[English translation of the original Japanese]

Summary of Q&A Minutes from Briefings on Generative AI-related Businesses

This is an English translation of the summary of the Japanese Q&A created by AI.
Please note that there may be some differences between this summary and the simultaneous English interpretation provided for the briefings.

[Date & Time] Wednesday, November 27, 2024 / 13:05-14:05 (JST)
[Speakers] Panasonic Industry Co., Ltd.
- Shinji Sakamoto, President & CEO
- Ryo Kitaori, CSO
- Satoshi Nakaya, CTO

Panasonic Energy Co., Ltd.
- Kazuo Tadanobu, President & CEO
- Kunio Tanaka, CSO

1	Q	Energy storage system consists of battery cells, modules and shelves. What are the strengths of each component of Panasonic Energy's storage system? Additionally, how does Panasonic Energy differentiate itself from competitors when these components are combined as a system?
	A	(Kazuo Tadanobu) As explained in our presentation slides, the enhanced performance of GPUs creates various challenges, such as heat generation and increased power consumption. Therefore, it is critical to address these issues. We believe that the strengths of our cells and systems can effectively tackle these challenges. Our cells are exceptionally reliable and highly heat-resistant. We utilize cells with material technology that is very stable in thermal environments, making them well-suited to handle the demands posed by the evolution of GPUs. Furthermore, there are fewer companies in the industry that vertically integrate cells and modules like we do. We provide energy storage systems to customers in a state that allows immediate operation by delivering complete systems. In addition, we design energy storage systems in collaboration with hyperscalers, which is one of the unique characteristics of our business. Data centers require a high degree of reliability, as they are responsible for safeguarding valuable data. Our commitment to safety and reliability in our energy storage systems has received high praise. Additionally, since data centers consume a substantial amount of electricity, we believe that a manufacturer like Panasonic, thoroughly understanding battery characteristics and material technology, can manage every aspect to minimize overall energy loss. By offering these solutions in a one-stop manner, we can provide customers with extremely high reliability and performance.
2	Q	Demand for batteries in the energy storage systems is forecast to reach 2.4 GWh by 2030, which is approximately double the current level. However, I think that demand for the energy storage systems will continue to grow even further. Therefore, Panasonic’s sales are also expected to increase at CAGR of over 20%. What is the outlook for future demand for the energy storage systems, and what factors will drive this growth?
	A	(Kazuo Tadanobu) The demand of 2.4 GWh pertains only to cells. We plan to expand its business from module and rack production to larger systems which we refer to as our

		“layer-up” business. We anticipate that even greater loads will be required in these areas, particularly with the advent of next-generation GPUs. Customers are increasingly requesting to incorporate more advanced designs and collaborate with us to create more efficient overall solutions. In response to these requests, we are developing next-generation cells and dedicated cells necessary for these advancements, and we are nearing completion. By addressing customer needs, we forecast an overall sales increase at CAGR of over 20%. Based on our current projects pipeline, we estimate that we will be able to make steady progress until around 2030.
3	Q	What is your outlook on the marginal profit ratio for the battery backup unit over the next three years? In particular, I believe that the unit price will increase as the system ratio rises. What impact will this have on the marginal profit ratio? Additionally, I understand that most hyperscalers have adopted your energy storage systems, but none of them is exclusively supplied by Panasonic. With competition from other suppliers, is there a risk that the competitive environment will become more intense, potentially leading to a decrease in the marginal profit ratio?
	A	(Kazuo Tadanobu) In general, you may perceive that the marginal profit ratio will decrease when the source and assembly processes are involved. However, as the requirements for power units in data centers become more sophisticated and complex, the added value of creating a comprehensive product exceeds that of cells alone, making it considerably less likely for the marginal profit ratio to be adversely affected. While I cannot provide a precise numerical answer, I believe that by producing everything from cells to systems, the marginal profit ratio remains strong. Additionally, as we incorporate customer requests in our energy storage systems over multiple years, along with the evolution of the next-generation GPUs, we will develop our products based on each company's design philosophy. Therefore, we focus on providing solutions that exceed customer expectations rather than simply competing with other companies. It is difficult to determine whether we are currently dominating the market share, but we do maintain a very high market share and aim to establish a solid position going forward.
4	Q	As the architecture of GPU for AI servers changes and evolves, how does Panasonic Industry's share of MEGTRON change, and what is the outlook for it?
	A	(Shinji Sakamoto) Regarding MEGTRON, we hold the largest share of this type of substrate materials in the global market, but not the top position for the generative AI server market. We think that we are currently in second place. However, I am not pessimistic about the future. The most significant step we need to take is in product development. We can achieve a balance between performance and cost by minimizing transmission loss and ensuring the material composition that is both stable and affordable. Therefore, I think it will take about three years for our market share to change significantly. In this industry, update cycles occur every two to four years for CPUs, while GPUs are updated almost every year. We view this as both a business opportunity and a threat in the competition for the market share. The key factor will be how effectively we can leverage Materials Informatics (MI) to accelerate our development process. We do not believe we can keep pace with this speed relying solely on its development with traditional labor-intensive methods. We

		have been preparing for this new challenge, and CTO Nakaya-san will elaborate our approach to automated experiments.
		(Satoshi Nakaya) Substrates and capacitors fall within the chemical field, and until now, our development process has typically involved extensive trial and error, resulting in long development times and relying on one's experience. Now, we have started to compile all this information into a database and are utilizing Materials Informatics (MI), computational science, which I believe puts us ahead of our competitors. We have also automated our experiments and are conducting development relatively at a high speed. In this field, high-frequency characteristics are particularly important. GPUs and CPUs are becoming increasingly fast, and generative AI requires the transmission of large amounts of data. Consequently, all peripheral substrates are evolving to support these higher speeds, necessitating the development of MEGTRON 7, 8, and beyond. For example, there is a standard called PCIe, which in the context of generative AI, doubles its speed every four years. Therefore, peripheral substrates require even higher communication speeds, specifically low-loss substrates, and we are currently establishing a development cycle to meet these demands.
		(Shinji Sakamoto) Right now, we are not yet able to implement automated experiments or Materials Informatics (MI) for all products. We are starting with capacitors and electronic materials. Compared to our previous development speed, we are now approximately 20 times faster than before. Our results from last year and the year before demonstrated that what used to take five months can now yield results in about one week. We will leverage this advantage to expand further. While we are not currently in the leading position at this early stage of the generative AI industry, we aim for MEGTRON to become the number one product in this industry as soon as possible.
5	Q	Regarding the energy storage systems, you mentioned that you have the largest market share. Could you please provide more quantitative information such as how many competitors there are, which countries they are based in, and the overall competitive environment as much as possible.
	A	(Kazuo Tadanobu) First, energy storage systems for data centers are broadly divided into centralized and distributed types, as explained earlier. When we refer to the first and second generations, we are specifically talking about the generations of GPUs. We began our energy storage systems for data centers, designing them for the first-generation GPUs, when distributed types emerged. That was about five or six years ago. In the current landscape, I believe the ratio of distributed to centralized energy storage systems has been approximately half and half over the past year. Both distributed and centralized systems are growing, but their growth rates differ. The centralized systems are growing at a few percent, while the distributed systems are experiencing growth rates at several tens of percent. We focus on the distributed systems. Moreover, some hyperscalers, primarily GAFAM, have adopted the distributed systems, and some are transitioning from the centralized to the distributed systems. In the distributed systems market, there is always competition. Regarding the second generation, there are fewer competitors. But we believe the competitive environment is likely to intensify as the market continues to grow.

		Furthermore, we are providing our customers with various energy management solutions including power supplies and large racks, beyond our battery cell business. In this context, our competitors include not only battery manufacturers but also power supply manufacturers and companies that produce larger systems. We will continue to leverage our strength in vertical integration, starting with batteries, which are our key products, and aim to maintain the high market share we currently hold going forward.
6	Q	In Industry segment, as of 2024, the demand for capacitors is forecasted to be 22 times larger in quantity and 30 times larger in value. My question is whether this applies to products that are already in widespread use, or if it is related to cutting-edge products as of 2024? How should we expect this to change in the following year and the year after, given this rate of growth in both quantity and value?
	A	(Shinji Sakamoto) I have been in this industry for a long time, but it is the first time I have seen such dramatic changes in both number of installed capacitors and unit prices for similar systems. For generative AI servers, there are several types of products, conductive polymer capacitors such as POSCAPs, SP-CAPs, and hybrid capacitors, each utilizing the most advanced technology available. I believe this is due to the demanding performance requirements. But we do not expect the number of installed capacitors to continue increasing at the current rate. If it were to increase, I believe the equipment will not be able to cope with the additional heat generated. Power consumption seems to have already reached its limits, and the heat-resistant requirements are so demanding. Therefore, if the number of installed capacitors were to increase further, the systems may not be able to withstand the additional load. In that scenario, we think the equipment manufacturers will do their best to address these issues. As part of our roadmap, we have developed our own hypothesis regarding the measures how the equipment manufacturers will take in the future. We then determine what our design and performance should be based on these assumptions. According to this hypothesis, while performance requirements will become more demanding in the future, we do not anticipate a significant increase in the number of units.
7	Q	Regarding energy storage systems, could you please explain how you calculate their capacity? For example, in the case of a server equipped with 72 units of the latest GPUs, if the energy consumption of one rack requires about 1,000 kilowatts and lasts about 90 seconds as a standard, how many watts of batteries would be needed? We understand that the required watts increase linearly. It would be helpful if you could provide an approximate estimate. Additionally, there is a view that if the wattage for both CPU and GPU increases to a threshold of 500 or 600, then water cooling will be implemented, resulting in switching from UPS to BBU. If this is true, we can expect your company's sales, which have increased three times so far, to continue to increase three times in the future. Please also explain If there are any conditions under the switch from UPS to BBU occurs.
	A	(Kazuo Tadanobu) This is a difficult question to answer. The battery capacity can vary significantly by manufacturer, depending on the customer’s processing methods. Therefore, it is difficult to provide specific numbers based on a particular threshold. When considering how many battery cells we use per rack, the answer again varies according to each customer’s specifications, so I cannot provide an exact

		figure. When we design systems using 18mm-diameter cells and fit them into each shelf of the racks, there are several hundred cells in each shelf per rack. We have enhanced these designs by slightly altering the cell chemistry and transitioned to cells with larger output. Recently, the configuration has evolved to include multiple shelves, each with several hundred battery cells per rack. This is an example of the current configuration. I think other companies also utilize similar designs. Also, I think that if the demand for GPUs continues to grow, there will not be enough power generation to meet it, which becomes a social issue. We may not be able to keep pace. Our energy storage systems are currently required not only for backup power as functionality but also to alleviate the load on the power generation side, a process commonly referred to as peak shaving. As a result, our second-generation of energy storage systems primarily focus on these aspects. The future of power supply will depend on the overall capacity of large-scale power generation and its implementation in society. We must create a comprehensive system that conserves energy and minimizes energy losses. Furthermore, heat management is becoming a significant concern for the future. This issue poses substantial challenges for data centers, which are actively working to address it. Therefore, we need to ensure that the specifications of our battery cells are highly heat-resistant and that they work in conjunction with the system and cooling mechanisms. In what we refer to as the next third generation, heat management will require greater design consideration, and in some cases, we may need to evaluate the feasibility of only deploying water-cooling system.
8	Q	Do you think that the first and second generations align with those defined by standards organizations such as Open Compute Project (OCP)?
	A	(Kazuo Tadanobu) When we observed early signs of changes in energy storage systems from centralized to distributed types, we began providing energy storage systems that fit in racks. In conventional data centers, it was common to have centralized energy storage systems with lead-acid batteries in separate rooms to generate the necessary power. However, with the rapid growth of data centers, lead-acid batteries were the constraints in terms of scalability by rack. To enable more output on a per-rack basis and to improve efficiency, while reducing energy losses, distributed power supply systems began to emerge within the past ten years. Today, they have become the mainstream. With the increasing use of generative AI, GPUs have significantly changed the requirement of energy storage system. As a result, the design has evolved in response, and new functions have been added. Internally, we think the evolution of GPUs is a major trend point, leading to what we refer to as the second generation of design.
9	Q	Regarding energy storage systems, what factors could increase profitability in the future, such as standardization of certain components of the solution or increased maintenance business?
	A	(Kazuo Tadanobu) I understand your interest in profitability, but it is difficult to provide specific figures. In Energy segment, we disclose figures by Industrial/Consumer and by In-vehicle. Regarding the outlook for this fiscal year, more than half of Industrial/Consumer's profit is generated from this data center-related business alone. This is an image that we can share with you. While we are maintaining that level of profitability, in terms of expanding profitability, as Sakamoto-san mentioned earlier, in the context of the evolution of

		data center technology and the increasing demands of society, the key factor is how much we can expand the areas we incorporate based on the requirements in the future, and how well we can maintain a high market share in those areas. Therefore, we must develop a production system that supports this. Amid various changes in the world, we aim to create added value step by step, such as strengthening the supply chain and introducing new cell technologies for data centers. If market growth aligns with the evolution of our technology, we will be able to increase profitability. Unlike general durable goods, data centers require a high level of reliability, leading to regular replacements. Some are replaced with new ones, while others are updated periodically. There is a consistent demand for replacement over time. Since there is almost no reuse, I think that new and continuous business opportunities will continue to arise in this sector.
10	Q	Regarding the development of next-generation products in Industry, when will it begin and what impact on profitability can be expected? Can we anticipate further improvements in your competitive advantage? Will there be changes related to cost, considering there are development expenses?
	A	(Shinji Sakamoto) Regarding the timeline for when the new-type capacitors will be required, our hypothesis is that they will be needed within 2.5 years at the earliest and 4 to 5 years at the latest. We anticipate that the requirements will include applications that cannot be supported by the basic performances of the current ceramic capacitors, nor by our conductive polymer and hybrid capacitors. We believe it is unlikely that other viable solutions exist, so we are proceeding with product development in this direction. In terms of profitability of Industry segment, about 40% are from the assembly-type products, mainly automotive usage. 60% are from material- and process-related products. In three years, during the next medium-term, we aim to increase the ratio of material- and process-related from the current 60% to 70%. By 2030, we aim for 80%. The products we are talking about today will be the core of material- and process-related business. With regard to material- and process-related business, although the current market conditions for automotive- and industrial-usage are somewhat challenging, we have been able to maintain double-digit profitability, even with slight economic fluctuations. Therefore, if this ratio increases, it will be a positive effect on company-wide profitability. We are planning the next medium-term strategy based on this assumption. By dividing the number of capacitors for this usage by the selling price, it is clear that the average price has increased, with higher-level products used in this industry compared to general servers ten years ago. In that sense, the contribution will be quite large.
11	Q	In terms of batteries for data centers, there are not yet many competitors in the second generation. I think that the competition may be with companies that deal with power supplies and systems. In that regard, are there any elemental technologies that you are lacking, or any areas you need to address through some kind acquisition? Or are you capable of competing on your own? Please share your thought on the source of your competitiveness along with the development of your competitors.
	A	(Kazuo Tadanobu) Our engineering resources initially started with chemicals related to cells, and today we are adding up the business layers, from power supply to racks. We have teams dedicated for batteries, and teams to make modules for systems. We

		have spent the past several years in enhancing our engineers to improve development capabilities. However, considering the time horizon, we also work on partnership with our suppliers in certain areas of expertise. We are working on both internal strength development, as well as joint development with specialized partners such as customers with expertise in module installment, or suppliers. Working on this for several years, we aim to become a company that can work on our large core areas by ourselves.
12	Q	You are hosting a joint briefing by Panasonic Energy and Panasonic Industry together. Are there any synergies between the two as Panasonic Group? For example, having the same hyperscaler as a customer for both? Also, are there cases in which you approach customers together?
	A	(Shinji Sakamoto) In the past, there has not been much synergy with the consumer electronics industry, and neither today as we are a devices business. On the other hand, there always is significant synergy effect in terms of B2B businesses such as batteries, mounting machines of Connect, or Automotive businesses. To be specific, it was CTO Nakaya-san who developed the basis of the backup power supply we are talking about today. At that time, I was working with him as a member of the Automotive & Industrial Systems Company, and the battery part was included in its industrial-related business. Depending on the times, there are differences in which organization the business belongs to, but the industry we face are quite similar. In particular, in terms of chemistry, only the battery business and Industry are the ones involved within the Panasonic Group. This is because, for an electronics manufacturer, the area of chemistry is quite a rare and niche area. In this sense, there are many things we can support each other such as sharing resources, and we are doing so on a daily basis. For example, in terms of customers, Industry segment has more than 25 thousand contacts globally, so we have an overwhelming level of customer pipelines and information. While thoroughly implementing internal management to prevent contamination of customer information (leakage of confidential information resulting from mixing of confidential information from different sources at the R&D stage), we want to thoroughly raise synergy effect cooperating with Energy and Connect in the possible areas.
13	Q	Recently, discussions related to data centers have focused on the Innovative Optical and Wireless Network (IOWN) and optical/electrical integration. I think you might be collaborating with them in terms of networking. Will there be any changes to batteries and electronic materials with such technological changes?
	A	(Satoshi Nakaya) As explained earlier, there is a strong need for high-speed connections between GPUs, its peripherals, and other servers. In addition, there are predictions that optical conversion will occur in 2030. The announcement on IOWN said that output from GPU, CPU, or ASIC would see an optical conversion by the 2030s. Each country is moving toward that direction, whether it is IOWN-based or not. The current stage is how to standardize the various standards going forward, including the organizations such as OCP. We are considering how to get involved while conducting R&D. We assume the industry is in the same situation.
14	Q	You have shown us the medium- to long-term growth image until 2030 for both Energy and Industry. This year's CAGR is expected to grow 80% year-on-year. There is a larger gap between the current growth rate and medium- to long-term CAGR. What is your way of thinking on the growth rate for the coming two to three years, and toward the time when CAGR is at around 20%. How should I

		understand the positioning of the current growth rate.
	A	(Kazuo Tadanobu) As for Energy, I mentioned earlier that our sales are around the mid-100-billion-yen range for this fiscal year. In reality, we can expect the effect of exchange rates, and specific projects may bring an upward effect. Currently, we are experiencing a strong momentum. For the next year, as Sakamoto-san mentioned, AI servers still account for a small portion among all data centers, and we are receiving orders ahead of schedule from hyperscalers, who are facing competition. We believe this situation will continue for several years, until the AI servers account for about half of the data centers in total. The current estimate of 20% CAGR is a minimum, and it might be higher depending on the competition or requirements. Since we have mostly completed the designing, we can expect sales growth to be proportional to market demands. Our current focus is what to be done next.
		(Shinji Sakamoto) As the basis to answer your question, in terms of general servers and AI servers combined, I think the CAGR of around 3% to 6% will not change, while there may be some fluctuations. Regarding the portion of AI servers shown today, the increase from 2023 to 2024 was somewhat extraordinary. Looking at the data center industry as a whole, this year is expected at 180% to 200% year-on-year, and there are shortages of various products. For the next year, its industry does not expect another 200% year-on-year. Growth will slow down next year and the year after. Looking at five years ahead, the industry's current estimate is a CAGR of 23% to 25%. I understand the main point of your question is how it will affect this fiscal year, and what we can expect for next fiscal year, in addition to its impact on profitability. In Industry segment, we had only around 2-billion-yen sales in FY3/23. This fiscal year, we expect around 35 to 40 billion yen. I think that we will definitely land in this range. For the next fiscal year, in terms of AI servers, we can expect an increase of around 10 billion yen, 120% to 125% year-on-year. This is the base of our business plan for next fiscal year, and I think that it will land in this range.
15	Q	In Industry, the growth rate may slow down toward next year and the year after that. Is this because you are currently receiving demand that has been brought forward, as in Energy?
	A	(Shinji Sakamoto) This year was extraordinary. Last year, there was almost no production, this year we saw a boom, and all parties including hyperscalers are thinking that generative AI-related sales will increase and become profitable. This year has seen an overheated situation including excessive competition in gaining market share, so comparing it to last year is not meaningful. Last year was so small, and this year we are reaching a certain level, so I do not expect that it will continue to double in this scale.
		(Kazuo Tadanobu) The situation for Energy is a little different from that of Industry. When comparing what we refer to as the "second generation" from the "first generation," the unit price is significantly different because of the difference in the "layering-up" per unit. In Energy, AI servers account for a larger portion of data centers. With the increase in the numbers of generative AI servers, our sales amount will increase significantly. Even if the increase in the number of units sold is small, we can see a high sales growth rate because of the higher unit price.

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