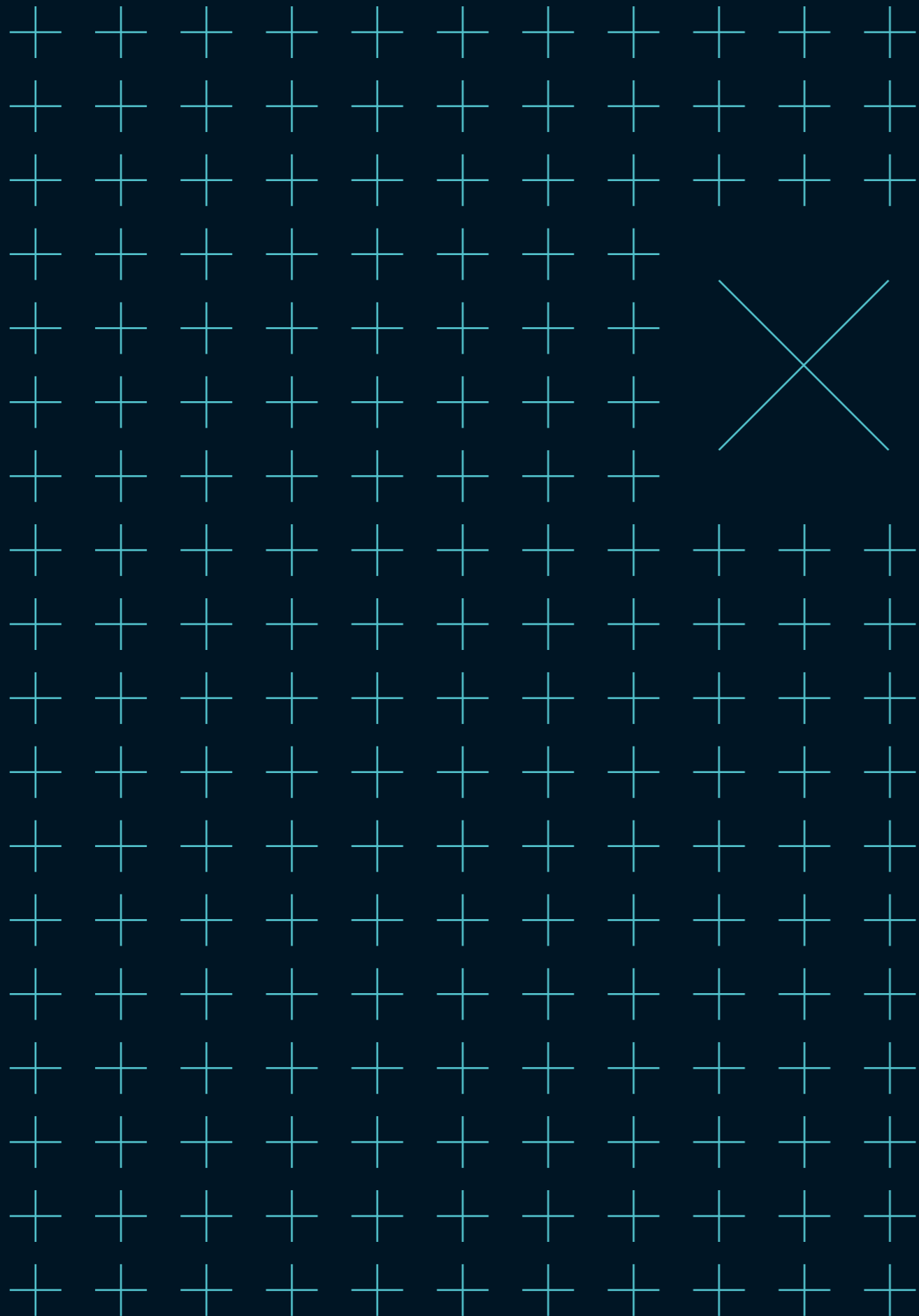


Powering a decarbonized
world for everyone



Your journey
to sustainable
energy solutions





The time is now

The future of energy is coming.

And while there are many unknowns, one thing is certain; we need to change how we produce and use energy, now.

Wherever you are on this critical journey, Sumitomo SHI FW is here to help you make the transition to cleaner, more sustainable energy sources; allowing you to take advantage of changing energy market opportunities, and play your part in creating a decarbonized world for all.

130 Years of history

1800 Skilled experts

20+ Locations worldwide

Your partner in the transition to cleaner energy

Sumitomo SHI FW has been committed to the creation of technologies that meet the world's changing energy needs, since 1891.

From our world-leading boilers and gasifiers to our cutting-edge Liquid Air Energy Storage, our integrated solutions aim to help you produce energy in the most affordable, sustainable and environmentally responsible way possible.

Many corporations talk about partnership, but for us it's fundamental. Because we know that working closely with our customers to understand their unique businesses and challenges, is the best way to help them solve their problems.

And we don't stop there. Sumitomo SHI FW is a lifecycle partner, using our proven expertise, financial stability and global reach to help you optimize the efficiency of your new solutions in the real world.

Whether you're refining your existing low-carbon operations, or taking your very first step towards cleaner energy, we're with you.

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Our vision is to become the leading technology provider of integrated energy solutions for decarbonized energy.



Support at every step

Almost every industry leader and government is trying to work out how to best tackle the technological, economic and regulatory hurdles presented by climate change, without compromising energy security.

From inception to design, and across installation, optimization and ongoing maintenance, we're with you - even when that means building an entirely new plant from scratch.

Integrated Services

Maintenance

Reliable Operations

Basic maintenance

- Tuning for compliance with new regulations
- Balancing air and fuel flows for reduced erosion and corrosion
- Local service corners and spare part services
- Outage, emergency, inspection and specialists services
- Condition monitoring of pressure parts

Digital Services

Optimized plant operations

- Boiler envelope
- Bed management
- Fouling management
- Leakage detection

Modernization

Reduced carbon footprint and efficiency improvement

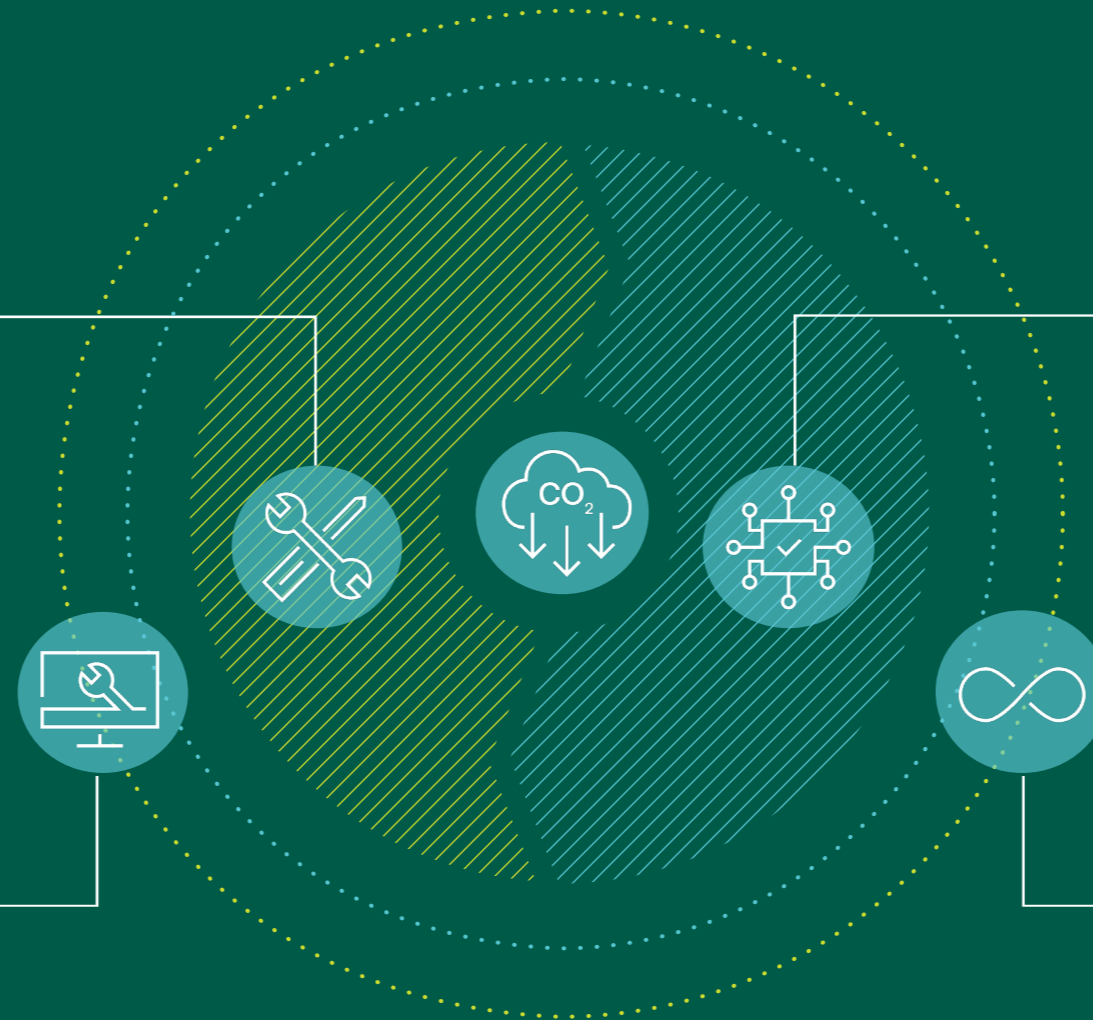
Technology modernization and upgrades:

- Fuel range expansions and conversions
- Capacity upgrades and process improvements
- BFB & CFB retrofits, CFB scrubber, DSI and fabric filter retrofits
- Biomass gasifiers retrofits
- Plant optimization studies, CFD, 3D modeling

Service agreements

Predictable cost and performance

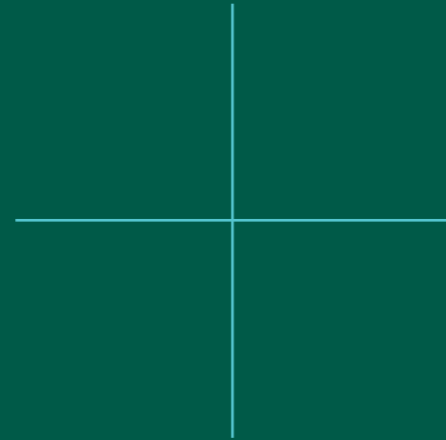
Full and long-term service agreements which enables your new boiler investment to realize full potential



Energy solutions

World-leading technologies to help you maintain energy security, reduce carbon emissions and play your part in a net zero world.

Energy Generation



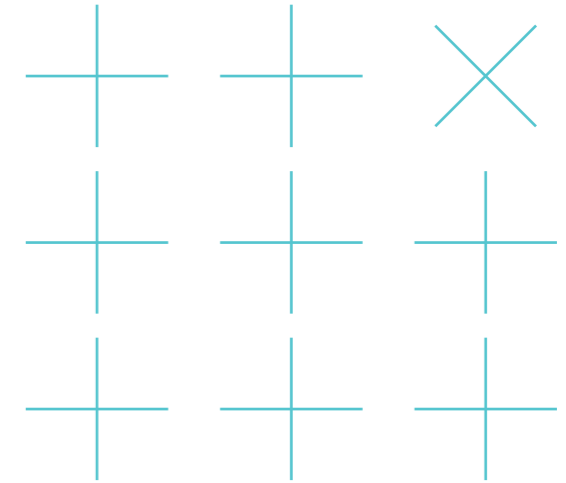
Circulating fluidized bed boilers - CFB

Our pioneering CFB boilers have been the backbone of global energy generation for decades. Today they use all kinds of solid fuels, including biomass and refuse-derived fuel (RDF), to produce reliable and efficient clean energy.

This fuel flexibility enables a reduction in the reliance on fossil fuels at the same time as cutting CO₂ emissions - and all while using alternative renewable fuels that are locally available to you.

What's more, SFW works closely with you to provide comprehensive support and engineering services ranging from advisory and planning, to design, procurement, construction, and after-sales services. Besides our design and development bases in Finland and Japan, we have engineering, sales, manufacturing, and service offices across Asia and Europe.

We are proud to have delivered more than 500 CFB boilers to a wide range of customers around the world, from in-house industrial steam generation to thermal power stations in the utility sector.



Bubbling fluidized bed boilers - BFB

Our BFB technologies provide you with a reliable solution for recovering energy from difficult fuels, such as residual biomass and industrial waste. SFW's BFB boilers can handle a wide range of high-moisture and high-ash fuels with low emissions and high operational flexibility.

This flexibility means BFBs can help you to balance variable renewable energy generation sources, such as solar PV and wind, while providing cost-effective back-up power and heating.

BFBs are recommended for combined heat and power, industrial steam, power and district heating applications.

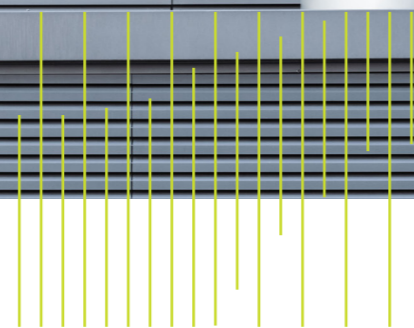
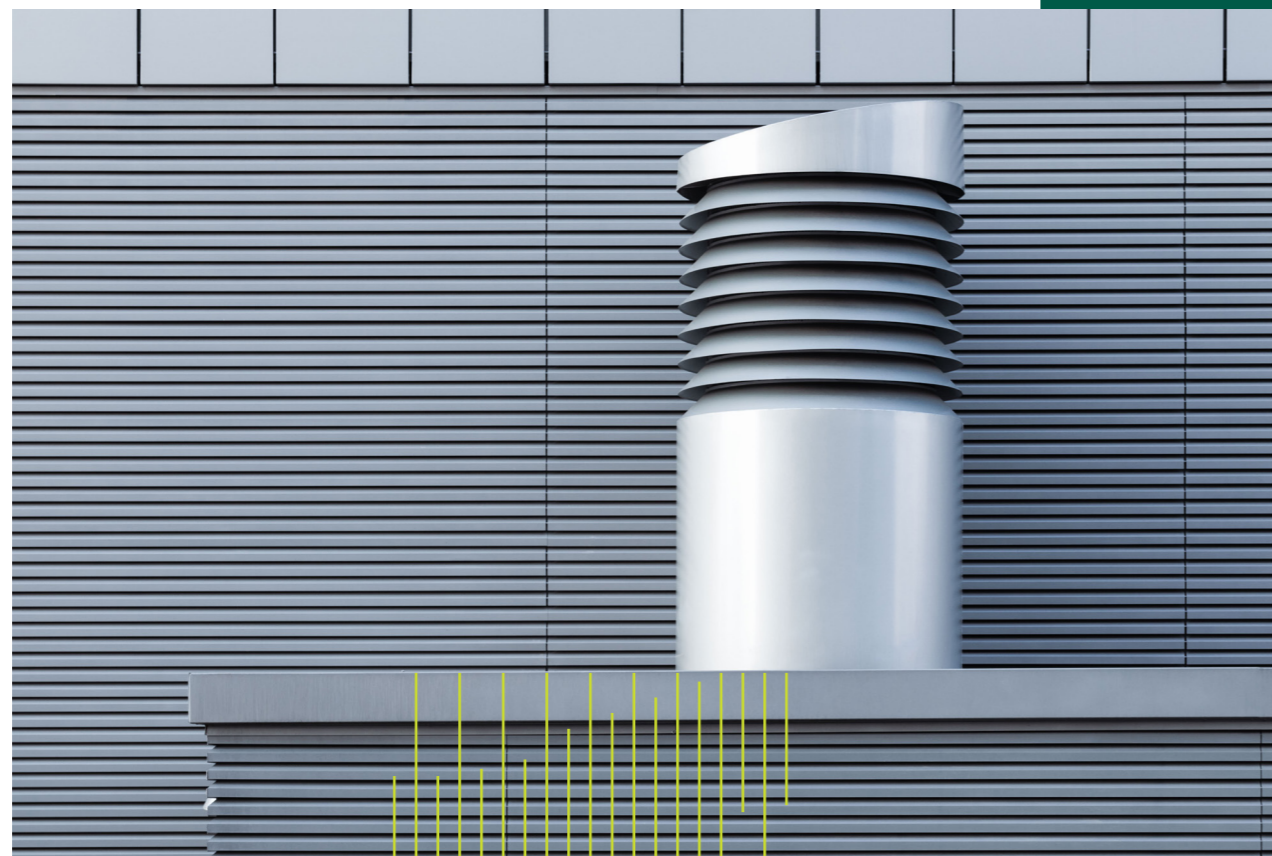
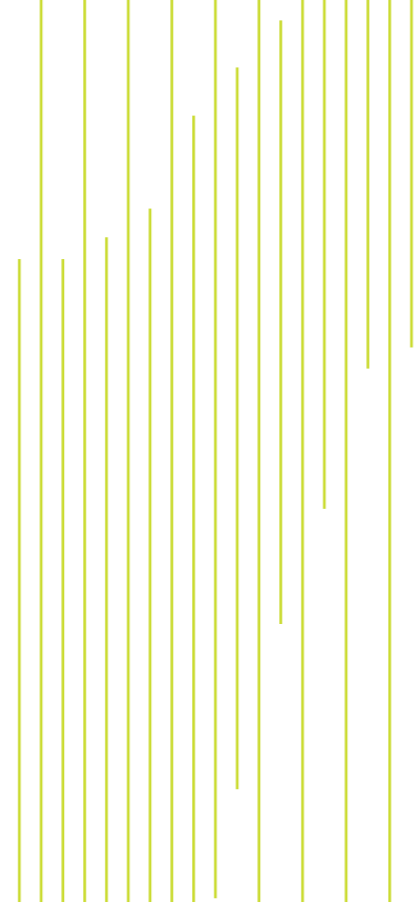


Waste heat boilers - WHB

SFW's WHB boilers are designed to recover energy from hot process gases in non-ferrous pyrometallurgical furnaces or similar processes. Heat recovery increases energy efficiency, ultimately reducing fuel consumption, carbon emissions, and environmental impact.

SFW has supplied and supported the operation of over 100 WHBs around the world.

Emission control



Circulating fluid bed scrubbers – CFBS

Emission limits for pollutants like SO_x, NO_x and particulate matter continue to tighten for power plants and industrial facilities worldwide. Acid gas and heavy metal emissions, such as of HCl, HF, and Hg, are a major concern as well.

Our CFBS are an efficient and flexible flue gas cleaning (FGC) technology for removing a wide array of pollutants from flue gasses from almost any combustion and industrial process. The technology has been applied widely in power plants, steel mills, refineries, waste-to-energy plants, combined heat and power plants, and plants in many other industries. It has been demonstrated over a range of flue gas flow rates from small industrial boilers to large power plants with capacities over 500 MWe.



Baghouse, dry sorbent injection and activated carbon injection

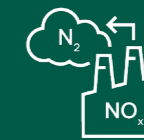
Sumitomo SHI FW offers comprehensive solutions that enable the adaptation of new and existing facilities to meet the continuously decreasing levels of permitted pollutants i.e. the achievable emission level associated with the best available techniques (BAT-AEL). Many years of experience in the field of combustion processes and the accompanying mechanisms of pollution formation affect the optimal selection of flue gas cleaning concepts, as well as the possibility of optimizing the cooperation between the boiler and the flue gas cleaning installation.

Regardless of the type of fuel used, i.e. whether it belongs to conventional sources, such as coal, gas, or alternative sources like biomass or RDF, the combustion process is accompanied by the formation of polluted gasses. The flue gases contain many components that are harmful to all living organisms.

Dry sorbent injection (DSI) and activated carbon injection (ACI) are flue gas treatment methods based on injecting dry reagent

material (alkaline sorbents or activated carbon) directly into the flue gas duct; mainly to reduce acid gasses, mercury and PCDD/Fs (dioxins and furans) from flue gases.

Fabric Filters are used in order to achieve the most restrictive dust emissions in flue gases, especially to capture fine dust particles such as PM_{2.5} and PM₁₀.



Flue gas denitrification systems

The use of fuels such as coal, oil products, natural gas, and municipal and industrial waste to produce energy in combustion plants causes the formation of pollutants such as nitrogen oxides (NO_x). These are contained in the flue gas and can cause considerable damage to the environment.

NO_x emission reduction can be achieved by converting the NO_x formed by burning process, into N₂ and H₂O via either selective non-catalytic reduction (SNCR process) or selective catalytic reduction (SCR process).

Both SNCR and SCR are based on the injection of reduction reagents (ammonia water or urea) into the flue gas stream.

Carbon Capture



SFW Oxy+

SFW Oxy+ solutions can be used to enable the creation of carbon negative heat and power. These cutting-edge technologies replace boiler combustion air with oxygen and recycled flue gases to create a product gas that is inherently rich in CO₂. This in turn allows the capture of CO₂ without post combustion systems.

The resultant rich CO₂ stream can then be either delivered to a permanent storage or utilized as valuable biofuels or bio-chemicals.

The oxygen required for this process can be produced in air separation units, as by-product from electrolyzers splitting water into hydrogen and oxygen, or via SFW's Liquid Air Energy Storage system that is equipped with air distillation for additional benefits.

Gas processing units may be required downstream to purify CO₂ and increase concentration to the levels required for carbon storage and utilization.

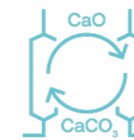
SFW has ready design for up to 300MWe power generation, and capabilities for further upscale. This game-changing technology has been demonstrated with several thousand operational hours in Compostilla Spain in 30MWth scale.

- Waste to energy plants (Tail end CaL)
- Cement plants (Integrated or tail-end CaL)
- Steelmaking process (Integrated or tail-end CaL)
- Pulp mills (Tail-end and integrated CaL)

SFW CaL+ has been demonstrated in MWth scale with coal and clean biomass and is upscalable to meet your needs.

The technology can be installed as stand-alone in new deliveries or retrofitted to existing industrial facilities.

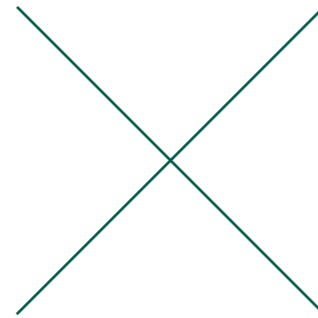
As with SFW Oxy+, the oxygen required for this process can be produced in air separation units, as a by-product from electrolyzers splitting water into hydrogen and oxygen, or via SFW's liquid air energy storage system that is equipped with air distillation for additional benefits. Gas processing units may be required downstream to purify CO₂ and increase concentration to the levels required for carbon storage and utilization.



SFW CaL+

SFW CaL+ utilizes natural materials such as limestone to capture CO₂ and does not require the production, utilization, or disposal of highly toxic materials or solvents. SFW CaL+ can be used to separate and capture carbon across a range of processes and sectors including:

Gasification



Oxy-steam fluidized bed gasifiers

Oxy-steam gasification is a process that converts traditional fuels such as biomass, municipal and industrial waste into valuable syngas. This technology uses a mixture of oxygen and steam, instead of air, as the gasifying agent. By replacing air with a mixture of oxygen and steam, the resulting gas, called syngas or product gas, is free from nitrogen, making it suitable for other applications than combustion.

In this case, the main components of syngas are hydrogen and carbon monoxide, the basic building blocks of many valuable chemicals and fuels, including ethanol, diesel and jet fuel. This means that oxy-steam gasification technology can unlock the value of your waste streams by turning them into energy or feedstock for biorefineries, with the resultant effect of replacing traditional transport fuels, reducing CO₂ emissions and promoting circularity.



Air fluidized bed gasification

Gasification is a process that can find new value in traditional fuels such as biomass, municipal and industrial waste by converting these materials into combustible gasses. The resulting gas, called syngas or product gas, can replace fossil fuels in multiple applications.

Our air gasification process uses heat to break down low-quality solids or liquid fuels into their basic gaseous chemical components. The result is a gas stream rich in hydrogen and carbon monoxide, with calorific values up to 8 MJ/Nm₃. This gas can be used in multiple applications, such as replacing fossil fuels in heat and power generation, lime and cement kilns and gas turbines.



Modular waste-to-energy plants

Together with our strategic partner, Woima Corporation, SFW delivers turnkey waste-to-energy plants based on well-proven grate combustion technology. The wasteWOIMA® solution is a pre-engineered plant with factory-fabricated, container-size modules. For the customer, this means a reliable, high-quality and cost-effective solution with simple construction and a short time to commercial operation.

The world produces around two billion tons of municipal solid waste (MSW) every year, of which more than 70% is still being landfilled, often at non-sanitary dump sites. The World Bank estimates that this figure will grow to 3.4 billion tons by 2050 - a colossal increase of 70%.

By utilizing locally available waste to produce electricity or heat, our customers are able to reduce fossil fuel dependency and help mitigate the environmental impact of this otherwise valueless, polluting waste.

Our trusted partner

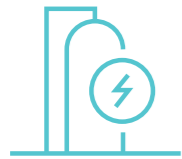


Woima Corporation develops innovative modular, standardized solutions that enable the utilization of waste streams to their fullest potential, either as raw material or as energy. It is based in Vaasa, Finland.

SFW has partnered with Woima Corporation since 2021.



Liquid Air Energy Storage



There is a global push to increase the contribution of renewable energy sources (RESs) to the energy mix. With a significant expansion in the installed capacity of RESs, grid operators across the world are grappling with emerging challenges such as the intermittent nature of RESs, grid congestion and the economic curtailment of RES generation. In this context, energy storage systems have become essential to increase the absorption of RESs in the power system and minimize any economic curtailment. Specifically, numerous independent studies have identified long duration energy storage (LDES) systems as the missing link to realizing 100% RES-based power systems.

Liquid Air Energy Storage (LAES) is a game changing technology which can unlock the full potential of renewable energy by making it as reliable and dispatchable as energy from conventional sources.

Sumitomo SHI FW will lead the LAES business, applying our technology development, engineering, and global project delivery capabilities to help our customers in their energy transition and net-zero journeys. LAES harnesses a freely available resource—air, to provide a reliable, flexible, and sustainable energy storage solution.

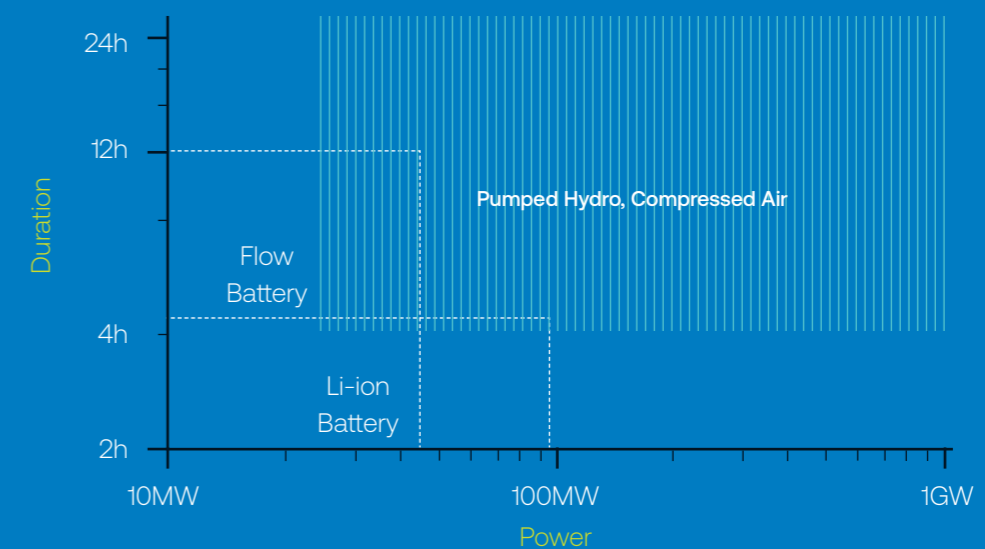
LAES is the only LDES technology available on the market today that offers multiple GWh of storage, is scalable with no size or geographic constraints, and produces zero emissions. LAES is ultra-flexible, durable, cost-competitive and free from the capacity degradation issues observed in some conventional energy storage technologies.

The discharge power of a LAES system typically ranges from 25MW to over 100MW while the storage capacity typically ranges from 200MWh to 2.5GWh. With the charge power, discharge power and storage capacity being decoupled, the LAES is well-suited for long duration storage and bulk energy shifting applications.

LAES is particularly effective when it is combined with variable RESs. A LAES system can be charged during periods of high RES generation and discharged over long durations during periods of low RES generation. The versatility of the LAES system makes it capable of serving every level of the electrical power system.

The LAES system can provide a range of services including but not limited to:

- 24x7 firm and dispatchable renewable energy
- ancillary services which can be monetized depending on the specific energy market
- rotational inertia support to RES dominated power grids
- reactive power support, short circuit capacity and black start support





Industries

How we're decarbonizing yours



Energy

Generating the energy the earth needs for electricity and heat produces around 13 gigatonnes (Gt) of CO₂ emissions each year. This makes the energy generation sector by far the world's largest source of emissions, with coal-based power generation still contributing as much as 10 Gt.

Contact SFW about

- Long duration energy storage (LDES) and liquid air energy storage solutions – to solve power intermittency challenges
- Modular waste-to-energy plants for power and heat generation
- Gasifiers that produce renewable gas to offset coal usage in existing thermal boilers
- SFW Oxy+ and carbon capture solutions for fossil or biomass-based thermal power plants to achieve negative carbon emissions
- High-efficiency multi-fuel fluid-bed boilers for the non-recyclable fractions of biomass residues and waste.



Featured project: The world's largest and most efficient biomass CFB plant

Teesside, UK

Startup year: **2020**

Capacity: **299 MWe**

Fuel: **Biomass, wood pellets, wood chips**

The plant provides reliable and dispatchable renewable power and heat within an industrial cluster. SFW supplied the CFB boiler with a multi-year long-term service agreement.

Waste

Waste-related emissions – including methane emissions from landfills – were calculated at 1.6 Gt in 2020. This accounts for some 3% of total global greenhouse-gas emissions. In that same year, global volumes of municipal solid waste were estimated at 2,000 megatonnes (Mt). This figure is forecast to hit 3,400 Mt by 2050 – a colossal increase of more than 70%.

Contact SFW about

- High-efficiency multi fuel fluid-bed boilers for RDF and industrial waste
- Modular waste-to-energy plants for energy production
- Waste gasifier solutions to convert waste streams into chemicals that can be used to create sustainable transport fuels, green chemicals or recycled plastics.



Featured project: Turning waste into clean power

Deagu, South Korea

Startup year: **2013**

Capacity: **23MWe**

Fuel: **Refuse derived fuel**

Our CFB technology provides an ideal solution for cleanly converting local refuse-derived fuels into valuable steam and power at Deagu's striking Green Energy Center.

Sustainable fuels

Total CO₂ emissions from world transport stand at approximately 8 Gt. Road traffic is by far the largest CO₂ contributor in the transport sector, producing 6 Gts of emissions. Meanwhile, shipping produces 0.9 Gt of CO₂, accounting for 2.3% of total global energy-related emissions. Finally, the aviation industry produces 0.9 Gt of energy-related emissions, 2.5% of the global total.

Contact SFW about

- The use of gasification technology to produce bio-based fuels for the transport sector.
- Our comparable reference gasifier project with renewable-energy provider Neste and pulp and paper company, Stora Enso.
- Our work with the EU's BioSFerA, a project aimed at developing sustainable aviation and maritime fuels.



Featured project: NSE Biofuels
Forerunner oxy-steam gasification plant producing sustainable transportation fuels

Varkaus, Finland

Start up year: 2009

Capacity: 12 MWth

Fuel: Biomass, forestry residues

The plant, which includes CFB gasification and a syngas cleaning system, started up in 2009 and converts woody biomass into renewable diesel. The project was developed together with Stora Enso and Neste.

Metals

Figures from 2020 show that global steel production is at 1.9 Gt. Every tonne of steel produced generates 1.8t of CO₂ emissions. That's 8% of total energy and process-related emissions. Currently there is only one option to decarbonize aluminum to net zero; source all electricity and heat from renewables, and replace coal-based anodes with sustainable alternatives.

Contact SFW about

- Building captive iron and steel industry power plants using the non-recyclable fractions of biomass residues and waste
- Carbon capture solutions for the iron and steel industry through calcium looping
- Industrial thermal power plants for the aluminum industry that run on biomass and future opportunities for replacing coal-based anodes with biochar.
- The use of liquid air energy storage (LAES) technology to solve intermittency issues and ensure reliable power generation in the aluminum industry.

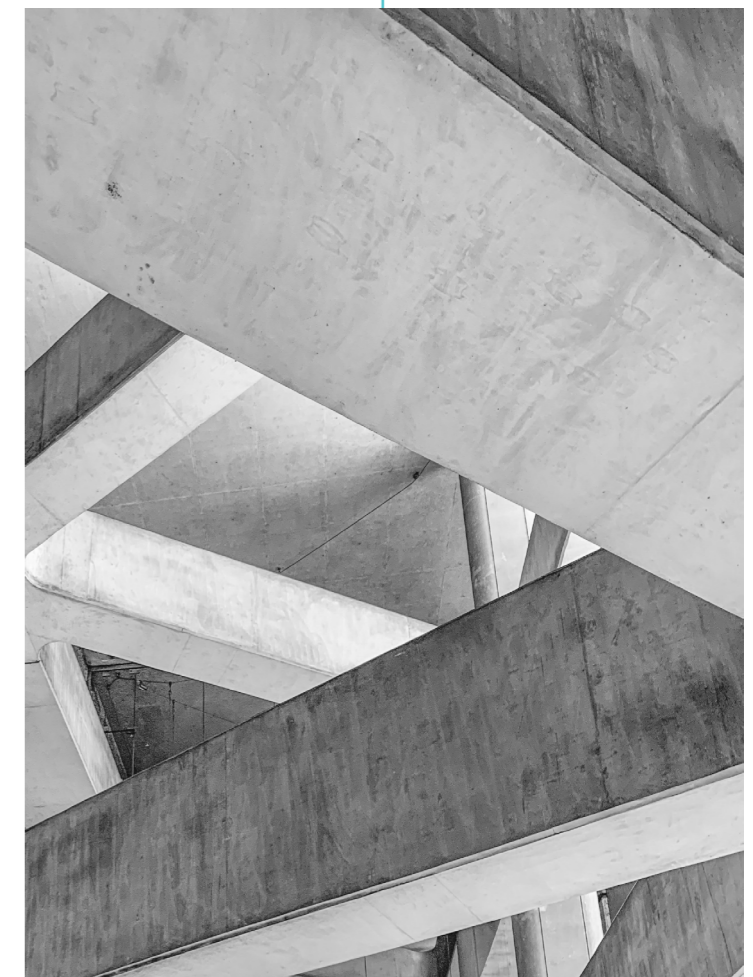


Cement

Construction of cities is on the rise in many parts of the world, driving up cement production. In 2019, 4.1 Gt was produced globally. The cement industry produces approximately 2.5 Gt of CO₂ emissions – both directly and indirectly – accounting for 7% of total energy and process-related CO₂ emissions.

Contact SFW about

How to integrate our SFW Cal+ technology with the cement manufacture process to enable carbon capture, utilization and storage.





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About us

Since 1891, Sumitomo SHI FW have developed and delivered the highest quality technology solutions within the everchanging energy market. Now the transition to a net zero world is reshaping industries and economies to improve our impact on our environment.

We work in partnership with our customers, cultivating a deep understanding of their businesses, to deliver integrated energy solutions.

We want to be a life-cycle partner, bringing complementary expertise and working closely with our customers across the entire process. This is from customer value creation to design, scope, installation, execution, maintenance, and operations.

We partner with a diverse array of experts to meet rapidly evolving customer needs. With our unique knowledge, proven expertise, leading

technology, and global reach, we go further, together. By working closely with our customers, we enhance customer value and can reach decarbonization goals faster.

Whatever the customer challenge, we endeavor to find the solutions.

**Powering a decarbonized world
for everyone.**