



INTERIM METHODOLOGY

Waste Model

Technical Manual

The International Foundation for Valuing Impacts, Inc. (IFVI) is a section 501(c)(3) public charity dedicated to building and scaling the practice of impact accounting to promote decision-making based on risk, return, and impact.

This publication is subject to the terms and conditions, including the disclaimers and qualifications, set forth at ifvi.org.

© International Foundation for Valuing Impacts, Inc.

Table of Contents

1 INTRODUCTION	3
1.1 DOCUMENT PURPOSE	3
1.2 MODEL INPUT DATA VERSUS IMPACT DRIVER MEASUREMENTS.....	4
2 MODEL STRUCTURE AND FUNCTIONALITY	6
2.1 HIGH-LEVEL DATA ARCHITECTURE	6
2.2 UNDERSTANDING AND OPENING THE MODEL	6
2.3 MODEL STRUCTURE	7
3 ADAPTING THE MODELS FOR BESPOKE ANALYSIS.....	10
3.1 UPDATES TO INPUT DATA, ASSUMPTIONS, AND PARAMETERS	10
APPENDIX A: FULL LIST OF INPUT DATA	11
BIBLIOGRAPHY	14

1 Introduction

1.1 Document purpose

1. This document is the Interim Waste Model Technical Manual, which provides a description of the Interim Waste Model's structure and functionality, input data, and assumptions. It aims to help readers better understand and expand the model that informs the Interim Waste Methodology. The Model Technical Manuals aim to improve transparency and confidence in the Global Value Factors Database (GVFD), and support companies' use of the GVFD for decision-making and sensitivity analysis.
2. The Interim Waste Methodology is part of a series of four interim environmental methodologies released by IFVI, as complements to the impact accounting methodologies produced by IFVI in partnership with the Value Balancing Alliance. All four methodologies are designed with similar structures and resources, outlined below.
3. For general implementation and understanding of the Interim Methodologies, the following primary resources should be utilized:
 - a) **Global Value Factors Database:** An Excel file compilation of all value factors of all methodologies. Companies should use the outputs shown here in estimating their impact values.
 - b) **Methodologies:** These documents describe the Methodology of each environmental impact topic, including key assumptions and conceptual underpinnings and the data requirements of entities in using them.
4. These resources are underpinned by supplemental resources, including the following:
 - a) **Models:** Excel files for each methodology. All calculations that form the output value factors for each impact topic can be viewed and understood in detail here.
 - b) **Technical Manuals:** These documents provide a high-level description of the structure and functionality of each environmental impact valuation model.
 - c) **Central Input Data Workbook:** Upon request, users can access a single Excel file of input data that links the models across all methodologies through PowerQuery.
5. These supplemental resources are provided for three main reasons:
 - a) *Transparency:* along with the methodology documents for each model, the models are made available so each step in the calculation pathway can be examined by interested users.

- b) *Sensitivity analysis or bespoke analysis for decision making*: if users want to understand the sensitivity of the value factors to different parameters or data points in the models, then having the full models allows for this. If more geographically specific analysis of impacts under different scenarios is required for business decision making, then the models can be used as a basis for this.
 - c) *Creation of value factors for additional decision-making contexts*: value factors for all countries are provided in the GVFD but if users want to produce additional value factors for particular decision-making purposes, such as for more granular geographic locations, then the models and technical manuals are provided to allow this.
6. Review of the models and technical manuals should be done in coordination with the other resources available to ensure thorough understanding of the contents.

1.2 Model input data versus impact driver measurements

7. A distinction should be made between impact driver measurements of an entity (i.e. metric tons of waste) and input data used to create the value factors of the Methodology. Companies using the GVFD and the Interim Waste Methodology will need impact driver measurements (i.e. the metric tons of waste for which they are responsible), whereas the input data used in the GVFD is contained within the Model (the full list of input data is outlined in Appendix A). The relationship between these types of data is depicted in Figure 1.

How an entity should estimate waste impact:

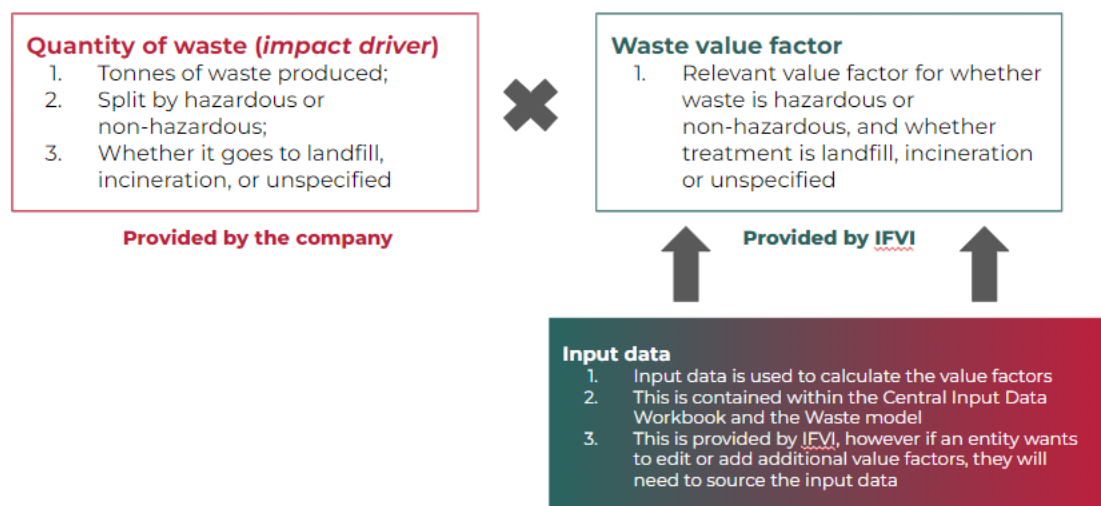


Figure 1: Difference between impact driver measurements and model input data

8. This manual focuses on model input data, rather than impact driver measurements. More detail on impact driver measurements is available in the Interim Waste Methodology.

2 Model Structure and Functionality

2.1 High-level data architecture

9. There are three core elements to the data that informs each Interim Methodology: the Global Value Factors Database (GVFD), the models themselves, and the Central Input Data Workbook (CIDW). The models and the Global Value Factors Database are both publicly available, while the Central Input Data Workbook is available upon request.
10. The Central Input Data Workbook is a central repository for all the input data sources used in all models including the links to the sources, units and year. It also contains all key assumptions and parameters used in the models. Given the complexity of the data architecture and the importance of consistent and comparable applications of impact accounting, this workbook is only available upon request.
11. The individual models then combine the relevant input data sources and calculate the value factors for each country and impact area.
12. The final value factors are then collated in the Global Value Factors Database. For most users looking to use the value factors to value environmental impacts, this will be the most important resource and can be used independently of the models and CIDW.

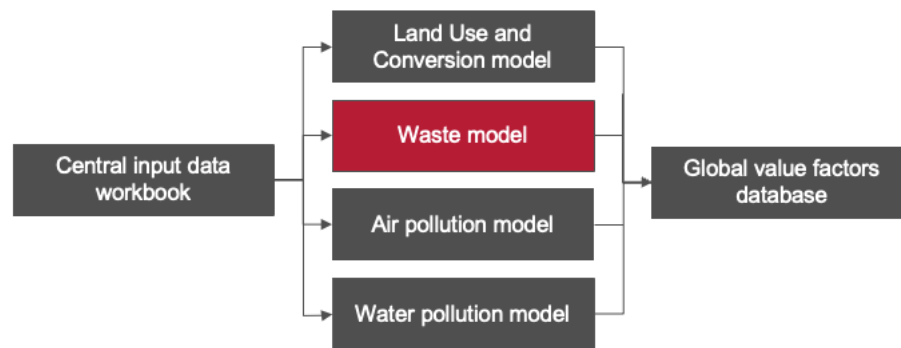


Figure 2: high-level diagram of the model architecture

2.2 Understanding and opening the model

13. Each model contains a cover sheet that provides an overview of each tab and the appropriate way to navigate them.
14. The model is organized, and color coded to indicate which sheets represent data inputs, calculations, or value factors. Any updates or changes to the underlying data within the

model should be applied to the data inputs, which will then be carried through the calculation sheets to produce updated value factors.

15. Any modifications to these models may produce distinct value factors distinct from those produced by IFVI and should not be considered endorsed or approved by or a representation of the IFVI methodology.
16. When opening the Excel model for the first time, a banner may appear signifying the file is in protected view. Select 'Enable editing.' A Security Warning banner may then appear as the file has external data connections. Select 'Enable Content.'

2.3 Model structure

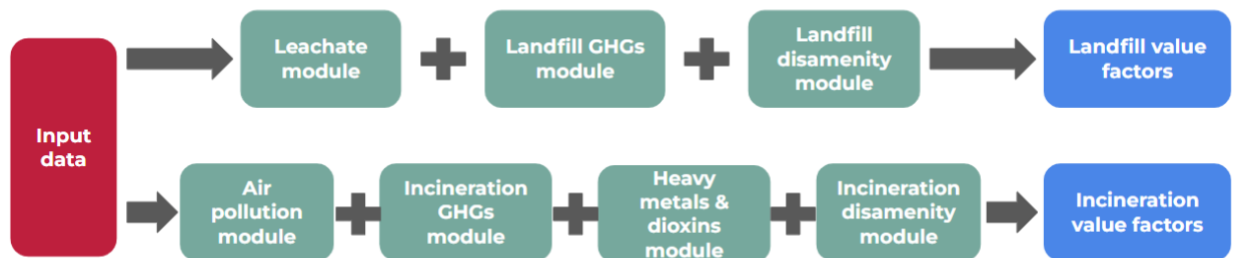


Figure 3: Interim Waste Model Structure

17. The Model is made up of seven modules (which form the calculations for four impact pathways outlined in the Methodology). Three of these modules form the landfill value factors and four form the incineration value factors. This is illustrated in Figure 3. Note that in the Interim Waste Model, disamenity impact is calculated for both landfill and incineration in one sheet, hence why there are only six sheets described below.
18. The main model calculations for each module are colored in dark green. Any supplementary models or calculations are shown in the lighter green color. The module that they relate to is given by the module number.

a) **Sheet: 1. Leachate**

The Leachate module calculates value factors of leachate from landfills for hazardous and non-hazardous waste. HARAs scores are used to assign likelihood of impact based on soil permeability, population density and % of lined landfills within the country. ERQ scores are used as proxy where % of lined landfills is not known.

b) **Sheet: 2. Air Pollution**

The air pollution module calculates value factors for NO_x, SO_x, PM₁₀ and PM_{2.5}

from waste incineration. Avoided emissions from energy recovery within countries is removed from the gross emissions of the pollutants.

c) **Sheet: 3. Heavy Metals & Dioxins**

The heavy metals & dioxins module values health impacts from incineration. Dioxin impacts are valued through cost of fatal (VSL) and non-fatal (WTP) cancers. Cost of lead and mercury are valued through lost IQ (WTP).

d) **Sheet: 4. Disamenity**

The disamenity module values impacts of living near a landfill or incineration site. Discounted waste flows from both sites are calculated in the LF DWF and IN DWF tabs and combined with country housing factors to value disamenity impact.

e) **Sheet: 4a. LF DWF**

This sheet shows the landfill discounted waste flow. The calculations discount waste flow from landfills over their remaining lifetime. This feeds into the disamenity module.

f) **Sheet: 4b. IN DWF**

This sheet shows the Incineration discounted waste flow. The calculations discount waste flow from incinerators over their remaining lifetime. This feeds into the disamenity module.

g) **Sheet: 4c. Hedonic Pricing**

This sheet shows the calculations that form the hedonic pricing transfer function that forms part of the final disamenity calculations.

h) **Sheet: 5. Landfill GHGs**

This sheet shows the outputs of the IPCC Landfill Greenhouse Gas model. Users can change the type of waste being sent to landfill under the Waste Type Input drop down. Clicking 'Update coefficients' runs a macro for the IPCC model for all countries. Hazardous and non-hazardous coefficients are shown.

i) **Sheet: 5a. IPCC Model**

Forms the calculations for the landfill GHGs module. Uses IPCC Model to determine methane generation rates, which are then transformed to carbon and valued with the social cost of carbon.

j) **Sheet: 6. Incineration GHGs**

The incineration GHGs module values greenhouse gas impacts from incineration. Avoided emissions from energy recovery are removed from the gross emissions emitted.

k) **Sheet: 7. Interim Value Factors**

These interim coefficients combine all value factors in the model for the modified list of countries. Regional and income averages are calculated and used to gap-fill for all other countries where primary data is not available

l) **Sheet: Waste Value Factors**

Final value factors (VFs) for the solid waste impact pathways. The value factors as presented are the same values in the Global Value Factors Database, but if a user adjusts the data in the model they may change and should not be considered endorsed or approved by or a representation of the IFVI methodology.

m) **Input Data Sheets**

- **Waste Assumptions Sheet:** contains all assumptions for the Waste model.
- **Waste Data Sheet:** contains all country-specific data for the Waste model.
- **Country Mappings:** contains the modified country list that is used in the waste model.
- **Inflation Calculations:** Inflation data used to convert all values to 2023 USD.
- **Waste HARAS ERQ:** contains HARAS and ERQ data that is used in the leachate module.
- **Waste MGR:** contains IPCC Methane Generation data that forms the IPCC model in the Landfill GHG module.

3 Adapting the models for bespoke analysis

3.1 Updates to input data, assumptions, and parameters

19. The intent of the impact accounting methodology is to provide consistent and comparable impact accounting methodologies that can be applied across entities. As such, the methodologies are intended to be used as is. IFVI will update the input data variables, assumptions, and parameters as necessary and on a regular basis, without the need for model users to make their own updates.
20. However, if any sensitivity or bespoke analysis is desired, the input data can be updated in the Models.
21. If the input data is changed by the model user, the landfill GHGs module will need to be re-run. This will not happen automatically in the model and the Excel macro will need to be manually run by the user.
22. Should an entity wish to add new countries, regions or geographical areas specifically to the Interim Waste Model, this can be done by amending the Waste Data Sheet in the model.
23. There are 32 different data points that make up the variables in the Interim Waste Model. Data will need to be gathered for all 32 for each specific country, region or geographical area that is being added.
24. A full list of the data points are listed in Appendix A.
25. Some data inputs to the models apply across multiple models. For users wishing to conduct bespoke analysis across multiple models with consistent and efficient data, this can be done by making adjustments to the underlying Central Input Data Workbook. This workbook and a set of models that are directly linked to it via PowerQuery are available upon request.

Appendix A: Full List of Input Data

Data point per country / region / geographic area	Unit
ERQ score	Number
SOx intensity of national grid	Metric tons / kwh
NOx intensity of national grid	Metric tons / kwh
PM2.5 intensity of national grid	Metric tons / kwh
PM10 intensity of national grid	Metric tons / kwh
Average CO2e grid factor	Metric tons / kwh
Household size	People / house
Total waste generated	Metric tons
Landfill waste flow	%
Total landfill waste	Metric tons
Incineration waste flow	%
Total incineration waste flow	Metric tons
Number of landfills	Number
Number of incineration plants	Number
Incineration with energy recovery	%
Lined landfills	%
Waste collection	%
Average property price	2023 USD
Fraction of methane captured from landfill - Hazardous	%
Fraction of methane captured from landfill – Non-hazardous	%

Fraction of methane captured, then burned - Hazardous	%
Fraction of methane captured, then burned – Non-hazardous	%
GNI PPP per capita	2023 USD
Soil permeability	Classification below
Climate zone	Temperate Wet, Temperate Dry, Tropical Wet or Tropical Dry
Population density	People / km ²
Hazardous waste incinerated	Metric tons
Non-hazardous waste incinerated	Metric tons
NOx Value Factor	2023 USD, from Air Pollution model
SOx Value Factor	2023 USD, from Air Pollution model
PM2.5 Value Factor	2023 USD, from Air Pollution model
PM10 Value Factor	2023 USD, from Air Pollution model

Soil permeability ranking:

Soil permeability is used as an indicator of how readily leachate will infiltrate water and soil systems. The Model uses country permeability rankings from Gleeson et al (2011). To assign countries a score of Best, Medium and Worst, these definitions are used:

- Best: 10⁽⁻¹⁵⁾ to 10⁽⁻¹⁷⁾ logk m²
- Medium: 10⁽⁻¹²⁾ to 10⁽⁻¹⁵⁾ logk m²
- Worst: 10⁽⁻¹⁰⁾ to 10⁽⁻¹²⁾ logk m²

Where no data is available, we assume medium case. Should an entity wish to update the soil permeability or add a new country / region / geographic area, these definitions should be used.

Bibliography

Gleeson, T. et al (2011), Mapping Permeability over the Surface of the Earth, Geophysical Research Letters, Vol.38(2), pp.1-6

Please note: This bibliography only refers to sources referenced in this user guide. For a bibliography that includes the theoretical and empirical basis of the methodology, please refer to the separate methodology document.