



# PLASTIC RECYCLING & 3D PRINTING RE-FABRICATOR SYSTEM

(Designed for NASA Mars Mission – Waste Reuse & Sustainable Manufacturing)



## 2. System Overview

**Machine Name:** Plastic Recycling & 3D Printing Refabricator

**Main Function:** Converts used plastic waste into 3D printable filament and reprints it into new tools or spare parts.

**Operation:** Fully automatic, closed-loop process with temperature and emission control.

**Power Need:** ~1.2–1.5 kW average

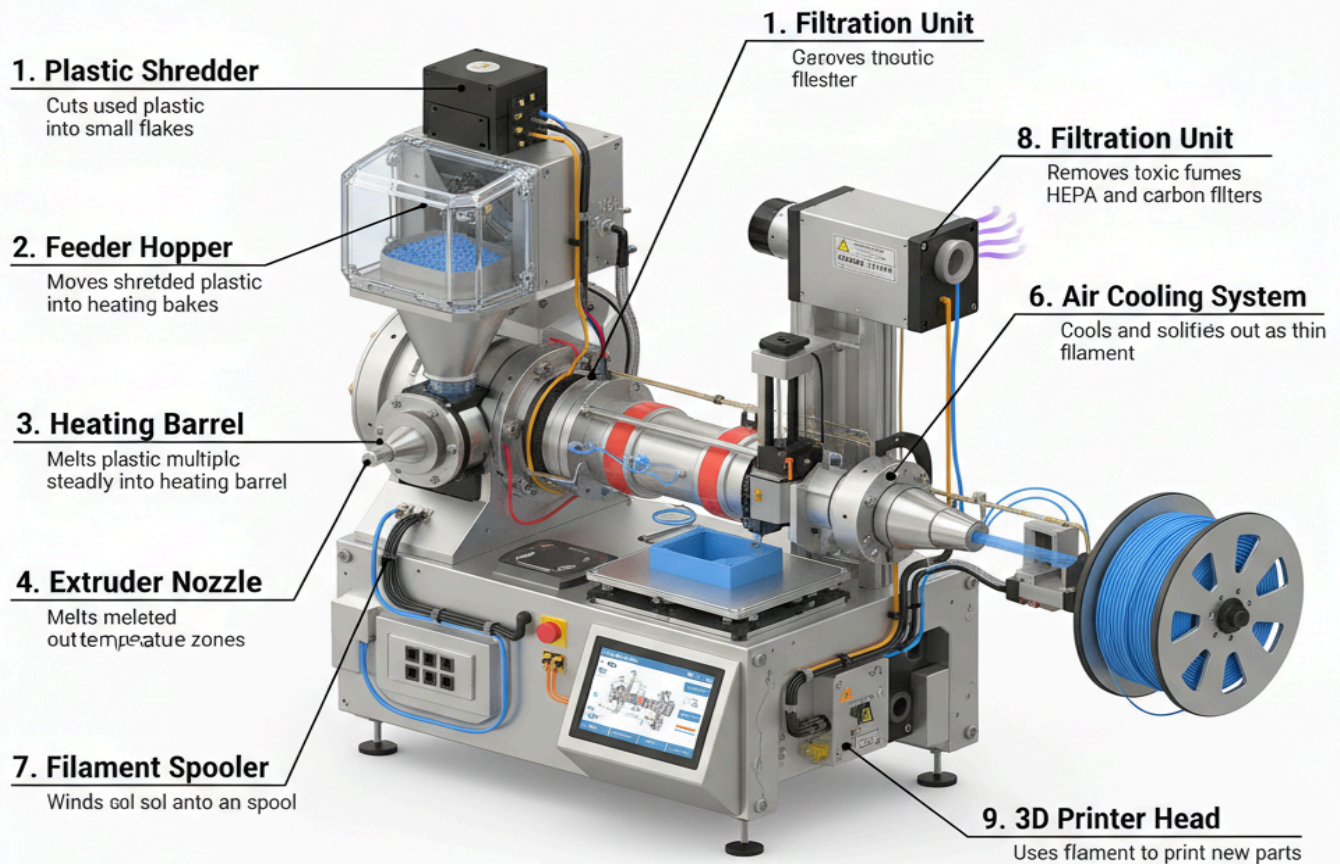
**Output:** ~1 kg recycled plastic every 3 hours



## 3. Machine Components and Functions

# NASA MARS REFABRICATOR SYSTEM

## PLASTIC RECYCLING & 3D PRINTING



Component	Function
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- |                           |                                                             |
|---------------------------|-------------------------------------------------------------|
| 1 <b>Plastic Shredder</b> | Cuts used plastic parts into small flakes for easy melting. |
| 2 <b>Feeder Hopper</b>    | Moves shredded plastic steadily into the heating barrel.    |

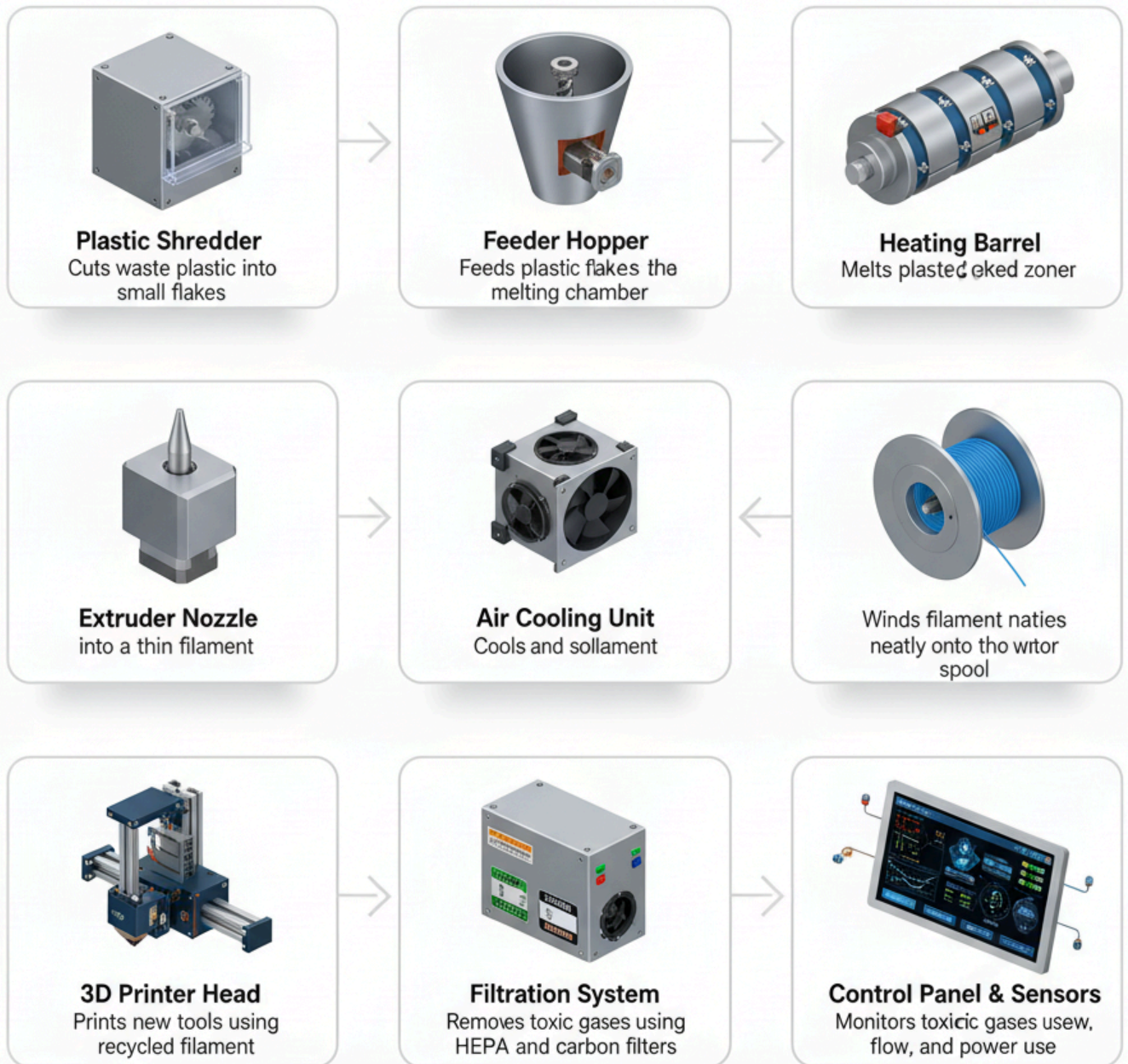
- 3 **Heating Barrel**      Melts plastic at multiple controlled temperature zones.
- 4 **Extruder Nozzle**   Pushes melted plastic into a thin filament.
- 5 **Air Cooling System**      Cools and solidifies the filament without using water.
- 6 **Filament Spooler**      Winds filament onto a spool for storage or 3D printing.
- 7 **3D Printer Head**      Prints new tools and spare parts from the filament.
- 8 **Filtration Unit**      Removes toxic gases using HEPA and carbon filters.
- 9 **Control Panel & Sensors**      Monitors temperature, pressure, and motor speed.



## 4. Process Flow



# Plastic Recycling and 3D Printing Refabricator – Component Breakdown



**Step 1:** Waste plastic parts (e.g., containers, packaging) are shredded.

**Step 2:** Plastic flakes enter the heating barrel, melting in separate zones.

**Step 3:** The molten plastic passes through the extruder nozzle and forms filament.

**Step 4:** The filament cools, solidifies, and winds onto a spool.

**Step 5:** The filament is used by the 3D printer to create new tools and parts.

**Step 6:** Toxic gases are filtered and recycled safely.

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## 5. Features for Mars Environment

Mars Challenge	Design Adaptation
Low gravity affects material flow	Screw-feeder maintains steady input
Limited energy supply	High insulation + low-power heaters
No liquid water	Air-based cooling system
Dust and contamination	Fully sealed design with filters
Crew safety	Automatic shutdown and gas monitoring system

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## 6. Impact & Benefits

- Reduces resupply dependency from Earth
- Enables sustainable, on-site manufacturing
- Minimizes waste storage needs
- Supports Mars base circular economy

- Protects crew health through closed-loop operation
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## 7. NASA References

1. *Waste Materials Recycling for In-Space Manufacturing* – NASA Technical Report, 2018
  2. *Dual Use of Packaging on the Moon (Logistics-to-Living)* – NASA, 2020
  3. *Waste Management Options for Long-Duration Space Missions* – NASA, 2005
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## 8. Future Integration

This plastic recycling module will be one part of the larger **TPMR (Tri-Phase Modular Recycler)**,

where metal and foam/fabric recycling units will combine to form a single all-in-one system for Mars waste management.

