Waste-to-Energy Systems Engineering Training Course

Professional Development Training Course Outline

Category	Renewable Energy	**Duration**	5 Days
Base Fee	$1,500 USD	**Delivery Mode**	Online / On-site Hybrid

Course Introduction

Waste-to-Energy (WtE) Systems Engineering Training Course provides a comprehensive, industry-focused understanding of how municipal, industrial, and commercial waste streams can be transformed into electricity, heat, renewable fuels, and other valuable energy products. The course integrates circular economy, resource recovery, energy transition, sustainable waste management, decarbonization, and advanced thermal conversion principles with practical systems-engineering approaches. Participants explore the complete WtE value chain from waste characterization and feedstock assessment through technology selection, plant design, energy conversion, emissions control, grid integration, operations, maintenance, and performance optimization.

Designed around real-world engineering challenges, the program develops practical capabilities in anaerobic digestion, landfill-gas recovery, incineration, refuse-derived fuel (RDF), gasification, pyrolysis, waste heat recovery, energy efficiency, carbon management, environmental compliance, and techno-economic assessment. Through applied case studies, engineering scenarios, and project-based learning, participants learn how to evaluate WtE projects for technical feasibility, economic viability, environmental performance, operational reliability, and social sustainability, supporting the development of resilient and low-carbon energy systems.

Programme Curriculum

Waste-to-Energy Systems Engineering Training Course

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5 days

Course Objectives

By the end of the course, participants will be able to:

1. Understand Waste-to-Energy systems engineering, circular economy principles, and integrated resource recovery.
2. Characterize waste streams using feedstock analysis, composition profiling, calorific-value assessment, and data analytics.
3. Evaluate WtE technology pathways, including anaerobic digestion, combustion, gasification, pyrolysis, and landfill-gas recovery.
4. Apply process engineering and systems engineering principles to WtE facility design.
5. Develop energy and mass balances for waste conversion and energy recovery processes.
6. Assess renewable energy generation, energy efficiency, heat recovery, and grid integration opportunities.
7. Apply emissions-control, air-quality, environmental compliance, and pollution-prevention strategies.
8. Evaluate carbon reduction, decarbonization, life-cycle assessment, and climate-impact performance.
9. Conduct techno-economic analysis, CAPEX/OPEX assessment, financial modeling, and project feasibility studies.
10. Apply digitalization, automation, IoT monitoring, predictive maintenance, and process optimization to WtE facilities.
11. Identify occupational health, process safety, risk management, and emergency-response requirements.
12. Develop effective operations, maintenance, reliability, and asset-management strategies.
13. Design and communicate bankable, sustainable, scalable, and resilient WtE project concepts.

Target Audience

1. Environmental Engineers.
2. Mechanical and Process Engineers.
3. Civil and Municipal Engineers.
4. Energy and Power Professionals.
5. Waste Management Managers
6. Project Developers and Consultants.
7. Government, Municipal, and Regulatory Professionals
8. Operations, Maintenance, Sustainability, and HSE Professionals

Course Modules

Module 1: Waste-to-Energy Fundamentals and Systems Engineering

- **Circular economy** and integrated waste-management principles.
- Global **energy transition** and the role of WtE.
- Waste hierarchy, resource recovery, and waste-stream classification.
- **Systems engineering** approaches for integrated WtE facilities.
- Key technical, environmental, economic, and social performance indicators.
- **Case Study:** Integrated municipal WtE strategy combining material recovery, organic-waste treatment, and energy recovery.

Module 2: Waste Characterization and Feedstock Engineering

- Waste composition, moisture, density, and **calorific value**.
- Sampling, laboratory analysis, and feedstock variability.
- **RDF/SRF** production and quality specifications.
- Feedstock preprocessing, sorting, shredding, and conditioning.
- Mass-balance and energy-balance development.
- **Case Study:** Engineering assessment of mixed municipal solid waste for RDF production and energy recovery.

Module 3: WtE Conversion Technologies

- **Anaerobic digestion** and biogas-to-energy systems.
- **Incineration/combustion** and steam-cycle generation.
- **Gasification** and syngas production.
- **Pyrolysis** and production of fuels and carbon-rich products.
- Landfill-gas capture and **renewable natural gas** pathways.
- **Case Study:** Technology-selection comparison for an urban waste stream based on energy yield, emissions, cost, and feedstock characteristics.

Module 4: Plant Design, Energy Recovery, and Integration

- Process-flow diagrams and **plant systems architecture**.
- Boilers, turbines, generators, heat exchangers, and CHP systems.
- **Waste heat recovery** and industrial heat integration.
- Electrical systems, controls, instrumentation, and grid connection.
- Energy-efficiency and performance optimization.
- **Case Study:** Conceptual design of a WtE CHP facility supplying electricity and useful heat to an industrial cluster.

Module 5: Emissions Control, Environmental Engineering, and Carbon Management

- Air-emission sources and **pollution-control technologies**.
- Particulate, acid-gas, NOx, and trace-contaminant management.
- Ash, digestate, wastewater, and residuals management.
- **Carbon accounting, life-cycle assessment, and decarbonization**.
- Environmental monitoring and regulatory compliance.
- **Case Study:** Environmental-performance improvement program for a WtE facility facing tightening emissions standards.

Module 6: Digital WtE, Automation, and Operational Excellence

- **SCADA, IoT, sensors, and real-time process monitoring**.
- Data analytics for plant performance management.
- **Artificial intelligence and predictive maintenance** applications.
- Reliability engineering and asset-performance management.
- Digital dashboards, KPIs, and continuous improvement.
- **Case Study:** Predictive-maintenance strategy using equipment-condition data to reduce unplanned downtime.

Module 7: Techno-Economic Assessment and Project Development

- **CAPEX, OPEX, lifecycle cost, and financial modeling**.
- Revenue streams from electricity, heat, fuels, recyclables, and recovered materials.
- **Levelized cost of energy** and project economics.
- Risk assessment, sensitivity analysis, and scenario modeling.
- Procurement, contracting, financing, and project-development considerations.
- **Case Study:** Feasibility assessment for a city-scale WtE project under multiple energy-price and waste-supply scenarios.

Module 8: Safety, Sustainability, Operations, and Future WtE Systems

- **Process safety, HSE, hazard identification, and risk management**
- Operations, maintenance, reliability, and workforce competency.
- Community engagement and social sustainability.
- **Net-zero, carbon-negative opportunities, circularity, and resource recovery**.
- Future technologies, policy trends, and scalable WtE systems.
- **Case Study:** Development of a resilient, low-carbon WtE master plan integrating energy recovery, recycling, organics treatment, and emissions reduction.

Training Methodology

- Interactive lectures and presentations.
- Group discussions and brainstorming sessions.
- Hands-on exercises using real-world datasets.
- Role-playing and scenario-based simulations.
- Analysis of case studies to bridge theory and practice.
- Peer-to-peer learning and networking.
- Expert-led Q&A sessions.
- Continuous feedback and personalized guidance.

Register as a group from 3 participants for a Discount

Send us an email: info@fineskilltrainingcenter.org or call *+254769199797*

Certification

Upon successful completion of this training, participants will be issued with a globally- recognized certificate.

Tailor-Made Course

We also offer tailor-made courses based on your needs.

Key Notes

a. The participant must be conversant with English.

b. Upon completion of training the participant will be issued with an Authorized Training Certificate

c. Course duration is flexible and the contents can be modified to fit any number of days.

d. The course fee includes facilitation training materials, 2 coffee breaks, buffet lunch and A Certificate upon successful completion of Training.

e. One-year post-training support Consultation and Coaching provided after the course.

f. Payment should be done at least a week before commence of the training, to Fineskill Training Center account, as indicated in the invoice so as to enable us prepare better for you.

Upcoming Scheduled Sessions

Start Date	End Date	Location	Price
23 Nov 2026	27 Nov 2026	Online	$1,000
23 Nov 2026	27 Nov 2026	Physical	$1,500
23 Nov 2026	27 Nov 2026	Physical	$3,000
23 Nov 2026	27 Nov 2026	Physical	$3,000
23 Nov 2026	27 Nov 2026	Physical	$6,000
23 Nov 2026	27 Nov 2026	Physical	$4,500
23 Nov 2026	27 Nov 2026	Physical	$6,000
23 Nov 2026	27 Nov 2026	Physical	$6,000

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