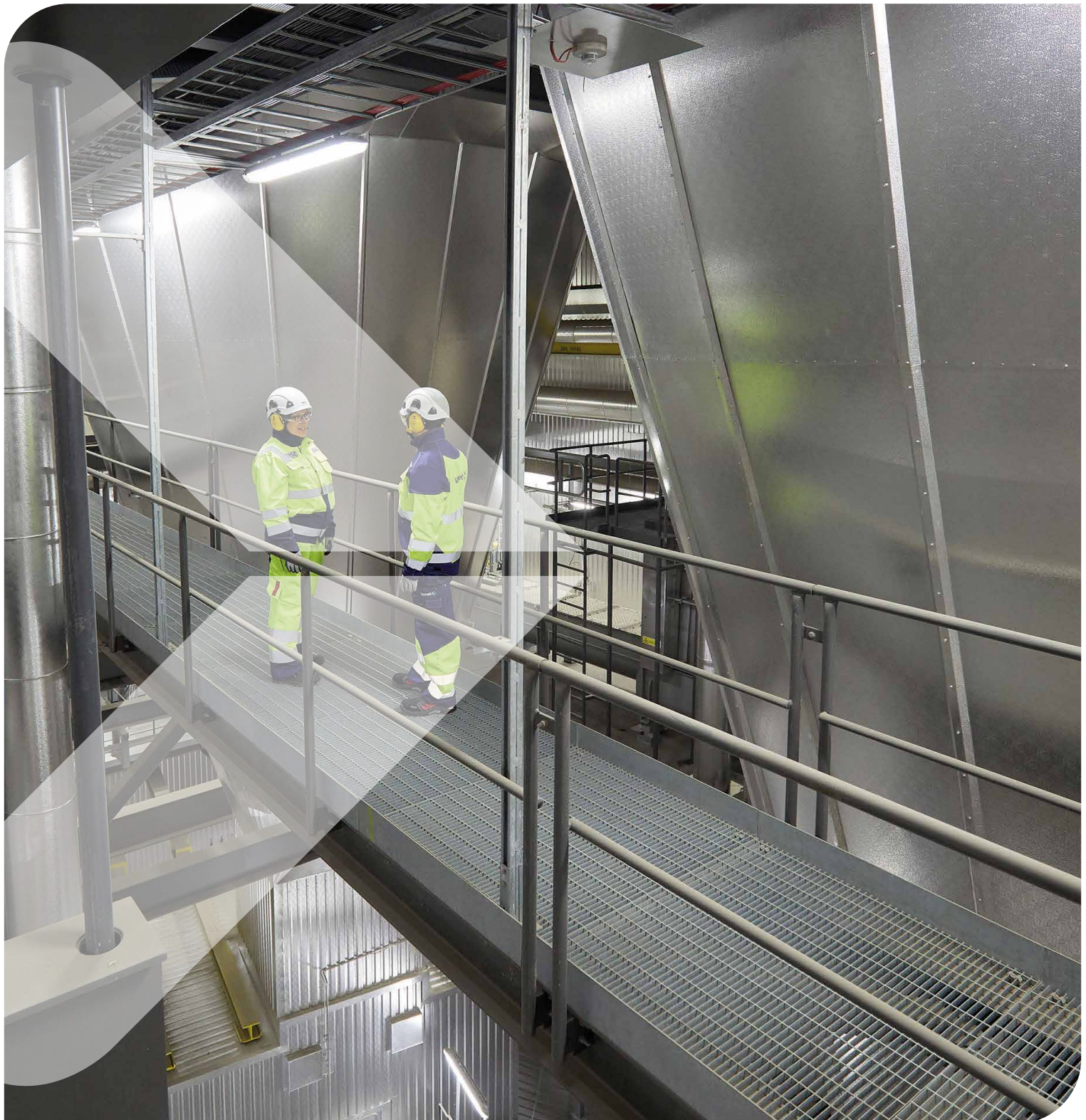


Valmet CFB Boiler

Excellent fuel flexibility



Valmet CFB Boiler opens new fuel opportunities

Valmet's circulating fluidized bed (CFB) boiler offers high reliability and unparalleled fuel flexibility in a class of its own. It combines high-efficiency combustion of various solid fuels with low emissions – even when burning fuels with completely different calorific values at the same time. The wide size range covers boilers from 30 to 1200 MW_{th}.

In the CFB process, the large amount of inert bed material allows for a wide variation in fuel properties or fuel changes online without any major disturbance to the combustion. Solids circulation improves heat transfer and enables the combustion of high-calorific-value fuels while keeping the temperature in the 850 to 900 °C range. The low combustion temperature minimizes the fouling and slagging of heat surfaces and simplifies emission control. Good cyclone performance is key to efficient combustion and low limestone consumption.

During the past over 30 years, Valmet has continually developed its CFB boiler components to feature higher reliability and better performance. We were the first company to launch water-cooled cyclone and loop seal designs in the late 80s. Later when demanding fuels, such as waste and residues, entered the CFB fuel portfolio, we improved the cyclone loop seal design and the final superheater to minimize corrosion.

A tailored Valmet CFB solution:

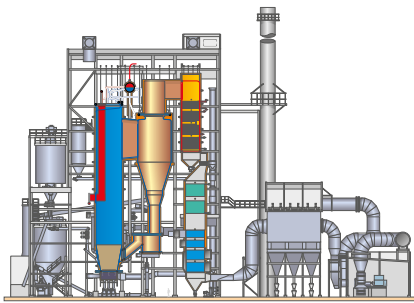
- Robust CFB core technology: a water-cooled furnace construction, high-efficiency cyclones and multifunctional loop seals. No hot expansion joints
- Well-proven design, including dedicated superheaters for corrosive fuels
- Tailored design to meet customer requirements



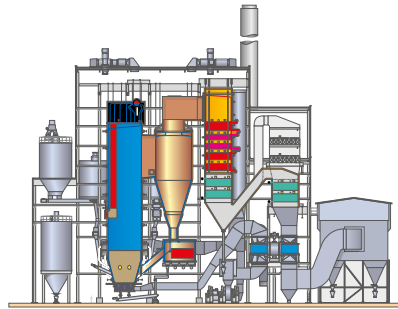
Bed material flows with flue gas from the furnace to the cyclone and returns to the lower furnace via the loop seal.

The CFB core concept for many applications

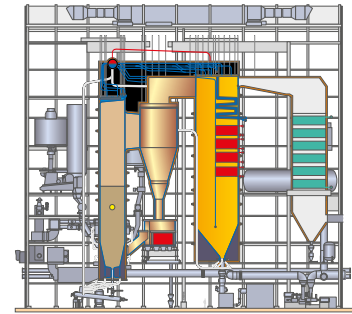
Classic CFB



Flexible CFB



Waste-to-energy CFB



Fuel

- Coals and coal residues
- Petrochemical side streams, such as pet coke and asphaltene

- Wood-based biomass
- Recycled wood
- Industrial residues and small amounts of agrofuels

- Treated municipal solid waste (MSW)
- Refuse-derived fuel (RDF)
- Recycled wood
- Industrial residues, such as old corrugated cardboard (OCC) rejects

Challenges

- Reliable fuel feeding and ash handling with varying fuel properties
- Effective emission control, especially NO_x and SO₂ removal

- Mainly alkali and chlorine-related challenges in bed agglomeration, fouling and corrosion

- High amount of debris in fuel
- High amount of alkalis, chlorine and heavy metals causing fouling and corrosion in a wide temperature range

Features

- Basic water-cooled hot loop
- Fuel and ash handling designs based on fuel properties
- Optimized combustion and emission control

- Robust bed quality management system
- Optimized convection pass design
- Fluidized Bed Heat Exchanger (FBHE)

- Empty pass design in the back pass
- Patented FBHE layered-tube design
- Fully covered heat surfaces available for the whole CFB hot loop

Valmet CFB Boiler for cost-effective conventional fuels

The classic CFB design provides a robust option for industrial and utility energy production using fuels with modest corrosion potential. Typical fuels suitable for this design vary from refinery residues to both high- and low-grade fossil fuels. Options for the co-combustion of selected biomass fuels are naturally available. Boiler sizes available range from 30 to 1,200 MW_{th} with advanced steam parameters.

Typical fuels

- Lignite
- Petroleum coke
- Bituminous coal
- Asphaltene
- Coal residues

The main challenges with the fuels listed on the left are related to fuel feeding, bottom ash cooling and flue gas emission control.

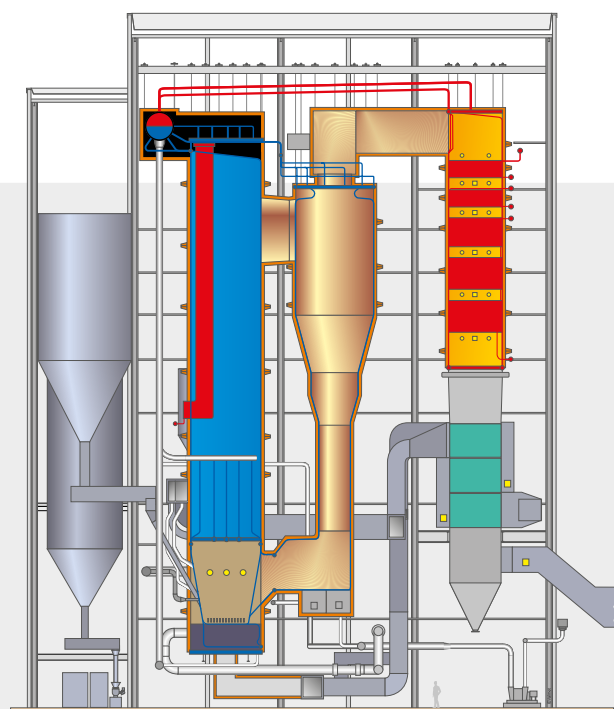
To tackle the challenges with fuel feeding, Valmet has developed special solutions to feed even sticky fuels in a reliable way. For high-ash residue fuels, integrated ash coolers are available to increase thermal boiler efficiency. When

utilizing high-sulfur residues, it is important to manage the in-furnace sulfur removal parameter. It is optimized together with other primary emissions by controlling the combustion process. Key components include high-efficiency cyclones and the means to feed fuel, limestone and air into the furnace in the right way.

Capacity range for the classic CFB

- 30–1200 MW_{th}
- Maximum of 565 °C
- Up to 175 bar

The classic CFB concept.



References



PT Cikarang Listrindo, Indonesia 2 × 140 MW_e (2 × 134 kg/s, 130 bar, 543 °C)

- **Driver:** To allow industrial customers to use local low-cost fuel instead of natural gas
- **Valmet's scope:** Two Valmet CFB Boilers, Flue gas cleaning system and a plant-wide Valmet DNA Automation System
- **Special features:** CFB was a natural choice, as the quality of local coal is degrading. The fuel portfolio was later widened by adding a feeding system for biomass consisting of palm kernel shells



Kilpilahti Power Plant, Finland 145 MW_{th} (56 kg/s, 104 bar, 540 °C)

- **Driver:** A refining residue, asphaltene, from a new solvent deasphalting (SDA) unit has a high sulfur (4%) and low ash (<1%) content. Although it cannot be utilized as a raw material anywhere, it is valuable as an energy source
- **Valmet's scope:** Valmet CFB Boiler, two Valmet oil and gas boilers, Valmet flue gas cleaning technology for all boilers, Valmet DNA Automation System
- **Special feature:** Valmet DNA controls the whole power plant and the entire refinery



Roquette America, USA 230 MW_{th} (80 kg/s, 82 bar, 510 °C)

- **Driver:** To enable food industry customers to produce more steam with low-cost fuel, such as petroleum coke coming from a nearby oil refinery's coker
- **Valmet's scope:** Valmet CFB Boiler with flue gas cleaning system
- **Special feature:** Pet coke has a very high sulfur content of 6%

Valmet CFB Boiler for a wide fuel portfolio

For fuels and fuel mixtures with medium corrosion potential, Valmet's flexible CFB design offers both excellent availability and efficiency. Design features, such as a fluidized bed heat exchanger as the finishing superheater, allow a wider fuel palette than the classic CFB design, including the co-combustion of selected recycled fuels. Boiler sizes range from 30 to 1000 MW_{th} at 175 bar with steam parameters up to 565 °C.

Typical fuels

- Wood-based biomass
- Recycled wood
- Industrial residues
- Agrofuels

The fuels listed on the left typically cause corrosion and fouling in superheaters since they contain alkalis, chlorine and heavy metals, such as lead (Pb). Bed management can be challenging due to alkalis, phosphorus and debris.

To overcome these challenges, Valmet offers advanced technical solutions, such as a fluidized bed superheater. Our performance-

improving solutions include moderate flue gas design velocities and wide superheater element spacing in the convective pass together with appropriate tube material selection. In addition, the robust furnace floor design ensures efficient debris removal.

Capacity range for the flexible CFB

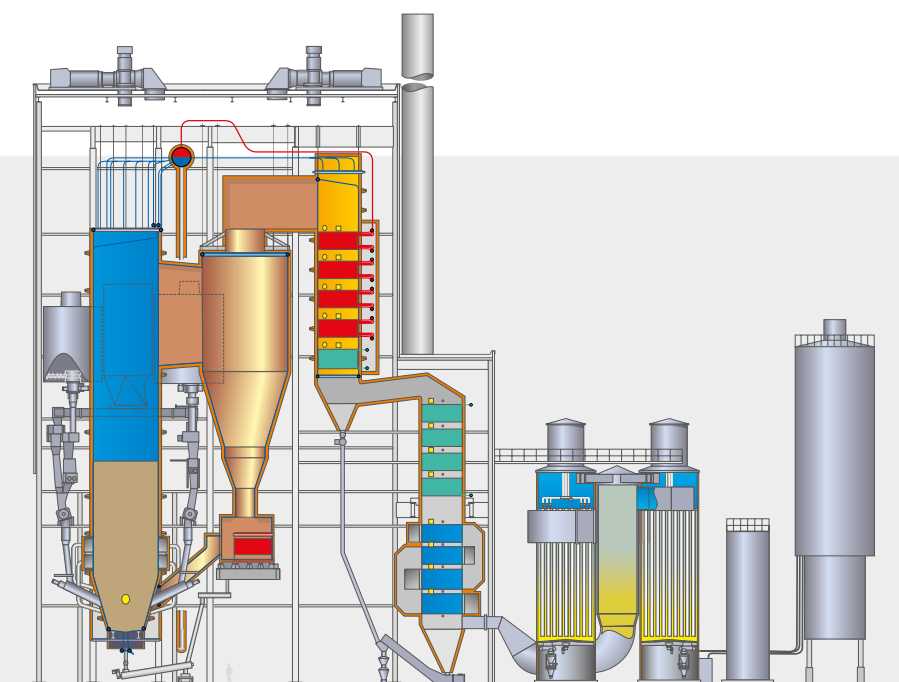
Biomass

- 30–1000 MW_{th}
- Maximum of 565 °C
- 175 bar

Recycled wood

- 30–300 MW_{th}
- Maximum of 540 °C
- 90–120 bar

Valmet's flexible CFB design.



References



Hofor Energiproduktion, Denmark 459 MW_{th} (184 kg/s, 140 bar, 560 °C)

- **Driver:** To produce district heat with carbon-free fuels in Copenhagen
- **Valmet's scope:** A biomass receiving and handling system, Valmet CFB Boiler and part of an emission control system
- **Special feature:** The plant imports certified biomass from global markets to its own harbor



Buzen New Energy, Japan 75 MW_e (64/57 kg/s, 142/28 bar, 557/540 °C)

- **Driver:** Power demand and feed-in tariff (FIT) for biomass
- **Valmet's scope:** Valmet CFB Boiler with Valmet flue gas cleaning technology
- **Special feature:** There is a reheater to maximize electricity production



Hamburger Hungaria, Hungary 158 MW_{th} (62 kg/s, 113 bar, 520 °C)

- **Driver:** To produce heat and power for the board mill from its own residues, avoid landfilling and minimize the use of natural gas
- **Valmet's scope:** Valmet CFB Boiler with Valmet flue gas cleaning technology and Valmet DNA Automation System
- **Special feature:** Flue gas emission limits are quite tight as mill residues fall under the Waste Incineration Directive (WID)

Valmet CFB Boiler for the most challenging fuels

The most demanding fuels require dedicated solutions. Valmet offers designs with a specialized fluidized bed superheater, smooth furnace floor, empty pass and state-of-the-art emission control systems to facilitate efficient and clean combustion of a wide range of corrosive and debris-containing fuels. Typical applications include recycled fuels from RDF to demolition wood. The boiler size ranges from 30 to 300 MW_{th} at 90 bar with steam parameters up to 540 °C.

Typical fuels

- Treated MSW
- RDF
- Recycled wood
- Industrial residues
- Recycled rejects, such as plastics

Alkalis, chlorine and heavy metals, such as lead (Pb), in the fuels listed cause corrosion and fouling on all boiler surfaces. For proper bed management, alkalis, phosphorus and debris are challenging.

To enable you to avoid these challenges, Valmet offers many technical solutions, such as a fluidized bed superheater with a patented coaxial construction. An empty pass, moderate flue gas design velocities and wide superheater element spacing in

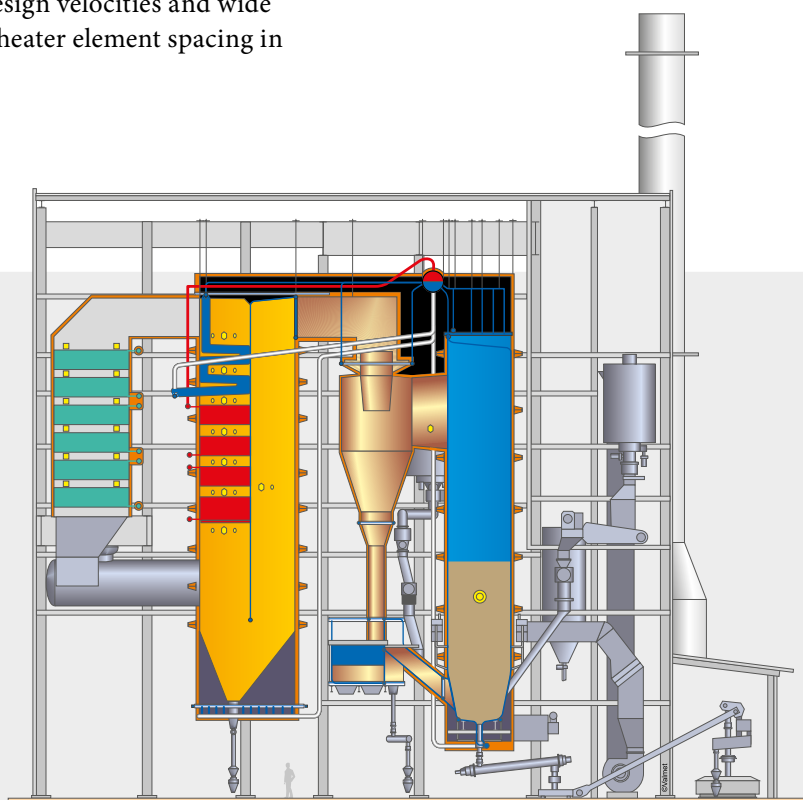
the convective pass, together with proper tube material selection, also contribute to a better combustion process. Moreover, there is a range of corrosion and erosion protection methods to choose from.

For debris removal, the waste-to-energy boiler concept features a robust furnace floor design together with an effective bottom ash sieving and recycling system.

Capacity range for the waste-to-energy CFB

- 30–300 MW_{th}
- Maximum of 480 °C / 70 bar – 520 °C / 90 bar

Valmet's waste-to-energy design.



References



Mälarenergi, Sweden **155 MW_{th} (56 kg/s, 74 bar, 470 °C)**

- **Driver:** To reduce CO₂ emissions in district heat and power production
- **Valmet's scope:** Valmet CFB Boiler with auxiliaries
- **Special feature:** The plant is the largest single-line waste-to-energy unit in the world with 480,000 tons of MSW processed annually into 400,000 tons of RDF on site



S.A. Industrias Celulosa Aragonesa, Spain **140 MW_{th} (51 kg/s, 75 bar, 520 °C)**

- **Driver:** To produce steam for a recycled board mill by using mill rejects as fuel instead of landfilling them
- **Valmet's scope:** Valmet CFB Boiler, Valmet flue gas cleaning technology and Valmet DNA Automation System
- **Special feature:** High steam temperature utilized successfully together with OCC rejects (mainly plastics) combustion.



Zibo Green Energy New Energy, China **108 MW_{th} (37 kg/s, 80 bar, 520 °C)**

- **Driver:** To allow a waste management company to have a scaled-up design that is reliable with high efficiency
- **Valmet's scope:** Valmet CFB Boiler
- **Special feature:** 330,000 tons per year of RDF is prepared on site from local MSW

Valmet Industrial Internet solutions and remote services for energy

The Valmet Industrial Internet (VII) offering covers an extensive range of energy solutions and applications.

Through remote solutions and intelligent automation technology, Valmet's experts offer support in technical challenges whenever needed. Processes, troubleshooting and corrections can be monitored and performed remotely. Using the capabilities of the Industrial Internet, process operations are optimized based on vast monitoring data.

Remote solutions turn Valmet's expertise into concrete benefits through minimized downtime, improved energy efficiency and reduced operational costs. In addition, mobile solutions help your operators work as effectively and efficiently as possible.

Valmet Industrial Internet - VII solutions for energy

Reliability

Recognize threats to plant availability proactively

Energy Efficiency

Discover efficiency improvement potential in real time

Environment

Control emissions and minimize use of consumables

Production Capacity

Capture potential of maximum and minimum capacity in real time

Fleet Management

Balance supply with demand accurately
Compare performance against set targets

Data Discovery

Discover how data analytics can solve process challenges

Valmet Performance Center

Easy access to Valmet process specialists to support on plant operation



Process technology



Services

Automation

- Approx. 100 service centers
- 98 sales offices
- 43 production units
- 16 R&D centers

Unique offering covers process technology automation and services

Valmet's automation solutions are designed to be reliable and cybersecure as well as to maximize the profitability of our customers' businesses by improving their production performance and their cost, material and energy efficiency.

Solid experience from technology combined with process know-how and automation form the base for our innovative product and service development aimed at improving the efficiency and competitiveness of our clients.

To support our customers in the best possible way, we combine our long experience with the latest findings in energy solutions. With a global team of engineers and experts, Valmet offers a full range of customized support services to meet your local

challenges. Our own workshops and local staff ensure fast and safe service implementation.

Automation solutions

Valmet DNA distributed control system (DCS)

Industrial applications

- Boiler controls
- Turbine controls
- Balance of plant controls
- Boiler and turbine protection (SIS)
- Cybersecurity solution
- Condition monitoring
- Process optimization
- Performance monitoring and reporting

Analyzers and measurements

- Boiler diagnostic systems

Industrial Internet solutions

Automation services solutions

- Spare parts
- Maintenance and technical support
- Cybersecurity services
- Lifecycle services and upgrades
- Condition monitoring services
- Process performance services

Learning services

- Training simulators

Customized support services

- Performance services
- Competence development
- Boiler and plant upgrades
- Maintenance services
- Components and parts
- Support products



Valmet's professionals around the world work close to our customers and are committed to moving our customers' performance forward – every day.



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