AI Usage Across the M-REGS Project

1. System Architecture & Flow Design

- **ChatGPT** was used to structure the recycling pipeline into modular components (Shredder → Sorter → Pyrolyzer → Gas Cleanup → Condenser → SOFC → Outputs).

- ChatGPT generated **Mermaid flowcharts** and helped refine process sequences for clarity and technical accuracy.

- This modular visualization allowed rapid adaptation from the **Mars version** to the **Dhaka version**.

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2. Waste Sorting & Classification (AI Vision)

- **Lobe (Lovable AI)** was used to **train and test image classification models** for waste sorting (metal, glass, plastics, fabrics, etc.).

- This enabled **smart, automated bin sorting** using a lightweight AI model deployable on cameras or embedded devices.

- Contribution: reduced human error, ensured faster preprocessing, and made the system autonomous.

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3. Technical Specification Generation

- **ChatGPT** was used to generate **SolidWorks-ready specification sheets** for each module.

- Provided details like **operating temperatures, catalyst types, material specs, and housing dimensions**.

- These AI-generated specs formed the **Bill of Materials (BOM)** for CAD modeling.

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4. Simulation & Performance Modeling

- **Gemini** and **ChatGPT** were used to estimate **energy yields** from pyrolysis and SOFC conversion.

- Modeled:

    - **Thermal reuse efficiency** (e.g., pyrolyzer heat loop feeding into dryer).

    - **Water recovery percentages** from condensation.

    - **Waste-to-energy conversion ratios**.

- Integrated **NASA POWER API** (via ChatGPT + Gemini for API scripting) to calculate **solar availability** based on latitude/longitude.

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5. Dashboard & Software Development

- **ChatGPT** was used to generate production-ready **React dashboards** with:

    - Real-time waste intake sliders.

    - Override buttons (e.g., all waste → pyrolyzer).

    - Dynamic energy graphs (solar, SOFC, thermal reuse).

    - API integration for solar projections (NASA POWER API).

- **Gemini** assisted in testing logic consistency and improving API integration reliability.

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6. Cost Modeling & Localization

- **ChatGPT** analyzed cost data from Bangladesh for solar, shredders, and industrial equipment.

- Helped project **per-unit cost ranges** (~USD $16k–$29k for Dhaka deployment).

- For Mars, Gemini was used to estimate **energy demand vs. module scalability** instead of monetary cost.

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7. Communication, Storytelling & Creativity

- **ChatGPT** created structured **video scripts, narration flows, and scene sequencing**.

- **Gemini** suggested creative optimizations like **energy cascading** and **modular water loop designs**.

- AI enabled **interactive what-if simulations** in the dashboard (days projection, location change).

Creativity Amplified by AI

- **Lobe (Lovable)** enabled **practical AI waste sorting**, turning a concept into deployable models.

- **ChatGPT** structured chaos into **professional outputs** — BOMs, dashboards, reports, scripts.

- **Gemini** acted as a **co-simulator**, balancing logic, technical feasibility, and system resilience.

Together, these AIs made M-REGS **faster to design, smarter in operation, and more impactful**.
 Our team's role was not replaced but **augmented**: we steered the creativity, adapted solutions to Mars and Earth contexts, and ensured cultural + practical relevance.