LCA Report Generation Guide

For the Replit Development Agent

Version: 1.0
Date: 2025-07-23
Author: Replit Coach Too
Status: Draft

1. Objective

This document provides a detailed technical guide for the Replit Agent to build a feature that dynamically generates a comprehensive, multi-page Life Cycle Assessment (LCA) report in PDF format. The structure and content of this report must be modeled after the provided "Avallen LCA Feb 2021.pdf" to ensure it meets professional and ISO standards.

2. Part 1: Backend Logic & Technology

2.1. PDF Generation Service

- **Technology:** The Python backend will use a robust library for creating complex PDFs from HTML or data, such as **WeasyPrint** or a similar alternative. This library must be able to convert a structured HTML template with CSS into a PDF.
- **Asynchronous Process:** The generation of this detailed report will be a **Celery background task** to avoid timing out user requests.

2.2. Data Aggregation

- **Trigger:** This process is initiated when a user with an "Approved" report clicks the "Download Report" button.
- **Logic:** The Celery worker will fetch all necessary data from the database for the specific report_id:
    1. The final calculated results from reports.report_data_json.
    2. The full, structured input dataset from the corresponding lca_questionnaires.lca_data field.
    3. Company and product details from the companies and products tables.
- **Output:** The worker will pass this aggregated data into a templating engine (e.g., Jinja2) to populate an HTML template, which is then rendered into the final PDF.

3. Part 2: Structure & Content of the Generated LCA Report

This section defines the structure of the HTML template that will be rendered into the PDF.

Section 1: Cover Page

- **Content:**
  - **Title:** "Life Cycle Assessment of [Product Name]"
  - **Subtitle:** "Produced by [Company Name]"
  - **Branding:** Include the Avallen Solutions logo.
  - **Date:** "[Report Generation Date]"
- **Data Source:** products.sku_name, companies.company_name, reports.generated_at.

Section 2: Executive Summary / Main Findings

- **Content:** A dynamically generated paragraph that summarizes the key findings.
- **Logic:**
  - Extract the total GWP100 result (carbon footprint) from reports.report_data_json.
  - Identify the top 2-3 "hotspots" (the processes or inputs with the highest contribution to the carbon footprint) from the detailed results.
  - State the final results clearly. Example text: "This study assessed the climate impact of [Product Name]. The total carbon footprint was found to be [X] kg CO2-eq per bottle. The primary impact drivers were identified as [Hotspot 1] ([Y]%) and [Hotspot 2] ([Z]%)."

Section 3: Introduction

- **3.1. Background:** A static text block describing the client company, populated with their name.
- **3.2. Goal and Scope Definition:**
  - **Goal:** A static text block: "The goal of this study is to assess the environmental impacts of a bottle of [Product Name]. Results can be used for internal improvement and external communication."
  - **Scope:** Static text: "The scope of the assessment is 'cradle-to-gate'."
  - **Functional Unit:** Dynamic text: "The functional unit is defined as: One [Product Volume, e.g., 0.7L] bottle of [Product Name], including all primary and secondary packaging."
  - **Impact Categories:** Static text: "The assessment focuses on the Global Warming Potential (GWP100) and Water Consumption."

Section 4: Inventory Analysis

- **4.1. Process Description:**
  - **Visual:** For the MVP, a static, generic process flow diagram image (similar to Figure 1 in the Avallen LCA) will be included.

- **4.2. Process Data:**
  - **Logic:** The system will dynamically generate a series of tables based on the data stored in lca_questionnaires.lca_data. Each key in the JSON object (e.g., agriculture, processing, packaging) will become a titled table in the report, displaying the specific inputs and outputs.
- **4.3. Dataset References:**
  - **Content:** A static table listing the primary background database used (e.g., "Ecoinvent 3.5") and the impact assessment method (e.g., "IPCC 2013 GWP 100a").

Section 5: Impact Assessment & Interpretation

- **5.1. Contribution Analysis:**
  - **Visual:** The system must generate a **bar chart** (similar to Figure 4 in the Avallen LCA) that visually represents the contribution of each life cycle stage/input to the total carbon footprint. This chart will be generated using a Python charting library (e.g., Matplotlib, Plotly) that can save the chart as an image to be embedded in the HTML template.
  - **Data Source:** The detailed breakdown from reports.report_data_json.
- **5.2. Results Table:**
  - **Content:** A clear table summarizing the final impact scores for each category (e.g., Climate Change, Water Consumption).

Section 6: Benchmarking (Optional)

- **Logic:** If the platform has sufficient anonymized data to create a benchmark for the product's category, this section will be included.
- **Visual:** A bar chart comparing the client's product's carbon footprint against the industry average.
- **Content:** A brief explanation of the benchmark and the product's performance relative to it.

Section 7: References

- **Content:** A static page listing the ISO standards (ISO 14040, ISO 14044) that the methodology adheres to.