













# DP Waste Management

## Solutions

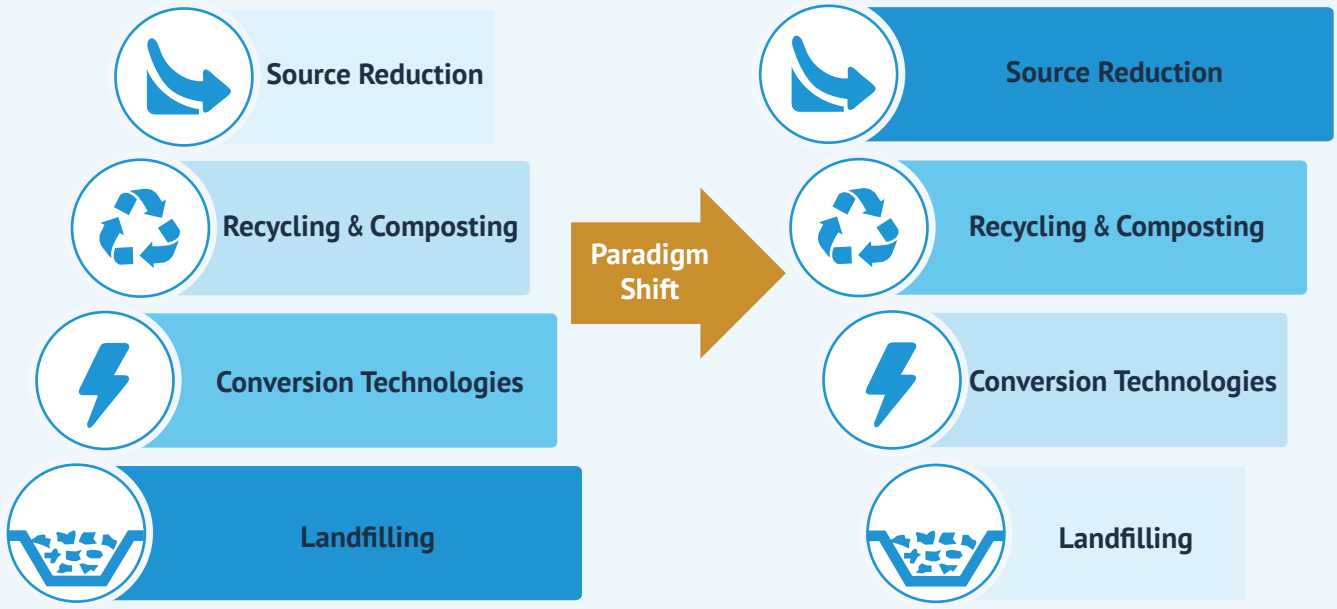
DP CleanTech

*Clean energy, natural solutions*



# Industry Development Cycle

Recent years have seen considerable changes in the Waste to Energy market and industry. The traditional waste management cycle of development for most countries is from waste disposal through landfill, to mass burn of waste, to a more holistic approach to waste management. In most developed countries, the market has been evolving for many years to more efficiently use waste as an energy source, eliminate environmentally damaging landfills, and create residual value through policies aimed to “Reduce, Reuse, Recycle and Recover” waste.




The key driver behind this shift is the growing recognition that maximizing value from every step of the waste collection, management, recovery, disposal and conversion to energy process goes hand in hand with significant economic and environmental benefits. There is now a real interest towards positive management of waste to become a profitable, environmentally friendly resource.

Such policies require the establishment of municipal waste management infrastructures and adopting waste management technologies that can efficiently and effectively recycle, sort and homogenize waste prior to disposal or conversion to energy at the front end of the process, and recover value from waste materials at the back end of the process.

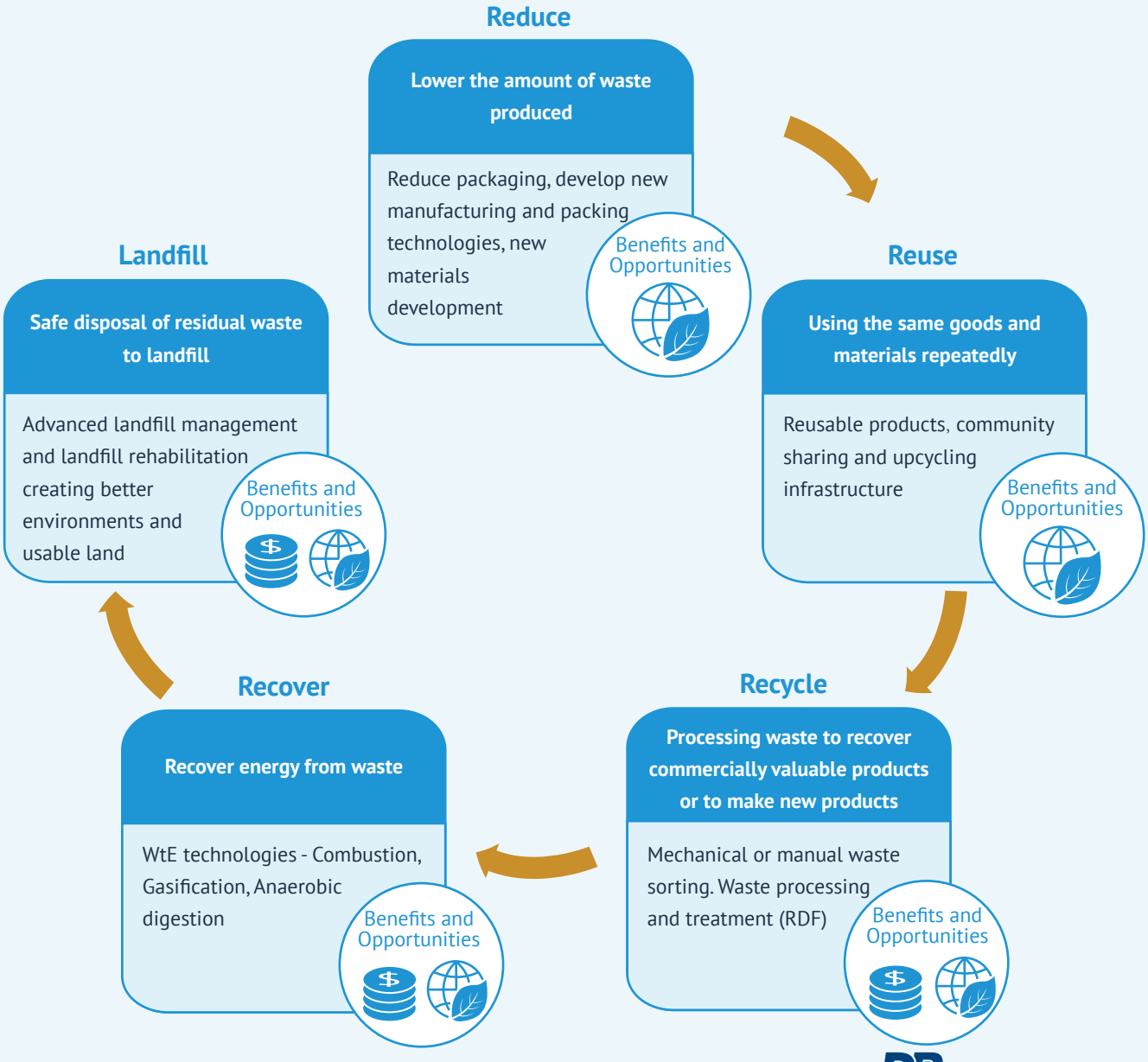
In less affluent regions, waste management is still less structured and efficient and environmental waste management is usually secondary to subsistence scavenging and poor waste handling processes. Rapid urbanization has magnified the problem of municipal waste, and low - quality and untreated waste is often disposed of as environmentally damaging landfill or is incinerated using ‘mass burn’ technology. In such countries, there is substantial legacy capacity designed for mass burn and large-scale conversion to energy. This is increasingly in conflict with the need for scalable, distributed energy sources.

# Maximising Value From Waste

Waste management is a growing problem for many countries and regions - from the harmless disposal of waste to the environmental problems created by existing landfills. At the same time, there is greater impetus to develop and deploy sustainable sources of energy and to create a robust circular economy. Modern technologies to manage waste, extract value, create renewable energy and reclaim waste land and are being increasingly deployed, but the key to success lies in creating the right infrastructure and selecting the right technologies.

Different countries and regions are at different stages of development and some countries are now poised to move rapidly from traditional landfill and mass burn solutions to more integrated waste sorting, energy recovery and other waste to energy technologies with objectives to reclaim or create value from waste at every stage of the process and improve environmental credentials. At the same time, there is also an opportunity to create value from existing landfills.

All these factors will have profound implications for developers in defining and integrating technology. DP is a solutions company that has a portfolio of scalable waste processing and waste-to-energy solutions to meet the varying requirements of our customers. We assess the challenges and requirements from the developer's perspective and devise the most appropriate solutions, from waste process management to conversion to energy and landfill management. DP CleanTech has anticipated the technologies, capabilities and knowhow to guide clients towards the best total solutions.




DP Waste Management

# DP Expertise

The integration of the solid waste management process can help communities and businesses optimize the value of their waste. A properly integrated waste management solution can exploit synergies in energy, staff resources, equipment and infrastructure to optimise the value from waste.

DP understands the business of waste management - from collection and waste processing to energy conversion and emissions management.

Equipment is only part of the total solution and DP's knowhow in selecting the appropriate technology solutions for each stage of the waste management process; designing for different fuels, conditions and outputs at the design stage is critical. For power plants, the equipment automation and the correct installation and integration of equipment are fundamental to the long-term performance. These are all core areas of DP's expertise. Operational excellence is essential for optimal performance and DP's knowledge is hugely important in training operators and providing maintenance advice or packages.

In 2018, DP incorporated Austrian company IUT GmbH, a leading waste management company which has been instrumental in the development of pioneering solid waste strategies and technologies since 1985.

With the addition of IUT technologies, DP now has a wide portfolio of waste management solutions with which to ensure that for every waste management project, we can provide clients with




# Understanding Waste Processing Technology

The aim of modern waste management is to derive the maximum benefits from waste materials. This includes using waste as a secondary source of raw materials, for conversion to energy and downstream for recovering materials from existing landfills.

## Collection and Sorting

At the start of the process, careful classification, treatment and sorting is the basis for the recycling of materials and is a prerequisite for efficient further processing process.

Different technologies are required throughout the waste management process, but ideally should be part of an integrated process and infrastructure.

Waste sorting and classification can be done manually, but mechanical sorting is much more efficient, and a modular system allows further flexibility. The most advanced modular system offered by DP for mechanical treatment has its origins in IUT advanced sorting and treatment technologies which process waste streams and recover marketable raw materials.



These technologies are behind numerous mechanical treatment centres built to turn a wide range of waste into secondary raw materials. Hazardous substances are removed, and the calorific value of combustible fractions is optimised. Materials that can be recovered and recycled and organic waste are treated to make them fit for further use.

Once the waste has been separated, DP can implement a variety of customized options.

- Recycling: Recovery of marketable products from MSW, separately collected waste, CDW, organics, etc.
- RDF production: Refuse-derived fuel for the cement industry and/or boiler plants
- Pre-treatment: For anaerobic digestion and compost plants, or for mass burn incineration plants
- MBT process: Waste-to-renewable-energy plants
- Upgrade recycling: Recovered plastic is used to produce granulate

# Recovery of Energy

The main technologies for MSW conversion to energy are mass burn combustion, anaerobic digestion and gasification and the choice of technology is dependent on several factors.

- The types of waste
  - ➤ Unsorted, mass burn
  - ➤ Discrete waste types - waste wood, industrial, hazardous, unsorted,
  - ➤ RDF (and which type)
  - ➤ Organic waste
- The range in calorific values
- The range of moisture content
- Volume of waste and required energy output
- Environmental regulations (in particular, emissions standards)
- Labour costs
- Revenue structure (gate fees/ off take pricing).

# Disposal/Landfill

Materials that cannot be used for recycling or energy recovery must be disposed of in a sanitary manner, using appropriate landfill technology.

# Typical Waste Fuel Characteristics



| | Waste Wood | RDF | RPF (Korea) | MSW |
|---|---|---|---|---|
| LHV, MJ/Kg | 12.4 | 12 - 23.5 | 17.5 MJ/KG | 6 to 10 |
| MC.% | 33 | 4.1 to 20 | 6 to 10% | 40 |
| VM, dry | 83.2 | 82.6 | | |
| Ash, dry | 0.34 | 12.2 | 8 | 20 |
| Fixed C, dry | 16.5 | 5.2 | | 22 |
| C, dry% | 48.7 | 56.8 | | 2.2 |
| H, dry% | 5.7 | 7.9 | | 2.2 |
| N, dry% | 0.13 | 0.74 | | 0.43 |
| S, dry% | 0.05 | 0.25 | 0.06 | 0.1 to 0.25 |
| Cl, dry% | <0.1 | 0.82 | 0.39 | 0.7 to 1 |
| O, dry% | 45 | 21.3 | | 15.6 |
| Ash Fusion | 1,200 | 1,100 | | 900 |

# DP Waste to Energy Technologies and Capabilities

Different waste stream characteristics and customer requirements can lead to different solutions for creating energy from waste.

On a >20MW scale, combustion technology is typically the most proven commercialized method for waste-to-energy conversion. DP's core, patented combustion technology originated in Denmark; and is behind the highest-performing biomass and waste-to-energy power plants in the world. The technology and grate for DP's Specialist boilers is modified for different types of MSW. Depending on the actual fuel, DP's Specialist boiler can be combined with either a Step Waste Grate or DP's Water Cooled Vibrating Grate for highly efficient waste-to-energy conversion.

However, gasification technology has been demonstrated to have some advantages over combustion, particularly in terms of efficiency and low emissions. Typically smaller in scale (<20MW) than incineration plants, gasification can produce syngas from waste materials. DP has established partnerships and licensing agreements with specialist gasification technology company Energos to provide technically advanced, fit-for-purpose and commercially proven gasification solutions for the conversion of non-hazardous wastes.

Biogas production through anaerobic digestion is a natural process in which organic matter is decomposed by micro-organisms in the absence of oxygen. Of the biological treatment options, anaerobic digestion, followed by aerobic stabilization, is a good choice for many organic fractions, including those from MSW treatment plants, as it allows co-generation of electrical and thermal energy, as well as production of high quality natural fertilizer. DP's ADOS Biogas technology is one of the most robust and straightforward solutions, with excellent energy balance (low consumption versus high green energy generation) and cost effectiveness (even at small plant sizes).



# DP Combustion

## (MSW – Unsorted, RDF)

The choice of boiler and grate type for combustion is partially dependent on the fuel types being used. These cannot be fully determined without a detailed fuel analysis, but in general the range of fuels - in terms of heat value - is from highly sorted, pre-processed and higher heat value to low-level sorted and low heat value. The combination of boiler design and grate technology is important, and different grates types are used for different types of fuels.

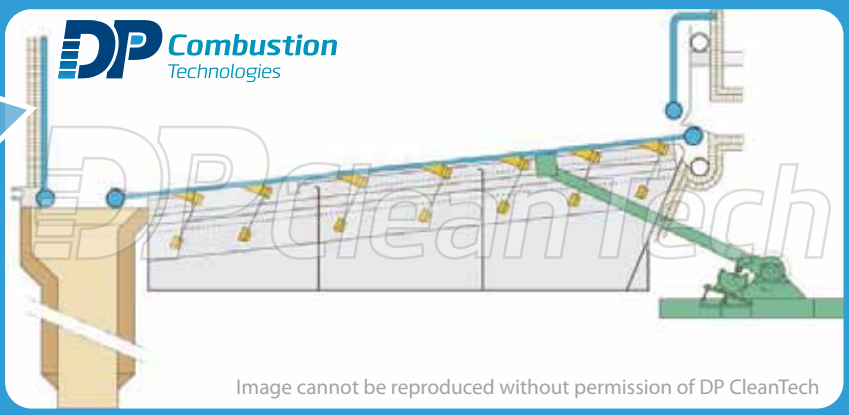
- **Reciprocating/Step Grate:**

Used for fuels which can easily become fouled. Depending on calorific values, DP boiler solutions are specifically designed to address the related issues of heat conservation/dissipation and corrosion. All these waste solutions are at MPMT (460°C and lower pressure). Modularity of equipment enables different outputs and additional lines to be added to increase output.

- **Water Cooled Vibrating Grate:**

The WCVG has a number of advantages which make it very suitable for RDF and waste wood. With low maintenance costs (no chains or step mechanisms) and high efficiency, the DP grate has a unique flex tube design for fuel flexibility. Combined with a HPHT boiler of 540°C and 110 bar (all depending on the fuel types/ corrosion propensity) this is the most efficient solution for fuels with high caloric heating values above 18 MJ/kg (RDF). Special materials can be used to counter the accelerated corrosion from some fuels.





# DP Gasification

## (MSW, RDF, Industrial Waste, Waste Wood)

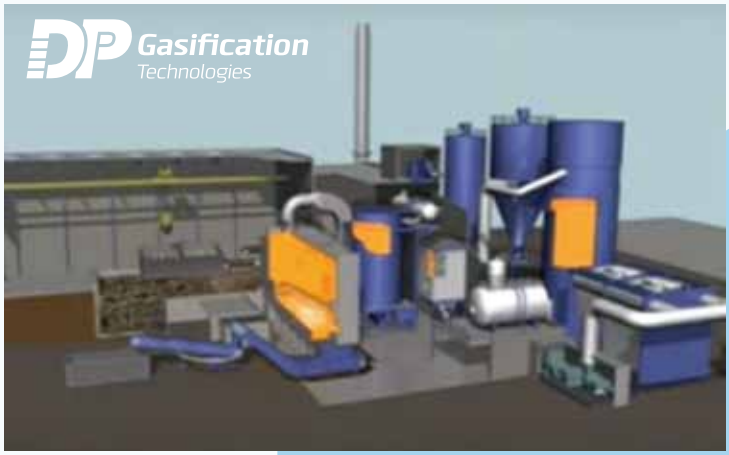
DP has partnered with European waste-to-energy gasification company Energos to provide patented and commercially successful energy enhanced solutions in Asia. The technology is highly suitable for the clean conversion of many types of commercial and household waste and has the benefit of low emissions.

This technology is an advanced two-stage thermal treatment process that converts residual, non-recyclable waste into a gas by using the heat of partial combustion to liberate the hydrogen and carbon within the waste. The waste is fed into a gasification chamber, where it is used to produce a syngas.

This syngas is transferred to a secondary high temperature oxidation chamber where it is fully combusted under tightly controlled conditions which results in very low emissions. The resulting heat energy is used to produce steam, which can be used to supply renewable heat and/or generate renewable electricity.

It is controlled with a proprietary system to manage and optimise the 2-stage process. The modular, scalable technology facilitates flexibility, and can be built to various configurations with options for high calorific value and mixed waste streams.

The gasification chamber, high temperature oxidation chamber, water-tube boiler, smoke- tube boiler and the control system are patented, proprietary designs. The technology has been proven and is operating at 8 commercially successful plants in Europe.




# DP Biogas

## (Organic Waste, Kitchen Waste)

The IUT Group

2 types of technology originally developed by IUT GmbH are offered by DP for Anaerobic Digestion.

| | ADOS | DAD |
|---|---|---|
| Flexibility for different feedstock | Yes | Yes |
| Feeding | Automatic | Manual |
| Process | Thermophilic | Mesophilic |
| Gas yield | Very high | Low |
| End product | High quality | Medium - High |
| Investment cost | High | Low |
| Operation cost | Medium | Low |

## ADOS System

The ADOS System (Anaerobic Digestion of Organic Slurry) is a “semi-dry process”, which combines the advantages of the wet and dry techniques and uses a slurry which consists of approximately 15% of solids. The technology is particularly suited to organics derived from separately collected or source-sorted waste, but is also highly suitable for the mechanically separated organic fraction from unsorted MSW. The key factor that need to be adjusted for different feedstocks is the adjustment of the solid content by recirculation of digestate to provide the optimum slurry consistency.

The ADOS System is the most efficient system for the treatment of organic waste from:

- Mechanical separation (fraction <80mm) of unsorted municipal solid waste
- Food and kitchen waste from households, restaurants, commercial entities, military camps etc.
- Agriculture
- Slaughterhouse waste, markets and processing industries

# ADOS System - Typical Configuration

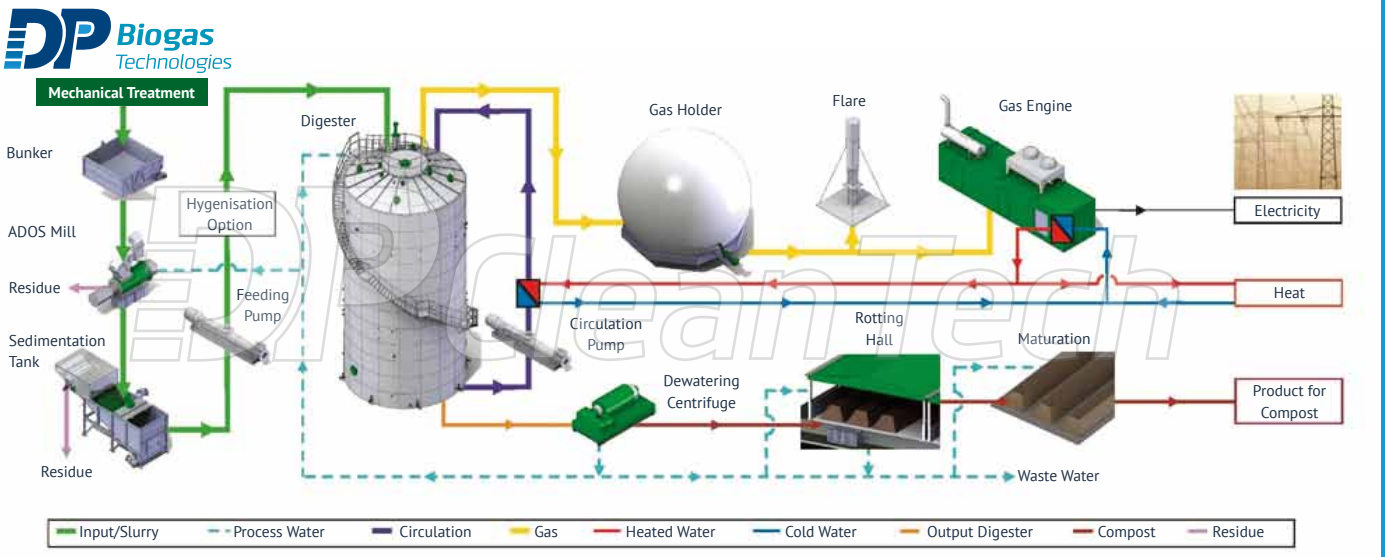



Image cannot be reproduced without permission of DP CleanTech

The ADOS System is ideal for use downstream of a municipal solid waste treatment plant. The feedstock requires simple pre-treatment removal of ferrous metals and inerts before passing through the “ADOS mill”, which creates the optimum slurry conditions for the processes of sedimentation, digestion and biogas production. Feedstock containing animal by-product waste materials requires prior hygienisation treatment - as stipulated by EU standards.

The ADOS System combines the best features of the wet and dry techniques and minimizes the disadvantages by:

- Reducing the complexity of the mechanical pre-treatment system
- Using small and efficient pumps
- Implementing thermophilic conditions to maximise the gas yield
- Avoiding big digester volumes
- Ensuring homogeneous conditions inside the digester




## DAD System

Also suitable for organic biomass, the DAD (Dry Anaerobic Digestion) technique produces less biogas than the typical wet or semi-dry systems - but the initial investment and running costs are lower. The process takes place in several gas-tight boxes which are maintained at 30-35°C through floor heating systems that use heat released by gas engines. The hydraulic retention time (HRT) is designed to be 26 days.

# Schematic Diagram of DAD System

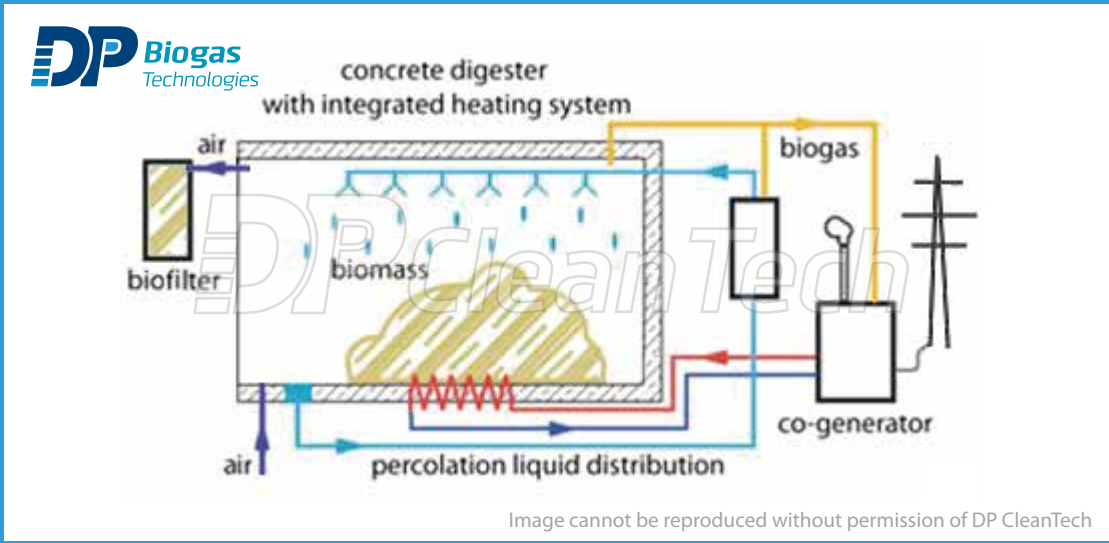



Image cannot be reproduced without permission of DP CleanTech

The incoming screened MSW (<60 mm) or other organic solid waste is activated through the sprinkling of leachate water that is rich in bacteria and increases organic degradation and gas production. The leachate is collected and distributed through a leachate tank and closed sprinkler system. The process of activation starts immediately, and the produced biogas consists of approximately 50-60% CH4 and about 40-50% CO2. This ratio remains very constant. The gas is stored in a gas holder situated above the leachate tank which generates a gas pressure of 20 mbar. After this, the biogas can be used by gas engines for power and heat generation.

After 26 days of anaerobic treatment and biogas production, the anaerobic process is paused by blowing fresh air into the box, and air is extracted through a biofilter to remove methane. After 2 days of aerobisation the anaerobic micro-organisms are inactive and no longer produce methane, allowing the box to be safely opened and unloaded, and the treated material can be sent to an affiliated compost plant for further degradation and stabilisation.

# DP Landfill Management

## - Odour Stabilization, Excavation and Treatment

The IUT Group



Existing landfills are often an environmental and health hazard, partly due to the odour and gas emissions resulting from the biologically transformed anaerobic status of organic landfill material. The odour problem affects both the economic and environmental health of the surrounding area. As well as methane emissions, problems with leachate and groundwater contamination create environmental hazards. There is both need and desire to rehabilitate landfill sites, however, any landfill mining or excavation must necessarily be accompanied by first solving the odour problem.

The process of stabilizing the landfill is achieved through the patented Smell-Well system, which prevents the formation of methane and other odours and hazardous landfill gases. Aeration of the landfill with Smell-Well dramatically reduces methane emissions. Air is sucked in through a biofilter and forced into the landfill while the gas present in the landfill is extracted and purified by passing it through biofilters.

This unique system allows unhindered excavation and treatment work to proceed safely. Changing the landfill status from anaerobic to aerobic reduces the quantity of leachate by up to ten times and reduces gas production to levels whereby odour treatment is often no longer required. The process of creating an aerobic environment takes only 4 to 6 days and thereafter that part of the landfill is stabilized and can be excavated. The excavated material maintains its aerobic state for approximately 6 weeks and can be treated. The treatment of excavated waste can vary, DP can advise on various technologies for treatment depending on the waste material recovery characteristics and the requirements of the customer.

# Principle of the Smell-Well System

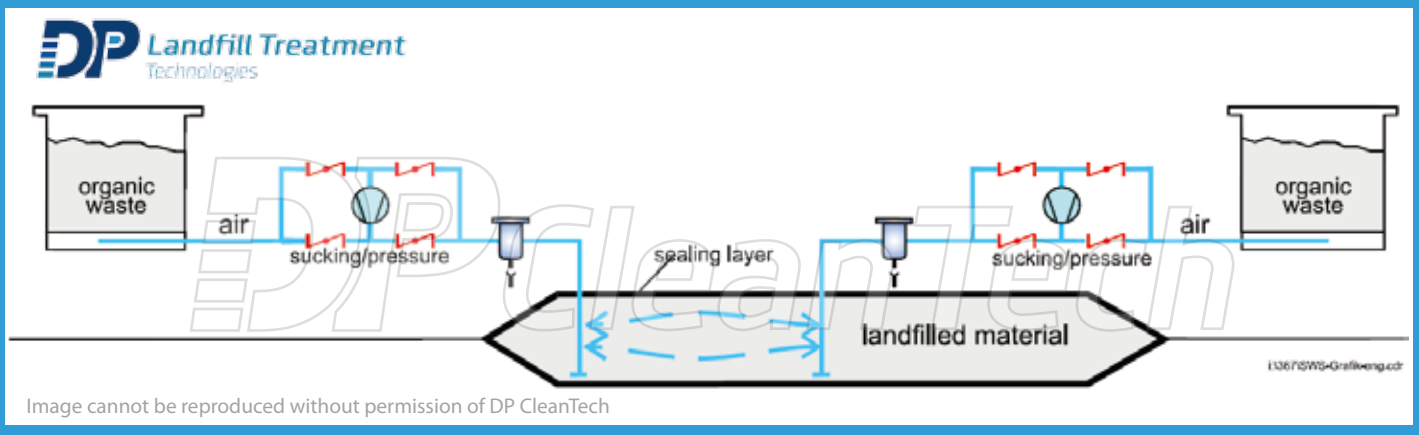



Image cannot be reproduced without permission of DP CleanTech

The use of the patented Smell-Well System for the stabilization of landfills works can take place under extreme conditions, such as in Canada at minus 30 degrees Celsius and more than plus 50 degrees Celsius in the Emirate of Sharjah, United Arab Emirates.

# DP Emissions Management

DP solutions already integrate emissions management technology. However, additional or specialized flue gas cleaning technology is an important and necessary part of our portfolio. With increasingly strict emissions standards being imposed worldwide, DP's state-of-the-art Dry Scrubbing Systems can be effectively incorporated into most existing plants, or as part of a new project to ensure that such standards are met. Our Flue Gas Cleaning team is based in the UK and has extensive experience in redefining complex requirements to deliver specialized solutions.

# DP Advanced Control and Automation

A plant's operational and financial performance is optimized by using appropriate levels of automation. DP has designed and implemented an Advanced Automatic Boiler Control solution which controls the complete boiler process. By automatically regulating the boiler load and output, stable boiler operation is ensured. This enhances performance and reduces cost. As a standalone improvement, automation can minimise the number of staff and reduce human error to have a positive and significant impact on performance and lifetime of the boiler. DP offers advanced, customised automation packages for integration with both new and existing plants; as well as providing the commissioning and operator training to ensure that the benefits are fully realised.



# DP Plant Services for Waste to Energy Projects

Improving the performance and flexibility of existing plants can have a significant positive economic impact, and plant performance optimization is a core DP competence. We use our considerable experience to systematically assess, identify and eliminate malfunctions in the installation and operation of boiler island components, including those from other suppliers. DP's expert diagnostic processes identify the best technology and solutions for retrofits and modifications.

DP has partnered with Europe's leading WtE service companies Dublix and Tiska to provide relevant waste grate technology expertise and automation to support optimization, servicing and retrofits for all types of WtE plants in Asia.

DP's retrofits, upgrades and improvements packages can also offer operator training and maintenance schedules to ensure performance improvements are sustained.

***DUBLIX*** *is Europe's most experienced automation control company; and DP have a licensing agreement to bring their advanced technology and expertise to clients in Asia.*

***TISKA*** *is an expert in grate combustion optimisation and mechanical repair and servicing.*

*For more details on technology and capabilities see*

*https://www.dublix.com/*

*http://www.tiska-online.de/*

# Case Studies and References

## REFA Nykøbing Falster, Denmark
## (Waste to Energy)

### Situation



- Two outdated WtE lines, each with a capacity of 3t/h.
- One WtE line with capacity 9t/h.
- All three lines needed upgrading to newer technology in two stages.
- Fuel type: household and industrial waste

### DP Solution

*Stage 1 (2010) – Conversion*

DP CleanTech redesigned and converted the existing three pass boiler into a four pass boiler. This included new heating surfaces in the fourth pass to reduce the flue-gas temperature to below 550°C before the convection pass.

The convection pass is built as a free standing economizer tower with four bundles of tube coils. The availability is improved by installing water cleaning in the second, third and fourth passes of the boiler, together with steam soot-blowers in the economizer tower.

*Stage 2 (2011) – New combustion system*

The second stage of the complete solution involved installing a new combustion system with waste fuel feeding system to give an optimal and steady feeding to the existing combustion grate. To improve the combustion system, a new air preheater with secondary air nozzles was installed to improve the combustion air distribution. The volume of combustion air was further increased with new primary and secondary fans.

New water-cooled wear zones were installed in the furnace to reduce the furnace temperature, which would subsequently improve performance and reduce maintenance costs of refractory materials.

### Resulting Plant Performance

When the rebuild is completed, the plant is expected to undergo only one annual shut-down in 2012 for maintenance and cleaning, and the capacity of each line is expected to increase to 4.5 t/h of waste.



# Sarpsborg, Norway
## (Energos)

### Situation

Borregaard Industries is a major supplier of wood-based chemicals. The company owns and operates one of the world's most advanced bio-refineries in Sarpsborg, where it has demonstrated its commitment to sustainability by securing the supply of renewable heat for its operations. The plant has been constructed in 2 phases.

Sarpsborg 1 was originally contracted and operated by Østfold Energi from 2002 to 2012, after which Borregaard took over the facility. Since 2012, the plant has continued to be commercially successfully in supplying low cost renewable heat, producing 210 GWh per annum, displacing around 18,000 tonnes of fossil fuel. Borregaard identified that further energy cost savings and carbon reductions could be achieved with the addition of a second renewable energy plant.

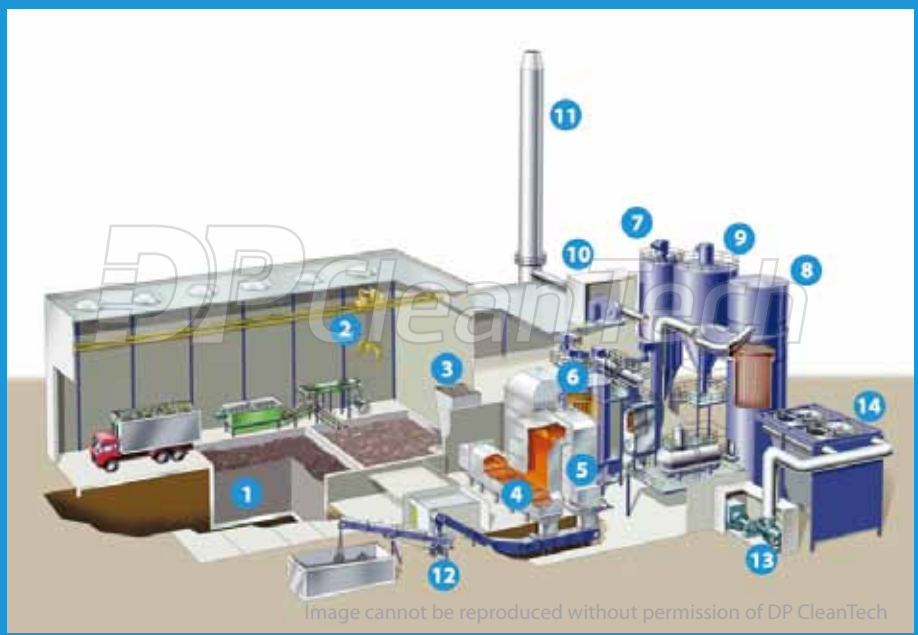
### The Solution

A second contract - Sarpsborg II - was awarded to Energos in February 2008. Working with one of Norway's leading power suppliers - Hafslund Heat and Power AS, ENERGOS supplied, installed and commissioned the mechanical and electrical equipment.

The Sarpsborg II plant was officially handed over to Borregaard in July 2010, ahead of schedule and within budget. Sarpsborg II has since been producing 256 GWh per annum, displacing around 22,000 tonnes of fossil fuel annually.

### Typical Plant Layout

1. Fuel bunker
2. Fuel crane
3. Hopper
4. Primary chamber (Gasification)
5. Secondary chamber (High temperature oxidation)
6. Heat Recovery Steam generator (HRSG)
7. Lime and carbon silo
8. Bag house filter
9. Filter residue silo
10. Flue gas fan
11. Chimney
12. Bottom ash extraction
13. Steam turbine
14. Air cooled condenser



DP CleanTech
Image cannot be reproduced without permission of DP CleanTech

### Technical Information

The ENERGOS technology is an advanced two-stage thermal treatment process that converts residual, non-recyclable waste into a gas by using the heat of partial combustion to liberate the hydrogen and carbon within the waste. The waste is fed into a gasification chamber, where it is used to produce a syngas.

This syngas is transferred to a secondary high temperature oxidation chamber where it is fully combusted under tightly controlled conditions which results in very low emissions. The resulting heat energy is used to produce steam, which can be used to supply renewable heat and/or generate renewable electricity.

The design data for the Heat Recovery Steam Generator is as follows:

| Heat Recovery Steam Generator Data | |
|---|---|
| Steam pressure [bara] | 22 |
| Steam outlet temperature [°C] | 220 |
| Feed water inlet temperature [°C] | 105 |
| Nominal HRSG capacity [MW] | 16.4 |

## Control and monitoring system

The process is controlled automatically via the human machine interface (HMI) which presents important process data, including flue-gas emissions. In emergency situations, an independent shutdown system (ESD) automatically secures the plant to avoid damage to humans, environment and equipment. Emission monitoring of flue-gas components is performed in accordance with Directive 2010/76/EU. A separate historical data logging system stores all process data in a database and is used for analysis purposes.

## Utilities

The plant is supplied with the following process utility systems:

- Electrical system excl. transformer and connection to the grid
- Emergency power generating unit
- Process air system
- Re-circulated flue gas system
- Compressed air system
- Hydraulic system
- Water cooling system
- Thermal oil system
- Recovered water system
- Fuel oil or gas system





## Plant performance

The new plant of 33 MW capacity generates up to 256 GWh of steam per year and this high quality process steam is delivered to several nearby chemical process plants. The gasification facility treats 78,000 tpa of locally sourced, non-recyclable, non-hazardous commercial and industrial waste, and recovers more than 80% of the latent energy.

The £45 million project reduces carbon dioxide emissions by approximately 47,000 tpa and complements the existing Sarspborg I 27MW (thermal) ENERGOS facility that has been generating 210GWh/a of steam. This brings the total 2-line capacity for residual waste treatment to 156,000 tpa.

# Mahachai, Thailand
## (Automation)

### Situation

The world's first coconut waste biomass power plant capable of utilising all the waste from the coconut industry - including husks, stems and fronds – is located in Mahachai, Thailand. As well as pioneering the utilisation of this highly complex fuel type - which is prone to cause equipment corrosion and fouling - the seasonal variability in fuel quality causes additional problems. In the rainy season, moisture levels can reach 65%; and the variation in size of different coconut biomass residues makes combustion and handling difficult.



### DP Solution

DP's longstanding experience and expertise in corrosive fuel combustion and technical solutions was used to create an innovative solution to the problems of fuel corrosion and fouling and varying fuel sizes. However, to address fuel quality challenges, an automated approach to controlling the plant operation was put in place. This unique 9.9MWe High Temperature High Pressure Biomass power plant with DP's automation was commissioned by DP experts, and has been in operation since April 2016.

DPCT developed and programmed the entire advanced boiler control system to enable 100% automatic operation in continuous run-time; and the plant can operate at full capacity for more than 8,000 hours per year with minimal operator assistance. The control system's proprietary software monitors the key boiler processes, using data supplied from field instrumentation. The process is regulated automatically but can also be manually controlled if necessary through an easy-to-use graphical interface in the control room. Powerful data trend and automatic reporting functions enable fast diagnosis and troubleshooting, minimizing downtime. All boiler protection and plant safety interlock functions are also controlled by the DPAAC solution for maximum safety and reliability.

Fuel quality is the main challenge faced by the power plant. The automation system is designed to monitor and make constant adjustments to the combustion process and fuel feeding system, and the operation has been able to remain stable at full load.

### Resulting Plant Performance

DP's high performing specialist boiler and process automation have contributed to strong plant performance. During the initial six months of operation (excluding a planned maintenance shutdown), the plant operated for 3,132 hours (>130 days). The plant consumes around 320 tons per day of coconut waste, as well as other biomass residue. During the first year in operation (after commissioning), the plant has maintained a stable operation and runs at full load to generate 8 MWe of green power which is being fed into the public PEA grid, benefitting the plant owner, the local community and the environment.



# Quebec, Canada
## (Landfill Remediation Using Smell-Well System)

### Situation

The Depot Rive North landfill is located in Quebec, Canada. The landfill owner wished to increase the value of his investment in the landfill without incurring difficult approval procedures. This could only be done by increasing the volume of the existing landfill, retaining the original footprint, and ensuring that the environmental impact of the total landfill was sustainably reduced.

### The Solution

An economically feasible remediation plan was devised to increase the landfill volume, and it was conducted in 4 phases. To increase the landfill volume 3.7 million $m^3$ of landfill waste was remediated and processed, releasing 50% of volume for profitable re-use. In addition, the bottom of the landfill was deepened with excavation. These actions extended the usage and life of the landfill - and increased the value of the investment - without difficult approval procedures.





The remediation work started in September 2007 and finished in June 2013, using the Smell-Well system as a key element in the stabilisation and remediation works. Despite difficult climatic conditions, with temperatures of -30°C, and melting snow cover, the system operated perfectly and there were no functionality issues. The excavation took place in 3m levels, and the treatment of the excavated material took place in mobile rotating drum screens. The objective of the treatment was to produce a landfill cover material (fine fraction) which could develop a methane oxidizing level and reduce the later gas emissions from the landfill surface. The remaining oversize fraction was compacted and buried again in the new area of the landfill.

# Naga City, Cebu, The Philippines
## (DAD Biogas production)

FDR Integrated Resource Recovery Management Inc. (FDR-IRRMI), a company based in Cebu, started the Philippines' first hybrid Dry Anaerobic Digesting (DAD) biogas plant in Naga City, Cebu in June 2017. The waste-to- energy facility was designed and constructed by IUT GmbH.

The DAD biogas facility is the latest addition to the resource recovery operations in Naga City, Cebu. It already has a material sorting facility from IUT, a facility for RDF production from residual waste (for use by a cement plant), and a composting facility for the use of "Sergio's Farm", which produces organic vegetables and Cebu's strawberries.




### Project Development and Execution

The DAD biogas plant produces electricity and heat by fermenting pre-sorted organic waste from domestic garbage which is being collected from the Cities of Naga, Carcar and the Municipality of Minglanilla in Cebu Province. This production of renewable energy by fermenting organic waste fractions is the first project of its kind in the Philippines. The organic fraction used in the process (kitchen, garden and market waste) consists of screened mixed solid waste and organic waste delivered directly from household, commercial and industrial entities.

IUT delivered the equipment in 2016, and civil construction, equipment installation and piping took place between August 2016 and January 2017.

### Plant Performance

The DAD plant has the capacity to treat up to 130 tpd of organics, and produces 650 kWh/h electric power which is used to run FDR's facilities and delivered to grid. The success of the plant has led to a further contract for extension to the plant of a 150 ton/day RDF and 1 MW anaerobic digestion plant which is due to be completed by the end of 2018.

# City of Benesov, Czech Republic
## (ADOS Biogas)

### Situation

In 2006, the city of Benesov in the Czech Republic had an existing waste sorting plant which needed an upgrade to add a 1MWe digestion plant for the conversion of organic waste to energy. The feedstock was primarily organic waste - waste from households, industry, foodwaste and slaughterhouses and other organic waste from the local area.



A joint investment and operating venture (Bio Servis Benešov spol.s r.o) was established as an international Public Private Partnership (PPP) with the IUT Group (Austria) to develop and operate the plant. Work began on the plant in 2006.

## The Solution

A food waste treatment plant (105 tpd) was designed to sort the waste and convert it to energy and fertilizer, using the ADOS System of anaerobic digestion and composting. The process of sorting, digestion, hygienisation and fertilizer production are all co-located on one site. The ADOS process involves thermophilic digestion of the organic waste; incorporating the benefits of dry and wet digestion. This process requires better control than mesophilic digestion, but it produces a greater quantity of biogas.



The MSW fuel is shredded and sorted using rotating drums and screens and metal separators to remove inorganic materials - metal, plastics >60mm in size and ash <10mm. The reject waste that cannot be used in the digester is separated and sent to landfill.

After separation, the remaining 25-30% of the initial waste is fed to the 2 ADOS mills to create an organic slurry that is pumped into the 2 x 1000$m^3$ digester units. In the digesters the slurry is continuously circulated at the ideal temperature for bacteria to break down the organics and generate biogas. The biogas is extracted and stored in a storage tank prior to being used in 2 x gas engine generators which generate electricity (up to 1MW). Hot air from the engines is extracted and used to heat the slurry in the digesters. Residual slurry is removed and treated before use as fertiliser on local farms. The plant is air controlled using scrubbers.

Construction work started in Autumn 2007, the plant was commissioned in 2008 and full operations commenced in February 2009.

## Plant Performance

Feeding waste: organic fraction of MSW, food and kitchen waste, market waste, commercial and industrial organic waste
Daily waste capacity: up to 105 tons
Digesters: 2 units x ~ 1.000 $m^3$ each producing up to 35$m^3$ of slurry per digester
ADOS Mills: 2 units
Hygienisation: 2 units for treating Cat. III waste (slaughterhouse, food waste, expired meat)
Fertilizer production: in house production under air control of ~ 70 tons per day
Biogas production : 12, 000$m^3$ of biogas a day can be produced.
Electricity to the public grid: 0.9 - 1 MW

# Contact Us

DP has 9 offices around the world in 8 countries – Austria, China, Czech Republic, Denmark, Poland, Thailand, UAE and UK.

To ensure that we can address your needs appropriately, please email **info@dpcleantech.com** for enquiries or further information.

## About DP CleanTech

- ✓ Founded in 2004, DP CleanTech Group designs, engineers, manufactures and commissions biomass and waste to energy power plants, providing complete solutions for turning waste materials into clean energy.
- ✓ DP's core technologies originate in Europe and are behind over 300 biomass and waste projects around the world.
- ✓ DP built the first biomass power plant in China and has ~30% of the market.
- ✓ DP has facilities and multiple references across Europe and Asia; and has projects under development in Africa and South America.
- ✓ DP's pioneering tradition continues with an expanded portfolio of innovative waste-to-energy and environmental management technologies with which to lead the advancement of renewable energy and environmental protection.

www.dpcleantech.com

V2.3