| 東アジアバイオマスリサーチセンター | |
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| 題目 | 地域主導型スマートコミュニティの構築の海外展開に関する研究 |
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## 1. Background

Waste separation is key to energy and material recovery. The understanding of this concept is particularly important for the situation in the emerging countries in Southeast Asia where municipal waste collection is low and landfilling is still the main practice. For example, Indonesia's collection rate is only around 63.3% (BRIN, 2024) The largest portion of the collected waste is also still landfilled (UNEP, 2024) due to the lack of infrastructure for waste reduction, recycling, and energy recovery.

Meanwhile, the Southeast Asian region is also facing scarcity of fuel especially for the transportation sector. The oil stock is depleting and the international pressure for coal plants to retire early (IEA, 2024). Looking at these two challenges. Our study explores the potential of developing appropriate technologies and approaches that can help bridge them through energy recovery from waste as clean fuel to power mobility.

Considering the recent accelerated pace of smart technology development such as Artificial Intelligence (AI), deep learning, data analytics, sensors, and robotics, we also explored how smart technologies can assist in addressing the sustainability issues in waste management and transportation sectors.

## 2. Research results in academic year 2024

(1) Survey-based research on municipal waste separation

In this study, we distributed a questionnaire in Indonesia containing questions regarding people's waste separation behavior (Fig. 1), their awareness of Bank Sampah, which is community-initiated waste separation and recycling centers, and about their participation rate. We found that people who separated their waste to be driven by environmental awareness and financial incentives while those who do not separate found it troublesome to separate waste. Our findings highlight the importance of education to build the habit of separating waste as civic norms. Most respondents expressed positive perception about the possibility of automated waste pick up and waste separation technologies.

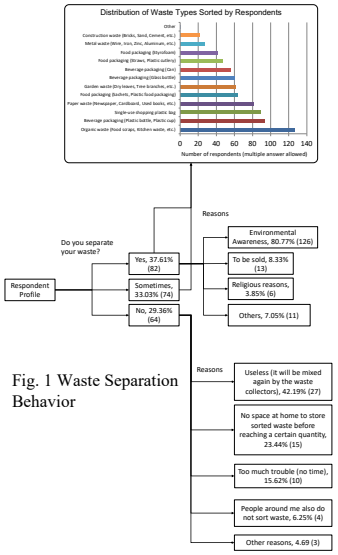


Fig. 1 Waste Separation Behavior

(2) Readiness level of waste separation technologies

To clarify the readiness level of waste separation technologies, we collected data globally from open sources (company websites, government websites, and research papers) and analyzed them with the Japanese Technology Readiness Assessment (J-TRA) methodology. We managed to collect 140 cases using English, Chinese, Japanese, and Indonesian languages. We found that mixed municipal waste is the most popular waste type application, but the readiness level is lower than pre-sorted waste such as plastic waste and glass waste.

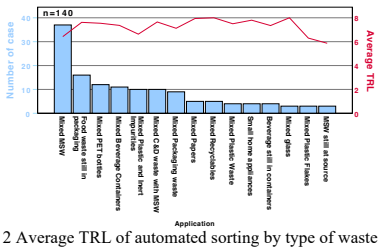


Fig. 2 Average TRL of automated sorting by type of waste

(3) Survey-based research on public transportation in Jakarta smart city

The Jakarta metropolitan area (JMA) has been trying to adopt various smart technologies and systems to create a more seamless public transportation in the city. We conducted both questionnaire survey to 1000 people and interviews to regular commuters of Jakarta public transport to understand about their satisfaction level and identify rooms for improvements for the current system. We found that there is a higher satisfaction level on those means of transport that runs on rails and special lanes. The lower satisfaction level on regular lanes is due to the higher exposure to traffic-jams. Furthermore, people need to rely on on-demand transport such as *grab*, taxi, and *gojek*, at a significantly higher price since the connectivity between means of transport is still poor. However, smart payments such as digital wallets and prepaid cards are widely used with ease.

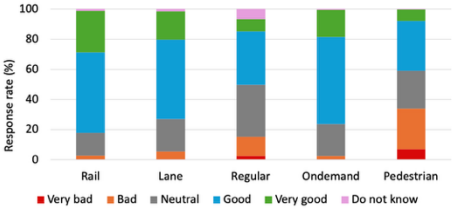


Fig. 3 Likert-scale results of satisfaction level of various public transportation in JMA

## 3. Next year's research plan

In the next academic year, we will advance research on sustainable energy recovery technologies, focusing on biorefineries using wet organic waste. Collaborating with partners in Indonesia, Thailand, and the Philippines, we will use spatial data to identify optimal sites for the biorefinery to produce various biomass fuel for mobility, and analyze socio-techno-economic factors influencing adoption in each country.

## 4. Research Publications

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[3] (Scopus) T. Cheng, A.H. Pandyaswargo, H. Onoda, "Environmental and Economic Assessment Toward the Utilization of CCUS Technology in Waste Incineration Facilities," in EcoDesign for Circular Value Creation: Volume II, pp. 373–393, 2025.

[4] C. Shan, A.H. Pandyaswargo, H. Onoda, "Readiness Status of Smart Waste Collection and Processing Technologies for Plastic Waste Recycling," in EcoDesign for Circular Value Creation: Volume I, pp. 393–406, 2025.

[5] (Scopus) A.H. Pandyaswargo, M.F.N. Maghfiroh, T.D. Sofianti, H. Onoda, "Factors Influencing Smart Technologies Social Acceptance: A Mini Review Study," in EcoDesign for Circular Value Creation: Volume I, pp. 195–212, 2025.

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[10] (Scopus) Y. Guo, A.H. Pandyaswargo, H. Zhang, H. Onoda, "Policy Assessment of Japan's 'Decarbonisation-Leading Regions'," IET Smart Cities, vol. 7, no. 1, e70002, 2025.

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[12] (Scopus) R. Zhao, A.H. Pandyaswargo, H. Onoda, "A bottom-up approach for greenhouse gas emission estimation at the community level: A case study in Japan," Energy, vol. 307, 132530, 2024.

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