# UPCYCLE PLASTICS RECYCLING

RECLAIM. RECYCLE. REPEAT.

Honeywell
UOP

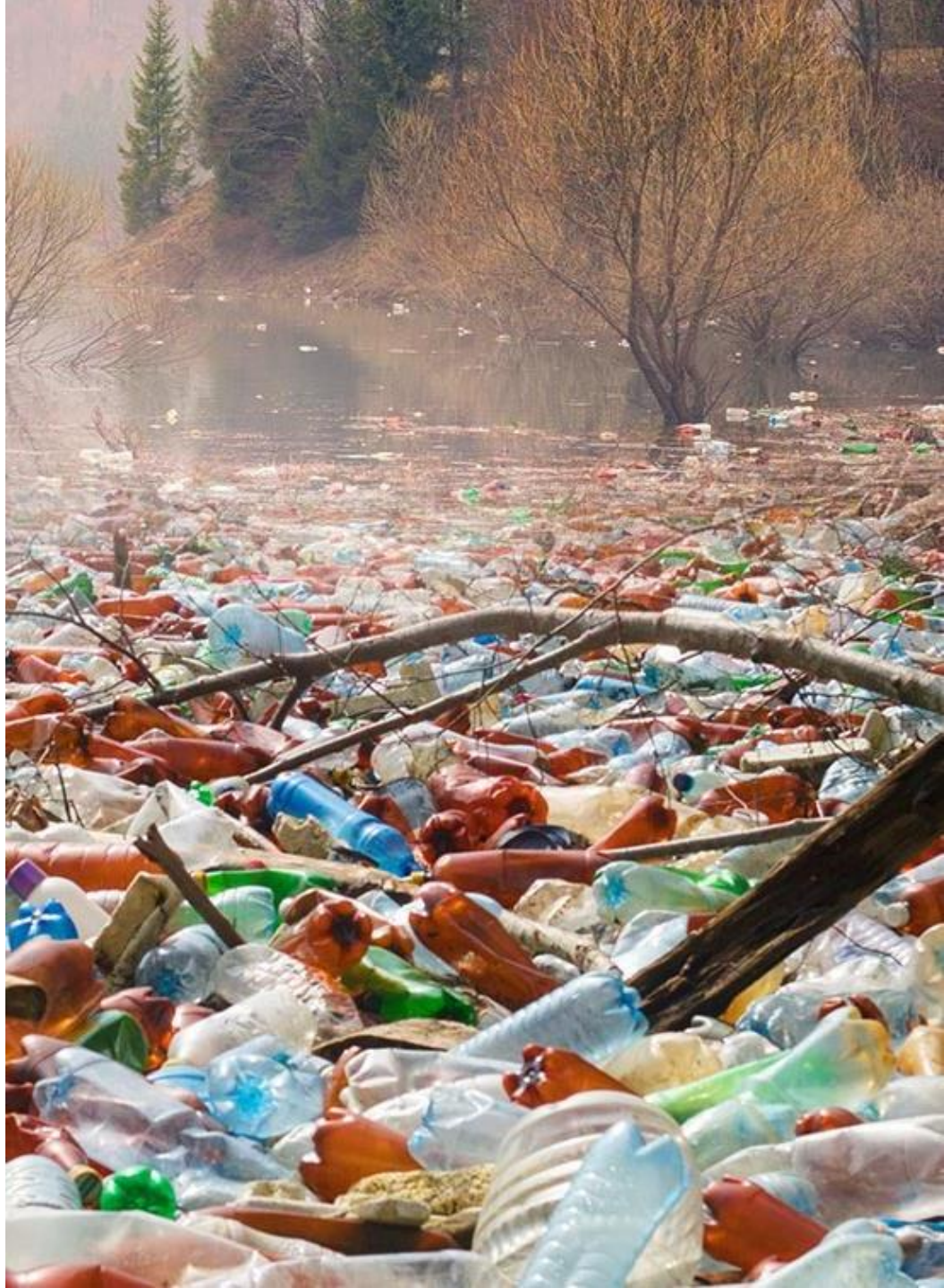
Environment

## OUR OFFERINGS

# UPCYCLE PLASTICS RECYCLING

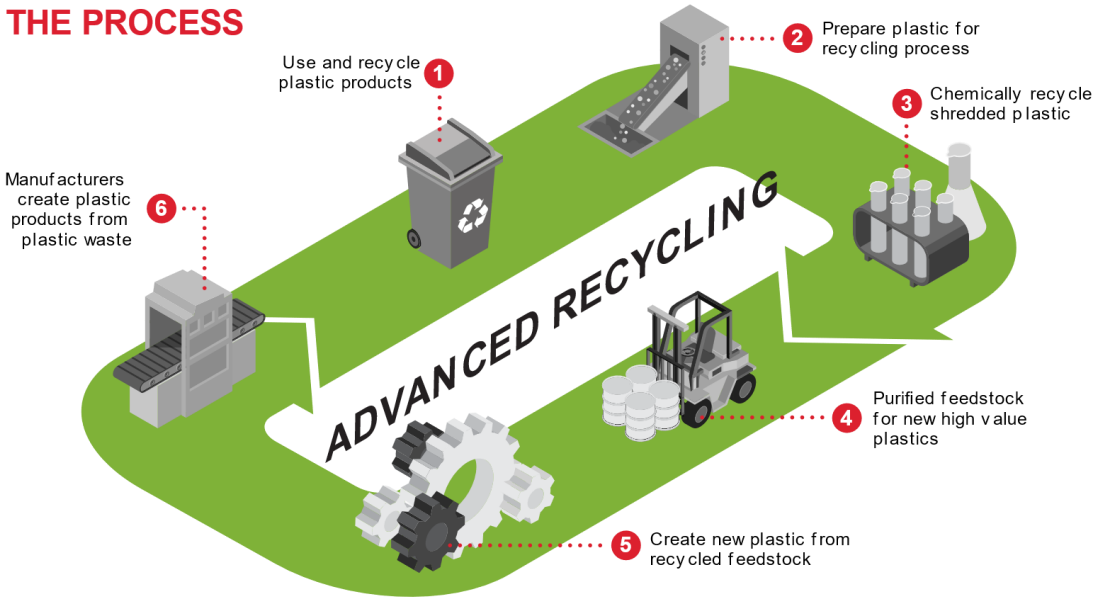
### REDUCING PLASTIC WASTE FLOW TO THE ENVIRONMENT

- **Honeywell's UpCycle Process Technology** expands the types of plastics that can be recycled
- **Increases the amount of global plastic waste to that can be recycled,** when used in conjunction with other chemical and mechanical recycling processes, and improvements to collection and sorting.**
- For a case study in Spain, new technology can produce recycled polymer feedstock used to make plastics **with 57% less $CO_2$ equivalent emissions** versus those produced using fossil feeds



# UPCYCLE PLASTICS RECYCLING

## THE PROCESS




For illustrative purposes only

## Waste Plastic Recycling is Accelerating

**$950 per ton** — European Union is taxing non-recycled plastic packaging at $950 (€800) per ton

**$450 per ton** — U.S. states offer tax credits for plastic recycling investments averaging >$450 per ton of capacity

**$280 per ton** — Extended producer responsibility fees average >$280 per ton in EU and Canada

## Partnering with Waste Management to Produce "Drop-In" RPF

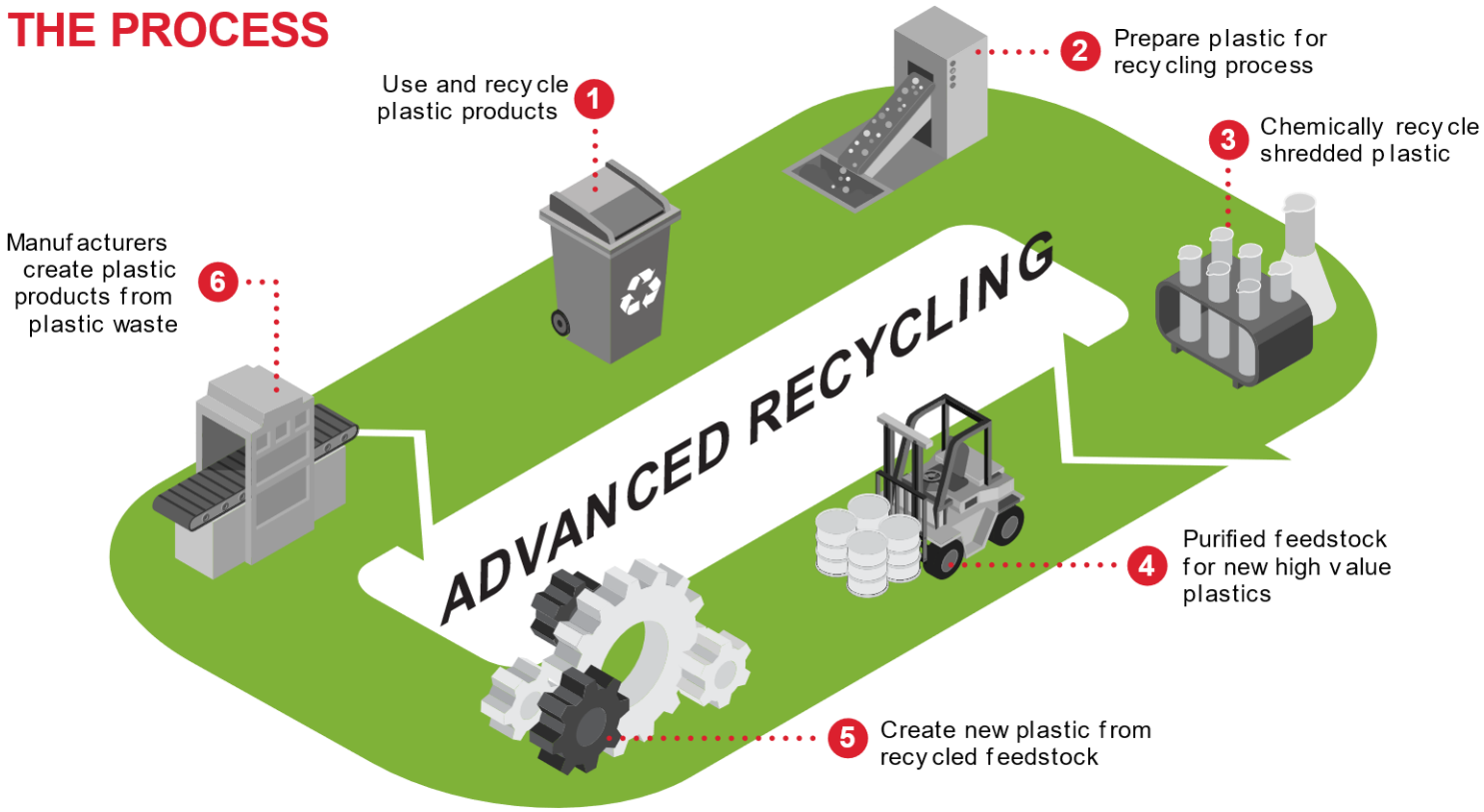
- UOP investing in waste plastic conversion to produce recycled polymer feedstock (RPF) for Steam Crackers
- **Benefits for Steam Crackers (SC)**
  - Honeywell Cl and metal levels can enable RPF blending up to 25% feed to SC
  - Light olefin yield similar or higher than naphtha
  - Product end point adjusted to meet most SC feed specs
- A phased and economic approach to increased plastics circularity

## HON RPF: A Next-Generation PyOil with Superior Properties

| Recycled Polymer Feedstock Properties | |
|---|---|
| Specific Gravity | 0.77-0.83 |
| Naphtha (wt%) | 20-35% |
| Distillate (wt%) | 45-60% |
| Gas Oil (wt%) | 2-10% |
| Sulfur (ppmw) | <500 ppm |
| Nitrogen (ppmw) | <2000 ppm |
| Chloride (ppmw) | <15 ppm |
| Olefins (wt%) | 25-50% |

# HONEYWELL UOP UPCYCLE
## ENABLING PLASTIC CIRCULARITY

Honeywell innovation makes a plastic circular economy possible and solves the end-of-life impact of plastic waste

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# LIFECYCLE OF PLASTIC WASTE
## RECYCLING MORE OF THE WORLD'S PLASTICS

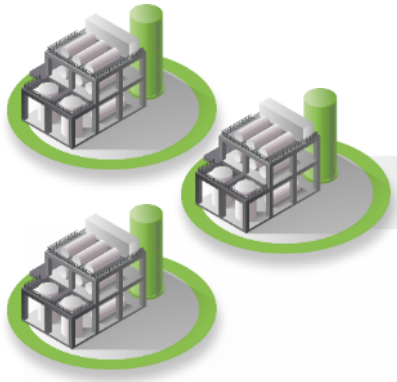
Developing multiple plastics recycling solutions

WASTE

HONEYWELL TECHNOLOGIES IN DEVELOPMENT

| | | | |
|---|---|---|---|
| 1 | PET | POLYETHYLENE TEREPHTHALATE | SOLVOLYSIS → POLYMER PLANT → POLYMER |
| 2 | HDPE | HIGH DENSITY POLYETHYLENE | |
| 3 | PVC | POLYVINYL CHLORIDE | Opportunity to process up to 4% |
| 4 | LDPE | LOW DENSITY POLYETHYLENE | PYROLYSIS → STEAM CRACKER OR FCC with PRU → MONOMER |
| 5 | PP | POLYPROPYLENE | |
| 6 | PS | POLYSTYRENE | |
| 7 | OTHER | OTHER PC POLYCARBONATE | |

# ADVANCED RECYCLING VALUE CHAIN

| ADVANCED RECYCLING | RECYCLED POLYMER FEEDSTOCK | OFFTAKE & TRANSPORT | UPGRADING AND POLYMERIZATION | POST-CONSUMER RESIN | PLASTIC PRODUCTS |
|---|---|---|---|---|---|
|  |  |  |  |  |  |
| **43kmta waste plastic at a 70% yield into pyrolysis process**<br><br>**Target #3-7 bales for pyrolysis feed** | **Stable recycled polymer feedstock (RPF)**<br><br>**Transport ~1 truck per day** | **Post-consumer resins (PCR) produced from recycled polymer feedstock** | **Enables post-consumer resin (PCR) content in packaging** | amazon Walmart<br>P&G Coca-Cola<br>ESTĒE LAUDER<br><br>AND MANY MORE | |

**Technology to Dramatically Increase Recycling**