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Greenhouse Gas Reduction Strategy at PT. XYZ Uses Fishbone Method and Analytical Hierarchy Process (AHP)

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***Abstract*—** Climate change is becoming a global issue today. The world responded to the issue of climate change by convening a UN Convention called the UNFCCC with the main objectives that include efforts to limit global temperature rise to 1.5°C and releasing a Special Report on it. The World Resources Institute (WRI), CDP, WWF and the UN Global Compact responded to the Special Report by creating an initiative called Science-based targets (SBTi) that shows companies how much and how quickly businesses need to reduce their GHG emissions to prevent the worst impacts of climate change. XYZ Company, a multinational company that also runs its business in Indonesia, joined SBTi's commitment and decided to implement project selection using the Fishbone & Analytical Hieararchy Project (AHP) method to reduce Greenhouse Gas emissions by 37.8%. The results of the study were obtained in the form of selecting policies that can be done to reduce GHG impacts, namely by substituting the use of electrical energy, the most priority is the purchase of a Renewable Energy Certificate (REC) with the highest weight of 0.545, the second priority is the installation of Solar Power with a weight of 0.232, the next priority is to use Savings for some of its activities with a weight of 0.130 and the last priority is to replace the type of Freon with weight of 0.093.

***Keywords*—** AHP, GRK, SBTi, emission reduction, REC.

I. INTRODUCTION

Project management is a discipline that involves planning, organizing, directing, and supervising resources to achieve certain goals within established time limits and budgets. A project is defined as a complex, non-routine endeavor limited by time, budget, resources, and performance specifications to meet customer needs.

Company XYZ, a multinational company that also runs its business in Indonesia, joined SBTi's commitment and decided to implement the project selection using the Analytical Hieararchy Project method (AHP) to reduce Greenhouse Gas emissions by 37.8%.

Company XYZ has set two specific goals to achieve zero emissions. The first goal is a reduction in direct emissions under operational control (scope 1) and indirect emissions from purchased energy (scope 2) by 37.8% compared to 2021. The second goal is to reduce all indirect emissions in Company XYZ's value chain (scope 3) by 25% compared to the 2022 baseline. The following is data on emission sources &; energy use from XYZ Company's operations in 2022-2023:

Table 1. *XYZ company's Emission Footprint for 2022-2023*

Emission Footprints (tonnes CO2e-)	Oct	Nov	Dec	Jan	Feb	March
Diesel	7,11	0,27	0,36	0,27	0,27	0,36
LPG	0,00	0,00	0,15	0,00	0,00	0,00
Refrigerant	0,00	44,66	0,00	0,00	0,00	95,05
Vehicular Emissions	5,31	5,80	5,77	4,92	6,20	6,78
Natural Gas	377,10	388,04	339,41	381,52	316,72	324,78
Total Scope 1	**390**	**439**	**346**	**387**	**323**	**427**
Electricity Consumption	436,86	501,62	459,94	519,21	448,14	548,56
Total Scope 2	**437**	**502**	**460**	**519**	**448**	**549**
Total Scope 1 & 2	**826**	**940**	**806**	**906**	**771**	**976**

Source: Internal Data of XYZ Company

Refer to the data in Table 1. The carbon footprint generated from purchasing electricity from PLN is at an average of 450 tons of CO2e-, followed by emissions from the use of LNG from PGN at an average of 350 tons of CO2e-, so from data analysis, further development research is needed on how to reduce carbon emission footprint and initiation of appropriate carbon reduction projects in order to achieve PT. XYZ to achieve zero emissions. The following is the percentage of carbon footprint of XYZ company's total emissions for 2022-2023.

Table 2. *Percentage of Company XYZ's Emission Footprint 2022- 2023*

Emission Footprints	Oct	Nov	Dec	Jan	Feb	Mar
Diesel	0,86%	0,03%	0,04%	0,03%	0,03%	0,04%
LPG	0,00%	0,00%	0,02%	0,00%	0,00%	0,00%
Refrigerant	0,00%	4,75%	0,00%	0,00%	0,00%	9,74%
Vehicular Emissions	0,64%	0,62%	0,72%	0,54%	0,80%	0,69%
Natural Gas	45,63%	41,26%	42,13%	42,11%	41,06%	33,29%
Purchased Electricity	52,86%	53,34%	57,09%	57,31%	58,10%	56,23%

Source: *Internal Data of XYZ Company*

Refer to the data in Table 2. The carbon footprint generated from purchasing electricity from PLN is at a percentage of 58.1%, followed by emissions from the use of LNG from PGN at a percentage of 41.06%, so from data analysis, further research is needed on how to reduce carbon emission footprint and initiate appropriate carbon reduction projects in order to achieve PT. XYZ to achieve zero emissions.

The company has sorted the percentage of energy use for 2022-2023:

Table 3. *Energy Consumption Percentage of Company XYZ*

Energy Consumption	Oct	Nov	Dec	Jan	Feb	March
Electricity	21,1%	23,2%	24,0%	24,2%	24,8%	28,2%
Diesel (Generator)	1,0%	0,0%	0,1%	0,0%	0,0%	0,1%
Diesel	0,5%	0,5%	0,7%	0,4%	0,7%	0,7%
LPG	0,0%	0,0%	0,0%	0,0%	0,0%	0,0%
Petrol (Vehicular)	0,3%	0,3%	0,3%	0,3%	0,3%	0,4%
Natural Gas (boiler)	77,0%	75,9%	75,0%	75,1%	74,1%	70,6%
Total	100,0%	100,0%	100,0%	100,0%	100,0%	100,0%

Sumber: Data Internal

From table 3, it can be seen that the criteria for the percentage of the company's energy consumption for 6 months are dominated by PGN's natural gas by 75% and the percentage of energy consumption from PLN's electricity purchases is 23%.

From these criteria, project selection will be identified with a priority scale in order to achieve the renewable energy mix target and reduce XYZ company emissions. Not only producing a list of project selections, later a feasibility study analysis will be carried out on renewable energy projects that may be carried out at XYZ company.

World experts recognize the importance of project management in climate mitigation efforts, particularly related to reducing greenhouse gas emissions. Through research and different initiatives, as described in MIT's Climate Grand Challenges and the World Resources Institute, comprehensive strategies have been designed

to address these challenges across a range of industry sectors, including textiles and clothing.

According to MIT's Climate Grand Challenges, the textile industry, responsible for 5-10% of global greenhouse gas emissions, can reduce its carbon footprint through innovations in science, technology, operations, and business practices. The strategy includes the development of low-carbon ingredients and additives, more efficient manufacturing processes, smart products, changes in consumer behavior, and systemic analysis to measure the impact of new technologies on reducing greenhouse gas emissions.

Meanwhile, the World Resources Institute (2022), in collaboration with the Apparel Impact Institute, has released a roadmap outlining the steps the apparel sector must take to achieve net zero emissions. This includes collaboration to improve GHG impact data, improve manufacturing energy efficiency, invest in renewable energy in supply chains, increase the use of sustainable materials, and invest in R&D for next-generation materials. These measures could contribute more than 60% of the emissions reductions needed for industry to stay on track at 1.5°C under the Paris Agreement

This research was conducted at PT. XYZ to identify alternative emission reduction projects, find out the criteria for renewable energy projects, get priority from the selection of project proposals and greenhouse gas emission reduction policies.

II. LITERATURE REVIEW

Climate mitigation (IPCC, 2022) is an effort to reduce greenhouse gas (GHG) emissions that cause climate change. Climate mitigation is important to prevent or mitigate the negative impacts of climate change, such as sea level rise, changes in weather patterns, and biodiversity loss.

There are many ways to mitigate climate. Some common ways to do this include:

- Switch to renewable energy, such as solar, wind, and hydro. Renewable energy produces no GHG emissions, so it can help reduce emissions significantly.
- Reduce energy use, such as by saving energy at home and at work.
- Reduce deforestation, because forests play an important role in absorbing GHGs from the atmosphere.
- Support sustainable agriculture, such as by using fertilizers and pesticides wisely

In the implementation of GHG emission mitigation strategies, there are 4 main strategies (Wahyudi, 2018). That is:

1. Elimination: Avoid or eliminate activities that use equipment that can cause GHG emissions. Example: Using manual equipment that does not use electrical energy.
2. Reduction: Perform efficiency if using equipment that requires electrical energy. Examples: Turn off lights when not in use, unplug cables when equipment is not in use, etc.
3. Substitution: Replacing or changing technology that is more efficient and lower CO2 emissions. Example: Replacing Incandescent Bulbs with LEDs, Changing PLN Energy sources to Solar Power / renewable energy, etc.
4. Offset: Increase absorption of CO2 emissions. Examples: Expanding Green Space, Reforestation, buying energy attribute certificate (EAT), etc.

III. METHOD

The methodology used in this study is qualitative. Data collection used in depth interview, observation, questionnaire and Forum Group discussion. Prioritization of emission reduction project criteria and determination of alternative projects for emission reduction and renewable energy mix using AHP (Analytic Hierarchy Process). Microsoft Excel and expert choice software are tools in processing data.

AHP is used for the project priority of reduction strategy and fishbone to determine the root cause analysis of the project improvement to reduce GHG emission in the future.

IV. RESULT

Based on the results of the research from the questionnaire given to respondents, it is then compiled in a comparison matrix of criteria. The average value is calculated using the geSSometric mean formula. The results of the calculation of the average assessment of the comparison matrix can be seen in the following Table 4 Average Assessment of Sub Criteria Comparison Matrix.

Kriteria	A	B	C	D
A	1.000	3.280	4.124	6.662
B	0.305	1.000	2.128	2.532
C	0.242	0.470	1.000	2.116
D	0.150	0.395	0.473	1.000

Source: *Processed Data (2023)*

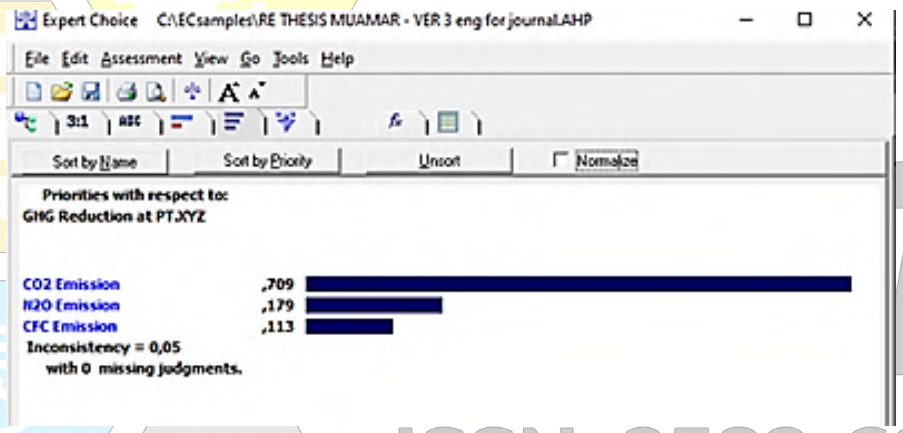
Information:

a. Electricity Usage
b. Waste Management
c. Use of Freon
d. Fuel Usage

1. Based on the Comparison of criteria

A comparison of priority criteria can be seen in Figure 1. In the picture, the results of CO2 Emission Reduction are very priority with the highest weight value of 0.709, while the second priority is the reduction of N2O emissions with a weight of 0.179 and the lowest priority is CFC emission reduction with a weight of 0.113. In overall criteria weighting has an inconsistency value of 5%.

Added a description of theoretical paragraphs, operational what is the meaning of the results of each images from previous research.



Picture. 1 *Comparison of priority criteria*

2. Based on Sub Criteria comparison

The comparison of SubCriteria priority can be seen in Figure 2. In the picture, CO2 Emission reduction activities with the top priority on the use of electrical energy with the highest weight of 0.538, the second priority is the use of fuel directly with a weight of 0.341, priority. Next is the use of freon with a weight of 0.072 and the last priority is the handling of 0.049 waste. In weighting the Subcriteria as a whole has an inconsistency value of 3% (0.03<0.1)). So that an analysis (alternative) and conclusions can be made from the results that have been obtained. Validation based on inconsistencies whether acceptable or inappropriate).

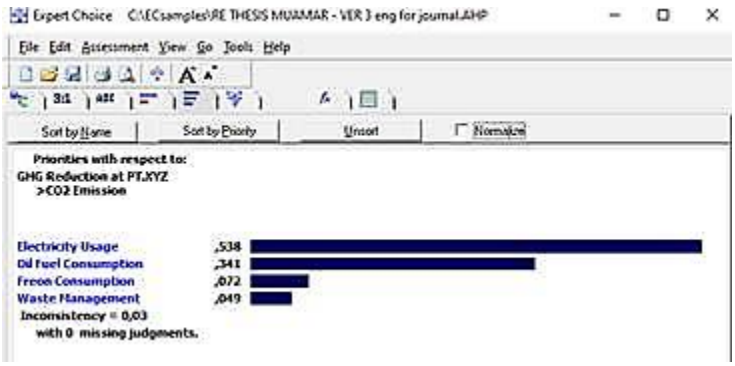


Figure 2. *SubCriteria priority comparison*

3. Based on priority comparison of Alternative 1

A comparison of alternative priority 1 can be seen in Figure 3. In the figure, from the activities of using electrical energy, alternative 1 is obtained the most priority is Substitution (Replacement) with the highest weight of 0.561, the second priority is reduction with a weight of 0.258, the next priority is offset with a weight of 0.118 and the last priority is elimination of 0.063. In the overall weighting of alternative 1 has an inconsistency value of 4% (0.04 < 0.1), analysis and conclusions can be made from the results obtained.

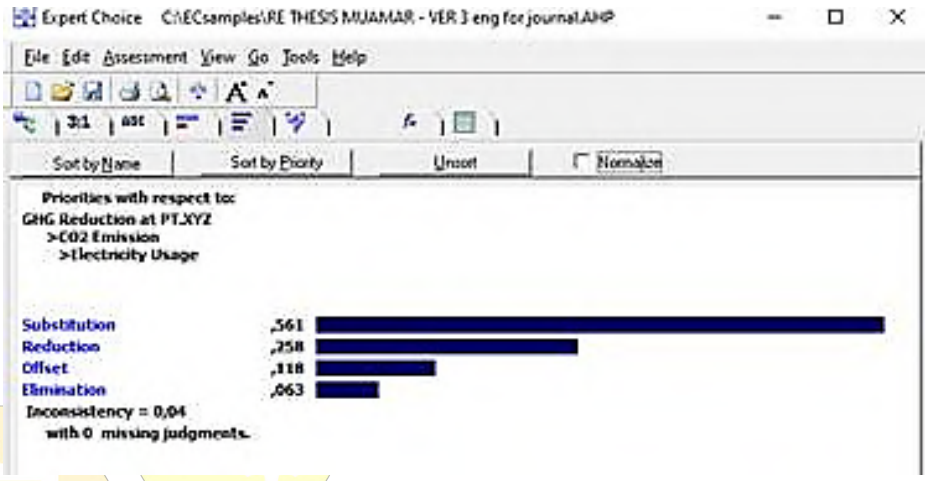


Figure 3. *Comparison of priority alternatives 1*

4. Based on the comparison of priorities of Alternative 2

In figure 4 below is Alternative 2 as a policy option that can be done to reduce the use of electrical energy, the most priority is the purchase of a Renewable Energy Certificate (REC) with the highest weight of 0.545, the second priority is the installation of Solar Power with a weight of 0.232, the next priority is to use Savings for some of its activities with a weight of 0.130 and the last priority is to replace Freon type 0.093. In the overall weighting of Alternative 2 has an inconsistency value of 2% (0.02 < 0.1), analysis and conclusions can be made from the results obtained.

Figure 4. *Comparison of alternative priorities 2*

4. Fishbone Analysis

In this study, fishbone and AHP methods were used. Fishbone in figure 5 to determine the root cause of the impact resulting from the phenomenon, namely Greenhouse Gases. The following fishbone analysis is used to obtain criteria that will then be processed in the AHP method to determine project selection that is possible to Reduce Greenhouse Gas Impact. Analystis Fishbone yang dilakukan yaitu menggunakan analisis approach to HR, Process, Equipment, Management, Environmental, and material aspects. Problem solving was done by voting with 9 respondents.

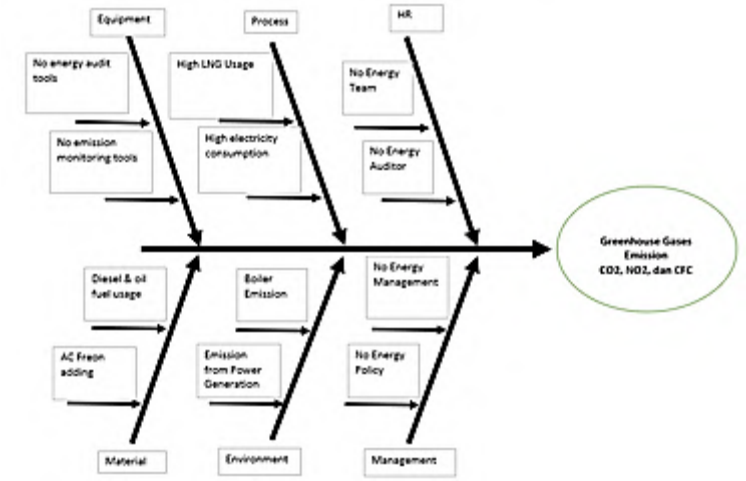


Figure 5. *Fishbone Analysis of Causes of Greenhouse Gas Impacts*

Description	Root Cause	∑vote
HR	No Energy Team	3
	No Energy Auditor	3
Process	High LNG Usage	6
	High electricity consumption	8
Equipment	No energy audit tools	2
	No emission monitoring tools	3
Management	No Energy Policy	4
	No Energy Management	4
Environment	Emission from Power Generation	9
	Boiler Emission	7
Material	AC Freon adding	5
	Diesel & oil fuel usage	5

Table 5. *Cause voting results in Fishbone analysis*

From the fishbone analysis that was then voted, the highest vote results were obtained, namely: Emissions from power plants (PLTU) (score 9), high electricity consumption (score 8), Emissions from boilers (7), High LNG gas consumption (6), and AC Freon Replacement (score 5).

So from the fishbone results above, researchers formulated it into criteria as the root cause of the Greenhouse Gas cause at PT. XYZ.

1. Use of Electrical Energy (High usage, PLTU emissions)
2. Waste Handling (Boiler Emissions)
3. Fuel Handling (PGN Gas Usage, diesel)
4. Use of Freon

Then, the 4 criteria produced above will be processed into the distribution of questioners to 9 respondents to get the right project selection priority in reducing Greenhouse Gas PT. XYZ.

VII. CONCLUSION

From the selection analysis and project priority selection strategy to reduce the impact of Greenhouse Gases on PT. XYZ, then it can be concluded

1. The results of Fishbone and AHP Analysis obtained Electricity consumption is the main cause of the magnitude of Greenhouse Gas PT. XYZ, and from the analysis of alternative project priorities obtained:
    a. By purchasing a Renewable Energy Certificate (REC), it will reduce the GHG impact of PT. XYZ is almost 55% of the scenario planning calculation.
    b. With Solar Panel Installation, it will reduce the GHG impact of PT. XYZ is almost 5% of the scenario planning calculation.
2. To achieve the 23% renewable energy target, there are two highest priority choices obtained from the results of the AHP Analysis, namely REC and Solar

Panels. However, based on scenario planning calculations, only REC can achieve this, because REC can cover 100% of energy from renewable sources, while solar panels can only be installed to cover electricity consumption by 5%.

3. The AHP design that must be carried out in the project selection proposal for emission reduction by 37.8% from the results of expert choice analysis 11 is:

The choice of policies that can be done to reduce the use of electrical energy is the most priority is the purchase of a Renewable Energy Certificate (REC) with the highest weight of 0.545, the second priority is the installation of Solar Power with a weight of 0.232, the next priority is to use Savings for some of its activities with a weight of 0.130 and the last priority is to replace the type of Freon 0.093.

The advice given by the author based on this study is in analyzing policy selection for project selection in order to reduce a company's GHG emissions, especially in the textile manufacturing sector, that is, companies can implement energy transition in other electricity and fossil sources and can also carry out energy consumption reduction programs, When these things are done, the multiplier of carbon emissions will decrease.

The author's hope for further research is that this research can be used for implementation in similar companies and can be used as further material in policy considerations.

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