



OUTOTEC ENERGY SOLUTIONS

Outotec energy solutions encompass technologies and services for both renewable and conventional energy production. Our flexible technologies can use a wide variety of different fuel sources, and our offering also includes sustainable solutions for ash and sewage sludge ash treatment. Our lifecycle solutions support you every step of the way, from plant design and implementation to ongoing operational support, as well as maintenance and modernization.

BENEFITS

- Fuel flexibility eliminates the risk of reliance on a single supplier or fuel type
- Industry-leading delivery scope covers the entire process chain from fuel to energy
- Tailored lifecycle solutions to enhance your business and ensure the best return on investment
- Local presence and support through our global network of service centers



LIFECYCLE SOLUTIONS THAT ENSURE THE BEST RETURN ON YOUR INVESTMENT

We at Outotec work closely with you to create sustainable and reliable lifecycle solutions that ensure the best return on your investment and enhance your business. We can provide the fluidized bed technology, the boiler island, or the entire power plant as a complete turnkey delivery.

We offer a comprehensive range of services that can be combined into a tailored solution to meet your precise requirements and asset needs. For example, with an operations and maintenance agreement we can supply professional personnel for your plant. All these services are supplied through our global network of service centers.

We offer lifecycle solutions for every stage of your project:

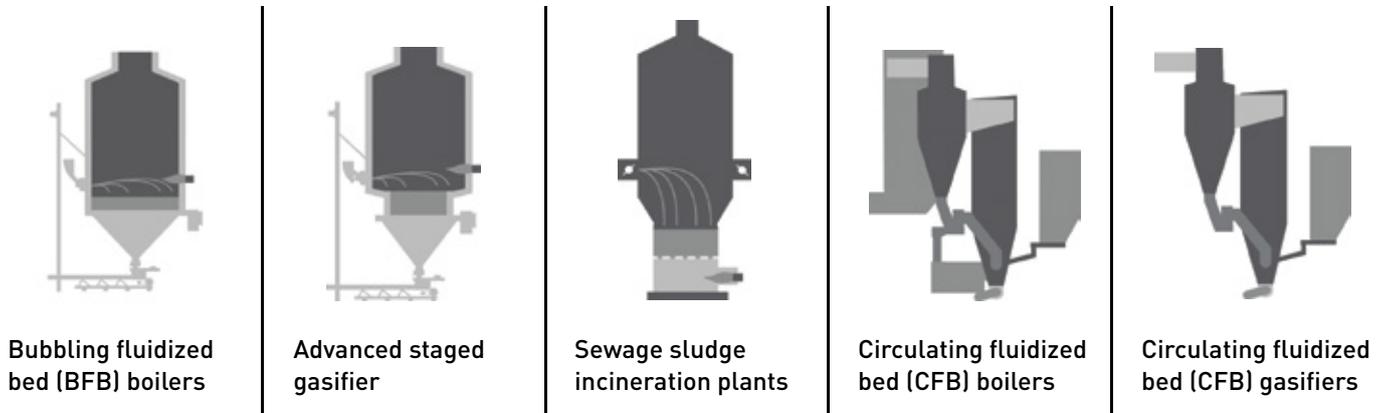
- Advisory services
 - Feasibility studies
 - Project management and control
- Basic and detailed engineering
- Proprietary equipment supply
- Ramp-up services
 - Construction management and site services
 - Plant commissioning and start-up services
- Operation and maintenance agreements
- Remote services
- Spare part solutions
- Modernization and upgrade services

With our service offering you benefit from unparalleled expertise that you can rely on to maximize equipment performance, environmental efficiency, reliability, and safety. Our goal is to help you optimize total cost of ownership, minimize equipment downtime, and maximize production efficiency.

Our sustainable lifecycle solutions help you optimize total cost of ownership, minimize equipment downtime, and maximize production efficiency.

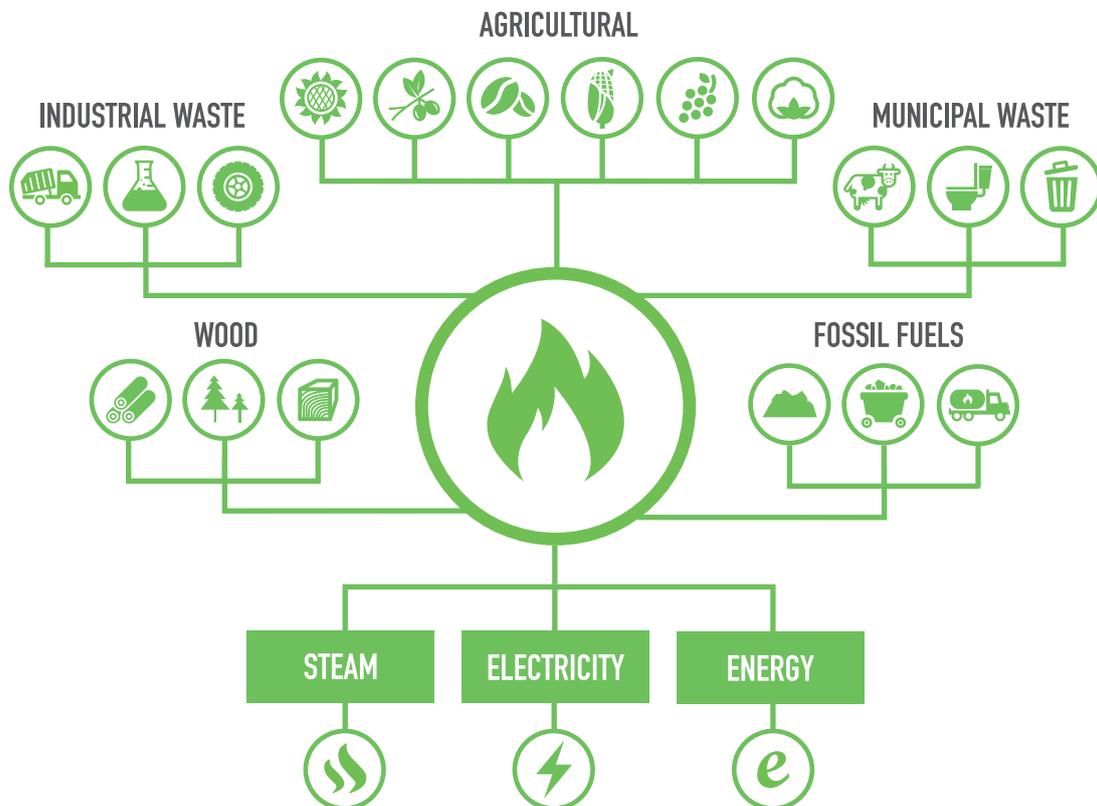
OUTOTEC TECHNOLOGIES FOR ENERGY PRODUCTION

We offer the following proprietary fluidized bed technologies for energy production:



Fuel flexibility for greater operational flexibility

With Outotec energy solutions you can use a wide range of fuels, ensuring greater operational flexibility and eliminating the risk associated with reliance on a single supplier or fuel type. Our solutions can use a diverse range of fuels, including agricultural waste, municipal solid waste, wood waste, industrial and municipal sludge, plastic, and tires, as well as fossil fuel sources like coal and oil shale. We also offer solutions for the treatment of ash and effluents.



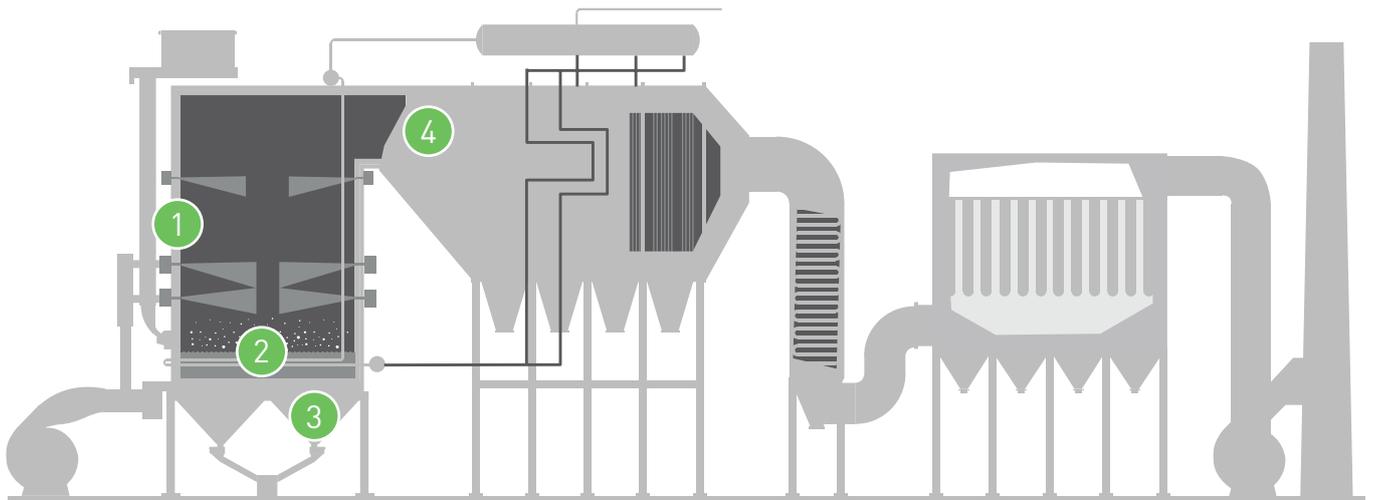
COMBINE PERFORMANCE AND FLEXIBILITY WITH AN OUTOTEC WASTE-TO-ENERGY BFB BOILER

Outotec BFB Boilers can use a diverse range of fuel sources. As well as conventional fuels such as coal and biomass, our boiler solutions can operate on agricultural waste, sorted municipal solid waste (refuse-derived fuel or solid-recovered fuel), wood waste, industrial and municipal sludge, plastic, and tires. Fluidized bed systems are also capable of efficiently combusting fuels of varying consistency.

Using residue fuels and by-products, our solutions can convert industrial waste products such as pulp and paper rejects, lignin from ethanol production, or even chicken manure, into electricity and heat, or steam that can be used elsewhere in the manufacturing process.

For residue fuels with a high amount of large inorganic components such as stone, glass, and bricks, Outotec fluidized bed solutions use an open-nozzle grid design, which allows for a stable combustion process and proper debris removal.

PROPRIETARY SOLUTION FOR BURNING HIGHLY CALORIFIC FUELS IN A BFB BOILER



1. Combustion chamber with full refractory lining and steel casing acts as a heat equalizer, reducing the thermal fluctuations that can result from varying fuel properties
2. Partly coated in-bed or vapor-space tubes eliminate hotspots in the combustion area
3. Bed cleaning and reinjection system removes agglomerations
4. Water wall protects superheaters from chlorine corrosion

More than 250 different fuels or fuel mixes have already been used in over 100 Outotec fluidized bed solutions.

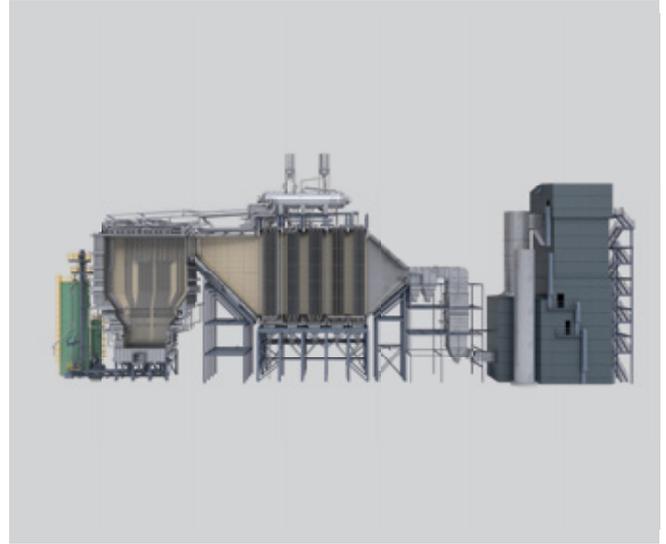
ADVANCED STAGED GASIFICATION TECHNOLOGIES FOR ENHANCED OUTOTEC BFB CAPABILITIES

Depending on your needs and fuel characteristics, Outotec offers two BFB gasifier technologies. The Outotec BFB Gasifier produces low or medium calorific value gas that can be used directly in internal combustion engines or turbines, or further developed into liquid fuels. The Outotec Advanced Staged Gasifier incorporates the best characteristics of gasifier and combustion technologies to produce steam.

An advanced staged gasifier offers the following advantages over a BFB boiler:

- Significantly reduced forced-draft fan power consumption
- Smaller bed size
- Low bed operating temperature enables use of fuels with low ash-softening temperature
- Staged combustion with long retention time eliminates exhaust-gas contaminants

The Outotec Advanced Staged Gasifier is especially suitable for fuels with a low ash-softening temperature due to the lower furnace temperature. Our bed-material drawdown and recirculation technology eliminates disturbances in the bed area by removing any small agglomerations, even at low bed temperatures.



OUTOTEC SEWAGE SLUDGE INCINERATION PLANT

Our state-of-the-art fluidized bed sewage sludge incineration plant is self-sustaining, requiring no external fuel sources when in continuous operation. This is made possible through sludge pre-treatment and preheating of the combustion air. We offer three different plant solutions depending on the required capacity.

- The Outotec Sewage Sludge Incineration Plant 100 can produce a surplus of electrical power or heat and complies with the strictest global emission standards. It is designed for treating sewage sludges from cities or communities of around one million inhabitants, but the capacity can be adjusted according to the needs of your project.
- The Outotec Sewage Sludge Incineration Plant 30 and 50 solutions are suitable for thermal treatment of sewage sludges from medium-size cities or communities (from 300,000–500,000 inhabitants). The surplus heat can be used, for example, in industrial or district heating.



CIRCULATING FLUIDIZED BED TECHNOLOGY

The Outotec Circulating Fluidized Bed (CFB) Boiler and CFB Gasifier can use a wide range of primary fuels, including both conventional fuels such as coal, or renewable fuels such as biomass. Our CFB technology reduces fuel costs by enabling co-firing of lower heating-value fuels like waste materials, sludge, or refuse-derived fuel with higher heating-value fuels

Our CFB boilers are widely used in metallurgical applications as roasters. Because of their robust design, it is also possible to use petcoke and coal as primary fuels.

Due to the low combustion temperatures in CFB boilers, plants can usually achieve low emission levels without additional flue-gas cleaning – typically only limestone injection into the furnace using a baghouse is sufficient to keep emissions within the required levels.

ENEFIT 280 OIL WINNING TECHNOLOGY

Due to the increasing scarcity of conventional natural resources, unconventional fossil fuel sources such as oil shale or oil sand are being revisited to investigate what they can offer in the long-term future. Enefit is a joint venture between Outotec and Eesti Energia that aims to develop a sustainable, energy-efficient, and economically viable solution for processing oil shale.

The Enefit Oil Winning Plant is based on Outotec's CFB and retort technologies. High performance in oil and gas extraction is complemented by complete combustion of organic residues in an Outotec CFB Boiler and heat recovery in Outotec Fluidized Bed Coolers. A waste heat boiler is used for electricity generation, making the process a net producer of electricity.



Our robust, low-emission CFB technology can use a wide range of primary fuels.

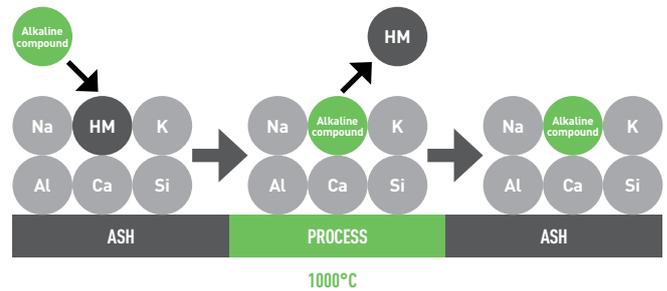
ASH DEC TECHNOLOGY FOR HEAVY METAL REMOVAL OR PHOSPHORUS RECOVERY

The basic ASH DEC (DEContamination) technology is a thermochemical process for separating heavy metals from ashes generated during the combustion of industrial and municipal waste. Ash and special chlorine carriers are fed to a thermal reactor, where they are thermally treated. The resulting reaction captures the heavy metals as dust in a filter. Treating ash in this way not only enables waste to be turned into raw material or directly into a product, it also reduces hazardous landfill volumes and ash-handling costs.

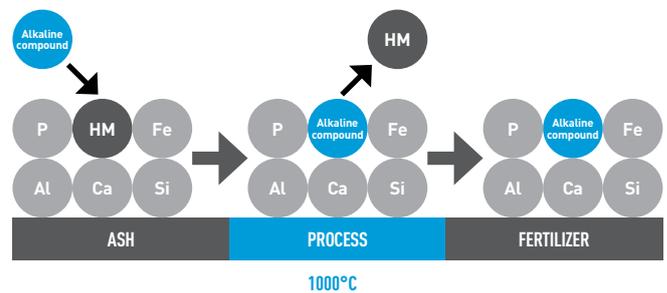
The ASH DEC process for phosphorus recovery integrates heavy metal removal and phosphate solubilization. Ash, alkaline salts, and a reducing agent are fed to a rotary kiln, where they are thermally treated at a high temperature. Volatile heavy metals are captured as dust in a filter. Small phosphate granules, rich in secondary and trace nutrients and pollutant free, are continuously discharged from the reactor. Any remaining organic contaminants are destroyed during the thermal treatment process.

Specially designed fertilizers suitable for different crops, soil types, and climate conditions can be produced by mixing ash with additional nutrients.

ASH DEC is ideal for treating sewage sludge ashes to reduce nutrient leakage to the environment.



ASH DEC process for heavy metal removal



ASH DEC process for phosphorus recovery

ASH DEC is our solution for sustainable recovery and recycling of phosphorus as fertilizer.

Outotec provides leading technologies and services for the sustainable use of Earth's natural resources. As the global leader in minerals and metals processing technology, we have developed many breakthrough technologies over the decades for our customers in metals and mining industry. We also provide innovative solutions for industrial water treatment, the utilization of alternative energy sources and the chemical industry. Outotec shares are listed on NASDAQ OMX Helsinki. www.outotec.com