BioTradX

Waste-to-Biofuel Conversion Efficiency Benchmarks

Category-wise yields, processing efficiency by waste type, and best-performing feedstocks for India

Conversion efficiency (how much fuel you can realistically produce from a tonne of feedstock) is one of the fastest ways to compare waste categories. Buyers can use these benchmarks to pick feedstock that delivers **higher output, smoother processing, and lower variability**.

Below are practical, **order-of-magnitude benchmarks** (actual yields vary with moisture, contamination, pre-treatment, and plant technology).

Category-wise conversion yields

1) Used Cooking Oil (UCO) → Biodiesel (FAME)

- **Typical yield: ~0.84–0.98 kg biodiesel per kg UCO** (84–97.5% conversion range reported across studies). Sciepub
- **Benchmark for planning: ~0.91 kg biodiesel per kg UCO**. ICCT
  Why it performs well: UCO is an energy-dense, relatively direct conversion route.

2) Crop residues (Rice straw) → 2G Ethanol

A useful India-specific benchmark comes from an official 2G plant reference:

- **~200,000 tonnes rice straw → ~30 million litres ethanol/year**
  ⇒ approx **150 L ethanol per tonne** (site-specific but publishable as a real-world benchmark). Press Information Bureau+2Advanced Biofuels USA+2

3) Pressmud (Sugar industry) → Biogas / Bio-CBG

- **Typical biogas yield: ~82–105 m^3 biogas per tonne of pressmud** (reported range). World Biogas Association (WBA)
  Why it performs well: consistent industrial waste stream + good digestibility profile (vs many dry residues).

4) Food waste / organic MSW → Biomethane

Methane yield is often expressed per volatile solids (VS), but practical planning ranges are commonly used:

- Food waste mono-digestion methane yield ranges are widely reported (tech-dependent). ScienceDirect+1
  Practical takeaway: segregated food waste typically yields higher and more stable gas than mixed wet waste.

5) Rice straw → Biomethane

- Reported biomethane yield examples for rice straw vary substantially based on VS content and yield assumptions; published ranges include **~92–280 L CH_4 per kg** (i.e., **~92–280 m^3 CH_4 per tonne**, depending on basis/assumptions). MDPI
  Note: dry residues often need pre-treatment/co-digestion to achieve stable yields.

6) Waste Plastics → Pyrolysis Oil

- Peer-reviewed reviews report **liquid oil yields up to ~90 wt%** in some systems (wide ranges by polymer, catalyst, and reactor). ScienceDirect
- Experimental studies often report **~60–76% oil** under specific conditions. PMC
  Best performers: PE/PP-rich streams generally outperform mixed/contaminated plastics.

Processing efficiency by waste type

Efficiency isn't only "yield"; it's also **how reliably plants can run**:

- **High efficiency, low variability:** UCO (clean), pressmud/spent wash (industrial), segregated food waste. ICCT+2World Biogas Association (WBA)+2
- **Medium efficiency, higher variability:** agro residues (straw/husk) due to moisture, ash/silica, and seasonal logistics. Press Information Bureau+1
- **High potential, high sensitivity:** plastic pyrolysis (very feedstock-quality dependent). ScienceDirect+1

Best-performing materials

If your goal is **maximum output with minimum uncertainty**, these typically rank well:

1. **UCO → Biodiesel** (high conversion, clear QC parameters) ICCT+1
2. **Pressmud → Biogas/Bio-CBG** (strong reported yield ranges; consistent industrial supply) World Biogas Association (WBA)
3. **Segregated food waste → Biogas/Bio-CBG** (high methane yield when clean) ScienceDirect+1
4. **Rice straw → 2G ethanol** (proven India reference benchmark) Press Information Bureau+1

Why this is useful for BioTradX buyers

These benchmarks help buyers:

- Shortlist feedstocks with better conversion ROI
- Set QC requirements that actually impact yield (moisture, purity, water content, plastics mix)
- Compare offers on an "energy output per ₹ landed" basis (not just ₹/ton)