Summary

Entrusted Study and Examination Work Concerning the Introduction Situation of PV Power Generation Systems, etc. through AI Analysis, etc. in FY 2021

The Ministry of the Environment (MoE) has been continually implementing the "Study on the Introduction Potential of Renewable Energies" and the "Development of Basic Zoning Information Concerning Renewable Energies" since FY 2009 as part of its efforts to consolidate an information base on the potential of all kinds of renewable energies, such as PV power, wind power, small and medium-scale hydropower, geothermal heat, solar heat and underground heat. While converting such information on the potential of renewable energies into cartographic information, the MoE disclosed the Renewable Energy Potential System (REPOS) superimposing various types of relevant data for easy understanding in June, 2020.

 Following the declaration of carbon neutral in October, 2020, the Government of Japan declared on 22nd April, 2021 the ambitious target of reducing the emission of GHG by 46% by FY 2030 from the FY 2013 level in line with the FY 2050 target while continuing its challenge of achieving 50% or more.

To achieve this FY 2030 target, it is essential to maximise the introduction of PV power generation systems (PV systems) of which the lead time for introduction is relatively short. One effective way of accelerating PV systems becoming the main force of renewable energy is for public organizations themselves to make the maximum efforts to introduce such systems. For this reason, the Regional Decarbonisation Roadmap compiled by the Council for National and Local Decarbonisation lists targets for the introduction of PV systems for central and local government buildings and land.

In the light of these targets, this Entrusted Work aims at continually studying the actual and potential introduction situation of PV systems at public facilities by means of (i) establishing the actual introduction performance of PV systems at public facilities and (ii) conducting a comparative analysis by overlaying the information on actual introduction to information on the renewable energy potential.

1．Preparation of Aerial Images, etc. Required to Establish the Introduction Situation of PV Systems

Having examined the specification of aerial images and satellite images suitable for AI analysis, the advantages and disadvantages of candidate aerial images and satellite images

for purchase were sorted and a comparative evaluation of these images was conducted. Those aerial images and satellite images which were given a high evaluation score were purchased and such data was arranged for AI analysis.

To establish the introduction situation and introduction potential of PV systems, the results of aerial photogrammetry, including the latest high resolution aerial images possessed by local public bodies, constitute important basic data. Because of this, the actual situation concerning the surveying results possessed by local public bodies was examined along with whether or not there is a way to gather the aerial images possessed by local public bodies in a sustainable as well as efficient manner.

2. Survey on Nationwide Introduction of PV Systems Installed at Buildings, etc. (AI Analysis)

AI analysis was conducted using aerial images and satellite images which had been arranged for AI analysis as described in 1. above (Fig.-1). The recall ratio was then checked to verify the effectiveness of the AI analysis results. A new analysis model was formed based on the verification results to make the AI relearn to improve the recall ratio (Fig.-2).
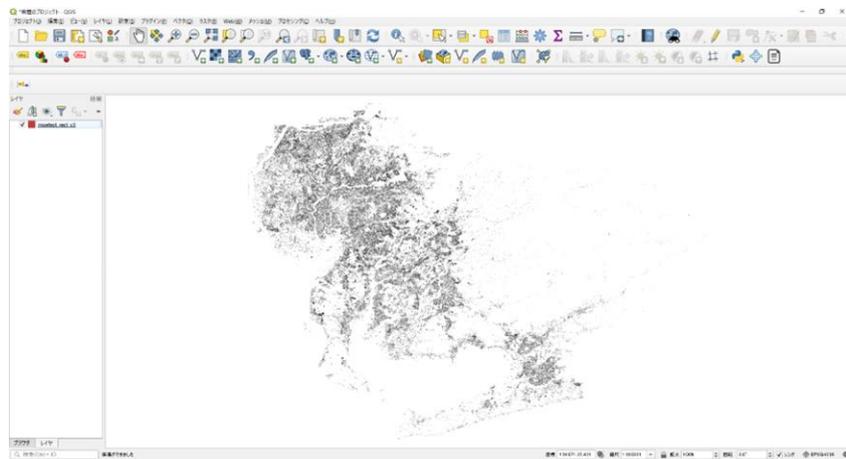

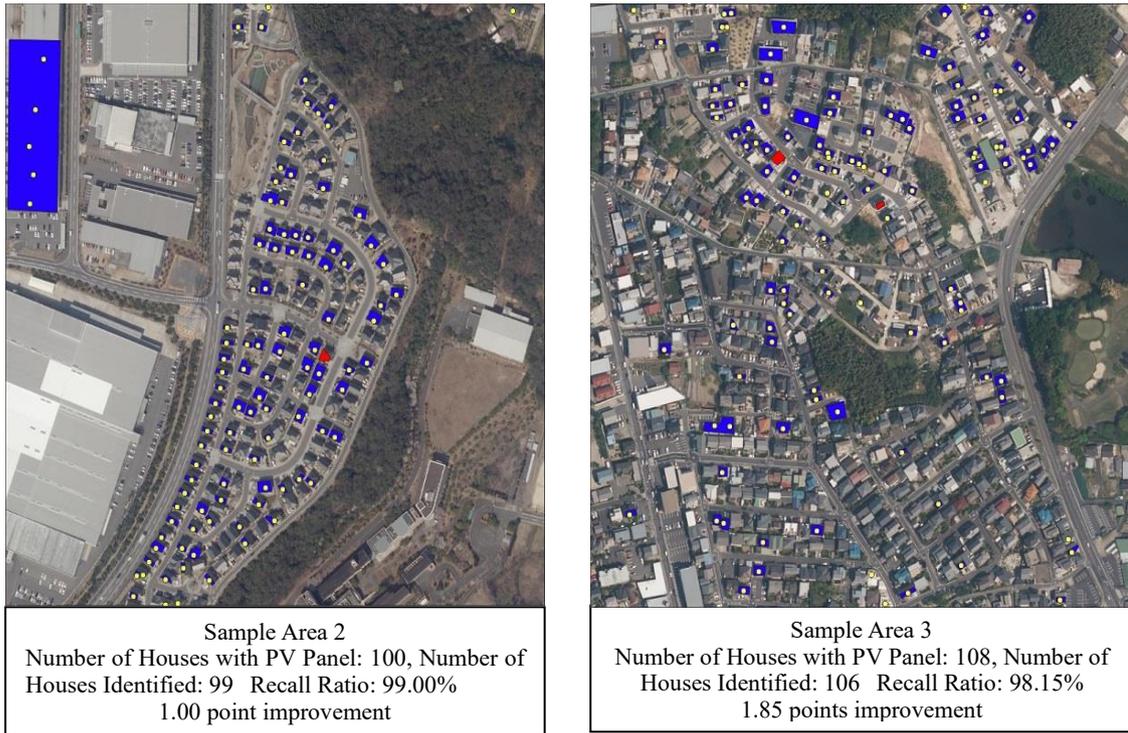Fig.-1　Visualization of PV Detection Results (Aichi Prefecture)

Sample Area 2
Number of Houses with PV Panel: 100, Number of
Houses Identified: 99   Recall Ratio: 99.00%
1.00 point improvement

Sample Area 3
Number of Houses with PV Panel: 108, Number of
Houses Identified: 106   Recall Ratio: 98.15%
1.85 points improvement

Fig.-2   AI Analysis Results and Verification Results of Improved Recall Ratio

3. Establishment of Nationwide Location Information on Public Facilities

Following examination of the base data specifications pertaining to the acquisition of location information on public facilities and comparative evaluation of the candidate base data, appropriate base data was procured. This base data was then tied to the building polygon and annotation points for buildings, etc. to establish suitable data.

Table-1 Building Polygon Extraction Results for Public Facilities/Buildings

Types of Annotation Points Such for Buildings, etc.			Type of Building by Building Polygon Data
Primary Category	Secondary Category	Type	
Transport-related Facility	Road-related	Michi-no-Eki	Entertainment/ Commercial Facility
Government Building	—	—	Government Building
School/ Hospital	School	—	School
	Hospital	—	Hospital
Entertainment/ Commercial Facility	—	(Excluding those listed below)	Entertainment/ Commercial Facility
		Market	Market
		Petrol Station	Petrol Station
		Public Bath	Other Building
		Rent-a-car	Other Building
Factory/ Bank/ Building	—	(Excluding those listed	Other Building

		below)	
		Factory	Factory
		Warehouse	Warehouse
Accommodation Facility	Accommodation Facility	—	Accommodation Facility
	Multiple-dwelling Complex	—	Multiple-dwelling Complex

4. Study on the Installed Capacity and Installation Potential of PV Systems at Public Facilities

The results of the exercises in 2. And 3. above were overlaid on GIS to extract public facilities with a PV system and those without a PV system. A PV system installation coefficient by category of public facility was established based on the panel area of each public facility which was interpreted using aerial images and AI analysis conducted for some geographical areas. Using this coefficient, the installed capacity at public facilities with a PV system was established and the installation potential of a PV system at public facilities without such a system was estimated.
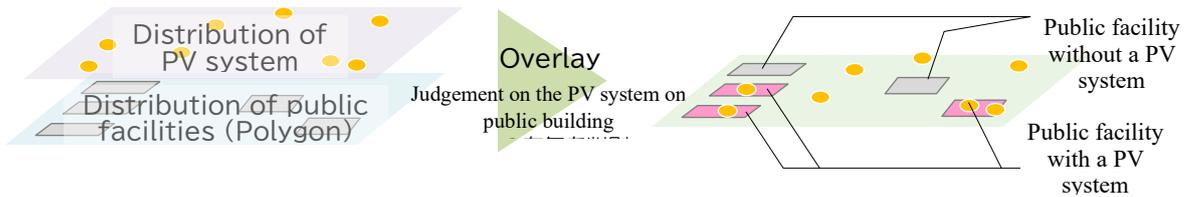

Fig.-3   Discrimination Image on the Situation of PV System Introduction
by Overlaying Distribution of PV systems and Public Facilities

Table-2   Estimation Results of Installed Capacity of Existing
PV Systems by Attribute Data (Excerpt)

Category of Public Facility			Number	Floor Area (m²)	Installed Capacity of Existing PV System(kW)
Primary Category	Secondary Category	Type			
Transport-related Facility	Road-related	Michi-no-Eki	134	157,656	1,574.1
Government Building	Prefectural, Municipal or Village Government Office	Prefectural Government Office	45	225,933	1,360.4
		City Office	374	964,672	5,808.6
		Ward Office	77	209,764	1,263.0
		Town/Village Office	245	408,032	2,456.9
		City/Town/Village Branch Office	477	718,589	4,326.8
		Offices of 23 Tokyo Wards	7	25,537	153.8
	Public Office, etc.	Public Office	674	1,122,758	14,201.6
		Courthouse	52	96,633	1,222.3
		Prison	103	540,336	6,834.6
		Health Centre	72	126,887	1,605.0
		Police Station	175	260,844	3,299.4
		Fire Station	424	410,328	5,190.2
		Tax Office	30	30,948	391.5
		Post Office	535	769,247	9,730.1
		Forest Station	4	1,277	16.2
		Police Box	276	393,863	4,981.9
	Other Public Facility	Community Centre	1,861	1,111,994	10,503.0
		Imperial Facility	2	8,308	78.5
		Other Public Facility	5,123	8,470,698	80,007.6
(Government Buildings: Sub-Total)			10,556	15,896,649	153,431.2

5. Examination for Advancement of the Establishment of the Installation Potential of PV Systems

A study was conducted on the precedent of a solar light mapping system which contributes to the accelerated installation of PV systems. This was followed by examination of (i) the requirements (functional requirements) for a solar light mapping system, assuming the need for PV power generation in the coming years, and (ii) the data, etc. required for the actual adoption of such functions.