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LIFE-INOFEED: Design Optimization and Pilot-Scale Construction of Upgraded Decentralized Bio-Waste Drying Units

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4,000 t	1,600 t	−5,600 t	6 + 1	09/2025 – 08/2029	3.74 M€	2.25 M€
bio-waste treated/year	animal feed produced	CO_2-eq savings	AOSDU units deployed	48-month duration	total eligible cost	EU contribution (60%)

1. BACKGROUND & CHALLENGE

Agri-food bio-waste generation across the EU represents a major environmental and economic challenge. Centralised treatment solutions are often economically unviable for dispersed, small-to-medium waste producers.

LIFE-INOFEED addresses this gap through the development and pilot-scale deployment of Autonomous On-Site Drying Units (AOSDUs): containerised, modular, transferable and combinable units that valorise food-related bio-wastes into safe, marketable animal feed components using solar-assisted energy.

Building upon an existing prototype, the upgraded AOSDU has undergone a comprehensive redesign supported by advanced engineering and detailed construction planning, focusing on enhanced modularity, structural robustness, airflow distribution, drying homogeneity and energy performance.

PROTOTYPE UNIT

2. AOSDU DESIGN OPTIMIZATION

Each AOSDU is composed by a Shredding Module, a Drying Module and a Solar Panel Module. Each module is housed within a standard 20-foot container, enabling cost-efficient manufacturing, simplified transport, rapid on-site deployment and high operational flexibility. Upgraded automation, real-time process monitoring and enhanced safety features guarantee operational reliability and full EU regulatory compliance.

SM — Shredding Module

1. Controlled size reduction & homogenisation
2. Powerful cutting mechanisms with overload protection
3. Uniform raw material size → improved drying efficiency & process stability

SM

SPM — Solar Panel Module

1. IEC 61215-certified photovoltaic panels
2. Smart energy management system
3. $LiFePO_2$ battery storage for off-hours operation
4. R290 heat pump (GWP <1) as backup
5. Virtual net metering - minimised grid dependency

SPM

DM — Drying Module

1. Hybrid drying unit with two insulated drying tanks
2. Optimized airflow management
3. High-efficiency ventilation elements
4. Use of heat pump to increase drying temperature
5. Unit cover - greenhouse type - solar drying
6. Real-time temperature and humidity monitoring
7. Targeted moisture content ≤12%
8. Feed safety performance according to HACCP standard

DM

3. LIFE-INOFEED PROCESS FLOW

Bio-waste Input → Shredding (SM) → Solar Drying (DM) → Central Facility → Quality Control → Feed Market

The central processing facility (ENV) handles final drying (1 t/hr), homogenisation, quality control (BIOLAB), packaging and temporary storage, bridging decentralised production with the animal feed ingredients market.

4. PILOT DEPLOYMENT — AOSDUs HOST FACILITIES

Unit	Facility	Bio-waste Stream	Ctry.
UNIT 1	**Supermarket**	Non-marketable fruits & vegetables, mixed with Rice, pasta, flour products (also non-marketable)	GR
UNIT 2	**2 - phase Olive Oil Mill**	2-phase olive pomace	GR
UNIT 3	**Poultry Slaughterhouse**	Poultry by-products (Cat. 3 Animal By-products)	GR
UNIT 4	**Fruit & Vegetable Auction**	Non-marketable fruits & vegetables	GR
UNIT 5	**REHORECA (hospitality sector)**	Catering / food waste	GR
UNIT 6	**INAGRO Research Centre**	Brewers' spent grain & agro-industrial residues	BE

5. CONSTRUCTION & TRL PROGRESSION

Construction of the 1st AOSDU commenced March 2026. The 1st drying Module is expected by end of June 2026. At least 5 fully integrated pilot-scale AOSDU units will be constructed and deployed at host facilities by M24. A phased commissioning approach enables integration issues to be identified on the first unit before full deployment.

TRL Progression: 5–6 → TRL 8

TRL 5-6 (prototype) → TRL 8 by M48

6. TECHNICAL INNOVATION

Energy System
1. Solar + heat pump hybrid drying
2. $LiFePO_2$ battery backup storage
3. Smart energy management
4. Virtual net metering

Modularity
1. 20-ft container housing
2. Transferable & combinable
3. Rapid on-site deployment
4. Scalable in modular sections

Sustainability
1. 8-layer anti-drip cover (+1.5% light transmittance)
2. R290 heat pump (GWP <1)
3. Minimised carbon footprint
4. EU Green Procurement criteria

Monitoring
1. Real-time temperature & humidity sensors
2. Remote process control
3. HACCP-compliant traceability
4. Full EU feed safety compliance

7. EXPECTED IMPACTS

Environmental
- ✓4,000 t bio-waste diverted from landfill/year
- ✓−5,600 t CO_2-eq (demonstration phase)
- ✓>90% solar energy coverage for drying
- ✓Full LCA/PEF assessment (ISO 14044)

Economic
- ✓New revenue streams for agri-food businesses
- ✓Commercially viable decentralised model
- ✓NPV €6.25M (Crete expansion scenario)
- ✓Payback period: <3 years (Scenario A)

Social
- ✓18 new green jobs created
- ✓Support for rural & remote areas
- ✓Strengthened local SMEs & primary producers
- ✓FSTP: Learn · Evolve · Replicate actions

Policy
- ✓Legislative amendment proposal (Reg.1069/2009)
- ✓Licensing pathways & best-practice guidelines
- ✓Contribution to EU Bioeconomy Strategy
- ✓Evidence for regulators & policymakers

9. CONCLUSIONS

1. The upgraded AOSDU design demonstrates significant advances in modularity, energy efficiency and scalability over the original prototype, confirming technical readiness for pilot-scale deployment.
2. The three-module architecture (SM + DM + SPM) enables flexible, site-adapted configurations accommodating the full range of bio-waste streams across the six host facilities.
3. Integration of solar energy with heat pump backup and battery storage ensures reliable year-round operation in both Mediterranean and northern European climates.
4. LIFE-INOFEED establishes a replicable, close-to-market circular economy model with documented environmental, economic, social and policy impacts, fully aligned with EU Green Deal objectives.

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