J.P.Morgan
Asia Pacific Equity Research
21 July 2026

Electronic Components Sector

FC-BGA (ABF) substrate technology seminar report

Japan Equity Research
Technology - Electronic Components
Akinori Kanemoto AC
(81-3) 6736 8628
akinori.kanemoto@jpmorgan.com
Ikki Shibata
(81-3) 6736 8641
ikki.shibata@jpmorgan.com
JPMorgan Securities Japan Co., Ltd.

We invited Mr. Toshihiko Nishio of SBR Technology to conduct a seminar on future technological trends for flip chip ball grid array (FC-BGA) substrate (Ajinomoto build-up film [ABF] substrate) on July 14. Main topics of discussion included technological trends for cores (organic cores, glass cores, high-density interconnect [HDI] cores, and ceramic cores), embedded multi-die interconnect bridge with through-silicon vias (EMIB-T) from the standpoint of substrate, and trends for chip-on-wafer-on-substrate (CoWoS), chip-on-panel-on-substrate (CoPoS), and chip-on-wafer-on-platform (CoWoP). We provide an overview of the seminar below and summarize implications for the electronic components sector.

Our view

- For CoWoS and CoPoS, connection (soldering) reliability during mounting has become an issue due to larger reticle sizes, and it appears that this could necessitate the use of high-rigidity substrates and glass core substrates. Meanwhile, although EMIB-T achieves higher connection reliability than CoWoS and CoPoS as a result of not using an interposer, Mr. Nishio cited a need to establish both mass production capabilities for the substrate and assembly processes. Considering this point, we think that CoWoS and CoPoS will require substrate technologies that deliver high rigidity and flatness, and that larger reticle sizes could increase Ibiden's relative competitive advantages. We also think that Ibiden and other Japanese companies could become key suppliers for EMIB-T. We think larger reticle sizes could increase Ibiden's competitive advantages over the medium term.

Seminar overview

- **CoWoS-S/CoWoS-L**: (1) Chip-on-wafer-on-substrate with silicon interposer (CoWoS-S) is a structure in which a local silicon interconnect (LSI) and high-bandwidth memory (HBW) are mounted on a large silicon interposer, with ABF substrate below the interposer. However, as interposers increase in size, warping also increases and mounting (soldering) reliability decreases. Mr. Nishio said a reticle size of 3.3x is the upper limit for this reason. (2) Chip-on-wafer-on-substrate-large (CoWoS-L) does not use a silicon interposer, and instead has a structure in which redistribution layer (RDL) wiring is formed on a mold and silicon bridges are positioned at the connection points between LSIs and HBM. TSMC has disclosed plans to expand reticle size from 3.3x to 5.5x and then to 9.5x by 2029. However, ensuring flatness during assembly is difficult and connection problems are more severe because large blocks are formed using materials with different coefficients of thermal expansion (CTE; e.g., mold resin, copper RDL wiring, silicon bridges, chips, and ABF substrate). Rubin Ultra, based on a 5.5x reticle size, has faced difficulty in implementation evaluations, and Mr. Nishio thinks a 9.5x size will be very hard to achieve. Soldering has been identified as an issue for 9.5x reticle size as of 1H 2027, and although evaluations are currently underway for Rubin Ultra with 5.5x reticle size, Mr. Nishio said this is not going well. He said that if CoWoS-L with 9.5x reticle size does not succeed, limitations on packaging technology could make it difficult to achieve the Nvidia Feynman generation

See page 4 for analyst certification and important disclosures, including non-US analyst disclosures.

JPMorgan Securities Japan Co., Ltd.
Akinori Kanemoto [AC]
(81-3) 6736 8628
akinori.kanemoto@jpmorgan.com

in 2029. Substrate sizes also increase to 85mm × 85mm for 3.3x reticle size, 110mm × 110mm for 5.5x reticle size, and 130mm × 140mm for 9.5x reticle size.

- **EMIB/EMIB-T**: (1) EMIB is a packaging technology from Intel that embeds silicon bridges in the package substrate and connects LSI and HBM with localized fine-pitch wiring. Large silicon interposers are not required. The bump pitch for HBM4 could shrink from 65μm to 36μm in the future, and because this is finer than the typical LSI connection pitch, it requires high-density wiring between the HBM and LSI. (2) EMIB-T is a structure in which through-silicon vias (TSV) are formed in a silicon bridge to enable signal and power delivery to HBM and LSI from the substrate side. The ability to optimize power supply on the bridge enables the suppression of power noise in HBM operating at high frequencies and low voltages. In addition, because HBM and LSI with different sizes and connection conditions can be mounted individually on the substrate without using a large interposer, it eliminates the need to bond an entire large module at once, as is done with CoWoS-L, making the overall interposer less susceptible to warping and offering advantages for back-end process yields. Mr. Nishio said Intel claims EMIB-T can support up to 12x reticle size and can serve as an alternative for CoWoS-L. (3) While Intel has a mass production track record with conventional EMIB, Mr. Nishio explained that EMIB-T has not yet been established as a mass production technology, given a lack of reliable mass production capacity for external customers at Intel Foundry Services (IFS) and inadequate capabilities on the substrate side as well. Broadcom and Google have expressed interest, but whether Intel can launch EMIB-T as a mass production technology is a key focus point. (4) EMIB-T faces challenges not only for developing substrate but for assembly processes as well, but Mr. Nishio said IFS plans to license assembly technology to Amkor Technology and outsource assembly to Amkor.
- **CoPoS/CoWoP**: (1) CoPoS is a production method in which the CoWoS processes that are normally done on a 300mm wafer are instead implemented on a 310mm square panel. This method improves productivity by using glass carriers and fully utilizing the area of a square panel. Mr. Nishio said the launch of this technology could proceed as TSMC plans, or could be delayed by up to around two years. However, Mr. Nishio believes this technology is relatively easy for TSMC to control, because any delays can be offset by increasing existing CoWoS capacity. (2) CoWoP is a packaging technology that Nvidia aims to adopt in the future. CoWoP eliminates conventional ABF substrate and directly mounts interposers equipped with graphics processing units (GPUs) and HBM on substrate-like printed circuit boards (SLP). Reducing the number of intermediate substrates is expected to simplify the structure, shorten signal paths, increase design flexibility for heat dissipation, and reduce costs. Mr. Nishio said Nvidia intends to reduce its reliance on Japanese substrate makers and use the PCB supply chains in Taiwan and China. (3) However, CoWoP requires miniaturization to an SLP trace width of 10μm or less for mass production, versus the current 15-20μm. Other remaining challenges include PCB processing precision, yield, and flip-chip mounting. Consequently, Nvidia needs to change chip-side wiring rules and bump pitch, but this would make standardization with existing CoWoS chips difficult. With Nvidia prioritizing support for the Feynman generation, Mr. Nishio believes it has limited capacity for simultaneously developing CoWoP as a separate technology, and has doubts about the feasibility of CoWoP. Mr. Nishio noted that while Nvidia's HGX products use SMX and have a dual-layer structure with one PCB mounted on another PCB, it might want to eliminate the intermediate PCB in this dual-layer structure.
- **Organic cores**: (1) ABF substrates that use an organic core are currently the mainstream for advanced packaging. The shift to chiplets and the increase in package sizes have created a need for larger substrates. Packaging is also embedding a rising percentage of silicon components, such as AI chips and HBM. CTE mismatches between substrate and chips cause warping during assembly and solder connection failures. It is important for organic cores to have low CTE and high rigidity. (2) Nittobo's T-glass is a type of glass

cloth used in organic cores, and its ability to control substrate CTE and help to improve strength and electrical properties make it an extremely important material. At present, other glass cloth makers such as Taiwan Glass are unable to keep pace technologically, and Mr. Nishio said Nittobo is effectively the only supplier for high-end products. Nittobo is moving forward with capex in response to requests to increase production from Nvidia, Broadcom, and other end-users, but because it also sees risk from competitors catching up and future oversupply, Mr. Nishio said it is gradually expanding capacity while watching demand. (3) Low CTE and high rigidity make substrate harder and increases the difficulty of drilling. Mr. Nishio said Union Tool is the leader in supplying drilling tools capable of stable micro-hole machining in such hard materials, and other companies are unable to keep pace.

- **Glass cores**: Glass cores are superior in terms of low CTE, high rigidity, and flatness, and can mitigate warping in large packaging. Consequently, Mr. Nishio said Intel, AMD, and others view glass cores as a future core material. While many substrate makers are developing glass cores, virtually none are capable of mass production, and Mr. Nishio said Absolics is currently the only company that has mass production facilities and has advanced to the stage of small-scale production. Ibiden, Shinko Electric Industries, and Unimicron are still at the development stage and have not announced specific start dates for mass production. Samsung Electro-Mechanics announced the construction of a mass production plant with Sumitomo Chemical and plans to start mass production prototyping from 2028, but customer certifications will take time after completing plant production. Mr. Nishio said Dai Nippon Printing has not made a decision on full-scale investment. Consequently, glass cores still have inadequate infrastructure, including mass production plants, and Mr. Nishio thinks mass production will be difficult until 2030. The recent announcement at the JPCA Show 2026 that TSMC will cooperate with Ibiden and Innolux to develop glass core substrate for CoPoS has attracted attention.
- **Other core materials**: (1) HDI cores replace conventional cores comprised of two layers of copper clad laminate (CCL) with around eight HDI layers (multilayer PCB). HDI cores make it easier to use existing PCB technologies than glass cores, and evaluations are underway. However, substrate makers will need to cooperate with external parties if they are unable to make high-rigidity cores in-house, resulting in a more complex supply chain. Mr. Nishio said production is currently not possible at either Ibiden or Shinko Electric Industries. (2) Regarding ceramic cores, ceramic substrate was used in IBM mainframes and Intel products from the 1980s to the 1990s, and although the mainstream then shifted to organic, there are existing material technologies and mass production plants for ceramic. Mr. Nishio said ceramic cores have attracted attention as one option amid the slow launch of glass cores, but also noted lingering issues in terms of drilling holes in ceramic and bonding with ABF.

JPMorgan Securities Japan Co., Ltd.
Akinori Kanemoto [AC]
(81-3) 6736 8628
akinori.kanemoto@jpmorgan.com

Analyst Certification: The Research Analyst(s) denoted by an "AC" on the cover of this report certifies (or, where multiple Research Analysts are primarily responsible for this report, the Research Analyst denoted by an "AC" on the cover or within the document individually certifies, with respect to each security or issuer that the Research Analyst covers in this research) that: (1) all of the views expressed in this report accurately reflect the Research Analyst's personal views about any and all of the subject securities or issuers; and (2) no part of any of the Research Analyst's compensation was, is, or will be directly or indirectly related to the specific recommendations or views expressed by the Research Analyst(s) in this report. For all Korea-based Research Analysts listed on the front cover, if applicable, they also certify, as per KOFIA requirements, that the Research Analyst's analysis was made in good faith and that the views reflect the Research Analyst's own opinion, without undue influence or intervention.

All authors named within this report are Research Analysts who produce independent research unless otherwise specified. In Europe, Sector Specialists (Sales and Trading) may be shown on this report as contacts but are not authors of the report or part of the Research Department.

Important Disclosures

Company-Specific Disclosures: J.P. Morgan does and seeks to do business with companies covered in its research reports. As a result, investors should be aware that the firm may have a conflict of interest that could affect the objectivity of this report. Investors should consider this report as only a single factor in making their investment decision. Important disclosures, including price charts and credit opinion history tables (if applicable), are available for compendium reports and all J.P. Morgan–covered companies, and certain non-covered companies, by visiting https://www.jpmm.com/research/disclosures, calling 1-800-477-0406, or e-mailing research.disclosure.inquiries@jpmorgan.com with your request.

Explanation of Equity Research Ratings, Designations and Analyst(s) Coverage Universe:
J.P. Morgan uses the following rating system: Overweight (over the duration of the price target indicated in this report, we expect this stock will outperform the average total return of the stocks in the Research Analyst's, or the Research Analyst's team's, coverage universe); Neutral (over the duration of the price target indicated in this report, we expect this stock will perform in line with the average total return of the stocks in the Research Analyst's, or the Research Analyst's team's, coverage universe); and Underweight (over the duration of the price target indicated in this report, we expect this stock will underperform the average total return of the stocks in the Research Analyst's, or the Research Analyst's team's, coverage universe. NR is Not Rated. In this case, J.P. Morgan has removed the rating and, if applicable, the price target, for this stock because of either a lack of a sufficient fundamental basis or for legal, regulatory or policy reasons. The previous rating and, if applicable, the price target, no longer should be relied upon. An NR designation is not a recommendation or a rating. Some stocks under coverage have a rating but no price target; in these cases, we expect the stock will outperform/perform in line/underperform the average total return of the stocks in the Research Analyst's, or the Research Analyst's team's, coverage universe of the relevant duration of the region. In our Asia (ex-Australia and ex-India) and U.K. small- and mid-cap Equity Research, each stock's expected total return is compared to the expected total return of a benchmark country market index, not to those Research Analysts' coverage universe. If it does not appear in the Important Disclosures section of this report, the certifying Research Analyst's coverage universe can be found on J.P. Morgan's Research website, https://www.jpmorganmarkets.com.

Coverage Universe: Kanemoto, Akinori : Alps Alpine (6770) (6770.T), Hirose Electric (6806) (6806.T), Ibiden (4062) (4062.T), Japan Aviation Electronics (6807) (6807.T), Kyocera (6971) (6971.T), MinebeaMitsumi (6479) (6479.T), Murata Manufacturing (6981) (6981.T), NISSHA (7915) (7915.T), Nichicon (6996) (6996.T), Nidec (6594) (6594.T), Nippon Chemi-Con (6997) (6997.T), Niterra (5334) (5334.T), Rohm (6963) (6963.T), TDK (6762) (6762.T), Taiyo Yuden (6976) (6976.T), Wacom (6727) (6727.T)

J.P. Morgan Equity Research Ratings Distribution, as of July 04, 2026

	Overweight (buy)	Neutral (hold)	Underweight (sell)
J.P. Morgan Global Equity Research Coverage*	53%	36%	12%
IB clients**	83%	80%	73%
JPMS Equity Research Coverage*	51%	37%	12%
IB clients**	95%	92%	87%

***Please note that the percentages may not add to 100% because of rounding.**
****Percentage of subject companies within each of the "buy," "hold" and "sell" categories for which J.P. Morgan has provided investment banking services within the previous 12 months.**
For purposes of FINRA ratings distribution rules only, our Overweight rating falls into a buy rating category; our Neutral rating falls into a hold rating category; and our Underweight rating falls into a sell rating category. Please note that stocks with an NR designation are not included in the table above. This information is current as of the end of the most recent calendar quarter.

Equity Valuation and Risks: For valuation methodology and risks associated with covered companies or price targets for covered companies, please see the most recent company-specific research report at http://www.jpmorganmarkets.com, contact the primary analyst or your J.P. Morgan representative, or email research.disclosure.inquiries@jpmorgan.com. For material information about the proprietary models used, please see the Summary of Financials in company-specific research reports and the Company Tearsheets, which are available to download on the company pages of our client website, http://www.jpmorganmarkets.com. This report also sets out within it the material underlying assumptions used.

History of Investment Recommendations:
A history of J.P. Morgan investment recommendations disseminated during the preceding 12 months can be accessed on the Research & Commentary page of http://www.jpmorganmarkets.com where you can also search by analyst name, sector or financial instrument.

Analysts' Compensation: The research analysts responsible for the preparation of this report receive compensation based upon various factors, including the quality and accuracy of research, client feedback, competitive factors, and overall firm revenues.

Registration of non-US Analysts: Unless otherwise noted, the non-US analysts listed on the front of this report are employees of non-US affiliates of J.P. Morgan Securities LLC, may not be registered as research analysts under FINRA rules, may not be associated persons of J.P. Morgan Securities LLC, and may not be subject to FINRA Rule 2241 or 2242 restrictions on communications with covered companies, public appearances, and trading securities held by a research analyst account.

Other Disclosures

J.P. Morgan is a marketing name for investment banking businesses of JPMorgan Chase & Co. and its subsidiaries and affiliates worldwide.

UK MIFID FICC research unbundling exemption: UK clients should refer to UK MIFID Research Unbundling exemption for details of J.P. Morgan's implementation of the FICC research exemption and guidance on relevant FICC research categorisation.

All research material made available to clients are simultaneously available on our client website, J.P. Morgan Markets, unless specifically permitted by relevant laws. Not all research content is redistributed, e-mailed or made available to third-party aggregators. For all research material available on a particular stock, please contact your sales representative.

Any long form nomenclature for references to China; Hong Kong; Taiwan; and Macau within this research material are Mainland China; Hong Kong SAR (China); Taiwan (China); and Macau SAR (China).

J.P. Morgan Research may, from time to time, write on issuers or securities targeted by economic or financial sanctions imposed or administered by the governmental authorities of the U.S., EU, UK or other relevant jurisdictions (Sanctioned Securities). Nothing in this report is intended to be read or construed as encouraging, facilitating, promoting or otherwise approving investment or dealing in such Sanctioned Securities. Clients should be aware of their own legal and compliance obligations when making investment decisions.

Any digital or crypto assets discussed in this research report are subject to a rapidly changing regulatory landscape. For relevant regulatory advisories on crypto assets, including bitcoin and ether, please see https://www.jpmorgan.com/disclosures/cryptoasset-disclosure.

The author(s) of this research report may not be licensed to carry on regulated activities in your jurisdiction and, if not licensed, do not hold themselves out as being able to do so.

Exchange-Traded Funds (ETFs): J.P. Morgan Securities LLC ("JPMS") acts as authorized participant for substantially all U.S.-listed ETFs. To the extent that any ETFs are mentioned in this report, JPMS may earn commissions and transaction-based compensation in connection with the distribution of those ETF shares and may earn fees for performing other trade-related services, such as securities lending to short sellers of the ETF shares. JPMS may also perform services for the ETFs themselves, including acting as a broker or dealer to the ETFs. In addition, affiliates of JPMS may perform services for the ETFs, including trust, custodial, administration, lending, index calculation and/or maintenance and other services.

Options and Futures related research: If the information contained herein regards options- or futures-related research, such information is available only to persons who have received the proper options or futures risk disclosure documents. Please contact your J.P. Morgan Representative or visit https://www.theocc.com/components/docs/riskstoc.pdf for a copy of the Option Clearing Corporation's Characteristics and Risks of Standardized Options or https://www.finra.org/sites/default/files/2020-08/Security_Futures_Risk_Disclosure_Statement_2020.pdf for a copy of the Security Futures Risk Disclosure Statement.

Changes to Interbank Offered Rates (IBORs) and other benchmark rates: Certain interest rate benchmarks are, or may in the future become, subject to ongoing international, national and other regulatory guidance, reform and proposals for reform. For more information, please consult: https://www.jpmorgan.com/global/disclosures/interbank_offered_rates

Notification for Credit Ratings: If this material includes credit ratings, such credit ratings provided by Japan Credit Rating Agency, Ltd. (JCR) and Rating and Investment Information, Inc. (R&I), are credit ratings provided by Registered Credit Rating Agencies (credit rating agencies registered under the Financial Instruments and Exchange Law of Japan (FIEL)). With respect to credit ratings that are provided by credit rating agencies other than JCR and R&I and have no stipulation that such credit ratings are provided by Registered Credit Rating Agencies, this means that such credit ratings are Non Registered Ratings (credit ratings provided by credit rating agencies not registered under the FIEL). Among the Non Registered Ratings, with respect to those credit ratings provided by S&P Global Ratings (S&P), Moody's Investors Service (Moody's), or Fitch Ratings (Fitch), prior to making investment decision based on such Non Registered Ratings, please carefully read the "Explanation Letter regarding Non Registered Ratings" for the corresponding credit rating agency, which we separately have sent or will send.

Private Bank Clients: Where you are receiving research as a client of the private banking businesses offered by JPMorgan Chase & Co. and its subsidiaries ("J.P. Morgan Private Bank"), research is provided to you by J.P. Morgan Private Bank and not by any other division of J.P. Morgan, including, but not limited to, the J.P. Morgan Corporate and Investment Bank and its Global Research division.

Legal entity responsible for the production and distribution of research: The legal entity identified below the name of the Reg AC Research Analyst who authored this material is the legal entity responsible for the production of this research. Where multiple Reg AC Research Analysts authored this material with different legal entities identified below their names, these legal entities are jointly responsible for the production of this research. Where more than one legal entity is listed under an analyst's name, the first legal entity is responsible for the production unless stated otherwise. Research Analysts from various J.P. Morgan affiliates may have contributed to the production of this material but may not be licensed to carry out regulated activities in your jurisdiction (and do not hold themselves out as being able to do so). Unless otherwise stated below in the legal entity disclosures, this material has been distributed by the legal entity responsible for production, or where more than one legal entity is listed under the analyst's name, the first legal entity will be responsible for distribution. If you have any queries, please contact the relevant Research Analyst in your jurisdiction or the entity in your jurisdiction that has distributed this research material.

Legal Entities Disclosures and Country-/Region-Specific Disclosures:
Argentina: JPMorgan Chase Bank N.A Sucursal Buenos Aires is regulated by Banco Central de la República Argentina ("BCRA"- Central Bank of Argentina) and Comisión Nacional de Valores ("CNV"- Argentinian Securities Commission - ALYC y AN Integral N°51).

Australia: J.P. Morgan Securities Australia Limited ("JPMSAL") (ABN 61 003 245 234/AFS Licence No: 238066) is regulated by the Australian Securities and Investments Commission and is a Market Participant of ASX Limited, a Clearing and Settlement Participant of ASX Clear Pty Limited and a Clearing Participant of ASX Clear (Futures) Pty Limited. This material is issued and distributed in Australia by or on behalf of JPMSAL only to "wholesale clients" (as defined in section 761G of the Corporations Act 2001). A list of all financial products covered can be found by visiting https://www.jpmm.com/research/disclosures. J.P. Morgan seeks to cover companies of relevance to the domestic and international investor base across all Global Industry Classification Standard (GICS) sectors, as well as across a range of market capitalisation sizes. If applicable, in the course of conducting public side due diligence on the subject company(ies), the Research Analyst team may at times perform such diligence through corporate engagements such as site visits, discussions with company representatives, management presentations, etc. Research issued by JPMSAL has been prepared in accordance with J.P. Morgan Australia's Research Independence Policy which can be found at the following link: J.P. Morgan Australia - Research Independence Policy.

Brazil: Banco J.P. Morgan S.A. is regulated by the Comissao de Valores Mobiliarios (CVM) and by the Central Bank of Brazil. Ombudsman J.P. Morgan: 0800-7700847 / 0800-7700810 (For Hearing Impaired) / ouvidoria.jp.morgan@jpmchase.com.

Canada: J.P. Morgan Securities Canada Inc. is a registered investment dealer, regulated by the Canadian Investment Regulatory Organization and the Ontario Securities Commission and is the participating member on Canadian exchanges. This material is distributed in Canada by or on behalf of J.P.Morgan Securities Canada Inc.

Chile: Inversiones J.P. Morgan Limitada is an unregulated entity incorporated in Chile.

China: J.P. Morgan Securities (China) Company Limited has been approved by CSRC to conduct the securities investment consultancy business.

Colombia: Banco J.P. Morgan Colombia S.A. is supervised by the Superintendencia Financiera de Colombia (SFC). Any reference in this material to products or services offered abroad by entities other than the Bank in Colombia is included exclusively for descriptive purposes. Such references do not constitute, and should not be construed as, promotional activity or the provision of financial products or services within Colombian territory, as defined under applicable Colombian regulation.

Dubai International Financial Centre (DIFC): JPMorgan Chase Bank, N.A., Dubai Branch is regulated by the Dubai Financial Services Authority (DFSA) and its registered address is Dubai International Financial Centre - The Gate, West Wing, Level 3 and 9 PO Box 506551, Dubai, UAE. This material has been distributed by JP Morgan Chase Bank, N.A., Dubai Branch to persons regarded as professional clients or market counterparties as defined under the DFSA rules.

European Economic Area (EEA): Unless specified to the contrary, research is distributed in the EEA by J.P. Morgan SE ("JPM SE"), which is authorised as a credit institution by the Federal Financial Supervisory Authority (Bundesanstalt für Finanzdienstleistungsaufsicht, BaFin) and jointly supervised by the BaFin, the German Central Bank (Deutsche Bundesbank) and the European Central Bank (ECB). JPM SE is a company headquartered in Frankfurt with registered address at TaunusTurm, Taunustor 1, Frankfurt am Main, 60310, Germany. The material has been distributed in the EEA to persons regarded as professional investors (or equivalent) pursuant to Art. 4 para. 1 no. 10 and Annex II of MiFID II and its respective implementation in their home jurisdictions ("EEA professional investors"). This material must not be acted on or relied on by persons who are not EEA professional investors. Any investment or investment activity to which this material relates is only available to EEA relevant persons and will be engaged in only with EEA relevant persons.

Hong Kong: J.P. Morgan Securities (Asia Pacific) Limited (CE number AAJ321) is regulated by the Hong Kong Monetary Authority and the Securities and Futures Commission in Hong Kong, and J.P. Morgan Broking (Hong Kong) Limited (CE number AAB027) is regulated by the Securities and Futures Commission in Hong Kong. JP Morgan Chase Bank, N.A., Hong Kong Branch (CE Number AAL996) is regulated by the Hong Kong Monetary Authority and the Securities and Futures Commission, is organized under the laws of the United States with limited liability. Where the distribution of this material is a regulated activity in Hong Kong, the material is distributed in Hong Kong by or through J.P. Morgan Securities (Asia Pacific) Limited and/or J.P. Morgan Broking (Hong Kong) Limited.

India: J.P. Morgan India Private Limited (Corporate Identity Number - U67120MH1992FTC068724), having its registered office at J.P. Morgan Tower, Off. C.S.T. Road, Kalina, Santacruz - East, Mumbai – 400098, is registered with the Securities and Exchange Board of India (SEBI) as a

‘Research Analyst’ having registration number INH000001873. J.P. Morgan India Private Limited is also registered with SEBI as a member of the National Stock Exchange of India Limited and the Bombay Stock Exchange Limited (SEBI Registration Number – INZ000239730) and as a Merchant Banker (SEBI Registration Number - MB/INM000002970). Telephone: 91-22-6157 3000, Facsimile: 91-22-6157 3990 and Website: http://www.jpmipl.com. JPMorgan Chase Bank, N.A. - Mumbai Branch is licensed by the Reserve Bank of India (RBI) (Licence No. 53/ Licence No. BY.4/94; SEBI - IN/CUS/014/ CDSL : IN-DP-CDSL-444-2008/ IN-DP-NSDL-285-2008/ INBI00000984/ INE231311239) as a Scheduled Commercial Bank in India, which is its primary license allowing it to carry on Banking business in India and other activities, which a Bank branch in India are permitted to undertake. For non-local research material, this material is not distributed in India by J.P. Morgan India Private Limited. Compliance Officer: Ashutosh Sharma; ashutosh.j.sharma@jpmchase.com; +912261575002. Grievance Officer: Ramprasadh K, jpmipl.research.feedback@jpmorgan.com; +912261573000. Registration granted by SEBI and certification from NISM in no way guarantee performance of the intermediary or provide any assurance of returns to investors. Please visit Terms and Conditions and Most Important Terms and Conditions (MITC). The annual Compliance audit report is available at http://www.jpmipl.com/#research.

Indonesia: PT J.P. Morgan Sekuritas Indonesia is a member of the Indonesia Stock Exchange and is registered and supervised by the Otoritas Jasa Keuangan (OJK).

Korea: J.P. Morgan Securities (Far East) Limited, Seoul Branch, is a member of the Korea Exchange (KRX). JPMorgan Chase Bank, N.A., Seoul Branch, is licensed as a branch office of foreign bank (JPMorgan Chase Bank, N.A.) in Korea. Both entities are regulated by the Financial Services Commission (FSC) and the Financial Supervisory Service (FSS). For non-macro research material, the material is distributed in Korea by or through J.P. Morgan Securities (Far East) Limited, Seoul Branch.

Japan: JPMorgan Securities Japan Co., Ltd. and JPMorgan Chase Bank, N.A., Tokyo Branch are regulated by the Financial Services Agency in Japan.

Malaysia: This material is issued and distributed in Malaysia by JPMorgan Securities (Malaysia) Sdn Bhd (18146-X), which is a Participating Organization of Bursa Malaysia Berhad and holds a Capital Markets Services License issued by the Securities Commission in Malaysia.

Mexico: J.P. Morgan Casa de Bolsa, S.A. de C.V., J.P. Morgan Grupo Financiero is member of the Mexican Stock Exchange (“Bolsa Mexicana de Valores”) and the Institutional Stock Exchange (“Bolsa Institucional de Valores”), and it is authorized to act as a broker dealer by the National Banking and Securities Exchange Commission (“Comisión Nacional Bancaria y de Valores”).

New Zealand: This material is issued and distributed by JPMSAL in New Zealand only to "wholesale clients" (as defined in the Financial Markets Conduct Act 2013). JPMSAL is registered as a Financial Service Provider under the Financial Service providers (Registration and Dispute Resolution) Act of 2008.

Philippines: J.P. Morgan Securities Philippines Inc. is a Trading Participant of the Philippine Stock Exchange and a member of the Securities Clearing Corporation of the Philippines and the Securities Investor Protection Fund. It is regulated by the Securities and Exchange Commission.

Singapore: This material is issued and distributed in Singapore by or through J.P. Morgan Securities Singapore Private Limited (JPMSS) [MDDI (P) 057/08/2025 and Co. Reg. No.: 199405335R], which is a member of the Singapore Exchange Securities Trading Limited, and/or JPMorgan Chase Bank, N.A., Singapore branch (JPMCB Singapore), both of which are regulated by the Monetary Authority of Singapore. This material is issued and distributed in Singapore only to accredited investors, expert investors and institutional investors, as defined in Section 4A of the Securities and Futures Act, Cap. 289 (SFA). This material is not intended to be issued or distributed to any retail investors or any other investors that do not fall into the classes of “accredited investors,” “expert investors” or “institutional investors,” as defined under Section 4A of the SFA. Recipients of this material in Singapore are to contact JPMSS or JPMCB Singapore in respect of any matters arising from, or in connection with, the material.

South Africa: J.P. Morgan Equities South Africa Proprietary Limited and JPMorgan Chase Bank, N.A., Johannesburg Branch are members of the Johannesburg Securities Exchange and are regulated by the Financial Services Conduct Authority (FSCA).

Taiwan: J.P. Morgan Securities (Taiwan) Limited is a participant of the Taiwan Stock Exchange (company-type) and regulated by the Taiwan Securities and Futures Bureau. Material relating to equity securities is issued and distributed in Taiwan by J.P. Morgan Securities (Taiwan) Limited, subject to the license scope and the applicable laws and the regulations in Taiwan. **To the extent that J.P. Morgan Securities (Taiwan) Limited produces research materials on securities not listed on the Taiwan Stock Exchange or Taipei Exchange (“Non-Taiwan Listed Securities”), these materials shall not constitute securities recommendations for the purpose of applicable Taiwan regulations, and, for the avoidance of doubt, J.P. Morgan Securities (Taiwan) Limited does not act as broker for Non-Taiwan Listed Securities.** According to Paragraph 2, Article 7-1 of Operational Regulations Governing Securities Firms Recommending Trades in Securities to Customers (as amended or supplemented) and/or other applicable laws or regulations, please note that the recipient of this material is not permitted to engage in any activities in connection with the material that may give rise to conflicts of interests, unless otherwise disclosed in the “Important Disclosures” in this material.

Thailand: This material is issued and distributed in Thailand by JPMorgan Securities (Thailand) Ltd., which is a member of the Stock Exchange of Thailand and is regulated by the Ministry of Finance and the Securities and Exchange Commission. The registered address is 548 One City Center Building, 50th Floor, Ploenchit Road, Lumphini, Pathum Wan, Bangkok 10330.

UK: Research is produced in the UK by J.P. Morgan Securities plc (“JPMS plc”) which is a member of the London Stock Exchange and is authorised by the Prudential Regulation Authority and regulated by the Financial Conduct Authority and the Prudential Regulation Authority or J.P. Morgan Markets Limited (“JPMML Ltd”) which is authorised and regulated by the Financial Conduct Authority. Unless specified to the contrary, this material is distributed in the UK by JPMS plc and is directed in the UK only to: (a) persons having professional experience in matters relating to investments falling within article 19(5) of the Financial Services and Markets Act 2000 (Financial Promotion) (Order) 2005 ("the FPO"); (b) persons outlined in article 49 of the FPO (high net worth companies, unincorporated associations or partnerships, the trustees of high value trusts, etc.); or (c) any persons to whom this communication may otherwise lawfully be made; all such persons being referred to as "UK relevant persons". This material must not be acted on or relied on by persons who are not UK relevant persons. Any investment or investment activity to which this material relates is only available to UK relevant persons and will be engaged in only with UK relevant persons. A description of J.P. Morgan EMEA's policy for prevention and avoidance of conflicts of interest related to the production of Research can be found at the following link: J.P. Morgan EMEA - Research Independence Policy.

U.S.: J.P. Morgan Securities LLC ("JPMS") is a member of the NYSE, FINRA, SIPC, and the NFA. JPMorgan Chase Bank, N.A. is a member of the FDIC. Material published by non-U.S. affiliates is distributed in the U.S. by JPMS who accepts responsibility for its content.

General: Additional information is available upon request. The information in this material has been obtained from sources believed to be reliable. While all reasonable care has been taken to ensure that the facts stated in this material are accurate and that the forecasts, opinions and expectations contained herein are fair and reasonable, JPMorgan Chase & Co. or its affiliates and/or subsidiaries (collectively J.P. Morgan) make no representations or warranties whatsoever to the completeness or accuracy of the material provided, except with respect to any disclosures relative to J.P. Morgan and the Research Analyst's involvement with the issuer that is the subject of the material. Accordingly, no reliance should be placed on the accuracy, fairness or completeness of the information contained in this material. There may be certain discrepancies with data and/or limited content in this material as a result of calculations, adjustments, translations to different languages, and/or local regulatory restrictions, as applicable. These discrepancies should not impact the overall investment analysis, views and/or recommendations of the subject company(ies) that may be discussed in the material. Artificial intelligence tools may have been used in the preparation of this material, including assisting in data analysis, pattern recognition, and content drafting for research material. J.P. Morgan accepts no liability whatsoever for any loss arising from any use of this material or its contents, and neither J.P. Morgan nor any of its respective directors, officers or employees, shall be in any way responsible for the contents hereof, apart from the liabilities and responsibilities that may be imposed on them by the relevant regulatory authority in the jurisdiction in question, or the regulatory regime thereunder. Opinions, forecasts or projections contained in this material represent J.P. Morgan's current opinions or judgment as of the date of the material only and are therefore subject to change without notice. Periodic updates may be provided on companies/industries based on company-specific developments or announcements, market conditions or any other publicly available information. There can be no assurance that future results or events will be consistent with any such opinions, forecasts or projections, which represent only one possible outcome. Furthermore, such opinions, forecasts or projections are subject to certain risks, uncertainties and assumptions that have not been verified, and future actual results or events could differ materially. The value of, or income from, any investments referred to in this material may fluctuate and/or be affected by changes in exchange rates. All pricing is indicative as of the close of market for the securities discussed, unless otherwise stated. Past performance is not indicative of future results. Accordingly, investors may receive back less than originally invested. This material is not intended as an offer or solicitation for the purchase or sale of any financial instrument. The opinions and recommendations herein do not take into account individual client circumstances, objectives, or needs and are not intended as recommendations of particular securities, financial instruments or strategies to particular clients. This material may include views on structured securities, options, futures and other derivatives. These are complex instruments, may involve a high degree of risk and may be appropriate investments only for sophisticated investors who are capable of understanding and assuming the risks involved. The recipients of this material must make their own independent decisions regarding any securities or financial instruments mentioned herein and should seek advice from such independent financial, legal, tax or other adviser as they deem necessary. J.P. Morgan may trade as a principal on the basis of the Research Analysts' views and research, and it may also engage in transactions for its own account or for its clients' accounts in a manner inconsistent with the views taken in this material, and J.P. Morgan is under no obligation to ensure that such other communication is brought to the attention of any recipient of this material. Others within J.P. Morgan, including Strategists, Sales staff and other Research Analysts, may take views that are inconsistent with those taken in this material. Employees of J.P. Morgan not involved in the preparation of this material may have investments in the securities (or derivatives of such securities) mentioned in this material and may trade them in ways different from those discussed in this material. This material is not an advertisement for or marketing of any issuer, its products or services, or its securities in any jurisdiction.

Confidentiality and Security Notice: This transmission may contain information that is privileged, confidential, legally privileged, and/or exempt from disclosure under applicable law. If you are not the intended recipient, you are hereby notified that any disclosure, copying, distribution, or use of the information contained herein (including any reliance thereon) is STRICTLY PROHIBITED. Although this transmission and any attachments are believed to be free of any virus or other defect that might affect any computer system into which it is received and opened, it is the responsibility of the recipient to ensure that it is virus free and no responsibility is accepted by JPMorgan Chase & Co., its subsidiaries and affiliates, as applicable, for any loss or damage arising in any way from its use. If you received this transmission in error, please immediately contact the sender and destroy the material in its entirety, whether in electronic or hard copy format. This message is subject to electronic monitoring: https://www.jpmorgan.com/disclosures/email

Akinori Kanemoto AC
(81-3) 6736 8628
akinori.kanemoto@jpmorgan.com

constitute investment advice nor an endorsement of any product or project; (4) are provided solely for informational purposes; and (5) are not warranted to be complete, accurate or timely. Sustainalytics is not responsible for any trading decisions, damages or other losses related to it or its use. The use of the data is subject to conditions available at https://www.sustainalytics.com/legal-disclaimers. ©2026 Sustainalytics. All Rights Reserved.

"Other Disclosures" last revised July 04, 2026.

Completed 21 Jul 2026 11:04 AM JST

Disseminated 21 Jul 2026 11:04 AM JST