**Questionnaire Number:**

| | | |
|---|---|---|
| | | |

# Research Instrument
# Analyzing PET-Bottle Waste Technology Using Analytic Hierarchy Process Method

Warm Greeting,

We invite you as a recognized expert in the field to help us to understand the impact that the introduction of poly(ethylene terephthalate) bottle waste (PET-BW) technology in Indonesia could have on society and environment. The aim of this research is to evaluate possible alternative routes for the treatment of PET-BW using the Analytical Hierarchy Process (AHP). Therefore, we would be glad if you could share your opinion about five aspects (environment, resource consumption, economy, society, policy, and technical applicability) concerning the utilization of PET-BW.

Your participation in this research is voluntary and without coercion. It will require about 30 minutes to fill the questionnaire. For assurance and professional courtesy, it should also be clarified that data collected for this work will only be used for the purpose of this study and research analysis within the academic realm of the conducted research. It will not be used for any commercial or other purpose unrelated to the academic field as it is stated in this questionnaire.

This research is conducted by

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| **PROFILE** |
| --- |
| **Name** : ……... |
| **How many years of experience have you had in this research field ?**<br><br>Answer : ……..<br>(Option)<br>1. Less than 5 year<br>2. More than 5 year<br>3. More than 10 year<br>4. More than 20 year<br>5. More than 30 year |

## GENERAL INFORMATION

As an expert in the field, I would appreciate your assistance in carrying out a pair-wise comparison of criteria and sub-criteria used in our AHP approach by filling the following tables with the numbers from the importance scale in Table 1.

Table 1. Scale for pair-wise comparison (Saaty, 1980)

| Importance Scale | Definition of the Importance scale |
|---|---|
| 1 | Equal importance of the row criterion over the column criterion |
| 2 | Between equal and weak importance of the row criterion over the column criterion |
| 3 | Weak importance of the row criterion over the column criterion |
| 4 | Between weak and strong importance of the row criterion over the column criterion |
| 5 | Strong importance of the row criterion over the column criterion |
| 6 | Between strong and demonstrated importance of the row criterion over the column criterion |
| 7 | Demonstrated importance of the row criterion over the column criterion |
| 8 | Between demonstrated and absolute importance of the row criterion over the column criterion |
| 9 | Absolute importance of the row criterion over the column criterion |

The PET bottle waste technology alternatives considered are as follows:

Table 1. Definitions of technology alternatives under consideration.

| **Technology Alternatives** | **Definition** |
|---|---|
| Open Landfill | Waste final disposal on separated or excavated land to accommodate various types of waste |
| Sanitary Landfill | Waste final disposal on excavated land for various types of waste covered by soil to reduce the negative impact; possibility of energy production from exhaust gases |
| Incineration with energy recovery | Converting waste into energy (electricity and heat) |
| Pelletizing Plastic Bottle Waste | Remelting and extrusion of PET to be used as raw material |
| Hydrolysis | Conversion of PET by water at high temperatures and pressures to produce terephthalic acid (TPA) and EG. |
| Glycolysis | Conversion of PET by ethylene glycol (EG) to produce bis(hydroxyethyl)terephthalate (BHET) |

The above Technology options will be subjected to pair-wise comparisons based on the following criteria and sub-criteria:

Table 2. Criteria and Sub-Criteria

| Criteria | Sub-Criteria |
|---|---|
| Environment | Air Pollution |
| | Soil Pollution |
| | Water Pollution |
| | Biodiversity |
| | Climate Change |
| | Land Use |
| Resources Consumption | Energy Consumption |
| | Avoided Chemical Production |
| Society | Public Acceptance |
| | Job Creation |

| | |
|---|---|
| | Public Participation |
| | Human Health |
| | Waste Prevention Behavior |
| Economy | Initial Investment Cost |
| | Operation and Management Cost |
| | Gate Fee |
| Policy | Regulation |
| | Administrative Incentive |
| | Public Organization |
| Technical applicability | Maturity |
| | Feasibility |
| | Capacity |
| | Product Value |

# Part I

In this section, you will be asked to fill in the comparison value provided for each comparison. This section has 38 comparison boxes. Please fill in each degree of comparison between the right and left columns and the number of comparisons between 1 and 9.

# Environment and Sub-Criteria

The environment is an important aspect in the sustainable development and determination of PET bottle waste technology. In this section, you will assess the comparison of sub-criteria in the environment.

In environmental criteria, you will compare 6 sub-criteria used in evaluating PET bottle waste technology. Please help us compare and decide which criteria are important to use by selecting the answer to each pairwise comparison.

| AHP Scale | Sub-Criteria A | Sub-Criteria B | AHP Scale |
|---|---|---|---|
| | Air Pollution | Soil Pollution | |
| | Air Pollution | Water Pollution | |
| | Air Pollution | Biodiversity | |
| | Air Pollution | Climate Change | |
| | Air Pollution | Land Use | |
| | Soil Pollution | Water Pollution | |
| | Soil Pollution | Biodiversity | |
| | Soil Pollution | Climate Change | |
| | Soil Pollution | Land Use | |
| | Water Pollution | Biodiversity | |
| | Water Pollution | Climate Change | |
| | Water Pollution | Land Use | |
| | Biodiversity | Climate Change | |
| | Biodiversity | Land Use | |
| | Climate Change | Land Use | |

# Resource Consumption and Sub-Criteria

Resource consumption is an important part of selecting PET bottle waste management technology.
What is more important between energy consumption and avoiding the production and use of pure PET in the resource consumption criteria?

| AHP Scale | Sub-Criteria A | Sub-Criteria B | AHP Scale |
|---|---|---|---|
| | Energy Consumption | Avoided Chemical Production | |

# Economy and Sub-Criteria

Economic criteria must be considered in the management and technology of PET bottle waste.
Which is more important among the 3 sub-criteria (Initial Investment Cost, Operation and Management Cost, Gate Fee) in the economic criteria?

| AHP Scale | Sub-Criteria A | Sub-Criteria B | AHP Scale |
|---|---|---|---|
| | Initial investment cost | Operation and management Cost | |
| | Initial investment cost | Gate fee | |
| | Operation and management Cost | Gate fee | |

# Society and Sub-Criteria

Society criteria must be considered because the community has an important role in the technology and management of PET bottle waste.
Which is more important among the 5 sub-criteria (Public Acceptance, Job Creation, Public Participation, Human Health, Waste Prevention Behavior)

| AHP Scale | Sub-Criteria A | Sub-Criteria B | AHP Scale |
|---|---|---|---|
| | Public Acceptance | Job Creation | |
| | Public Acceptance | Public Participation | |
| | Public Acceptance | Human Health | |
| | Public Acceptance | Waste Prevention Behavior | |
| | Job Creation | Public Participation | |
| | Job Creation | Human Health | |
| | Job Creation | Waste Prevention Behavior | |
| | Public Participation | Human Health | |
| | Public Participation | Waste Prevention Behavior | |
| | Human Health | Waste Prevention Behavior | |

# Policy and Sub-Criteria

The policy criteria are important because they have a role in implementing PET bottle waste management and technology.
Which is more important among the 3 sub-criteria (Regulation, Administrative Incentives, Public Organization)?

| AHP Scale | Sub-Criteria A | Sub-Criteria B | AHP Scale |
|---|---|---|---|
| | Regulation | Administrative Incentive | |
| | Regulation | Public Organization | |
| | Administrative Incentive | Public Organization | |

# Technical Applicability and Sub-Criteria

Technical applicability criteria are important in PET bottle waste management and technology.
Which is more important among the 4 sub-criteria (Maturity, Feasibility, Capacity, Product Value)?

| AHP Scale | Sub-Criteria A | Sub-Criteria B | AHP Scale |
|---|---|---|---|
| | Maturity | Feasibility | |
| | Maturity | Capacity | |
| | Maturity | Product Value | |
| | Feasibility | Capacity | |
| | Feasibility | Product Value | |
| | Capacity | Product Value | |

# Part II

In this section, the pairwise comparison between the main criteria, namely **Environment, Resource Consumption, Economic, Society, Policy, and Technical Applicability**, are the most important to be considered in the management of PET bottle waste.

You will be asked to fill in the comparison value in the box provided for each comparison. This section has 15 comparison boxes. Please fill in each degree of comparison between the right and left columns and the number of comparisons between 1 and 9.

In your opinion, which is the more important environment, resource consumption, economy, society, policy, and technical Applicability in managing PET bottle waste?

| AHP Scale | Sub-Criteria A | Sub-Criteria B | AHP Scale |
|---|---|---|---|
| | Environment | Resources Consumption | |
| | Environment | Economy | |
| | Environment | Society | |
| | Environment | Policy | |
| | Environment | Technical Applicability | |
| | Resources Consumption | Economy | |
| | Resources Consumption | Society | |
| | Resources Consumption | Policy | |
| | Resources Consumption | Technical Applicability | |
| | Society | Society | |
| | Society | Policy | |
| | Society | Technical Applicability | |
| | Society | Policy | |
| | Society | Technical Applicability | |
| | Policy | Technical Applicability | |