

Benefits of Small and Decentralized Waste-to-Energy Modules for DutchPowerGroup B.V. (DPG)

Background

In many regions worldwide, particularly in remote or developing areas, waste management remains a persistent challenge due to the lack of suitable infrastructure and scalable solutions. Traditional large-scale waste-to-energy (WtE) facilities are often not viable in these locations because of prohibitive costs, logistical complexities, and the absence of centralized waste collection systems. Additionally, the dependency on extensive transportation networks exacerbates environmental impacts and increases operational expenses, making these facilities less attractive for local implementation.

The decentralized nature of DPG's small WtE modules offers a solution to these challenges. By being strategically positioned closer to waste generation points, these compact, modular plants reduce the need for extensive transportation while providing a sustainable and scalable approach to waste processing and energy generation. Furthermore, the containerized design ensures that the modules can be transported, assembled, and operationalized even in areas with limited infrastructure, such as poorly maintained roads or restricted waterways.

The environmental compliance, adaptability, and modular scalability of DPG's WtE solutions address both immediate waste management needs and long-term sustainability goals. These systems create new opportunities for local energy generation, support circular economy initiatives, and provide a foundation for community development, including job creation and energy independence.

By introducing technologies such as the Chameleon (Grate Combustion) and Phoenix (Fluidized Bed) models, DPG is pioneering a waste management approach tailored to the unique needs of diverse communities. These systems bring the potential for reliable energy access, improved waste treatment, and environmental compliance, even in challenging circumstances. Their compact, relocatable design ensures that they can adapt to changing needs while fostering sustainable development across regions.

1. Logistics

The decentralized nature of DPG's waste-to-energy (WTE) modules, such as the Chameleon (Grate Combustion) and Phoenix (Fluidized Bed) models, reduces the need for extensive waste

transport logistics. These plants can be strategically located closer to waste generation sources, minimizing transportation costs and carbon emissions.

Key Features:

- Compact design: Requires 3 hectares (1 for the facility, 2 for truck mobility and operations).
- Processing Capacity: 50-150 tonnes/day (25,000 to 50,000 tonnes/year), scalable to increased or decreased needs
- Modular setup: Easy to scale with multiple lines of 50Kton per year.
- Containerised construction: Facilitates simplified transport and setup.
- Re-location of the plant is viable and relatively quick (3 to 4 months)

2. Social Acceptance

Our WTE modules are designed with (European) environmental compliance and community integration in mind. By adhering to the highest standards of emissions and odour control, they reduce public concerns often associated with the positioning and operation of waste treatment facilities.

Social Benefits:

- Minimal odour emissions through active odour suppression systems in storage bunkers.
- Compliance with EU and World Bank regulations as a minimum ensures environmental safety, due to modular design, retrofit improvements during plant life cycle on emission control is easy to implement and therefore very viable.
- Creation of local jobs (approx. 10 - 30 people per line depending on level of automation of plant, operating 24/7 in shifts throughout 330 days a year).
- Integration into local (small) communities: Provides clean energy and supports the circular economy, and simultaneously provide power as well as residual heat
- Due to the small footprint, the integration within an existing landfill area or other appropriate (licensed) area is very beneficiary to the rapid deployment

3. Investment

The investment in DPG's WTE modules is cost-efficient, scalable, and attractive to stakeholders aiming for sustainable solutions and a fit for purpose investment schedule. Instead of large-scale investment into a mass-burn facility of 250Kton with a minimum investment of 200 to 300 Million a phased approach, introducing line after line may seem more attractive and will be achieved against almost half the price!

Financial Overview:

- Procurement Cost: €15-17 million. (excluding civils) investment covers all steps from detail engineering onwards till handover, fully operational.
- Engineering Costs: Basic engineering: €500,000 (4-6 months);
- Feed study/Consultancy: €150,000.
- Construction Time: 18 months till ready for shipment, civil works on site in parallel ; 3-4 months for on site deployment, commissioning and start-up
- Operational Efficiency: Delivery of heat capacity at 20 MWh/thermal.(depending on feedstock) Produces net power output of approx. 4 to 5 MWe at a waste processing capacity of approx. 150 tonnes/day.
- DPG reserves the option to construct the plant, or parts thereof in the land ordering the machinery in order to reduce transport cost as well as better local standard compliance.

4. Re-location of the Module

Our WTE plants are modular and containerized, making them relocatable and adaptable to changing waste management needs or new project locations.

Relocation Highlights:

- Standard 20' and 40' container units for modular assembly.
- Simplified dismantling and reassembly processes.

5. Accommodating Gas Emissions and Retrofit Price Impact

DPG's WTE modules are engineered to meet stringent WHO standards, Dutch standards, and EU regulations. We can adapt emission cleaning technologies to achieve desired levels of compliance.

Emission Control:

- Compliance with the Industrial Emissions Directive (IED) and Air Quality Directive.
 - Industrial Emissions Directive – *IED – Directive 2010/75/EU*: which requires the use of Best Available Techniques (BAT) for the reduction of gas and particulate emissions. These techniques ensure that odours from the combustion and waste storage process are minimally perceptible to nearby communities.
 - Optional: In the storage bunker, we implemented active odour suppression systems that capture and redirect air to the energy recovery process, preventing the release of volatile compounds. This approach is aligned with the standards of the Air Quality Framework Directive (*Directive 2008/50/EC*), which sets strict limits for air pollutants, ensuring that the impact on local air quality is negligible.

With a 750m radius distance from the plant stack, it ensures that the direct environment is not affected in any way in relation to the gases coming from our process. This mainly applies to deployment within highly populated areas (Dutch situation) we expect to be able to work in more remote locations.

- Advanced flue gas cleaning systems to meet WHO and EU limits.
 - World Bank's - *Environmental, Health, and Safety Guidelines for Waste Management Facilities*. These guidelines provide comprehensive directives on managing emissions from waste incineration processes, and our module is of course attaining to the threshold standard expected from this equipment.
 - EU Environmental Impact Assessment Directive - *EIA - Directive 2011/92/EU, as amended by Directive 2014/52/EU*. Before construction, we conduct comprehensive studies that assess how the facility will interact with its natural and urban environment. These studies consider factors such as biodiversity, air quality, water consumption and landfill reduction, aligning with the sustainability objectives of the EU Circular Economy Action Plan.
- Retrofit options available for enhanced emission controls during plant lifecycle.
- Pricing Impact: Retrofit costs depend on specific compliance levels and are not included in our original offer. However, we can accommodate this adaptation if required during life cycle of the plant against cost.

6. Indicate Volumes and Steps of 50Kton per Line

Each WtE module processes approximately 50,000 tonnes of (MSW) waste per year. The Chameleon and the Phoenix models have a capacity ranging from 50 to 150 tonnes/day. Both models are designed for scalability, enabling modular expansions to accommodate higher waste volumes.

7. Output Heat and Power Amounts

Chameleon Model:

- Power generation capacity: Approx. 5 MWe per line
- Thermal energy capacity: Approx. 20 MWth
- Provides steam for heating and industrial purposes and cooling options for warehouses.

Phoenix Model:

- Power generation capacity: Up to 5 MWe per line
- Thermal energy capacity: Approx. 20 MWth
- Optimized for e.g. sewage sludge treatment, dedicated and homogeneous waste streams.

8. Carbon Capture Options

DPG offers a versatile range of carbon capture utilization (CCU) and carbon capture storage (CCS) options to enhance the environmental performance of our WTE facilities. Although our preference is to utilize the carbon into process that would contribute to manufacturing new or recycled goods, our engineering team can always investigate the incorporation of carbon capture methods that suit the available feedstock and the needs of the client.

9. Other Aspects

Operation and Maintenance:

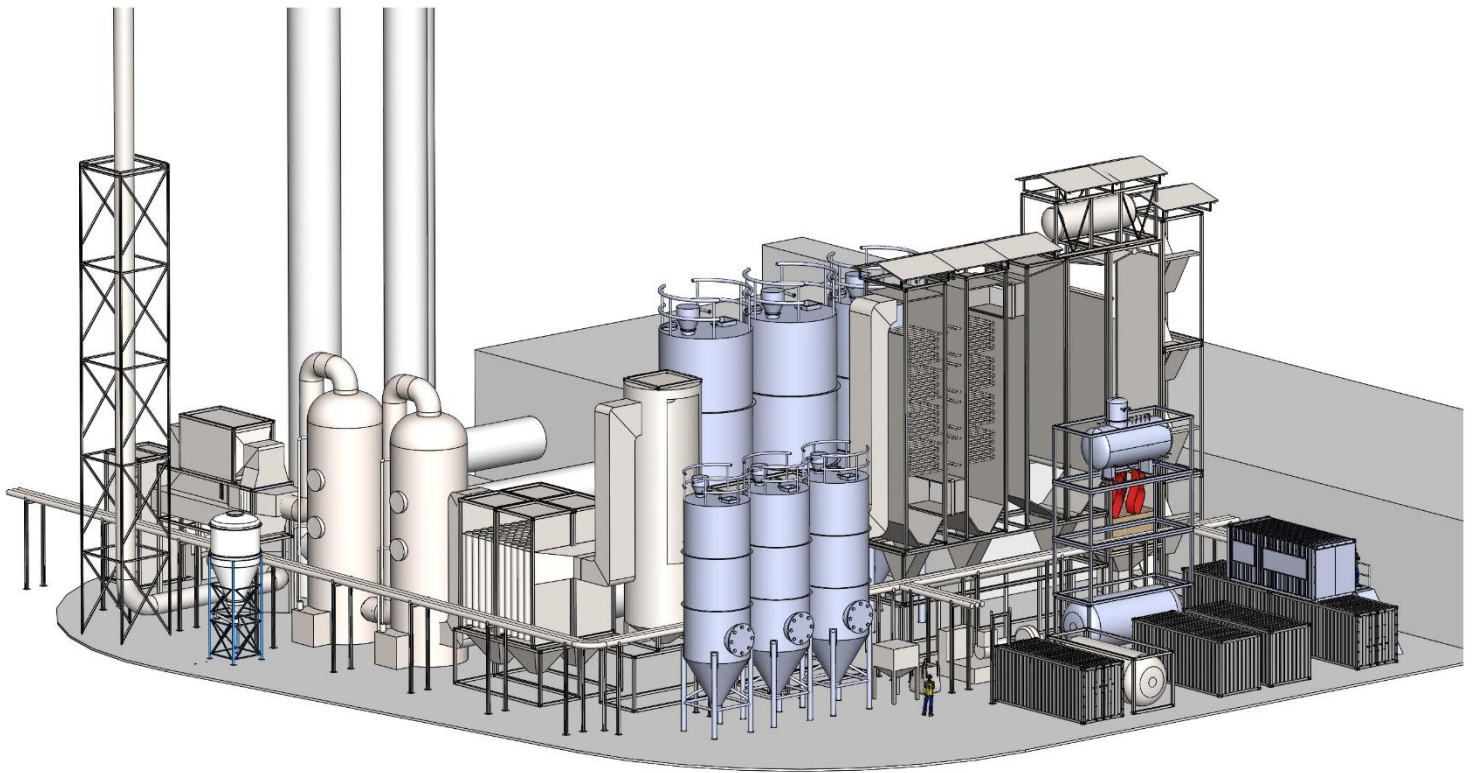
- 330 operating days/year, 30 maintenance days.
- Requires a skilled management layer and record-keeping for waste recording and governance compliance.

Building / execution Time:

- Total project completion: Approx. 18-24 months, including site development, construction, and commissioning.
 - Site Development and Civil Infrastructure: 6 – 8 months
 - Facility Design and Procurement: 12 – 18 months
 - Facility Site Construction and installation: 3 – 4 months
 - Facility Commissioning and Training: 1 – 3 months

Disclaimer: this document provides an overview of the technical, economic, and environmental benefits of DPG's small and decentralized WtE modules, showcasing their potential to revolutionize waste management while supporting circular economy goals. Further details can be tailored upon request.

Annex



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