ZHENGYANG ZHANG

Department of Environmental Studies for Advanced Society
Graduate School of Environmental Studies
Tohoku University, Sendai
468-1, Aoba, Aramaki, Aoba-ku, Sendai 980-8571, Japan
Phone: +81 (80) 8490-6595
Email: zhengyang.zhang.a8@tohoku.ac.jp
Researcher ID: 40875465
ORCID ID: https://orcid.org/0000-0002-5647-3515
Web: http://web.tohoku.ac.jp/matsubae.lab/en/index.html

EDUCATION

Ph.D. **Tohoku University**, Environmental Science March 2020
Dissertation: "Dynamic Material Flow Analysis of Metals Derived from End-of-Life Vehicles: Focusing on reuse"
Advisor: Prof. Kazuyo Matsubae
Graduated as an outstanding Ph.D. student

M.S. **Tohoku University**, International Politics and Economics March 2013
Thesis: "Characteristics and Issues of Vehicle Diffusion During the Period of High Economic Growth: A Case Study in Ordos, Inner Mongolia"
Advisor: Prof. Yu Jeongsoo

B.S. **University of Science and Technology Beijing** July 2010
Japanese Language and Literature

SELECTED RESEARCH EXPERIENCE

Assistant Professor, **Tohoku University**, Sendai, Japan April 2020-present
Environmental and Economics Lab

- Evaluated the impacts of innovative aluminium recycling technologies on global aluminium cycles by material flow analysis in collaboration with Prof. Tetsuya Nagasaka, Prof. Hongming Zhu, et al. at Tohoku University. (Publication in *Nature*, funded by the Promotion of Science (JSPS), etc.)
- Identified multi-regional land disturbances induced by the production of vehicles in Japan by using total material requirement in collaboration with Prof. Eiji Yamasue, Assoc. Prof. Shoki Kosai, et al. at Ritsumeikan University. (Publication in *Resources, Conservation and Recycling;* Funded by the JSPS, etc.)
- Studied the potential of applying vertical farming to supplement traditional agriculture in Kuwait on alleviating the food insecurity in collaboration with Dr. Meshal Abdullah from Kuwait Environment Public Authority. (Publication in *Sustainability* and another manuscript in preparation; Funded by the JSPS.)
- Studied the energy consumption, CO_2 emissions and benefits of reclamation in one coal mining site in Indonesia, using cost-benefit analysis in collaboration with a PhD student in my lab. (Publication in *Resources* and was funded by the Japanese Ministry of Education, Culture, Sports, Science, and Technology.)

- Received 6 grants from Japan as a principal investigator or co-investigator
- Collaborating with experts from top universities in Japan (The University of Tokyo, Ritsumeikan University, Kyoto University, Research Institute for Humanity and Nature, National Institute for Environmental Studies), and Tsinghua University and University of Science and Technology Beijing in China.

PhD Candidate, **Tohoku University**, Sendai, Japan April 2017-March 2020
Advisor: Prof. Kazuyo Matsubae

- Developed a dynamic material flow analysis model and indicators for analysing steel cycles and the effectiveness of recycling, reuse, and remanufacturing through vehicle engine's life cycles. (Publications in *Resource, Conservation and Recycling*, *Matériaux & Techniques*; Funded by the JSPS.)

TEACHING EXPERIENCE

Research advisor, **Tohoku University**, Sendai, Japan 2021-present
Environmental and Energy Economics laboratory

- Assisting in managing the laboratory contains 15 graduate students from diverse countries and backgrounds.
- Organizing seminars, weekly meetings, practices, and discussions with students.
- Providing one-on-one tutorials for conducting research, writing and reviewing proposals/papers, forming research plans, extracting information, using analysis tools, and fixing research difficulties.
- Evaluated by students for stimulating independent thinking, developing skills in writing and publishing research papers, and logically presenting research findings and thesis defenses.

Doctoral students under advising 2021-present

- Tomoya Sugiyama, "Supply chain risk analysis of mineral resources: Focusing on disaster risks at mining site"
- Binze Wang, "Quantifying global environmental impacts of aluminium recycling"
- Junbin Xiao, "Environmental impacts of copper mining"
- Chuan Zhao, "Analysis of local food demand and agriculture production in China"

Masters' students under advising 2022-present

- Takuro Inoue, "Industrial nitrogen and phosphorus flows in Japan",
- Soh Takemoto, "Life cycle assessment of tungsten hexafluoride (WF_6) gas in Japan's semiconductor industry", 2022-present

Guest lecturer, **Tsinghua University**, Beijing, China May 9, 2022
Course: Material Flow Analysis

- Developed and delivered one 90-minute online lecture on "The evolution of material flow analysis" to graduate students.

The 580th Environmental Academic Salon September 23, 2021

- Developed and delivered 90-minute online lecture on "Is Japan's high recycling rate good enough" to students and young professionals from diverse backgrounds.

Guest lecturer, University of Technology and Science Beijing September 27, 2021
Seminar on Resource Use and Climate Change

- Developed and delivered 90-minute lecture on "Carbon footprint: Concept and calculation method" with clicker questions.

Lecturer, **Tohoku Gakuin University**, Sendai, Japan 2021-2022
Course: Information Literacy Course

- Developed and delivered two weekly 90-minute lectures to 60 freshmen in Japanese for two semesters, covering contents of information ethics, internet security, information collection/analysis/transmission, economic statistical analysis, and group presentations.
- Developed course materials, group work, quizzes, and assignments.
- Graded weekly assignments, provided individual feedback, and awarded credits.
- Freshers gained knowledge and abilities to extract information, and use Microsoft office to analyse data, write reports, and make presentation materials.

Co-Lecturer, **Tohoku University**, Sendai, Japan Spring 2021
Course: Seminar on Environmental Studies

- Co-designed course topics: resource depletion, energy transition, climate change, water security, overpopulation, biodiversity reduction.
- Co-developed lecture contents, tests, and evaluation criteria.
- Coordinated grading with 2 lecturers.

Teaching assistant, **Tohoku University**, Sendai, Japan Fall 2018
Course: Chinese Language

- Assisted in preparing lecture materials and grading exams.
- Supported students with communication and writing.

INDUSTRY EXPERIENCE

SEINAN Cooperation, Hirosaki, Japan April 2013-March 2017
Department of Market Planning

- Assisted in improving existing recycling businesses and planning on new recycling projects, involving vehicles, scrap metals, waste electrical and electronic equipment, and other industrial wastes.
- Evaluated potential cost benefits of steel scrap recycling business in Mongolia.
- Led industry-academia collaboration in recycling.
- Obtained the national license for recycling small waste electrical and electronic equipment issued by the Ministry of the Environment Government of Japan.
- Launched a project on dismantling waste computers in 2 facilities for handicapped in Hirosaki-city.
- Designed an unmanned waste recycling station project that has been set up 6 stations in Japan.
- Promoted recycling of car interior plastics into car dashboards. Recycled dashboards have been adopted in new cars by a Japanese car manufacturer.

RESEARCH GRANTS

2023-2028 **Development of a nudge support system for smart food choices: Towards sustainable eating behavior design**
Principal Investigator: Prof. Eiji Yamasue,
Ritsumeikan University, Kyoto,
Japan National Agriculture and Food Research Organization, 862,227,000JPY
Role: Co-investigator.

2023-2026 **Integrated nitrogen management for reducing nitrogen waste**
Principal Investigator: Senior Researcher Dr. Kazuya Nishina,
National Institute for Environmental Studies, Japan, Tsukuba,
Japan Environmental Restoration and Conservation Agency (ERCA),
JPMEERF20235001, 68,693,000JPY
Role: Co-investigator.

2021-2025 **Accelerating the promotion of zero emission vehicles and abolition of gasoline vehicles: Comparative analysis of strategies in Japan, China, and Korea**
Principal Investigator: Assoc. Prof. Gregory Trencher,
Kyoto University, Kyoto,
Japan Society for the Promotion of Science, 16,770,000 JPY
Role: Co-investigator. My work on the material flow analysis of vehicle batteries and policy analysis of zero emission vehicle market and phase-out of gasoline vehicles in China. I wrote progress reports for Tohoku University.

2021-2024 **Technology development of refining aluminium alloy scrap to high-purity aluminum by solid-state electrolysis using molten salts**
Principal Investigator: Prof. Tetsuya Nagasaka
Tohoku University, Sendai,
New Energy and Industrial Technology Development Organization, Japan,
198,550,000 JPY
Role: Co-investigator. My work on an optimization analysis of aluminium supply-demand balance through the application of innovate aluminium recycling technology at regional and global level. I wrote progress reports and answered related queries.

2021-2024 **Dynamic material flow analysis of automotive lightweight materials and effects of remanufacturing strategy**
Principal Investigator: Assist. Prof. Zhengyang Zhang
Tohoku University, Sendai,
Japan Society for the Promotion of Science, 2,730,000 JPY

2021-2023 **Accurate assessment of the resource potential and urban metabolism mechanism of end-of-life vehicles in China and Japan**
Principal Investigators: Prof. Kazuyo Matsubae; Prof. Xianlai Zeng
Tohoku University, Sendai; Tsinghua University, Beijing,
FY2021 Tohoku University–Tsinghua University Joint Research Fund,
2,500,000 JPY

Role: Co-investigator. My work on the analysis of the latest development of Japan's vehicle recycling policies/ technologies and vehicle-derived resources circulation.

2021-2023 **Establishment of resource logistics analysis system for minimizing supply chain risks of mineral resources**
Principal Investigators: Prof. Kazuyo Matsubae
Tohoku University, Sendai,
Japan Science and Technology Agency, 45,500,000 JPY
Role: Co-investigator. My work on the mitigation of supply chain risks of food and mineral resources. I assisted in supervising the overall progress of the project and writing progress reports with other required materials.

2021-2028 **Towards Sustainable Nitrogen Use Connecting Human Society and Nature**
Principal Investigators: Prof. Kentaro Hayashi
National Agriculture and Food Research Organization, Tsukuba,
Research Institute for Humanity and Nature, 66,000,000 JPY
Role: Co-investigator. My work on the estimation of nitrogen utilization associated with the changes in materials and technologies used in vehicles.

AWARDS AND HONOURS

Best Poster Award, Tokyo Electron Limited 2024
Zhang, Z., Takemoto, S., Matsubae, K. Supply Chain Risks Analysis of Semiconductor Products. International Symposium on Digital Talent Development for a Sustainable Society. Sendai, Japan. February 1st, 2024.

Professional Director for Sustainable Environment, Tohoku University 2020
Only one awarded from all doctoral graduates in the graduate school. Awarded for the sense of internationalism, practical know-how, management capability, and the leadership and group-minded orientations in strategic planning in environmental science.

Certificate of Merit for University House Advisor, Tohoku University 2020
Awarded the active promotion of cross-cultural understanding, encouragement of resident interaction, and exemplary behaviour as a dormitory advisor.

Best Poster Award, The 1st Academic Forum on Environmental Studies 2019
Tohoku University
One of the three awarded from eighty submissions.

Best Student Oral Presentation, Sino-Japan Symposium for Industrial Ecology 2018
Xiamen, China

Award of Excellent Presentation 2018
The 13th International Conference on Waste Management and Technology, Beijing, China

Japanese Scholarship Award, Tatsunoko Foundation of Japan 2018
One of the nine awarded on a national basis.

PUBLICATIONS

Peer-reviewed publications

1. Zhao, C., Wang, Y., Lian, Z., Zhang, Z., Ma, S., & Matsubae, K. (2024). Agricultural plastic pollution in China: Sources, supply chain drivers, and mitigation strategies. *Sustainable Horizons*, 11. https://doi.org/10.1016/j.horiz.2024.100102
2. Zhao, C., **Zhang, Z. *,** & Matsubae, K. (2024). Adequacy and Distribution Equity of Nutrition Supplies across China. *Nutrients*, 16(3). https://doi.org/10.3390/nu16030426
3. Xu, Q, Wu, D., Hu, W., **Zhang, Z.,** Liu, X., Yang, F., & Wang, Z. (2023). Recycling NdFeB Magnets and Rare Earth Fluorescent Materials from Electronic Waste. *The Journal of The Minerals, Metals & Materials Society (TMS)*. https://doi.org/10.1007/s11837-023-06235-1
4. Li, Z., Zheng, Q., Nakajima, A., **Zhang, Z.**, Watanabe, M. (2023). Organic Acid-Based Hydrothermal Leaching of LiFePO4 Cathode Materials. *Advanced Sustainable Systems*,2300421. https://doi.org/10.1002/adsu.202300421
5. **Zhang, Z.**, Abdullah, M. J., Xu, G., Matsubae, K., & Zeng, X. (2023). Countries' vulnerability to food supply disruptions caused by the Russia-Ukraine war from a trade dependency perspective. *Scientific Reports, 13*(1), 16591. https://doi.org/10.1038/s41598-023-43883-4
6. Xiong, X., Zeng, X., **Zhang, Z.**, Pell, R., Matsubae, K., & Hu, Z. (2023). China's recycling potential of large-scale public transport vehicles and its implications. *Nature Communications Engineering*, *2*(1), 56. https://doi.org/10.1038/s44172-023-00106-y
7. Zhao, L., Wu, D., Hu, W., Li, J., **Zhang, Z.**, Yang, F., Wang, Z., & Ni, W. (2023). Coupling Mineralization and Product Characteristics of Steel Slag and Carbon Dioxide. *Minerals*, *13*(6), 795. https://doi.org/10.3390/min13060795 (Q3, IF: 2.818)
8. Wang, B.*, **Zhang, Z. *,** Zeng, X., & Matsubae, K. Hu, W. (2023). Material flow analysis of secondary aluminium: Focusing on electric vehicles in China. *Resources, Conservation and Recycling*, 191, 106877. https://doi.org/10.1016/j.resconrec.2023.106877 (IF: 13.716).
9. Lu, X., **Zhang, Z.,** Hiraki, T., Takeda, O., Zhu*, H., Matsubae, K., & Nagasaka, T.* (2022). A solid-state electrolysis process for upcycling aluminium scrap. *Nature*. https://doi.org/10.1038/s41586-022-04748-4 (IF: 69.504)
10. Kosai, S.*, Hanqing, L., **Zhang, Z.,** Matsubae, K., & Yamasue, E. (2022). Multi-regional land disturbances induced by mineral use in a product-based approach: A case study of gasoline, hybrid, battery electric and fuel cell vehicle production in Japan. *Resources, Conservation and Recycling*, 178, 106093. https://doi.org/10.1016/j.resconrec.2021.106093 (IF: 13.716)
11. **Zhang, Z.*,** Matsubae, K., & Nakajima, K. (2021). Impact of remanufacturing on the reduction of metal losses through the life cycles of vehicle engines. *Resources,*

Conservation and Recycling, 170, 105614. https://doi.org/10.1016/j.resconrec.2021.105614 (IF: 13.716)

12. Setiawan, I. E.*, **Zhang, Z.,** Corder, G., & Matsubae, K. (2021). Evaluation of Environmental and Economic Benefits of Land Reclamation in the Indonesian Coal Mining Industry. *Resources*, 10(6), 60. https://doi.org/10.3390/resources10060060

13. Hu, W.*, Tian, K., **Zhang, Z.,** Guo, J., Liu, X., Yu, H., & Wang, H. (2021). Flotation and Tailing Discarding of Copper Cobalt Sulfide Ores Based on the Process Mineralogy Characteristics. *Minerals*, 11(10), 1078. https://doi.org/10.3390/min11101078 (IF: 2.818)

14. **Zhang, Z.*,** Takeyama, K., Ohno, H., Matsubae, K., Nakajima, K., & Nagasaka, T. (2019). An estimation of the amount of dissipated alloy elements in special steel from automobile recycling. *Matériaux & Techniques*, 107(1), 105. https://doi.org/10.1051/mattech/2019007

Industry reports and others
(In Japanese)

15. **Zhang, Z.*** (2018). Report on the 12th society and materials international conference (SAM12). Journal of Life Cycle Assessment, Japan 14(3), 234-235. https://doi.org/10.3370/lca.14.234

16. **Zhang, Z.*,** Matsubae, K. (2018). Introduction to Matsubae laboratory in Tohoku University. Journal of Life Cycle Assessment, Japan 14(2), 186-187. https://doi.org/10.3370/lca.14.186

17. **Zhang, Z.** (2016). Documents for national license for recycling business plan for waste electrical and electronic equipment. *Ministry of the Environment Government of Japan.*

18. **Zhang, Z.** (2016). Report on commercial area analysis and site selection of unmanned resource recycling station project. *SEINAN Corporation, Japan.*

19. **Zhang, Z.** (2016). Disassembly and management manuals for waste electrical and electronic equipment for handicapped workers. *SEINAN Corporation, Japan.*

20. **Zhang, Z.** (2016). Presentation materials for the long-term experience with gasification of shredder residues at SEINAN, Japan. *16th International Automobile Recycling Congress (IARC)*. Berlin, Germany. March 17, 2016.

21. **Zhang, Z.** (2015). Recruitment documents for the SEINAN Scholarship Program. *SEINAN Corporation, Japan.*

22. **Zhang, Z.** (2015). Post-event report on the post-disaster reconstruction project: Memorial rebirth in Kesennuma, Japan. *SEINAN Corporation, Japan.*

23. **Zhang, Z.** (2014). Report on the recovery of interior plastics derived from end-of-life vehicles. *SEINAN Corporation, Japan*.

24. **Zhang, Z.** (2014). Report on the recovery of neodymium magnet derived from end-of-life hybrid vehicles. *SEINAN Corporation, Japan*.

PRESENTATIONS

Oral presentations

1. **Zhang, Z.,** Takeyama, K., Nakajima, K., Matsubae, K. Development of the MaTrace model for evaluating the effect of automotive product remanufacturing. *The 10th International Conference of the International Society for Industrial Ecology*. Beijing, China. July 8, 2019.

2. **Zhang, Z.,** Takeyama, K., Nakajima, K., Matsubae, K. Modelling the flow of engine-derived steel in successive rounds of reuse and recycling. *The 177th Spring Meeting of the Iron and Steel Institute of Japan*. Tokyo, Japan. March 20, 2019.

3. **Zhang, Z.,** Takeyama, K., Nakajima, K., Matsubae, K. Transition and losses of steel alloy elements used in internal combustion engines throughout multiple life cycles. *Sino–Japan Symposium for Industrial Ecology 2018.* Xiamen, China. November 29, 2018.

4. **Zhang, Z.,** Takeyama, K., Nakajima, K., Matsubae, K. A comparative study of the potential for material losses reduction between auto parts reuse and recycling strategies. *The 13th Biennial International Conference on EcoBalance.* Tokyo, Japan. October 12, 2018.

5. **Zhang, Z.,** Takeyama, K., Nakajima, K., Matsubae, K. Estimating the amount of steel alloy elements dissipated in recycling of end-of-life vehicles. *The 12th Society and Materials International Conference.* Metz, France. May 22, 2018.

6. **Zhang, Z.,** Takeyama, K., Matsubae, K. Analysis of material recovery potentials of introducing reuse strategies into recycling of end-of-life vehicles in Japan. *The 13th International Conference on Waste Management and Technology.* Beijing, China. March 24, 2018.

7. **Zhang, Z.,** Matsubae, K. Cost-benefit analysis of recycling of end-of-life gasoline and hybrid electric vehicles in Japan. *The 175th Spring Meeting of the Iron and Steel Institute of Japan.* Chiba, Japan. March 21, 2018.

8. **Zhang, Z.,** Takeyama, K., Nakajima, K., Matsubae, K. Development of the MaTrace model for steel cycles: Focusing on auto parts reuse. *The 13th Meeting of the Institute of Life Cycle Assessment, Japan.* March 7, 2018.

9. **Zhang, Z.,** Takeyama, K., Nakajima, K., Matsubae, K. Effects of auto parts reuse on avoiding material losses and losses in value in nickel and chromium cycles. *Study Group on Visualization of Social Value of Steel by Innovative Life Cycle Assessment Approach*. Tokyo, Japan. December 12, 2017.

10. **Zhang, Z.,** Takeyama, K., Nakajima, K., Matsubae, K. Dynamic material flow analysis of alloyed steel used in vehicle engines. *The 4th International Conference on Final Sinks.* Kyoto, Japan. October 25, 2017.

11. **Zhang, Z.** Challenges and issues of recycling end-of-life vehicles in Japan. *Tohoku University–Ritsumeikan University Joint Seminar.* Sendai, Japan. September 9, 2017.

Poster presentations

1. **Zhang, Z.,** Takemoto, S., Matsubae, K. Supply Chain Risks Analysis of Semiconductor Products. International Symposium on Digital Talent Development for a Sustainable Society. Sendai, Japan. February 1st, 2024.

2. **Zhang, Z.,** Abdullah, M. J., Matsubae, K. Potentials for Food Self-sufficiency Improvement through Indoor Vertical Farming in Kuwait. The 14th ISIE Socio-Economic Metabolism section conference. Vienna, Austria. September 19-21, 2022.

3. **Zhang, Z.,** Takeyama, K., Nakajima, K., Matsubae, K. Dynamic material flow analysis of engine-derived steel scrap and associated elements—nickel and chromium—in Japan. *The 1st Academic Forum on Environmental Studies, Tohoku University.* Sendai, Japan. June 28, 2019.

4. **Zhang, Z.,** Yu, J., Che, J. Trends in the diffusion of vehicles in China and Mongolia. *The 5th Asian Automotive Environmental Forum*. Gold Coast, Australia. December 1, 2012.

5. **Zhang, Z.,** Yu, J., Che, J. Analysis of the status of the rapid motorization and recycling of end-of-life vehicles in Inner Mongolia, China. *The 4th Asian Automotive Environmental Forum.* Kuala Lumpur, Malaysia. November 10, 2012.

PROFESSIONAL TRAINING

Practical English Course
Tohoku University, Sendai, September to November 2017
Description: An extracurricular training specializing in English presentation skills.

EcoLeaD Premium Summer School 2017
Environmental Human Resources Consortium (EcoLead), Tokyo, September 11-15, 2017
Description: Trained diverse concepts and methodologies on knowing/recognizing the limits and future of the planet along with the evaluation of sustainability at national and regional level from nine most influential environmental scientists from Japan.

PROFESSIONAL AFFILIATIONS

Environmental Economics and Policy Studies, Japan, 2020-present

International Society for Industrial Ecology, 2018-present

The Iron and Steel Institute of Japan, 2018-present

The Institute of Life Cycle Assessment of Japan, 2017-present

PROFESSIONAL SERVICE

Host member
Tohoku University alumni "Shuyukai" – The Chinese Chapter, 2022-present
Supporting the mutual understanding and academic exchange activities between Tohoku University and Faculties from various Chinese universities and/or institutions.

President
The Student Chapter of International Society for Industrial Ecology, 2019-2020
Elected on a board-wide basis to serve on a student-led Board to promote the development of the Chapter. Duties involved organizing the ISIE conference for students and monthly board meetings, establishing peer-groups and communication plat forms, networking events for students, running elections, and enhancing diversity and equality of membership.

Asian Representative
The Student Chapter of International Society for Industrial Ecology, 2018-2019
Elected on an organization-wide basis. Duties involved supporting within the Chapter, coordinating student-centered factory tours, and poster presentations, and answering to student needs during the ISIE conference in Beijing,

Journal Editors for:

- Current Research in Environmental Sustainability (IF: 4.4), 2024.02–present, **Associate Editor**
- Environmental Research (Q1, IF: 8.3), 2023.06–present, **Guest Editor**

Peer Reviewers for:

- Environmental Research Letters (Q2, IF: 6.7), 2023.12–present
- Scientific Reports (Q2, IF: 4.996), 2023-present
- Resources, Conservation & Recycling (IF: 10.204), 2022-present
- Frontiers of Environmental Science & Engineering (IF: 4.375), 2022-present
- Journal of Industrial Ecology (IF: 6.946), 2021-present

LANGUAGES

- **Japanese**: Native-level speaker, Advanced teaching, reading, and writing
- **English**: Advanced communicating, listening, reading, and writing
- **Chinese**: Native language

COMPUTER SKILLS

Software proficiency:

- programming with Matlab,
- MiLCA (a Japanese software for Life Cycle Assessment)
- ArcGIS (a geographic information analysing and visualizing software)
- Sankey Diagram (a data visualizing software)
- OriginPro (a data analysis and graphing software)

OTHER

Press Releases

1. “Recycling of high-purity aluminum from scrap, avoiding deterioration of quality and saving energy, developed by Tohoku University.” *The Mainichi Newspapers*, May 12, 2022. https://mainichi.jp/articles/20220512/k00/00m/040/073000c

2. “Tohoku University’s aluminum scrap recycling technology saves energy to less than half of that to produce primary aluminum ingots.” *MIT Technology Review*, April 27, 2022. https://www.technologyreview.jp/n/2022/04/27/274592/

3. “Recycling of high-purity aluminum from scrap, Tohoku University's new technology.” *Nihon Keizai Shimbun*, April 26, 2022. https://www.nikkei.com/article/DGXZQOCC266XU0W2A420C2000000/

4. “Development of a new sustainable recycling technology for aluminum: Aiming to overcome the aluminum crisis.” *Tohoku University*, April 26, 2022. https://www.tohoku.ac.jp/japanese/2022/04/press20220426-05-aluminium.html

REFERENCES

Prof. Kazuyo MATSUBAE
Graduate School of Environmental Studies 503, Tohoku University
468-1, Aoba, Aramaki, Aoba-ku, Sendai 980-8572, Japan
Tel: +81 (22) 7522-264
Email: kazuyo.matsubae.a2@tohoku.ac.jp

Prof. Jeongsoo YU,
Vice-Dean, Graduate School of International Cultural Studies
Graduate School of International Cultural Studies, Tohoku University
41 Kawauchi, Aoba-ku, Sendai 980-8576, Japan
Tel: +81 (22) 795-7618
Email: jsyutom@gmail.com