Journal of Ecohumanism
2024
Volume: 3, No: 8, pp. 6384 – 6393
ISSN: 2752-6798 (Print) | ISSN 2752-6801 (Online)
https://ecohumanism.co.uk/joe/ecohumanism
DOI: https://doi.org/10.62754/joe.v3i8.5271

Optimization of Evaluation Criteria for Energy Research Proposals using the Patton-Sawicki Framework: A Case Study in The Research Organization for Energy and Manufacture

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Abstract

The global energy crisis has affected energy markets and policies around the world. In addition, the issue of global warming requires the world to switch to clean energy sources. The Indonesian government has committed to switching from fossil energy subsidies to renewable energy to achieve Net Zero Emissions (NZE) by 2060 or sooner. The National Research and Innovation Agency (BRIN) established the Energy and Manufacturing Research Organization (OREM) to support the NZE program. One of OREM's initiatives is the Call For Joint Collaboration (CFJC) which provides an opportunity for researchers to propose research proposals in various energy fields. However, the assessment of the CFJC proposal has not used scientific methods or criteria so that the results of the proposal evaluation are not optimal yet. Therefore, this study proposes optimization of evaluation criteria using the Patton-Sawicki Framework to determine the qualified proposal to be accepted. The research uses a qualitative approach method using CFJC proposal data on OREM in 2023. The results show that the proposed method is able to improve the quality of the proposal evaluation process by only accepting proposals that meet the requirements to support the development of NRE sector in Indonesia.

Keywords: *Net Zero Emission (NZE), New and Renewable Energy (NRE), Proposal evaluation criteria, Patton-Sawicki Framework.*

Introduction

The world is currently experiencing a global energy crisis with an unprecedented depth of complexity. Moreover, the Russia-Ukraine war has had a significant impact on the global energy crisis by disrupting the flow of energy resources from Russia to countries around the world, especially Europe (Hubacek et al., 2023). This has a major influence on markets, policies, and economies around the world (IEA, 2022). The most affected by the crisis are low- and middle-income countries (Goldthau, 2022). The world energy crisis also has a significant impact on Indonesia, which is an importer of oil and gas. Indonesia's energy-dependent economy was affected by the crisis that led to a recession in 2020. The increase in crude oil prices due to the global energy crisis has caused an increase in the burden of subsidies and compensation for the State Budget (Setiadi, 2023).

Energy consumption in Indonesia is still dominated by fossil energy, namely petroleum, natural gas, and coal, while New and Renewable Energy (NRE) is still considered as an alternative (Lestari, 2021). The Indonesian government plans to shift subsidies from fossil energy to renewable energy, which is included in the National Medium-Term Development Plan (Perdana, 2023). This commitment is to achieve the Net Zero Emissions (NZE) target by 2060 or sooner (The Ministry of Finance (Republic of Indonesia), 2022). This is supported by the fact that Indonesia has considerable potential sources of renewable energy, including solar, wind, marine, and bioenergy energy (IRENA, 2022; International Trade Administration, 2024). However, until 2023, the contribution of NRE has only reached 13.09% of the total energy mix. This realization is still below the target set at 17.87% (Indonesian Ministry of Energy and Mineral Resources-ESDM, 2024).

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The Ministry of Energy and Mineral Resources has projected investment costs to increase NRE plants to reach USD36.95 billion by 2029. One of the efforts to optimize the potential of innovations in the field of sustainable energy is synergy with local governments, universities, research institutions, and industries both national and multinational companies (Coaction Indonesia, 2021). The National Research and Innovation Agency (BRIN) as a research institution is committed to developing research and innovation in the field of NRE to encourage "energy sovereignty" in Indonesia (The National Research and Innovation Agency, 2022). In carrying out research in the energy sector, BRIN established The Energy and Manufacturing Research Organization (OREM) on March 4, 2022. OREM-BRIN as the only research institution in the field of non-structural energy in Indonesia, is expected to be able to produce research activities that are right on target to support the Indonesian government's program to achieve NZE in 2060.

In 2023, OREM was supported by 7 Research Centers with 75 Research Groups. Starting in 2023, OREM is opening a research funding scheme called "Call For Joint Collaboration (CFJC)". This funding scheme provides opportunities for researchers within BRIN to submit research proposals with main topics that include the development of Organic Rankine Cycle (ORC) technology, Fuel Cell and Hydrogen, Smartgrid, Underground Coal Gasification, Carbon Capture, Utilization, and Storage (CCUS), Energy conservation, Biomass Co-firing, solar, water, wind, Geothermal Power Plant, Biofuel, waste to energy, and energy storage. In the implementation of CFJC in 2023, there are 210 research proposals with various topics in the energy sector. With the limited resources (funds, manpower3, time) and accuracy of intending recipients of research funds at OREM, the proper evaluation of CFJC proposals in the energy sector is needed.

LITERATURE REVIEW

In public administration, the evaluation of activities has an important role because it helps measure the effectiveness, efficiency, and impact of policies implemented by the government. Patton and Sawicki's model generally use evaluation criteria that are important to the problem and relevant to decision-makers in the implementation process. Patton-Sawicki theory proposes four dimensions in carrying out policy evaluation (Patton, C. et al., 2016), namely: (a) Technical feasibility; (b) Political viability; (c) Economic and financial possibility; (d) Administrative operability. In addition to formative and summative evaluation, they are also known as "outcome evaluation" and "process evaluation" (California State University Long Beach, 2024).

The Patton-Sawicki model evaluation criteria have been applied to various projects. In public policy evaluation, The Patton-Sawicki evaluation is used to evaluate the impact of regional development programs by comparing economic indicators before and after the implementation of the policy (Wijayanti et al., 2021; Rachmawati & Rinjany, 2016). Healthcare interventions often use Patton-Sawicki's model evaluation to analyze revealed areas where the policy could be enhanced to ensure timely, safe, and appropriate discharges for all patients. By identifying problems, determining clear policy objectives, establishing evaluation criteria, and suggesting viable alternatives, the study emphasizes the importance of ongoing monitoring and evaluation (Hamzah et al., 2014). Additionally to evaluate the impact of healthcare access policies on the practices of primary healthcare providers and assess their perspectives on access disparities (Josephs, 2015).

As a results, studies on policy evaluation have been carried out by previous researchers from various fields. However, based on Scopus data, studies on policy evaluation using the Patton-Sawicki framework to assess proposals for research activities in the energy field have not been found. Therefore, this study aims to fill the gap in the topic of policy evaluation by using the Patton-Sawicki framework in assessing research proposals for energy sector that can complement the topic of policy evaluation studies and are expected to be able to produce quality research activities with efficient resource allocation and ensure research success. Patton-Sawicki's evaluation criteria can be applied in the energy sector to assess proposed renewable energy policies, energy efficiency measures, or greenhouse gas emission reduction strategies.

The policy of NRE research development in Indonesia is regulated by Presidential Regulation Number 22 of 2017 concerning the General Plan of National Energy which formulates policies, strategies, and

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programs for energy resources management and energy utilization in Indonesia. OREM followed up this policy through the implementation of CFJC in the field of NRE concerning the Implementation of New Energy Development Research Activities in 2023. This research proposes an evaluation method using the Patton-Sawicki criteria to determine potential recipients of research funding.

METHODS

This research uses a qualitative research method approach. Qualitative methods are research approaches used to understand and explain human phenomena in their natural context, with emphasis on the interpretation, context, and meaning involved. This approach involves collecting non-numerical data, such as interviews, observations, or document analysis, and analyzing that data descriptively and interpretively (Cresswell, 2014; Merriam & Tisdell, 2015; Patton, 2014). This qualitative method approach can produce a richer and more comprehensive understanding (Cresswell, 2014), provide greater flexibility (Merriam & Tisdell, 2015), and be able to uncover aspects that are not measurable (Patton, 2014). The flow chart methodology of this study is shown in Figure 1.

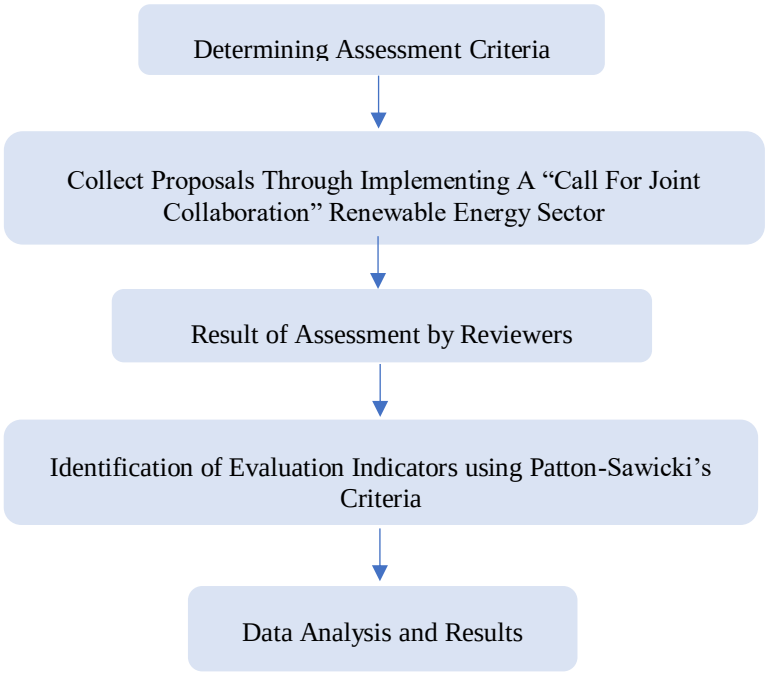

Figure 1. Flowchart of the methodology

Patton-Sawicki's evaluation criteria is used to emphasize qualitative aspects such as relevance, effectiveness, and stakeholder satisfaction (Patton, 2014; Fetterman et al., 2015). Each of the stages is described as follows:

Determining Assessment Criteria

The criteria are prepared based on the goals and context of the proposal in the energy sector, namely (1) Proposal Content (Introduction, Background, Goals, and Objectives); (2) Researcher's Track Record; (3) Partnerships; (4) Output target; and (5) Description of the prototype.

Table 1. CFJC Assessment Criteria for Energy Sector in 2023

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Judging Criteria	Indicator
1. Content of the Proposal (Introduction, Background, Goals, and Objectives)	a. Linkage to the topic of NRE b. Originality/Novelty c. Rationality to achieve goals
2. Track Record Researcher	a. Research Coordinator qualification b. Team competence b. Continuity of research from the previous year
3. Partnership	a. Partner competencies with the research topic b. Financial sharing
4. Output Target	a. International publications b. Intellectual Property Right b. Prototype
5. Description of the prototype (if the main target is prototype)	a. Facility Availability b. Mass production Probability

Collect Proposals Through Implementing a "Call For Joint Collaboration" Renewable Energy Sector

In 2023, OREM opens an opportunity for the BRIN community to propose research proposals in NRE development. This activity is called "Call Joint For Collaboration" because it is open to all BRIN researchers, not limited to researchers at OREM only. This funding scheme is a stage for the implementation of research activities in 2024.

Table 2. CFJC Research Topic in 2023

Cluster	Topic
1. Main Outputs and Energy Conservation Technologies	a. additive development for high-biomass cofiring power plant b. Organic Rankine Cycle (ORC) and low enthalpy generation system c. Carbon Capture and Storage d. Waste to energy e. Green infrastructure and energy conservation
2. Liquid Fuels	a. Bio-Diesel b. Bio-Ethanol c. Bio-avtur d. Bio-fuel
3. Fuel Gas	a. Hydrogen b. Green Ammonia c. Biogas d. Syngas and Hydro Carbon based products
4. Electrical NRE Cluster	a. Variable Renewable Energy (VRE) b. Smart grid c. Energy Management System d. Ocean energy e. Floating Solar Power Plant (Appropriate Technology) f. Hydro Energy (Appropriate Technology) g. Wind Energy (Appropriate Technology)

Result of Assessment by Reviewers

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An evaluation is carried out by reviewers who are experts in NRE sector according to the topic. The purpose of this assessment is to determine the quality, excellence, and feasibility of the proposal. This assessment uses the criteria in step 2.1 and sets a minimum threshold for the value of proposals. Then the results of this assessment will be used to determine whether the proposal is worthy of further funding or not.

Identification of Evaluation Indicators using Patton Sawicki's Criteria

Based on the results of the reviewers' assessment, data collection was carried out using qualitative methods following an approach involving contextual understanding and document analysis (Rubin & Rubin, 2011) of CFJC proposals. Then the indicator identification was carried out using Patton-Sawicki's evaluation criteria. This evaluation criterion will be weighted based on interviews with experts in the NRE sector.

Table 3. Indicators based on Patton Sawicki's evaluation criteria

Evaluation Criteria	Indicator
1. Technical feasibility	a. Technical capacity of man power b. Resource availability c. Suitability of technology for end user d. Compliance with applicable standards
2. Economic and financial possibility	a. Availability of funding b. Cost analysis c. Projected income obtained from research d. Return on investment
3. Political viability	a. Policy support b. Impact on the public interest c. Support from stakeholders
4. Administrative operability	a. Availability of infrastructure and administrative facilities b. Availability of supporting human resources c. Managerial capacity

Data Analysis and Result

Data analysis is carried out by identifying the indicators set out in Table 3. Each proposal will be analyzed into 5 (five) categories based on the number of criteria that the proposal can fulfill. First, "Very Inappropriate" means that none of Patton-Sawicki's evaluation criteria were met by the proposal. Second, "Not Appropriate" indicates that only 1 criterion is met by the proposal. Third, "Suitable Enough" means that only 2 criteria are met by the proposal. Forth, "Suitable" indicates that there are 3 criteria met by the proposal. "Very Suitable" means that all criteria are met by the proposal. Based on this category, management can see the quality of the proposal and provide input to researchers so they can organize information, reduce complexity, and make data analysis easier so that research can be finished successfully (Neuman, 2014).

From data analysis using Patton-Sawicki's evaluation criteria approach, proposals that meet the criteria can be obtained so that they can provide recommendations for accepted and rejected proposals. Therefore, this study is expected to provide deeper insight into the quality and success of proposals in the energy sector. Moreover, this study also can be use as a recommendation for improving the criteria for the next CFJC evaluation.

RESULTS

Data collection of the research's proposal have been obtained from CFJC in NRE sector in the period 2-20 October 2023 for the 2024 financial year. There are 210 submitted proposals and divided into 4 clusters

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as shown in Figure 2, namely (1) Main Output and Energy Conservation Technology: 80 proposals; (2) Liquid Fuels: 55 proposals; (3) Fuel Gas: 30 proposals; and (4) Smart Electricity: 40 proposals. Some proposals that are not related to the four clusters will be categorized into Cluster 5, Other Cluster as many as 5 proposals. This cluster is used as a basis for determining the team of reviewers based on expertise.

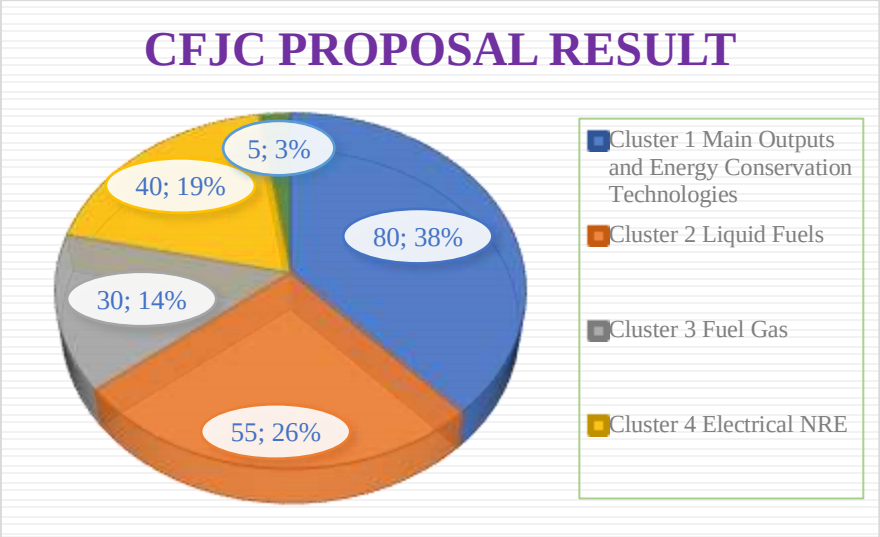

Figure 2. Submitted Proposals in CFJC by Cluster

The reviewers conducted an assessment using the given criteria by OREM's Management as shown in Table 1 with a threshold value of 70 for acceptable proposals. As a results, 103 proposals were accepted, and 107 proposals were rejected, and the assessment results for each cluster can be seen in Figure 3.

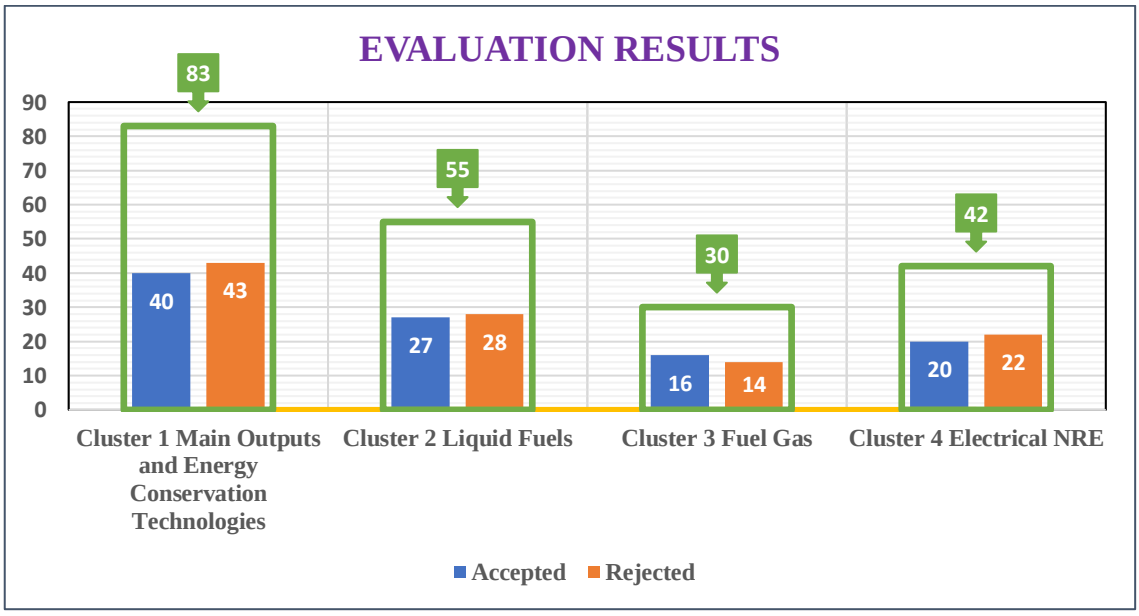

Figure 3. Evaluation Results of CFJC Proposal

Then, the evaluation results from the reviewer are used as input data in Patton-Sawicki's evaluation criteria approach as shown in Table 3. The assessment results are classified into 5 categories, namely (1) Very Inappropriate, (2) Not Appropriate, (3) Suitable Enough, (4) Suitable, (5) Very Suitable. The categories are then compared with the percentage of the budget received and the budget proposed in the proposal. This budget percentage indicates that in terms of Economic and financial possibility, the ability of researchers

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to estimate their budget needs against the assessment of budget rationality based on reviewers who are experts in NRE sector. The assessment results of each cluster are shown in Figure 4.

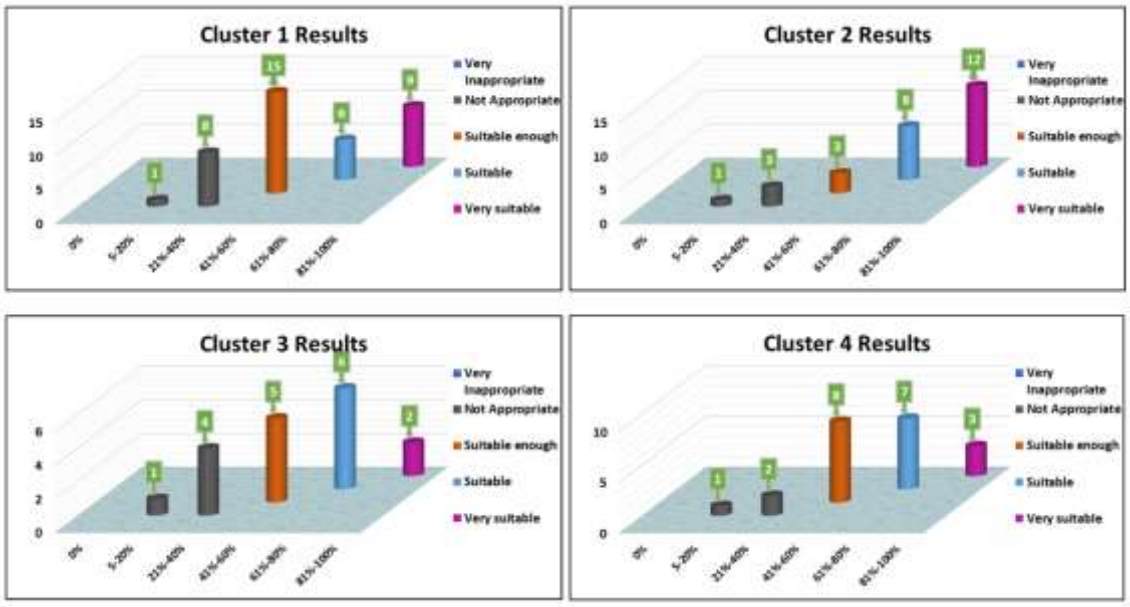

Figure 4. Evaluation Results using Proposed Evaluation Method by Clusters

In Cluster 1, the majority proposals fall into the categories of "Suitable Enough", "Suitable", and "Very Suitable". This mean that most proposals in this cluster meet some or all of Patton-Sawicki's evaluation criteria well. A significant proportion of proposals fall into the "Suitable Enough" category, meaning almost all criteria are met, but there are still have opportunities for improvement of proposals. Cluster 2 shows that the majority of proposals fall into the "Suitable" and "Very Suitable" categories. This shows that most of the proposals in this cluster meet Patton-Sawicki's evaluation criteria, with optimal budget allocation. The proportion of Cluster 3 is almost like Cluster 1, where the majority of proposals in this cluster fall into the categories of "Suitable Enough", "Suitable", and "Very Suitable". However, Cluster 3 has fewer proposals that fall into the "Very Suitable" category compared to Cluster 1 and Cluster 2. Finally, Cluster 4 showed that the majority of proposals received good reviews, with most falling into the categories of "Suitable Enough", "Suitable", and "Very Suitable". However, the number of proposals that fall into the "Very Suitable" category is slightly lower than that of Cluster 2. Overall, it appears that the majority of proposals in each cluster have been assessed well according to Patton-Sawicki's evaluation criteria. In addition, the proportion of proposals that obtained a "Very Suitable" rating was quite high indicating that most proposals had met all criteria well with appropriate budget allocations. Cluster 1 and Cluster 2 may perform slightly better than Cluster 3 and Cluster 4, especially for the proportion of proposals that fall into the "Very Suitable" category.

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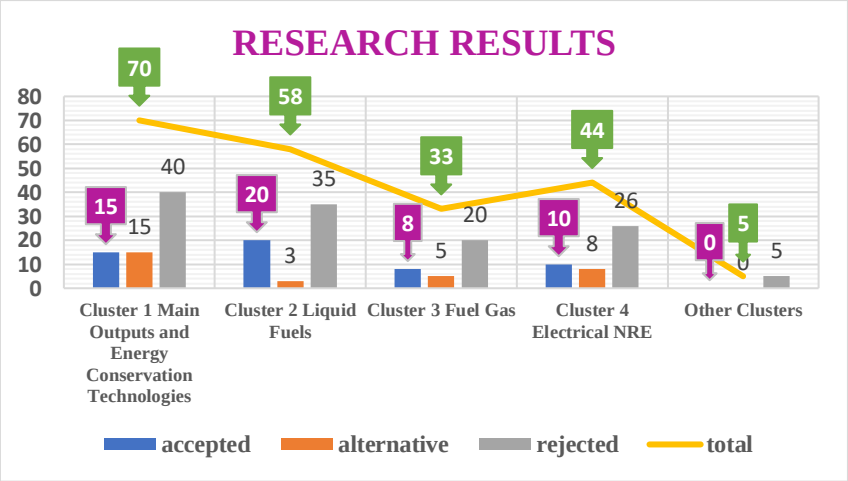

Figure 5. Evaluation Results Based on Proposed Research Method

From the CFJC proposal, 5 proposals do not meet all criteria, because the technical feasibility criteria are not met where the proposal is not included in the research topic set by OREM management. This resulted in the proposal being rejected immediately. Then proposals that fall into the category of very inappropriate and not appropriate are also rejected because they are only able to meet 1 criterion. From this study, 126 proposals were rejected. Then there are 31 proposals, where the status is an alternative proposal because it is only able to meet 2 criteria but can still be improved proposals to meet the required criteria. Furthermore, 53 proposals were received because they were able to meet at least 3 Patton-Sawicki criteria as shown in Figure 5.

Conclusions

Evaluation Criteria Optimization using the Patton-Sawicki Framework has been proposed in this study. Proposal Evaluation has been carried out for Energy Research Proposals in the Research Organization for Energy and Manufacture. The implementation of CFJC in the NRE sector is important to support the Indonesian government's program to achieve NZE in 2060. The improvements of proposal evaluation by adding underrepresented evaluation criteria, namely Economic and financial possibility, and administrative operability using Patton-Sawicki's platform has been done in this study. This study is important to support the best decision-making for the advancement of research in the field of NRE, especially in OREM-BRIN. Thus, the addition of underrepresented evaluation criteria and the more consistent application of Patton-Sawicki's evaluation criteria can help improve the quality of the proposal assessment process and ensure that only the best proposals are received to support progress in NRE sectors at OREM and support government programs. However, other aspects may not be represented by Patton-Sawicki's evaluation criteria, such as environmental or social factors relevant to technology-based energy projects. In this context, future research needs to examine other influential criteria in energy research. Moreover, further research is needed using quantitative methods so that assessment criteria can be formulated specifically and can be measured clearly.

Acknowledgments: We thank Dr. Cuk Supriyadi Ali Nandar S.T., M.Eng, Head of The Energy and Manufacturing Research Organization, who provided insight and expertise that greatly assisted the research, and Dr. Haznan Abimanyu Dip.Ing., Former Head of The Energy and Manufacturing Research Organization, for giving permission to collect data for this paper/research.

Funding: This research was funded by a grant from Degree By Research (DBR) The National Research and Innovation Agency (BRIN), grant No. 161/II.2.3/KP/2023.

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