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115th Year
687th Meeting

Arvind Krishna
Chairman and Chief Executive Officer
IBM

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Moderator: Sara Eisen, Anchor
“Closing Bell”, CNBC

Introduction

President Barbara Van Allen

Good afternoon everyone. We're going to get started. Welcome to the 687th meeting of The Economic Club of New York. I'm Barbara Van Allen, President and CEO of the Club. It's an honor to be here with all of you today. As we've mentioned at prior meetings, this is our 115th anniversary. We had a wonderful celebration earlier this week. For those that were there, I suspect you enjoyed it too.

The Economic Club continues to be the leading forum in the country for discussions on social, economic and political issues. More than 1,000 prominent guest speakers have come before the Club over the last century, and we have a strong tradition of excellence which obviously continues through to today. A special welcome to members of the ECNY 2022 Class of Fellows – a select group of rising, next-gen business thought leaders, as well as students from the CUNY Graduate Center, NYU Stern School of Business, the Gabelli School of Business at Fordham, and Pace University, all of whom are joining us virtually.

As a reminder, we are taking applications now for the 2023 Fellows Program and the Board actually voted this week to allow us to launch a national digital Fellows Program. So we're soon going to be expanding that program around the country, and we'll have

our first class in 2023. We'd like to also mention that our DEI programming has been well under way with the help of our corporate partners – BlackRock, Bloomberg, Mastercard, PayPal, S&P Global and Taconic Capital. We do have some of those partners in the room with us today. Thank you for joining.

Today, I am truly honored to welcome our special guest, Club Trustee and Chair and CEO of IBM, Arvind Krishna. As a business leader and technologist, he's led the building and expansion of new markets for IBM in artificial intelligence, cloud, quantum computing, and blockchain. He has also played a significant role in the development of innovative IBM products and solutions based on these emerging technologies.

Over his 30-year career at IBM, Arvind led a series of transformations and delivered proven business results. He most recently drove the successful \$34 billion acquisition of Red Hat – the largest software acquisition – that has defined the hybrid cloud market. As many of you know, we were lucky enough to interview the CEO of Red Hat earlier this year. Together, IBM and Red Hat give clients the unique ability to build mission-critical applications once and run them anywhere.

Arvind previously was Senior Vice President of Cloud and Cognitive Software, where he pioneered the company's hybrid cloud business, transformed IBM's entire software and services portfolio and offerings for cloud, and grew the business. He's headed IBM

Research, where he drove innovation in core and emerging technologies including artificial intelligence, quantum computing, blockchain, cloud platform services, data-driven solutions, and nanotechnology. In 2016, *Wired* magazine selected Arvind as “one of the 25 geniuses who are creating the future of business” for his foundational work on blockchain.

At IBM, Arvind has been an outspoken advocate for learning at every stage in one’s career. He has made scientific contributions in several different technical fields including wireless networking, security systems and databases. In addition, he founded IBM’s security software business and helped create the world’s first commercial wireless system.

The format today will be a conversation, and we’re delighted to have fellow Club member and CNBC co-anchor of the “Closing Bell”, Sara Eisen, doing the honors of moderating. As a reminder, this conversation is on the record and we do have media, both in the room and online. If all of you would please come up, and welcome please Arvind and Sara as they come to the stage.

Conversation with Arvind Krishna

SARA EISEN: Thank you. Next time, Arvind, you come on the show with me, I’m going

to introduce you that way.

ARVIND KRISHNA: That was overly generous.

SARA EISEN: That was a lovely bio. Well, first of all, I'm thrilled to do this. And Arvind and I talk every quarter, so I'm intimately aware of his business and what he has been doing at IBM. But I do think it's worth stepping back a moment because you've been CEO for 2 ½ years, at the company for over 30, and have transformed it. It's a different IBM. So what is IBM right now?

ARVIND KRISHNA: So, we are focused on two technologies, I'll call it, that I believe transformational, and we're still in the first few innings of those – hybrid cloud and artificial intelligence. As opposed to doing everything, we have changed our business. Seventy percent of our business is now software and consulting, both of which are high-growth areas. So those are both growing, complete market, probably high single digits. In today's inflation, maybe low double digits. And we are very much focused on that.

We are also training and retraining our teams to be much more – I'll use the word "experiential." Go in and help clients get value. Show them how it adds to them as opposed to doing what I'll call a classic product sale, which is you sell a product, you walk away. So all of that is a big, big transformation. And then you say, so you

mentioned Red Hat.

SARA EISEN: Your deal, your baby.

ARVIND KRISHNA: My deal. I'll say it's tattooed on my head. 2019. So that is bringing a new team in. And you say take a company that has been largely proprietary and now be the biggest open-source fan on the planet. Then 2020, we announced taking out Kyndryl, which is taking out 90,000 people in the managed services. Twenty-five acquisitions from April 2020 to today. So all of that put together changes the portfolio, changes how we sell and changes capital allocation

SARA EISEN: And culture, I would imagine, too.

ARVIND KRISHNA: Massive change in culture. Because if you tell people you need to give value to your clients right now, don't worry about closing the deal, that will come, it's going to come as a natural consequence. It begins to change the mentality and takes people into an area much more risk-taking, much more about value in the current environment. And we use the term garages on one side because it's evocative of doing things quick. Take a few people from both the client and us, sit down together, do things, and then get a victory down the road.

SARA EISEN: So that's a big change.

ARVIND KRISHNA: A big change.

SARA EISEN: What is demand like across the business right now?

ARVIND KRISHNA: So third quarter numbers are out. So there I can say, and our constant currency, because FX, on which Sara probably is a bigger expert than I am, is definitely a concern, but our constant currency, 16% in Europe, 16% in Asia, 13% in the Americas. That's a pretty good statement. So am I slightly cautious about what could happen? Yes. That said, in the data we don't really see any reduction for enterprise technology demand.

SARA EISEN: But technology spend always goes down in recessions. Doesn't it?

ARVIND KRISHNA: It does. I am actually an optimist but I would tell you it's not obvious to me that unless we have a catastrophic recession, it'll go down. And the reason on that is, so you have high interest rates, right? We have inflation. You have supply chain issues. You have demographic issues. What's an answer for most enterprises in the face of all that, including government? So technology is deflationary. Technology can be used to offset labor costs. Technology can be used to offset capital costs. So if you start

taking those things, then technology is a possible answer through this.

As I talk to CEOs and CIOs, pretty much across the globe, almost none of them are talking about cutting down their technology spending. Now, as I will caution, that is with all the predicting around, maybe I'll call it mild recessions in some cases to moderate maybe in some cases. Most of them see it as short-lived, not long-lived in that environment. So most of them want to sort of power through it, come out stronger, not sort of batten the hatches and prepare for massive storms.

SARA EISEN: So this time really could be different in terms of tech spending holding up and growing in a time of economic downturn.

ARVIND KRISHNA: Correct. So I think that tech spending is going to be, you can debate 2, 3, or 4% ahead of GDP. So if GDP goes to zero, because globally that would be sort of the worst-case prediction right now, that means tech spending is still at 3, 4%. And that is a big difference from before when sort of tech and GDP would go together and actually tech would be under them. So, you know, GDP goes down, tech goes down further. Then it come back up, it booms. I think it's actually much more stable.

I kind of jokingly say the way that people worry about balance sheets and financials, tech has probably become as critical to the business as those. And that's a massive

statement when you think about how much attention people pay to their debt, to their balance sheet, to the assets of the company compared to tech now. And we can see this. When the airlines went through the 2020 crisis, very few of them said we are not going to do technology spending. Almost all of them said can we use this opportunity to come out stronger at the time, and they weren't sure whether it was going to be 12 or 24 months. And those who did, I think it served them well.

SARA EISEN: So are you saying that that demand held up in Europe as well?

ARVIND KRISHNA: So far, yes.

SARA EISEN: Even though they're facing this energy crisis, no growth, stagflationary environment?

ARVIND KRISHNA: Right. So that is my one caution, that if Western Europe goes through a major energy crisis, I think hopefully it won't be this winter, because they have enough storage, but at some point it will catch up. And the prices on energy are definitely catching up already. The way I look at it is globally; Western Europe is 20% of the GDP. If the Union has a 10% hit, that's a 2% hit globally. Then I come back with, but it's not. The companies that are going to face that are going to relocate their operations elsewhere. So some portion of it will get mitigated, not maybe all of it. And so the impact at a global scale is a lot less. Locally there could be an impact of as much as 10%. It's

possible. I'm not enough of an economist to be able to get through that and tell you, is it or is it not? But the one area where I sense a little bit of caution is in those countries.

SARA EISEN: What about the war in Ukraine? Because this made an impact for you, on our business. How is it affecting you now?

ARVIND KRISHNA: Well, I'll be very direct. So the war in Ukraine implied that we had to pull out of Russia, right? We had no ifs, ands, or buts about it. The day the war broke out, the next day we said we're pausing our business within...

SARA EISEN: How big was that business?

ARVIND KRISHNA: \$300 million in revenue and very good in cash flow because it is mostly a product business, not a services business. And so very rich in cash flow, about \$300 million. We kept our people on for a few months but with no work because we pulled out completely. And then I think in May, end of May, we made the decision that we're going to completely wind down that business. So that had an impact on us for the year, for sure. But we kind of went through it. But despite that, Sara, Eastern Europe, in the second and third quarter actually grew in constant currency so that is, to me, the impressive statement. Eastern Europe grew despite the war between Russia, or from Russia on Ukraine. So I think the energy crisis in Western Europe is because of the

war. That's the bigger medium-term impact probably.

SARA EISEN: Will you ever go back to Russia?

ARVIND KRISHNA: Ever is a very strong word. Do I see ourselves going back in the current environment? No.

SARA EISEN: Was that hard to make that exit?

ARVIND KRISHNA: It was hard logically because you don't want to take people who have been loyal employees for years and tell them that, look, we can't really be here. We have clients who have been with us for decades. And so you had to tell them we can't really service you any longer. We hate doing that. It's just kind of, it's at odds with our culture. So that was hard. But given what was going on, there was no choice. By the way, none of our clients, I think, were on the sanction list. So it was not that we were dealing with sanctions and those things, but we didn't feel that we could help the country's financial services, transportation, logistics and so on because that's our usual set of clients.

SARA EISEN: Did you have local competitors? Like, who is doing that business that IBM did in Russia now?

ARVIND KRISHNA: I'm not sure there's a local competitor. Because if you look at it, you could say, okay, could you move it to more, I'll call it commodity hardware and software, okay, that's possible. But the commodity hardware in the end needs semiconductors underneath and those come out of mostly American or Japanese or Taiwanese companies. So I think they can always carry on. I think they're very smart people. They're very clever people. They'll manage to figure some things out for a short number of years. And then what is the big question mark.

SARA EISEN: So you've said that you touch, you obviously touch a lot of different industries and a lot of different businesses, and you're working with them to boost their technology capabilities. What are the top issues, besides that, that they're facing right now, that you're getting?

ARVIND KRISHNA: So number one is going to be around labor demographics. Actually labor demographics comes up above inflation and interest rates, meaning I can't get enough skilled talent. I need to move our business forward. I need to digitize. So it's like in many things. The first group of digitization was all about can I take the process as is and transfer it to digital? That doesn't really get you a big advantage. If you really want to think through all your processes and you want to go how do I begin to really take advantage, cut through processes, take out the people steps, make it much faster, now you need the skills. So those are what the clients are looking for? How can I really get

through this?

So when I talk about airlines, they began to think through, why do you have to go through a process and get on your phone or get in a long line at the airport when you land because of a weather delay? We know that. Could we do something to do it for you? But that means you've got to cut through processes because the booking center is different from the weather center is different from the scheduling center. So you've got to cut through processes to get to the end goal. And that is something they come to us and say, okay, can you help us do that? So what are the skills in terms of people who know business and technology? What are the actual technologies? What is the automation?

That's where AI comes in, right? Because how can you re-book somebody and give them what they prefer is where you begin to intersect the data and your preferences, what's going on? You know, we happen to know, okay, Sara likes to get to her destination on time. It doesn't matter, the flight could be at 11 pm, she needs to get there even if it's 2 am. Somebody else will say just give a hotel room here, I'll take a night, maybe half a day here.

SARA EISEN: Oh, no, never do that. But it still feels like you have a lot of work to do there with the airlines.

ARVIND KRISHNA: I think they're making progress. I think there's a lot of work always to be done, so I'll acknowledge that. The fact that they get to 90% full gives them a lot of options.

SARA EISEN: So it's labor. Labor is still top issue.

ARVIND KRISHNA: Labor is the top issue. Once you get past labor, then people are going to worry about both interest rates and inflation, and those go together. I mean, like one causes the other. It's not like those are very separate issues. But amount of labor, I can't get it. So just cyber has half a million jobs that are left begging in this country. If you go globally, probably two or three million. So where are you going to get these? You can't grow people like that in a week, right? It takes a good six months to a year of training to get it done. And that's just one area, cyber.

SARA EISEN: So you say I have a whole consulting force at IBM to offer you, right?

ARVIND KRISHNA: That's why the business is doing well. So you can say, you know, in the depths of the pandemic, recession, back in 2020, we leaned in and we said, we're going to hire ahead because we see the demand snapping back. And that worked to our advantage because we then had the capacity when demand came back in '21. But this is also reshaping itself. People are much more flexible about where the work happens.

People are much more flexible about remote as opposed to on-site.

SARA EISEN: Is your team back in the office, remote? I can never keep track.

ARVIND KRISHNA: So I'll be candid. I was not really very remote. I went mostly to the office. It helps to be categorized as essential. So being essential you could go to the office even in May and June of 2020. Our teams are, I'll say, somewhat hybrid right now. I'll use that word. So depending on the country, Europe is actually 50, 60% on average in the office. I think China, subject to lockdowns, is in the office. Japan, I think very much culturally goes back to the office. India is probably a bit less in the office, but I think, I was there two weeks ago and it looked like 30, 40% in the office. The U.S. is probably getting close to 50%. I'd love for it to get to 60% and then I'll be much happier. When it was 25%, like in the early part of this year, I was worried.

But what it does to culture, productivity was there, so that was not the issue. The issue to me is we hire a lot of people. How do you get them known to the culture? How do they know how to learn experientially from other people? Apprenticeship goes begging. Serendipity, the conversation that you have when four people just get together and sort of have a creative idea because they're all together. That's what goes missing. You don't actually see the impact in the short term because you can live off what you have built up over the previous many years. You will see the impact, I think, in the medium to

long-term in terms of the career trajectories of the people who haven't gotten all of that mentoring and learning from others who are more experienced.

SARA EISEN: But if you mandate it, then you might lose employees to some of these other tech firms.

ARVIND KRISHNA: Which is why we stop short of mandating. So we'll encourage. We'll cajole. We'll offer free food.

SARA EISEN: Lunch? Free lunch...

ARVIND KRISHNA: We'll bring in food trucks. We'll bring in beer in the evening. We'll have competitions. We'll improve the real estate so you do everything short of mandating. We might get there. I'll say might, but probably not. Because if I'm seeing the numbers go and they're heading in the right direction, I think we're good.

SARA EISEN: So you mentioned labor. You know, we've seen a lot of tech layoffs just in the past few weeks alone. Meta, Twitter, who am I forgetting? Alphabet's on a hiring freeze. Microsoft. I mean a lot of these companies are sort of retrenchment mode, freezing or actually laying off people. So doesn't that change the labor dynamic in the country and specifically in tech?

ARVIND KRISHNA: Well, that's why I said I don't think we need to do more than cajole over the medium term. I think in the short term there is still a labor shortage so that's still going to be the case for right now. But as we begin to get through this, look, we're doing this in-person. We have done a few video interviews, but I think in-person is much more interesting.

SARA EISEN: Much better.

ARVIND KRISHNA: My kids, one is still in college. She couldn't wait for classes to get back to in-person and be with people and meet with friends on campus. I think humans want their social interaction. And there is social interaction at work which is different than education which is different than social-social, but I think we all, we thrive with that. That's not 100%. There's probably 10, 20% who are fine. They're deep subject matter experts. They can do their work in isolation. Maybe it's better. But that's 10 to 20%. Another 20 or 30% may have a mixture. Maybe they're in two, three, four days a week, maybe they're not. Maybe it's not ten of us in the workplace, maybe it's only five or six, and that's the flexibility.

But going back to your layoff question. Look, I think some people probably got ahead of themselves in terms of where is the top. Maybe it's going to be 30% growth forever. Well, 30% growth forever, as you all know, it means you're sort of quadrupling every

four or five years. That probably doesn't carry on forever. So you've got to probably adjust a little bit. So I think some of it is just adjusting to what they think is going to happen. But I look at ourselves right now and I look at my demand for 2023, I feel quite comfortable about where we are.

SARA EISEN: Are you hiring?

ARVIND KRISHNA: We are hiring.

SARA EISEN: You're not freezing?

ARVIND KRISHNA: We are not freezing. Are we balancing in terms of where, given what I see as the different geographies and so on? Absolutely. Am I going to be cautious? Am I going to hire 30,000 people like we did last year? Maybe not that many. But we will hire. We have so much demand. Our consulting business grew at 17% last quarter. At constant currency, we see double digits for this whole year. We have a book of business that says we go well into next year. So given in that business we lose 10,000, 15,000 people a year, we've got to at least backfill, even if the business stays flat, we've got to backfill what we have.

SARA EISEN: How many people work for IBM now?

ARVIND KRISHNA: 250,000, round numbers.

SARA EISEN: And how much more are they getting paid than they were, I don't know, a year or two ago?

ARVIND KRISHNA: Way too much. (Laughter)

SARA EISEN: You would say that at any time, not just in an inflationary environment, though, right?

ARVIND KRISHNA: No, I think, look, I think some amount of inflation is reasonable. You know, 2, 3, 4%. Somebody else who is smarter will say what's the correct number?

Because some amount of inflation is good, it allows things to grow. It reduces the value of debt. There are some advantages. Now, at 8, 9%, you begin to say now inflation is outpacing the ability of a business to keep track. Because if our labor, underlying goes up by 8 or 9%, that's a big part of our expenses. And the cost of goods coming in is 8, 9% and those for whom we take third party services want to raise it 8, 9%, I've got to pass 8, 9% back on to our clients. I think that's unlikely.

SARA EISEN: That's the wage-price spiral.

ARVIND KRISHNA: Right. I think that we can pass on some, so definitely. So if it's 8, 9% once over two years, it's okay. Maybe we can pass on 5 or 6 and in two or three years we catch up and life is good. But 9% for a long time, I think, is a problem because I don't see GDP growing at 9%.

SARA EISEN: Do you think inflation is really coming down here?

ARVIND KRISHNA: The numbers say it has. It has come down some. But to your point about if we begin to see the...as I said, I'm most concerned about wage inflation, more than all inflation. And I'll admit that's unique to us as a business. My clients care about all inflation, not just wage inflation. So I need both. I need my clients to be thriving because then they can give us business. I need us to be able to give our clients great service. I do think that there are early green shoots that inflation is beginning to come down, and I do sense a little bit of heat coming off the labor market. But the next few months are going to tell us that.

SARA EISEN: You touched on a lot of different technologies – AI, you mentioned some of them, semiconductors, blockchain, quantum. What are you most excited about right now?

ARVIND KRISHNA: So I always go by what is today and what's around the corner? So

today, I think the opportunity for all our clients to leverage both hybrid cloud and artificial intelligence to improve their businesses, take costs out, is incredible. I think on cloud, people can see it. I don't think we have to convince people anymore. I think on AI, they have yet to see the full benefit. I think, to use a baseball analogy, we may be in the first or second innings of artificial intelligence. Then I think sustainability is as much about getting efficiency and cost as it is about the purpose of being good to the environment.

And then there is quantum, which I think is going to be bigger than cloud, but probably a decade from now. And that's a big prediction to say it's going to be that big. Cloud is hundreds of billions in revenue today. Right? Sixteen years maybe in the making. In 2006, I'll say was year one for cloud. Why do I say that? Because some of the big hyperscalers, that's when they began to come out. Sixteen years in, we're a few hundred billion. I think a decade from now, quantum could be that big. But if I think about artificial intelligence, two and half quintillion bytes of data per day, so that's 21 zeros per day. There is no way you're going to be able to digest the data without some technology. I think the only technology we know of to harness data at that scale is artificial intelligence.

And I'll sort of mention four use cases that I think every business should take advantage of. One, at the height of the vaccine coming out, one of our clients, CVS, said we're going to buy vaccines. We think we'll get 60 million phone calls of people saying, hey, I

have this medical condition, this is my insurance, can I schedule an appointment? Not too complicated but not too simple. Do you want to hire 10,000 people into a call center for six months? How do you train them? How do you keep them? Or can you begin to use artificial intelligence to address that? I think we had 80% that handled it with AI. So I think that whole area of interaction with people, I'll call them the simple use cases, is an obvious one.

I think next is going to be around applying AI for information technology itself. We have millions of people globally who are just watching the systems, monitoring the systems, making sure they're all up and running. I think there's a massive use of AI to IT itself. And that is the next wave that is happening.

And the third one I'll mention is about knowledge extraction. So when you think about reading through hundreds of thousands of pages for discovery, for due diligence, so we work with both EY and Deloitte, and they use AI like crazy now to really speed up the due diligence process. So if you think about this, how many things can we think of across where you can begin to automate, I'll call it routine work, process work? And this is all in front of us. This is all going to play out. And that's why I'm so excited about what AI can do.

SARA EISEN: Which industry gets it? Who is doing the best job?

ARVIND KRISHNA: I think the tech industry probably gets it. I mean you can look at some of the consumer companies. I'll say they are probably well into the fifth or sixth innings, the B2C tech industries. Because that's how they get scale. That's how they get the margins. Now you can say next is probably financial is getting it. I see a little hesitation in wanting to go there. Now they have some issues around regulatory burdens, proving that the AI is correct, proving that there is no bias, because they get called to the mat on all those issues. But I see a lot of attention there on this topic.

I was at the RBC tech conference yesterday and Dave McKay was talking about their AI trading algorithm, which he's very proud of, which he thinks is doing as well as some of the people who do trading. Maybe not in all cases, but definitely in some cases.

SARA EISEN: Well, and some of your use cases, it did make me wonder what the implications are going to be for the job market if you're replacing 10,000 people picking up phones at CVS with AI.

ARVIND KRISHNA: But we have full employment.

SARA EISEN: Right now. But you said we're only in what inning?

ARVIND KRISHNA: In the first or second innings of AI. But I'll go back to, let's take

agriculture. In 1900, 50% of the people in this country worked in agriculture. Today, it's less than 3%. I don't think 47% are going away. You create others. So when you're in a replacement ratio that is below one for the bulk of the world, certainly North America, certainly China, Western Europe, I mean the replacement ratio, by the way, women who have children, I think the average is now hitting 2.0 here.

SARA EISEN: 2.1, I think.

ARVIND KRISHNA: 2.1. So 2.1 would be flat. By the way, very few distinguish between women who were born in the U.S. versus women who were born outside. I hear the difference is 1.9 to 2.3 or something like that. So you have replacement ratios that are below one in a lot of the world. So we're actually going to have fewer people. So if you don't do this, our quality of life will actually go down, not up. Actually I believe that there's so many jobs, whether it's in cyber or whether it's in healthcare, whether it's in education that need to get filled, that I actually, I'm an optimist on that front. The nature of the jobs is going to change. I will acknowledge that.

SARA EISEN: What about quantum, it's going to be bigger than cloud, was that the first time you've ever said that? Did you just make news here?

ARVIND KRISHNA: It is probably the first, maybe the second time I've ever said that.

Quantum will be bigger than cloud, but a decade from now.

SARA EISEN: So what does that mean exactly? What does that look like?

ARVIND KRISHNA: So quantum is not going to replace traditional computing. Let's just acknowledge that. Quantum is good for a certain class of problems that traditional computing really can't get to. So your bank accounts. They're going to be on a traditional computer. Why? Because a quantum computer is essentially probabilistic in nature. It may not give you the same answer each time. I think for your bank account you probably want to get the same answer when you ask it a second and third time. So that is going to stay on traditional computing.

Now, think about doing pricing. Think about doing risk. Think about inventing new materials. Think about carbon sequestration. When you think of these problems, I think today's classical computers are not going to be able to address those. And they don't, they're not really designed for them. They don't do it really very well. So if you approach these problems, so let's suppose somebody uses a quantum to come up with a better battery for electric vehicles. Do you think that has a little bit of money attached to it?

SARA EISEN: Probably.

ARVIND KRISHNA: Or if you come up with better pricing for somebody who is doing ___ or if you can improve risk by even two-tenths of a percent because you can do it in 30 milliseconds as opposed to in three hours.

SARA EISEN: It's valuable.

ARVIND KRISHNA: That's a lot of value attached to it. I think that's what excites us about quantum. And we just recently, a week ago announced that we have 433 qubits. So qubits is how people measure quantum computers today. And then you say, like, okay, if you're getting like this, what's the issue? The issue are these machines are noisy, which is a polite way of saying they make a lot of errors. And they don't stay, I'll use the word coherent. They don't stay functioning very long before they kind of dissipate. Just think quantum mechanics in your head, so this is the stuff that most people when they began to address it in college, nine out of ten people drop out of that class and said not for me. So it is reasonably complicated.

SARA EISEN: You weren't one of those, of course.

ARVIND KRISHNA: No. But I didn't go on to do graduate work in quantum physics. That's its own unique category. But if you think about it, so they are complicated machines. So you have to learn how to use them. So today we are probably two, three,

four years from the threshold where we'll begin to address some of these problems. But we're probably a bit more than that from when it becomes mass use. This is why I say in a decade.

So if you could come up with a better fertilizer, so we talk about the world's population is what? Seven billion, I think, and change, eight. If we can get better about food production, if we can get to better fertilizers. So fertilizers cause damage to the environment, but without fertilizers, forget it, we won't have enough food. But fertilizers consume 3 to 4% of all energy and all hydrocarbons. If we get better about it, why do I say could we get better about it? Bacteria do the same job. They don't use that much energy and they don't use that much hydrocarbons. So there is a way. We don't have access to it as humans yet. We are still living off techniques that were invented by German scientists, I think in the late 1800s.

SARA EISEN: I don't know my fertilizer history.

ARVIND KRISHNA: So we haven't really improved since then. Steelmaking, steel and cement produce as much carbon dioxide, greenhouse gas emissions as transportation. Can we get better at it? I mean, because these are techniques that go back hundreds of years. I do believe that we can. The question is, now what is that? And you're not going to go experimenting a big blast furnace. I mean that's kind of impractical. But could a

quantum computer tell us what can come together as materials? Because quantum computers are going to be good at emulating what's happening at the physical chemistry and quantum mechanical level, which is this material world that I'm talking about – from fertilizers to steel to cement to carbon sequestration. That's what they're going to be great at doing. We just need a bit more progress. Not a lot more, a bit more.

SARA EISEN: So is IBM a leader in this space? And who else is doing this?

ARVIND KRISHNA: First, I begin with, it's such an exciting space that nations and companies are chasing it. So I'll just throw out a few. So certainly China, we know has a big investment program. Certainly the United States has a big investment program. When you look at universities, you can say MIT, Waterloo, Illinois, Chicago, Stanford. So clearly there's a lot of interest. When your quantum computing classes get sold out, then you know there's interest. This is why I call it, it's maybe ten years behind AI. That's what was happening to AI circa 2012, 2013. That's happening to quantum now. So usually you say, hey, these are really smart kids so if they want to do that, there is something here.

Then if I look at the companies, look, other than of course OD/OLPA and the U.S. government here, certainly, you know, Google, Amazon, Microsoft, Honeywell, IonQ, there's a bunch of, these are major companies, there's probably 100 startups who are

there. There's a lot of venture money going into it. So I'll say all that. Then I'll ask the question, how many people have an actual quantum computer? Not a simulation because you really cannot, you can try to do some things, but a simulation is not the real thing. How many people have an actual quantum computer? And I'll very quickly come down to, maybe the fingers of both hands.

Okay, amongst those then, who are willing to put them up for access to people to say, hey, try it out. Not the simulation, not the software, an actual quantum computer. We are one of them. I'll leave it to the room to go determine how many are there who are willing to do that. Because you've got to figure out the quantum computing. You've got to figure out the electronics that lets you interact with the computer. You've got to figure out that each time it runs something, which, by the way, it takes a few milliseconds, do you now need six PhDs to come tune it? Because that's not going to be cost-effective. Or can it keep running? We've written all of the control systems; I'll say keep up for a year at a time. So maybe there's an advantage in some of those aspects.

We have 22 of them up and running that you can access remotely. We actually don't even control how you get access. There is a queue of people who want to run it. So I think that's an advantage. But I'm never going to be of the point of view that's an advantage that cannot get caught up. There are a lot of smart people out there. There's a lot of money out there. You combine talent with capital and you can lose a lead really

quickly. So I'll always be paranoid about that. So I do think we have a lead, but there's a lot of capital and smarts that are chasing it so it behooves us to keep going. And in the end, the value lies in using it.

So can we work with people to figure out what are the use cases that will drive early value? And so that's why, by the way, we work with clients. That's our revenue stream today. So we work with 150 different, between, some are universities but more of them are actually use cases – financial industries, material industries, automobile, battery. Those are all real use cases that we're working on because as they learn to use it and they say, okay, when you get to this point, we can see an advantage coming. And they're all sensing we're getting closer to that point.

SARA EISEN: Is China ahead of us on this?

ARVIND KRISHNA: I believe not, but it's a belief. Do we have full knowledge? No. The reason I think, I think that China has focused a lot on certainly what is called quantum communication, which is can you communicate without anybody being able to eavesdrop, which sounds, I know, really kind of mind-bending? What do you mean? So quantum is one of those weird things where if somebody eavesdrops on a quantum communication, you know it, which means you can stop communication. Which is why I say it's not an _____. So could you have a set of communications in a country around

quantum that lets you get an advantage? I think they're certainly invested in that. I'd be surprised if maybe those agencies who worry about that here are also not investing in that.

From what we can see, I think that they're certainly investing a lot. I haven't really seen people talk about a lot of, I'll call it quantum computing use cases yet. But when you talk, you see people, they're talking about trapped ions and lasers and those kinds of things, the conclusion you can draw is, okay, they're certainly there. They're investing. They haven't yet come out with a result that is going to change the world.

SARA EISEN: We're going to beat them on fertilizer.

ARVIND KRISHNA: We're going to beat them on fertilizer. We're going to beat them on risk. We're going to beat them on materials. And we are definitely not going to let them decrypt our encrypted data.

SARA EISEN: What about AI? Are they ahead there?

ARVIND KRISHNA: I actually am one of the few people who believe no. So, look, there are a certain number of consumer cases, facial recognition, surveillance, policing, knowing what people are doing, putting a social metric on people – are you a good

citizen or a bad citizen? Sure. But can you imagine doing a surveillance state in a democracy? I don't think that's going to happen.

So some of those use cases, maybe structurally they're advantaged. But then I ask the question, who beat Go? Was it a Chinese company or an American company? It was Google, right? I mean with DeepMind. Jeopardy, that was also IBM. Protein folding, that's all the biotech companies here that are leveraging that to help design drugs. So if I begin to look upon all the areas where there's a lot of progress being made, whether it's in foundation models, whether it's in cyber, in the cutting edge, I think it's still very much driven by western universities and western companies taking advantage.

Deployment is very different from invention of the technology. I think that absolutely deploying, we tend to publish our results out of universities. Can people read those and then emulate because they've learned? So put, I'll say IP issues to the side, so if you're willing to ignore IP issues, can you learn from what somebody else has done and go ahead and do things? Of course you can. But I'm waiting to see when are they going to do things that we can copy maybe. That would be the proof point of who is ahead.

SARA EISEN: There's nothing.

ARVIND KRISHNA: Not so far.

SARA EISEN: They can't win Jeopardy. So how do you operate in China as a U.S. technology company with IP? Because you have a pretty big...

ARVIND KRISHNA: Absolutely. And, look, I'm a firm believer in David Ricardo's principles of there should be competitive advantage across nations and each country should do what it does. An overall bigger ecosystem is pretty proven. It leads to a better GDP and a better economic outcome for everyone. So we operate because we don't, we have not done what some others have been forced to which is give up our IP to put it in a joint venture. We have not done that.

So as long as we can operate by keeping our IP and selling our products, software and hardware, of doing consulting, we are happy to do so. And we find that we do have a demand for our products and for our consulting teams because they, in turn, bring...and you'd say, why do you want consulting from an American company in China? Well, because they bring what everybody else is doing. Right? So why do people hire consultants? Because they bring, they have a knowledge of what everybody around the world is doing so they bring the knowledge of what's considered to be the best practice. What is leading edge? And so they are willing to use that and deploy that.

And when we sell, whether it's mainframes or whether it's storage, etc., we don't give the IP of that to anybody that is local. Certainly they're welcome to deploy it and use it

but we don't give the insights and the IP away. As long as we can operate, I'll call it with those reasonable fair rules, we are good.

SARA EISEN: Are you good with the Chinese government?

ARVIND KRISHNA: It's the Chinese government, so I mean, like...

SARA EISEN: Do you have to interact with them?

ARVIND KRISHNA: Well, certainly a number of the state-owned entities are our clients. So, in effect, we interact with them. We operate in the regulatory environment that is there. We operate on the basis of what's allowed to be sold, what are the rules. So, yes, we interact with the government. We are not inside the government by any stretch of the imagination. And that's not our desire. I mean, like we want to operate commercially and so we encourage both sides. I was really glad to see President Xi and Biden sit down at the G-20 because at least that's a signal from both sides that they're willing to work together as opposed to just getting into a hostile standoff. I don't think a trade war serves anybody well.

SARA EISEN: Because a lot of the people do see this issue as being a trade war, a technology war, you know, before it becomes anything more, even more serious

geopolitically. When it comes to the tech war, over Taiwan, semiconductors, where do you think that's going?

ARVIND KRISHNA: Look, semiconductors are essential for most nations today, right? Because semiconductors is what runs technology. So I think that there is certainly a little bit of worry on Taiwan which happens to be a source, which they built up, by the way, I mean kudos to the Taiwanese companies and government for encouraging that investment over multiple decades to get there. That said, everybody else has to catch up. So that's why you see the U.S. with the CHIPS Act. You see similar actions in Europe. You're seeing similar statements coming out of Japan.

So I think that there has to be an alternate to, you don't place all your eggs in one basket. So I think it shouldn't be looked upon as those need to be put down, but I think any sane business would say, look, I'd like a second source. I'd like a third source. I need some resilience. I mean we sell computing to people. Anybody who works with critical computing, any bank that's in a regular country says, hey, I need to be triple active, because in one area electricity might go away. You could get a hurricane. You could get an earthquake. I think the same thing applies in the end to something as essential as semiconductors.

SARA EISEN: So are you investing in that part of your business?

ARVIND KRISHNA: So we are one of the few entities in the world who has full R&D capability. I take immense pride. We are, I think, the first to put a 2-nanometer chip out. So state of the art right now is 7-nanometers. So how small is the future scale on these things? At 2-nanometers you're building a chip that's the size of your thumbnail with 50 billion transistors in it. So that's the scale we are at.

So you'd say that's a little advanced technology. We have of all the R&D, fully self-sufficient to be able to do that. We have declared we are not in semiconductor manufacturing. So we work with Samsung. We work with Intel. We are willing to work with some others subject to, this is subject to, at the leading, leading edge, it is subject to U.S. government agreement. That was part of the CHIPS Act. I think they said anything below 14-nanometers requires permission. Fourteen and older technologies – it's kind of funny to call 14-nanometers old, because that's the bulk of what's being built and deployed right now, although they are less careful about what it can do. And so we are investing, because it helps. While we're not a manufacturer, we do want access to these technologies.

Now, you could say does working on those technologies maybe aid you in quantum computing, because that's pretty advanced semiconductors, maybe you could draw linkage on why we think we're advantaged to the fact that we do some of that work. Because when you think about quantum computing, you're talking about doing, it is

semiconductors at the end, but it's not digital logic. It is different. It is super-conducting semiconductors. They have to worry about materials that can do all of that at temperatures that are colder than outer space. So maybe the knowledge in super-conductors, maybe the knowledge of semiconductors, maybe the knowledge of materials, all does come together with having the quantum physicists there, it is there. So I do draw a linkage between those two things.

But on semiconductors, our goal right now is those are entities that are allowed. We are happy to work with them, to help advantage them to go build it. We are going to deploy our capital much more towards software and consulting acquisitions as opposed to building these plants, which by the way, as you can see on the announcements from Intel and from Micron, they cost \$20 billion a pop, which is pretty heavy capital investment. And so I think that's got to be your primary business model if that's what you do.

SARA EISEN: It's good that the R&D is still happening in America, though.

ARVIND KRISHNA: Absolutely.

SARA EISEN: But manufacturing is happening outside.

ARVIND KRISHNA: Well, we're hoping that these announcements, that's why I mentioned Intel and Micron. Intel has said in Ohio, but also in Phoenix, if I remember. And Micron has said both in Idaho and in New York State. So they're going to build more advanced facilities. I think so will others. I think Samsung will probably build facilities onshore. I think TSMC will build facilities onshore. Arizona for one, or I think Texas for the other. I think there's others who are going to build facilities as well. So I think there will be more on-shoring or re-regionalization on these topics.

SARA EISEN: I also wanted to ask you about the blockchain because I know you're excited about that, and IBM does have a business there. I've heard you talk about it in a sort of boring way about supply chain and using the blockchain for supply chain. What about what's happening right now in the not-so-boring world of bitcoin and this massive blowup? Does that affect you as a player in blockchain?

ARVIND KRISHNA: So, it does not affect us. I'll say it that way. Now, it's interesting to watch it. It's some level of theater. I can make no prediction of where it's going to end up. So I'll leave that to it. I'll be very clear. We, as IBM, are not going to go into blockchain for crypto. By the way, I will also make a difference between crypto and fiat currencies. Fiat currencies is a preserve of central banks and governments. That could well be a use case. But that, to me, is very much like supply chain. What's the provenance? Can you make sure that you have an indelible record of the transactions?

Though you don't want to go __of energy and proof of work and proof of stake, etc.

So can you begin to use these technologies for the use case of no change, provenance, etc.? And that means that it's a way to share information, which kind of sounds funny because my next point is going to be, without revealing all of the information. And so can you begin to do that? There isn't another technology that lets you do that. And so the use cases around supply chain, whether it's to get rid of paperwork or whether it's to get much better visibility, I think in logistics, I believe there is going to be a big market there. And that is what is there. But supply chain for most people compared to, you know, when something goes from 70 to 50 to 20, you have bankruptcies, you have personalities, it's a little bit more boring. Maybe more money in it in the long term.

SARA EISEN: So you're saying if you believe in the blockchain you should buy IBM stock and not bitcoin?

ARVIND KRISHNA: I'll leave that to the investment bankers and the bankers to decide.

SARA EISEN: But is that going to be a big business for you?

ARVIND KRISHNA: It is a business for us today. So we actually do these projects with many clients. We have demonstrated around food safety, around tracking across

oceans. I was in the Middle East recently. A few of the governments there got together and did a fiat exchange project on blockchain. So those are happening. Has it scaled yet to where people can look at it and say, wow, this is a really at-scale business? Not yet.

SARA EISEN: So what inning on blockchain? What inning, since you're using the innings?

ARVIND KRISHNA: Oh, I think we're at the zero inning. We're not even in the Major Leagues yet.

SARA EISEN: And what is the competitive landscape there?

ARVIND KRISHNA: I think the competitive landscape here is going to be much more about consulting and use cases. So I think it's going to be less about the technology. The technology, a lot of it is going to be an open source, right? I mean whether you take Hyperledger or you take one of the Ethereum-like blockchain networks, those are going to be, I think, much more open source. I think here is when we get driven by the use cases and what is the business value. Not so much in the pure technology.

SARA EISEN: You talked a little bit about China and we talked about the chips,

investing in technology. Does the U.S. have, are we investing enough in technology? Are we focused in the right spots when it comes to government, Congress, or national policy?

ARVIND KRISHNA: Look, we got lucky. We got President Biden to come down to Poughkeepsie, which is where we do the heart of our mainframe and quantum, etc. And I had this discussion straightforwardly and he publicly acknowledges it. It may not in public fully. The U.S. used to spend 2% of GDP on federally-funded R&D. That was in the 50's and 60's. We are down to .6, .7% and that includes health. So if you look upon that, my short answer is no. And I'm a believer that actually this mixture of public-private is essential if you want to be ahead on some of the new areas.

We are really proud of what the U.S. has done on internet companies. But do people realize that is on the back of what OD/OLPA and OLPA and the NSF funded for networking and universities. And you can say, well, why do I care about universities? Because it's all those people who came out and founded companies that became the backbone of today's internet economy. So you want to do that because it allows you to take a 10 to 20-year view on what is ahead. Those are really risky projects.

Recently, if you look upon the vaccines. Why did so many of the vaccines that are effective on Covid come out of the U.S.? I think they wrote a check for \$11 billion. How

many of those vaccines do people remember actually made it out all the way? Three out of the 11. That's a pretty low batting average, right? So when the money is that much and the risk is that much, I think that the government ought to lean in very heavily. And why am I saying that? In the CHIPS Act, there is the \$52 billion for chips. That was funded. There was another \$150 billion for federally-funded R&D. That is not yet funded. So the bill is there, it passed, but you need appropriation. So that would be a big step.

SARA EISEN: Are you lobbying for that?

ARVIND KRISHNA: We, lobbying is a strong word.

SARA EISEN: You don't lobby.

ARVIND KRISHNA: We encourage policy. We are willing to speak with senators and congressmen, but we are not willing to fund PACs. We're not willing to fund elections. We are not willing to do all that, and that's a pretty strong principle. It has been one for 110 years so we're not going to be that. That's why I just react to the word, lobbying. But we certainly will speak up for it and we have spoken up for it. We have probably spoken to 30 different senators to say, get moving on this, please. It's good for the nation. We pushed very strongly for the CHIPS Act. We are not a manufacturer, so we

are going to get zero benefit from the money for semiconductor manufacturing. But we will be a secondary benefiter. As more of that source comes onshore, we hope we can use it, but at a full commercial price, to our benefit.

SARA EISEN: You did mention, I just want to finally end on it, you mentioned sustainability and use cases there. It's a huge issue for you. It's become ingrained in what you do and so many other companies we talk to now. How do you deal with that topic and find solutions through technology with your own business and with your clients?

ARVIND KRISHNA: So we've made a commitment to net zero by 2030, not 2050, and without purchasing offsets. We think we can probably get 90% at least of the way there by doing clean energy. So that's Scope 1 and Scope 2. I want to be clear. We're not a Scope 3 company and our Scope 3 would be tiny, even if we could measure it. But others do have that issue. We think that the final 5 to 10%, we'll probably have to do sequestration of some type as opposed to purchasing an offset. An offset to me is kind of vague.

SARA EISEN: It's the easiest way to do it.

ARVIND KRISHNA: Yes, but it's a financial instrument. It doesn't necessarily get the

greenhouse gas out of the atmosphere. So with the energy prices that are there today, is it about purpose or is it about profit? The two align. And I'm a really big believer, when you can get the two to align, you get massive traction. And I think that is the difference between two years ago and today.

So if I go to a business today, we have done an experiment with our data centers in the U.K., could you take 30% of the energy out by just doing way more data, way more observation? And that's the number. Most data centers could probably take 30% out by getting a lot more careful about what you do. I actually believe that you can get 20 to 30% of efficiency.

How many times does the air-conditioning run at 72 degrees even at night when there's no people in the workplace? How many places in the winter will keep the heat still in the 60s and there's nobody there? What about running water, just running because there's no use for them? How many computers just run even though they're lightly utilized? If we can get 30% demand down, that helps people today. That means less greenhouse gases going into the atmosphere. Maybe that 30% demand that's coming over the next decade is handled in the infrastructure. That means less capital.

So I am excited about what we can do. But this means data, because without data you have no idea what's really being used versus not. It means a little bit of IoT. It means a

little bit of edge computing. It means \$5 sensors. By the way, a sensor to turn the air-conditioning on and off is \$5. You probably save that in one night, if you think about the building. So these things pay for themselves.

And I'm so excited about what we can do when purpose and profit are put together, without even worrying about upstream and methane and emissions and full electrification and all those things. And I mentioned cement and steel, which I think are as big a problem as transportation, which is on everyone's mind.

SARA EISEN: Well, we've gotten the signal from Barbara. We could do a whole other hour on just this topic, but we've got to leave it there. Thank you so much. Arvind Krishna, optimist, technologist and leader. Appreciate it. Thank you.

PRESIDENT BARBARA VAN ALLEN: Well, I think we all feel very lucky to have been in the room for that conversation. That was just outstanding. Thank you, Arvind. Thank you, Sara.

We have a few more events lined up. The year is not quite over. So it's time when I turn to that to share. We're going to return from Thanksgiving with a webinar with Club Chair, John Williams, of the New York Fed. He'll speak Monday, November 28th. That will be, again, a webinar. So please be sure you don't miss it. Mike Wirth of Chevron is

going to join us in-person for a luncheon December 1st. We'll follow that with Sukhinder Singh Cassidy, the former CEO of StubHub on December 6th. That will be a webinar. And then Marcia Fudge, the Secretary of Housing and Urban Development, will join us December 7th. And then we're going to close the year with The Honorable Joe Manchin, U.S. Senator, West Virginia, December 8th. So that will also be here, by the way. And we're going to have what might be our first Holiday Party in 115 years, to get together on Monday, December 12th. So for those of you that are in town that evening, it'll also be here. We hope to see you. So thank you. And for everyone online, thank you for joining us and have a great rest of your day. And for everybody here, enjoy your lunch. Thank you.