quantum solutions will benefit Americans in ways they may not even be aware. Globally, the race is on to apply quantum computing to problems of transport, energy production, health science, pharmacology and chemistry, finance and insurance, defense and national security.

As an example, major financial institutions currently calculate their risk position, or value at risk, once a day, usually by running time-consuming and expensive processes overnight to understand the balance sheet. What if we could do this faster than once a day? How would the way we understand risk and manage financial position change if we could solve every hour, or every minute? Quantum computing may give us a new tool in the toolbox to enable domestic financial institutions to not only improve business processes to the benefit of shareholders, but also help protect and advance the financial interests of Americans in the competitive global marketplace.

Quantum computing will manifest in the cloud. Today, QxBranch already uses a mixed-compute environment to solve problems. Meaning we use multiple different types of computers to solve different problems, because different classes of processor are suited to solving different algorithms.

Quantum computing is a new, specialist processor that will be become accessible through commercial cloud platforms like those operated by Amazon, Google and Microsoft. You will not have one in your pocket, but you will access one from your pocket. Quantum computers won't replace classical computers. Rather, they will be used together with classical computers to accelerate tough, valuable applications.

And we want our applications to be the first apps in a "quantum app" store.

Looking forward to the first kinds of quantum computers that are likely to be commercially available over the next decade, there are broadly three classes of application that become possible in the near-term:

1. Optimization problems – like transport and logistics routing, production streamlining, and financial portfolio optimization;

2. Machine learning – accelerating the most computationally expensive part of training artificial intelligence systems to detect patterns in large and complex data; and

3. Chemical simulation – using a quantum computer to simulate the behavior of molecules and materials, a quantum process that is extremely challenging to simulate using classical computers.

Across these three applications, the potential value to everyday citizens is immense. Let me give you a concrete example of where this could apply:

QxBranch recently completed a study into quantum computing applications with Merck, the major pharmaceutical company. We worked together to design a quantum algorithm and test it on today's hardware that may reduce the costs involved in producing a particular drug. Merck faces an extremely challenging production optimization problem for this drug and quantum computing gave us the tools to look at the manufacturing process in a very different way with the potential to deliver

significant savings to the consumer. It is applications such as this that we are focused on at QxBranch - breakthroughs enabled by a new approach to computing to that change the way we think about current intellectual, business and manufacturing processes.

There are some challenges ahead in realizing this technology, and the federal government can help create the environment for industry to lead.

The three biggest challenges I'd like to highlight today are:

1. Skills and workforce. If we are to be successful at bringing quantum computing to market, we need a highly-skilled, multi-disciplinary, diverse workforce. A team with core skills in quantum information science, computer science, data analytics, machine learning and artificial intelligence, combined with domain expertise in industrial areas like finance, pharmaceuticals and energy. We need American universities to send us more graduates with these skills.

2. International cooperation. As American companies compete in the emerging quantum computing ecosystem, they will achieve their fullest success through international cooperation. Valuable scientific research and engineering development has been made elsewhere, including key allies like Australia, the United Kingdom, Canada, Japan and Singapore. We need to be able to access the best talent and technology globally, and that means partnering. There will be national security considerations for this technology, but if export restrictions are applied prematurely or without due consideration it will stifle commercial innovation.

3. Maximizing and leveraging private-sector investment. Over the past 18 months, we have seen an incredible acceleration of private sector investment into quantum computing from corporate R&D and venture capital. This is an exciting time, but I stress that we are just at the beginning and there is a tremendous amount of hard science that is yet to be done. The government can maximize and leverage private-sector investment through targeted funding and coordination to reduce gaps and overlaps in the R&D and help accelerate the technology.

In closing, I want to reiterate my appreciation for the opportunity to join you today. The subcommittee is addressing important issues that will help bring quantum computers to commercial reality, giving us a powerful new tool to deliver valuable solutions in transport, health, and energy. Leadership in this area will not only impact American business and competitiveness in an important technology, but they also have the potential to benefit every person in our country, as innovation benefits us all.