

Roundtable Meeting with Stakeholders Reducing the Environmental Impact of Semiconductor Production Equipment

The Tokyo Electron Group regards reducing the environmental impact of its semiconductor production equipment delivered to customers' factories as one of its major social responsibilities. We invited three people from semiconductor manufacturers who are our customers to attend a roundtable meeting with our employees engaged in sales and equipment development. At the meeting, participants discussed the Group's challenges and expectations from its customers, focusing on energy-saving equipment.

Sharing Information with Semiconductor Manufacturers Is Essential for Developing Energy-Saving Equipment

Mr. Ibuka (TEL): In recent years, environment-conscious design has been attracting much attention. In particular, there are strong demands for improvements in energy efficiency, and so the Tokyo Electron Group is trying to contribute to the earth and society by providing more energy-efficient equipment. Today, we would like to ask you, the users of our equipment, for your honest opinions. We will incorporate your opinions into future product development.

Mr. Kagino: The semiconductor industry is committed to reducing its energy use in consideration of the environment. We, however, want to maintain the yield level while reducing our energy use. Accordingly, we started to improve the energy efficiency of peripheral facilities first, including clean rooms and air conditioners, which will not exert much influence over the yield. If we promote the use of energy-saving semiconductor production equipment in the essential manufacturing process, it might badly affect the yield, and so it is difficult for us to proceed. However, as we implemented more energy-saving measures for air conditioners, the percentage of the total energy use that the production equipment accounted for became more significant. The equipment is powered on even while it is not used for manufacturing semiconductors and this standby electricity is indeed a waste of energy. However, we cannot proceed with countermeasures, because it might lower the yield. I believe it is necessary for semiconductor manufacturers and semiconductor production equipment manufacturers to cooperate together to reduce energy use in the semiconductor manufacturing process.

Mr. Yamanaka (TEL): It seems difficult to obtain yield-related information from semiconductor manufacturers. For example, if we supplied improved equipment to you, would you let us know how

it contributed to energy efficiency and yield at your factory?

Mr. Kagino: Certainly there is a question of whether or not you can obtain that kind of information, and even if you did, other semiconductor manufacturers might not accept the same improvement method. There have been cases where an improvement initiative that worked well at Factory A for a certain semiconductor manufacturer did not work or was not accepted at the same manufacturer's Factory B. As the background to this, semiconductor production equipment is customized for each customer. However, I think that semiconductor manufacturers need to change their attitude to this.

Mr. Tsuru (TEL): Each customer's factory has different needs regarding manufacturing methods and energy saving measures, and we cannot provide a "one-fits-all" solution. If the customer can standardize the needs of all their factories and show them to us with other necessary information, we can press forward with energy saving more easily. Do you think that will be possible?

Mr. Kagino: I think that's the direction we must take from now on.

Promoting Energy Saving for Existing Equipment

Mr. Sakaguchi (TEL): We manufacture and deliver new equipment mainly to new factories. However, there are machines that we delivered in the past and are currently in use at customers' factories ("existing equipment") and the number of those machines is more than ten times the number of new machines being delivered to new factories. For this reason, we think it necessary to focus on reducing the energy being used by existing equipment. However, it will need time, labor, and money to improve existing equipment. Would you give us your ideas on energy-saving measures for existing equipment?

Mr. Kagino: As a semiconductor manufacturer, we can implement energy-saving measures from two aspects: (1) to reduce the



total energy use and (2) to reduce the energy use per unit of production. The semiconductor industry is on a growth trend and so its energy use is increasing. It would therefore be difficult to reduce the total energy use. We have announced reductions in energy use per unit of production, i.e., per wafer or per semiconductor chip. In the future, however, we need to implement measures to reduce the total energy use, and the most effective way to do this is to make improvements to existing equipment. There may be a greater need to improve existing equipment than to provide new equipment. In my opinion, the best way to improve existing equipment is to apply the ideas used in new equipment to existing equipment. I would like you, as a manufacturer of semiconductor production equipment, to keep this in mind in developing new equipment, and to propose effective methods of improving existing equipment.

Mr. Sakaguchi (TEL): We do not have a clear picture of the semiconductor market in this respect. If we are assured that semiconductor manufacturers are willing to spend money for energy-saving equipment, we can launch a special task force to tackle this, because it will be feasible as a business model. In this case, however, as discussed earlier, we need to make customized responses to each manufacturer and to each factory. If we can overcome this problem, I think we can provide you with a satisfactory solution.

Mr. Kagino: I believe each manufacturer thinks it necessary to reduce the energy used by existing equipment. However, if we implement energy-saving measures focusing on existing equipment, it will take time and labor and those measures may not be practical. As I said earlier, I wonder if it is possible to adapt the energy-saving technology used in new equipment to improving existing equipment. It would be wonderful if the cost of doing this could be included in the cost of developing new equipment to keep the cost of improving existing equipment low. I would like to have existing equipment improved at the time it is overhauled, without spending too much time and money for it.

Mr. Tada: It costs a lot to improve the peripheral pipes and if it is possible to implement energy-saving measures concurrently with pipe improvements, we can afford to pay the extra cost. To do this, we need to cooperate with the department in charge of factory facility management.

Mr. Takahashi: With regard to factory facilities, in order to reduce exhaust gas emissions with high global warming coefficients, we need a device to recycle and reuse the gas.



Mr. Tada: How about recovering all the emissions, an idea that is now attracting much attention? It might be necessary to install a separate pipe, but it would be worth the cost if we could recover and recycle all the emissions, including fluorinated acid.

Contributing to Higher Energy Efficiency through Semiconductors

Mr. Tada: It would be relatively easy to improve the energy efficiency of equipment by 20 to 30%. However, I want semiconductor production equipment manufacturers to completely review their development concept to come up with a technology that can substantially reduce the energy used by their products.

Mr. Kagino: I agree with you. It might be possible to reduce the energy that semiconductor production equipment consumes by 50% from the present levels. I would like equipment manufacturers to rack their brains to come up with energy-saving technologies for components, for example, by examining the interrelationship between the electrode structure and exhaust emissions.

Mr. Ibuka (TEL): You said that energy use per wafer is decreasing while total energy use is increasing. Towards the future, we must make efforts to contribute to higher energy efficiency for society at large by promoting the use of semiconductors, instead of just providing energy-saving equipment. To this end, semiconductor manufacturers and semiconductor production equipment manufacturers need to cooperate.

Mr. Tada: I am the leader of the LCA* working group at the Japan Electronics and Information Technology Industries Association (JEITA). We use LCA to calculate the total environmental impact of semiconductors. It is true that manufacturing semiconductors has an impact on the environment because the process consumes large amounts of energy. Semiconductors, however, also contribute to reducing the use of energy when incorporated in state-of-the-art products used by consumers. We would like to calculate both the positive and negative impact of semiconductors with LCA.

* LCA: Life cycle assessment is a method developed to assess a product's full environmental impact throughout its lifecycle, from procurement of materials to disassembly and disposal.



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Complying with the SEMI S23 Guide* as an Industry Standard

Mr. Komatsu (TEL): I am in charge of EHS for the Group's factories. In the past, we endeavored to reduce our own energy use. In addition, we have now started to design environment-friendly products. However, it is difficult for a factory to pursue productivity and environment-friendliness at the same time. I am glad that I can listen to invaluable opinions directly from semiconductor manufacturers today. Maybe we should do more comparison of energy consumption for different types of equipment in addition to developing component technologies and building a new business model. If semiconductor production equipment manufacturers can show customers comparative data on the energy their equipment uses, i.e. how much it consumes under standard specifications and standard conditions, customers can decide which equipment to buy, and this will lead to further energy saving.

Mr. Kagino: That's exactly what we were aiming at. The SEMI S23 Guide has already incorporated comparative indicators, and if every equipment manufacturer refers to S23 in deciding the specifications of their equipment, semiconductor manufacturers can easily compare and choose equipment from different equipment manufacturers.

Mr. Ibuka (TEL): It is also important for larger numbers of semiconductor manufacturers to demand that the semiconductor production equipment manufacturers comply with S23. If the number of semiconductor manufacturers who demand this increases, the cost of the compliance imposed on equipment manufacturers will be smaller. So in a sense it is up to the semiconductor manufacturers.

Mr. Ishida (TEL): It would be easier for us to comply with the S23 Guide if the semiconductor industry as a whole, not just individual



manufacturers, regards the Guide as an industry standard.

Mr. Kagino: Specifications vary depending upon the manufacturing process. For energy saving, however, we want equipment manufacturers to promote relevant measures based on common criteria. All semiconductor manufacturers want to promote energy saving if it doesn't have harmful effects on yield. If equipment manufacturers voluntarily comply with the S23 Guide as an industry standard, semiconductor manufacturers will be able to accept it more easily.

Mr. Yamamoto (TEL): We would like to set an industry standard for energy saving, but it will be difficult to implement it without cooperation from the semiconductor manufacturers. In many cases, semiconductor manufacturers eventually choose equipment based on its cost. Some customers even tell us to remove the energy-saving function to lower the cost.

Mr. Kagino: However, once the function has become a standard, it would be rather costly to remove it. I want the function to be truly standardized.





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Mr. Tada: It might be better to incorporate the energy-saving function as an integral part of the equipment.

Mr. Tsuru (TEL): If the S23 Guide is more widely accepted as a standard, we will be able to promote energy saving more smoothly.

Mr. Kagino: Semiconductor manufacturers belonging to JEITA will all be adopting the S23 Guide in the near future. So it will be ideal if semiconductor manufacturers and semiconductor production equipment manufacturers cooperate to improve the S23 Guide and make it an industry standard.

*SEMI S23: Guide for Conservation of Energy, Utilities and Materials Used by Semiconductor Manufacturing Equipment (prepared by the Semiconductor Equipment and Materials International (SEMI))

Environment-Friendliness Now An Essential Elements

Mr. Kagino: Environment-friendliness, including energy saving, has been increasingly importance for equipment. At our company, we implement environmental assessment in developing products. We do not commercialize any products unless they have higher environmental efficiency than previous models. I think that some semiconductor manufacturers will buy energy-saving equipment that uses only half the amount of energy used by ordinary equipment and has equal performance, even if it costs more.

Mr. Tada: We are attributing more importance to energy saving. In the past, we didn't compare how much energy different types of equipment consumes when we chose equipment from among multiple products, but now, in addition to performance, we have included energy consumption among the selection criteria.

Mr. Takahashi: Semiconductor manufacturers are all implementing environmental assessment on their products. They are committed to reducing their environmental impact using comprehensive indicators.



Also, JEITA has established a system to compare products using LCA. For equipment as well, systems for standardization and comparison will be established. I expect that the S23 Guide will provide the driving force for the spread of energy-saving equipment, and that semiconductor production equipment manufacturers will make more efforts towards saving energy.

In response to the roundtable meeting

We invited representatives from Toshiba, Elpida Memory, and Renesas Technology, which are our customers, to a roundtable meeting. This meeting gave a great opportunity to our staff engaged in marketing, design, development, and EHS to exchange information on energy-saving semiconductor production equipment with customers. We will continue to solicit our customers' opinions and incorporate them in design and development.

As for customers' requests to apply improvement technologies used in new equipment to existing equipment, we will

carry out in-depth studies, including deciding on specific methods. Also, the meeting highlighted the importance of identifying how much energy our products use based on the SEMI S23 Guide, thereby promoting higher energy efficiency and lower energy consumption. To meet customers' expectations and gain their trust in this, we will continue to take a leadership role in the industry.

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