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A Study of Emission Inventory of CO_2e in Manufacturing Printing Company (Case Study: PT. XYZ)

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Abstract. As one of Indonesia's printing companies, PT XYZ strives to meet consumer demand by producing so many waste. Looking at that situation, it is clear that the industrial process might have an effect on the environment. In light of this, the goal of this study is to determine and estimate the possible effects of emissions from the energy supply on the printing manufacturing process and environmental impact on land based on volatile organic compound materials.The method of measuring the amount of emissions is called emission inventory. ReCiPe 2016 is a method that will use to analyse the impact through manual calculation based on Green House Gases Protocol.Based on the above data it can be concluded that the total emissions produced by PT. XYZ in 2021 and 2022 are 1,616 tons of CO_2e and 1,722 tons of CO_2e based on electricity purchases paid annually by PT. XYZ. However, calculations from the emission inventory modeling carried out show that the total emissions produced by PT. XYZ in 2021 and 2022 is 1,405 tons of CO_2e and 1,389 tons of CO_2e.

Objectives: The goals for this journal are as follows:To Identify and calculate the major contributor of CO_2e released from electricity and fuel consumed of each tier in printing until delivery process, To Identify and calculate the potential environmental impact from hazardous waste, To calculate the carbon tax produced by PT. XYZ.

Method and results: This research was started by identifiying the problem in PT.XYZ to determine the purpose of conducting this research. After that, the next step is to determine the scope of this research by making the flow chart description. Next step was carried out by finding some existing literature study that reffer to this research. Followed steps was conducted by collect some data from PT. XYZ document, some data must be calculating further to become a final data. Last step is process all the data to become a refernce in determining the conclusion and recommendation. Estimated GHG emissions from poultry in Indonesia with the IPCC Tier 1 method for 2021 and 2022 are 1,405 and 1,389 CO2e. From this result, the final emission produced using functional unit has found is $267.16\ \text{Ton}\ CO_2e\ /12{,}329{,}569\ m^2$.

Conclusion: The highest contributor in 2021 and 2022 is machines usage about 1,024 and 1,025 Ton CO2e, following by AC consumed about 312 and 303 Ton CO2e. third place is IT consumed is about 30 and 26 Ton CO2e, fourt place is lamp consumed is about 24 and 20 Ton CO2e and last position is cooler and CCTV is about 15 Ton CO2e. However this research also calculated hazard emission. Due to its propensity to cause human cancer, it will be deemed hazardous waste and must be transformed to reduce its environmental effect according to recipe 2016. Isoprene now makes up the majority of VOCs and has an environmental effect of 0,0024 1,4-DCB eq. Based on the calculation, PT XYZ has produced about 22,8936 1,4-DCB eq impacted the environment. Lastly, Based on final calculation and government regulation, PT. XYZ, must pay around Rp. 42,150.000 for 2021 and Rp. 41,670,000 for 2022 to government as their comitmment to protect our environment

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1 Introduction

Earth's temperature increases along with the concentration of these gases. The potential for climate change and temperature increase brought on by the increase in Earth's average temperature caused by human activity. The transportation industry is responsible for more than 1/4 (one quarter) of all carbon emissions worldwide. Fossil fuels (petroleum and coal) combustion is the primary cause of carbon dioxide emissions worldwide, contributing to 36% of emissions from the energy sector (power plants, oil refineries, etc.), 27% of emissions from transportation, 21% of emissions from industry, 15% of emissions from home & services, and 1% of emissions from other sectors. Based on that data, the top 3 contributor coming from industry. Industry devided into some sector one of them is manufacturing company. Case study of this research is PT. XYZ as one of manufacturing printing company. As one of the big printing company with the total capacity per year is 100.000.000 m^2 make PT.XYZ contribute more emission to earth atmosphere. By realizing this reasons, an emission inventory should carried out. An emission inventory will help PT. XYZ knowing the most emission contributor and as well as helping PT. XYZ in overcoming the carbon tax, so there is no excessive budget.

The goals for this journal are as follows: to Identify and calculate the major contributor of CO_2e released from electricity and fuel consumed of each tier in printing until delivery process, to Identify and calculate the potential environmental impact from hazardous waste, to calculate the carbon tax produced by PT. XYZ.

1.1 Emission Inventory Methodology

a) Emission Factors

Emission factors are the average rate of emission of a pollutant per unit of activity data for a given sector [25]. Default values from manuals are applied when there is no emission factor that accurately reflects the local condition. To get an emission factor that accurately represents the condition by direct measurement is preferable if the default factor is thought to be unsuitable. Emission factors, fuel factors, and the potential environmental impact of hazardous waste were the three considerations used in this study. Details are as follows:

1. Emission factors: This research using emission factors about 0.891 kg/kWh based on Surat Mentri ESDM no 378/21/600.5/2008
2. Fuel factors: This research using emission factor for fuel (diesel oil) about 74 100 Kg/TJ based on IPCC Guidelines. By using equation from IPCC, the fuel emission factor will be multiplied by fuel consumption on TJ unit.
3. Hazardous waste potential impact: The value is 0.1 VOC Lbs/Unit based on EIIP Volume 3, Chapter 14 Criteria Air Pollutants. Since it has a carcinogens impact to human, it must converted to environmental impact potential based on recipe 2016. In recipe 2016, VOC included in Human carcinogenic toxicity. Most VOCs in earth's atmosphere are biogenic, largely emitted by plants. Isoprene become the most composition in VOC and give impact to environment about 0,0024 1,4-DCB eq.

b) Data Activity

Activity data provide an indication of the level of activity responsible for the emissions. In general, statistics and surveys can be used to get the required information.

Emission = Emission Factor x Activity data (1)

2 Method

2.1 Research Framework

This research was started by identifiying the problem in PT.XYZ to determine the purpose of conducting this research. After that, the next step is to determine the scope of this research by making the flow chart description. Next step was carried out by finding some existing literature study that reffer to this research. Followed steps was conducted by collect some data from PT. XYZ document, some data must be calculating further to become a final data. Last step is process all the da ta to become a refernce in determining the conclusion and recommendation.

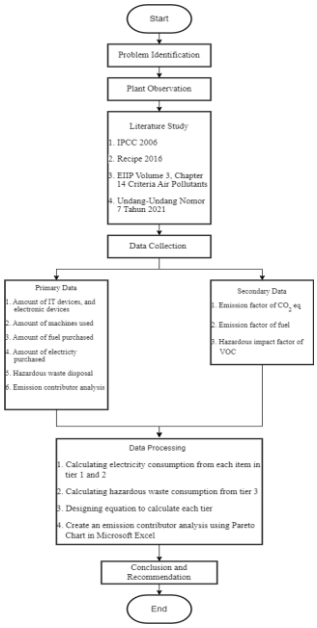


Figure 1 Research Framework

2.3 Data Collection Method

2.3.1 Functional Unit

Functional unit of this research is 12,329,569 m^2 of printed label. This functional unit was selected due to the nature of produced label when is reflect in area size. Here is the detail of selected functional unit:

$$\text{Area Size} = \text{L x W}$$

$$\text{Area Size} = 30{,}823{,}923\ \text{m} \times 0.4\ \text{m}$$

$$\text{Area Size} = 12{,}329{,}569\ \text{m}^2 \text{ of printed label}$$

2.3.1 Design Calculation

The data was taken from January – September during 2021 and 2022. The sampling data was taken from various source such as IT, HRGA, Maintenance, Production line and finishing line department. The data consist of watt, volt and ampere. Further data was taken from the system called "CERM". At PT. XYZ, Machines divided into some part which are production line and finishing line. In Production line the data from machines taken from the system called "CERM". The specific data such as, length of time, breakdown time, amount of semi-finished good, amount of waste was detected. In finishing line the data from machines taken manually by operator by using the form. For amount of fuel purchased by company. This data was taken manually by warehouse operator and reported in one file through Microsoft excel. Lastly, data of waste production from every machine. This data was taken by third parties and reported to company every month.

2.3 Design Calculation Method

a) Tier 1 (Electricity consumption from Machine and Facility)

$$\boldsymbol{W = P\ x\ t} \quad (2)$$

Where:

W = Energy; P = Power; T = Time

The secondary emission factor for electricity is multiplied by the amount of power used by each division or work unit at PT. XYZ to determine the amount of secondary CO_2 emissions from electricity use. It is calculated using the following formula, which is based on IPCC 2006 [8]:

$$\boldsymbol{CO_2\ Emission = \frac{F_{cy}Electricty\ x\ EF\ CO_2}{1000}} \quad (3)$$

Where:

EF CO_2 = Emission Factor CO_2

F_{cy} Electricity = Electricity Consumption (Ton)

$CO_2\ Emission$ = Total Emission (Ton CO_2e)

A. Tier 1 (Fuel Consumption from delivery transportation)

$$\boldsymbol{CO_2\ Emission = EF\ CO_2\ x\ F_{cy}\ Fuel} \quad (4)$$

Where:

EF CO_2 = Emission Factor CO_2 Fuel (Kg/TJ)

F_{cy} Electricity = Fuel Consumption (TJ)

$CO_2\ Emission$ = Total Emission (Ton)

B. Tier 2 (Electricity Consumption from purchased electricity)

$$\boldsymbol{CO_2\ Emission = \frac{F_{cy}Electricty\ x\ EF\ CO_2}{1000}} \quad (5)$$

Where:

EF CO_2 = Emission Factor CO_2

F_{cy} Electricity = Electricity Consumption (Kg)

$CO_2\ Emission$ = Total Emission (Ton CO_2e)

C. Tier 3 (Environmental Damaged from Waste Generated)t:

$$\textbf{Hazard Emission} = EF\ VOC\ x\ F_{cy}\ Waste \quad (6)$$

Where:

EF CO_2 = Environmental Impact VOC (1,4-DCB eq)

F_{cy} Waste = Waste Consumption (Lbs)

2.3 Data Analysis Method

All of the data was process through manual calculation using Microsoft Excel. We divided every data into its part and use some of manual calculation. We also look at Green House Gases Protocol book to know the exact formula. We calculate based on the tier calculation from tier 1 until tier 3.

3 Results and Discussion

3.1 Inventory Analysis

a. Tier 1 (Electricity Consumption from IT Devices 2021 vs 2022)

Scope 1 emissions are defined as direct emissions from company-owned and -controlled resources. Alternatively put a collection of business-level activities that cause a collection of emissions into the environment. The four categories are process emissions, mobile combustions, fugitive combustions, and stationary combustions (such as fuels and heating sources). Scope 1 must include all fuel sources that produce GHGs.

Table 1 Electricity Consumption from IT Devices 2021 vs 2022

No.	Items	2021	2022	Unit
1	Low Spec Desktop	19,292	19,186	KwH
2	High Spec Desktop	9,610	4,778	KwH
3	Notebook	2,482	2,469	KwH
4	Monitor	1,660	1,651	KwH
5	Thin Client	331	281	KwH
6	Printer	349	348	KwH
Electricity Consumption		33,724	28,713	KwH
Emission		30	26	Ton CO2e

Note: Specifications depend on Processor, Storage Type and RAM

Desktop High Specs = Type of storage: SSD, RAM: > 16GB

Low Spec Desktop = Storage type: Hard Disk, RAM: 8 GB

Based on the data above, the largest usage is on Light Spec Desktops, about 19,292 kWh in 2021 and 19,186 kWh in 2022. Total emissions from electronic use (Desktop, Notebook, Monitor, Thien Client and printer) are:

a. Emission CO_2 $= \frac{\boldsymbol{F_{cy}\ Electricty\ x\ EF\ CO_2}}{\boldsymbol{1000}}$ (3)

Emission CO_2 $= \frac{33{,}274\ \text{x}\ 0.891}{1000}$

Emission CO_2 = 30 Ton CO_2e

b. Emission CO_2 $= \frac{\boldsymbol{Fcy\ Electricty\ x\ EF\ CO2}}{1000}$ (3)

Emission CO_2 $= \frac{28{,}713\ \text{x}\ 0.891}{1000}$

Emission CO_2 = 26 Ton CO_2e

b. Tier 1 (Electricity Consumption from Cooler and CCTV 2021 vs 2022)

Cooler and CCTV included in fugitive combustion in tier 1. its has the direct impact to green house effect and atmosphere. Here is the details for cooler and CCTV consumption in 2021 and 2022.

Table 2 Electricity Consumption from Cooler and CCTV 2021 vs 2022

No.	Item	2021	2022	Unit
1	DVR Kguard	3,669	3,669	KwH
2	CCTV Kguard	3,145	3,145	KwH
3	DVR Dahua	2,516	2,516	KwH
4	DVR Avtech	2,516	2,516	KwH
5	Big Cooler	2,162	2,162	KwH
6	CCTV Avtech	1,258	1,258	KwH
7	CCTV Dahua	1,048	1,048	KwH
8	Small Cooler	491	491	KwH
Electricity Consumption		16,806	16,806	KwH
Emission		15	15	Ton CO2e

The total emissions from the use of cooler and CCTV in 2021 and 2022 are:

a. Emission CO_2 $= \frac{F_{cy}\ \boldsymbol{Electricty\ x\ EF\ CO_2}}{1000}$ (3)

Emission CO_2 $= \frac{16{,}806\ \text{x}\ 0.891}{1000}$

Emission CO_2 = 15 Ton CO_2e

For the years 2021 and 2022, the outcomes of the cooler and CCTV are comparable. Its major justification is related to usage frequency. CCTV and a cooler must be on continuously. The purpose of a cooler is to maintain a constant temperature inside so that food, drinks, and other contents stay fresher for longer. For installations and locations with medium to high levels of security, CCTV must be on constantly to maintain perimeter security.

c. Tier 1 (Electricity Consumption from Lamp 2021 vs 2022)

Lamp is included in fugitive combustion in tier 1. The result of lamp consumption is reduce and close enough between 2021 and 2022. It happen because in 2022 some of the lamp in production area has changed from TL lamp into LED, where LED lamp watt is lower that TL lamp watt.

Table 3 Electricity Consumption from Lamp 2021 vs 2022

No.	Items	2021	2022	Units
1	Finishing LT. 2	8,671	4,971	KwH
2	Produksi	7,409	7,710	KwH

3	R.QC	4,585	3,542	KwH
4	LT. 3	2,427	2,375	KwH
5	R. WH	1,920	1,998	KwH
6	R.IT	918	898	KwH
7	R. Ink Lab	662	689	KwH
8	R. Lobby	256	251	KwH
Electricity Consumption		26,848	22,434	KwH
Emission		24	20	Ton CO2e

The total emission from the use of Lamp is:

a. Emission CO_2 $= \frac{\boldsymbol{F_{cy}\ Electricty\ x\ EF\ CO_2}}{\mathbf{1000}}$ (3)

Emission CO_2 $= \frac{26{,}848\ \text{x}\ 0.891}{1000}$

Emission CO_2 = 24 Ton CO_2e

b. Emission CO_2 $= \frac{\boldsymbol{F_{cy}\ Electricty\ x\ EF\ CO_2}}{\mathbf{1000}}$ (3)

Emission CO_2 $= \frac{22{,}434\ \text{x}\ 0.891}{1000}$

Emission CO_2 = 20 Ton CO_2e

d. Tier 1 (Electricity Consumption from AC 2021 vs 2022)

This table displays the location where staff members frequently utilize air conditioning on a daily basis. Due to the need to regulate the area's temperature, the production room has become one of the most functional spaces. Because it houses production equipment, the room temperature must be steady because when it gets too hot, the equipment will malfunction.

Table 4 Electricity Consumption from AC 2021 vs 2022

No.	Items	2021	2022	Unit
1	Production	189,606	184,227	KwH
2	Finishing	97,781	95,007	KwH
3	3rd Floor	27,445	26,885	KwH
4	Prepress	19,055	18,514	KwH
5	Schober Room	6,801	6,632	KwH
6	Lobby	4,862	4,678	KwH
7	Canteen	4,063	3,849	KwH
Electricity Consumption		349,613	339,792	KwH
Emission		312	303	Ton CO2e

The total emission from the use of AC is:

a. Emission CO_2 = $\frac{Fcy\ Electricty\ x\ EF\ CO2}{1000}$ (3)

Emission CO_2 = $\frac{349{,}613\ x\ 0.891}{1000}$

Emission CO_2 = 312 Ton CO_2e

b. Emission CO_2 = $\frac{F_{cy}\ Electricty\ x\ EF\ CO_2}{1000}$ (3)

Emission CO_2 = $\frac{339{,}792\ x\ 0.891}{1000}$

Emission CO_2 = 303 Ton CO2e

e. Tier 1 (Electricity Consumption from Machine 2021 vs 2022)

Flexo Machine become the most usable machine because that machine produced all the product in PT. XYZ. This machine always running every time and every day except break time, Preventive maintenance and downtime. It's also affect the kWh of every machine.

Table 5 Electricity Consumption from Machine 2021 vs 2022

No.	Items	2021	2022	Unit
1	Flexo	607,974	589,566	KwH
2	Chiller	232,780	229,279	KwH
3	Finishing	153,941	164,437	KwH
4	Schouber	80,320	85,348	KwH
5	Compressor	44,743	50,160	KwH
6	Tooling	16,064	17,768	KwH
7	Prepress	13,612	13,318	KwH
No.	Items	2021	2022	Unit
8	Letter Press	185	181	KwH
Electricity Consumption		1,149,618	1,150,057	KwH
Emission		1,024	1,025	Ton CO2e

The total emission from the use of Machine is:

a. Emission CO_2 = $\frac{F_{cy}\ Electricty\ x\ EF\ CO_2}{1000}$ (3)

Emission CO_2 = $\frac{1{,}149{,}618\ x\ 0.891}{1000}$

Emission CO_2 = 1,024 Ton CO_2e

b. Emission CO_2 = $\frac{F_{cy}\ Electricty\ x\ EF\ CO_2}{1000}$ (3)

Emission CO_2 = $\frac{1{,}150{,}057\ x\ 0.891}{1000}$

Emission CO_2 = 1,025 Ton CO2e

f. Tier 1 (Fuel Consumption from transportation 2021 vs 2022)

The fuel that used is diesel oil (gasoline). There are 2 trucks that used, both of them has the license of emission result. To get how much liters from the total purchased fuel, it's divided by looking at the price of fuel. The difference in price of fuel affect the litters and it has the impact to the final result, but not as significant as it was.

Table 6 Fuel Consumption 2021 vs 2022

No.	Months	2021	2022	Unit
1	Jan	3,587	2,578	Liters
2	Feb	3,047	1,801	Liters
3	Mar	3,807	2,910	Liters
No.	Months	2021	2022	Unit
4	Apr	4,582	2,223	Liters
5	Mei	3,546	2,381	Liters
No.	Months	2021	2022	Unit
6	Jun	3,916	2,359	Liters
7	Jul	2,484	1,839	Liters
8	Aug	2,735	2,324	Liters
9	Sept	2,897	2,317	Liters
Fuel Consumption		30,601	20,732	Liters
Fuel Consumption		1.05	0.70	TJ

The total emission from the use of fuel consumption is:

a. Emission CO_2 = $EF\ CO_2\ x\ F_{cy}\ Fuel$ (4)

Emission CO_2 = 74 100 Kg/TJ x 1.05 TJ

Emission CO_2 = 77,805 $KgCO_2e$ or 77.8 Ton CO2e

b. Emission CO_2 = $EF\ CO_2\ x\ F_{cy}\ Fuel$ (4)

Emission CO_2 = 74 100 Kg/TJ x 0.709 TJ

Emission CO_2 = 51,870 KgCO2e or 51.87 Ton CO2e

After calculating thoroughly, the emission results from all activities will be summarized into a single unit from scope 1 (Electricity source), as follow:

Table 7 Electricity Consumption from SCOPE 1 2021 vs 2022

No.	Items	2021	2022	Unit
1	Machines	1,024	1,025	Ton CO2e
2	AC	312	303	Ton CO2e
3	IT	30	26	Ton CO2e
No.	Items	2021	2022	Unit
4	Lamp	24	20	Ton CO2e
5	Cooler & CCTV	15	15	Ton CO2e
Emission		1,405	1,389	Ton CO2e

This data will procces to the next calculation which are emission calculation using functional unit and carbon tax calculation. This will represent emission produced from PT. XYZ for the whole year in 2021 and 2022.

g. Tier 2 (Purchased Electricity 2021 vs 2022)

The data of purchased electricity coming from the third parties who provided us the data of electricity consumption from 2021-2022. The data on kWh and it will be multiplied by the emission factor of CO_2. This is become the real data because this data represent the real electricity consumed by PT. XYZ for the past 2 years.

Table 8 Purchased Electricity 2021 vs 2022

No.	Months	2021	2022	Unit
1	January	187,982	195,265	KwH
2	February	220,199	197,405	KwH
3	March	214,346	185,661	KwH
No.	Months	2021	2022	Unit
4	April	209,625	226,262	KwH
5	May	138,440	181,326	KwH
6	June	223,088	219,812	KwH
7	July	200,774	235,715	KwH
8	August	206,930	243,830	KwH
9	September	212,352	247,462	KwH
Electricity Consumption		1,813,736	1,932,738	KwH
Emission		1,616	1,722	Ton CO2e

The total emission from the purchased electricity is:

a. Emission CO_2 = $\frac{\boldsymbol{Fcy\ Electricty\ x\ EF\ CO2}}{1000}$ (5)

Emission CO_2 = $\frac{1{,}813{,}736\ \text{x}\ 0.891}{1000}$

Emission CO_2 = 1,616 Ton CO_2e

b. Emission CO_2 = $\frac{\boldsymbol{Fcy\ Electricty\ x\ EF\ CO2}}{1000}$ (5)

Emission CO_2 = $\frac{1932{,}738\ \text{x}\ 0.891}{1000}$

Emission CO_2 = 1,722 Ton CO2e

h. Tier 3 (Hazardous Waste 2021 VS 2022)

Since it has a carcinogens impact to human, it's will be considered as hazardous waste and it must converted to environmental impact potential based on recipe 2016. In recipe 2016, VOC included in Human carcinogenic toxicity. The majority of VOCs in the earth's atmosphere are biogenic and mostly released by plants. Isoprene become the most composition in VOC and give impact to environment about 0,0024 1,4-DCB eq.

Table 9 Hazardous Waste (B3) 2021 vs 2022

No.	Hazardous Waste	2021	2022	Total	Unit
1	Contaminated Majun	33,485	38,799	72,285	Lbs
2	Ink packaging	6,215	8,197	14,412	Lbs
3	Used Solvent	3,337	5,354	8,690	Lbs
Environmental Impact				9,539	Lbs VOC

The total of Hazardous waste potentital to environment is,

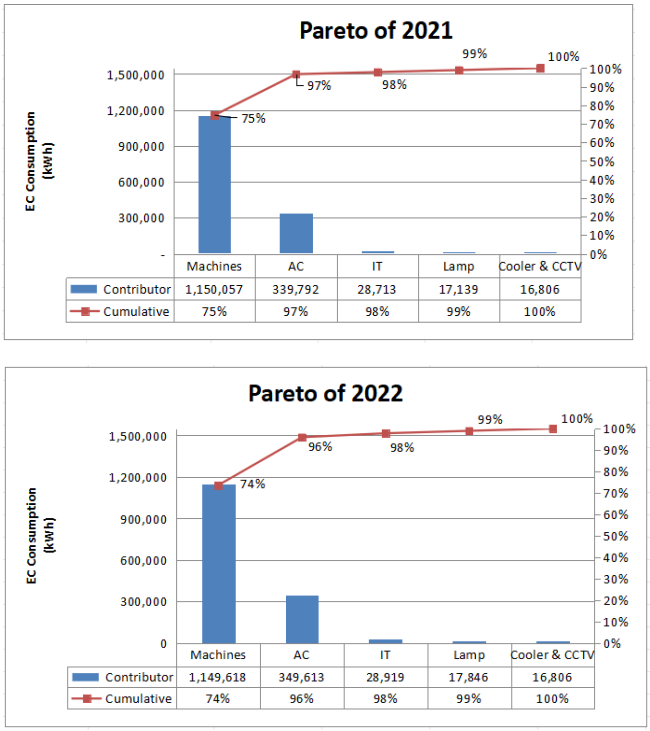
A. Hazard Emission = $\mathrm{EF\ VOC\ x\ F_{cy}waste}$ (6)

Hazard Emission = $95{,}387\ \mathrm{x}\ 0.1$

Hazard Emission = 9,539 Lbs VOC x 0.0024 = $22{,}8936\ 1.4\ \mathrm{DCB\ eq}$

3.2 Emission Contributor Analysis

The main source of emissions is manufacturing equipment. This is because production equipment is a key component of the business and uses a lot of power and time over the course of a year. Air conditioning is the second-largest cause. This is because a lot of air conditioning was used to achieve the appropriate temperature. An air conditioner, for instance, must achieve its temperature in a production room to chill a space filled with industrial machinery. In order to cool the space, the air conditioner must now work harder. The use of IT gadgets is the next largest source of emissions. IT equipment that is still in use to manage business administration increases the creation of emissions.



2021

Figure 3 Pareto Electricity Consumption 2022

After found the most emission contributor, the next step was carried out. The next step is to calculate the emission produced using functional unit. This step is want to proof that this functional unit is quantifiable to reflect and represent the total emission in PT. XYZ. Here are the detail of the calculation:

$$\text{Emission } CO_2e \text{ /12,329,569 m}^2 = \frac{\text{Total Emission (2021 + 2022)}}{\text{Functional Unit}} \text{x } 1{,}000{,}000$$

$$\text{Emission } CO_2e \text{ /12,329,569 m}^2 = \frac{3{,}294}{12{,}329{,}569} \text{x } 1{,}000{,}000$$

$$\text{Emission } CO_2e \text{ /12,329,569 m}^2 = 267.16 \text{ Ton}$$

3.2 Carbon Tax

According to UU No. 7 Year 2022 about Tax Harmonization Law, the lowest carbon tax rate is IDR 30 per kilogram of carbon dioxide equivalent. According to the findings of this study, PT. XYZ will emit roughly 1,405 tons of CO2 in 2021 and 1,389 tons in 2022. The following computation can be used to determine the amount of carbon tox PT. XYZ should pay to the government based on that result:

A. $\mathbf{Carbon\ Tax\ 2021 = CO_2\ Emission\ (Kg)\ x\ Rp.\ Carbon\ Tax/Kg}$

$\mathbf{Carbon\ Tax\ 2021 = 1{,}405{,}000\ x\ Rp.\ 30.00}$

$\mathbf{Carbon\ Tax\ 2021 = Rp.\ 42{,}150{,}000}$

B. $\mathbf{Carbon\ Tax\ 2022 = CO_2\ Emission\ (Kg)\ x\ Rp.\ Carbon\ Tax/Kg}$

$\mathbf{Carbon\ Tax\ 2022 = 1{,}389{,}000\ x\ Rp.\ 30.00 = Rp.\ 41{,}670{,}000}$

4 Conclusions

Based on the result of calculation, it can be conclude as follows:

1. The major contributor of CO_2e released from electricity and fuel consumption of each tier in printing until delivery process:

   This research use a manual calculation to generate the emission production in printing process. The highest contributor in 2021 and 2022 is machines usage about 1,024 and 1,025 Ton CO2e, following by AC consumed about 312 and 303 Ton CO2e. third place is IT consumed is about 30 and 26 Ton CO2e, fourt place is lamp consumed is about 24 and 20 Ton CO2e and last position is cooler and CCTV is about 15 Ton CO2e. The GHG emissions produced by the printing company come from the CO_2 produced from the product produced per year. The amount of poultry GHG emissions is strongly influenced by the length of time the device is used, the type of device, the amount of product produced and process waste. Estimated GHG emissions from poultry in Indonesia with the IPCC Tier 1 method for 2021 and 2022 are 1,405 and 1,389 CO2e. From this result, the final emission produced using functional unit has found is about $\mathbf{267.16\ Ton\ CO_2e\ /12{,}329{,}569\ m^2}$.

2. The carbon tax produced by PT. XYZ:

   Based on final calculation and government regulation, PT. XYZ, must pay around Rp. 42,150.000 for 2021

and Rp. 41,670,000 for 2022 to government as their comitmment to protect our environment.

5 Aknowledgement

Since the author was able to finish the current Journal period by learning a great deal of new information that will be very helpful for author future career development, the author wishes to express his sincere gratitude to God the Almighty for His mercy and grace. Without a lot of support, this report is unlikely to be completed.

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