

ANALYSIS OF IMPACT MITIGATION POLICY AND GREENHOUSE GAS REDUCTION STRATEGIES AT PT XYZ

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Latar Belakang: Isu lingkungan kini telah menjadi topik yang sangat penting bagi perhatian negara-negara di seluruh dunia, terutama upaya pencegahan perubahan iklim dengan memitigasi dampak rumah kaca.

Tujuan: bertujuan untuk menganalisis kebijakan mitigasi dampak dan strategi pengurangan GRK yang dilakukan oleh PT XYZ sebagai salah satu industri manufaktur yang berkomitmen untuk berkontribusi dalam mitigasi dampak gas rumah kaca

Metode: metode AHP, dipengaruhi oleh penilaian ini. Matriks perbandingan berpasangan, atau matriks perbandingan berpasangan yang berisi tingkat preferensi dari beberapa pilihan untuk setiap kriteria, digunakan untuk mengatur temuan penilaian ini.

Hasil: menghasilkan emisi CO₂ tertinggi adalah akibat penggunaan Mesin-mesin Produksi di Lokasi factory 1 sebesar 14.599 Ton.CO₂eq pertahun, Atau 37% dari total emisi CO₂ di perusahaan ini, kemudian tertinggi kedua adalah dari lokasi factory 5 yaitu 14.311 Ton.CO₂ eq.

Kesimpulan: Maka PT XYZ dapat melakukan kebijakan Menurunkan emisi CO₂ dengan mitigasi melakukan pengurangan (*Reduce*) pada penggunaan energi listrik. Prioritas nya adalah pada pengoperasian mesin-mesin produksi di lokasi *Factory 1*. Strategi yang dilakukan antara lain mengganti mesin-mesin tua yang sudah tidak efisien dengan mesin-mesin baru yang lebih produktif, efisien dalam penggunaan listriknya, penggunaan teknologi tinggi Serta merubah Layout

atau tata letak mesin yang lebih ringkas dan dikelompokan berdasarkan jenis produknya.

Kata kunci: Perubahan iklim; Dampak GRK; Mitigasi dan Strategi

Abstract (English)

Background: *Environmental issues have now become a very important topic for the attention of countries around the world, especially efforts to prevent climate change by mitigating the greenhouse effect.*

Objective: *aims to analyze the impact mitigation policies and GHG reduction strategies carried out by PT XYZ as one of the manufacturing industries that is committed to contributing to the mitigation of greenhouse gas impacts.*

Methods: *AHP method, is affected by this assessment. Pairwise comparison matrices, or pairwise comparison matrices containing the preference levels of several options for each criterion, were used to organize the findings of this assessment.*

Results: *which produces the highest CO₂ emissions due to the use of Production Machinery in Factory 1 location of 14,599 Ton.CO₂eq per year, or 37% of the total CO₂ emissions in this company, then the second highest is from factory 5 location, namely 14,311 Ton.CO₂ eq.*

Conclusion: *So PT XYZ can carry out a policy of reducing CO₂ emissions by reducing the use of electrical energy. The priority is on the operation of production machines at the Factory 1 location. The strategies carried out include replacing old machines that are no longer efficient with new machines that are more productive, efficient in electricity use, use*

of high technology and changing the layout or layout. the location of the machine is more compact and grouped by type of product.

Keywords: *Climate change; GHG impacts; Mitigation and Strategy*

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BACKGROUND

There are six types of greenhouse gases that are harmful to humans because they can cause greenhouse gases and contribute to global warming, namely Carbon dioxide (CO₂), Methane (CH₄), Nitrous oxide (N₂O), Hydroperfluorocarbons (HFCs), Perfluorocarbons (CFCs), Sulfur Hexafluoride (SF₆) . Emissions from various greenhouse gases, especially carbon dioxide, produce a greenhouse effect (Shaikh et al., 2018). Currently these gases are mixed in the air (atmosphere). Earth's temperature rises to 13°C as a result of this layer reflecting back infrared heat from the sun. The more greenhouse gases there are, the higher the earth's temperature will be. Increased concentrations of GHGs contribute to climate change by trapping excessive heat in the atmosphere and destroying stratospheric ozone (Foges & Young, 2017). Under natural conditions the Greenhouse Effect is necessary to reduce the extreme temperature difference between day and night. One of the greatest threats to humanity is climate change, and it requires urgent action (Soutter & Møttus, 2020). CO₂ accounts for 76.7% of all GHG emissions (Wahyudi et al., 2016). Industrial activities are suspected to be one of the sources of CO₂ emissions. Industry must have a commitment to mitigate CO₂ emission reduction, in line with the Presidential Regulation of the Republic of Indonesia No. 61 of 2011 concerning Action Plans.

Mitigation policies are needed to control the growth of CO₂ emission production from the sector, the risk of emission growth can increase. In a revolutionary way, lifestyles and luxuries obtained by consuming too high energy need to be reduced (Bilgili et al., 2015). In the industrial sector, the use of energy, especially the energy of BBF (Fossil Fuels), production processes, and waste are

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sources of greenhouse gas emissions. In industry, manufacturing processes are highly dependent on energy. Energy is required for the production of steam, motor fuel, furnace fuel, boiler fuel for steam production, and other industrial applications. Due to worsening environmental problems, such as climate change, stakeholders place greater demands and pressure on companies to care about the environment. The presence of carbon accounting is a supplement to the adoption of the Kyoto Protocol (Pratiwi et al., 2021). To reduce emissions or increase GHG absorption and conversion capacity, mitigation is a policy measure required. The implementation of GHG emission mitigation consists of 4 main strategies (Wahyudi et al., 2016). Namely: Elimination: Avoiding or eliminating activities that use equipment that can cause GHG emissions. Example: Using manual equipment that does not use electrical energy. Reduction: Doing efficiency when using equipment that requires electrical energy. Example: Turning off lights when not in use, unplugging cables when equipment is not in use, etc. Substitution: Replacing or changing technology that is more efficient and has lower CO₂ emissions. Example: Replacing incandescent bulbs with LEDs, changing PLN's energy sources to solar power, etc. Offset: Increase absorption of CO₂ emissions. Example: Expanding Green Space, Reforestation (Reforestation), etc.

Calculating GHG Emissions: Electricity is one of the energy sources that people need for their daily life. Most people in the world, especially in Indonesia, use electricity 24 hours a day to help them carry out their activities (Paulus BK & Ninin G, 2016). Meanwhile, the Energy Sector is currently still using BBF (Fossil Fuels) so that without control and control in the energy sector, this non-renewable natural resource will run out more quickly. So that the energy sector becomes a priority. It is necessary to implement clean industrial processes and production because it will increase the efficiency of the use of raw materials and energy (Muryani, 2018).

The calculation of GHG emissions begins with the identification of the emission scope (Scope Emission) in the company (Industry). Greenhouse gas emissions produced by an industry consist of three categories (Awanthi & Navaratne, 2018). namely: Scope 1 is carbon emissions from activities that we can control directly, Example: the use of boilers, generators, and other fossil fuel-powered tools and facilities, as well as company operational vehicles for the movement of people and goods (transport). Scope 2 is emission from energy that we get or import from external sources, such as: steam that we get from external sources or electricity that we get from PLN. Scope 3 is emissions produced by parties who provide goods for company. Except for the difficulty of accessing

data and the relatively small number of them, emissions from scope 3 are rarely calculated.

From the three scopes above, PT XYZ as the object of research is included in Scope 1 and 2. Because it has activities that produce emissions but can be controlled directly. For example Boilers and company operational vehicles. and Energy used for production operations is purchased or obtained from outside (suppliers) namely PLN and other examples of driving production process machines, Furnace Fuel (Furnaces for melting and Casting). In general, fuel combustion emissions are energy emissions, not emissions from industrial processes. The term “Tier” is the degree of accuracy of the calculations used in GHG data collection activities.

Based on the Standard Intergovernmental Panel on Climate Change (IPCC) there are 3 Tiers (Sunarti et al., 2019). namely: Tier 1: Estimates are based on IPCC default activity data and emission factors. Tier 2: Estimates based on more accurate activity data and IPCC default emission factors or country specific/plant specific emission factors. Tier 3: estimates using country-specific methods that use more precise activity data (direct measurements) and country-specific/plant-specific emission factors. The level of GHG research is determined by the type of data relevant to a particular nation or country for develop methods or identify specific emission factors that can be used by that nation or country. In GHG research, Indonesia's sector/activity emissions use Tier-1, based on updated data and IPCC standard emission factors (KLH, 2012). The total energy used to produce one unit of product can be used to calculate the energy consumption of the industrial sector. This includes the energy used to move goods or raw materials used internally in the production area to make products (KLH, 2012). The units of energy used can be changed according to industry standards, such as: kCal/kg cement clinker in the cement industry, kWh/tonne of steel in the iron and steel industry, and GJ/ton of textile fabrics in the textile industry.

RESEARCH METHODS

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Intensitas Kepentingan	Keterangan
1	Kedua Elemen sama penting
3	Elemen yang satu sedikit lebih penting daripada elemen yang lainnya.
5	Elemen yang satu lebih penting daripada elemen lainnya.
7	Elemen yang satu sangat lebih penting daripada elemen lainnya.
9	Elemen yang satu Mutlak lebih penting daripada elemen lainnya.
2,4,6,8	Nilai diantara dua nilai pertimbangan yang berdekatan

Figure 1. Pairwise comparison rating scale

Data normalization: Tests for consistency and calculates its Vector eigenvalues, which represent the weight of each element. Data must be repeated if

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inconsistent. The above steps are carried out for all levels of the hierarchy. This step is to synthesize options in prioritizing elements at the lowest level of the Hierarchy to achieve the goal. Test the consistency of the hierarchy. If it does not meet the $CR < 0.100$ then the assessment must be repeated. Again: To simplify the above process, the author will use the "Expert Choice (EC) V11.0 Application. By using the averaging feature to flatten the paired results into a value, this application can combine the results of comparisons with multiple participants. The geometric mean calculation method is used to get the average value. The error rate in calculating the weights is very small, because there is no need to calculate the weights manually, but it is our accuracy in entering data that determines how accurate the Expert Choice application is. This makes this application suitable for analyzing problems in decision making that involve large hierarchies or with many levels and many alternatives of respondent preferences.

Calculating Electricity Consumption: To facilitate the Analysis of Electricity Consumption Companies are grouped into 3 major categories: Machinery Group. Use of all production machines. Lighting Group (Lamps) & General./ Use of all lamps for lighting and other general electrical equipment (PCs, Laptops, Photocopiers and Printers) Air conditioning group. Use of all air conditioners in the company. The three categories are further divided based on Factory-factories (different locations) in the company. Namely: Factory 1 in Cibitung, Factory 2 in Cibitung, Factory 3 in Cibitung and Factory 5 in Cikarang.

Calculating Carbon (CO₂) Emissions: The total amount of CO₂ emitted by activities, both long-term and short-term, is known as the Carbon footprint. According to the IPCC, there are two types of carbon footprint: Primary Carbon Footprint is the direct carbon footprint that abandoned by an activity. Burning fossil fuels is the main activity that leaves a carbon footprint, combustion processes and material degradation.

$$\text{Emisi CO}_2 = a \times EF \times \text{NCV}$$

Where : CO₂ emission : Total CO₂ emission (kg carbon) Fuel consumed (kg), EF : fuel CO₂ emission factor (mass unit/MJ), NCV : Net Calorific Volume (energy content) per unit mass or volume of fuel fuel (TJ/ton fuel) The use of electrically powered equipment is an example of a secondary carbon footprint, namely an indirect carbon footprint. The use of electrical energy is equivalent to this kind of carbon footprint (PLN). In principle, CO₂ emissions for each unit of production are the basis for all product carbon footprints.

$$\text{Emisi CO}_2 = \sum \text{FC} \times \text{CEF}$$

Where: FC = the amount of electricity consumed (Kwh), CEF = Carbon Emission Factor (kg CO₂/Kwh), then the total CO₂ emissions are:

$$\text{Emisi CO}_2 \text{ total} = \text{Emisi CO}_2 \text{ primer} + \text{Emisi CO}_2 \text{ sekunder}$$

HASIL DAN PEMBAHASAN

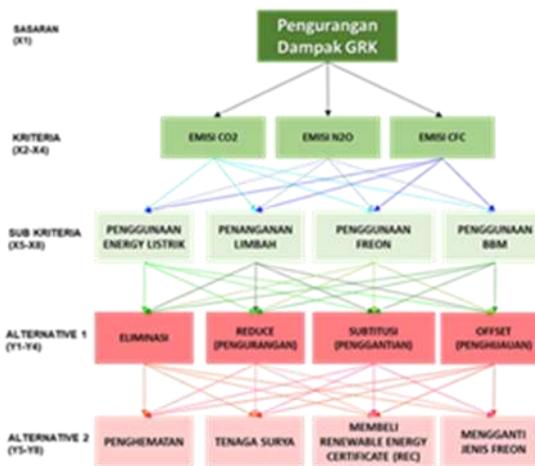


Figure 2. Research Hierarchy

Based on the research hierarchy above (figure 2), questionnaires were distributed to all respondents who have competencies and sustainability activities in the company. The results of the questionnaire answers from the respondents were followed by analysis using the Expert Choice ver.11.0 application to obtain recommendations for the most appropriate policy strategy as mitigation to reduce the impact of greenhouse gases. Based on comparison criteria.

In Figure 3 below the results of Reducing CO₂ Emissions become very priority with the highest weight value of 0.729, while the second priority is the reduction of CFC emissions with a weight of 0.192 and the lowest priority in reducing N₂O emissions with a weight of 0.079. The overall weighting of the criteria has an inconsistency value of 3%.

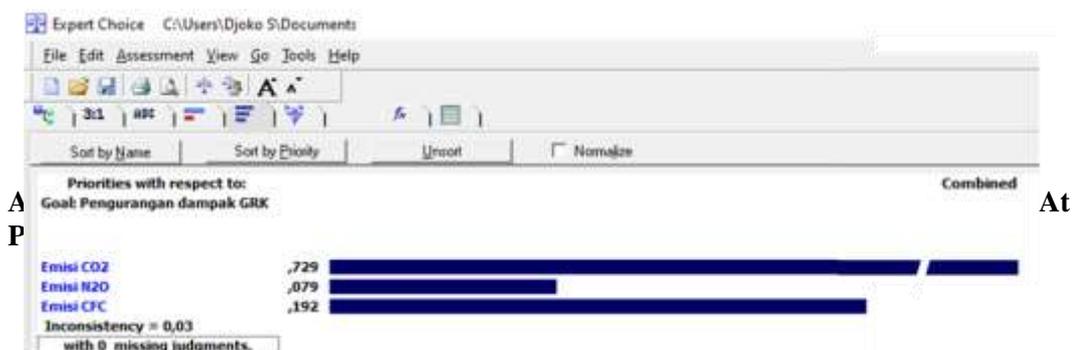
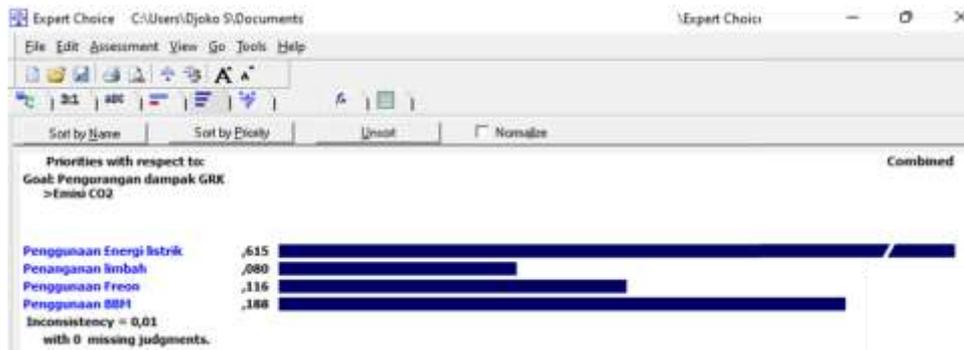


Figure 3. Comparison of priority criteria

In Figure 4 below the CO2 emission reduction activities with the main



priority on the use of electrical energy with the highest weight of 0.615, the second priority is the direct use of fuel with a weight of 0.188, the next priority is the use of Freon with a weight of 0.116 and the last priority is the handling of waste 0.080. On the weighting of the sub-criteria as a whole has an inconsistency value of 1% ($0.01 < 0.1$) then it can be done analysis and conclusions from the results that have been obtained analysis and conclusions from the results that have been obtained the results that have been obtained

Figure 4. Comparison of the priorities of the Sub-Criteria

From the activity of using electrical energy, it was found that the first alternative with the highest priority is Reduce with the highest weight of 0.554, the second priority is substitution with a weight of 0.255, the next priority is elimination with a weight of 0.131 and the last priority is an offset of 0.060. On the weighting of alternative 1 as a whole has an inconsistency value of 2% ($0.02 < 0.1$) then it can be analyzed and concluded from the results that have been obtained.



Figure 5. Comparison of alternative priorities 1

In the picture below is Alternative 2 as a policy option that can be done to reduce the use of electrical energy, the most priority is Savings with the highest weight of 0.545, the second priority is to buy an REC certificate with a weight of

0.232, the next priority is to use solar power for some of its activities with a weight of 0.130 and the last priority is to change the type of freon to 0.093. On the weighting of Alternative 2 as a whole has an inconsistency value of 2% ($0.02 < 0.1$) so it can be analyzed and concluded from the results that have been obtained.

CONCLUSION

From the analysis using the Analytical Hierarchy Process (AHP) method, it is found that the most priority greenhouse gas (GHG) mitigation policy is to reduce CO₂ emissions based on the use of electrical energy by reducing the use of electrical energy. Savings is the main alternative by making various improvements and innovations. And based on secondary data obtained during 2021 from the use of electricity that produces the highest CO₂ emissions, it is due to the use of Production Machines at Factory 1 location of 14,599 Ton.CO₂eq per year, or 37% of the total CO₂ emissions in this company, then the second highest is from factory 5 location which is 14,311 Ton.CO₂ eq.

So PT XYZ can carry out a policy of reducing CO₂ emissions by reducing the use of electrical energy. The priority is on the operation of production machines at the Factory 1 location. The strategies carried out include replacing old machines that are no longer efficient with new machines that are more productive, efficient in electricity use, use of high technology and changing the layout or layout. the location of the machine is more compact and grouped by type of product.

BIBLIOGRAFI

- Bilgili, M., Ozbek, A., Sahin, B., & Kahraman, A. (2015). An overview of renewable electric power capacity and progress in new technologies in the world. *Renewable and Sustainable Energy Reviews*, 49, 323–334. <https://doi.org/10.1016/j.rser.2015.04.148>
- Foges, C., & Young, N. (2017). Green House Effect. *Architectural Record*, 205(7), 109–113.
- KLH. (2012). *Pedoman penyelenggaraan Inventarisasi Gas rumah kaca Nasional buku II Volume 1 Metodologi penghitungan tingkat Emisi Gas Rumah Kaca*.
- Muryani. (2018). *Produksi bersih dan model kerjasama sebagai upaya mitigasi emisi gas rumah kaca pada sektor industri Clean production and cooperation model as a efforts to mitigate greenhouse gas emissions in the industrial sector*.
- Paulus BK, & Ninin G. (2016). *Laporan penelitian Dosen Universitas Sahid Analysis Of Impact Mitigation Policy And Greenhouse Gas Reduction Strategies At Pt Xyz*

Jakarta Analisis Emisi CO2 Berdasarkan jejak karbon sekunder.

- Pratiwi, L., Maharani, B., & Sayekti, Y. (2021). Determinants of Carbon Emission Disclosure: An Empirical Study on Indonesian Manufacturing Companies. *The Indonesian Accounting Review*, 11(2).
<https://doi.org/10.14414/tiar.v11i2.2411>
- Rajput, V., Kumar, D., Sharma, A., & Singh, S. (2018). A Literature Review on Ahp (Analytic Hierarchy Process). *Journal for Advance Research in Applied Sciences*, 5(1).
- Soutter, A. R. B., & Möttus, R. (2020). “Global warming” versus “climate change”: A replication on the association between political self-identification, question wording, and environmental beliefs. *Journal of Environmental Psychology*, 69, 101413.
<https://doi.org/10.1016/j.jenvp.2020.101413>
- Sunarti, Sunaryo, F. K., Prasetyo, B. E., Kurniadi, C. B., Setiadi, I., & Rabbani, Q. (2019). *Inventarisasi Emisi GRK Sektor Energi*.
- Wahyudi, J., Penelitian, K., Pengembangan, D., & Pati, K. (2016). Mitigasi Emisi Gas Rumah kaca. The Mitigation of Greenhouse Gases Emission. In *JurnalLitbang: Vol. XII* (Issue 2).



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