Enhanced LCA Data Collection Guide

For the Replit Development Agent

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Author: Replit Coach Too
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1. Objective

This document provides a detailed technical guide for the Replit Agent to upgrade the platform's data collection capabilities to ensure a highly accurate and comprehensive Life Cycle Assessment (LCA). The current data input forms will be replaced with an enhanced, multi-stage questionnaire modeled directly on the data points found in the "Avallen LCA Feb 2021.pdf" reference document.

2. Part 1: Database Schema Enhancement

To store the new, more granular data, the structure of the lca_data JSONB field within the lca_questionnaires table must be updated.

New lca_data JSONB Structure:

```
{
  "basic_info": {
    "product_name": "Heritage Apple Brandy",
    "sku_code": "HAB-700ML",
    "product_type": "Spirit",
    "volume_ml": 700
  },
  "agriculture": {
    "main_crop_type": "Apples",
    "yield_ton_per_hectare": 31.5,
    "diesel_l_per_hectare": 15,
    "sequestration_ton_co2_per_ton_crop": 0.40
  },
  "inbound_transport": {
    "distance_km": 10,
    "mode": "Lorry >32t"
  },
  "processing": {
    "water_m3_per_ton_crop": 0.056,
```

```
    "electricity_kwh_per_ton_crop": 10.21,
    "lpg_kg_per_l_alcohol": 0.16,
    "net_water_use_l_per_bottle": 1.23,
    "angels_share_percentage": 2
  },
  "packaging": [
    {
      "component_type": "Container",
      "container_name": "750ml Burgundy Bottle",
      "material": "Glass, white",
      "weight_grams": 540,
      "recycled_content_percentage": 80
    },
    {
      "component_type": "Label",
      "label_material": "Paper, from apple pulp",
      "label_weight_grams": 0.824
    }
  ],
  "distribution": {
    "avg_distance_to_dc_km": 150,
    "primary_transport_mode": "Lorry >16t"
  },
  "end_of_life": {
    "recycling_rate_percentage": 65,
    "primary_disposal_method": "Landfill"
  }
}
```


3. Part 2: New Frontend Data Collection Form

The existing "Enhanced Product Creation" form must be replaced with a new, more detailed multi-tabbed interface.

Tab 1: Basic Info (Matches current Screenshot ...08.17.53)

- **Fields:** Product Name, SKU Code, Product Type (Dropdown), Volume (e.g., 700ml).
- **No major changes needed here.**

Tab 2: Agriculture & Ingredients (Replaces Screenshot ...08.17.58)

- **Headline:** "Agriculture & Raw Materials"
- **Fields:**
  - **Main Crop:**
    - main_crop_type: (Dropdown: Apples, Grapes, Barley, etc.)
    - yield_ton_per_hectare: (Numeric Input)
    - diesel_l_per_hectare: (Numeric Input, for farm machinery)
  - **Other Ingredients:**
    - A repeatable form for other minor ingredients (e.g., yeast, botanicals) with fields for Ingredient Name, Amount, and Unit.
  - **Carbon Sequestration (Advanced):**
    - sequestration_ton_co2_per_ton_crop: (Optional Numeric Input with a tooltip explaining its purpose).

Tab 3: Packaging (Replaces Screenshot ...08.18.08)

- **Headline:** "Packaging Components"
- **Interface:** A repeatable list component where a user clicks "Add Component".
- **Fields for each component:**
  - component_type: (Dropdown: Container, Label/Printing, Stopper/Closure, Secondary Packaging).
  - **Conditional Fields based on component_type:**
    - **If "Container":** Container Name, Material (Dropdown), Weight (g), Recycled Content (%), Color.
    - **If "Label/Printing":** Label Material (Dropdown), Label Weight (g), Printing Method, Ink Type.
    - **If "Stopper/Closure":** Stopper Material (Dropdown), Stopper Weight (g).
    - **If "Secondary Packaging":** Packaging Material (Dropdown), Packaging Weight (g).

Tab 4: Production & Processing (Replaces Screenshot ...08.18.13)

- **Headline:** "Inbound Transport & Production"
- **Fields:**
  - **Inbound Transport:**
    - distance_km: (Numeric Input: "Average distance from farm/source to your facility")
    - mode: (Dropdown: Lorry >32t, Van, Rail, etc.)
  - **Processing (Dynamic based on Product Type):**
    - **For Spirits/Cider:**
      - water_m3_per_ton_crop: (Numeric Input: "Water for washing crop")

        - electricity_kwh_per_ton_crop: (Numeric Input: "Electricity for crushing/pressing")
        - lpg_kg_per_l_alcohol: (Numeric Input: "LPG or other fuel for distillation")
      - **For Aged Spirits:**
        - angels_share_percentage: (Numeric Input: "Annual evaporation loss during aging")
    - **General:**
      - net_water_use_l_per_bottle: (Numeric Input: "Total net water usage in the facility per final bottle")

Tab 5: Distribution & Logistics (Matches current Screenshot ...08.18.20)

- **Headline:** "Distribution & Logistics"
- **Fields:**
  - avg_distance_to_dc_km: (Numeric Input: "Average distance to first distribution center")
  - primary_transport_mode: (Dropdown)
- **No major changes needed here, but ensure field names match the new JSON structure.**

Tab 6: End of Life (Matches current Screenshot ...08.18.22)

- **Headline:** "End of Life Management"
- **Fields:**
  - recycling_rate_percentage: (Numeric Input)
  - primary_disposal_method: (Dropdown)
- **No major changes needed here, but ensure field names match the new JSON structure.**

4. Part 3: Backend Logic Update

- **Data Storage:** The backend API endpoint for submitting the form must be updated to accept and store the new, deeply nested JSON structure in the lca_questionnaires.lca_data field.
- **Data Processing:** The LCA Calculation Service (Celery worker) must be updated to parse this new JSON structure and correctly map the new, granular data points to the corresponding processes when building the product system in OpenLCA.