Product LCA Page Guide

For the Replit Development Agent

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1. Objective

This document provides a detailed technical guide for the Replit Agent to build the **Product Life Cycle Assessment (LCA) Page**. This is the primary user interface for displaying the environmental footprint of a single product. The implementation must follow the specified four-part structure to ensure the page is clear, intuitive, and actionable.

2. Part 1: Backend Enhancements

To power this new page, a dedicated API endpoint and a new analysis service are required.

2.1. New Backend Service: HotspotAnalysisService

- **Requirement:** A new service is needed to analyze the detailed LCA results and generate actionable insights.
- **Function:** analyze_lca_results(report_data_json)
- **Logic:** This function will:
  1. Parse the detailed LCA data from the reports.report_data_json field.
  2. Identify the single component with the highest percentage contribution to the **carbon footprint**.
  3. Identify the single component with the highest percentage contribution to the **water footprint**.
  4. Return a structured object containing these "hotspots" and pre-defined, context-aware suggestions. For example: {"carbon_hotspot": {"component": "Glass Bottle", "percentage": 55, "suggestion": "Explore options for lightweighting your bottle..."}}.

2.2. New API Endpoint

- **Endpoint:** GET /api/reports/<report_id>/visual-data
- **Logic:** This endpoint will orchestrate all the data needed for the LCA page. It will:
  1. Fetch the report, product, and company data from the database.
  2. Call the HotspotAnalysisService to generate the actionable insights.
  3. Aggregate the detailed component data into the four main life cycle stages (Liquid, Process, Packaging, Waste) for the primary breakdown charts.
  4. Return a single, comprehensive JSON object containing all the data needed for the

four sections of the page.

3. Part 2: Frontend Implementation

A new page must be created in the React application, accessible via a route like /app/products/<product_id>/lca.

3.1. Main Page Component: ProductLcaPage

- **Logic:** On load, this component will call the GET /api/reports/<report_id>/visual-data endpoint and pass the returned data down to its child components.

3.2. Section 1: The Header (LcaHeader Component)

- **UI:** A clean, prominent section at the top of the page.
- **Content:**
  - Product Name & Image: Display the product's name and its primary photo.
  - KeyMetricCard (x3): Three reusable components, each displaying:
    - The metric title (e.g., "Total Carbon Footprint").
    - The large numerical value (e.g., "850").
    - The unit (e.g., "g CO_2e per bottle").

3.3. Section 2: The Primary Breakdown (PrimaryBreakdownCharts Component)

- **UI:** Two stacked bar charts, one for Carbon and one for Water.
- **Technology:** Use the **Recharts** library.
- **Chart 1: Carbon Footprint Breakdown:**
  - A <BarChart> with a single <Bar> component using the stackId prop.
  - The data for the chart will be an array of the four life cycle stages: Liquid, Process, Packaging, and Waste.
  - Each segment of the bar must be color-coded and display its percentage contribution.
- **Chart 2: Water Footprint Breakdown:**
  - A second <BarChart> configured identically to the carbon chart, but using the water footprint data.

3.4. Section 3: Detailed Analysis (DetailedAnalysisTabs Component)

- **UI:** A tabbed interface to organize the detailed data tables.
- **Tab 1: Carbon Footprint (CO_2e):**
  - A table displaying the detailed carbon impact of every single component.
  - **Columns:** Component, Category, Impact per Bottle (g CO_2e), % of Total.
- **Tab 2: Water Footprint (Litres):**
  - An identical table structure for the water footprint data.
- **Tab 3: Production Waste (g):**
  - An identical table structure for the production waste data.

3.5. Section 4: Actionable Insights (ActionableInsights Component)

- **UI:** A visually distinct section at the bottom of the page with a title like "Key Insights & Opportunities".
- **Logic:** This component will receive the "hotspot" data generated by the HotspotAnalysisService.
- **Content:** It will display 2-3 InsightCard components. Each card will contain:
  - An appropriate icon (e.g., a lightbulb 💡, a water drop 💧).
  - A clear "Hotspot Alert" or "Insight" title.
  - The dynamically generated text that explains the finding and suggests a clear opportunity for improvement.