

19 Dec. 2024

LCS-R Net 15th Annual Meeting

“How can we accelerate action to stay below 1.5 degrees C?”

Agrivoltaics in Japan: **As a tool for sustainable land use and agricultural production**

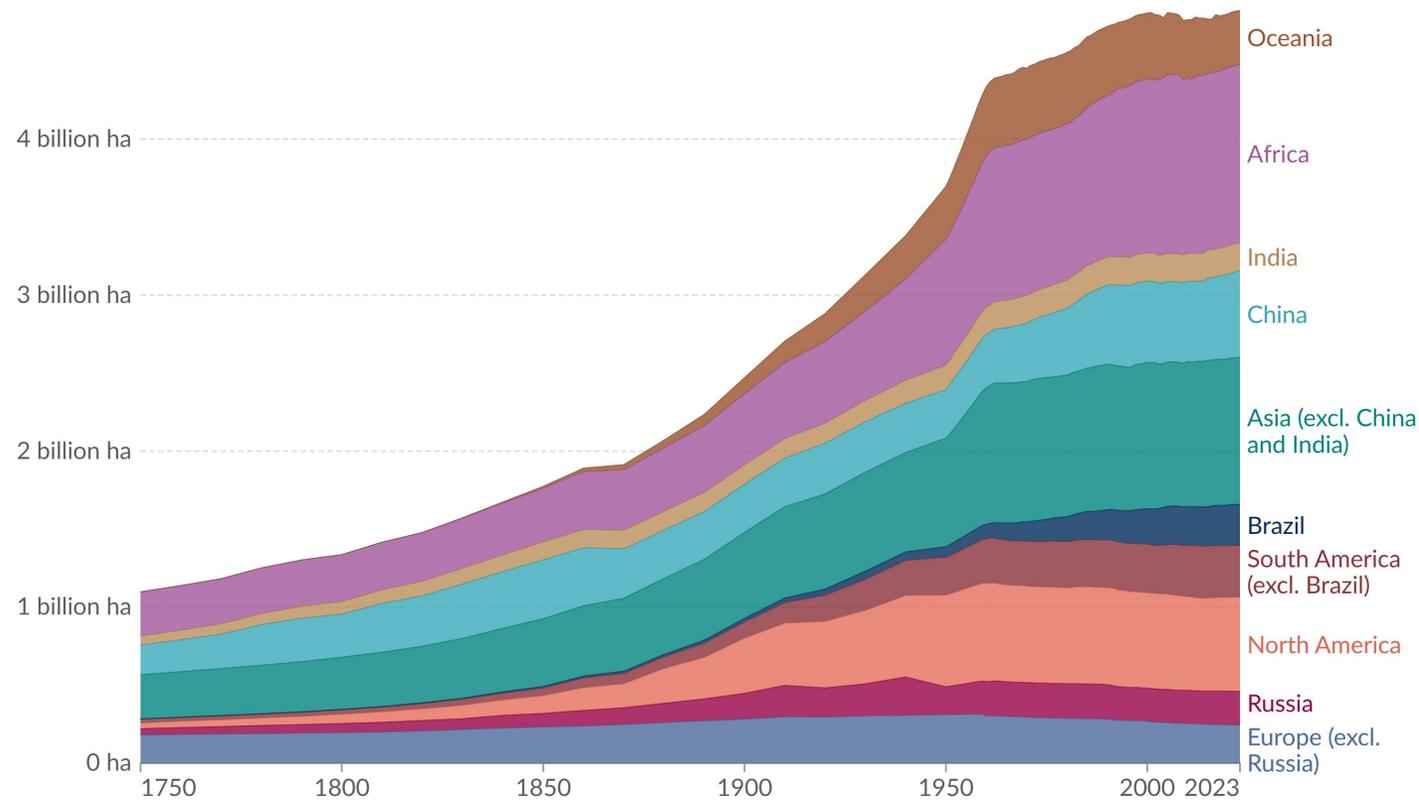
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Research Manager, Kansai Research Center

Rural areas in Japan has been facing the issue of “underutilization of land”

Agricultural area over the long-term, 1750 to 2023

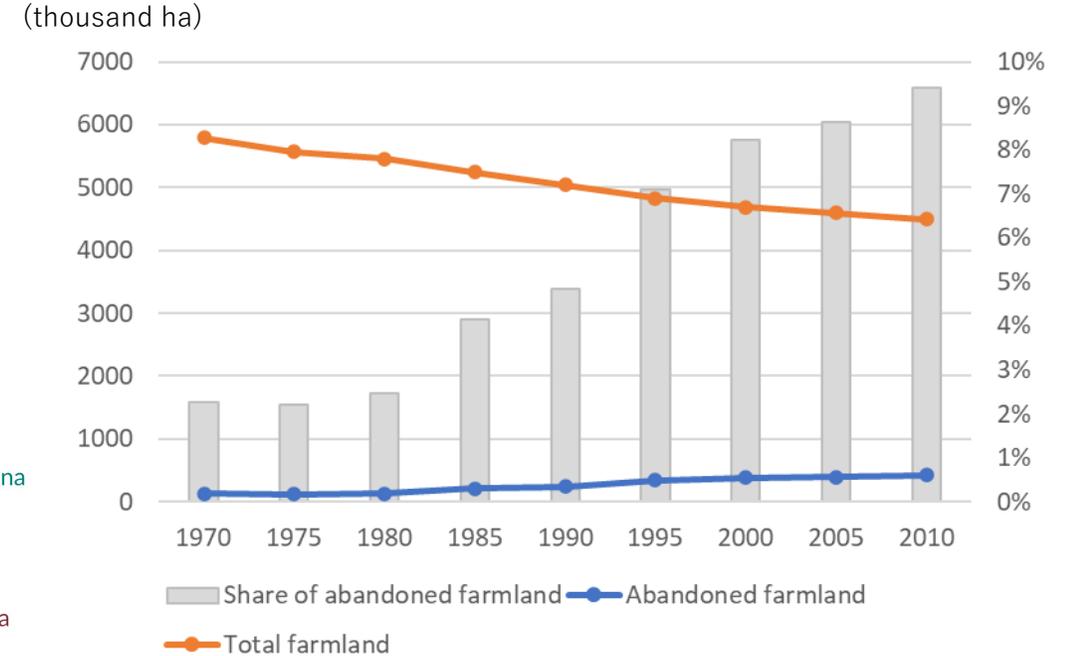
Total areal land use for agriculture, measured as the combination of land for arable farming (cropland) and grazing in hectares.



Data source: HYDE (2023)

OurWorldinData.org/land-use | CC BY

Abandoned farmland area and its share in Japan

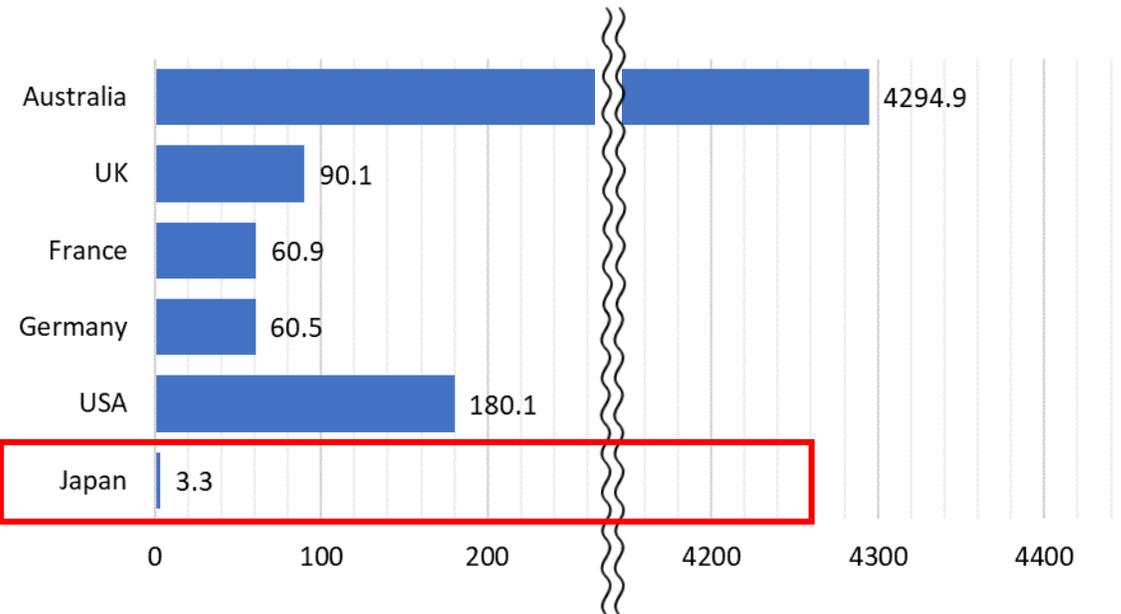


(Source: Ministry of Agriculture, Forestry, and Fisheries, 2016)



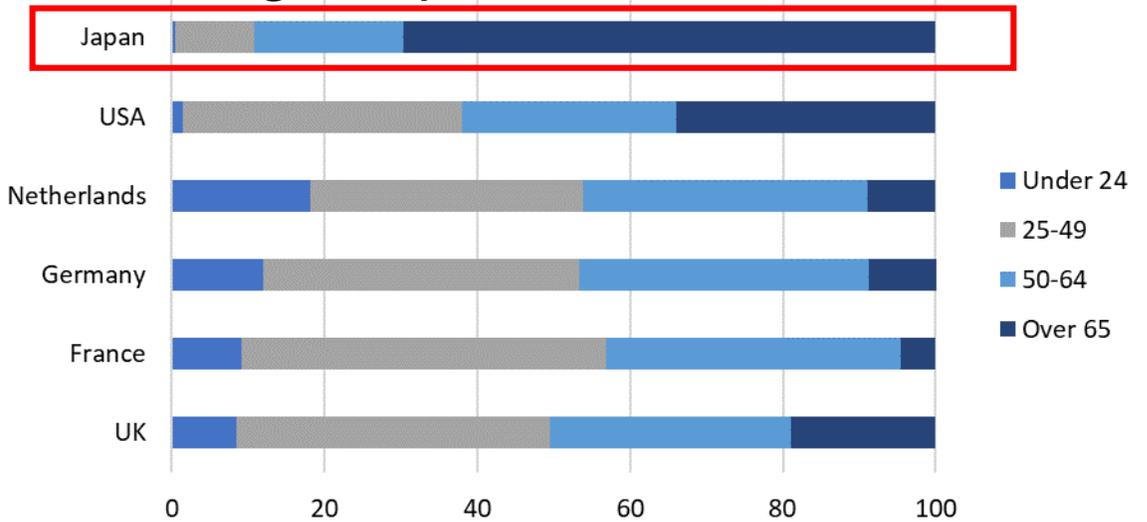
(Source: <https://www.patternz.jp/satoyama-japanese-mindscape-nature/>)

Area of Cultivated Land per Management Entities (ha)



(Source: Ministry of Agriculture, Forestry, and Fisheries, 2023)

Age Composition of Farmers (%)



(Source: Ministry of Agriculture, Forestry, and Fisheries, 2023)

“Solar sharing” was the concept initially invented by Akira Nagashima

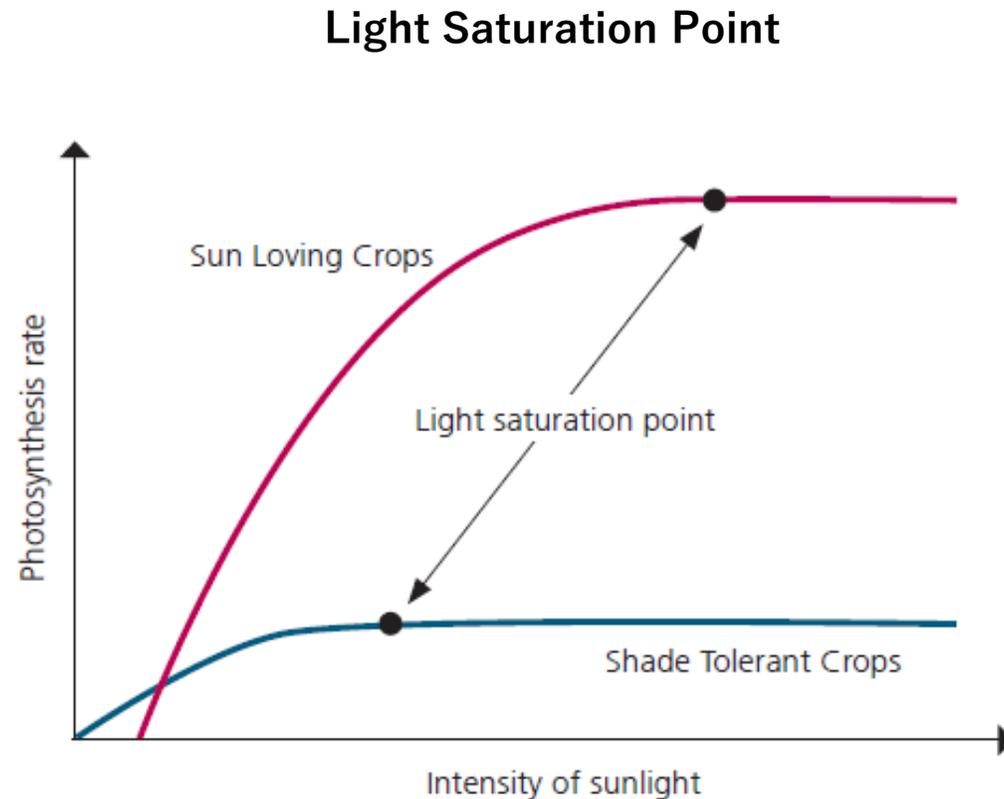


Fig. 35: Graph of the rate of photosynthesis against intensity of sunlight for sun loving and shade tolerant crops^[24]

© ASPS, modified by Fraunhofer ISE

(Source: Fraunhofer Institute for Solar Energy Systems ISE, 2024)



(Source: Japan Solar Sharing Federation)

Case in Sosa city: Revived abandoned farmlands



Farms are cultivated by a newly established company, including new young farmers



(Source: Citizen Energy Chiba Co., Ltd.)

Case of the Farmdo Group: highly productive protected horticulture

Protected horticulture with solar (rural area, >40 facilities)



Residence for weekend farmers (rural area)



Direct marketing (metropolitan area)



Farmdo group
Farmdo Holdings Co., Ltd.

Multiple potential benefits of agrivoltaics for farmers

Reduced plant drought stress

(Barron-Gafford, G. A., et al, 2019)

Reduced PV panel heat stress

(Barron-Gafford, G. A., et al, 2019)

Reduced water use

(Barron-Gafford, G. A., et al, 2019; Fraunhofer ISE, 2024)

Decreased frost damage

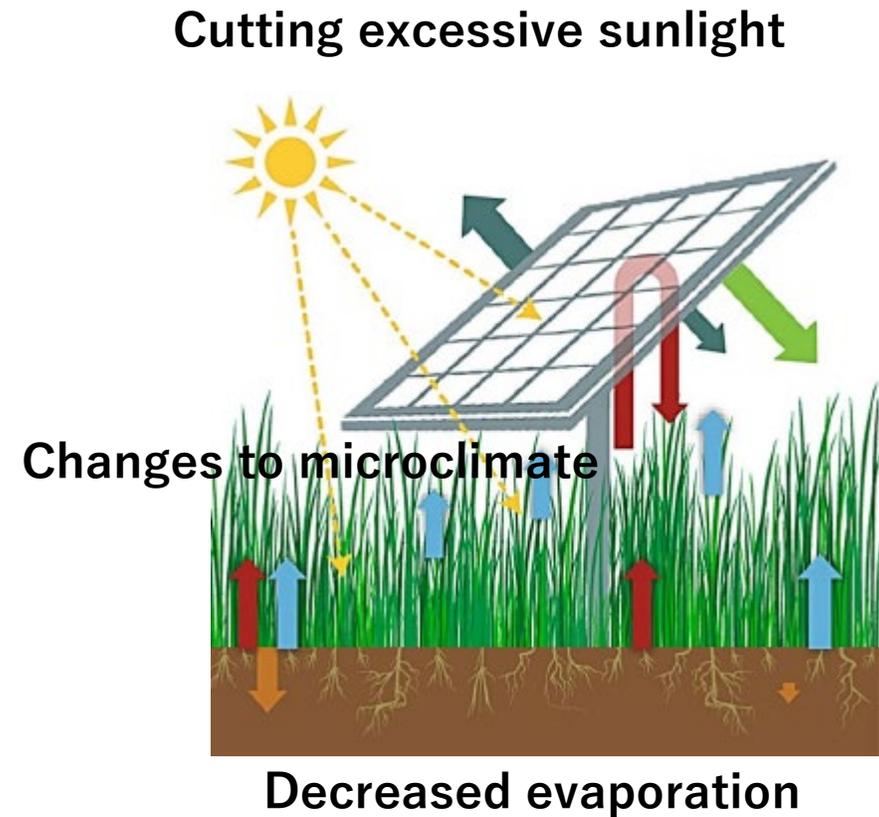
(Shizuoka prefecture, 2020)

Decreased high temperature injury

(Tani, 2020)

Decreased farmers' heatstroke and cancer

(Ravi, et al., 2016)

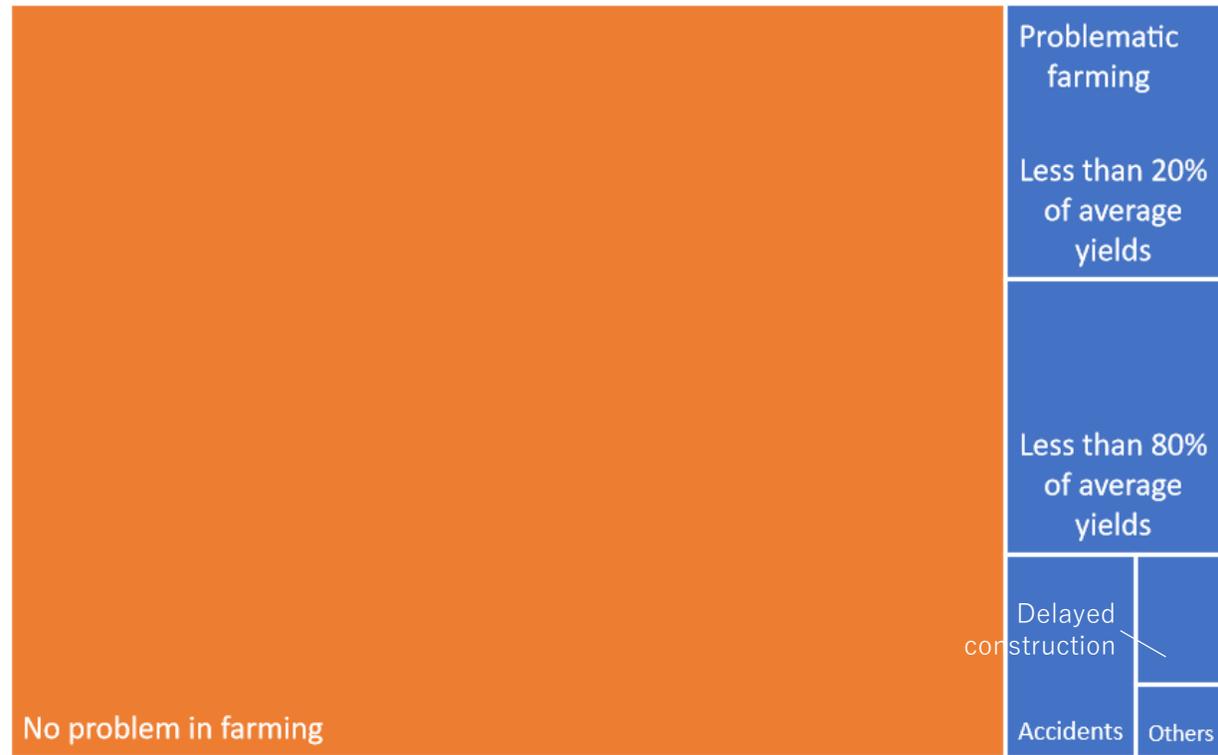


(Source: Adapted from Barron-Gafford, G.A., Pavao-Zuckerman, M.A., Minor, R.L. et al. Agrivoltaics provide mutual benefits across the food–energy–water nexus in drylands. Nat Sustain 2, 848–855 (2019). <https://doi.org/10.1038/s41893-019-0364-5>)

Share of problems in farming under agrivoltaics (based on the number of facilities)

Total number of permitted projects: 2,535 (as of March 2021)

■ Problematic farming ■ No problem in farming



Securing appropriate farming is a legal requirement to use farmland for agrivoltaics pillars (no less than 80% of average yield is required)

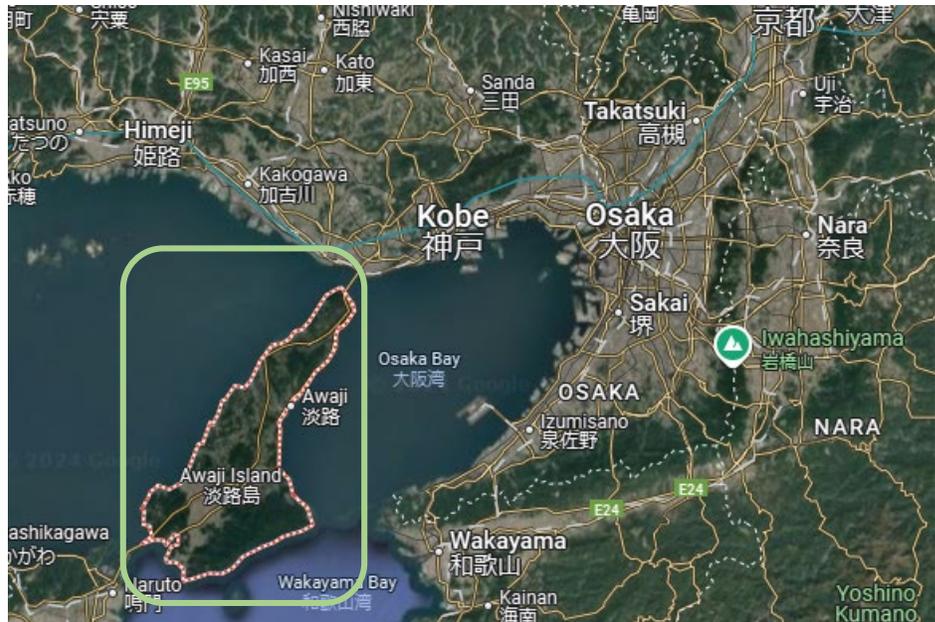
(Source: Ministry of Agriculture, Forestry, and Fisheries, 2021)

Share of cultivated crop under agrivoltaics (based on the number of farms)



(Source: Japanese Taste)

(Source: Ministry of Agriculture, Forestry, and Fisheries, 2024)



Awaji Environment Future Island Initiative (2010)

Goals:

- **Energy sustainability:** carbon neutrality, energy independency
- **Food and agriculture sustainability:** halve the abandoned farmland, double the new farmers
- Life sustainability: double the happiness index, maintain population

“Kleingarten” (allotment garden with residence)



(Source: Awaji Environment Future Island Initiative)



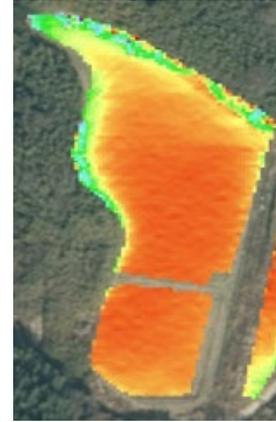
(Source: Awaji city)



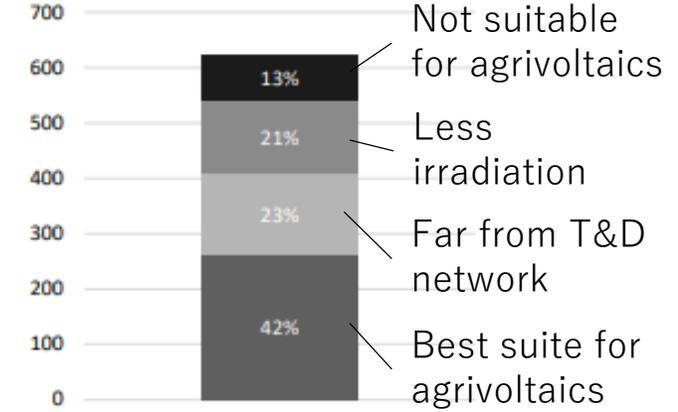
Identifying abandoned farmlands from satellite data



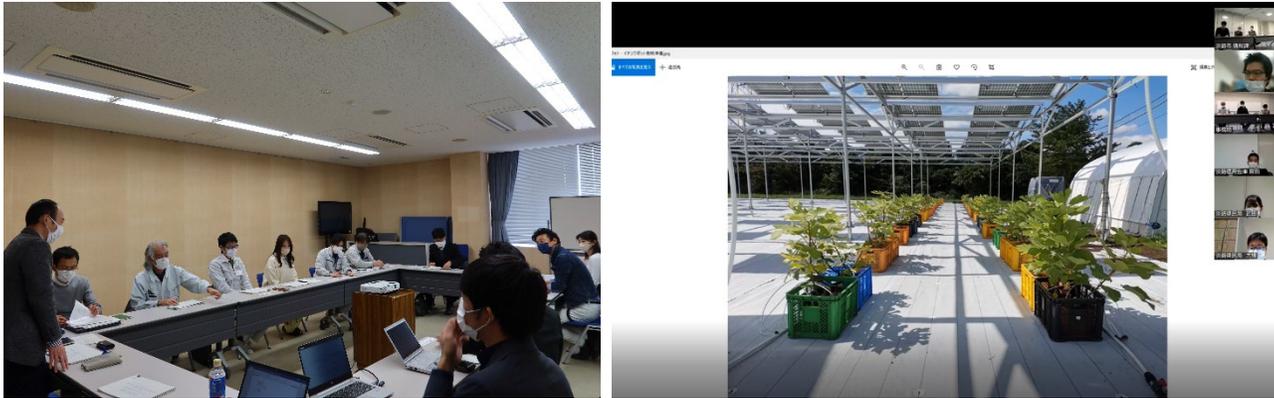
Assess solar irradiation



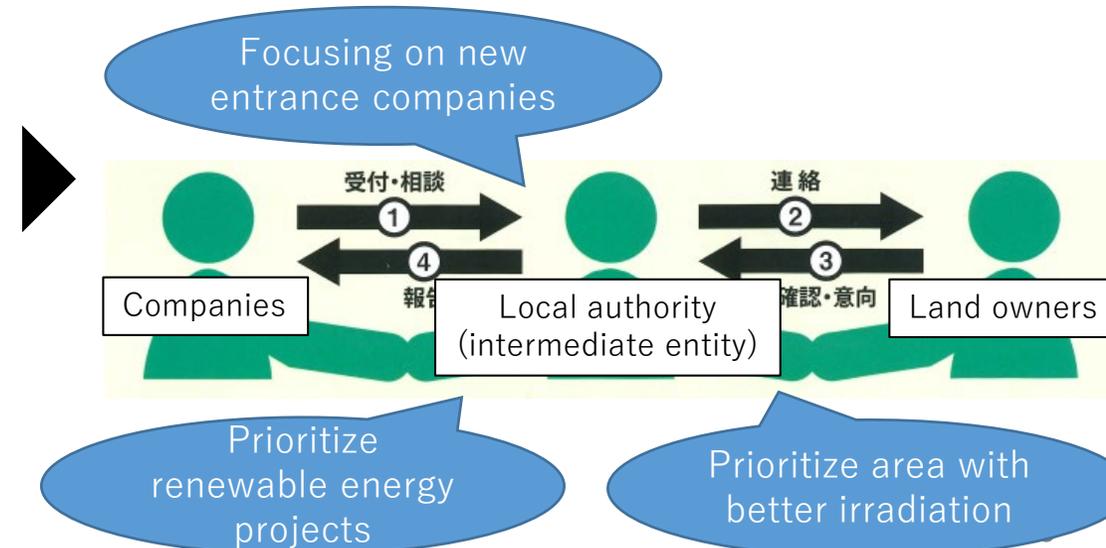
Screening and categorizing



Showcasing some potential business models and stakeholder engagement

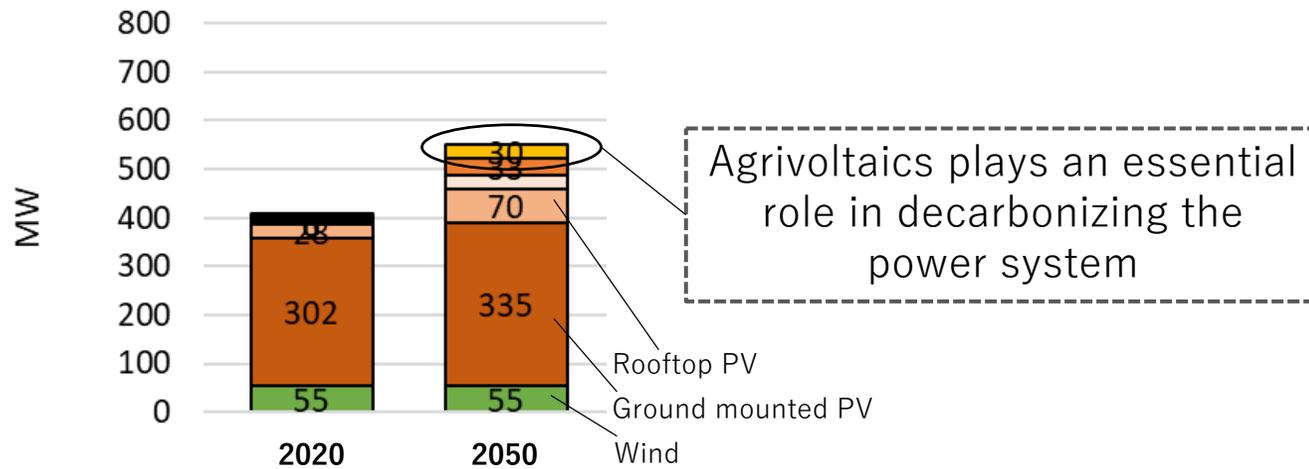


Policy suggestions

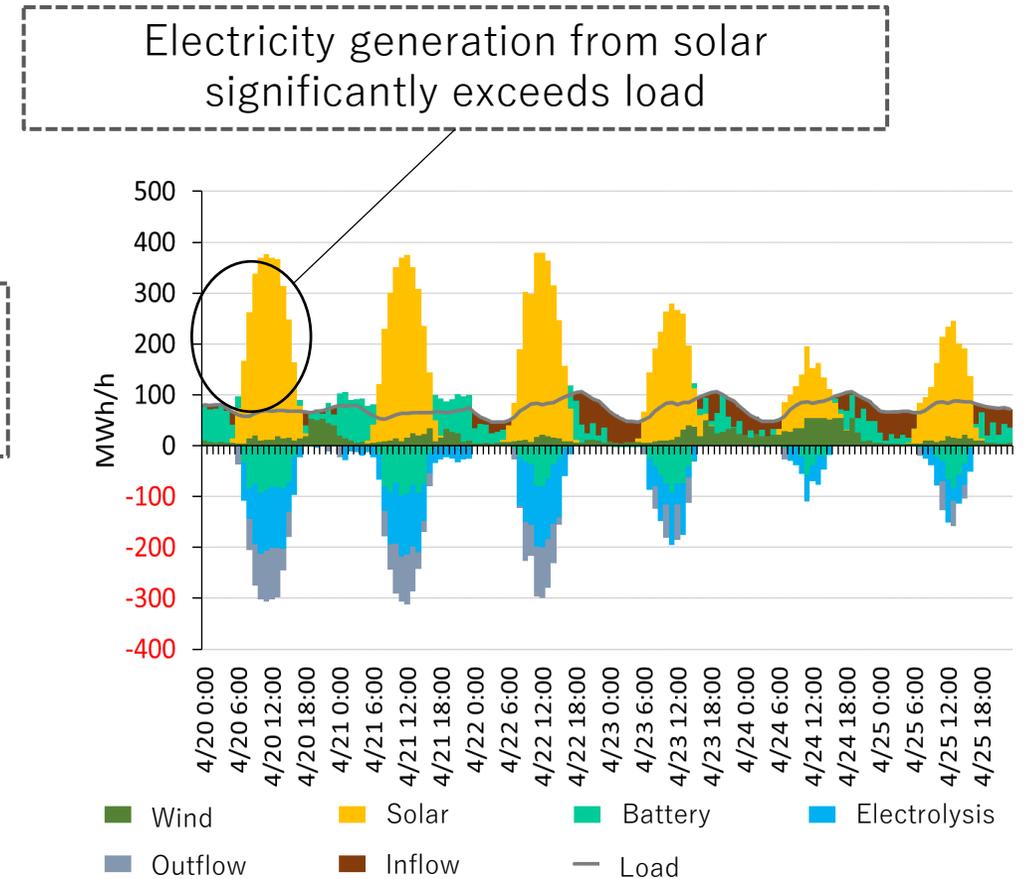


Scenario analysis to achieve carbon neutrality by 2050

Electricity generation capacity

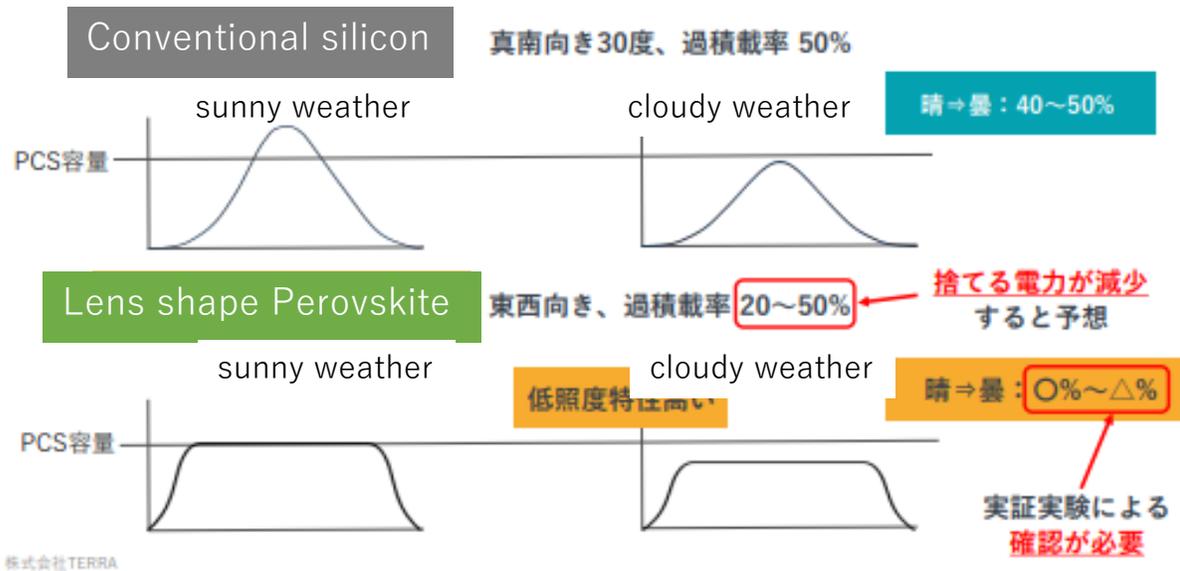


Power system simulation of Awaji island in 2050



A demonstration project as the next step

- Impact of agrivoltaics on crop yields
 - +
 - Verifying the benefits and risks of using perovskite cells
 - ✓ More flat electricity output due to lens shape
 - ✓ Better performance in low light intensity
 - ✓ Less need for support structure and pillars thanks to its reduced weight
- ⇒ Potential solution to Awaji Island



(Source: TERRA Co., Ltd.)



(Source: TERRA Co., Ltd., Sekisui Chemical Co., Ltd.)