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Session IV: Japanese Advanced Technologies

Next Generation Solar Cell Development: Perovskite-type Solar Cell

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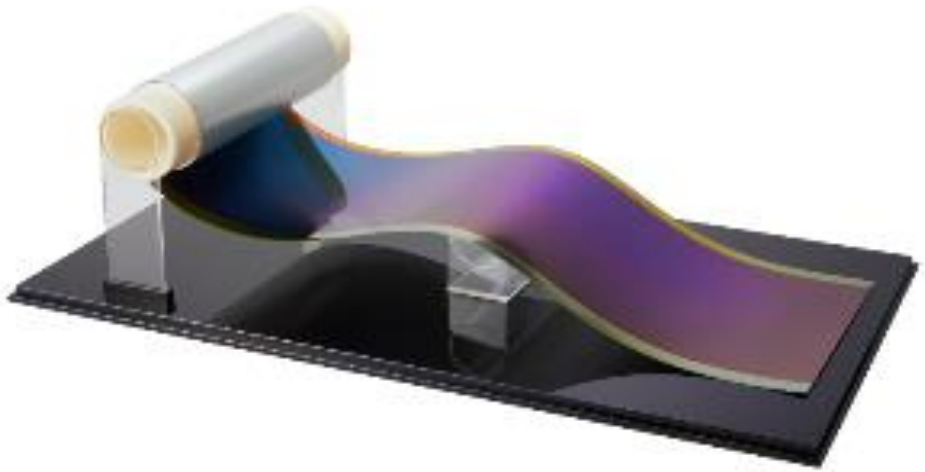
Perovskite Solar Cells



Acknowledgement

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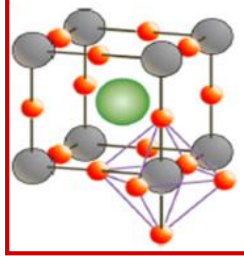
Dr. Takurou Murakami

Features of Perovskite Solar Cells

What Are Perovskite Solar Cells?

- A type of solar cell that employs a crystalline structure called perovskite

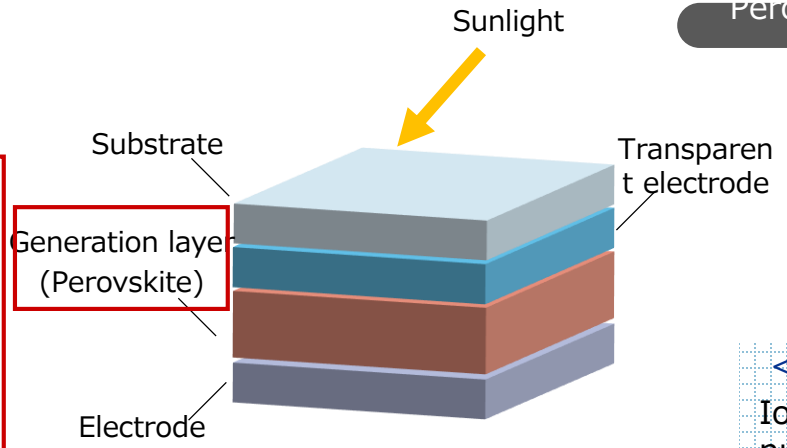
Perovskite Crystalline Structure (General Formula: ABX_3)



A = Methylamine ($CH_3NH_3^+$), etc.

B = Lead (Pb^{2+}), etc.

X = Iodine (I^-), etc.



Perovskite Solar Cell Features and Merits

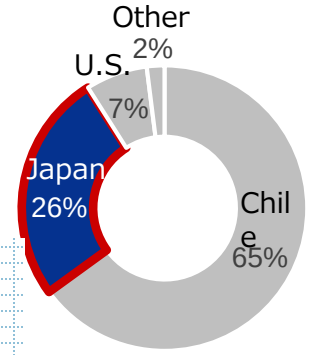
- ✓ Principal material, iodine, procured domestically
- ✓ Lightweight and flexible
- ✓ Power generation efficiency equivalent to that of silicon solar cells

<Reference> What is iodine?

Iodine: Halogen element with an atomic number of 53

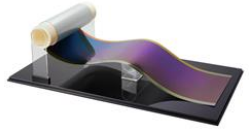
Principal application: X-ray contrast media, sterilizing and antifungal agent, etc.

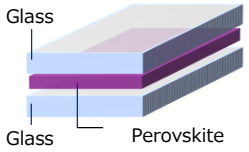
<International Share of Iodine Production>

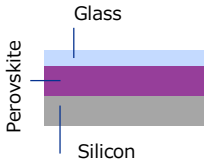


Company estimate

Types of Perovskite Solar Cells





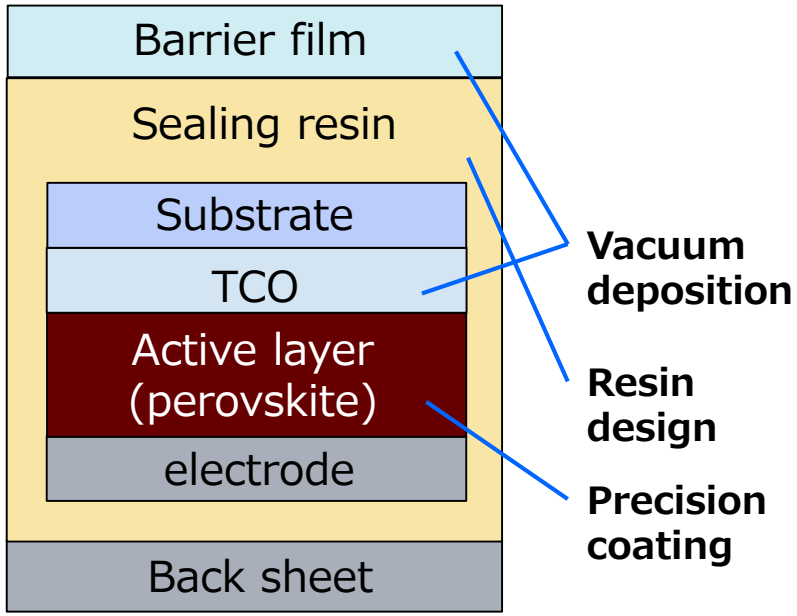


	Film-type	Glass-type	Tandem-type
Structure	Generation layer coated on a film	Generation layer sandwiched between glass	Stacked on silicon solar cells
Features	Lightweight, thin, and bendable	Easy to ensure durability	Easy to increase power generation efficiency
Intended application	Building walls and roofs with low load-bearing capacity	Window glass and balconies	Replacement for existing silicon solar cells

	Perovskite solar cell (Film-type)	Silicon solar cell
Weight	Lightweight 1.0-1.5Kg/㎡	10-15Kg/㎡
Thickness	Thin 1-3mm	10-22mm
Flexibility	Positive Curvature radius 15cm	Negative
Principal material	Iodine (Japan's global market share 26%)	Silicon (China's global market share 97%)
Power generation efficiency	15%～20%	14～20%
Durability	10 years	20-30 years (Statutory durability period 17 years)

The outline of film-type perovskite solar cell

- The film-type perovskite solar cell is lightweight and flexible.
- It can be installed in a variety of locations.
- The next-generation solar cell is packed with our own technologies (sealing, process, materials, and film deposition).



Cross section image of perovskite solar cell

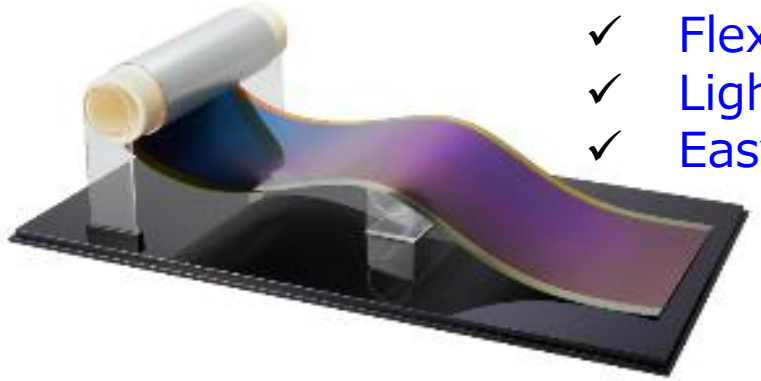
Features of Perovskite Solar Cell

Item	Characteristic	Remarks
Weight	Approximately 1.5kg/m^2	1/10 (compared to Si-PV)
Flexibility	Radius of curvature approximately 15 cm	-
Thickness	Approximately 1mm	1/20 (compared to Si-PV)
Main raw material	Iodine	About 30% of world production in Japan

Regarding of development results and future goals

Achieved power conversion efficiency of 15.0%

Characteristics:
- ✓ Flexible
- ✓ Light weight
- ✓ Easy Installable

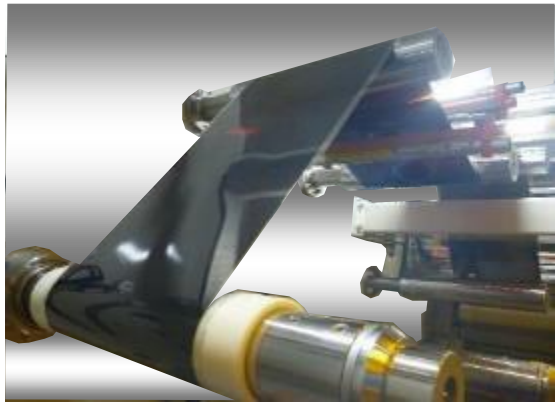


※ 300mm width R to R manufacturing

Confirmed outdoor durability for equivalent to 10 years

※ Compliant with IEC61215, a solar cell standard
Passed 5 major durability tests

Settlement of roll-to-roll element technology for 300 mm width



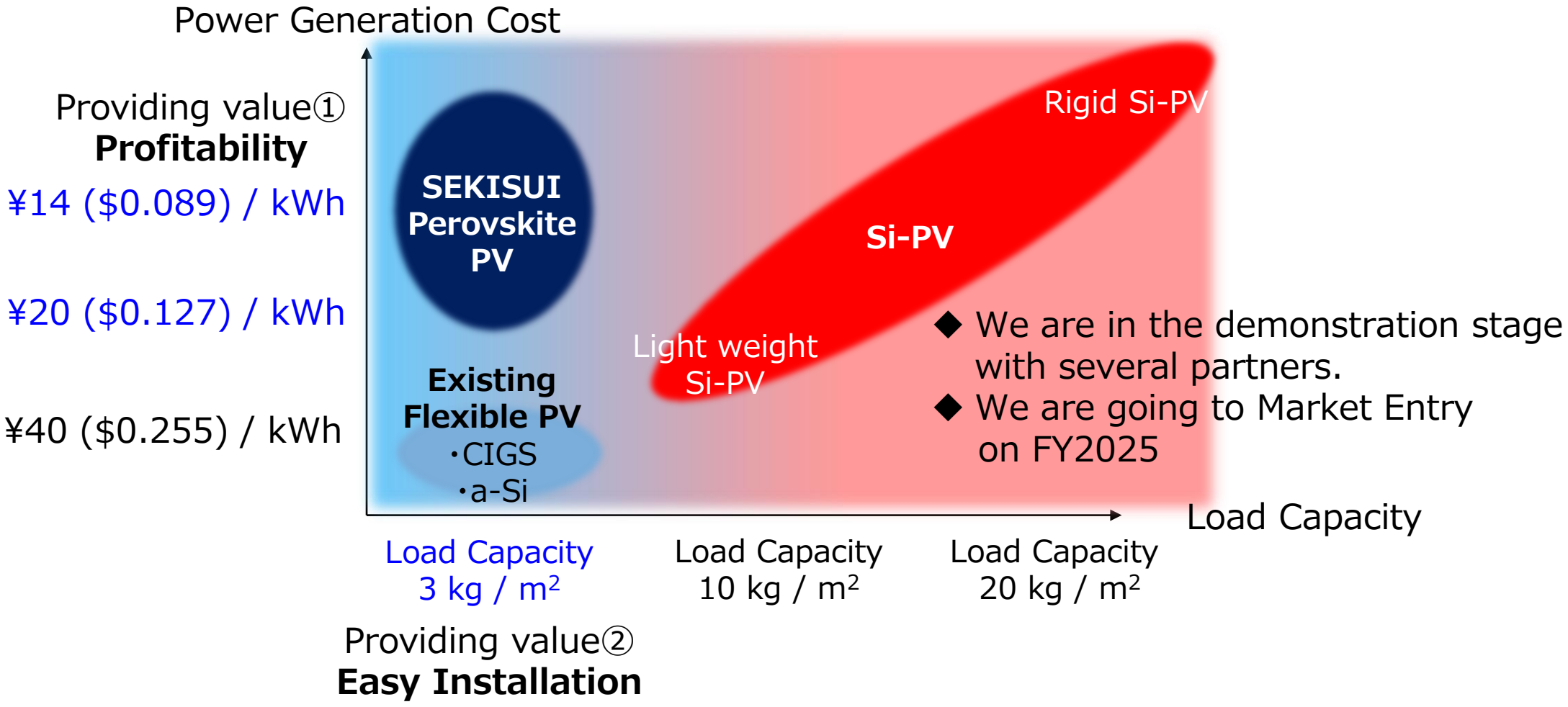
Future targets of perovskite solar cells

Item	Current	In future
Efficiency	15%	20%
Durability	10 years	More than 20 years
Width	300mm	1000mm

The Power Generation Cost (PGC)

Aim for PGC 20 yen (0.127$) / kWh

PGC is from the installation cost (i.e. equipment cost + construction cost) that is taken into account of power conversion efficiency and durability.



The film type perovskite solar cell - Possibility for installation -

The Light and flexible Perovskite solar cells are suitable to be set at new innovative demand.

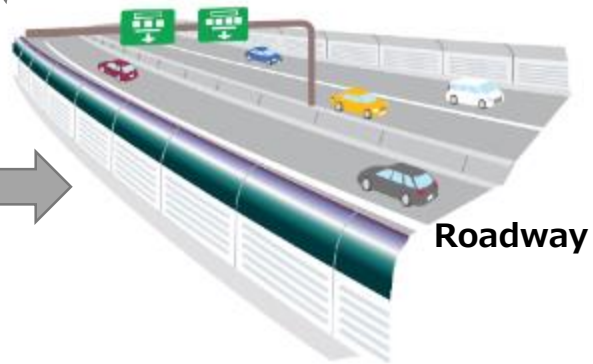
Building wall (tie-up with NTT data)

Airport & Harbor

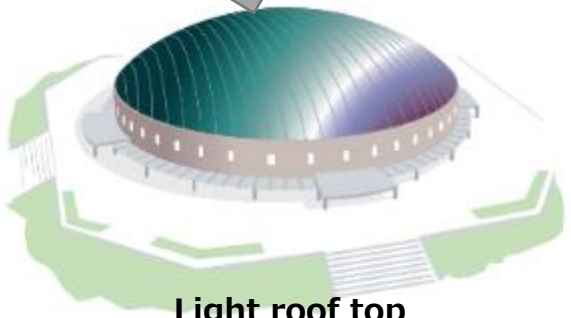
Rail way (tie-up with JR west)

Bus shelter

Treatment tank covers of sewerage (tie-up with Tokyo metropolitan government)



Roadway



Light roof top (e.g. factory, gymnasium)

- **Accumulated market size of Si solar cells → about 70GW (in Japan)**
- **Expected potential market size of Perovskite solar cells (in Japan) → 1.5-2 times larger than Si solar cells**
- **Expected potential market size of Perovskite solar cells (World) → more than 10 times of Japan**

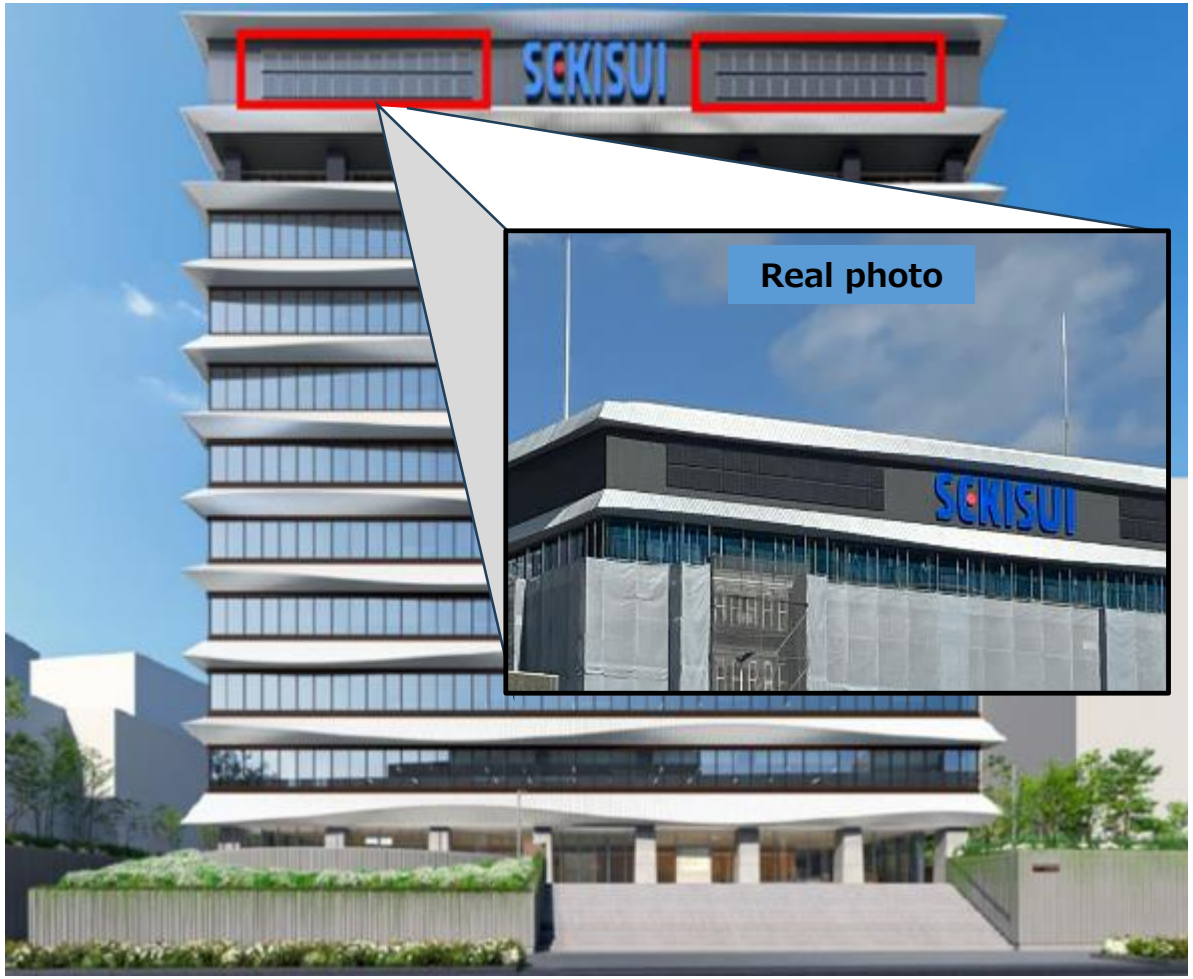
The Film type perovskite solar cell - Current Construction Project -

① Cover of the Sewerage Treatment Tank

Sekisui installed a total of 1kW cells as part of the implementation with the Tokyo Metropolitan Government. (May 2023)

② Walls of Building

Sekisui installed a total of 4kW cells on the wall on the 12th floor of our Osaka headquarters. (October 2023)



The Film type perovskite solar cell - Current Construction Project -

③ Wall of warehouses

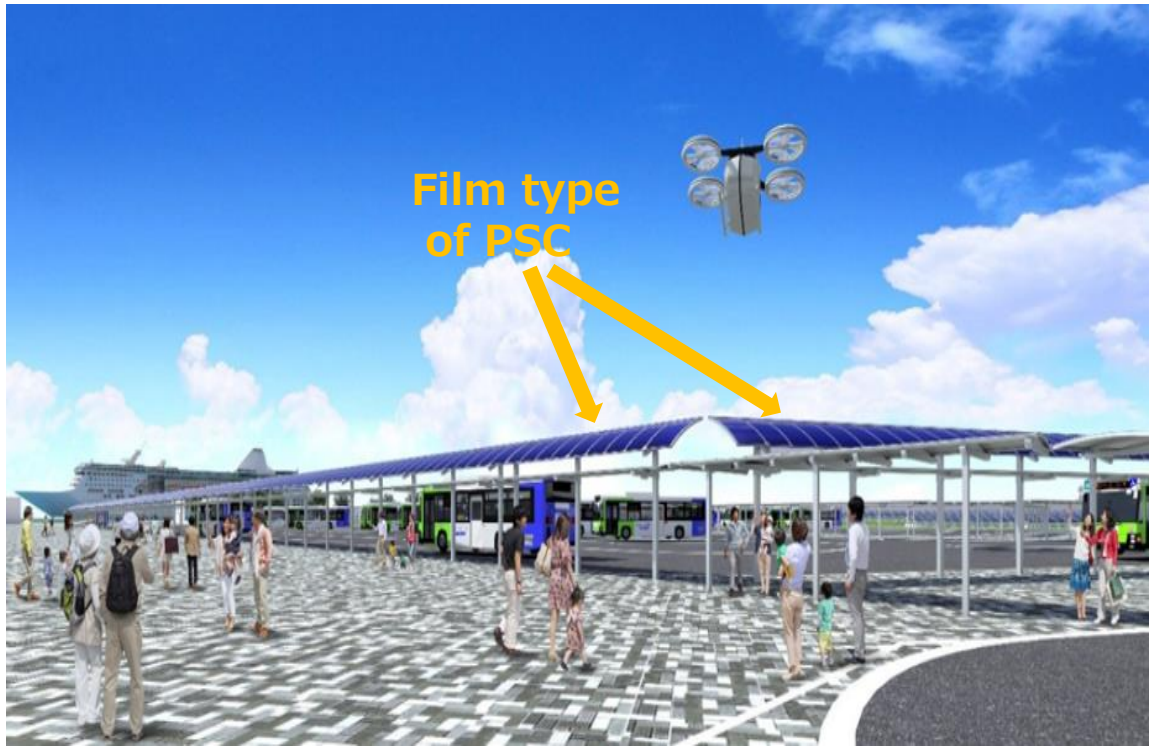
Sekisui installed a total of 16㎡ cells on the wall of the warehouse with SENKO. (March 2024)

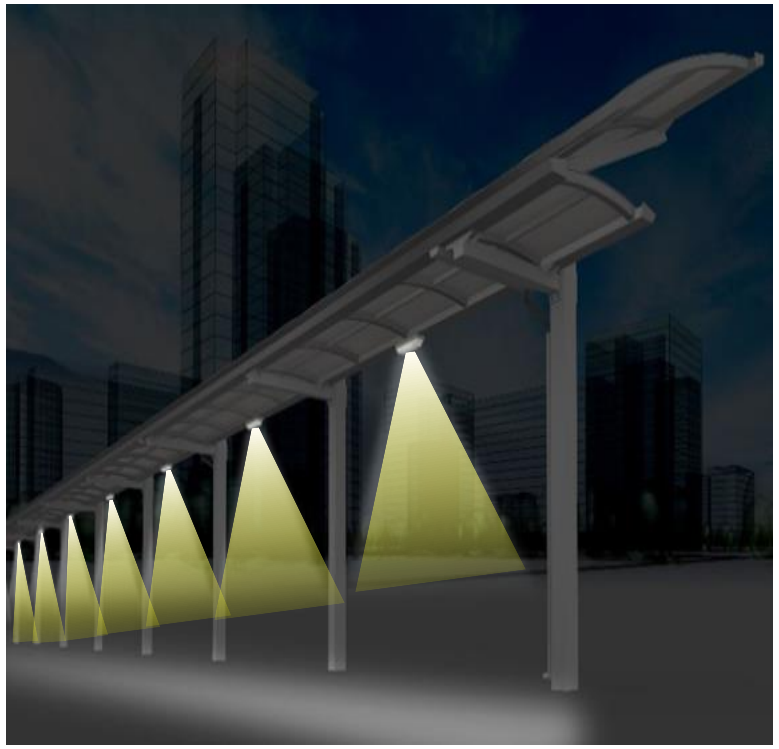
④Floating type PSCs in the swimming pool

Sekisui installed a total of 50㎡ cells in the swimming pool at the school in Tokyo with MM Bridge and KOEI. (April 2024)

⑤ The 2025 World Exposition at Osaka, Japan

Sekisui will install the film type of PSC at a total of 250 m of shelter for bus in EXPO with battery and LED as a system combination which is bright at night. (April ~ October 2025)





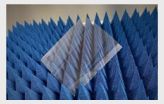
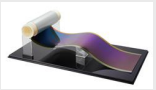
Society contribution to not only Energy but also Safety.

Company Overview

Toward Vision 2030

Emphasizing strategic preparation for achieving Vision 2030

＜Seven major themes for accelerating growth - Drive 2.0 - ＞

Growth-potential businesses	Key themes	Core technology	Investment benefit realization schedule (2023 / 2024 / 2025 / 2026~)
Entry into aeronautical fields 	Development of new applications Entry into the air mobility market	Molding technology	FY2025 business scale : From ¥19.0 billion
Next-generation communication components 	Collaboration with Telecommunications companies Development of radio wave environment business	Film processing technology	FY2025 business scale : From ¥1.0 billion
Smart city strategy 	Fusion of town and community development as well as AI digital technologies	Advanced housing, town and community development	FY2025 business scale : From ¥25.0 billion
Overseas expansion of Infrastructure-related Products 	Strengthening of overseas marketing	Infrastructure materials	FY2025 business scale : From ¥10.0 billion
API CDMO 	Conversion of base CMO business to CDMO with new modality support	Synthesis of low molecular compounds, microbial cultivation	Consider expansion through M&As
Perovskite Solar Cells 	Development of 1 m width production technology Promotion of demonstration through external collaboration	Sealing, deposition, processing technology, etc.	FY2025 business scale : From ¥5.0 billion
Biorefinary 	Promotion of demonstration through external collaboration Establishment ofresource circulation model	Microbial catalyst technology	Commercialization from FY2026

Press Release Summary

- Established a perovskite solar cell production and sales company while setting up a 100MW production line on the site of Sharp Corporation's Sakai Plant at a total investment cost of ¥90 billion.
- Selected to participate in the Support for Building GX Supply Chain Construction Support Project run by Japan's Ministry of Economy, Trade and Industry.
- Progressively invest additional funds through to 2030 with the aim of expanding production capacity levels to 1GW.

Press Release Summary (Published on 26th Dec. 2024)

Department in charge of the business

- Name: Sekisui Solar Film Co., Ltd.
- Address: 2-4-4 Nishitenma, Kita-ku, Osaka-shi
- Representative: Futoshi Kamiwaki (Director and Senior Managing Exective Officer of SEKISUI CHEMICAL)
- Main Business: Product design, manufacture, and sales of perovskite solar cells
- Capital: ¥0.1 billion
- Investment Ratio: Sekisui Chemical Co., Ltd. 86%, Development Bank of Japan Inc. 14%
- Date of Establishment: January 6, 2025

Overview of Capital Investment

- Purpose: To build a perovskite solar cell production line
- Investment Amount: ¥90 billion (Building purchase and construction of a 100MW production facility)
- Investment Period: January 2025 to March 2027 (Operating timing: April 2027)
- Production Capacity: 100MW

Content of adopted GX Supply Chain Construction Support Project

- Products: Film-type perovskite solar cell finished products
- Subsidies: Building, etc. acquisition costs, facilities costs, system purchase costs
- Subsidy Rate: ½
- Subsidized expenses: 2 billion doller
- Total amount of subsidies: 1 billion doller
- Subsidy Period: November 2024 to the end of February 2029
- Production Capacity: 1GW-level

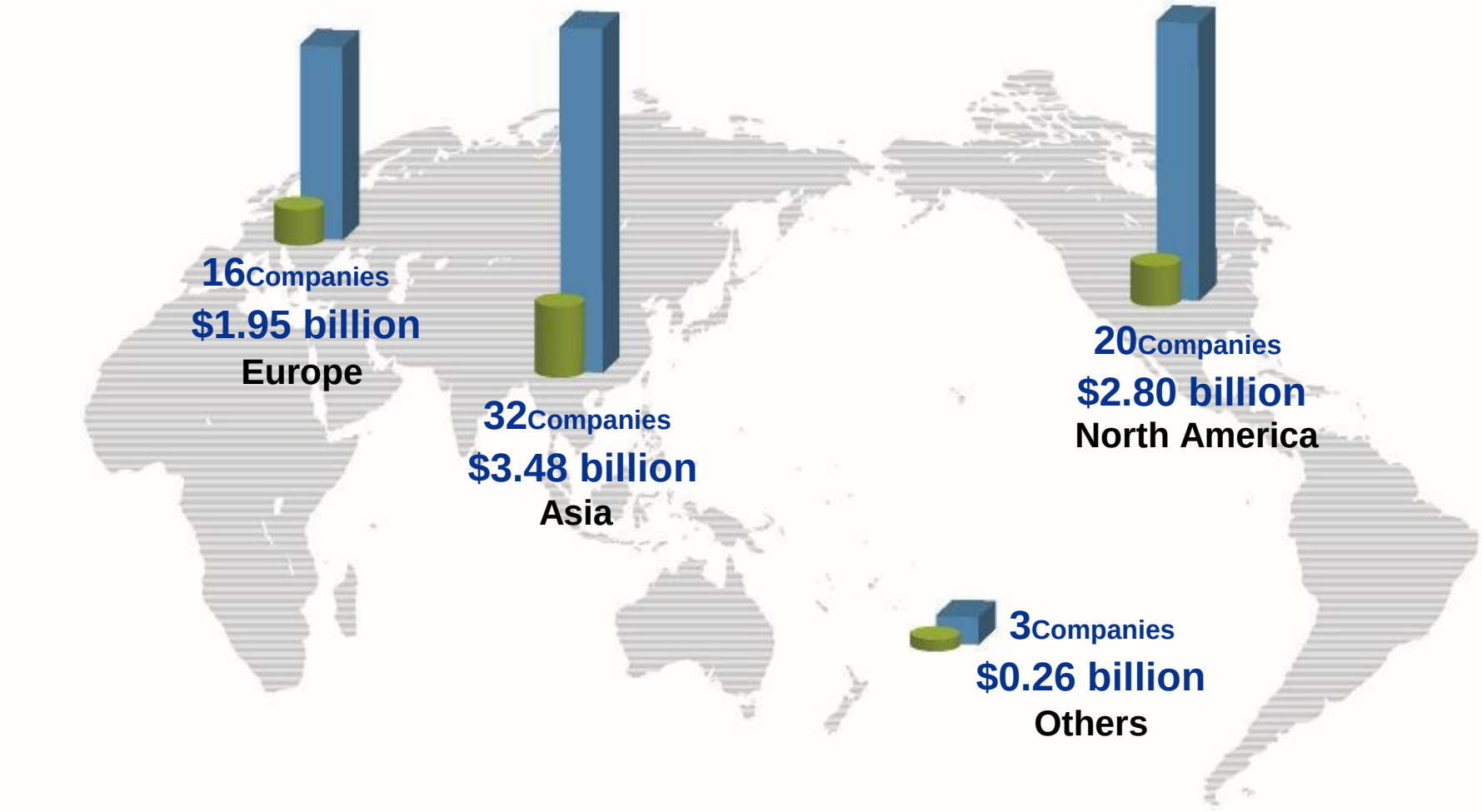
The company introduction

Name	**SEKISUI CHEMICAL CO., LTD.**
Paid-up Capital	¥100,002 million
Net Sales	¥ 1,242,500 million ≒ $ 8.5 billion (for the term ending March 2023; on a consolidated basis)
Ordinary Income	¥104,200 million ≒ $ 630 million (for the term ending March 2023; on a consolidated basis)
Number of Employees	26,838 (for the term ending March 2023)
Location of Headquarters	Osaka Head Office 2-4-4 Nishitemma, Kita-ku, Osaka 530-8565 Japan Tel: +81-6-6365-4110
Location of Headquarters	Tokyo Head Office 2-10-4 Toranomon, Minato-ku, Tokyo 105-8566 Japan Tel: +81-3-6748-6460
Establishment	March 3, 1947
President	Keita KATO
URL	http://www.sekisuichemical.com

Osaka Head Office

Tokyo Head Office

Global expansion



International Sales
Number of affiliated companies

- Total international companies: 71
- Net Sales: $8.5 billion (International Sales ratio:30%)

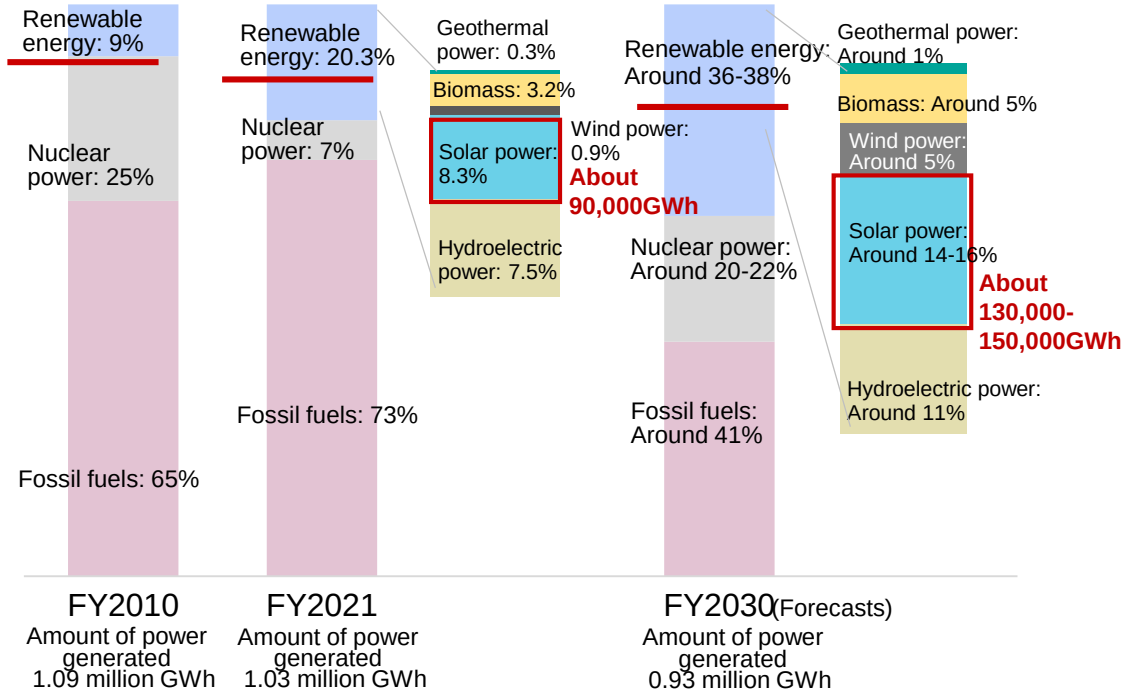
※The term ended March 2023 / International Sales : Consolidated basis
Number of affiliated companies : Includes non-consolidated subsidiaries

Appendix

The Government's Efforts to Expand Renewable Energy

- Solar power generation in FY2030 is expected to be 1.5 to 1.7 times higher than in FY2021
- Japan's Ministry of Economy, Trade and Industry announced details of the government's target to build a 20GW perovskite solar cell supply system (equivalent to 20 nuclear power plants) by FY2040 (November 2024)

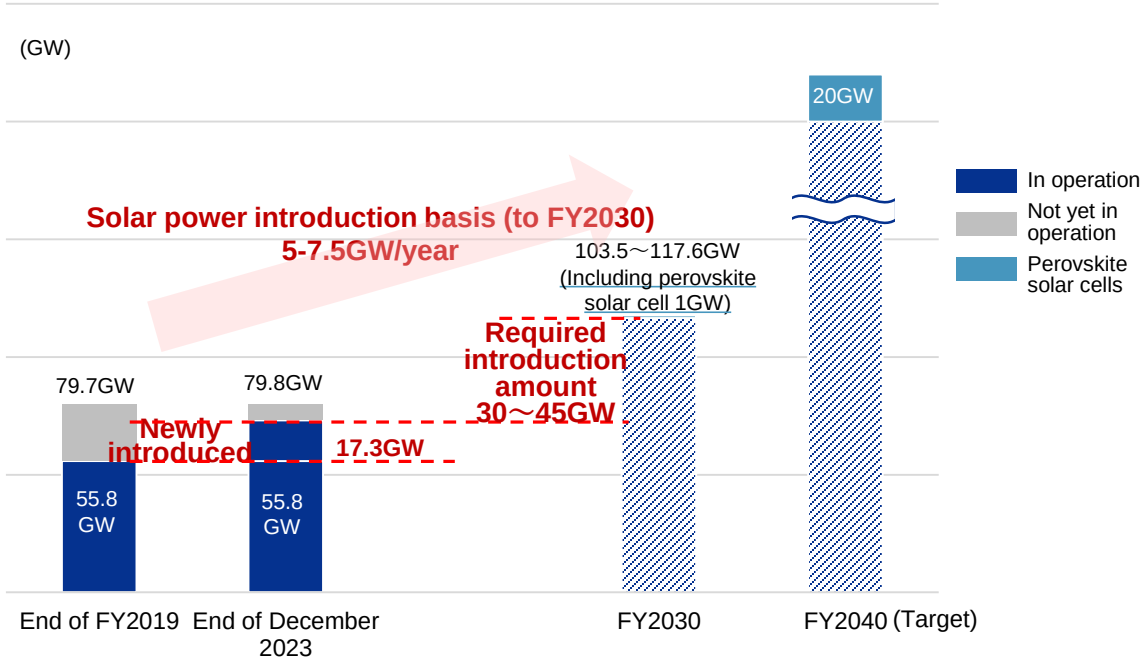
<Domestic Power Supply Market Composition Trends and Targets for FY2030>



- As far as the energy mix in FY2030 is concerned, the ratio of renewable energy is set at 36-38%. To achieve this, there is a critical need to further expand the introduction of renewable energy

<Reference>
W (Watt): Standard measure of electrical power
Wh (Watt-hour): Unit for the amount of electric power generated
Amount of electric power: = Electric power (W) x Time (h)
Unit conversion: ● 1kW=1,000W ● 1MW=1,000kW ● 1GW=1,000MW

<Status and Targets for the Introduction of Solar Power Generation>



- Currently, around 5GW/year; need to introduce 30-45GW over the next 6 years to achieve the 2030 target (103.5-117.6GW)
  (Need to continuously introduce at a rate of 5-7.5GW/year)

Source: "Future Energy Policy" issued by the Agency for Natural Resources and Energy on June 28, 2023
Prepared by the Company based on "Policy Trends in Solar Power Generation," issued on May 29, 2024