

# Techtopia with Chitra Ragavan

## Episode 4: John Neuffer

Chitra Ragavan:

The semiconductor chip shortage, what's causing it, why it matters, and what we need to do about it. That's the focus of our conversation today. Hello, everyone. I'm Chitra Ragavan, and this is Techtopia. Joining me is John Neuffer. He's President and CEO of the Washington, D.C.-based Semiconductor Industry Association. Neuffer is responsible for setting and leading the public policy agenda and serves as the primary advocate for maintaining U.S. leadership in semiconductor design, manufacturing, and research. John, welcome to Techtopia.

John Neuffer:

Hi, Chitra. Great to be here.

Chitra Ragavan:

I think we all have this vague understanding that all electronics are getting smaller and more portable, but I don't think we have a grasp of just how small and portable the underlying semiconductor chips are. For the lay audience, can you explain in simple terms what semiconductor chips are and how they've evolved over the decades in their size, and scope and scale of applications and importance?

John Neuffer:

Well, most semiconductors are made from silicon, and silicon comes from sand, and people don't realize it. Silicon is actually the second most abundant element in the earth's crust, only after oxygen. Why are they called semiconductors and not just conductors, and that's because they conduct electricity sometimes, and sometimes they don't. In that regard, there's kind of three types of materials. There's materials that conduct electricity like metal, there's materials that are insulators, they don't conduct electricity that's like glass, and there's semiconductors, and they can do both.

John Neuffer:

Whether they can conduct or insulate is controlled by the use of electric fields, and that's how you create your transistors, your on and off switches. That's essentially what a semiconductor is. There's actually very little kind of general knowledge of what these things are and really kind of how powerful they are.

Chitra Ragavan:

You've been in this industry for a long time. What's the thing that surprised you the most when you first started learning about chips and what's the thing that surprises you most now?

John Neuffer:

It's an awesome technology. In the last 60 years, there's just been an amazing pace of innovation. It's probably the most innovative industry in the world. The chips, the transistors on the chips have gotten amazingly small. Chip manufacturers are now manipulating materials at atomic levels to make these transistors so small.

John Neuffer:

The most packed chips now, the highest-end chip has 54 billion transistors on one chip. That's 54 billion on/off switches on one chip, and that's basically the size of a quarter. The other thing that's really happened is that chips have gotten amazingly cheap. If space travel had come down in price, as much as transistors have, the Apollo 11 mission, which cost \$350 million in 1969 dollars, and put Neil Armstrong on the moon, well, that would have cost as much as a latte, and so that has driven computing power to just soaring heights, Chitra. Some of the world's best computers in 1985 would take four and a half hours to process what the best chips now can process in one second, so it's just been amazing pace of innovation. I think that's a defining feature of the semiconductor industry.

Chitra Ragavan:

That's absolutely incredible. Do you have like a favorite chip story that sort of encapsulates where we are today with this evolution?

John Neuffer:

Well, I don't know if I have a favorite story, but I think it's kind of amazing what chips have brought to our lives. Because of this innovation, because of the power of the chip and the miniaturization of the chip, we have computers as wristwatches now. We have tiny pacemakers in hearts that can communicate with patients and doctors. We have cellphones with five cameras, so it just ... Chips are ubiquitous.

John Neuffer:

They're in medical imaging devices, they control electric grids, they power navigation systems for our planes, they provide the guts of 5G communications. Semiconductors are really the greatest innovation of the past century. Without chips, you simply don't have an Information Age. Without chips, we simply don't have AI, IoT, quantum computing. Everything that's kind of important for our future is being driven by innovation in the chip sector.

Chitra Ragavan:

Now, everything about the size and what you can pack into a chip has been sort of predicated or even predicted by something called Moore's law. Can you sort of describe what Moore's law is and whether it still holds true and why it matters in this context?

John Neuffer:

Yeah. Moore's law basically postulates that ... It was devised by Gordon Moore over 50 years ago, to one of the founders of Intel, and he said, "Listen, we should be able to double the number of transistors on a chip every couple of years." And for the last 50 years, about every 10 or 15 years, there's predictions that Moore's law will reach physical limits and we're just not going to be able to keep that pace up. Every time there's these dire warnings that we won't be able to keep the pace up, keep miniaturizing the transistors, keep driving, which has been the chief driving force for semiconductor innovation, there's breakthroughs, and Moore's law has marched forward. I will say though, that we are now, as an industry, really facing some physical limits, and Moore's law is slowing, and innovation is going to be driven by other things, by architecture, design, and materials.

John Neuffer:

I'm confident that innovation will proceed a pace in the sector. It's just not going to be as much about what they call scaling, which is miniaturization of the transistors on the chips.

Chitra Ragavan:

The global semiconductor market size was like around 500 billion, I think in 2019 and is projected to reach about 726 billion by 2027. What's attributing to the growth of this market?

John Neuffer:

You've done your homework, Chitra. Those are pretty accurate projections. It's really all being driven by our digital economy, by our Information Age. AI is a big driving force, autonomous vehicles, electric vehicles, IoT, the cellphones that we all have, the Zoom calls that we can do now. These are major driving forces for growth in the semiconductor industry, and it's a great industry to be in right now.

John Neuffer:

Very exciting industry, tons of innovation, a lot of challenges, but the future is very promising for the semiconductor industry, given all these demands for the chips. I should also point out that 5G, 6G communications, all driving innovation in the semiconductor industry and leading everyone to believe that it's a very promising future.

Chitra Ragavan:

Then, of course, you had COVID-19 sort of descend on the world, and that's resulted in this massive disruption, not just of the semiconductor supply chain, but all kinds of supply chain, and the chip industry is obviously no exception. Obviously, you recently had the cold spell in Texas, where there are a couple of chip factories, and that hasn't helped either, so what has been the impact of all of these crises on the industry and on all of the industries chips support?

John Neuffer:

Yeah. I think the biggest moment for us as an industry has been the pandemic crisis that swept the world really put into bold relief that we need to remedy some of our supply chain vulnerabilities. When I say that, I mean that a lot of our chips, about 75% of our chips are made in Asia. That's a big change in the last few decades. In 1990, we manufactured about 37% of the world's chips right here on U.S. shores.

John Neuffer:

That's now down to 12%. And like with medical equipment in pharmaceuticals, where people started thinking about supply chain security and resilience, people around the world, in Washington are thinking about, "Well, what's that mean for semiconductors?" I think there's a real effort now to think about rebalancing our supply chains so that more of our manufacturing is going to happen here in the U.S., but the reality is that we just don't manufacture enough chips here in the U.S., and we need to remedy that.

Chitra Ragavan:

It's also a geopolitical consideration, isn't it, given that so much of the chip manufacturing happens in China and Taiwan, and with our trade tensions with China in particular, and with Taiwan's trade tensions and other political tensions with China, it seems like there's a lot more at stake than just the economy.

John Neuffer:

Yeah, an awful lot of chips are produced in Taiwan. That's for sure. Something like 20% of the global chips, global supply for chips come out of Taiwan, but it's not actually accurate to say that a lot of chips are produced in China. China is still a fairly nascent market. For our industry, the real importance of China is its market as a consumer.

John Neuffer:

It's our largest consumer. We actually, as an industry, don't produce much in China. There's only a couple of fabs. Those are semiconductor manufacturing facilities that are U.S.-owned in China. We produce a lot of chips here. We produce chips in places like Taiwan, Israel, but not actually much in China.

Chitra Ragavan:

That's interesting, and so one of the things that I was really interested in reading was the impact this has had on the automotive industry.

John Neuffer:

Yeah. Yeah, exactly. It's been a rather jarring year for everybody because of the pandemic. For the auto industry, Q1, Q2 was very rough. Auto sales dropped just precipitously.

John Neuffer:

Not surprising, the auto industry started canceling its chip orders, and so chip orders collapsed for auto grade semiconductors. That all is kind of predictable, but what was

not predictable is that the auto industry came roaring back, partly driven by China coming back online much quicker than everyone else, but generally, auto industry came back. Folks sitting at home thinking, "I've got a little bit extra money that I've not been spending on my commuting. I might as well go out and buy a car," and so the problem is, is that auto industry is very, very efficient and very focused on this just-in-time delivery of goods from a supply chain. The chip industry is a little different because it takes about ...

John Neuffer:

It can take up to 26 weeks to manufacture a chip, so the supply chain is long, and that doesn't ... When the auto industry turned on again, third and fourth quarter last year, and they started ordering chips again, well, they couldn't get them right away because it takes so long to produce them. The other thing that happened is, it's not just the auto industry that's suffering, chip shortage, although the auto industry is suffering the most acute. There's tightening throughout the whole industry, all across the industry, and that's been driven by demand for products to address and to help us learn remotely and work remotely, and for respirator machines, so there's just been an explosion in the demand for chips in the last year, and the auto industry has just been the one that's kind of taken at the worst.

Chitra Ragavan:

I was fascinated to read about this kind of caste system in chip manufacturing and consumption that automakers use chips that are older and are lower priority for chip makers, because they are making these new, better, more sophisticated chips for 5G smartphones and video games, and all these other things, and so there's a bigger profit margin for making these higher-end chips. Is that true, that there is sort of this thing that's also exacerbating the problem for automakers?

John Neuffer:

Yeah. I wouldn't characterize it like that, Chitra. It's definitely not a caste system. The auto industry is very important to the semiconductor industry, that's for sure. There's no doubt about it, that the way the auto industry works and the way chips take a long time to be certified for autos, the auto industry tends to use lagging-edge technologies for chip technologies, that's for sure, and those ones, you're right, don't have the same margins as leading edge technologies, chips that go into data banks and things like that, but I can assure you, the industry, auto industry is viewed as very important by the chip industry.

John Neuffer:

I'll tell you, having talked to a lot of leadership in the chip industry about this, we are working tirelessly to help unkink the supply chains to get this worked out for the auto industry, but the reality is that the big problem is it just takes a long time to get the chips made and out the door to the auto companies, like I said, up to 26 weeks, and that's the essence of the problem. We're just playing catch up and we're doing as much as we can to help the auto companies and get out of this bind.

Chitra Ragavan:

What can we do? What are some of the things you are recommending?

John Neuffer:

Yeah. In the short-term, it's all of our companies working round the clock to produce as many chips as we can. Right now, we're at near full capacity, and companies are going very quickly to full capacity, but that process itself even takes time, even more time. In the short run, that's what we're going to do and that's what we're doing, and we'll get through this, but I think in the longer run, Chitra, and I mentioned it earlier, there's, Boston Consulting Group, projected that in the next 10 years, we're going to have a 56% increase in chip demand. That means we just need, around the world, a lot more capacity to build chips.

John Neuffer:

Right now, about 80% of the chips are being built in Asia, and what we're trying to do is get the U.S. government focused on helping provide manufacturing incentives to make more chip production here in the U.S., and the question is, "Do we want all these chips to be made here in the U.S., or do we want them to be made overseas?" The reason why there needs to be manufacturing incentives, Chitra, is that semiconductor industry is a market-driven, fiercely competitive industry, but when it comes to building these multi-billion dollar fabs to leading edge fabs, up to \$20 billion. That's like a nuclear aircraft carrier of price tag. Yeah, countries overseas, Chitra, provide massive multi-billion dollars incentives to lure companies to build their fabs there. Our federal government is not in that in business, so as a result, I mentioned this statistic earlier, where 1990, we were building about 37% of the world's chips, now we're building about 12%, and that's because we're not in a free market when it comes to building manufacturing facilities or fabs, so the U.S. government needs to step in and help incentivize that. Other governments are not going to change their practices, so we're kind of standing here on the start line, looking down the field, as all of our competitors overseas are kind of halfway down the field, and we're saying, "Gee, maybe we should get going here," and so that's something that we're focused very heavily on here in Washington.

Chitra Ragavan:

We've got a new administration in place. Have you had a chance to speak with the Biden administration, and what are some of the things they're doing to address this critical shortage?

John Neuffer:

Yeah. We've had a lot of conversation with folks, the Biden administration, and I think they are wisely kind of focused on the long game here. President Biden, just last week, when he was rolling out an executive order to review supply chains, including supply chains for semiconductors, he supported a multi-billion dollar effort to incentivize chip manufacturing in the U.S., and we were very happy that he displayed one of these beautiful chips. He held it up and said, "These are important to the American economy

and to American national security." We feel optimistic and encouraged with the direction of the Biden administration and look forward to working with folks on the Biden team to address some of these challenges.

Chitra Ragavan:

Looking at how the chip has changed our society, global societies over the decades, how do you see these changes evolving in the next five, 10, 20 years, and the chip evolving with it, and how is it going to transform our lives?

John Neuffer:

Wow, I'm not much of a futurologist, Chitra, but if you look at the trajectory of change that has been driven by the chip, the sky is the limit. I mentioned this to your earlier, Chitra, but I was talking to my daughter the other day. She said, "Dad, it's very hard." She's in her 20's. "It's very hard to be amazed by innovations these days because they come so fast and they come so big."

John Neuffer:

I mentioned that Neil Armstrong landed on the moon in 1969. That was a big deal for me, but I totally get her point. The age of the Internet started in the '90s, and here we are 30 years later, so evolved in this, with the social media, and the broadband, and the connectivity. I just think that we're going to see some amazing things with the electric cars. The sky's the limit.

Chitra Ragavan:

Do you think the shortage will be addressed over time?

John Neuffer:

In the short term, I'm confident that we'll get this problem tackled. By the end of last year, our shipments to the auto companies were already above our shipments to the auto companies the previous year, so we're cycling up, and we'll get the short-term problem fixed. I'm confident that working with the USG, we'll get incentives in place, whether they're grants or whether they're investment tax credits, tax incentives, that we'll get this longer-term problem licked as well. I mean, it's just that kind of failure is not an option. The stakes are very high.

John Neuffer:

I think people in Washington, whether it's in the Biden administration around The Hill, recognize that there's a lot of bipartisan support, which is kind of rare these days in Washington, to help incentivize manufacturing in the U.S., so I do feel optimistic both for the short-term issue, which is a difficult one for the car companies. It's a really tough issue, we get that, but I'm confident we'll get through this, and then, we'll go on and tackle the long-term challenge as well, to get more manufacturing here, more manufacturing generally for chips here to address the massive explosion in chip demand coming at us.

Chitra Ragavan:

That's great. Do you have any closing thoughts, any closing stories on the role of the chip in your life?

John Neuffer:

The thing that really comes to mind for me is that most people just don't really appreciate how powerful semiconductor innovation has been in their lives, and so I'm glad you had me on today, Chitra. The thing for us is we spend a lot of time kind of educating folks about the power of the chip. The problem with the chip, Chitra, is it's in everything, but no one can see it, no one can touch it, no one knows what it really is, and so I think we're just going to have a lot of work to do to beat the drum on educating folks about how important these chips are and how important it is to keep the U.S., which controls about half of the global chip market, to keep it at the tip of the innovation sphere in the semiconductor technology.

Chitra Ragavan:

Yeah, it's really one of the most powerful, invisible forces in our lives and in society today.

John Neuffer:

It's, in my view and not being an electrical engineer, Chitra, it's magic. What happens with silicon and these billions and billions of transistors on these chips? It just boggles the mind.

Chitra Ragavan:

Well, thank you so much for joining me and for this fascinating conversation.

John Neuffer:

Well, thank you, Chitra. This has been great.

Chitra Ragavan:

John Neuffer is the President and CEO of the Washington, D.C.-based Semiconductor Industry Association. Prior to joining the association, John served as Senior Vice President for Global Policy at the Information Technology Industry Council, and prior to that, he served for more than seven years at the United States Trade Representatives office, USTR. This is Techtopia. I'm Chitra Ragavan.

Chitra Ragavan:

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