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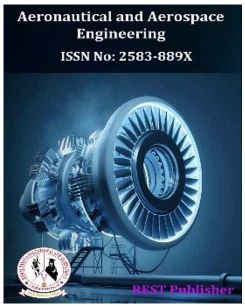

An Analysis of Selecting Sustainable Alternative Aviation Fuels in Supply Chain Management

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Abstract. *Aviation gases have been performing a significant role in the social and economic growth of any nation, and demand is anticipated to rise in the upcoming years as a result of the accelerated development of technology. Particularly, growing urbanization has significantly increased fossil fuel use, and excessive reliance on carbon-based fuels has seriously harmed the environment worldwide. As the globe looks for fresh approaches to combat "climate change and global warming", "Renewable fuels and hydrogen" have emerged as the ecological sectors' saviors. One such industry is aviation. The current aviation sector's objective is economically efficient aviation. To prevent global warming, there is gaining awareness in attaining carbon-neutral aviation. Since it is defined as comparing their respective priority in a limited number of options, the selection of the best sustainable AAF can be thought of as "a multi-criterion decision-making (MCDM) problem". Here "The EDAS method" is used to select the most preferred alternate aviation gasoline. The rank of "Algal-based fuel is third, Petroleum refining is fourth, Soybean-based fuel is second and Fischer-Tropsch synthesis based on natural gas is first". This study's findings indicate that among the alternative aviation fuels considered, "Fischer-Tropsch synthesis based on natural gas" is the best option, whereas "petroleum-refined Aviation gasoline (avgas)" is the least popular.*

Keywords: *Sustainable alternative aviation fuels, GHG emissions, social benefits, Efficiency and MCDM*

1. INTRODUCTION

Recent years have seen a significant increase in interest in "sustainable aviation fuel (SAF)", a feasible substitute for non-renewable fossil fuels that are produced from renewable bio-based supplies. The SAF offers a much smaller CO2 emission effect when subjected to fossil sources [1,2]. Given the benefits to the ecology, SAF is currently not economically competitive because of its high manufacturing costs. Several organizational initiatives, financial assistance from the government, and strong laws are required to promote the universal implementation of SAF by the aviation sector [3]. By enhancing technical comprehension of the production processes, examining the demands of the supply chain, and lowering the uncertainties and risks related to launching "commercial-scale bio-refinery projects, incentives" are also required to make SAF affordable with fossil energy [4]. The ecological impacts of SAF use, including carbon offset and water use, are also severely examined. Also investigated is a thorough comparative evaluation of various bio-conversion techniques using diverse feedstocks. SAF can dramatically cut "CO2 emissions from the aviation sector" and make a significant contribution to climate change remedies, although there are still technological, economic, and policy obstacles [5,6]. As the transition to carbon-neutral mobility proceeds, the aviation sector is under more stress than ever to reduce its carbon footprint. A further factor supporting the need for fewer emissions is the expectation that commercial aircraft traffic will continue the steady expansion it had before the pandemic. To reduce dependency on fossil fuels and achieve future emission objectives, alternative fuel use is crucial. " Sustainable aviation fuels (SAF)", which comprise bio and synthetic fuels, are currently the most practicable choice. As a long-term solution, hydrogen is also getting considered [7,8].

At the moment, kerosene fuels make up the majority of aviation fuels, however, it is acknowledged that switching to "sustainable aviation fuels (SAFs)" is both advantageous and necessary as petroleum dregs are depleting and, consequently, their prices are rising. The IATA has identified the production of drop-in self-sustaining petroleum products as possibly the best potential program to lower the sector's impact on the ecosystem because traditional fuel economy breakthroughs are inadequate to satisfy the company's objectives for carbon reduction and power generation along with sophisticated aircraft architecture or hydrogen involvement require extensive construction reconfiguration of the entire segment [9,10].
In particular, one of the key pillars supporting the advancement of sophisticated aviation fuel technology is fuel supply. In recent years, various sustainable alternative fuels, such as coal, gas, and biomass, have been employed in aviation fuel manufacturing in addition to the traditional dissolved crude products used to make aviation fuel. These alternative aircraft fuels (AAFs) can not only expand the sources of aircraft fuel but also firmly guarantee the supply of aircraft fuel while

taking environmental conservation into account [11,12]. Since more sophisticated aviation fuel innovations are more helpful to enable the attainment of a low-carbon aviation sector, it is imperative to support and advocate the use of a variety of alternative fuels to enhance and promote the sustainable expansion of the aviation industry. When confronted with a variety of AAFs that can be offered as candidates for aviation power, it is typically of utmost importance to choose the best AAF by weighing factors such as "product costs, availability, technological maturity, sustainability", etc. To put it another way, various aviation fuels may appear to differ regarding "economic, social, and other factors" [13,14]. Even though several new AAFs may have more favourable environmental effects than conventional aviation fuels, they may not be as advantageous in other ways. When faced with several conflicting criteria, this makes it difficult for decision-makers (DMs) to choose the best aviation fuel, which is also known as "a typical multi-attribute decision analysis (MADA) problem". The purpose of this study is to help DMs evaluate the sustainability of AAFs and choose the most appropriate one from a comprehensive view. As a result, it is crucial to investigate their sustainable showings to choose the most self-sustaining fuels for aeroplanes throughout their lives [15,16]. In this study, four aviation fuels are being considered as alternatives: "Fischer-Tropsch synthesis based on natural gas (A4), Algal-based fuel (A1), Petroleum refining (A2), and soy-based fuel (A3)". Regarding the DMs, it is acknowledged that the AAF selection is a rather difficult issue that calls for DMs to concurrently take into account "environmental, social, and technical performance in addition to economic performance" [17]. "Economic (Capital cost, Production cost per unit), environmental (GHG emissions), social (Social benefits, Efficiency), and technical criteria (Innovation) are chosen to be evaluated the sustainability aim. Additionally, from the body of current literature, sub-criteria relevant to each requirement were gathered and vetted.

2. MATERIALS AND METHODS

Keshavarz Ghorabaee et al. established the evaluation technique called "EDAS (Evaluation Based on Distance from Average Solution) (2015)". The "distance from average solution (AV)" correlated to the best option in the EDAS technique [18]. "The positive distance from average (PDA) and the negative distance from average (NDA)" are the first two measurements produced by the EDAS approach. These metrics can display the variance between every alternate solution and the median answer [19]. Greater PDA scores and lesser NDA rates will therefore signify the ideal solution. Larger PDA and/or NDA values indicate that the alternative option is superior to the average answer [20].

- Select the characteristics that best define the decision possibilities for the given decision problem. It constructed the choice matrix X, which shows how different solutions fare in comparison to particular standards.

$$X = \begin{bmatrix} x_{11} & x_{12} & \cdots & x_{1n} \\ x_{21} & x_{22} & \cdots & x_{2n} \\ x_{31} & x_{32} & \cdots & x_{3n} \end{bmatrix} \quad (1)$$

- Weights for the criteria are expressed in equation 2.

$$w_j = [w_1 \quad \cdots \quad w_n], \text{ where } \sum_{j=1}^{n}(w_1 \quad \cdots \quad w_n) = 1 \quad (2)$$

- The average result concerning all criteria must be computed using the formulas presented below, per the specification of the EDAS method:

$$AV_j = \frac{\sum_{j=1}^{n} k_{ij}}{n} \quad (3)$$

- The "positive distance from average (PDA)" is expressed in equation 4. Here B is "Beneficial criteria" and C is "non-beneficial criteria".

$$PDA_{ij} = \begin{cases} \frac{\max(0,(x_{ij}-AV_{ij})}{AV_{ij}} & | \ j \in B \\ \frac{\max(0,(AV_{ij}-x_{ij})}{AV_{ij}} & | \ j \in C \end{cases} \quad (4)$$

- The "negative distance from average (NDA)" is expressed in equation 5. Here B is "Beneficial criteria" and C is "non-beneficial criteria".

$$NDA_{ij} = \begin{cases} \frac{\max(0,(AV_{ij}-x_{ij})}{AV_{ij}} & | \ j \in B \\ \frac{\max(0,(x_{ij}-AV_{ij})}{AV_{ij}} & | \ j \in C \end{cases} \quad (5)$$

- Applying equation 2 calculated by multiplying by factors 4 and 5, respectively, "the weighted sum of the positive and negative distances from the average solution for all options" is normalized. The below Equation calculates "weighted sums of the positive and negative distance".

$$SP_i = \sum_{j=1}^{m} w_j \times PDA_{ij} \quad (6)$$

$$SN_i = \sum_{j=1}^{m} w_j \times NDA_{ij} \quad (7)$$

- The "weighted sum of the positive and the negative distance from the average solution for all alternatives" is normalized using equations 8 and 9.

$$NSP_i = \frac{SP_i}{max_i(SP_i)} \quad (8)$$

$$NSN_i = 1 - \left(\frac{SN_i}{max_i(SN_i)}\right) \quad (9)$$

- The "average of the normalized weighted sum of the positive and negative distances from the average solution for all alternatives" is used to determine the "final appraisal score (ASi) for all alternatives".

$$AS_i = \frac{(NSP_i + NSN_i)}{2} \quad (10)$$

where "0 ≤ ASi ≤ 1". The alternative with "the highest appraisal score" is selected as the most preferred choice among the other preferred choice [21,22]. In this research, "Algal-based fuel (A1), Petroleum refining (A2), Soybean -based fuel (A3), and Fischer-Tropsch synthesis based on natural gas (A4)", are being chosen for evaluation as alternatives. For the assessment, the criteria closely related to the conservation target are chosen, namely "economic (Capital cost, Production cost per unit), environmental (GHG emissions), social (Social benefits, Efficiency) and technical criteria (Innovation)".

3. ANALYSIS AND DISCUSSION

TABLE 1. Decision matrix for sustainability selection of AAFs

AAFs	EP1	EP2	EP3	EP4	EP5	EP6
AAF1	6	5	7	7	5	6
AAF2	4	6	2	4	5	5
AAF3	7	6	6	6	6	5
AAF4	6	5	3	3	3	1
AVj	5.75	5.50	4.50	5.00	4.75	4.25

Table 1 shows data for the "Decision matrix for sustainability selection of AAFs". the alternatives considered are "Algal-based fuel (AAF1), Petroleum refining (AAF1), Soybean -based fuel (AAF1) and Fischer-Tropsch synthesis based on natural gas (AAF1)". The attributes are considered "social benefits (EP1), Efficiency (EP2), Innovation (EP3), Capital cost (EP4), Production cost per unit (EP5) and GHG emissions (EP6)". "Social benefits, Efficiency and Innovation" are beneficial attributes. "Capital cost, Production cost per unit and GHG emissions" are non-beneficial attributes. Then, "the corresponding average solution (AV) for all evaluation criteria" is calculated from equation 3 which can be seen in the last row of Table 1.

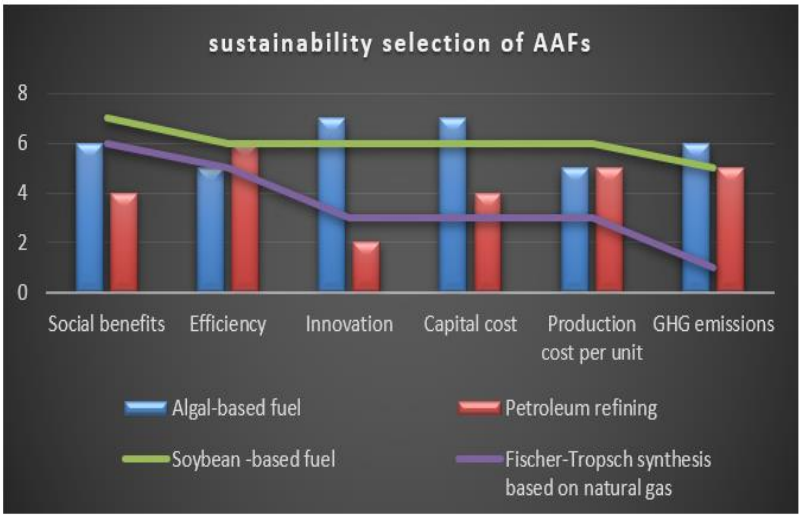

FIGURE 1. sustainability selection of AAFs

Figure 1 represents the data for the sustainability selection of AAFs. the alternatives considered are "Algal-based fuel (AAF1), Petroleum refining (AAF1), Soybean -based fuel (AAF1) and Fischer-Tropsch synthesis based on natural gas

(AAF1)". The attributes are considered "social benefits, Efficiency, Innovation, Capital cost, Production cost per unit and GHG emissions". "Social benefits, Efficiency and Innovation" are beneficial attributes. "Capital cost, Production cost per unit and GHG emissions" are non-beneficial attributes.

TABLE 2. PDA

0.0435	0.0000	0.5556	0.0000	0.0000	0.0000
0.0000	0.0909	0.0000	0.2000	0.0000	0.0000
0.2174	0.0909	0.3333	0.0000	0.0000	0.0000
0.0435	0.0000	0.0000	0.4000	0.3684	0.7647

Table 2 displays the PDA corresponding to the evaluation criteria. "The positive distance from average (PDA) value" is calculated using "the average solution" from table 1 concerning "type of criteria (Beneficial criteria and non-Beneficial criteria)" as displayed in equation 4.

TABLE 3. NDA

0.00000	0.09091	0.00000	0.40000	0.05263	0.41176
0.30435	0.00000	0.55556	0.00000	0.05263	0.17647
0.00000	0.00000	0.00000	0.20000	0.26316	0.17647
0.00000	0.09091	0.33333	0.00000	0.00000	0.00000

Table 3 displays the NDA corresponding to the evaluation criteria. "The Negative distance from average (NDA) value" is calculated using "the average solution" from table 1 about "type of criteria (Beneficial criteria and non-Beneficial criteria)" as displayed in equation 5.

TABLE 4. Weight

0.1667	0.1667	0.1667	0.1667	0.1667	0.1667
0.1667	0.1667	0.1667	0.1667	0.1667	0.1667
0.1667	0.1667	0.1667	0.1667	0.1667	0.1667
0.1667	0.1667	0.1667	0.1667	0.1667	0.1667

Table 4 shows the weights distributed to the alternatives. Here weights are equally distributed among evaluation parameters "social benefits, Efficiency, Innovation, Capital cost, Production cost per unit and GHG emissions". The weights assigned to the test parameters add up to one.

TABLE 5. Weighted PDA

Weighted PDA						SPi
0.00725	0.00000	0.09259	0.00000	0.00000	0.00000	0.09984
0.00000	0.01515	0.00000	0.03333	0.00000	0.00000	0.04848
0.03623	0.01515	0.05556	0.00000	0.00000	0.00000	0.10694
0.00725	0.00000	0.00000	0.06667	0.06140	0.12745	0.26277

Table 5 shows the data values of "the Weighted Positive Distance from the Average and the sum of the Weighted Positive Distance from the Average". It is calculated using equation 6. "The weighted matrix of PDA" is calculated using the multiplication of the matrix of PDA from table 2 and the matrix of criteria weight W from table 4. Then "the sum of the weighted PDA values" is calculated corresponding to the alternates.

TABLE 6. Weighted NDA

Weighted NDA						SNi
0.00000	0.01515	0.00000	0.06667	0.00877	0.06863	0.15922
0.05072	0.00000	0.09259	0.00000	0.00877	0.02941	0.18150
0.00000	0.00000	0.00000	0.03333	0.04386	0.02941	0.10660
0.00000	0.01515	0.05556	0.00000	0.00000	0.00000	0.07071

Table 6 shows the data values of "the Weighted Negative Distance from the Average and the sum of the Weighted Negative Distance from the Average". It is calculated using equation 7. "The weighted matrix of PDA" is calculated using the multiplication of the matrix of PDA from table 3 and the matrix of criteria weight W from table 4. Then "the sum of the weighted NDA values" is calculated corresponding to the alternates.

TABLE 7. NSPi and NSNi value

AAFs	NSPi	NSNi
AAF1	0.37995	0.12277
AAF2	0.18452	0.00000
AAF3	0.40697	0.41265
AAF4	1.00000	0.61043

Table 7 shows the normalized values of "the Weighted Positive Distance from the Average and the Weighted negative Distance from the Average". SPi and SNi values are normalized by equations 8 and 9 using values from tables 5 and 6.

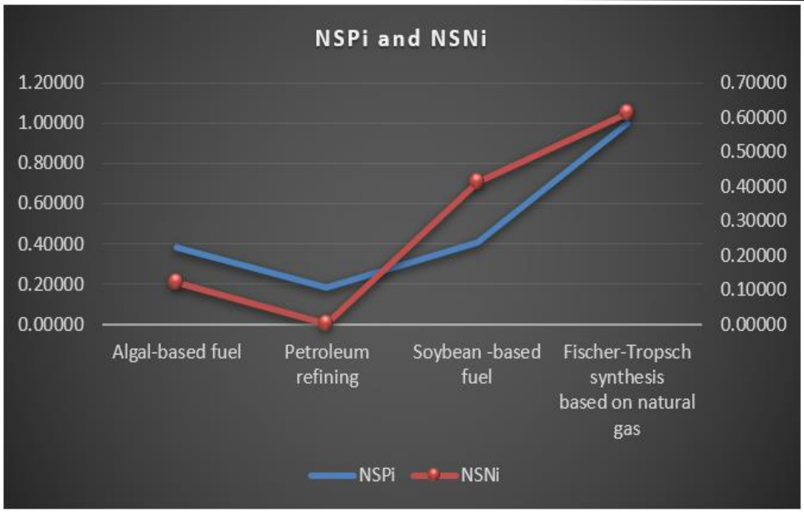

FIGURE 2. NSPi and NSNi value

Figure 2 shows a graphical representation of the normalized values of "the Weighted Positive Distance from the Average and the Weighted negative Distance from the Average". SPi and SNi values are normalized by equations 8 and 9 using values from tables 5 and 6.

TABLE 8. ASi

AAFs	ASi
AAF1	0.25136
AAF2	0.09226
AAF3	0.40981
AAF4	0.80522

Table 8 shows the final appraisal score of alternative aviation fuels calculated by using 10. The final appraisal score values were calculated using the average of NSPi and NSNi. Here the final appraisal score for "Algal-based fuel (AAF1) is 0.25136, Petroleum refining (AAF1) is 0.09226, Soybean -based fuel (AAF1) is 0.40981 and Fischer-Tropsch synthesis based on natural gas (AAF1) is 0.80522".

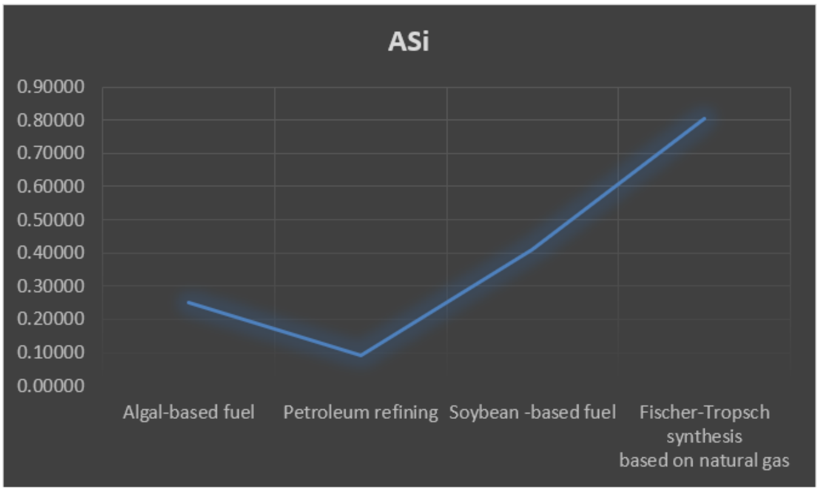

FIGURE 3. final appraisal score of alternative robots

Figure 3 illustrates the final appraisal score of alternative aviation fuels calculated by using 10. The final appraisal score values were calculated using the average of NSPi and NSNi. Here the final appraisal score for "Algal-based fuel (AAF1) is 0.25136, Petroleum refining (AAF1) is 0.09226, Soybean -based fuel (AAF1) is 0.40981 and Fischer-Tropsch synthesis based on natural gas (AAF1) is 0.80522".

TABLE 9. Rank

AAFs	Rank
Algal-based fuel	3
Petroleum refining	4
Soybean -based fuel	2
Fischer-Tropsch synthesis based on natural gas	1

Table 9 shows the final rank of alternative aviation fuels calculated by using 10. In this instance, the options are listed in decreasing order by the "final assessment score (AS)". Here rank of “Algal-based fuel is third, Petroleum refining is fourth, Soybean-based fuel is second and Fischer-Tropsch synthesis based on natural gas is first”. The ranking order is “AAF4>AAF3>AAF1>AAF2”

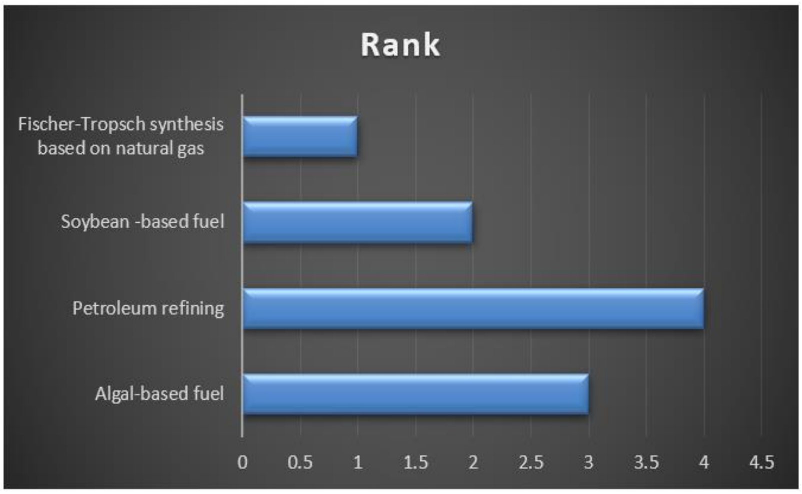

TABLE 4. The rank of alternative robots

Figure 4 shows a graphical representation of the final rank of alternative aviation fuels calculated by using 10. The options are listed here in order of descending of "the final appraisal score (AS)". Here rank of “Algal-based fuel is third, Petroleum refining is fourth, Soybean-based fuel is second and Fischer-Tropsch synthesis based on natural gas is first”. The result of this paper shows that “Fischer-Tropsch synthesis based on natural gas is the best alternate aviation fuel and petroleum refined Aviation gasoline (avgas) is the least preferred” among the selected alternate aviation fuels.

4. CONCLUSION

As the globe looks for new strategies to combat "climate change and global warming" sustainable fuels like hydrogen have emerged as saviors for environmentally harmful industries like flying. Ecological flying is currently the company's main priority. As a way to slow global warming, the goal of achieving carbon-neutral flying is becoming more and more popular. Hydrogen is a successful alternative energy source that is suited. It is abundant, pure, and produces no carbon dioxide, but after use, all that is left behind is water, which has the power to cool the environment. Additionally, one of the most crucial pillars supporting the advancement of sophisticated aviation fuel innovation is the availability of fuel. Recently, in addition to the aircraft fuels produced from conventionally distilled crude goods, several promising alternative energies have also been employed in aviation energy production. For instance, aircraft fuels can be derived from "coal, gas, and biomass". These "alternative aviation fuels (AAFs)" have the potential to diversify avgas fuel sources while also firmly ensuring the supply of aviation fuel while taking environmental conservation into account. This study's goal is to help DMs evaluate the sustainability of AAFs and choose the most appropriate one from a broad perspective. It is crucial to analyses their sustainable performances to choose the most ecological fuels for aircraft during their lives. The rank of “Algal-based fuel is third, Petroleum refining is fourth, Soybean -based fuel is second and Fischer-Tropsch synthesis based on natural gas is first”. The result of this paper shows that “Fischer-Tropsch synthesis based on natural gas is the best alternate aviation fuel and petroleum refined Aviation gasoline (avgas) is the least preferred” among the selected alternate aviation fuels.

REFERENCE

[1]. Wei, Hongjian, Wenzhi Liu, Xinyu Chen, Qing Yang, Jiashuo Li, and Hanping Chen. "Renewable bio-jet fuel production for aviation: A review." *Fuel* 254 (2019): 115599.

[2]. Rathor, Ketan, Jaspreet Kaur, Ullal Akshatha Nayak, S. Kaliappan, Ramya Maranan, and V. Kalpana. "Technological Evaluation and Software Bug Training using Genetic Algorithm and Time Convolution Neural Network (GA-TCN)." In *2023 Second International Conference on Augmented Intelligence and Sustainable Systems (ICAISS)*, pp. 7-12. IEEE, 2023.

[3]. Happonen, Maija, Lisa Rasmusson, Anna Elofsson, and Anneli Kamb. "Aviation’s climate impact allocated to inbound tourism: decision-making insights for “climate-ambitious” destinations." *Journal of Sustainable Tourism* (2022): 1-17.

[4]. Martinez-Hernandez, Elias, Luis Felipe Ramírez-Verduzco, Myriam A. Amezcua-Allieri, and Jorge Aburto. "Process simulation and techno-economic analysis of bio-jet fuel and green diesel production—Minimum selling prices." *Chemical Engineering Research and Design* 146 (2019): 60-70.

[5]. Kumar, Ashish, Ketan Rathor, Snehit Vaddi, Devanshi Patel, Preethi Vanjarapu, and Manichandra Maddi. "ECG Based Early Heart Attack Prediction Using Neural Networks." In *2022 3rd International Conference on Electronics and Sustainable Communication Systems (ICESC)*, pp. 1080-1083. IEEE, 2022.

[6]. Bauen, Ausilio, Niccolò Bitossi, Lizzie German, Anisha Harris, and Khangzhen Leow. "Sustainable Aviation Fuels: Status, challenges and prospects of drop-in liquid fuels, hydrogen and electrification in aviation." *Johnson Matthey Technology Review* 64, no. 3 (2020): 263-278.

[7]. Makde, Shivani, Sonali Deshmukh, Bhuvaneshwari Gaddamwar, Khushbu Akare Poonam Thakur, Nikita Dongre, Shraddha Malwe, and Ansar Sheikh. "A Review on Detection of Covid Symptoms." *International Journal of Computational and Electronics Aspects in Engineering* 2, no. 3 (2021).

[8]. Baumann, Franz. "Sounding the climate alarm—scientists and politics." In *Conservation Science and Advocacy for a Planet in Peril*, pp. 41-71. Elsevier, 2021.

[9]. Rajagopalan, Sundararaman, Sivaraman Rethinam, V. Lakshmi, J. Mahalakshmi, R. Ramya, and Amirtharajan Rengarajan. "Secure medical image sharing: a hardware authentication approach." In *2017 international conference on microelectronic devices, circuits and systems (ICMDCS)*, pp. 1-4. IEEE, 2017.

[10]. Aswini, S., S. Tharaniya, R. J. Joey Persul, B. Avinash Lingam, and P. Kogila. "Assessment of Knowledge, Attitude and Practice on Immunization among Primi Mothers of Children." *Indian Journal of Public Health Research & Development* 11, no. 3 (2020).

[11]. T. Santhosh; Harshitha. T. N,; Sathiyaraj Chinnasamy; M. Ramachandran, "Adaptive Subgradient Methods for Leadership And Development", Recent trends in Management and Commerce 4(2) 2023, 101-106.

[12]. Nygren, Emma, Kjell Aleklett, and Mikael Höök. "Aviation fuel and future oil production scenarios." *Energy Policy* 37, no. 10 (2009): 4003-4010.

[13]. Wang, Meng, Raf Dewil, Kyriakos Maniatis, John Wheeldon, Tianwei Tan, Jan Baeyens, and Yunming Fang. "Biomass-derived aviation fuels: Challenges and perspective." *Progress in Energy and Combustion Science* 74 (2019): 31-49.

[14]. Kousoulidou, Marina, and Laura Lonza. "Biofuels in aviation: Fuel demand and CO2 emissions evolution in Europe toward 2030." *Transportation Research Part D: Transport and Environment* 46 (2016): 166-181.

[15]. Rathor, Ketan, Sushant Lenka, Kartik A. Pandya, B. S. Gokulakrishna, Susheel Sriram Ananthan, and Zoheib Tufail Khan. "A Detailed View on industrial Safety and Health Analytics using Machine Learning Hybrid Ensemble Techniques." In *2022 International Conference on Edge Computing and Applications (ICECAA)*, pp. 1166-1169. IEEE, 2022.

[16]. MAHADULE, TUSHAR B., ROMESHWARI D. CHETULE, VARSHA V. KAMBLE, ASAWARI CHARDE, and ANSAR I. SHEIKH. "Remote Android Access via SMS." (2020).

[17]. Ng, Kok Siew, Danial Farooq, and Aidong Yang. "Global biorenewable development strategies for sustainable aviation fuel production." *Renewable and Sustainable Energy Reviews* 150 (2021): 111502.

[18]. Gonzalez-Garay, Andres, Clara Heuberger-Austin, Xiao Fu, Mark Klokkenburg, Di Zhang, Alexander van der Made, and Nilay Shah. "Unravelling the potential of sustainable aviation fuels to decarbonise the aviation sector." *Energy & Environmental Science* 15, no. 8 (2022): 3291-3309.

[19]. Gössling, Stefan, and Chris Lyle. "Transition policies for climatically sustainable aviation." *Transport Reviews* 41, no. 5 (2021): 643-658.

[20]. U. Midhundev; Harshith. T. N,; M. Ramachandran; Kurinjimalar Ramu, "An Empirical Investigation of Innovation and Technology in Banking" , Recent trends in Management and Commerce 4(2), 2023: 121-129.

[21]. Rene Robin, C. R., D. Moses, D. V. Babu, B. Subramanian, and S. Siva Shankar. "A Novel Hybrid Based Method in Covid 19 Health System for Data Extraction with Blockchain Technology." *International Journal on Recent and Innovation Trends in Computing and Communication* (2023): 81-94.

[22]. Rathor, Ketan, Anshul Mandawat, Kartik A. Pandya, Bhanu Teja, Falak Khan, and Zoheib Tufail Khan. "Management of Shipment Content using Novel Practices of Supply Chain Management and Big Data Analytics." In *2022 International Conference on Augmented Intelligence and Sustainable Systems (ICAISS)*, pp. 884-887. IEEE, 2022.

[23]. Raghu, D., T. Srikanth, and Ch Raja Jacub. "Probability based heart disease prediction using data mining techniques." *IJCST* 2, no. 4 (2011): 66-68.

[24]. Tasisa, Yirgalem Bekele, and Kogila Palanimuthu. "Psychosocial Impacts of Imprisonment among Youth Offenders in Correctional Administration Center, Kellem Wollega Zone, Ethiopia." *Medico-legal Update* 21, no. 2 (2021).

[25]. Manivannan, P., and CS Kanimozhi Selvi. "Pairwise relative ranking technique for efficient opinion mining using sentiment analysis." *Cluster Computing* 22 (2019): 13487-13497.

[26]. Yilmaz, Nadir, and Alpaslan Atmanli. "Sustainable alternative fuels in aviation." *Energy* 140 (2017): 1378-1386.

[27]. Yamuna Devi, M. M., J. Jeyabharathi, S. Kirubakaran, Sreekumar Narayanan, T. Srikanth, and Prasun Chakrabarti. "Efficient segmentation and classification of the lung carcinoma via deep learning." *Multimedia Tools and Applications* (2023): 1-15.

[28]. Capaz, Rafael S., Elisa Guida, Joaquim EA Seabra, Patricia Osseweijer, and John A. Posada. "Mitigating carbon emissions through sustainable aviation fuels: costs and potential." *Biofuels, Bioproducts and Biorefining* 15, no. 2 (2021): 502-524.

[29]. Abrantes, Ivo, Ana F. Ferreira, André Silva, and Mário Costa. "Sustainable aviation fuels and imminent technologies-CO2 emissions evolution towards 2050." *Journal of Cleaner Production* 313 (2021): 127937.

[30]. Gutu, Birhanu, Genene Legese, Nigussie Fikadu, Birhanu Kumela, Firafan Shuma, Wakgari Mosisa, Zelalem Regassa et al. "Assessment of preventive behavior and associated factors towards COVID-19 in Qellam Wallaga Zone, Oromia, Ethiopia: A community-based cross-sectional study." *PloS one* 16, no. 4 (2021): e0251062.

[31]. Spoorthi. S,; Harshith. T. N,; M. Ramachandran; Chandrasekar Raja, " A Review on Child Safety Monitoring System Based on IOT", Recent trends in Management and Commerce 4(2), 2023: 130-135.

[32]. Zhang, Libing, Terri L. Butler, and Bin Yang*. "Recent trends, opportunities and challenges of sustainable aviation fuel." *Green Energy to Sustainability: Strategies for Global Industries* (2020): 85-110.

[33]. Heyne, Joshua, Bastian Rauch, Patrick Le Clercq, and Meredith Colket. "Sustainable aviation fuel prescreening tools and procedures." *Fuel* 290 (2021): 120004.

[34]. Nirmala, A. P., Ansar Isak Sheikh, and R. Kesavamoorthy. "An Approach for Detecting Complications in Agriculture Using Deep Learning and Anomaly-Based Diagnosis." *Mathematical Statistician and Engineering Applications* 70, no. 2 (2021): 880-889.

[35]. Gajala, Gowtham, and Nagavarapu Sateesh. "Adopting Domain based Reuse for Large-scale Company." *International Journal of Science and Research (IJSR), ISSN*: 2319-7064.

[36]. Manjunath, C. R., Ketan Rathor, Nandini Kulkarni, Prashant Pandurang Patil, Manoj S. Patil, and Jasdeep Singh. "Cloud Based DDOS Attack Detection Using Machine Learning Architectures: Understanding the Potential for Scientific Applications." *International Journal of Intelligent Systems and Applications in Engineering* 10, no. 2s (2022): 268-271.

[37]. Palanimuthu, Kogila, Eshetu Fikadu Hamba Yigazu, Gemechu Gelalcha, Yirgalem Bekele, Getachew Birhanu, and Birhanu Gutu. "Assessment of Stress, Fear, Anxiety and Depression on COVID-19 Outbreak among Adults in South-Western Ethiopia." *Prof.(Dr) RK Sharma* 21, no. 1 (2021): 440.

[38]. Chai, Naijie, and Wenliang Zhou. "A novel hybrid MCDM approach for selecting sustainable alternative aviation fuels in supply chain management." *Fuel* 327 (2022): 125180.

[39]. Sundar, R., Sudhir Ramadass, D. Meeha, Balambigai Subramanian, S. Siva Shankar, and Gayatri Parasa. "Evaluating the Solutions to Predict the Impact of Lung Cancer with an Advanced Intelligent Computing Method." In *2023 5th International Conference on Smart Systems and Inventive Technology (ICSSIT)*, pp. 1733-1737. IEEE, 2023.

[40]. Madhusekhar, Y., P. Sandhya Priyanka, Deena Babu Mandru, and T. Srikanth. "Blockchain: A Safe Way to Transfer Signatures in a Distributed Intrusion Detection System." In *Intelligent Manufacturing and Energy Sustainability: Proceedings of ICIMES 2022*, pp. 261-273. Singapore: Springer Nature Singapore, 2023.

[41]. Dhumras, Himanshu, and Rakesh Kumar Bajaj. "Modified EDAS method for MCDM in robotic agrifarming with picture fuzzy soft Dombi aggregation operators." *Soft Computing* (2023): 1-22.

[42]. Zhang, Li, Sudhakar Sengan, and P. Manivannan. "The capture and evaluation system of student actions in physical education classroom based on deep learning." *Journal of Interconnection Networks* 22, no. Supp02 (2022): 2143025.

[43]. Krishna, S. Rama, Ketan Rathor, Jarabala Ranga, Anita Soni, D. Srinivas, and Anil Kumar. "Artificial Intelligence Integrated with Big Data Analytics for Enhanced Marketing." In *2023 International Conference on Inventive Computation Technologies (ICICT)*, pp. 1073-1077. IEEE, 2023.

[44]. Bhandekar, Prarthana, Chanchal Tomar, Divyani Kasewar, and Ansar Sheikh. "A Survey on Smart Trolley System Based on Android Application." *Engineering and Technology* 4, no. 4 (2018): 55-56.

[45]. Adali, Esra Aytac, Gülin Zeynep Öztaş, Tayfun Öztaş, and Ayşegül Tuş. "Assessment of European cities from a smartness perspective: An integrated grey MCDM approach." *Sustainable Cities and Society* 84 (2022): 104021.

[46]. El-Araby, Ahmed, Ibrahim Sabry, and Ahmed El-Assal. "A comparative study of using MCDM methods integrated with entropy weight method for evaluating facility location problem." *Operational Research in Engineering Sciences: Theory and Applications* 5, no. 1 (2022): 121-138.

[47]. Rathor, Ketan, Keyur Patil, Mandiga Sahasra Sai Tarun, Shashwat Nikam, Devanshi Patel, and Sasanapuri Ranjit. "A Novel and Efficient Method to Detect the Face Coverings to Ensurethe Safety using Comparison Analysis." In *2022 International Conference on Edge Computing and Applications (ICECAA)*, pp. 1664-1667. IEEE, 2022.

[48]. Gajala, Gowtham, and Nagavarapu Sateesh. "Multiple Routing Configurations for Fast IP Network Recovery." *International Journal of Advanced Research in Computer and Communication Engineering* 2, no. 4 (2013).

[49]. Toan, Pham Ngoc, Thanh-Tuan Dang, and Le Thi Thu Hong. "Evaluating video conferencing software for remote working using two-stage grey MCDM: a case study from Vietnam." *Mathematics* 10, no. 6 (2022): 946.

[50]. Palanimuthu, Kogila, Birhanu Gutu, Leta Tesfaye, BuliYohannis Tasisa, Yoseph Shiferaw Belayneh, Melkamu Tamiru, and Desalegn Shiferaw. "Assessment of Awareness on COVID-19 among Adults by Using an Online Platform: 26 Countries View." *Medico-legal Update* 21, no. 1 (2021).

[51]. Bhadra, Debanan, and Nikhil Ranjan Dhar. "Selection of the natural fiber for sustainable applications in aerospace cabin interior using fuzzy MCDM model." *Materialia* 21 (2022): 101270.

