Advance Sustainable Science, Engineering and Technology (ASSET)
Vol. 6, No.4, October 2024, pp. 02404024-01 ~ 02404024-22
ISSN: 2715-4211 DOI: https://doi.org/10.26877/asset.v6i4.1076

A New Approach to Measuring Institutional and Researcher Contributions to the SDGs: Combining Data from Elsevier SciVal and VOSviewer

Fungky Dyan Pertiwi[1], Dhimas Cahyo Anindito[1], Ilham Habibi[1*], Saifudin[1], Suroto Munahar[1], Bagiyo Condro Purnomo[1], Yun Arifatul Fatimah[1], Budi Waluyo[1], Muji Setiyo[1,2]

[1]Department of Mechanical Engineering, Faculty of Engineering Universitas Muhammadiyah Magelang, 56172, Indonesia
[2]Department of Sustainable Engineering, Saveetha School of Engineering, Saveetha Institute of Medical and Technical Sciences, Chennai 602105, India

*Habibi@unimma.ac.id

Abstract. The Sustainable Development Goals (SDGs), established by the United Nations in 2015, are a comprehensive global framework that addresses social, economic, and environmental challenges through sustainable development. This study examines the role of universities, specifically focusing on the Department of Mechanical Engineering at Universitas Muhammadiyah Magelang (UNIMMA), in contributing to the SDGs. The study utilized data from Elsevier's SciVal to analyze the department's contribution to the SDGs through scientific publications in the Scopus database. A total of 97 out of 156 articles published by nine researchers from the department were found to contribute to various SDGs, with a significant focus on Goals 7 (affordable and clean energy), 17 (partnerships for the goals), 9 (industry, innovation, and infrastructure), and 12 (responsible consumption and production). The study highlights the department's collaborative efforts and alignment with global sustainability goals. In addition, VOSviewer was used to map the research collaboration network within the department, revealing strong contributions to energy efficiency, sustainable technologies, and climate action. However, the department's research shows limited contribution to social SDGs such as poverty alleviation and gender equality. By mapping the university's contributions to the SDGs, this study helps faculty members identify opportunities for targeted research collaborations, address gaps in SDG contributions, and enhance partnerships with researchers from other institutions, thus broadening the university's impact on global sustainable development goals.

Keywords: Sustainable Development Goals (SDGs); Mechanical Engineering; Times Higher Education; World University Rankings; Research Impact; Elsevier SciVal; VOSviewer; Research Collaboration; Energy Efficiency; Sustainable Technologies.

(Received 2024-09-17, Accepted 2024-10-23, Available Online by 2024-10-26)

1. Introduction

On September 25, 2015, the United Nations (UN), through the General Assembly, established the Sustainable Development Goals (SDGs) as a new global development framework, replacing the Millennium Development Goals (MDGs), which were in effect from 2000 to 2015 [1]. The SDGs consist of 17 goals that holistically target social, economic, and environmental aspects, with an ambitious vision to end poverty, reduce inequality, protect the environment, and ensure welfare and prosperity for all by 2030 [2]–[4].

The establishment of SDGs is oriented to answer increasingly complex global challenges. Therefore, it requires a more sustainable development approach [5], [6]. In addition, SDGs are designed to strengthen inclusivity and equality and ensure that no individual or group is left behind [7], [8]. Within this framework, the UN bridges collaboration from all countries worldwide to achieve better common goals for future generations. These goals also reflect a global commitment to comprehensive sustainable development principles, emphasizing economic growth [9], environmental sustainability, and social welfare. The implementation of SDGs is expected to create a long-term positive impact on all aspects of global community life [10], [11].

Therefore, universities play a crucial role in achieving these SDGs. As centers of education, research, and community service, universities have a great responsibility and potential to support the realization of these 17 goals. By integrating the principles of sustainable development into the curriculum, universities can produce graduates with theoretical knowledge and practical skills in facing various global challenges such as climate change, inequality, and environmental degradation [12]. For instance, several research studies conducted by various university faculty members focus on optimizing energy utilization [13]–[15]. Universities also have a significant role in building literacy and awareness of the SDGs through education [16], [17]. Thus, university graduates are expected to become agents of change to provide innovative solutions for global development. As research centers, universities can develop science-based solutions to address issues across the SDG spectrum [18]–[20], from health and well-being to renewable energy and green technology. Research by faculty/researchers and students focused on developing sustainable technologies, energy efficiency, and improving the quality of life of the poor can help accelerate the achievement of the SDGs, both locally and globally [21]–[23]. In addition to its role in education and research, universities have social contributions through community service programs. Many universities are involved in community service projects that empower local communities, increase access to health services, skills training, and increase environmental awareness. This community service not only directly impacts the welfare of local communities but also provides field experience for students and researchers to understand the complexities of sustainable development more comprehensively [24].

Furthermore, universities also play a role as a forum for building global and local partnerships in achieving the SDGs. Collaboration with governments, the private sector, and international organizations allows transferring knowledge and technology to realize sustainable development [25], [26]. Through this collaboration, universities can act as a bridge connecting various sectors in a joint effort to address various global problems. Universities also play a role as drivers of public policy, where scientific evidence produced from research in universities can be used as a basis for policymakers in designing more appropriate and sustainable policies. Thus, universities are not only educational institutions but also agents of change that play an essential role in achieving the SDGs, which requires a joint commitment from all parties at the local and global levels.

In recent years, universities' contributions to the SDGs have increasingly been considered in measuring the global impact of higher education. Vargas et al [27] examined how universities have integrated the SDGs into their operations, mainly through research. Bibliometric analysis is used for the paper to conclude that universities have emerged as key players in sustainable development, with an increase in intellectual output around the SDGs since 2015. The study also identifies the need for systemic change in higher education to address the SDG agenda fully. Universities have an essential role as change agents in achieving the SDGs, especially in education. Through bibliometric mapping, five main clusters can be identified: SDGs in general, SDG 4 on Quality Education, Education for

Sustainable Development, Higher Education, and Educational Management. The findings show that there has been a significant increase in the number of related publications, with a strong focus on the importance of transforming the role and function of higher education to support sustainable development [28].

Higher-ranked universities tend to disclose more information and firmly commit to SDGs related to health, education, industry, responsible consumption, climate action and partnerships [29]. The study reveals significant differences between top- and bottom-ranked universities regarding geographical location, information disclosure, and impact. In particular, the study finds that SDG 9 (industry, innovation and infrastructure) and SDG 17 (partnerships for the goals) are highly influential in aligning universities' rankings with their sustainability actions across multiple dimensions and subjects. The study recommends that universities integrate SDG actions into their strategic management to improve their sustainability performance and contribute effectively to sustainable development. The University of Leicester has recently mapped the research contributions of higher education institutions (HEIs) to the SDGs. Mathematical text mining techniques are integrated into an automated software tool that can quickly and effectively measure a university's academic contribution to the SDGs. This success has led to increased ambition and efforts to develop software that can map the entire operations of an HEI or business, enabling them to report on their contribution to the SDGs more comprehensively [30].

Elsevier and Times Higher Education (THE) are two institutions that provide frameworks for measuring the role of universities in achieving these goals. The metrics developed by these institutions guide universities in assessing their contributions to the SDGs in various aspects, such as research, institutional policies, and community engagement. Starting in 2023, Elsevier, through the SciVal platform, provides a tool to analyze research output related to the SDGs. Each university can measure its contribution to the SDGs through scientific publications, collaborations, and citation impact in fields relevant to the SDG spectrum. In addition, SciVal allows universities to map their research against the SDGs, helping them assess the global impact of their academic activities and collaborations. By Elsevier data science, the SDGs are mapped to documents by matching terms from Scopus records using search queries, plus predictive learning matching elements for each SDG. The terms used in the articles are derived from the title, keywords, key descriptors, journal subject areas, and abstracts. Elsevier's data science team created an initial query at the request of THE to help them define the SDG search query that will be used in the SDG University Impact Rankings [31].

Meanwhile, THE takes a broader approach to measuring university contributions through its Impact Rankings. THE assesses universities' success in addressing global challenges related to the SDGs based on several key criteria. In addition to research, THE also evaluates universities' operational policies and practices, such as resource management, gender equality, and sustainability. In addition, universities' engagement with local and global communities to address SDG issues is also an important assessment factor. Universities can choose specific SDGs to be evaluated, with SDG 17 (Partnerships for the Goals) as a mandatory indicator that reflects universities' global collaboration, especially in research. To participate in this measurement, universities voluntarily submit relevant data to THE, including case studies, institutional policies, and statistics related to activities supporting the SDGs. Elsevier supports this process by providing bibliometric data on research outputs, allowing universities to assess their impact on research and citations related to the SDGs. In doing so, the two institutions provide universities with a comprehensive tool to assess and publish their contributions to sustainable development. Universities can track and highlight their role in supporting the SDGs by leveraging platforms like Elsevier's SciVal and participating in THE Impact Rankings. THE Impact Rankings not only strengthen the reputation of the university but also measure its real contribution to achieving the SDGs.

Therefore, this study presents a novel approach by applying SciVal and Elsevier's VOSviewer to quantitatively and visually map the contribution of a specific department (Mechanical Engineering at UNIMMA) to the SDGs. By focusing on department-level analysis, the study provides detailed insights into how individual researchers and their collaborative networks contribute to global sustainability efforts. This department-specific focus is relatively unique, as most previous studies have analyzed the

university's contribution as a whole or general trend across institutions. Combining bibliometric tools (SciVal) and collaborative network analysis (VOSviewer) introduces a comprehensive framework for assessing SDG-related research output at the micro-level, offering a model for other institutions to assess their specific contributions to sustainable development.

To identify the contribution of institutions and researchers to SDGs, find relationships between researchers, and map the contribution of each researcher, a specific department is needed as a case study. Therefore, we use the Department of Mechanical Engineering, Universitas Muhammadiyah Magelang (UNIMMA) as a case study in this study. This department is supported by nine lecturers/researchers, collaborating with senior lecturers and junior lecturers. This department has a scientific vision to become a leading national mechanical engineering department with a sustainable engineering perspective to support global sustainability, which is very relevant to SDGs. The articles from the nine lecturers/researchers have been indexed in the Scopus database to be included in the analysis. The researcher IDs are presented in Table 1.

Table 1. Researcher's data source (accessed 8 September 2024)

No	Full name	Initial	Scopus ID	Total doc.
1	Yun Arifatul Fatimah	YAF	57189027940	22
2	Muji Setiyo	MS	57189574332	97
3	Budi Waluyo	BW	57190971941	35
4	Bagiyo Condro Purnomo	BCP	57193447890	21
5	Suroto Munahar	SM	57189352149	24
6	Saifudin	S	57193447744	14
7	Ilham Habibi	IH	57671975300	5
8	Fungky Dyan Pertiwi	FDP	58696506100	5
9	Dhimas Cahyo Anindito	DCA	57208795476	4
				227

2. Methods

In this study, we used data provided by Elsevier. First, select the organization on the main search menu in Scopus, then enter the keyword. The search results by the system will display the selected institution, which displays four main menus: Documents, Structure, Collaborators, and Sustainable Development Goals 2023. From the four options, select the Sustainable Development Goals 2023 menu. All articles produced by the institution and their contributions to the 17 SDGS spectrums will be displayed, as presented in Figure 1.

However, the data in Figure 1 presents the institution's overall publication output. To measure the specific contribution of the Department of Mechanical Engineering, we conducted a targeted search within each SDG spectrum. Given the relatively small number of relevant publications, we opted for manual validation to ensure accuracy. First, we carefully checked all documents in each spectrum by tabulating the detailed data. Second, we calculated the percentage contribution of these articles to their respective SDG spectrum. Third, because a single article can be relevant to multiple SDG spectrums, we used Excel to sort and filter the data, identify the number of articles produced by the nine lecturers in the department and map them to all applicable SDG spectrums. Finally, we calculated the specific contribution of each lecturer to the SDGs. The detailed sequence of validation and data analysis is illustrated in Figure 2.

To map the relationships between researchers, we utilized VOSviewer, a tool for building and visualizing bibliometric networks. The process began with the data collection phase, where all relevant references were exported from Mendeley into RIS file format. The choice of RIS allowed us to effectively capture and organize bibliographic information, facilitating the transition to the next step in the analysis. Once the RIS file was prepared, it was imported into VOSviewer for further analysis and processing. In this study, we focused specifically on nine selected authors. These authors are lecturers/researchers affiliated with the Department of Mechanical Engineering, UNIMMA as presented in Table 1.

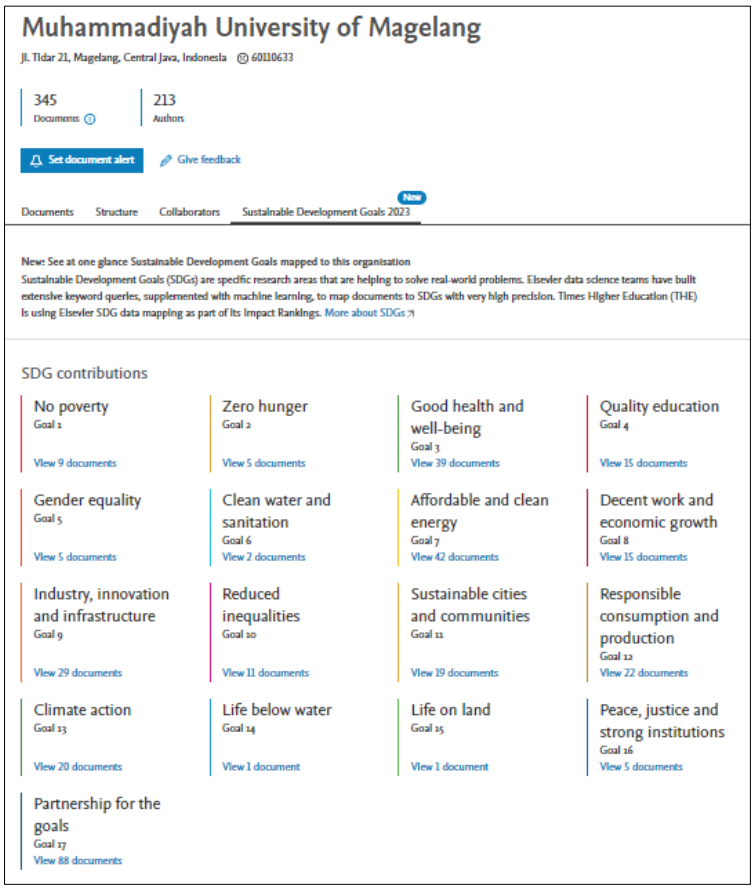

Figure 1. Landing page for searching institutional contributions to SDGs at Elsevier, accessed 8 September 2024 (https://www.scopus.com/pages/organization/60110633#tab=sdgs)

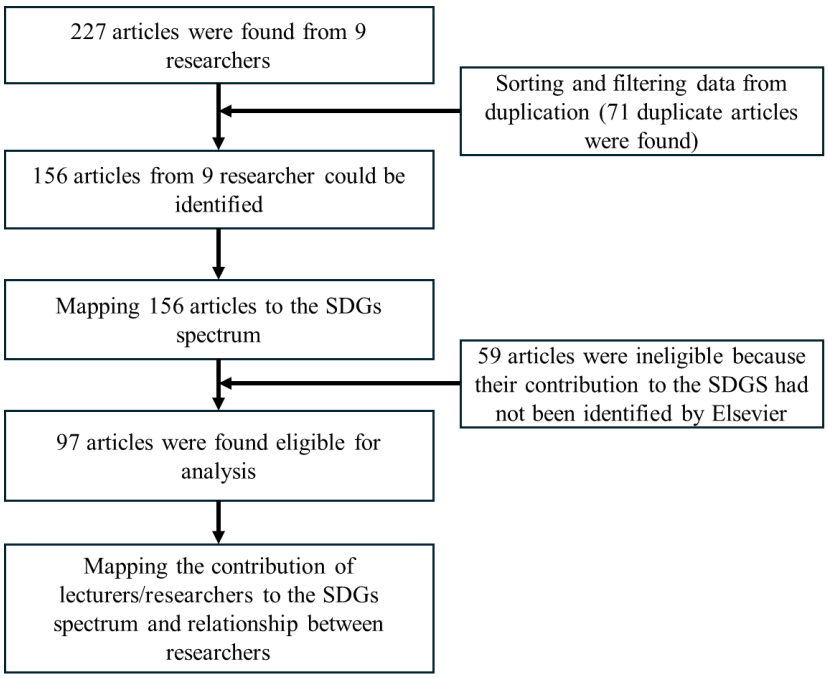

Figure 2. Methods for mapping research contributions of lecturers/researchers to SDGs

VOSviewer allowed a detailed and visually intuitive depiction of these academic relationships, offering a clearer understanding of the collaborative dynamics within the department. This visualization made identifying key actors and their roles in ongoing research easier and helped determine research clusters and groups of researchers working on closely related topics. By understanding these clusters, we were able to recognize emerging research areas and their potential for future collaboration, thus fostering strategic partnerships that could enhance the department's research output and impact. This approach provides a comprehensive overview of the collaborative landscape. The insights gained from this analysis will be crucial to visualize this co-authorship network and the correlations and potential synergies between researchers towards the SDGs, as set out as the objective of this study.

3. Results and Discussion

3.1. Metric Contribution

The sorting mechanism as illustrated in Figure 2, produced 87 articles as shown in Table 2. To map articles' contributions to the SDGs, we validated them individually in the Scopus database to obtain a correlation matrix between articles, authors, and contributions to the SDGs.

Table 2. Correlation matrix of articles, SDGs, and researchers

Refs	Type	SDGs spectrum																	Researcher								
		G1	G2	G3	G4	G5	G6	G7	G8	G9	G10	G11	G12	G13	G14	G15	G16	G17	YAF	MS	BW	BCP	SM	S	IH	FDP	DCA
[32]	J							√												√							
[33]	P							√																	√		
[34]	P											√	√					√	√								
[35]	J																	√		√							
[36]	J																	√		√	√						
[37]	J							√												√							
[38]	J									√				√						√							
[39]	P									√			√	√					√								
[40]	J							√												√							
[41]	J							√															√				
[42]	J							√										√		√					√	√	√
[43]	J							√	√									√					√				
[44]	J							√												√	√						
[45]	J																	√		√							
[46]	J											√						√		√	√						
[47]	J							√												√							
[48]	J								√									√	√								
[49]	J													√						√							
[50]	P							√													√			√			
[51]	P												√				√	√				√					
[52]	P																	√		√							
[53]	J			√								√								√							
[54]	J																	√		√							
[55]	J							√												√	√		√				
[56]	J							√												√	√	√					
[57]	J																	√		√	√						

Refs	Type	SDGs spectrum																	Researcher								
		G1	G2	G3	G4	G5	G6	G7	G8	G9	G10	G11	G12	G13	G14	G15	G16	G17	YAF	MS	BW	BCP	SM	S	IH	FDP	DCA
[58]	J							√		√				√						√							
[59]	P									√		√	√					√	√								
[60]	J			√																			√				
[61]	P									√														√			
[62]	P			√				√				√										√	√				
[63]	J									√			√					√	√								
[64]	C											√	√					√	√								
[65]	J			√				√						√							√	√					
[66]	J								√		√			√				√		√							
[67]	P							√													√						
[68]	J							√												√							
[69]	J							√												√	√						
[70]	J							√						√					√	√	√				√	√	
[71]	P											√		√						√	√						
[72]	J											√						√		√							
[65]	J			√				√				√									√	√					
[73]	P								√	√				√						√							
[74]	P							√																			√
[75]	P							√										√		√							
[76]	J			√				√												√							
[77]	J							√																			√
[78]	J											√								√	√						
[79]	J																	√		√	√						
[80]	P													√						√		√	√				
[81]	J							√												√	√			√			
[82]	J							√															√				
[83]	J							√		√		√								√							
[84]	P							√						√									√				
[85]	J			√																			√				
[86]	J						√		√	√		√	√	√				√	√								
[87]	J									√										√							
[88]	J							√										√		√	√						
[89]	J									√									√								
[90]	P			√					√	√			√						√								
[91]	J							√												√			√				
[92]	J												√								√						
[93]	J			√																√							
[94]	J			√				√												√							
[95]	P							√												√	√						
[96]	P			√								√						√		√							
[97]	P			√																√	√	√	√				
[98]	P																	√		√							
[99]	P									√			√					√	√								

Refs	Type	SDGs spectrum																	Researcher								
		G1	G2	G3	G4	G5	G6	G7	G8	G9	G10	G11	G12	G13	G14	G15	G16	G17	YAF	MS	BW	BCP	SM	S	IH	FDP	DCA
[100]	P								√	√			√	√				√	√								
[101]	P									√			√					√	√								
[102]	P									√								√	√								
[103]	J							√						√						√							
[13]	J									√			√					√		√							
[104]	P								√											√		√	√				
[105]	J			√						√				√						√							
[106]	J							√														√					
[107]	J							√												√							
[108]	J							√													√						
[109]	P									√			√						√								
[110]	J						√	√	√	√			√			√				√							
[111]	J							√	√	√			√						√								
[112]	P								√	√			√				√		√								
[113]	J				√			√		√				√						√							
[114]	J											√								√							
[115]	P							√												√	√	√		√			
[116]	J													√						√							
[117]	J							√												√							
[118]	J									√		√	√					√	√								
[119]	J							√												√				√			
[120]	J							√												√							
[121]	J												√							√							
[122]	J									√										√							
[123]	J							√												√	√						
[124]	P							√																			√
[125]	J							√												√							
[126]	C											√	√	√				√	√								

YAF: Yun Arifatul Fatimah; MS: Muji Setiyo; BW: Budi Waluyo; BCP: Bagiyo Condro Purnomo; SM: Suroto Munahar; S: Saifudin; IH: Ilham Habibi; FDP: Fungky Dyan Pertiwi; dan DCA: Dhimas Cahyo Anindito. J: Journal, P: Proceedings, and C: Book Chapter.

Based on the data presented in Table 2, a comprehensive analysis was conducted by linking articles, SDG codes (G1-G17), and researchers involved. 97 out of 156 articles produced by nine researchers in the Department of Mechanical Engineering at UNIMMA have contributed to one or more of the SDGs spectrums. Meanwhile, the remaining 59 articles have not been detected by Elsevier as having contributed to the SDGs, some of which are newly published articles, and some of which may be because they do not contribute to the SDGs, including a preface at a conference indexed by Scopus [127]–[129]. The 97 identified articles cover a wide range of research topics, including renewable energy, waste management, sustainable transportation, biofuels, environmental sustainability, and industrial optimization. Many articles focus on energy, industrial innovation, sustainable cities, and climate action, indicating that much research is aimed at improving energy efficiency and reducing environmental impacts.

Furthermore, the most frequently supported SDG is G7, which includes research on renewable energy sources, optimization of energy consumption, and development of alternative fuels. The second

most supported SDG was G17, where many articles emphasized the importance of collaboration and partnerships in achieving sustainability goals. The third most supported SDG was G9, which covers industrial optimization, sustainable manufacturing processes, and technology development research. Fourth place was G12, which addresses responsible consumption and production, followed by G13 (climate action) and G11 (sustainable cities and communities). The involvement of 9 researchers in several articles demonstrates a collaborative approach, particularly in areas such as energy efficiency and sustainable fuels (G7, G13), which include articles on biodiesel, fuel cell technology, and energy saving methods—reflecting interdisciplinary efforts. Circular economy and waste management also significantly contribute to the SDGs, particularly G9, G12, and G17, with articles on remanufacturing, sustainable production, and waste management, highlighting cross-disciplinary collaboration and the need for integrated solutions to sustainability challenges. This analysis shows strong alignment between articles and important global goals, particularly energy, industrial innovation, and climate action. This analysis also underlines collaborative efforts among researchers to achieve sustainable solutions through technological and policy advances.

3.2. Overall Contribution

From Table 2, 97 articles produced by Department of Mechanical Engineering UNIMMA contributed to 13 of the 17 SDGs. Consistent with the engineering field, the most extensive contributions were to Goal 7 (affordable and clean energy) (24.73%), Goal 17 (partnerships for the goals) (16.13%), Goal 9 (industry, innovation and infrastructure) (13.44%), and Goal 12 (responsible consumption and production) (10.75%), with all four goals exceeding 10%. In contrast, contributions below 10% include Goal 13 (climate action) and Goal 11 (sustainable cities and communities) at 9.68% and 8.60% respectively; Goal 3 (good health and well-being) (6.99%); Goal 8 (decent work and economic growth) (5.91%). Goal 6 (clean water and sanitation), Goal 16 (peace, justice and strong institutions), Goal 4 (quality education), Goal 10 (reduced inequality), and Goal 15 (life on land) each have contributions below 5%. 4 SDG spectrums have not been contributed by nine researchers in the Department of Mechanical Engineering UNIMMA, namely Goal 1 (no poverty), Goal 2 (zero hunger), Goal 5 (gender equality), and Goal 14 (life below water). Data on contributions to each SDG spectrum are presented in Figure 3.

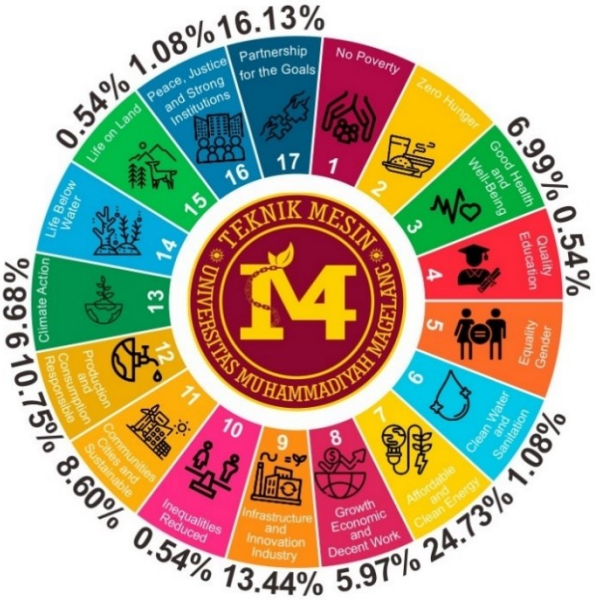

Figure 3. Contribution of the Department of Mechanical Engineering UNIMMA to SDGs

3.3. Overall Networking

Figure 4 presents the network of researchers in the department, as derived from VOSviewer, combined with their contributions to the SDGs. The thickness of the connecting lines between each author indicates the level of collaboration; thicker lines signify more frequent collaboration than thinner lines. The codes labelled "G" in the boxes connecting authors represent the corresponding SDG goals, with the numbers indicating the specific spectrum. For instance, G7 denotes collaboration related to Goal 7 (affordable and clean energy), while G13 indicates contributions to Goal 13 (climate action).

For further clarification, the connection between "Setiyo, Muji" and "Waluyo, Budi" is illustrated with a green thick line and codes G3, G7, G11, G13, and G17. The connection indicates that these authors have jointly contributed to Goal 3 (Good Health and Well-Being) [97], Goal 7 (affordable and clean energy) [44], [55], [56], [69], [70], [81], [88], [95], [115], [130], Goal 11 (sustainable cities and communities) [46], [71], [78], Goal 13 (climate action) [70], [71], and Goal 17 (partnerships for the goals) [36], [46], [79], [88], [131]. Using the same logic, each author's contribution to the SDGs can be identified based on the connections and associated codes. Meanwhile, Figure 5 illustrates the density of contributions from the nine lecturers/researchers in the department.

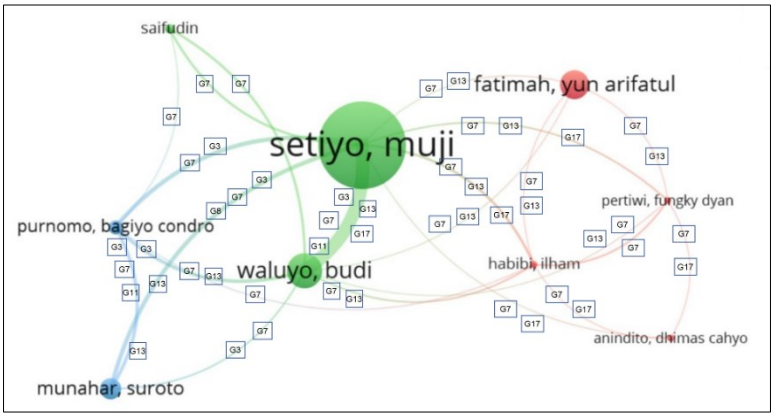

Figure 4. Overall networking of researchers in the Department of Mechanical Engineering UNIMMA obtained from VOSViewer

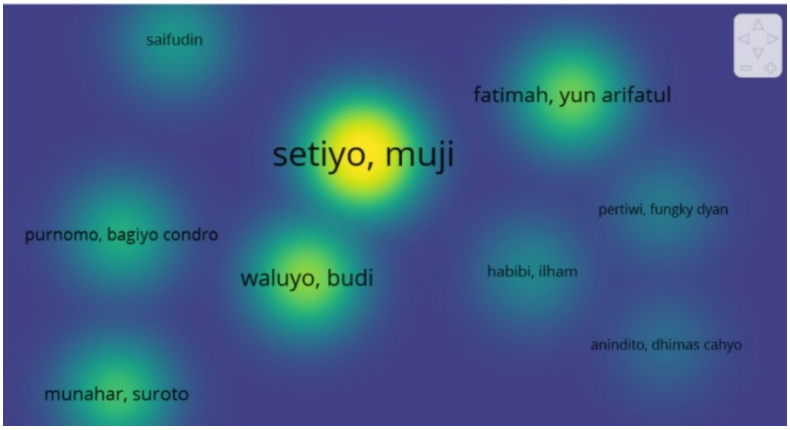

Figure 5. Density of contribution of 9 lecturers/researchers in the Department of Mechanical Engineering UNIMMA to SDGs

3.4. Lecturer/Researcher Contribution

From the available data, the contribution of researchers in the department to the SDGs can be analyzed through several approaches. First, there is a significant variation in the proportion of contributions to each SDG. Some SDGs receive more attention than others, namely SDG 7 (affordable and clean energy),

SDG 12 (responsible consumption and production), SDG 9 (industrial and infrastructure innovation), and SDG 17 (partnerships to achieve the goals). Research on renewable energy technology and energy efficiency is essential, considering the global challenges in the clean energy transition and the need to reduce carbon emissions. This focus makes a real contribution to environmental change and can be a competitive advantage for UNIMMA in green technology research. Second, SDG 9 (industrial and infrastructure innovation) and SDG 12 (responsible consumption and production) are other areas in which researchers in this department contribute well. Research in the field is related to sustainable economic development and efforts to balance industrial development and environmental impacts. Third, SDG 17 (partnerships to achieve the goals) is one of the SDGs that has received many contributions from several researchers. The result shows that UNIMMA researchers are also trying to build collaborations with external parties, both at the national and international levels. This partnership is important to strengthen the impact of research and expand UNIMMA's network of influence in realizing the SDGs. Fourth, Contributions to SDG 13 (climate action) are also quite prominent from several researchers. Several researchers show a commitment to research related to climate change. The commitment is important considering the increasing urgency of global action on climate change and the need to develop environmentally friendly technologies.

However, researchers in this department do not have any contributions to the social SDGs, which include SDG 1 (no poverty), SDG 2 (zero hunger), SDG 5 (gender equality), and SDG 10 (reduced inequality). Overall, research at the Department of Mechanical Engineering UNIMMA focuses heavily on technical and industrial aspects, especially in terms of clean energy, industrial innovation, and responsible consumption. This emphasis is in line with the global trend in research focusing on technological solutions to energy and infrastructure problems, as presented in Figure 6.

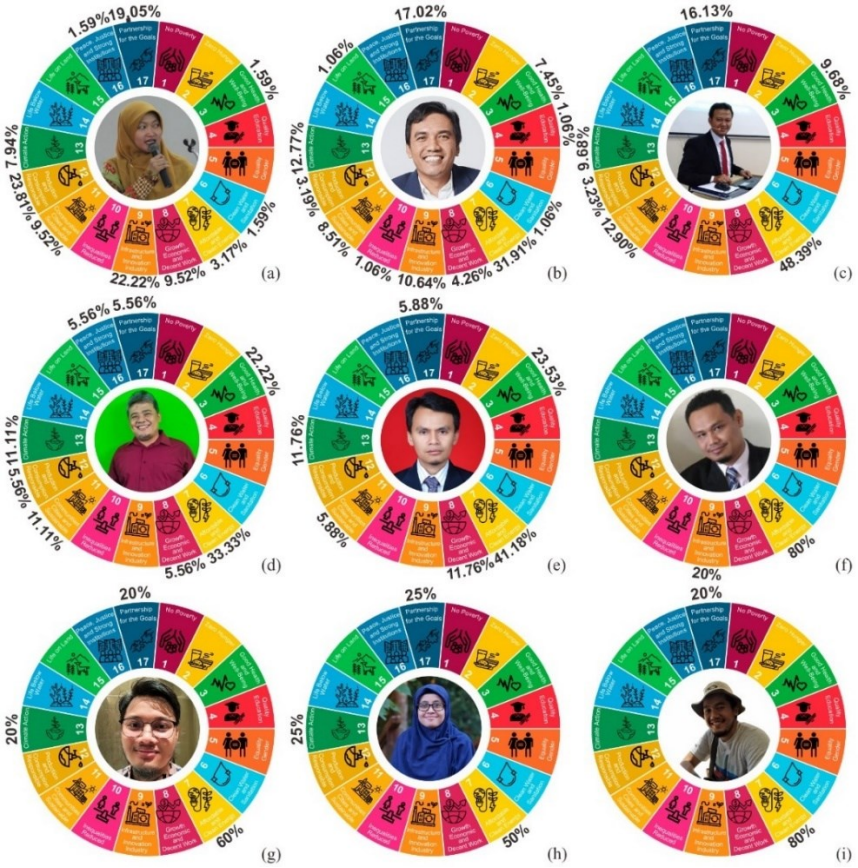

Figure 6. Contribution map of researchers to SDGs: (a) YAF, (b) MS, (c) BW, (d) BCP, (e) SM, (f) S, (g) IH, (h) FDP, and (i) DCA

Of the 87 articles contributing to the SDGs, only 26 involved at least two researchers in the department. The rest were collaborations between researchers in the department, researchers outside the department, and even outside the institution. Then, the contributions of researchers (YAF, MS, BW, BCP, S, IH, FDP, and DCA) and their relationships in advancing the SDGs can also be identified and analyzed. First, regarding individual contributions, YAF, in the Department of Mechanical Engineering, contributes to biodiesel fuel research, focusing on developing more efficient renewable fuels. YAF collaborates with MS, BW, IH, and FDP to innovate alternative fuel technologies to accelerate the adoption of clean energy technologies, contributing to SDG 7 (affordable and clean energy) and SDG 13 (climate action).

MS has been involved in over 20 articles focusing on developing alternative fuel technologies such as LPG, biodiesel, and energy optimization for transportation. His research extends into technical innovations like renewable energy-based fuel control systems and cooling systems. In many of his publications, MS focuses on sustainable energy and transportation solutions that reduce carbon emissions, improve fuel efficiency, and promote clean technologies. He works closely with researchers, such as BW, BCP, SM, S, IH, FDP, and DCA. He strongly collaborates with BW on energy efficiency research, alternative fuels, and transportation technology innovations. MS's contributions span SDG 7 (clean energy), SDG 11 (sustainable transportation), SDG 13 (climate action), and SDG 17 (partnerships).

BW intensively works on alternative fuel development and energy efficiency, such as LPG and biodiesel. He also focuses on vehicle technology and environmentally friendly transportation solutions, including fuel combustion and cooling systems innovations. His central collaboration is with MS, but he also engages with YAF, BCP, SM, and S in various research projects. BW is crucial in bridging topics on renewable energy and transportation technology innovation. Most of his articles contribute to SDG 7 (clean energy) through research on alternative fuels and energy system optimization, SDG 11 (sustainable cities) via renewable energy-based transportation solutions and vehicle efficiency, and SDG 13 (climate action) due to the direct impact of his innovations on reducing greenhouse gas emissions.

BCP collaborates with MS, BW, and SM on various projects, particularly safety and energy efficiency. They research driver behavior, vehicle safety, and the development of more efficient fuel technologies. BCP also contributes to exhaust emission research and its environmental impact. His contributions align with SDG 3 (health) by focusing on transportation safety, SDG 7 (clean energy) through contributions to alternative fuel technologies, and SDG 13 (climate action) due to his role in reducing vehicle emissions.

SM focuses his research on cooling systems and fuel control, contributing to the development of vehicle safety technology. He works closely with MS and BW on fuel technology and cooling systems and with BCP on vehicle safety system development. His contributions impact SDG 7 (clean energy) through innovations in renewable energy-based cooling systems, SDG 13 (climate action) by optimizing fuel control to reduce emissions, and SDG 3 (health) through vehicle safety system development.

S collaborates with MS and BW to research fuel blending innovations and their impact on energy efficiency. They contribute to SDG 7 (clean energy) by advancing more efficient and safer fuel blends, supporting the transition to greener energy. Meanwhile, IH, FDP, and DCA are new researchers in the department. IH collaborates with MS, BW, and DCA on research involving smart optimization technologies and renewable energy innovations. His contributions are seen in SDG 7 (clean energy) and SDG 13 (climate action), with research aimed at reducing emissions and improving energy efficiency, and SDG 17 (partnerships) through multidisciplinary research combining various fields and technologies for energy solutions.

FDP and MS, BW, IH, and DCA develop optimization technologies and alternative fuels. His contributions align with SDG 7 (clean energy) through innovations in optimization technologies and energy efficiency, SDG 13 (climate action) through efforts to reduce carbon emissions, and SDG 17 (partnerships) through multidisciplinary research collaborations. Lastly, DCA also collaborates with MS, IH, and FDP on energy optimization projects and has contributed to SDG 7 (clean energy) by improving energy efficiency and SDG 17 (partnerships) through cross-disciplinary collaborations for

technological innovation. The relationship patterns among the researchers in the Department of Mechanical Engineering are illustrated in Figure 7.

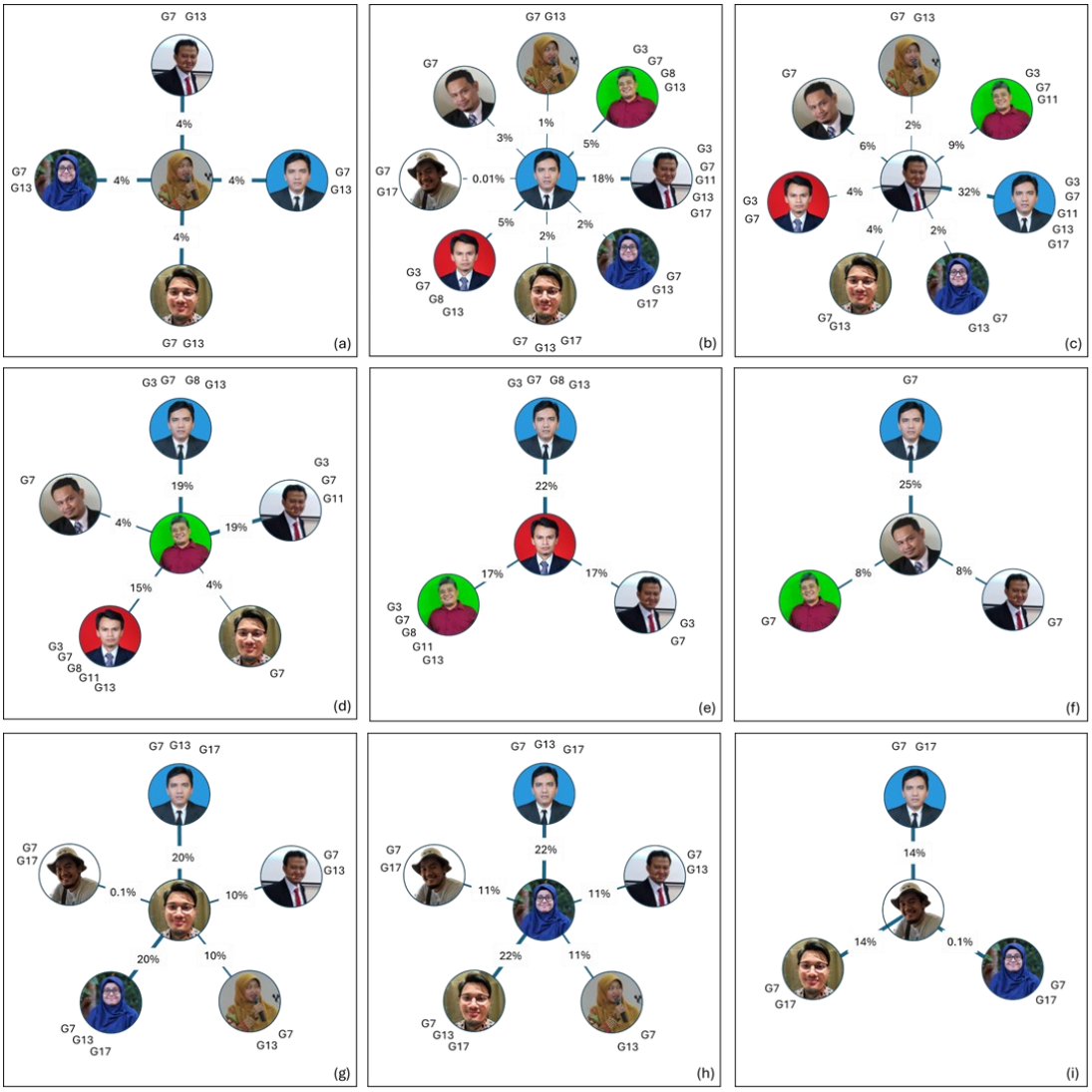

Figure 7. The relationship between researchers in the department towards the SDGs: (a) YAF, (b) MS, (c) BW, (d) BCP, (e) SM, (f) S, (g) IH, (h) FDP, and (i) DCA

3.5. Discussion

In examining the contribution of universities to the SDGs, various studies have revealed how academic institutions play a role in achieving this global agenda. Körfgen et al. [132] highlighted a map of the contribution of Austrian university research to the SDGs. The study showed that while SDG 3 (health and well-being) and SDG 4 (quality education) received significant attention, some other SDGs such as SDG 1 (no poverty) and SDG 14 (life below water) received less attention. This provides an overview of the focus and gaps in SDG research in Austria, which can help universities plan the thematic orientation of their research to support SDG implementation more effectively. Another study [30] discusses the responsibility of universities in supporting the SDGs more generally. This article explains that although all UN member states have signed the 2030 Agenda, universities also must contribute to the achievement of the SDGs. However, this study does not single out specific universities but rather provides a general framework for the role of universities in supporting the SDGs. A more specific approach by conducting a bibliometric analysis of scientific publications related to the SDGs, with a

special focus on education, has been carried out by Jiménez et al [28]. This study found five core clusters in publications related to the SDGs, including SDG 4 (quality education) and educational management. By highlighting the evolution of publications and research contributions in the context of higher education, this study underlines the importance of the shifting role of higher education in facing the challenges of the SDGs. Meanwhile, Hong et al. [133] assessed the engagement of universities with the SDGs and their contributions, as well as plans for further development. The results showed that university contributions varied and were often fragmented, and indicate the need for further research covering different countries and universities to comprehensively understand the achievements and challenges in implementing the SDGs. Finally, Poza et al. [29] introduced a different approach by using the Times Higher Education (THE) rankings to analyze the reporting and achievement of SDGs by higher education institutions (HEIs). This study showed that higher-ranked universities tended to be better at reporting SDG achievements, especially in the aspects of health, education, and industry. Differences in SDG reporting between top and bottom-ranked universities are also evident based on geographic location and the information disclosed. Our current study, meanwhile, offers a unique and in-depth contribution by focusing on a single department within a university. Unlike other studies that may be more general or country-based, our study provides detailed insights into how specific departments contribute to the SDGs and maps out research collaboration networks among the researchers in the department.

4. Conclusion and Limitations

This article evaluates the Department of Mechanical Engineering UNIMMA's contribution to the Sustainable Development Goals (SDGs) by utilizing publication data from Elsevier. The 97 articles produced by nine researchers in the department contribute to 13 of 17 SDGs. The most extensive contributions, consistent with the engineering field, are directed towards Goal 7 (affordable and clean energy) with a contribution of 24.73%, Goal 17 (partnerships for the goals) with 16.13%, Goal 9 (industry, innovation, and infrastructure) with 13.44%, and Goal 12 (responsible consumption and production) with 10.75%. These four goals each exceed 10% contribution. In contrast, lower contributions are seen for Goal 13 (climate action) and Goal 11 (sustainable cities and communities) at 9.68% and 8.60%, respectively; Goal 3 (good health and well-being) at 6.99%; and Goal 8 (decent work and economic growth) at 5.91%. Contributions to Goal 6 (clean water and sanitation), Goal 16 (peace, justice, and strong institutions), Goal 4 (quality education), Goal 10 (reduced inequalities), and Goal 15 (life on land) are each below 5%. However, contributions to SDGs focusing on social issues, such as poverty reduction, zero hunger, gender equality, and reduction of inequalities, have not been provided by this department. On the other hand, this study has several limitations, including the reliance on publication data available in Scopus, which may not cover all relevant publications, especially those not yet indexed. In addition, the analysis of collaboration networks may not fully cover all potential partnerships, both outside the institution and with non-academic sectors. The findings suggest that the department should explore further interdisciplinary collaborations, particularly in addressing social SDGs such as poverty alleviation and gender equality, to broaden its contribution to sustainable development goals. The interdisciplinary collaborations can enhance the department's research scope and societal impact while positioning the university as a leader in sustainable innovation.

References

[1] "Transforming our world: the 2030 Agenda for Sustainable Development." Sep. 08, 2024, [Online]. Available: https://sdgs.un.org/2030agenda.

[2] G. Mujtaba, M. U. H. Shah, A. Hai, M. Daud, and M. Hayat, "A holistic approach to embracing the United Nation's Sustainable Development Goal (SDG-6) towards water security in Pakistan," *Journal of Water Process Engineering*, vol. 57, p. 104691, 2024, doi: 10.1016/j.jwpe.2023.104691.

[3] D. O. Obura, "Getting to 2030-Scaling effort to ambition through a narrative model of the SDGs," *Marine Policy*, vol. 117, p. 103973, 2020, doi: 10.1016/j.marpol.2020.103973.

[4] N. P. Hariram, K. B. Mekha, V. Suganthan, and K. Sudhakar, "Sustainalism: An integrated socio-economic-environmental model to address sustainable development and sustainability," *Sustainability*, vol. 15, no. 13, p. 10682, 2023, doi: 10.3390/su151310682.
[5] E. Hoss-Golan, A. Gofen, and A. M. Wellstead, "Meeting expectations? Response of policy innovation labs to sustainable development goals," *Policy and Society*, vol. 43, no. 3, pp. 334–350, 2024, doi: 10.1093/polsoc/puae023.
[6] A. Breuer, J. Leininger, D. Malerba, and J. Tosun, "Integrated policymaking: Institutional designs for implementing the sustainable development goals (SDGs)," *World Development*, vol. 170, p. 106317, 2023, doi: 10.1016/j.worlddev.2023.106317.
[7] P. Vera-Sanso, "Will the SDGs and the UN decade of healthy ageing leave older people behind?," *Progress in Development Studies*, vol. 23, no. 4, pp. 391–407, 2023, doi: 10.1177/1464993423119380.
[8] P. Pattberg and K. Bäckstrand, "Enhancing the achievement of the SDGs: lessons learned at the half-way point of the 2030 Agenda," *International Environmental Agreements: Politics, Law and Economics*, vol. 23, no. 2, pp. 107–114, 2023, doi: 10.1007/s10784-023-09615-9.
[9] A. Famalika and P. R. Sihombing, "Implementation of K-Means and K-Medians Clustering in Several Countries Based on Global Innovation Index (GII) 2018," *Advance Sustainable Science, Engineering and Technology*, vol. 3, no. 1, p. 343547, 2021.
[10] K. Henderson and M. Loreau, "A model of Sustainable Development Goals: Challenges and opportunities in promoting human well-being and environmental sustainability," *Ecological Modelling*, vol. 475, p. 110164, 2023, doi: 10.1016/j.ecolmodel.2022.110164.
[11] M. Kuc-Czarnecka, I. Markowicz, and A. Sompolska-Rzechuła, "SDGs implementation, their synergies, and trade-offs in EU countries–Sensitivity analysis-based approach," *Ecological Indicators*, vol. 146, p. 109888, 2023, doi: 10.1016/j.ecolind.2023.109888.
[12] T. Adams, S. M. Jameel, and J. Goggins, "Education for sustainable development: mapping the SDGs to university curricula," *Sustainability*, vol. 15, no. 10, p. 8340, 2023, doi: 10.3390/su15108340.
[13] D. I. Setyanansyach, M. Setiyo, and T. Raja, "Review and Bibliometric Analysis of Biogas Power Plants in Indonesia," *Advance Sustainable Science, Engineering and Technology (ASSET)*, vol. 5, no. 3, p. 2303015, 2023, doi: 10.26877/asset.v5i3.16806.
[14] H. A. M. Salman, R. A. Wahyuono, and T. Warsokusumo, "Optimizing Biomass Pre-Treatment Technologies for BBJP Plants in Indonesia: A Multi-Criteria Decision Making Approach," *Advance Sustainable Science, Engineering and Technology*, vol. 6, no. 1, p. 2401021, 2024.
[15] A. Alwahab, P. T. Maharani, A. Alimin, and A. Zaeni, "Optimization of Biogas Liquid Waste from Livestock Manure as a Source of Renewable Energy through Microbial Fuel Cell (MFC) Technology," *Advance Sustainable Science, Engineering and Technology*, vol. 6, no. 2, p. 240202, 2024.
[16] M. Dey, "Role of university libraries in Sustainable Development Goals realisation," *International Journal of Public Sector Performance Management*, vol. 11, no. 4, pp. 481–493, 2023, doi: 10.1504/IJPSPM.2023.131344.
[17] M. C. Unegbu, O. Immaculata, and B. N. Emuchay, "Information literacy and sustainable development goals implementation: The role of libraries and librarians," *International Journal of Social Science and Education Research Studies*, vol. 3, no. 1, pp. 1017–1112, 2023, doi: 10.55677/ijssers/V03I1Y2023-13.
[18] N. Alfirević, L. Malešević Perović, and M. Mihaljević Kosor, "Productivity and impact of sustainable development goals (SDGs)-related academic research: a bibliometric analysis," *Sustainability*, vol. 15, no. 9, p. 7434, 2023, doi: 10.3390/su15097434.
[19] W. Leal Filho *et al.*, "Integrating the Sustainable Development Goals into the strategy of higher education institutions," *International Journal of Sustainable Development & World Ecology*, vol. 30, no. 5, pp. 564–575, 2023, doi: 10.1080/13504509.2023.2167884.
[20] S. Pakkan, C. Sudhakar, S. Tripathi, and M. Rao, "A correlation study of sustainable development

goal (SDG) interactions," *Quality & Quantity*, vol. 57, no. 2, pp. 1937–1956, 2023, doi: 10.1007/s11135-022-01443-4.
[21] H. G. Abera, "The role of education in achieving the Sustainable Development Goals (SDGs): A global evidence based research article," *International Journal of Social Science and Education Research Studies*, vol. 3, no. 01, pp. 67–81, 2023, doi: 10.55677/ijssers/V03I1Y2023-09.
[22] P. G. Fuchs, C. P. Finatto, R. S. Birch, A. R. de Aguiar Dutra, and J. B. S. O. de Andrade Guerra, "Sustainable development goals (SDGs) in Latin-American universities," *Sustainability*, vol. 15, no. 11, p. 8556, 2023, doi: 10.3390/su15118556.
[23] M. E. Angelaki, F. Bersimis, T. Karvounidis, and C. Douligeris, "Towards more sustainable higher education institutions: Implementing the sustainable development goals and embedding sustainability into the information and computer technology curricula," *Education and Information Technologies*, vol. 29, no. 4, pp. 5079–5113, 2024, doi: 10.1007/s10639-023-12025-8.
[24] C. Persson, D. Einarson, and M. Melén, "Educating the educators to be a driving force in higher education towards sustainable development," *International Journal of Sustainability in Higher Education*, vol. 24, no. 9, pp. 197–212, 2023, doi: 10.1108/IJSHE-10-2022-0332.
[25] E. Mokski, W. Leal Filho, S. Sehnem, and J. B. S. O. de Andrade Guerra, "Education for sustainable development in higher education institutions: an approach for effective interdisciplinarity," *International Journal of Sustainability in Higher Education*, vol. 24, no. 1, pp. 96–117, 2023, doi: 10.1108/IJSHE-07-2021-0306.
[26] D. R. Adhikari and P. Shrestha, "Knowledge management initiatives for achieving sustainable development goal 4.7: higher education institutions' stakeholder perspectives," *Journal of Knowledge Management*, vol. 27, no. 4, pp. 1109–1139, 2023, doi: 10.1108/JKM-03-2022-0172.
[27] G. Murillo-Vargas, C. H. Gonzalez-Campo, and D. I. Brath, "Mapping the Integration of the Sustainable Development Goals in Universities: Is It a Field of Study," *Journal of Teacher Education for Sustainability*, vol. 22, no. 2, pp. 7–25, 2020, doi: 10.2478/jtes-2020-0013.
[28] E. Prieto-Jiménez, L. López-Catalán, B. López-Catalán, and G. Domínguez-Fernández, "Sustainable development goals and education: A bibliometric mapping analysis," *Sustainability (Switzerland)*, vol. 13, no. 4, pp. 1–20, 2021, doi: 10.3390/su13042126.
[29] E. De La Poza, P. Merello, A. Barberá, and A. Celani, "Universities' reporting on SDGs: Using the impact rankings to model and measure their contribution to sustainability," *Sustainability (Switzerland)*, vol. 13, no. 4, pp. 1–30, 2021, doi: 10.3390/su13042038.
[30] A. Mistry, H. Sellers, J. Levesley, and S. Lee, "Mapping a university's research outputs to the UN Sustainable Development Goals," *Emerald Open Research*, vol. 1, no. 9, Dec. 2023, doi: 10.1108/EOR-09-2023-0004.
[31] Elsevier, "What are Sustainable Development Goals (SDGs)? - Scopus: Access and use Support Center." Sep. 08, 2024, [Online]. Available: https://service.elsevier.com/app/answers/detail/a_id/31662/supporthub/scopus/.
[32] A. Kolakoti, M. Setiyo, and M. L. Rochman, "A Green Heterogeneous Catalyst Production and Characterization for Biodiesel Production using RSM and ANN Approach," *International Journal of Renewable Energy Development*, vol. 11, no. 3, pp. 703–712, 2022, doi: 10.14710/ijred.2022.43627.
[33] I. Habibi, Triyono, and N. Muhayat, "A Review on Aluminum Arc Welding and It's Problems," in *Proceedings of the 6th International Conference and Exhibition on Sustainable Energy and Advanced Materials*, 2020, pp. 819–826, doi: 10.1007/978-981-15-4481-1_78.
[34] Y. A. Fatimah, R. Murniningsih, A. Setiawan, and M. Aman, "A Smart Sustainable approach for waste management in post-natural disaster phase," *IOP Conference Series: Materials Science and Engineering*, vol. 674, no. 1, p. 012042, Nov. 2019, doi: 10.1088/1757-899X/674/1/012042.
[35] M. Setiyo, "Alternative fuels for transportation sector in Indonesia," *Mechanical Engineering for Society and Industry*, vol. 2, no. 1, pp. 1–6, 2022, doi: 10.31603/mesi.6850.
[36] M. Setiyo, B. Waluyo, A. Suryawan, M. B. Triyono, and D. E. Murniati, "Alternative model of

curriculum development for vocational higher education: Indonesian perspective," *Curriculum Perspectives*, 2020, doi: 10.1007/s41297-020-00114-4.
[37] M. Murugan *et al.*, "An overview on energy and exergy analysis of solar thermal collectors with passive performance enhancers," *Alexandria Engineering Journal*, vol. 61, no. 10, pp. 8123–8147, Oct. 2022, doi: 10.1016/j.aej.2022.01.052.
[38] T. Raja, M. Setiyo, V. Murugan, and S. Dhandapani, "Analysis of the Temperature Variation of Bizarre Thermal Barrier Coatings and their impacts on Engine," *Automotive Experiences*, vol. 6, no. 3, pp. 497–514, 2023, doi: 10.31603/ae.9802.
[39] C. Rosenthal, Y. A. Fatimah, and W. K. Biswas, "Application of 6R Principles in Sustainable Supply Chain Design of Western Australian White Goods," *Procedia CIRP*, vol. 40, pp. 318–323, 2016, doi: 10.1016/j.procir.2016.01.048.
[40] Y. D. Herlambang *et al.*, "Application of a PEM Fuel Cell Engine as a Small-Scale Power Generator for Small Cars with Different Fuel Concentrations," *Automotive Experiences*, vol. 6, no. 2, pp. 273–289, Aug. 2023, doi: 10.31603/ae.9225.
[41] A. Triwiyatno, S. Munahar, M. Munadi, and J. D. Setiawan, "Application of driving behavior control system using artificial neural network to improve driving comfort by adjusting air-to-fuel ratio," *IIUM Engineering Journal*, vol. 24, no. 2, pp. 337–353, Jul. 2023, doi: 10.31436/iiumej.v24i2.2781.
[42] F. D. Pertiwi, D. C. Anindito, I. Habibi, T. V. Kusumadewi, M. Setiyo, and A. Kolakoti, "Application of Particle Swarm Optimization in Duty Cycle Adjustment for Optimization of Oxyhydrogen Generator," *ASEAN Journal of Science and Engineering*, vol. 4, no. 2, pp. 221–236, 2024, doi: 10.17509/ajse.v4i2.70509.
[43] S. Munahar, A. Triwiyatno, J. D. Setiawan, and M. Munadi, "Assessment of fuel management clusters in the development of a driving behavior control system model using lookup table mapping to improve fuel savings," *Results in Engineering*, vol. 18, p. 101170, Jun. 2023, doi: 10.1016/j.rineng.2023.101170.
[44] A. Kolakoti, M. Setiyo, and B. Waluyo, "Biodiesel Production from Waste Cooking Oil: Characterization, Modeling and Optimization," *Mechanical Engineering for Society and Industry*, vol. 1, no. 1, pp. 22–30, 2021, doi: 10.31603/mesi.5320.
[45] R. P. Putra, D. Yuvenda, M. Setiyo, A. Andrizal, and M. Martias, "Body City Car Design of Two Passengers Capacity: A Numerical Simulation Study," *Automotive Experiences*, vol. 5, no. 2, pp. 163–172, 2022, doi: 10.31603/ae.6304.
[46] M. Setiyo and B. Waluyo, "Captain Seat: Smart Solution for Physical Distancing on Buses During the Covid-19 Pandemic," *Automotive Experiences*, vol. 4, no. 1, pp. 1–4, 2021, doi: 10.31603/ae.4383.
[47] H. Y. Nanlohy, H. Riupassa, and M. Setiyo, "Characterizing of Nano Activated Bio-Carbon of Sago Waste as a Homogeneous Combustion Catalyst," *Automotive Experiences*, vol. 7, no. 1, pp. 77–85, Apr. 2024, doi: 10.31603/AE.10619.
[48] Y. A. Fatimah, D. Kannan, K. Govindan, and Z. A. Hasibuan, "Circular economy e-business model portfolio development for e-business applications: Impacts on ESG and sustainability performance," *Journal of Cleaner Production*, 2023, doi: 10.1016/j.jclepro.2023.137528.
[49] D. Yuvenda *et al.*, "Combustion and Emission Characteristics of CNG-Diesel Dual Fuel Engine with Variation of Air Fuel Ratio," *Automotive Experiences*, vol. 5, no. 3, pp. 507–527, 2022, doi: 10.31603/ae.7807.
[50] A. Damara, B. Waluyo, and Saifudin, "Combustion Velocity Constant of Gasoline-Metanol-(Ethanol) Blend Using the Single Droplet Combustion Method," *E3S Web of Conferences*, vol. 500, p. 03016, Mar. 2024, doi: 10.1051/E3SCONF/202450003016.
[51] M. I. Rosyidi, A. H. Purwantini, L. Muliawanti, B. C. Purnomo, and A. Widyanto, "Communication Participation in Community Empowerment for Energy Independent Tourism Villages in the Pandemic Era," *E3S Web of Conferences*, vol. 232, p. 01036, Jan. 2021, doi: 10.1051/e3sconf/202123201036.

[52] E. M. Widodo, M. Setiyo, M. I. Rosyidi, T. A. Purnomo, M. Husni, and S. Sudaryono, "Comparison of engine performance of Bajaj Qute RE60 using gasoline and LPG," 2020, doi: 10.1088/1742-6596/1517/1/012001.
[53] D. W. Karmiadji, M. Gozali, M. Setiyo, T. Raja, and T. A. Purnomo, "Comprehensive Analysis of Minibuses Gravity Center: A Post-Production Review for Car Body Industry," *Mechanical Engineering for Society and Industry*, vol. 1, no. 1, pp. 31–40, 2021, doi: 10.31603/mesi.5250.
[54] M. I. Rosyidi, E. M. Widodo, T. A. Purnomo, M. Setiyo, and D. W. Karmiadji, "Converting ToD vehicle from gasoline to LPG in Indonesia: Cost identification and investment analysis," *International Journal of Technology*, vol. 11, no. 1, pp. 100–110, 2020, doi: 10.14716/ijtech.v11i1.2161.
[55] M. Setiyo, B. Waluyo, N. Widodo, M. L. Rochman, S. Munahar, and S. D. Fatmaryanti, "Cooling effect and heat index (HI) assessment on car cabin cooler powered by solar panel in parked car," *Case Studies in Thermal Engineering*, vol. 28, no. August, p. 101386, 2021, doi: 10.1016/j.csite.2021.101386.
[56] B. Waluyo *et al.*, "Cooling effect characteristic of the novel half-cycle refrigeration system on a liquefied petroleum gas (LPG) fueled vehicle," *Thermal Science and Engineering Progress*, vol. 34, p. 101405, 2022, doi: 10.1016/j.tsep.2022.101405.
[57] M. Setiyo, D. R. B. Syaka, B. Waluyo, N. Hamidi, and B. F. T. Kiono, "Cooling effect potential from liquefied petroleum gas flow in the fuel line of vehicle," *International Journal of Automotive and Mechanical Engineering*, 2017, doi: 10.15282/ijame.14.4.2017.9.0370.
[58] S. O. Effiom *et al.*, "Cost, Emission, and Thermo-Physical Determination of Heterogeneous Biodiesel from Palm Kernel Shell Oil: Optimization of Tropical Egg Shell Catalyst," *Indonesian Journal of Science and Technology*, 2024, doi: 10.17509/ijost.v9i1.64006.
[59] Y. A. Fatimah, A. Widianto, and M. Hanafi, "Cyber-physical System Enabled in Sustainable Waste Management 4.0: A Smart Waste Collection System for Indonesian Semi-Urban Cities," 2020, doi: 10.1016/j.promfg.2020.02.169.
[60] R. M. Susanto, T. Nurrochman, S. Munahar, and A. I. Ramadhan, "Design and application of electronic tracking control systems (ETCS) to improve vehicle safety," *Automotive Experiences*, 2019, doi: 10.31603/ae.v2i3.2766.
[61] E. Emagbetere *et al.*, "Development and performance evaluation of a portable and cost-effective three-axis CNC drilling machine suitable for small and medium scale manufacturing industries," 2023, doi: 10.1063/5.0120849.
[62] S. Munahar, M. Munadi, B. C. Purnomo, and H. R. Fatoni, "Development of Driver Behavior Research on Vehicles: Article Review," *E3S Web of Conferences*, vol. 500, p. 03005, Mar. 2024, doi: 10.1051/E3SCONF/202450003005.
[63] Y. A. Fatimah, P. O. H. Putra, and Z. A. Hasibuan, "E-business adoption and application portfolio management in remanufacturing small and medium enterprises," 2017, doi: 10.1109/IAC.2016.7905743.
[64] Y. A. Fatimah, R. Murniningsih, and A. Setiawan, "Ecological Smart and Sustainable Waste Management: A Conceptual Framework," in *Sustainable Production, Life Cycle Engineering and Management*, 2021.
[65] B. Waluyo and B. C. Purnomo, "Exhaust Gas Emissions of Homogeneous Gasoline-Methanol-(Ethanol) Blends," *Automotive Experiences*, vol. 5, no. 2, pp. 173–181, 2022, doi: 10.31603/ae.6599.
[66] M. Setiyo, E. M. Widodo, M. I. Rosyidi, T. A. Purnomo, B. S. Rahardja, and S. Suryantoro, "Economic values and CO2 simulation on the application of LPG for public fleets in magelang, Indonesia: Executive data to support the clean city program," *Periodica Polytechnica Transportation Engineering*, vol. 48, no. 2, pp. 159–172, 2020, doi: 10.3311/PPtr.12841.
[67] N. Anisa, D. B. Darmadi, Sugiono, Ngafwan, B. Waluyo, and I. N. G. Wardana, "Effect of papaya latex bio-activators on the morphological changes of recycled pulp fiber and paper properties: A progress towards green technology," 2023, doi: 10.1063/5.0120577.

[68] A. Kolakoti, B. Prasadarao, K. Satyanarayana, M. Setiyo, H. Köten, and M. Raghu, "Elemental, Thermal and Physicochemical Investigation of Novel Biodiesel from Wodyetia Bifurcata and Its Properties Optimization using Artificial Neural Network (ANN)," *Automotive Experiences*, vol. 5, no. 1, pp. 3–15, 2022, doi: 10.31603/ae.6171.
[69] M. Setiyo, B. Waluyo, P. Gobbato, and M. Masi, "Energy efficiency ratio (EER) of novel air conditioning system on LPG fuelled vehicle: A lab-scale investigation," *International Journal of Automotive and Mechanical Engineering*, 2019.
[70] B. Waluyo, Y. Arifatul Fatimah, I. Habibi, F. D. Pertiwi, M. Setiyo, and E. Marlina, "Enhancing Biodiesel-Methanol blends with 1-Butanol for stable and efficient fuels," *Fuel*, 2024, doi: 10.1016/j.fuel.2023.130667.
[71] E. M. Widodo *et al.*, "Environmental benefit of public fleet fueled by LPG/VI-Gas in Magelang City, Indonesia: A Simulation Study," 2019, doi: 10.1088/1757-899X/674/1/012052.
[72] D. W. Karmiadji, M. Gozali, A. Anwar, H. Purnomo, M. Setiyo, and R. Junid, "Evaluation of Operational Loading of the Light-Rail Transit (LRT) in Capital Region, Indonesia," *Automotive Experiences*, vol. 3, no. 3, pp. 104–114, 2020, doi: 10.31603/ae.v3i3.3882.
[73] C. N. Nwaokocha *et al.*, "Experimental investigation into the viability of waste derived fuel from cassava wastes," 2023, doi: 10.1063/5.0120448.
[74] D. C. Anindito, S. Hadi, and D. D. D. P. Tjahjana, "Experimental investigation of stage modification on Savonius rotor," in *AIP Conference Proceedings*, 2023, p. 020015, doi: 10.1063/5.0125824.
[75] W. Anggono, S. Sutrisno, F. D. Suprianto, M. Setiyo, R. Wibisono, and G. J. Gotama, "Experimental investigation of the effect of Nephelium Lappaceum seed biodiesel to the automotive diesel engine performance," 2019, doi: 10.1088/1755-1315/257/1/012039.
[76] A. Kolakoti, A. V. Kumar, R. Metta, M. Setiyo, and M. L. Rochman, "Experimental studies on in-cylinder combustion, exergy performance, and exhaust emission in a Compression Ignition engine fuelled with neat biodiesels," *Indonesian Journal of Science and Technology*, vol. 7, no. 2, pp. 219–236, 2022, doi: https://doi.org/10.17509/ijost.v7i2.49680.
[77] S. Hadi, M. Sidiq, D. C. Anindito, A. Prasetyo, D. D. D. P. Tjahjana, and R. Hadiani, "Experimental study of the effects of blade twist on the performance of Savonius water turbine in water pipe," *Journal of Advanced Research in Fluid Mechanics and Thermal Sciences*, vol. 57, no. 2, pp. 202–207, 2019.
[78] M. Setiyo, E. M. Widodo, M. I. Rosyidi, B. Waluyo, Z. B. Pambuko, and N. Tamaldin, "Feasibility study on small cars as an alternative to conventional fleets due to low occupancy: case study in Indonesia," *Heliyon*, vol. 6, no. 1, p. e03318, 2020, doi: https://doi.org/10.1016/j.heliyon.2020.e03318.
[79] M. Setiyo and B. Waluyo, "Fuel as secondary refrigerant on LPG fuelled vehicle: A thermodynamics analysis," *Journal of Mechanical Engineering and Sciences*, vol. 13, no. 1, pp. 4390–4402, 2019, doi: 10.15282/jmes.13.1.2019.04.0374.
[80] S. Munahar, M. Setiyo, B. C. Purnomo, and Y. Rifangi, "Fuel control system modeling for LPG fueled engine using Adaptive Neuro-Fuzzy Inference Systems (ANFIS)," 2020, doi: 10.1088/1742-6596/1517/1/012013.
[81] B. Waluyo, M. Setiyo, Saifudin, and I. N. G. Wardana, "Fuel performance for stable homogeneous gasoline-methanol-ethanol blends," *Fuel*, vol. 294, p. 120565, 2021, doi: 10.1016/j.fuel.2021.120565.
[82] S. Munahar, A. Triwiyatno, M. Munadi, and J. D. Setiawan, "Fuel Saving Indeks Assessment on Driving Behavior Control System Prototype Model Using Neural Network," *Archives of Transport*, vol. 63, no. 3, pp. 123–141, Sep. 2022, doi: 10.5604/01.3001.0016.0019.
[83] I. C. Setiawan and M. Setiyo, "Fueling the Future: The Case for Heavy-Duty Fuel Cell Electric Vehicles in Sustainable Transportation," *Automotive Experiences*, vol. 7, no. 1, pp. 1–5, Apr. 2024, doi: 10.31603/ae.11285.
[84] S. Munahar, M. Munadi, A. Triwiyatno, and J. D. Setiawan, "Fuzzy Logic Control System For

Fuel-Saving Using Steering Behavior," 2023, doi: 10.1007/978-981-19-3629-6_7.
[85] S. Kamal, S. Munahar, A. Abbas, Y. Ito, and A. Wahyudi, "Hospital Bed for Diabetes Care : An Invention to Support Professional and Hygienic Nursing Practice," *Mechanical Engineering for Society and Industry*, vol. 1, no. 1, pp. 7–13, 2021, doi: 10.31603/mesi.5262.
[86] Y. A. Fatimah, K. Govindan, R. Murniningsih, and A. Setiawan, "Industry 4.0 based sustainable circular economy approach for smart waste management system to achieve sustainable development goals: A case study of Indonesia," *Journal of Cleaner Production*, 2020, doi: 10.1016/j.jclepro.2020.122263.
[87] M. Setiyo *et al.*, "Industry 4.0: Challenges of Mechanical Engineering for Society and Industry," *Mechanical Engineering for Society and Industry*, vol. 1, no. 1, pp. 3–6, 2021, doi: 10.31603/mesi.5309.
[88] T. Kivevele, T. Raja, V. Pirouzfar, B. Waluyo, and M. Setiyo, "LPG-Fueled Vehicles: An Overview of Technology and Market Trend," *Automotive Experiences*, vol. 3, no. 1, pp. 6–19, 2020, doi: 10.31603/ae.v3i1.3334.
[89] H. Hermansyah, L. Lukman, H. J. Prayitno, L. Andriyani, and Y. A. Fatimah, "Mechanical Engineering for Society and Industry: A Preface," *Mechanical Engineering for Society and Industry*, vol. 1, no. 1, pp. 1–2, Jul. 2021, doi: 10.31603/mesi.5313.
[90] M. P. Sari, Y. A. Fatimah, and A. Rifaí, "Microplastics in the Indonesian Small Screen-Printing Industries: Environment and Human Possible Risks," 2023, doi: 10.1063/5.0156148.
[91] S. Munahar, M. Setiyo, M. M. Saudi, A. Ahmad, and D. Yuvenda, "Modelling Fuel Cut Off Controller on CNG Engines Using Fuzzy Logic: A Prototype," *International Journal on Advanced Science, Engineering and Information Technology*, vol. 12, no. 5, pp. 1857–1865, 2022, doi: 10.18517/ijaseit.12.5.16849.
[92] B. Waluyo, B. Pujiarto, N. Ardana, A. Sholiah, M. L. Rochman, and A. T. Adi, "Optimizing energy harvesting from waste motor oil through steam reforming: A path to efficient combustion and emissions reduction," *Mechanical Engineering for Society and Industry*, vol. 3, no. 2, pp. 86–92, 2023, doi: 10.31603/mesi.10362.
[93] A. B. D. Nandiyanto, R. Ragadhita, M. Setiyo, A. S. M. Al Obaidi, and A. Hidayat, "Particulate matter emission from combustion and non-combustion automotive engine process: Review and computational bibliometric analysis on its source, sizes, and health and lung impact," *Automotive Experiences*, vol. 6, no. 3, pp. 599–623, 2023, doi: 10.31603/ae.10259.
[94] S. Sunaryo, S. Suyitno, Z. Arifin, and M. Setiyo, "Performance and emission of a spark-ignition engine using gasoline-plastic pyrolysis oil blends," *Mechanical Engineering for Society and Industry*, vol. 4, no. 1, pp. 68–81, Jul. 2024, doi: 10.31603/MESI.11278.
[95] M. Setiyo, B. Waluyo, N. Widodo, M. L. Rochman, and I. B. Raharja, "Performance of mini air cooler on parked car under direct sunlight," *Journal of Physics: Conference Series*, vol. 1517, no. 1, 2020, doi: 10.1088/1742-6596/1517/1/012002.
[96] L. Muliawanti *et al.*, "Physical distancing methods in public transportation to mitigate Covid-19: Practical evidence from ASEAN countries," 2023, doi: 10.1063/5.0120225.
[97] S. Munahar, M. Setiyo, B. C. Purnomo, B. Waluyo, and W. Himawan, "Prototype development of smart brake controller (SBC) for light-duty vehicles (LDVs) with manual," 2019, doi: 10.1088/1757-899X/674/1/012004.
[98] C. B. E. Praja *et al.*, "Recent patents for handling Covid-19: Snapshot from Indonesian patent database," 2023, doi: 10.1063/5.0120266.
[99] K. Kamigaki, M. Matsumoto, and Y. A. Fatimah, "Remanufacturing and Refurbishing in Developed and Developing Countries in Asia - A Case Study in Photocopiers," 2017, doi: 10.1016/j.procir.2016.11.223.
[100] Y. A. Fatimah and W. K. Biswas, "Remanufacturing as a means for achieving low-carbon SMEs in Indonesia," *Clean Technologies and Environmental Policy*, 2016, doi: 10.1007/s10098-016-1148-5.
[101] Y. A. Fatimah and W. K. Biswas, "Remanufacturing as pathway for achieving circular economy

for Indonesian SMEs," 2017, doi: 10.1007/978-3-319-57078-5_39.
[102] Y. A. Fatimah and M. Aman, "Remanufacturing sustainability indicators: An Indonesian small and medium enterprise case study," 2018, doi: 10.1088/1757-899X/403/1/012055.
[103] I. C. Setiawan and M. Setiyo, "Renewable and Sustainable Green Diesel (D100) for Achieving Net Zero Emission in Indonesia Transportation Sector," *Automotive Experiences*, vol. 5, no. 1, pp. 1–2, Mar. 2022, doi: 10.31603/ae.6895.
[104] S. Munahar, M. Setiyo, F. Masykur, and B. C. Purnomo, "Review of Research on the Application of CNG Fuel in Vehicle Engines: Research Bibliography 2017–2021," 2024, doi: 10.1007/978-981-99-7495-5_26.
[105] R. Rusdjijati, S. A. Subrata, Z. B. Pambuko, M. Setiyo, and M. Noga, "Strategy for Safe Passenger Transport during the COVID-19 Pandemic: From Review to Recommendation," *Automotive Experiences*, vol. 5, no. 2, pp. 90–102, 2022, doi: 10.31603/ae.6593.
[106] B. C. Purnomo, I. C. Setiawan, and H. A. Nugroho, "Study on Cooling System for Parked Cars using Mini Air Cooler and Exhaust Fan," *Automotive Experiences*, vol. 3, no. 2, 2020, doi: 10.31603/ae.v3i2.3801.
[107] Y. D. Herlambang *et al.*, "Study on Solar Powered Electric Vehicle with Thermal Management Systems on the Electrical Device Performance," *Automotive Experiences*, vol. 7, no. 1, pp. 18–27, 2024, doi: 10.31603/ae.10506.
[108] W. Purwanto, J. C. T. Su, M. L. Rochman, B. Waluyo, K. Krismadinata, and A. Arif, "Study on the Addition of A Swirling Vane to Spark Ignition Engines Fueled by Gasoline and Gasoline-Ethanol," *Automotive Experiences*, vol. 6, no. 1, pp. 162–172, 2023, doi: 10.31603/ae.7981.
[109] Y. A. Fatimah and W. K. Biswas, "Sustainability Assessment of Remanufactured Computers," 2016, doi: 10.1016/j.procir.2016.01.087.
[110] A. Kolakoti and M. Setiyo, "Sustainable energy for future needs: An imperative for a greener tomorrow," *Mechanical Engineering for Society and Industry*, vol. 4, no. 1, pp. 1–4, 2024, doi: 10.31603/mesi.11728.
[111] Y. A. Fatimah, W. Biswas, I. Mazhar, and M. N. Islam, "Sustainable manufacturing for Indonesian small- and medium-sized enterprises (SMEs): the case of remanufactured alternators," *Journal of Remanufacturing*, vol. 3, no. 1, p. 6, Dec. 2013, doi: 10.1186/2210-4690-3-6.
[112] Y. A. Fatimah and B. Pujiarto, "Sustainable nature tourism development through ICT implementation: A case of Indonesian Pines Village," 2019, doi: 10.1063/1.5085970.
[113] M. Setiyo, "Sustainable Transport: The Role of Clean Energy, Mass Rapid Transit, Non-motorized Mobility, and Challenges to Achievement," *Automotive Experiences*. 2023, doi: 10.31603/ae.9108.
[114] M. Setiyo, S. Soeparman, N. Hamidi, and S. Wahyudi, "Techno-economic analysis of liquid petroleum gas fueled vehicles as public transportation in Indonesia," *International Journal of Energy Economics and Policy*, 2016.
[115] M. Setiyo, Saifudin, B. C. Purnomo, B. Waluyo, and A. I. Ramadhan, "Temperature Distribution of R-134a Through Aluminum and PTFE Expansion Valve on Automotive Air Conditioning Applications," *ARPN Journal of Engineering and Applied Sciences*, vol. 12, no. 4, pp. 1046–1051, 2017, [Online]. Available: http://www.arpnjournals.org/jeas/research_papers/rp_2017/jeas_0217_5723.pdf.
[116] M. Setiyo, S. Soeparman, S. Wahyudi, and N. Hamidi, "The Alternative Way to Drive the Automobile Air-Conditioning, Improve Performance, and Mitigate the High Temperature: A Literature Overview," *Periodica Polytechnica Transportation Engineering*, vol. 46, no. 1, pp. 36–41, 2018, doi: https://doi.org/10.3311/PPtr.8892.
[117] M. Setiyo, D. Yuvenda, and O. D. Samuel, "The Concise Latest Report on the Advantages and Disadvantages of Pure Biodiesel (B100) on Engine Performance: Literature Review and Bibliometric Analysis," *Indonesian Journal of Science and Technology*, vol. 6, no. 3, pp. 469–490, 2021, doi: 10.17509/ijost.v6i3.38430.
[118] Y. A. Fatimah, K. Govindan, N. A. Sasongko, and Z. A. Hasibuan, "The critical success factors

for sustainable resource management in circular economy: Assessment of urban mining maturity level," *Journal of Cleaner Production*, vol. 469, p. 143084, Sep. 2024, doi: 10.1016/J.JCLEPRO.2024.143084.
[119] M. Setiyo, Saifudin, A. W. Jamin, R. Nugroho, and D. W. Karmiadji, "The Effect of Ethanol on Fuel Tank Corrosion Rate," *Jurnal Teknologi*, vol. 80, no. 6, pp. 19–25, 2018, doi: https://doi.org/10.11113/jt.v80.12324.
[120] S. Ozer, M. Akçay, B. Doğan, D. Erol, and M. Setiyo, "The Effects of Canola Oil/Diesel Fuel/Ethanol/N-Butanol/Butyl Di Glycol Fuel Mixtures on Combustion, Exhaust Gas Emissions and Exergy Analysis," *Automotive Experiences*, vol. 5, no. 3, pp. 268–287, 2022.
[121] R. Widyorini, N. H. Sari, M. Setiyo, and G. Refiadi, "The Role of Composites for Sustainable Society and Industry," *Mechanical Engineering for Society and Industry*, vol. 1, no. 2, pp. 48–53, 2021, doi: 10.31603/mesi.6188.
[122] M. Setiyo and M. L. Rochman, "The role of mechanical engineering in the era of industry 4.0 and society 5.0," *Mechanical Engineering for Society and Industry*, vol. 3, no. 2, pp. 54–56, Dec. 2023, doi: 10.31603/mesi.10786.
[123] B. Waluyo, I. N. G. Wardana, L. Yuliati, M. N. Sasongko, and M. Setiyo, "The role of polar ethanol induction in various iso-octane ethanol fuel blend during single droplet combustion," *Fuel Processing Technology*, vol. 199, p. 106275, 2020, doi: https://doi.org/10.1016/j.fuproc.2019.106275.
[124] A. I. Rahimi, D. C. Anindito, D. Danardono, and S. Hadi, "The Straight Blade Application to Increasing the Performance of the Savonius Water Turbine (Simulation Study)," in *Proceedings of the 6th International Conference and Exhibition on Sustainable Energy and Advanced Materials*, 2020, pp. 243–256, doi: 10.1007/978-981-15-4481-1_24.
[125] F. I. Abam *et al.*, "Thermodynamic modelling of a novel solar-ORC with bottoming ammonia-water absorption cycle (SORCAS) powered by a vapour compression refrigeration condensate for combined cooling and power," *Mechanical Engineering for Society and Industry*, 2023, doi: 10.31603/mesi.10365.
[126] A. Arisman and Y. A. Fatimah, "Waste Management in Indonesia: Strategies and Implementation of Sustainable Development Goals (SDGs) and Circular Economy," *Circular Economy Adoption: Catalysing Decarbonisation Through Policy Instruments*, pp. 131–157, Jan. 2023, doi: 10.1007/978-981-99-4803-1_5.
[127] M. Setiyo *et al.*, "Preface," in *Journal of Physics: Conference Series*, Apr. 2020, vol. 1517, no. 1, p. 011001, doi: 10.1088/1742-6596/1517/1/011001.
[128] M. Setiyo *et al.*, "Preface," in *E3S Web of Conferences*, Mar. 2024, vol. 500, p. 00001, doi: 10.1051/e3sconf/202450000001.
[129] Y. A. Fatimah, "Prefeace," in *IOP Conference Series: Materials Science and Engineering*, Nov. 2019, vol. 674, no. 1, p. 011001, doi: 10.1088/1757-899X/674/1/011001.
[130] B. Waluyo, I. N. G. Wardana, L. Yuliati, M. N. Sasongko, and M. Setiyo, "The role of polar ethanol induction in various iso-octane ethanol fuel blend during single droplet combustion," *Fuel Processing Technology*, 2020, doi: 10.1016/j.fuproc.2019.106275.
[131] M. Setiyo, D. R. B. Syaka, B. Waluyo, and ..., "Cooling effect potential from liquefied petroleum gas flow in the fuel line of vehicle," ... *Journal of Automotive ...*, 2017, [Online]. Available: http://ijame.ump.edu.my/images/Volume 14 Issue 4 2017/9_Setiyo et al.pdf.
[132] A. Körfgen *et al.*, "It's a Hit! Mapping Austrian research contributions to the sustainable development goals," *Sustainability (Switzerland)*, vol. 10, no. 9, pp. 1–13, 2018, doi: 10.3390/su10093295.
[133] X. Hong, A. Calderon, and H. Coates, "Universities and SDGs: evidence of engagement and contributions, and pathways for development," *Policy Reviews in Higher Education*, vol. 7, no. 1, pp. 56–77, Jan. 2023, doi: 10.1080/23322969.2022.2121311.