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CORPORATE PARTICIPANTS

C. C. Wei Taiwan Semiconductor Manufacturing Company Limited - CEO

Jeff Su Taiwan Semiconductor Manufacturing Company Limited - Director of IR

Wendell Huang Taiwan Semiconductor Manufacturing Company Limited - VP & CFO

CONFERENCE CALL PARTICIPANTS

Brad Lin BofA Securities, Research Division - Research Analyst

Brett Simpson Arete Research Services LLP - Senior Analyst

Charlie Chan Morgan Stanley, Research Division - Technology Analyst

Laura Chen Citigroup Inc., Research Division - Research Analyst

Gokul Hariharan JPMorgan Chase & Co, Research Division - MD, Co-Head of Asia TMT Research, Head of Taiwan Equity Research & Senior Tech Analyst

Krish Sankar TD Cowen, Research Division - MD & Senior Research Analyst

Mehdi Hosseini Susquehanna Financial Group, LLLP, Research Division - Senior Analyst

Sunny Lin UBS Investment Bank, Research Division - Director & Associate Analyst

Charles Shi Needham & Company, LLC, Research Division - Senior Analyst

Bruce Lu Goldman Sachs Group, Inc., Research Division - VP

PRESENTATION

Jeff Su - Taiwan Semiconductor Manufacturing Company Limited - Director of IR

(foreign language) Good afternoon, everyone, and welcome to TSMC's Third Quarter 2023 Earnings Conference Call. This is Jeff Su, TSMC's Director of Investor Relations and your host for today.

TSMC is hosting our earnings conference call via live audio webcast through the company's website at www.tsmc.com, where you can also download the earnings release materials. (Operator Instructions)

The format for today's event will be as follows. First, TSMC's Vice President and CFO, Mr. Wendell Huang, will summarize our operations in the third quarter 2023, followed by our guidance for the fourth quarter 2023. Afterwards, Mr. Huang and TSMC CEO, Dr. C. C. Wei, will jointly provide the company's key messages. Then we will open the line for the Q&A.

As usual, I would like to remind everybody that today's discussions may contain forward-looking statements that are subject to significant risks and uncertainties, which could cause actual results to differ materially from those contained in the forward-looking statements. Please refer to the safe harbor notice that appears in our press release.

And now, I would like to turn the call over to TSMC's CFO, Mr. Wendell Huang, for the summary of operations and the current quarter guidance.

Wendell Huang - Taiwan Semiconductor Manufacturing Company Limited - VP & CFO

Thank you, Jeff. Good afternoon, everyone. Thank you for joining us today. My presentation will start with financial highlights for the third quarter 2023. After that, I will provide the guidance for the fourth quarter 2023.

Third quarter revenue increased 13.7% sequentially in NT dollars or 10.2% in U.S. dollars, as our third quarter business was supported by the strong ramp of our industry-leading 3-nanometer technology and higher demand for 5-nanometer technologies, partially offset by customers' ongoing inventory adjustment. Gross margin increased 0.2 percentage point sequentially to 54.3%, mainly reflecting higher capacity utilization, partially offset by the margin dilution from N3 ramp.

Total operating expenses accounted for 12.6% of net revenue as compared to 12.1% in the second quarter, mainly due to higher R&D expenses to support our 3-nanometer and 2-nanometer development. Operating margin was 41.7%, down 0.3 percentage point from the previous quarter.

Overall, our third quarter EPS was TWD 8.14 and ROE was 25.8%.

Now let's move on to the revenue by technology. 3-nanometer process technology contributed 6% of wafer revenue in the third quarter while 5-nanometer and 7-nanometer accounted for 37% and 16%, respectively. Advanced technologies, defined as 7-nanometer and below, accounted for 59% of wafer revenue.

Moving on to revenue contribution by platform. HPC increased 6% quarter-over-quarter to account for 42% of our third quarter revenue. Smartphone increased 33% to account for 39%. IoT increased 24% to account for 9%. Automotive decreased 24% to account for 5%. And DCE decreased 1% to account for 2%.

Moving on to the balance sheet. We ended the third quarter with cash and marketable securities of TWD 1.55 trillion or USD 48 billion.

On the liabilities side, current liabilities increased by TWD 159 billion, mainly due to the increase of TWD 95 billion in accounts payable and the increase of TWD 59 billion in accrued liabilities and others. Long-term interest-bearing debt increased by TWD 30 billion, of which TWD 10 billion from new issuance and TWD 20 billion from foreign exchange rate movement.

On financial ratio, accounts receivable turnover days increased 3 days to 35 days while days of inventory decreased 3 days to 96 days.

Regarding cash flow and CapEx. During the third quarter, we generated about TWD 295 billion in cash from operations, spent TWD 227 billion in CapEx and distributed TWD 71 billion for fourth quarter '22 cash dividend. Overall, our cash balance increased TWD 35 billion to TWD 1.31 trillion at the end of the quarter. In U.S. dollar terms, our third quarter capital expenditures totaled \$7.1 billion.

I have finished my financial summary. Now let's turn to our current quarter guidance. Based on current business outlook, we expect our fourth quarter revenue to be between USD 18.8 billion and USD 19.6 billion, which represents a 11.1% sequential increase at the midpoint. Based on the exchange rate assumption of USD 1 to TWD 32, gross margin is expected to be between 51.5% and 53.5%, operating margin between 39.5% and 41.5%. This concludes my financial presentation.

Now let me turn to our key messages. I will start by making some comments on our third quarter '23 and fourth quarter '23 profitability. Compared to second quarter, our third quarter gross margin increased by 20 basis points sequentially to 54.3%, primarily due to a higher capacity utilization rate and a more favorable foreign exchange rate, partially offset by the margin dilution from the initial ramp-up of our 3-nanometer technology.

Compared to our third quarter guidance, our actual gross margin exceeded the high end of the range provided 3 months ago by 80 basis points, mainly due to a more favorable foreign exchange rate. We have just guided our fourth quarter gross margin to decline by 1.8 percentage points to 52.5% at the midpoint, primarily due to the continued margin dilution from the steep ramp of our 3-nanometer technology.

As a reminder, 6 factors determine TSMC's profitability: leadership technology development and ramp-up, pricing, cost reduction, capacity utilization, technology mix and foreign exchange rate. To manage our profitability in the next several years, we will work diligently on our internal cost improvement while continuing to strategically sell our value. Excluding the impact of foreign exchange rate, of which we have no control over, we continue to forecast a long-term gross margin of 53% and higher is achievable.

Next, let me talk about our 2023 CapEx and depreciation. Every year, our CapEx is spent in anticipation of the growth that will follow in future years. Given the near-term uncertainties, we continue to manage our business prudently and have tightened up our capital spending throughout the year where appropriate. We now expect our 2023 CapEx to be approximately USD 32 billion. Out of the approximately \$32 billion CapEx for 2023, about 70% of the capital budget will be allocated for advanced process technologies; about 20% will be spent for specialty technologies; and about 10% will be spent for advanced packaging, testing, mask-making and others.

Our depreciation expense is now expected to increase by low 20s percentage year-over-year in 2023 as compared to our January forecast of approximately 30% year-over-year increase.

Despite the near-term inventory cycle, our commitment to support customers' growth remains unchanged, and our disciplined CapEx and capacity planning remains based on the long-term structure market demand profile. We will continue to work closely with our customers to plan our long-term capacity and invest in leading-edge, specialty, and advanced packaging technologies to support their growth, while delivering profitable growth to our shareholders.

Now let me turn the microphone over to C. C.

C. C. Wei - *Taiwan Semiconductor Manufacturing Company Limited - CEO*

Thank you, Wendell. Good afternoon, everyone. First, let me start with our near-term demand and inventory. We concluded our third quarter with revenue of USD 17.3 billion, in line with our guidance in U.S. dollar terms. Our business in the third quarter was supported by the strong ramp of our industry-leading 3-nanometer technology and higher demand for 5-nanometer technologies, partially offset by customers' ongoing inventory adjustment.

Moving into fourth quarter 2023. While AI-related demand continues to be strong, it is not enough to offset the overall cyclicality of our business. We expect our business in the fourth quarter to be supported by the continued strong ramp of our 3-nanometer technology, partially offset by customers' continued inventory adjustment.

On the inventory side, we expect the fabless semiconductor inventory to have continuously reduced in the third quarter. However, due to the persistent weaker overall macroeconomic conditions and slow demand recovery in China, customers remain cautious in their inventory control. Thus, we expect the inventory digestion to continue in the fourth quarter.

Having said that, we are observing some early signs of demand stabilization in the PC and smartphone end markets. Together with such level of inventory control, we forecast the fabless semiconductor inventory to further reduce and exit 4Q '23 at a healthier level.

Next, let me talk about our global manufacturing footprint update. TSMC's mission is to be the trusted technology and capacity provider of the global logic IC industry for years to come. As we have said before, our strategy is to expand our global manufacturing footprint to increase customer trust, expand our future growth potential, and reach for more global talents. Our overseas decisions are based on our customers' needs and the necessary level of government support. This is to maximize the value for our shareholders.

In Europe, after conducting extensive due diligence, we announced our plan to build a specialty technology fab in Dresden, Germany focusing on automotive and industrial applications. We have received the strong commitment to support this project from our JV partners; the European Commission government; and German federal state and city governments. This fab will utilize 22/28-nanometer and 12/16-nanometer technologies for semiconductor wafer fabrication. Fab construction is scheduled to begin in second half 2024 and production is targeted to begin in late 2027.

In Arizona, we are receiving strong support from the city of Phoenix, State of Arizona and U.S. federal government and continue to develop positive relationship. We work closely with our local trade and union partners. We are making good progress on the fab infrastructure, utilities and equipment installation issues in our first fab and the situation is improving. We have also begun early preparation for our Arizona fab operations and hired close to 1,100 local TSMC employees so far. Many of them has been brought to Taiwan for extensive hands-on experience in our fab, so that they can further their technical skills while being immersed in TSMC operation environment and culture.

We continue to target volume production of N4 process technology in first half 2025 and are confident that once we begin operations, we will be able to deliver the same level of manufacturing, quality and reliability in Arizona as from our fabs in Taiwan.

In Japan, we built a specialty technology fab, which will utilize 12/16-nanometer and 22/28-nanometer process technologies. We have hired approximately 800 local TSMC employees so far with the majority having similarly been brought to Taiwan for hands-on experience. Equipment move-in has begun this month and volume production is on track for late 2024.

In China, we have recently received an extension from the U.S. Bureau of Industry and Security to continue our operation in Nanjing. We are currently in the process of applying for validated end user authorization and expect to receive permanent authorization in the near future.

From a cost perspective, the initial costs of overseas fabs are higher than TSMC fab in Taiwan due to, first, smaller fab scale; second, higher costs throughout the supply chain; and third, the early stage of semiconductor ecosystem overseas as compared to a matured ecosystem in Taiwan. TSMC's responsibility is to manage and minimize the cost gap to maximize the return for our shareholders. Our pricing will also remain strategic to reflect our value, which include the value of geographic flexibility. We will also work closely with government to secure their support.

At the same time, we are leveraging our fundamental competitive advantage of manufacturing technology leadership, large volume, economies of scale to continuously drive our costs down. By taking such actions, TSMC will have the ability to absorb the higher cost of overseas fabs and still deliver the long-term gross margin of 53% and higher and sustainable ROE of greater than 25%. We remain firm in our commitment to maximize the value for our shareholders.

Now let me talk about N3 and N3E ramp-up and progress, our 3-nanometer technology, the most advanced semiconductor technology in both PPA and transistor technology. N3 is already in volume production with good yield and we are seeing a strong ramp in the second half of this year, supported by both HPC and smartphone applications. We reaffirm N3 will contribute mid-single-digit percentage of our total wafer revenue in 2023, and we expect a much higher percentage in 2024 supported by robust demand from multiple customers.

N3E will leverage the strong foundation of N3 to further extend our N3 family with enhanced performance, power and yield and provide complete platform support for both HPC and smartphone applications. N3E has passed qualification and achieved performance and yield targets and will start volume production in fourth quarter of this year. We also continue to provide further enhancement of N3 technology, including N3P and N3X.

With our strategy of continuous enhancement of our 3-nanometer process technologies, we expect strong multi-year demand from our customers and we are confident that our 3-nanometer family will be another large and long-lasting node for TSMC.

Finally, I will talk about the N2 status. The recent surge in AI-related demand supports our already strong conviction that demand for energy-efficient computing will accelerate in an intelligent and connected world. The value of our technology platform is expanding beyond the scope of geometry shrink alone and increasing toward greater power efficiency.

In addition, as process technology complexity increases, the lead time and engagement with customers also start much earlier. As a result, we are observing a strong level of customer interest and engagement at our N2 similar to or higher than N3 at a similar stage from both HPC and smartphone applications.

Our 2-nanometer technology will be the most advanced semiconductor technology in the industry in both density and energy efficiency when it is introduced in 2025. Our N2 technology development is progressing well and on track for volume production in 2025. Our N2 will adopt nanosheet transistor structure, which has demonstrated excellent power efficiency. N2 will deliver full node performance and power benefits to address the increasing need for energy-efficient computing.

As part of N2 technology platform, we also developed N2 with Backside Power Rail solution, which is best suited for HPC applications. We are targeting Backside Power Rail to be available in the second half of 2025 to customers with production in 2026. With our strategy of continuous enhancement, N2 and its derivative will further extend our technology leadership well into the future.

This concludes our key messages, and thank you for your attention.

Jeff Su - Taiwan Semiconductor Manufacturing Company Limited - Director of IR

Thank you, C. C. This concludes our prepared statements. (Operator Instructions) Now let's begin the Q&A session.

QUESTIONS AND ANSWERS

Operator

The first one to ask questions, Gokul Hariharan from JPMorgan.

Gokul Hariharan - JPMorgan Chase & Co, Research Division - MD, Co-Head of Asia TMT Research, Head of Taiwan Equity Research & Senior Tech Analyst

Congratulations on a great result, and thanks for the details on N3 and N2. My first question is on the technology leadership. Given we are hearing a lot of competitive messaging from your U.S. IDM competitor/customer in the last few months, Intel seems to think that they will be getting into technology -- or process technology leadership in 2025.

Just wanted to hear what does TSMC think of Intel's claim. And when TSMC thinks about customer engagement, do you feel you will lose a little bit of market share to Intel when it comes to the N2 or the first generation of nanosheet transistors? Or you think your very high market share in N3 will continue into N2? That's my first question.

Jeff Su - Taiwan Semiconductor Manufacturing Company Limited - Director of IR

Okay. Thank you, Gokul. Please allow me to summarize your first question. So Gokul's first question is about technology leadership and competition with, I think, particularly IDM. He notes this IDM is very -- messaging about taking over process technology leadership from TSMC. And so Gokul's question is, how do we see this? Are we concerned that we will lose market share at nanosheet or N2 to this IDM given their claims of process -- regaining process technology leadership. Is that correct, Gokul?

Gokul Hariharan - JPMorgan Chase & Co, Research Division - MD, Co-Head of Asia TMT Research, Head of Taiwan Equity Research & Senior Tech Analyst

Yes, that's right.

C. C. Wei - Taiwan Semiconductor Manufacturing Company Limited - CEO

Well, Gokul, this is C. C. Wei. Let me answer your question with a very simple answer is that no, but what I will state a little bit long. Actually, we do not underestimate any of our competitors or take them lightly. Having said that, our internal assessment shows that our N3P, now I repeat again, N3P technology, demonstrated comparable PPA to 18A, my competitor's technology, but with an earlier time to market, better technology maturity, and much better cost.

In fact, let me repeat again, our 2-nanometer technology without backside power is more advanced than both N3P and 18A and will be semiconductor industry's most advanced technology when it is introduced in 2025. Does that answer your question, Gokul?

Gokul Hariharan - JPMorgan Chase & Co, Research Division - MD, Co-Head of Asia TMT Research, Head of Taiwan Equity Research & Senior Tech Analyst

Okay. That's quite clear. Could you talk -- also talk about -- my second question is, could we talk a little bit about the AI-related demand. You've seen a pretty strong demand on the data center side and you talked about AI being about 6% of revenues this year, mostly on the data center side.

Are we starting to see more engagement on AI demand on edge devices? Based on TSMC's expectations, is this going to be a big growth driver in the next 1 to 2 years for TSMC's leading-edge AI devices -- sorry, AI on edge devices? Do you think that, that is a bigger driver for you?

Jeff Su - Taiwan Semiconductor Manufacturing Company Limited - Director of IR

Okay. Thank you, Gokul. So Gokul's second question is on AI-related demand. He notes, of course, that we have talked last time also about our AI-related demand outlook and particularly focused on what we call server AI processors or Gokul referring to data centers.

So his question is really more about on-the-edge devices. Are we starting to see AI-related demand for edge devices? Do we expect this to be a big growth driver in the next 1 to 2 years for our leading-edge technologies as well?

C. C. Wei - Taiwan Semiconductor Manufacturing Company Limited - CEO

Well, the answer is also very simple, yes. We do see some activities from customers who add AI capability in end devices such as smartphone and PCs, through neural engine and AI and PC, whatever. And we certainly hope that this one will add to the course, help TSMC more strengthen under our AI's business.

Gokul Hariharan - JPMorgan Chase & Co, Research Division - MD, Co-Head of Asia TMT Research, Head of Taiwan Equity Research & Senior Tech Analyst

So do you see that happen in the next 1 year? Or is it something that will happen in a more longer term horizon? Just wanted to understand when to think about the cadence of this growth.

C. C. Wei - Taiwan Semiconductor Manufacturing Company Limited - CEO

Okay. Let me answer briefly. It started right now, and we will expect that the more and more customer will put that AI's capability into the end devices, into their product.

Operator

Next one to ask question, Charlie Chan from Morgan Stanley.

Charlie Chan - Morgan Stanley, Research Division - Technology Analyst

So my first question is about the cycle recovery. So much appreciate about your comments about end demand. So my question is about when do you expect that there will be an uptick of the fab utilization, assuming demand is stabilizing and also inventory get back to the healthy level? Because it's just very hard to believe your fab utilization outside of leading edge will stay at only 70%, 80%. So first question is about, do you see that overall fab utilization to pick up anytime soon?

Jeff Su - Taiwan Semiconductor Manufacturing Company Limited - Director of IR

Okay. So Charlie, I think your first question is sort of, if I'm correct, around the cycle and in terms of -- how do we see the cycle and the recovery? When -- do we see the fab utilization picking up, which really is a function of, I guess, do we see the cycle bottoming out and when do we expect a recovery. Is that correct?

Charlie Chan - Morgan Stanley, Research Division - Technology Analyst

Yes.

C. C. Wei - Taiwan Semiconductor Manufacturing Company Limited - CEO

Well, Charlie, this is C. C. Wei again. Let me answer your question. As I said, we do observe some early signs of demand stabilization in PC and smartphone end markets. Those 2 segments are the biggest segments for TSMC's business. We want to say that 2024 will be a very healthy growth. But right now, did we see the bottom? Very close, very close.

We want to -- I cannot give you a number, but -- because it's too early to call it a sharp rebound. But even with the macro environment remain uncertain, we're weighing customers' inventory control in first half of 2024, having said that, we already said that we are strong technology leadership and a broad customer base. And those two are unique and specific to TSMC, enable our customers to win business in their end market and TSMC continues to deliver healthy growth. And that's why we can do better than overall industry. And that's why we have confidence that we will have healthier growth next year.

Charlie Chan - Morgan Stanley, Research Division - Technology Analyst

Okay. Okay. Yes. So just want to kind of verify because we do see some green shoots and some rush orders to wafer foundry sector.

But second question is also about AI. My question is that over the past 3 months, do you see any upward revision of the forecast maybe from the GPU or just the custom chip?

And I know it's a very, very recent, right, just 2 days ago, U.S. put some additional export control on the AI shipment to China. Do you think that, that is going to have any kind of near-term or long-term impact to your AI semi revenue growth assumption?

Jeff Su - Taiwan Semiconductor Manufacturing Company Limited - Director of IR

Okay. Thank you, Charlie. So Charlie's second question is related to AI, two-parter. First, do we see over the last 3 months, I think his words were an upward revision in the demand from AI in the last 3 months. And then he wants to know, given the recent additional regulations announced, what would the impact to the AI demand be to TSMC, both for the short term and the long term?

C. C. Wei - Taiwan Semiconductor Manufacturing Company Limited - CEO

Charlie, the AI demand continues to grow stronger and stronger. So from TSMC's point of view, now we have about -- we have a capacity limitation to support them -- to support the demand. We are working hard to increase the capacity to meet their demand, that's for one thing.

Now U.S. government put a new regulation and to -- for some of the product cannot be shipped to Mainland China. However, it is just for a couple of days, we are still evaluating the -- we are still doing our assessment. But so far, we can tell you that the impact to TSMC is limited and manageable, at least for the short term. For the long term, we are still evaluating what is the consequence.

Charlie Chan - *Morgan Stanley, Research Division - Technology Analyst*

Got it. So actually, there was one embedded question about the custom chip. So may I know your perspective about this custom chip, long-term may kind of gain share or outgrow the GPU products. So what was your assumption for this custom chip in terms of the revenue contribution within AI or to TSMC, may I ask as a follow-up?

C. C. Wei - *Taiwan Semiconductor Manufacturing Company Limited - CEO*

Okay. Let me answer. Whether customer developed the CPU, GPU, AI accelerator or ASIC for all the type for AI applications, the commonality is that they all require usage of leading-edge technology with stable yield delivery to support larger die size and a strong foundry design ecosystem. All of those are TSMC's strengths. So we are able to address and capture a major portion of the market in terms of a semiconductor component in AI.

Operator

Next one to ask questions, Bruce Lu from Goldman Sachs.

Bruce Lu - *Goldman Sachs Group, Inc., Research Division - VP*

I think the question is try to ask about the outlook for next 2 years. I think -- I do recall that management mentioned about like 15% to 20% revenue CAGR from '21 to '26. The smartphone business is supposed to be in line or slightly below the corporate average in terms of the growth rate, but the smartphone business was down meaningfully in 2023. Do we expect to see a sharp rebound for the smartphone business to get back to the corporate average in terms of growth rate?

Also, the management also mentioned that the backend business will grow in line with the corporate average. Will we see a much stronger growth from the backend business in the coming 2 years?

Jeff Su - *Taiwan Semiconductor Manufacturing Company Limited - Director of IR*

Okay. So Bruce's question really is looking at we have -- indeed, you're right, Bruce we have said we will grow between 15% to 20% revenue CAGR in U.S. dollar terms from 2021 to 2026. So Bruce's question wants to break down the components here to look at smartphone, in particular. Given that it has been a slower-growing market these last few years, how do we see the growth of the smartphone market the next 1 to 2 years in the context of this CAGR.

And then also, I think Bruce is also asking about the backend growth. We have said previously it will grow slightly faster than the corporate average. What is the current expectation now also for the next 1 to 2 years. Is that correct, Bruce?

Bruce Lu - *Goldman Sachs Group, Inc., Research Division - VP*

Yes.

Wendell Huang - *Taiwan Semiconductor Manufacturing Company Limited - VP & CFO*

Bruce, this is Wendell. Yes, in the next 2 to 3 years, backing up to '21 to '26, we still expect that the smartphone, as a whole, will grow slightly slower than the corporate average. We still think that HPC will be the strongest one and will be the major growth contributor to our multi-year growth. This is your first question.

As to the growth of backend business, we still expect that the backend business, as a whole, will grow slightly faster than the corporate average in the 5-year time period.

Bruce Lu - Goldman Sachs Group, Inc., Research Division - VP

I see. So the next question is for the technology cadence. I mean, for TSMC, for revenue contribution for 5-nanometer, we start to see the meaningful revenue contribution for 5-nanometer starting in the third quarter 2020 and 3-nanometer is third quarter 2023. So the cadence, it looks like, is longer for 3 nanometers versus 5-nanometer and 7 nanometers.

What is the technology cadence moving forward? Are we able to see a meaningful revenue contribution of 2-nanometer in 2-year time frame or 3 years' time frame? I think the technology migration cadence is an important indicator still.

Jeff Su - Taiwan Semiconductor Manufacturing Company Limited - Director of IR

Okay. Thank you, Bruce. So Bruce's second question, again, as he said, is around the technology cadence. He notes that 5-nanometer started contributing revenue in 3Q '20, but I think you're saying 3-nanometer's revenue contribution in 3Q '23. So the cadence is growing longer to kind of 3 years between 5 and 3.

So what will be the technology cadence in the future? And thus, for 2-nanometer, when should we expect meaningful revenue as well. Is that correct, Bruce?

Bruce Lu - Goldman Sachs Group, Inc., Research Division - VP

That's correct.

C. C. Wei - Taiwan Semiconductor Manufacturing Company Limited - CEO

Okay. Bruce, let me answer the question. I think that we developed the technology to meet the customers' demand. That's the first priority to us. But then different customers may have different product schedule consideration. And as time goes by, the technology complexity actually become more and more complicated and our customer will design their product and react to the market situation.

So let me answer the question that's -- in a very simple way: TSMC's technology cadence remain constant and to support our customers' growth. But whether we got the same amount or same percentage of the revenue, it will depend on customers' product schedule.

Bruce Lu - Goldman Sachs Group, Inc., Research Division - VP

But the follow-up question is that if the customer doesn't really need the advanced technology as fast as before, maybe we slow it down a bit, which will make better returns, right?

Jeff Su - Taiwan Semiconductor Manufacturing Company Limited - Director of IR

So Bruce's follow-up is, so if the customers do not need the leading node as fast or as soon as before, then slow down the cadence, does that mean we will see better returns?

C. C. Wei - Taiwan Semiconductor Manufacturing Company Limited - CEO

Well, we don't slow down our technology development per se. We might slow down our capacity expansion according to customer's demand. Did I answer your question, Bruce? That's what we are doing right now.

Bruce Lu - Goldman Sachs Group, Inc., Research Division - VP

I see. Understand.

Operator

The next one, we have Laura Chen from Citi.

Laura Chen - Citigroup Inc., Research Division - Research Analyst

I think my question is also similar to what Bruce mentioned about the capacity expansion plan. As we see that healthier inventory situation right now and at the same time the most advanced process now depends on customers' demand, so just want to get your feeling about the overall CapEx outlook or capacity outlook into the next 2 years. Do you feel that we'll be better to resume the year-on-year CapEx next year or later, considering there's still quite strong demand on N3, N2 ramp-up? At the same time, the most advanced node seems you will see maybe 2x more expensive on N2 versus N3. So my question is just about the future capacity expansion. Yes.

Jeff Su - Taiwan Semiconductor Manufacturing Company Limited - Director of IR

Okay. So Laura's first question again is on the capacity expansion plan. She notes that, of course, the inventory, as we said, is becoming healthier but also with N3 and N2. So she really wants to know what is the CapEx and capacity outlook planned for the next 1 to 2 years.

Wendell Huang - Taiwan Semiconductor Manufacturing Company Limited - VP & CFO

Right. Laura, this is Wendell. C. C. is just mentioned our capacity plan will really depend on the customers' product plan.

Now in terms of CapEx, what we can see now is that we, in the past few years, have invested very heavily to capture the growth in the next few years. And as we begin to harvest those investments, we expect our -- the increase of our CapEx to be leveling off in the next few years. That doesn't mean the dollar amount is going to reduce. But the capital intensity is expected to decline in the next few years. That's what we can see at this moment.

Laura Chen - Citigroup Inc., Research Division - Research Analyst

I recall that previously, we mentioned about like we target longer term to back to like mid-30s for our CapEx intensity. So is any possibility we see or we achieve that target next year?

Wendell Huang - Taiwan Semiconductor Manufacturing Company Limited - VP & CFO

It's -- first of all, it's not a target. It's a forecast based on the customers' demand. And secondly, it's like 3 or 5 years out. It's not the immediate next year.

Laura Chen - Citigroup Inc., Research Division - Research Analyst

Okay. Very clear. And also my second question is about N2 progress. Appreciate C. C.'s previous sharing on the progress and also the backside power timeline. I'm just wondering that what would be the most challenging part if we migrate to like a backside power?

And also since the transistor density will become totally different on nanosheet, so I'm just wondering the clients' migration or intention to adopt the most advanced nodes into next 2, 3 years? And what will be the most challenging in technology perspective?

Jeff Su - Taiwan Semiconductor Manufacturing Company Limited - Director of IR

Okay. So Laura, let me make sure I got this right. So your second question is about N2 and you want to know with the adoption of Backside Power Rail, what is the most challenging part from a technology perspective and then how do we see the customer adoption?

Laura Chen - Citigroup Inc., Research Division - Research Analyst

Yes. Correct.

C. C. Wei - Taiwan Semiconductor Manufacturing Company Limited - CEO

Laura, I'll answer that as technology moving into more and more advanced node, the challenge is always there. Technology complexity increase dramatically. But we can do it, no doubt about it. And we still remain the technology leadership in this industry.

If you ask me what is the most challenging part, I would say it's cost. I mean, that's -- you look at it today, inflation, everything, and the tool have become more and more expensive. Although we can do it on time to meet customer's requirement, our challenge right now actually, I would say, number one, cost. I want to reduce the cost so more customers can afford it. But even with that, actually, we have a lot of customers interested and engaged with TSMC today. Actually, it's probably higher than the N3 at a similar stage. Okay. Did I answer your question -- yes.

Laura Chen - Citigroup Inc., Research Division - Research Analyst

Okay. Yes, very clear.

Operator

Right now, we have Brett Simpson from Arete Research.

Brett Simpson - Arete Research Services LLP - Senior Analyst

I had a question for C. C. regarding the hyperscalers. Major U.S. hyperscalers are hiring a lot of chip designers at the moment and looking to make their own AI silicon going direct to TSMC, much like Apple has done over the years. Are you -- is TSMC generally supportive of this trend or not? And can you give us your perspective as to whether hyperscalers have the in-house IP and skills to cut out the ASIC suppliers or not and go direct to TSMC?

Jeff Su - Taiwan Semiconductor Manufacturing Company Limited - Director of IR

Okay. Brett, thank you. So Brett's first question is looking at his observation, U.S. hyperscale companies are hiring a lot of people to do AI custom chips, silicon and working directly or coming directly to work with TSMC. So his question is, is TSMC support such efforts? And how do we see such type of customers, I guess? Is that your question, Brett?

Brett Simpson - Arete Research Services LLP - Senior Analyst

Yes. And generally, just share your perspective on how you see this part of the business developing at TSMC.

C. C. Wei - Taiwan Semiconductor Manufacturing Company Limited - CEO

All right, Brett. Okay, those are hyperscalers. I don't comment on the specific customer. But all we know or our fundamental rule is whether customer develop the CPU, GPU, AI accelerator or ASIC for their own application or for any purpose in the AI area, we will support them, actually. And because of our technology leadership and our good manufacturing, so we are able to address and capture a major portion of the market. And so you are asking whether we support it or not, we support every customer all over the world.

Brett Simpson - Arete Research Services LLP - Senior Analyst

Okay. That's very clear. And maybe just as a follow-up, I wanted to ask about some of the areas in the quarter that were weaker than expected, namely, 7-nanometer, I think it's halved year-on-year; and also automotive that saw a decline sequentially, a meaningful decline sequentially. Can you just help us understand how you build back up 7-nanometer? What led to the weakness? And what's happening in automotive? And how do you assess prospects for automotive over the next 6, 9 months or so?

Jeff Su - Taiwan Semiconductor Manufacturing Company Limited - Director of IR

Okay. So 2 parts to Brett's question. Maybe I'll start with the second, but anyway, looking at automotive demand and the weakness in the past quarter, how do we see the automotive demand.

And then also his question is about 7-nanometer, also year-on-year sharp revenue decrease. So how do we see the outlook for 7-nanometer as well.

C. C. Wei - Taiwan Semiconductor Manufacturing Company Limited - CEO

Well, let me answer the question on automotive demand. In fact, in the past 3 years, automotive demand is very strong. And we deliver whatever they asked. And today, I think the automotive demand already entered the inventory adjustment mode in the second half of 2023. However, we still expect the automotive demand will increase again in 2024 because more and more EV, more and more functionality being added to automotive and that's what we saw.

Now talking about the N7, the 7-nanometer technology, why we have such a low utilization or the revenue decreased. It's go beyond our initial -- our original plan because of we expect the N7 to be very -- fully utilized even now, but it is not. Let me answer the question because of we suddenly have -- in 10 years, the smartphone demand dropped dramatically from about 1.4 billion units to about 1.1 billion now. So that exactly, in this time frame, the N7's utilization has been impacted and followed by one major customer who delayed their product introduction. And so that's why we have a low utilization.

But saying that, we are confident to backfill our 7/6-nanometer capacity with additional wave of specialty demand from consumer, RF, connectivity and other applications and will return to a healthy level of utilization over the next several years. This is very similar to a situation that we have, 28-nanometer back in 2018 and 2019 timeframe, okay? At the beginning, it was underutilized for a period of time and we worked hard to -- with our customer and then to developer some specialty technologies and then now we have to expand 28-nanometer specialty capacity. That's the same kind of a story. Brett, did I answer your question?

Brett Simpson - Arete Research Services LLP - Senior Analyst

Yes.

Operator

Next one to ask questions, Brad Lin from Bank of America.

Brad Lin - BofA Securities, Research Division - Research Analyst

So first of all, congrats on the strong results and then also the impressive gross margin. So I have 2 questions. One is on the end device AI, edge AI and the other is on the CPO. So appreciate the management's constructive comments and growth outlook on the edge AI.

So besides the, well, interesting engagement with the clients, what are the implications for the wafer consumption for the firm? And also, eyeing on the computing power and energy consumption angle on the end device with AI in the -- additional AI functions, should we expect it to reaccelerate the node migration for the end devices? That's my first question.

Jeff Su - Taiwan Semiconductor Manufacturing Company Limited - Director of IR

Okay. So Brad's first question is about edge and end device AI. He wants to know what is the implications for wafer consumption?

And then with the increasing need for energy efficiency and power, he is wondering does this reaccelerate or increase the node for -- I guess, his words is node migration or adoption of leading-edge technologies.

C. C. Wei - Taiwan Semiconductor Manufacturing Company Limited - CEO

Well, the edge device start to -- that's including smartphone and PC, start to incorporate the AI functionality inside. We observed some of the neural engines has been added increasingly. So the die size will increase even the unit did not increase dramatically. But the die size is in mid-teens -- or no, not. I mean, mid-single digit is the die size increase so far. And I expect that this kind of trend will continue. And so more and more application of the -- on the AI side, will be incorporated into those kind of edge device. And that one need a very power-efficient chip to put into the edge device, especially when it is mobile.

So I do expect -- for my own perspective, I do expect that my customers will move into the leading edge node more and more quickly to compete in the market.

Brad Lin - BofA Securities, Research Division - Research Analyst

So -- well, so a bit of a follow-up is that, well, now it accounts for some mid-single digit of the die size incremental for a chip. So does that -- or are we seeing that to enlarge to something like mid-teens, or well, even bigger in the -- well, mid- to long term?

Jeff Su - Taiwan Semiconductor Manufacturing Company Limited - Director of IR

So Brad's quick follow-up is if the AI portion is kind of mid-single digit now, how should we expect -- can we expect mid-teens or what type of percentage in a few years' time?

C. C. Wei - Taiwan Semiconductor Manufacturing Company Limited - CEO

Well, I will answer the question. Actually, we see the increase in the die size, but we cannot nail down the, we say, the mid-single digit, but I expect it to start to increase. And whether that will increase our forecast and our growth or something, it's still too early to say to -- at this moment.

Wendell Huang - Taiwan Semiconductor Manufacturing Company Limited - VP & CFO

Yes, Brad. We are still quantifying the impact from this development. So we're maintaining the previous statement that we expect it to grow to about in 5 years about mid-single digits -- I'm sorry, [low-teens] (corrected by company after the call) of our revenue.

Jeff Su - Taiwan Semiconductor Manufacturing Company Limited - Director of IR

Yes. I think, Brad, probably just very simply, as we said, edge AI, we do see some activity. It will drive silicon content, but this will occur over time, okay? And we don't have any quantitative number to share, all right?

Brad Lin - BofA Securities, Research Division - Research Analyst

Got it.

Jeff Su - Taiwan Semiconductor Manufacturing Company Limited - Director of IR

Okay. What is your second question?

Brad Lin - BofA Securities, Research Division - Research Analyst

Okay. So the second question is on CPO. So basically, we have learned that TSMC is doing quite well, also leading the industry in CPO or so-called silicon photonics, and has introduced a platform to clients with the technology. So may we learn the opportunities and implications of the new technology for the industry and for our firm? And also, should we expect the platform to offer additional competitive advantage for TSMC in the mid to long run?

Jeff Su - Taiwan Semiconductor Manufacturing Company Limited - Director of IR

So Brad, your second question is on silicon photonics. Is that correct?

Brad Lin - BofA Securities, Research Division - Research Analyst

Yes.

Jeff Su - Taiwan Semiconductor Manufacturing Company Limited - Director of IR

So he wants to know our positioning or progress on silicon photonics, how important is this and will this be a competitive advantage for TSMC going forward in the future.

C. C. Wei - Taiwan Semiconductor Manufacturing Company Limited - CEO

Okay. Let me answer that question. Silicon photonics actually is growing its importance because of just a larger amount of data need to be collected, processed and transferred in an energy-efficient manner. Silicon photonics tends to be the best fit to that role. And TSMC have been working on silicon photonics for years, and most importantly, we're collaborating with multiple leading customers to support their innovations in this field.

It takes a lot of time to develop the technology and to build the capacity. And when we increase the volume production, we believe that TSMC's silicon photonics will be the best technology and -- when customer roll out all their innovations. But as I said, it's gradually increasing in their activity and gradually increasing their demand as of today.

Brad Lin - BofA Securities, Research Division - Research Analyst

Got it.

Operator

Next one, we have Sunny Lin from UBS.

Sunny Lin - UBS Investment Bank, Research Division - Director & Associate Analyst

So my first question is on advanced packaging. Incrementally, we are hearing more customer interest in the adoption to achieve better heterogeneous integrations. But want to get your thoughts on what could be the potential impact of customers relying a bit more on packaging to improve the system performance and perhaps less on the process migration given cost considerations.

Meanwhile, SoIC has been introduced for quite a while, whereas the customer adoption still seems to be limited at this point. And so when should we expect a more meaningful pickup of SoIC? And what could be the major catalyst?

Jeff Su - Taiwan Semiconductor Manufacturing Company Limited - Director of IR

Okay. So Sunny, sorry, I may have missed a little bit of the first part. But I think her question is on overall advanced packaging. Looking at this trend and the move to more, of course, heterogeneous integration, what are the cost implications and how does this advanced packaging work together with the process technology standpoint? And then also a question about the update or progress of SoIC. Is that correct, Sunny?

Sunny Lin - UBS Investment Bank, Research Division - Director & Associate Analyst

Well, so maybe if I may clarify, but -- so for the first part, I wonder if customers may consider relying a bit more on packaging whereas slowing down a bit on the process migration because of increasing costs.

Jeff Su - Taiwan Semiconductor Manufacturing Company Limited - Director of IR

Okay. So she's asking, will customers -- because of the increasing cost of the process technologies, will customers rely more on advanced packaging as a result.

C. C. Wei - Taiwan Semiconductor Manufacturing Company Limited - CEO

Let me answer that. It's not because of increasing of the cost in the more advanced node. And actually, they tried to -- our customers tried to maximize the system performance. That's the major portion. That, including the kind of speed improvement or the power consumption decrease,

all those kind of things. Put all together, maybe cost is also part of the consideration which we noticed about. And so more and more customers are moving into the very advanced technology node and they start to adopt the chiplet approaches.

And so no matter what, TSMC provide industry-leading solution in both very leading technology and also very advanced packaging technology and to work with our customer for their product and have a best system performance.

And the other one is you are asking about the SoIC, when it will become a high volume and a more substantial revenue for TSMC. It's coming. It's coming. Actually, the customer already ready to announce their new product, which will widely adopt. And I expect starting from now and next year, the SoIC will generate revenue and become one of the faster-growing advanced packaging solutions in the next few years.

Sunny Lin - UBS Investment Bank, Research Division - Director & Associate Analyst

Got it. If I may, a quick follow-up. Three months ago, you had a target to double your CoWoS capacities. And just now you mentioned AI demand continued to surprise on the upside. So wonder if there's any update on your CoWoS capacity expansion?

Jeff Su - Taiwan Semiconductor Manufacturing Company Limited - Director of IR

Okay. So I will take this as your second question, Sunny, but she's asking about CoWoS expansion. We had said that we will double the capacity 3 months ago. Can we provide an update on the overall CoWoS capacity. And I guess, CapEx and capacity go hand-in-hand, what is our plan.

C. C. Wei - Taiwan Semiconductor Manufacturing Company Limited - CEO

Well, Sunny, the last time we said that we will double our CoWoS capacity, we are working very hard to increase the capacity more than doubled, but today is limited by my supplier's capability or their capacity. So we still maintain that we will double our CoWoS capacity by the end of 2024. But the total output actually is more than doubled from 2023 to 2024 because of a very high demand in -- from our customer. So actually then this kind of a trend will continue to increase our CoWoS capacity to support our customers even into 2025.

Operator

Next one, please welcome Mehdi Hosseini from SIG.

Mehdi Hosseini - Susquehanna Financial Group, LLLP, Research Division - Senior Analyst

I understand there are a number of new products that you're ramping into year-end and into first half of '24 in various -- for various end markets. And I want to understand how the ramp of these new products are to impact the seasonality. Could we see a scenario where in the first half, the ramp of these new products, especially like the leading edge, to somewhat offset the seasonal factors? Any thoughts there? And I have a follow-up.

Jeff Su - Taiwan Semiconductor Manufacturing Company Limited - Director of IR

All right. Mehdi. Well, Mehdi's first question is in terms of new products, which, of course, customer products, we don't comment on, but he said we are ramping products into the second half and so how will this ramp of new products go is into -- as we go into first half '24? And can this offset or mitigate some of the seasonality.

Mehdi Hosseini - Susquehanna Financial Group, LLLP, Research Division - Senior Analyst

No. Let me rephrase that, contribution of customers' new products. And how would that impact -- or how could that offset seasonal factors.

Wendell Huang - *Taiwan Semiconductor Manufacturing Company Limited - VP & CFO*

Yes. Mehdi, I don't think we can comment on specific customer products, but I can tell you that we're not seeing any dramatic change in the seasonality as of now.

Mehdi Hosseini - *Susquehanna Financial Group, LLLP, Research Division - Senior Analyst*

Okay. Because I'm looking at your year -- calendar '23, and given your Q4 guide, you're actually doing better than what you guided 3 months ago. Firstly, you said revenues could be down 10% U.S. dollar and now it could actually be down high single digit. Is that a combination of a stronger new product ramp and better pricing? Is that a fair assessment?

Jeff Su - *Taiwan Semiconductor Manufacturing Company Limited - Director of IR*

Okay. So Mehdi is really looking at -- he rightly notes that 3 months ago we said this year we'll decline around 10% in U.S. dollar term. Now with the fourth quarter implied guidance, it's slightly better. So he wants to know what is the implication or behind this.

C. C. Wei - *Taiwan Semiconductor Manufacturing Company Limited - CEO*

Well, let me give you one simple reason: because our ramp-up of N3, because of the demand of N3 is strong, so we ramped up quickly to meet customers' demand. So the final result is better than we expected 3 months ago.

Jeff Su - *Taiwan Semiconductor Manufacturing Company Limited - Director of IR*

Yes. And we have also said that strong ramp of N3 will continue in next year, okay? That's about all the seasonality color we can give.

Mehdi Hosseini - *Susquehanna Financial Group, LLLP, Research Division - Senior Analyst*

Got you. Okay. And then perhaps, if I were to ask a second question. I just want to better understand your view on your customers' inventory correction. We're reaching the bottom where we don't have any visibility on how quickly they're going to refresh inventory. The slope of the recovery is still not clear. Did I understand you correctly?

Jeff Su - *Taiwan Semiconductor Manufacturing Company Limited - Director of IR*

So Mehdi's second question, he would like to clarify. So are we saying that customers' inventory is reaching or approaching the bottom, but the slope of the inventory is not clear. Is that what we are saying?

C. C. Wei - *Taiwan Semiconductor Manufacturing Company Limited - CEO*

Okay. I'll answer the question. Actually, in these couple months, we start to see the demand stabilized in the PC and smartphone end market. And in fact, we see some kind of an urgent PO ask for more device to be shipped to their place to meet the demand. That give us a hint of their inventory control already become more -- healthier than we thought.

So in terms of uncertain macro, it probably will continue but our expectation is very close to a healthy condition. So that's why we say we can expect 2024 to be healthy growth year for TSMC. Mehdi, did I answer your question?

Mehdi Hosseini - *Susquehanna Financial Group, LLLP, Research Division - Senior Analyst*

Great.

Operator

Next one to ask question is Krish Sankar from TD Cowen.

Krish Sankar - *TD Cowen, Research Division - MD & Senior Research Analyst*

I have two of them. First one is on gross margin. When do you expect N3 to reach corporate average gross margin?

And as you look into next year, as more mature node capacity comes online across the industry, how to think about mature node gross margins also? And I have a follow-up after that.

Jeff Su - *Taiwan Semiconductor Manufacturing Company Limited - Director of IR*

Okay. So Krish's first question is on gross margin. When do we expect 3-nanometer -- or N3, I should say, to reach the corporate average gross margin? And how do we see the gross margin trend for the more mature nodes.

Wendell Huang - *Taiwan Semiconductor Manufacturing Company Limited - VP & CFO*

Yes. Krish, in the past, our leading nodes normally reach gross margins -- corporate margin in about 8 quarters. But as we progress with more and more leading nodes, it will become more and more challenging because of several reasons.

Well, first of all, our corporate margin is higher than before. And secondly, the leading node, as I just said, is becoming more and more complex. And also, in the past few years, the inflation pressure that was not expected also contribute the higher cost in the N3.

So it's going to be pretty challenging for future leading nodes to reach corporate margin as in before -- like before in the same timeframe.

The mature nodes. I can tell you that our mature nodes are -- the gross margins are really congregated around the corporate average in a pretty narrow band because we focus on specialty technology. It's not a commodity capacity. Yes.

Krish Sankar - *TD Cowen, Research Division - MD & Senior Research Analyst*

That's very helpful. And then I'll -- and then as a follow-up. On Arizona, you mentioned that you'd hired about 1,100 local employees. I'm kind of curious, is that critical mass enough for you to start 4-nanometer production? Or do you have another target level of employees before they can actually start getting this production since you're still maintaining the output to being first half of 2025?

Jeff Su - *Taiwan Semiconductor Manufacturing Company Limited - Director of IR*

Okay. So thank you, Krish. So Krish's second question is about our first fab in Arizona. He notes that we have said we hired 1,100 local employees. So his question, is this enough critical mass or enough people basically to support the ramp of the first fab as we planned, as we said today in first half '25.

C. C. Wei - Taiwan Semiconductor Manufacturing Company Limited - CEO

Of course. We continue to hire the local talent to join TSMC's fab in Arizona. So when we start to have a volume production, we are confident that we will have enough resources to support our ramp-up in Arizona.

Operator

The last one to ask question, Charles Shi from Needham.

Charles Shi - Needham & Company, LLC, Research Division - Senior Analyst

First off, I really want to congratulate TSMC for delivering good results for Q3 and very good guidance for Q4. But I want to really call out the reported revenue for 5-nanometer in the third quarter. It looks like you are showing some really good countercyclical strength and probably a record high.

I want to understand the rebound in the 5-nanometer business in Q3. Is that going to be more in the following quarters? And what's behind that? And relative -- let's say, your expectation like 3 to 6 months ago when you were reducing the '23 outlook, is 5-nanometer doing better than expected? And how has the demand trended in the last 2, 3 months for 5-nanometer?

Jeff Su - Taiwan Semiconductor Manufacturing Company Limited - Director of IR

Okay. So Charles' first question is about 5-nanometer. He's asking in the very near term, he notes that he saw very strong sequential revenue increase in the third quarter so he's wondering what is driving this. And then he's asking about what is the outlook for the next 3 to 6 months for 5-nanometer specifically.

Wendell Huang - Taiwan Semiconductor Manufacturing Company Limited - VP & CFO

Yes. Charles, I can share with you the increase in revenue, N5, in the third quarter mainly comes from 2 platforms, HPC and smartphone. HPC also includes the AI-related demand. Smartphone, basically, customers -- some customers' product seasonalities.

Now forward-looking wise, I'm not going to share with you, but we will tell you in January what actual the next quarter N5 revenue will be the overall revenue.

Jeff Su - Taiwan Semiconductor Manufacturing Company Limited - Director of IR

The overall revenue. We don't provide revenue by process node, okay? What's your second question, Charles?

Charles Shi - Needham & Company, LLC, Research Division - Senior Analyst

Yes. The other question is about CapEx. It sounds like that you're expecting CapEx on absolute dollar might still grow going forward. I know that's a long-term comment. But I look at the near term, TSMC CapEx seems to be running at USD 7 billion per quarter in the second half '23, which kind of is at \$28 billion annualized run rate.

But if we are expecting total CapEx for '24 to grow in dollar term over '23, it seems like you're expecting CapEx ramp in 2024. Maybe that's your planning for some of the CapEx ramp in '24. Is that the right way to think about the CapEx? Is \$7 billion really like the really bottom level run rate for TSMC CapEx at this point?

Jeff Su - Taiwan Semiconductor Manufacturing Company Limited - Director of IR

All right. So Charles' second question is also -- is on CapEx. Basically, he's saying given the guidance he's looking at our CapEx, it's running at about USD 7 billion run rate. So he is assuming -- or although we do not comment on '24, he's assuming if next year's CapEx dollar amount is going to increase, but if we're running at \$7 billion run rate, does that imply \$28 billion, how should he reconcile this.

Wendell Huang - Taiwan Semiconductor Manufacturing Company Limited - VP & CFO

Charles, every year, the CapEx is invested based on the future opportunity to growth and we invested to capture those future opportunities. Too early to talk about 2024, really. We will share the guidance with you in January quarterly release.

Jeff Su - Taiwan Semiconductor Manufacturing Company Limited - Director of IR

Okay. All right. Thank you, Charles. Thank you, everyone. This concludes our Q&A session.

Before we conclude today's conference, please be advised that the replay of the conference will be accessible within 30 minutes from now. The transcript will become available 24 hours from now. Both of these, you -- are available and you can find through TSMC's website at www.tsmc.com.

So thank you, everyone, for taking the time to join us today. We hope everyone continues to be well, and we hope to see you join us again in January. Goodbye, and have a good day. Thank you.

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