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PRESENTATION

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

(foreign language) Good afternoon, everyone, and welcome to TSMC's Fourth Quarter 2022 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. If you're joining us through the conference call, your dial-in lines are in listen-only mode.

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 fourth quarter 2022, followed by our guidance for the first quarter 2023. Afterwards, Mr. Huang and TSMC's CEO, Dr. C.C. Wei, will jointly provide the company's key messages. Then TSMC's Chairman, Dr. Mark Liu, will host the Q&A session, where all 3 executives will entertain your questions.

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. Happy New Year, everyone. Thank you for joining us today. My presentation will start with financial highlights for the fourth quarter and a recap of full year 2022. After that, I will provide the guidance for the first quarter 2023. Fourth quarter revenue decreased 1.5% sequentially in U.S. dollar terms as our business was dampened by the end market demand softness and customers' inventory adjustment, despite the continued ramp-up of our industry-leading 5-nanometer technologies. It is at the low end of our previous guidance.

In NT dollar terms, revenue increased 2% in the fourth quarter due to a more favorable foreign exchange rate. Gross margin increased 1.8 percentage points sequentially to 62.2% mainly due to a more favorable foreign exchange rate and cost improvement efforts, partially offset by lower capacity utilization.

Total operating expenses accounted for 10.3% of net revenue. Operating margin was 52%, up 1.4 percentage points from the previous quarter. Overall, our fourth quarter EPS was TWD 11.41 and ROE was 41.7%.

Now let's move on to the revenue by technology. 5-nanometer process technology contributed 32% of wafer revenue in the fourth quarter while 7-nanometer accounted for 22%. Advanced Technologies defined as 7-nanometer and below, accounted for 54% of wafer revenue.

On a full year basis, 5-nanometer technology contributed 26% of 2022 wafer revenue. 7-nanometer was 27%. Advanced Technologies accounted for 53% of total wafer revenue, up from 50% in 2021.

Moving on to revenue contribution by platform. HPC increased 10% quarter-over-quarter to account for 42% of our fourth quarter revenue. Smartphone decreased 4% to account for 38%, IoT decreased 11% to account for 8%, automotive increased 10% to account for 6% and DCE decreased 23% to account for 2%.

On a full year basis, all 6 platforms had year-on-year growth. HPC increased 59% year-on-year to account for 41% of our 2022 revenue. Smartphone increased 28% to account for 39%, IoT increased 47% to account for 9%, automotive increased 74% to account for 5%, and DCE increased 1% to account for 3%.

Moving on to the balance sheet, we ended the fourth quarter with cash and marketable securities of TWD 1.56 trillion or USD 51 billion. On the liability side, current liabilities increased by TWD 137 billion, mainly due to the increase of TWD 48 billion in accounts payable, an increase of TWD 93 billion in accrued liabilities and others.

On financial ratios, accounts receivable turnover days remain at 36 days while days of inventory increased 3 days to 93 days.

Regarding cash flow and CapEx, during the fourth quarter, we generated about TWD 487 billion in cash from operations, spent TWD 337 billion in CapEx and distributed TWD 71 billion for first quarter 2022 cash dividend.

Overall, our cash balance increased TWD 47 billion to TWD 1.34 trillion at the end of the quarter.

In U.S. dollar terms, our fourth quarter capital expenditures totaled \$10.82 billion.

To recap our performance in 2022. We had a strong growth in 2022 as our technology leadership position enabled us to capture the industry's megatrends of 5G and HPC. Our revenue increased 33.5% in U.S. dollar terms to reach \$76 billion and 42.6% in NT terms to reach TWD 2.26 trillion. Gross margin increased 8 percentage points to 59.6%, mainly reflecting a more favorable foreign exchange rate, value-selling efforts and cost improvement, partially offset by lower capacity utilization. Thanks to better operating leverage, operating margin increased 8.6 percentage points to 49.5%.

Overall, full year EPS increased 70.4% to TWD 39.2 and ROE was 39.8%.

On cash flow, we spent USD 36.3 billion or TWD 1.1 trillion in CapEx. We generated TWD 1.6 trillion in operating cash flow and TWD 528 billion in free cash flow. We also paid TWD 285 billion in cash dividends in 2022, up from TWD 266 billion in 2021. I have finished my financial summary.

Now let's turn to our current quarter guidance. As overall macroeconomic conditions remain weak, we expect our business to be further impacted by continued end market demand softness and customers' further inventory adjustment.

Based on the current business outlook, we expect our first quarter revenue to be between USD 16.7 billion and USD 17.5 billion, representing a 14.2% sequential decline at the midpoint.

Based on the exchange rate assumption of USD 1 to TWD 30.7, gross margin is expected to be between 53.5% and 55.5%, operating margin between 41.5% and 43.5%.

Starting in 2023, certain tax exemptions from the Taiwan government have expired. However, the government has recently passed the amendments to the Statute for Industrial Innovations. All things considered, we expect our effective tax rate in 2023 and beyond to be approximately 15%. This concludes my financial presentation.

Now let me turn to our key messages. I will start by making some comments on our fourth quarter '22 and first quarter '23 profitability. Compared to third quarter, our fourth quarter gross margin increased by 180 basis points sequentially to 62.2%, of which 140 basis points was contributed by a more favorable foreign exchange rate. Meanwhile, cost improvement efforts also helped offset the impact from a lower capacity utilization.

Compared to our fourth quarter guidance, our actual gross margin exceeded the high end of the range provided 3 months ago, mainly due to cost improvement efforts.

We have just guided our first quarter gross margin to be 54.5% at the midpoint mainly due to a lower capacity utilization rate as customers further adjust their inventory levels and a less favorable foreign exchange rate.

In 2023, our gross margin faces challenges from lower capacity utilization due to semiconductor cyclicality, the ramp-up of N3, overseas fab expansion and inflationary cost.

In addition, R&D expenses accounted for 7.2% of our net revenue in 2022. In 2023, as we increase our focus on technology development and add more resources, we expect R&D expenses to increase by about 20% year-on-year and account for 8% to 8.5% of our net revenue.

To manage our profitability in 2023, we will work diligently on internal cost improvement efforts while continuing to strategically and consistently sell our value.

Excluding the impact of foreign exchange rate, we continue to forecast a long-term gross margin of 53% and higher is achievable.

Next, let me talk about our 2023 capital budget and depreciation. Every year, our CapEx is spent in anticipation of the growth that will follow in future years. As I have stated before, given the near-term uncertainties, we continue to manage our business prudently and tighten up our capital spending where appropriate. That said, our commitment to support customers' structural growth remains unchanged, and our disciplined CapEx and capacity planning remains based on the long-term market demand profile.

In 2022, we spent \$36.3 billion to capture the structural demand and support our customers' growth. In 2023, our capital budget is expected to be between USD 32 billion and USD 36 billion. Out of the USD 32 billion to USD 36 billion CapEx for 2023, about 70% will be allocated for advanced process technologies. About 20% will be spent for specialty technologies and about 10% will be spent for advanced packaging, mask making and others.

Our depreciation expense is expected to increase by approximately 30% year-over-year in 2023 mainly as we ramp our 3-nanometer technologies.

With this level of CapEx spending in 2023, we reiterate that TSMC remains committed to a sustainable cash dividends on both an annual and quarterly basis. We will continue to work closely with our customers to plan our long-term capacity and invest in leading-edge and specialty 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 2023 outlook.

Concluding 2022, the semiconductor industry growth excluding memory, was about 10%, while foundry increased about 27% year-over-year. TSMC's revenue grew 33.5% year-over-year in U.S. dollar terms.

Our business was supported by our strong technology leadership and differentiation, even as a semiconductor inventory correction began to dampen the momentum in second half 2022.

Entering 2023, we continue to observe softness in consumer end market segment, while other end market segments such as data center related have softened as well.

As customers and the supply chain continue to take action, we forecast the semiconductor supply chain inventory will reduce sharply through first half 2023, to rebalance to a healthier level.

In the first half of 2023, we expect our revenue to decline mid- to high single-digit percent over the same period last year in U.S. dollar terms.

Having said that, we also start to observe some initial signs of demand stabilization, and we will watch closely for more signals. We forecast the semiconductor cycle to bottom sometime in first half 2023, and to see a healthy recovery in second half this year.

In the second half of 2023, we expect our revenue to increase over the same period last year in U.S. dollar terms.

For the full year of 2023, we forecast the semiconductor market, excluding memory, to decline approximately 4% while foundry industry is forecast to decline 3%. For TSMC, supported by our strong technology leadership and differentiation, we will continue to expand our customer product portfolio and increase our addressable market, and we expect 2023 to be a slight growth year for TSMC in U.S. dollar terms.

Next, let me talk about the N7/N6 demand outlook. Three months ago, we said our N7/N6 capacity utilization in first half '23 will not be as high as it has been in the past 3 years, due to end market weakness in smartphone and PCs and customers' product schedule delay. Since then, the end market demand for smartphone and PCs has further weakened and the capacity utilization of N7/N6 is lower than our expectation 3 months ago. We expect this to persist through first half '23 as the semiconductor supply chain inventory takes a few quarters to rebalance to a healthier level, and we expect a mild pickup in our N7/N6 demand in second half '23 than our prior expectation.

However, we continue to believe N7/N6 demand is more a cyclical issue rather than structural. We are working closely with our customers to develop specialty and differentiated technologies to drive additional wave of structural demand from consumer, RF, connectivity and other applications to backfill our N7/N6 capacity over the next several years. Thus, we are confident our 7-nanometer family will continue to be a large and long-lasting node for TSMC.

Now I will talk about our N3 and N3E status. Our N3 has successfully entered volume production in late fourth quarter last year as planned, with good yield. We expect a smooth ramp in 2023 driven by both HPC and smartphone applications. As our customers' demand for N3 exceeds our ability to supply, we expect the N3 to be fully utilized in 2023. Sizable N3 revenue contribution, we expect to start in third quarter '23 and N3 will contribute mid-single-digit percentage of our total wafer revenue in 2023. We expect the N3 revenue in 2023 to be higher than N5 revenue in its first year in 2020.

N3E will further extend our N3 family with enhanced performance, power, and yield and offer complete platform support for both smartphone and HPC applications. Volume production is scheduled for second half '23.

Despite the ongoing inventory correction, we continue to observe a high level of customer engagement at both the N3 and N3E with a number of tape-outs more than 2x that of N5 in its first and second year.

Our 3-nanometer technology is the most advanced semiconductor technology in both PPA and transistor technology, thus, we expect customers a strong demand in 2023, 2024, 2025 and beyond for our 3-nanometer technologies and are confident that our N3 family will be another large and long-lasting node for TSMC.

Finally, let me talk about our plans to expand TSMC's global manufacturing footprint to increase customers' trust and expand our future growth potential. TSMC's mission is to be trusted technology and capacity provider for the global logic IC industry for years to come. Our job is to provide the optimal solutions for our customers to enable their success. This including technology leadership, manufacturing, cost, trust and recently also including more geographic manufacturing flexibility.

Based on customers' request, we are increasing our capacity outside of Taiwan to continue to provide our customers the optimal solution they need to be successful. TSMC's decisions are based on our customers' need and the necessary level of government support. This is to maximize the value for our shareholders. Our decisions are also based on the talent pool, land, electricity and water needs for TSMC's long-term growth.

In the U.S., we are in the process of building 2 advanced semiconductor fabs in Arizona. Our U.S. customers welcome us to build capacity in the U.S. to support their need and have pledged their strong commitment and support. We had an opening ceremony on December 6 last year to celebrate the arrival of the first batch of state-of-the-art semiconductor manufacturing equipment, and Fab 1 is on track to begin production of N4 process technology in 2024.

We also announced the construction of a second fab, which is scheduled to begin production of 3-nanometer process technology in 2026. TSMC Arizona will continue to provide the most advanced semiconductor technology commercially available in the U.S., enabling next-generation, high-performance and low-power computing products in the future years. Each of our fab will have a clean room area that approximately double the size of a typical logic fab.

We will also consider building additional mature node capacity outside of Taiwan. In Japan, we are building a specialty technology fab, which will utilize 12- and 16-nanometer, and 22/28 process technologies. Volume production is scheduled for late 2024. We are also considering building a second fab in Japan, as long as the demand from customers and the level of government support makes sense.

In Europe, we're engaging with customers and partners to evaluate the possibility of building a specialty fab, focusing on automotive-specific technologies, based on the demand from customers and level of government support. In China, we expand 28-nanometer in Nanjing as planned to support local customers, and we continue to follow all the rules and regulation fully. At the same time, we continue to invest in Taiwan and expand our capacity to support our customers' growth.

Our N3 has just entered volume production in Tainan Science Park. We are also preparing for N2 volume production starting in 2025, which will be located in Hsinchu and Taichung Science Park.

While capacity is not born overnight and takes time to build, we are committed to expanding our global manufacturing footprint to increase customer trust and expand our future growth potential. Depending on the demand from customers and level of government support, our 28-nanometer and below overseas capacity could be 20% or more of our total 28-nanometer and below capacity in 5 years or more time.

While initial cost of overseas fab are higher than TSMC's fab in Taiwan. Our goal is manage and minimize the cost gap.

Our pricing will remain strategic to reflect our value, which also including the value of geographic flexibility. At the same time, we are leveraging our competitive advantage of lost volume, economies of scale and manufacturing technology leadership to continuously drive cost down. We will also continue to work closely with our government to secure their support.

By taking such actions, TSMC will have the ability to absorb the higher cost of overseas fabs while remaining the most efficient and cost-effective manufacturer, no matter where we operate.

Thus, even we increased our capacity outside of Taiwan, we believe long-term gross margin of 53% and higher continue to be achievable, and we can earn a sustainable and healthy ROE of greater than 25% while delivering profitable growth for our shareholders. This concluding our key message. Thank you for your attention.

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

Thank you, C.C. This concludes our prepared remarks. (Operator Instructions) Now we will begin the Q&A session. Our Chairman, Dr. Mark Liu, will be the host.

Mark Liu - Taiwan Semiconductor Manufacturing Company Limited - Chairman

Hello, everyone. It's good to meet every one of you online again. At the beginning of the year, I wish you all stay healthy and have a happy new year. Now let's have answer your question.

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

Thank you, Chairman. Operator, let's begin, please proceed with the first caller on the line.

QUESTIONS AND ANSWERS

Operator

The first question is come from Randy Abrams with Credit Suisse.

Randy Abrams - *Crédit Suisse AG, Research Division - MD and Head of Taiwan Research in the Equity Research Department*

Okay. I wanted to ask the first question just about the rising investment costs and also the cost differential with the U.S. Just based on the 2 press releases, the Taiwan fab, you cited Fab 18, about USD 60 billion investment for 8 phases, which would be, I estimate about 200,000 capacity. That's about \$300 million per thousand wafer. The Arizona fab was \$40 billion for about 50,000, \$800 million per 1,000 wafers. So just 2 questions on it. If you could maybe discuss a bit more if there's differences in those releases on the investment in calculation, and a bit more color on the relative costs since you do the U.S. expansion?

And then the second part of the question is, is the cost seeing a significant acceleration? It's been rising with each new node. But are you seeing an accelerating pace as you move through 3- and 2-nanometer?

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

Okay. Randy, Thank you. Please allow me to summarize your question. So Randy's first question is he wants to understand, I think, he's referring, I think, to our press release when we -- about N3 in Tainan and the total investment there, and how does that compare to our announcement of the investment in Arizona for 2 phases.

Randy, if I got you correctly, basically what Randy is asking is, what is the cost in the U.S. seem much higher in terms of the investment? So what is driving this big difference or a gap, so to speak. That's the first part of your question, right, Randy. Okay. So that's the first part.

Randy Abrams - *Crédit Suisse AG, Research Division - MD and Head of Taiwan Research in the Equity Research Department*

Yes, that's right. That's the first part.

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

Okay. Randy, this is Wendell. Let me share with you this. The Arizona fab. We make the decision based on customers' request. And so we're planning on building the 2 fabs, one N5, actually N4 and the other one N3. We're not able to share with you a specific cost gap number between Taiwan and U.S., but we can share with you that the major reason for the cost gap is the construction cost of building and facilities, which can be 4 to 5x greater for U.S. fab versus a fab in Taiwan.

The high cost of construction includes labor cost, cost of permits, cost of occupational safety and health regulations, inflationary costs in recent years and people and learning curve costs. Therefore, the initial costs of overseas fabs are higher than our fabs in Taiwan.

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

And I think the second part of Randy's question was about the -- how do we see the CapEx per K as we go from, I guess, Randy, you're asking N5, N3 and 2.

Randy Abrams - *Crédit Suisse AG, Research Division - MD and Head of Taiwan Research in the Equity Research Department*

Yes, it's seeing a faster pace of expansion through these next couple of nodes.

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

Right. Randy, we're not able to disclose the specific CapEx per K for each node, but certainly, the CapEx per K is more expensive for a new node as the process capacity increases. Okay?

Randy Abrams - *Crédit Suisse AG, Research Division - MD and Head of Taiwan Research in the Equity Research Department*

Okay. And the second question, just wanted to ask actually 2 areas that came up in the remarks. The R&D, the over 20% increase. If you could give a feel like what's mainly driving that additional step up, is it the development cost for the new nodes, the packaging? Or is it some now expanding R&D into new geographic areas?

And if I can fit in the second part, just the tax rate, Taiwan was hyping a pretty big program of CapEx and R&D, but tax breaks, but your tax rate is going up from 11% to 15%. Is that alternative minimum tax or global tax? Just want to understand why not any benefit from that?

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

Okay. So Randy's second question, I guess, is sort of 2 parts financial related. First, we -- our CFO said, our R&D spending will increase about 20% year-on-year. So Randy wants to know what is driving behind that? Is it customer going overseas? Is it more technology development as a technology leader, et cetera? And then the second part, he wants to understand the guidance of effective tax rate of 15% given the recent legislation passed in Taiwan. Why is it not lower?

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

Okay. Randy, for the first question, we're the technology leader, and we intend to continue to maintain the leadership. Therefore, we are devoting more and more resources in R&D, including people and other kind of resources. That's the reason why our R&D expense will increase in 2023 and probably beyond.

The other thing about tax, in 2023, part of the tax exemptions -- or incentives in Taiwan have expired. Without the new amendments to this Industrial Innovation, the Statute of Industrial Innovation, our tax rate would have become between 18% to 19%. With this new amendment, our tax rates will drop to about 15%.

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

Okay. Does that answer your question, Randy?

Randy Abrams - *Crédit Suisse AG, Research Division - MD and Head of Taiwan Research in the Equity Research Department*

Yes, that does, I mean this mid-term R&D, do you think the rate stays at this level or could go up one more? That's my final one.

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

From what we are seeing at this moment, we expect the R&D to revenue ratio to be between 8% to 8.5% in the next several years.

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

Thank you, Randy. Operator, can we move on to the next participant, please?

Operator

Sure. And our next question is come from Bruce Lu with Goldman Sachs.

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

The first question is focused on the overseas capacity expansion. So I think you just mentioned that even though we cannot disclose it, but the cost is definitely higher for the overseas capacity, but the management believes that the margin will stay the same. So I mean -- I think I asked this question back to 2019, the management was talking about like the pricing will be the same across the board regardless of geographical locations. So what has changed now? So with the different pricing, can we say the overseas capacity will generate a similar return and profitability throughout the cycle? So -- or what is the benchmark you're looking for when you set out the different pricing scheme?

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

Okay. So Bruce from Goldman Sachs actually, his question is regarding -- first question regarding overseas expansion. His question is we said overseas costs are higher, yet that -- so his question is with regards to our pricing. Are we a higher price overseas? Or if it's overall? And what is the benchmark that we use when we go overseas in terms of financial returns and price? Is that roughly correct, Bruce?

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

Yes, that's correct.

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

Okay, Bruce, this is Wendell, we're not able to comment on pricing details, but our pricing is always strategic and consistent to reflect our value. Now value to our customers as C.C. said in his statement includes technology leadership, manufacturing efficiency and quality, cost, trust and recently also includes more geographic manufacturing flexibilities. Therefore, our overall pricing will remain strategic to reflect our value, which includes the value of geographic flexibilities. Does that answer your question?

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

Well, to some extent. Let me ask the question in different ways is that we do understand it will reflect TSMC's value, i.e., geographical location is [bad], but at the end of the day, it's the cost plus for everybody across the board. I mean, how confident that TSMC feels that the customers can swallow the cost. And the end customer will swallow the costs, i.e., without triggering the potential wafer price inflation or semiconductor inflation at the end of the day with more and more global capacity for TSMC.

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

Yes. Okay. Bruce, let me add that in C.C.'s statement, he also mentioned that we will -- aside from selling our value, we will continue to drive down our cost, but also to leverage our competitive advantages of large volume, economy of scale and manufacturing technology leadership. And with all these actions plus the government support, we are able to absorb the higher cost of overseas fabs and maintain our long-term financial goals, gross margin of 53% and higher.

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

Let me add some color. This is C.C. Wei. Actually, in our view, the semiconductor becomes more essential and more pervasive in people's life. And the semiconductor industry value in the supply chain is increasing. And if we look at our customers' performance, they are rising structural gross margin over the past 5 to 6 years, it continued to improve. That reflects what I just said, the semiconductor value has been recognized and also very important in our daily life. And so we set up our pricing strategy to reflect all the values we share to customer and customer also earn their value from the end market.

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

Thank you, C.C. Bruce? Do you have a second question?

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

Yes, please. The second question is for the N7. I think we spent some time for 7-nanometer, which is more cyclical. I think after 3 months, I think the correction is even bigger. So how -- can you share us the full year outlook for 7-nanometer? When we can expect the customer or the 7-nanometer capacity utilization to back to normal, back to like fully utilized? Or can we avoid the same cyclical symptom in 5-nanometer and 3-nanometer in 2, 3 years from now?

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

Okay. So Bruce's second question was on 7-nanometer. So his question is 7-nanometer seems to have deteriorated versus 3 months ago. So what is our view? Can it fully recover in this year?

And then I think, Bruce, the second part of your question is also how can we avoid the same cyclical systems at other nodes in the future. Is that correct?

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

Yes.

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

Okay.

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

So I answer this one? First, N7 most of business for TSMC in the last 2 years is from the PC and smartphone. And that happened to correct -- or let me say that inventory correct happened to be the most severe one. And so the end market dropped more severely than we thought. In fact, the unit will not increase, but the content will be increased, so is demand be more softened than we thought 3 months ago?

Will it be repeated at 5 or 3? Cyclical of the semiconductor always exist, but it's unlikely this time the scenario was to be repeated because our current downturn actually, it's kind of being enhanced or being degraded by the pandemic.

Due to the pandemic, the digital transformation progress have been enhanced. And so the demand being increased dramatically. But then due to the pandemic, the supply chain disruption happened. And people during this time, probably changed their strategy or their thoughts on the inventory buildup. So artificially, the inventory has been built up quickly and dramatically.

And then the response to the each industry are different. And so they manage that the inventory correction also differently. This kind of phenomenon all because of -- largely because of pandemic, and we don't think that it will happen again. And in the next 5-nanometer, 3-nanometer, I believe TSMC and TSMC's customer will be more prudent on planning that what is the demand and also the supply.

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

Okay. Bruce, does that answer your second question?

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

Yes, let me follow up a little bit. I mean so, C.C. just mentioned more external factors, right? So what does TSMC do to avoid the same thing for 5 and 3 in the future? For example, if you are cutting your capacity plan into a more conservative way or something like that? Is that something we should expect in the future nodes?

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

So Bruce is asking sort of a follow-on. So then with 7-nanometer, how do we avoid the same thing happening at 5 or 3 in the future? Will we cut our capacity? How do we change our capacity planning and build to avoid a similar situation?

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

Bruce, this is a very good question. Actually, let me share with you how we deal with it. In fact, between the N5, N3, the technology node our capacity buildup and with a lot of tools that can be commonly used by these 2 nodes. So in fact, for TSMC to build capacity, we put N5, N3 and maybe in the future N2 as a total picture to look at it. And we will keep our flexibility to increase or to adjust for the future. So we will be better prepared. That's what I can tell you.

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

Thank you, Bruce. Operator, can we move on to the next participant, please?

Operator

And our next question is come from Gokul Hariharan with JPMorgan.

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

Let me take my first question on the near-term 2023. So you mentioned first half, we have seen a worse kind of environment compared to 3 months back. Is it mainly HPC data center that has seen further reduction? Or are we seeing it across the board, including smartphone for first half?

And also on second half, just putting in rough numbers on your guidance, looks like we are looking for a pretty sharp rebound in second half of 2023, something like 25% to 30% second half versus first half of this year. Could we have some more color on what are the areas that gives you the confidence for such a strong rebound in the second half of the year to get us back to like a flattish revenue growth for the year?

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

Okay. So Gokul's first question is on the near-term outlook. He wants to understand first half, we said the inventory correction is sharper. So he wants to understand what are we seeing in different end market segments. Is the sharper correction driven by data center? Is it smartphone, PC? What are we seeing across the different segments first.

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

Well, let me answer the question. The inventory correction actually began last year. And at the peak of the third quarter, and we think the inventory has been peaked in third quarter last year and gradually reduced in the fourth quarter, and we did see some inventory reduce sharply recently, and it will continue to be so to first half of this year. So that's why we say we have confidence that in the second half, the business will rebound. But is that a very strong V shape? We didn't know yet, but certainly, it's not a U shape for the business to recover in the second half.

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

Okay. I think N3 is clearly one part of that ramp. But is there anything else that is -- that you are already seeing that strong confidence for the second half rebound in addition to the N3 ramp-up?

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

So Gokul is asking sort of in terms of second half, why can TSMC's business be better than the overall industry? Besides N3, are there any other factors when you think about technology leadership?

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

Gokul, you are right. N3's ramp-up here of the business to rebound, and also actually, let me share with you some of the HPC's customer. Also, we have a new product launch in the second half, especially in the AI area or in computing area. Did that answer your question?

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

Understood. Okay. That's my first question. Jeff, can I move on to the second one?

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

Yes, please.

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

My second question is on CapEx and capital intensity. CapEx, we are taking it down a notch for this year given the downturn, I guess, and some conservatism. Are we already seeing the peak in CapEx intensity in the cycle? Or we are likely to given the plans in Europe plans to expand more capacity in U.S.? Are we likely to see higher CapEx intensity in the out years as well?

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

Okay. Sorry. Is that your -- okay, Gokul. I think I got the gist of your question. So Gokul's second question is on CapEx and capital intensity. He notes this year, we have guided 32 to 36 [billion] (added by company after the call) given sort of some tightening up and such. So his question is -- does this represent, have we already seen or past the peak in terms of our capital intensity this cycle, or as we may continue to evaluate and expand overseas and such? Will there be another step-up in our capital intensity?

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

Okay. Gokul, this is Wendell. As we said before, we invest the CapEx this year for the growth in the future years. So we also said earlier that we are tightening up the spending where appropriate. But as long as we believe the growth opportunity is there, we will continue to invest.

Now we've given the guidance for this year, so you can calculate the capital intensity. It will be over 40%. From what we are able to see at this moment, several years down the road, we're seeing the CapEx intensity to be between mid- to high 30s. That's the current view.

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

Is that several years like 5 years out? Or is it like closer to that?

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

Yes. Something like that. Something like that.

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

All right. Thank you, Gokul. Operator, can we move on to the next participant?

Operator

And our next question is come from Charlie Chan with Morgan Stanley.

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

So first of all, a question to C.C. And so thanks for your sharing during the Mountain Jade Association Presentation on Semiconductor Challenge was really insightful.

So my question is that you mentioned during your peak saying that the biggest change for semiconductor is cost is getting higher, along so-called difficulty in supply chain. So I wanted to ask C.C. what's the true value-add of Moore's Law going forward since it becomes much more expensive and whether you really see that customers can continue to expand their gross margin and create value to this world. So this is my first question.

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

Okay. So Charlie's first question is around technology. He notes that the cost, I guess, and cost per transistor is getting higher and overall global costs are increasing as well. So his question is, what is the value? Or is there still value in the so-called Moore's Law going forward? How does TSMC view this issue?

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

Well, Charlie, let me share with you, nowadays, we look at our technologies value not only the geometries are shrinking actually. More importantly actually is the power consumption type efficiency. And also, we try to help our customers with our advanced 3D IC Fabric technology to improve the system performance, and that's where it's important.

In the future, we want the world to be more greener, more safer, better. So power consumption needs become very, very important. And while we still improve the system performance and that's where our customer can get their value. And that's what we view in the future.

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

So the follow-up to that is that we noticed that for your major smartphone SoC customers, they seem to slow down the migration to the newer nodes, right, or so-called bifurcation for their new SoC adoption. So do you think for mobile computing, particularly do you think a value-add is diminishing based on what you just said. And also another structural change we are seeing is about the custom chip by ASIC in HPC segment. So can management talk about that part of business, meaning the ASIC design in terms of total revenue contribution in HPC and the growth rate of the ASIC business?

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

Okay. So Charlie, I'm going to interpret. So he has a follow-up to his first question and then his second question. So the follow-up to his first question is then in terms of going back to cost again, do we see any sign of slowdown in smartphone SoC migration at the leading node. That's his follow-up. And then his second question is then do we see more companies designing ASICs? And can we disclose the revenue contribution from such customers? Correct, Charlie?

Charlie Chan - Morgan Stanley, Research Division - Technology Analyst

Yes, correct, please.

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

Okay. Charlie, let me answer your question. In fact, we do not see any slowdown on our customer to adopt the TSMC's leading-edge technology. Actually, they might have a different kind of product schedule. They might have a different kind of product plan and et cetera. But the technology adoption, actually, it did not slow down. That's my answer to your first follow-up question. And whether that's some kind of customer, some of the hyperscale customers want to develop their own chip. Yes, but I cannot give you more information than that. However, I can tell you that they also look at compute for their own business, the positioning for their opportunity actually increase their opportunity. And that requires TSMC's leading-edge technology. So we do have quite a few hyperscale customers working with TSMC to develop their own chips.

Charlie Chan - Morgan Stanley, Research Division - Technology Analyst

And would that cannibalize your merchant business, for example, does the merchant CPU, GPU, are they going to be replaced or impacted by those custom design growth?

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

Okay. Last question, Charlie is asking then his concern is that any hyperscalers are developing, will that cannibalize business for other types of companies?

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

I cannot comment, but I don't think so. They also developed the specific purpose for their own. I mean it's not a kind of to place, generalize the purpose of CPU, GPU, all those kind of things.

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

And I think also for TSMC, we're happy to work with all types of customers, whatever type they may be. Okay, thank you, Charlie. Let's move on to the next participant.

Operator

And our next question is come from Sunny Lin with UBS.

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

So my first question is on the N3 ramp up. And so if we look at the share revenue could be higher than 5-nanometer for the first year. But if we look at the sales contribution as a percentage of total sales, it's actually a bit lower. And so I wonder for this year, perhaps there's some market demand issue. But looking into 2024 and 2025 based on your current customer engagement, should we model a faster ramp-up into 2024 or 2025 or its overall ramp-up could be slight slower because of maybe customer schedule issues or planning? And if we think about the peak revenue contribution for 3-nanometer over time, do you think you will be able to reach 30% range, as N5 and N7. That's my first question.

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

Okay. So Sunny's first question is on 3-nanometer. She notes 3-nanometer revenue is greater than 5-nanometer in its first year, but the revenue percentage contribution of mid-single digit is smaller or lower. So she's wondering why is that. Is it because of the market slowdown? Is it less customer adoption and interest? What is the reason behind that? And does that mean what is our expectation for that ramp to continue [in 2024 and also beyond when do we see 3 nanometer, can it reach -- when can it reach 30% of revenue.

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

Okay, then, Sunny, let me start. The percentage of revenue for the advanced nodes becomes less important. This is because our base has become so big, much bigger than before. So I won't worry about the percentage issue. In fact, we continue to observe a high level of customer engagement at both the N3 and N3E (added by company after the call) the number of tape-outs more than double that of N5 in the first and the second year. So as a result, we expect the strong demand will continue in 2023, '24, '25 and beyond, for our N3 technologies driven by both the HPC and smartphone applications. Okay? Does that answer...

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

Yes, partially. So any thoughts on the potential peak revenue contribution in the next couple of years?

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

Too early to talk about that N3, but we continue to believe that it will be a large and long-lasting node for us.

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

It will be an important contributor to our 15% to 20% revenue CAGR in the next several years.

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

Got it. My second question is a quick one. And so for you to growth rate for this year. Just wonder what kind of industry growth are you assuming for the major end markets, including smartphone, PC, server, automotive?

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

Okay. Sunny, second question is TSMC. We have said we will grow -- have slight growth year-on-year in U.S. dollar terms this year. Her question is what are we assuming for the end market growth in areas like smartphones, PCs, automotive and others?

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

Well, let me answer the question, Sunny. What we look at in 2023, actually, we look at the smartphone and PC's unit, we think it's a little bit drop in terms of units. And the content will continue to increase. And for TSMC, actually, we increased our product portfolio. We also extend our market segment -- available market segment to TSMC. So that's why we expect the whole industry to drop slightly and TSMC still grow slightly. Sunny, did that...

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

Sorry. Yes. So just a quick follow-up on server and automotive. So any expectations on server units for this year. And for auto, I think on October earnings call, you mentioned there could be some slowdown going to first half of the year. Have you started to see the deceleration? That's all my questions.

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

So Sunny also wants to know what is our forecast for server units, automotive units, and then we said in October, 3 months ago, we said automotive demand was holding steady. What is the case now?

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

Well, the automotive demand continued to be very tight. I meant that -- I mean demand continued to increase actually. And today, we're still probably not 100% supply enough wafers to them. But it's improving, it's improving, and we expect the automotive to -- the shortage to be relaxed quickly.

And the units, for the units to grow, we expect the automotive to grow this year, but that's an OEM stuff.

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

Okay. Thank you, Sunny. Operator, can we move on to the next participant?

Operator

Our next question is come from Laura Chen with Citigroup.

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

My first question is also about the overseas expansion. Like C.C. mentioned that the overseas more advanced than 28-nanometer. We account for 20% in the longer-term perspective. And also, we are expanding more in the Advanced now in the U.S. I'm just wondering that will you also expand more like back-end or advanced packaging, along with your Advanced, now say like 5- or 3-nanometer in Arizona as well.

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

Okay. So Laura's first question is actually, C.C. said the 28-nanometer below capacity could be 28 -- 20% and more in several years' time. depending on customer demand and government support. But her question is, would we consider expanding advanced packaging overseas as well?

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

Well, today, actually we don't have a plan, but we do not rule out the possibility because the back end is a part of the total wafer service for our customer. Okay?

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

Okay. Got it. And because we see that a lot of advanced nodes used for the high computing PC. So along with that kind of application, we see now TSMC is very good at both 3DIC or the advanced packaging. So I'm just wondering that a longer-term perspective, whether that is also the direction in the U.S.

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

So I think what Laura is saying because, of course, that TSMC 3DIC solutions leading and HPC adoption is strong. So with advanced technologies, will there be a need to build or have packaging in the U.S. as we move advanced technology portion to the U.S.?

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

All right, Laura, I just answered, said that we don't rule out the possibility. But today, we don't have a plan yet.

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

Sure, sure. And my second question is about Gate-All-Around road map. Can you give us more colors on the current progress? We know that we have the schedule to ramping up in 2025 versus the EUV the high-voltage equipment will probably only ready then. Do you think that could be any like potential pushback to like a 2026 onward?

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

Okay. So Laura's second question is on the nanosheet transistor structure. She wants to know what is the progress for TSMC as we are adopting nanosheet structure at our N2. Will this be impacted or pushed out by the availability of things such as, I think you're asking high NA, Laura and things like that, correct?

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

Right.

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

Actually, our N2 technology development is on track, actually is better than what we thought. We have very good progress recently, and our risk production will be in 2024 and volume production in 2025. The schedule is not changed if we don't pull it in, but so far so good, let me assure you that.

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

Okay. Thank you, Laura. Operator, can we move on to the next participant, please?

Operator

Thank you. And our next question is come from Rolf Bulk with New Street Research.

Rolf Bulk - *New Street Research LLP - Research Analyst*

I had a question on your 2023 CapEx budget and your fab build-out plan. You, earlier on in the conference call, you talked about the build-out cost of fabs in the U.S. being 5x higher versus Taiwan. And in that context, I was wondering if you could talk about the share of CapEx spending that you expect to go towards fab build-out versus equipment this year versus last year? Will the larger share of CapEx go to those fab buildouts. And if so, how much more?

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

Okay. Sorry, Rolf. Let me try to summarize your first question. His first question is on our CapEx in 2023, and our fab build-out plans. I believe Rolf, you're referring to fab build-out plans overseas, correct?

Rolf Bulk - *New Street Research LLP - Research Analyst*

Yes, exactly. What I'm trying to understand is if I think about your CapEx such as for this year versus last year, what share will go towards infrastructures of that build-outs, and what percentage will go to equipment roughly?

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

Okay. So Rolf wants to know for our CapEx, how much is going to building and facilities, how much is for tools?

Rolf, I want to make one correction when our CFO said the, when you refer to 5x greater, I think our CFO was saying the construction costs are 4 to 5x higher, not the CapEx cost, but nonetheless, Rolf is asking for a breakout, of the CapEx?

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

Well, Rolf, we provide the breakdown of CapEx per year, advanced versus specialty technology, but we do not provide the breakdown between tools and constructions, but as I said, in the U.S., the construction of building and facilities is probably 5x that of Taiwan. And it lasts for a few years.

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

Right? Okay. Rolf, do you have a second question?

Rolf Bulk - *New Street Research LLP - Research Analyst*

Yes, as a second question. Could you talk about the growth that you achieved in your Advanced Packaging segment in 2022? And what growth you are expecting in 2023? And in particular, could you talk about your SoIC products and whether interest in those products is accelerating?

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

Okay. Thank you, Rolf. So Rolf second question is on the Advanced Packaging business. What was the growth in Advanced Packaging last year? And what do we expect the growth to be this year? And then also more specifically in terms of our SoIC technology, what is the outlook or the momentum there?

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

Okay. Rolf, this is Wendell. Again, in 2022, our Advanced Packaging grew at a similar rate to our corporate rate. So it accounted for about 7% of our total revenue in 2022. And we think that in this year, the growth will be also similar pretty -- well, slightly lower than the corporate, it will be probably flattish for the back end.

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

Okay. Thank you, Rolf. All right. Thank you. In the interest of time, maybe we'll take questions from the last 3 participants.

Operator

The next question is come from Charles Shi with Needham.

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

I want to ask a little bit about the 20% R&D expense step-up in this year. Can you provide a little bit more detail what the incremental R&D expense are going to be directed at? Well, for one thing, if I understand correctly, your N3 R&D team are going to move on to the N+2 node if we have 3 nanometer as the current N node, or is there any other incremental R&D spending this year you're expecting to be around design enablement, Advanced Packaging, specialty technology. Can you kind of give us a sense where the big step-up is coming from?

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

Okay. So Charles first question is on R&D. He wants to understand or actually more details in terms of the 20% approximately year-on-year increase. What is driving -- or the R&D spending going to be focused on? Is it N3? Is it N2? Is it design enablement by specific breakdown?

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

Charles, let me answer your question. All your comments are correct. I mean, that is because of a newer technology like a N2, N1.4 and also a lot of new chips are more expensive than before. Actually, the technology complexity continues to increase exponentially. So that's why we spend much more R&D budget. We want to continue to be #1 in the world. So we continue to invest including the geometry shrinkage, including the new transistor architecture, including the design enablement and including buying the new equipment that all adds up.

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

Okay. Charles do you have a second question?

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

Yes. Yes, I do. Maybe a second question. I want to ask about specialty technology. Obviously, you expect specialty technology to backfill your 7-nanometer fabs. I think this may be a more common knowledge inside the industry, but I recently spoke to some of your customers who are more on the analog mixed signal side. A lot of them are, I mean, driving volumes more from 28-nanometer and above, and they could tell me that the benefit of going to 14-nanometer, 16-nanometer for you, 7-nanometer is there, but it's not large enough as in the past, moving node to node. And at the same time, the cost is much higher, and I look at your technology road map, specialty technology, road map, it does seem to me that the specialty technology platforms are not as broad as the 7-nanometer if I compare with the 28-nanometer and above.

I just want to get some insights from you. How do you think about the progression of specialty technology going forward, as it seems to me that it's kind of slowing down a little bit more slowing a little bit down faster for the analog mixed signal customers.

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

So Charles' second question is on specialty technology. His observation is that the technology, specialty technology portfolio at 7-nanometer seems not as broad as prior nodes and that the -- his question is, do we see the slowing scaling of analog and mixed-signal areas in terms of the specialty technology development and moving down to lower nodes or more advanced nodes.

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

Charles, your observation is quite good. Actually, you are right. But then let me share with you a little bit more detail inside. Actually, you are right, for the analog portion or mixed signal portion, we do not need to really move into 7-nanometer or more ones node. But as time goes by, now it's more and more computing functionality needed to be added into the product.

Let me share with you that one thing like the WiFi, you need a really, very high speed to move to the next generation and also the RF. For those kind of things, you need a very high-performance of the computing together with low power consumption. It is important. And if you want to get the lower power consumption, the only the leading-edge node it can give you that kind of opportunities. All the footprint stays the same, then if you want to have a higher functionality with a lower power consumption, that's where you have to move into the 7-nanometer or more advanced node even with the analog product. Did that answer your question?

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

Yes. So I think this is above the reason that you feel still quite confident about 7-nanometer utilization will come back. You said it will mildly come back a little bit in '23, but you're still confident '24 and forward, the 7-nanometer will still be a very, very long-lasting node for you.

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

You are right.

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

Okay. All right. Thank you, Charles.

Operator

The next question is come from Brad Lin with Bank of America.

Brad Lin - BofA Securities, Research Division - Research Analyst

I have 2 questions. One is on the globalization challenge and the other on the mature nodes. So first of all, we know TSMC is excellent in managing the supply chain and the clusters in Taiwan. However, when we now expand Japan and U.S. footprint with the less of the cluster there. Would management please share with us why the strategy is to maintain the strong efficiency and the excellence that TSMC has been delivering.

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

Okay. Brad's first question is on our global footprint. He notes that TSMC has done a good job in terms of supply chain and cluster management. But as we go overseas to U.S. and Japan, how will we continue to ensure that we do a good job?

Mark Liu - Taiwan Semiconductor Manufacturing Company Limited - Chairman

Well, okay, let me answer. I think the Wendell has answered this question earlier, let me summarize a little bit. TSMC is in a service business, not in just pure production. The service depends on the trust from the customers. So in the past, our trust and service depends on our technology leadership, manufacturing excellence and the lowest cost and quality. But recently, the geopolitical development is evolving just in front of us, that 100% in one place cannot suffice our customers' needs. Therefore, we started the overall global footprint planning.

Now of course, the cost will be higher. And I think our team has been focused on how do we do this at the same time, keep our minimum gross margin to be 53% and above. And that is the standard that we decide how the pace of our global expansion going to be, and there are other segments in terms of the space, of course.

The global expansion increased the value to our customers and to the new geopolitical environment. And therefore, the pricing, how the customer can shoulder the increased cost in terms of pricing. And of course, the -- geopolitically, the semiconductor in the U.S. and Japan are all new. So I believe we are working hard on how to reduce the cost by building up the semiconductor supply ecosystem in U.S. and Japan. And I think indeed, both governments echo are -- not just us, also rather other major companies to build a similar capacity in this place to reduce the costs.

So that is the general arrangement we are planning. There's no fixed rate. Of course, the government support will be another factor. And so that is, we are cautiously step-by-step to make sure our shareholders' value still be kept.

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

Thank you, Chairman. Brad, do you have a second question?

Brad Lin - BofA Securities, Research Division - Research Analyst

Yes. So my second question is on the mature node. And there will be no mature node is long-lasting and generates pretty good profits with TSMC technology leadership. So while we are expanding overseas, what is the strategy for mature node in the long run, especially China expansion led by -- also by the government subsidies.

And also R&D is quite valuable for TSMC. And should we continue to allocate the R&D to mature node when maintaining good pace at leading edge and advanced packaging?

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

Okay. So Brad, second question, I think maybe to summarize this more on the mature nodes. So he wants to better understand our strategy on the mature nodes. As we expand our manufacturing footprint and increase capacity outside of Taiwan, what is our strategy for mature nodes? Will we bring mature nodes overseas? What is the status in China? How are we allocating R&D resources to mature nodes already, specialty technology strategies, et cetera.

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

Well, actually, our mature node capacity strategy is very simple. We develop differentiated specialty technology for our customer. In fact, we are working with customers and to define what they need and then what kind of technology that we need to develop. We don't add any commonly used logic technology per se, but we develop specialty and differentiated and for the long term, structural market demand, and that's our current strategy. And because of that, of course, we put R&D effort and resources to cooperate with our customer. And so we can generate profitability with a reasonable utilization.

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

Thank you, C.C. Thank you, Brad. Operator, well, can we move on to the last participant, please?

Operator

Sure. Our last question is come from Mehdi Hosseini with Susquehanna International Group.

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

Yes. I want to go back to gross margin. I'm a little bit confused if you could clarify something. Your wafer shipment in Q4 declined and also FX actually strengthened by a little bit, which should be negative on gross margin. So your cost-cutting efforts must have been greatly exceeding these trends. And I want to get a better feel for it, and I have a follow-up.

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

Mehdi's first question is on gross margin. He notes wafer shipments declined sequentially in the fourth quarter. The -- but with the foreign exchange movement, he notes it's a negative for gross margin. So he wants to -- but -- well -- and then he wants to understand what is the magnitude or rate of cost improvement. Maybe our CFO can clarify some of these, particularly the FX.

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

Right. Our fourth quarter gross margin is 180 basis points higher than that in the third quarter. Foreign exchange rate actually went towards our favor. The NT depreciated in the fourth quarter from TWD 30.32 in the third quarter to 31.39, so that gave us about 140 basis points of gross margin expansion. Now the remaining one, there are cost improvement but offset by, as we said, lower wafer utilization.

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

Okay. So the volume helped. Now if I just take your comment about the first half, declining 5% to 10% on a year-over-year basis. It does imply that there is a chance that revenues in Q2 would decline on a sequential basis. Would that also drive gross margin down on a sequential basis?

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

Okay. So Mehdi's second question is then we have noted, we did not say 5% to 10%, but our first half revenue will decline mid- to high single digit year-on-year. So he wants to know does this mean that second quarter revenue will be down sequentially? And is there -- does that mean that the gross margin will go below 53% or decline into it.

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

Right. We give you the guidance, so you can really calculate yourself on the revenue growth on the second quarter. And it's too early to talk about the gross margin in the second quarter and beyond. However, we can tell you that we work very diligently to make sure our gross -- long-term gross margins of 53% and higher is achievable even in this year.

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

Understood. Sure. Understood. But could it go below 53% and then rebound. So it would average to 53%.

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

It's too early to talk about that. But as I said, we work very diligently to make sure this long-term gross margin target of 53% and above can be achievable, including this year.

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

And we will give you the second quarter gross margin outlook in April, Mehdi, in 3 months. Okay.

All right. Thank you. Okay. 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 be available 24 hours from now, both of which you can find and is available through TSMC's website at www.tsmc.com. Thank you again for joining us today. We wish everyone a happy Lunar New Year, and we hope you will join us again next quarter. Goodbye, and have a good day.

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