

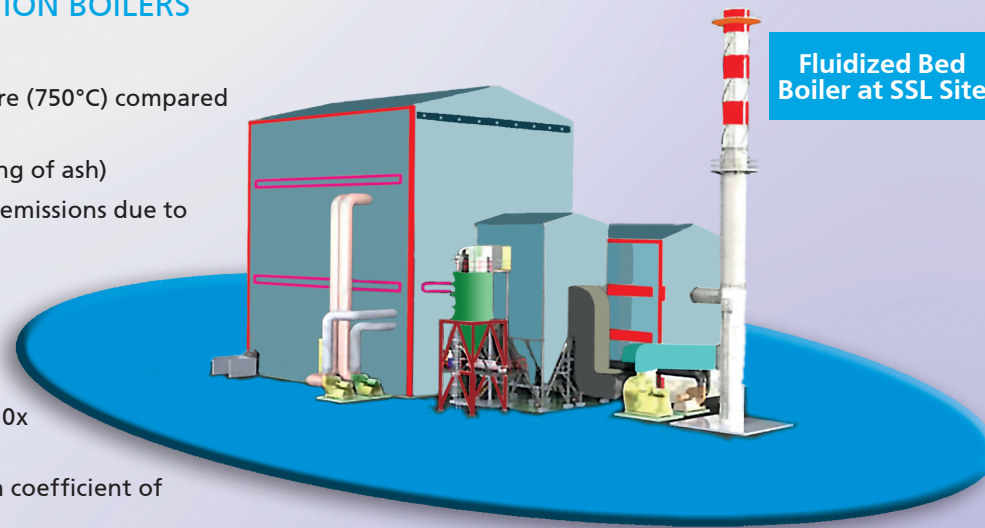
## ENERGY SAVINGS WITH FBC BOILERS AND CONDENSATE HEAT RECOVERY

After a thorough study of SSL's operations and business, IFC recommended a resource and energy efficiency program which the company then implemented. This included replacing the old boiler with one based on FBC technology and adopting energy efficiency measures, such as a compressed air system and condensate waste heat recovery technology.

### FLUIDIZED BED COMBUSTION BOILERS

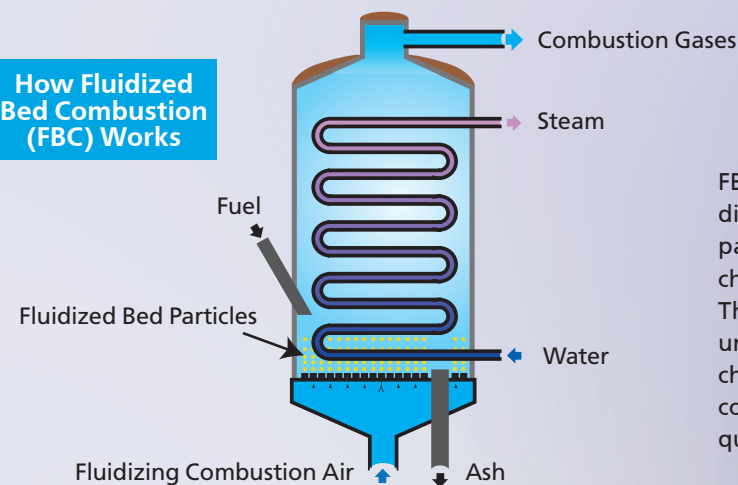
Salient features of FBC boilers:

- Lower combustion temperature (750°C) compared with ordinary boilers (850°C)
- A low sintering process (melting of ash)
- Lower Nitrogen Oxides (NOx) emissions due to the lower temperature
- Lower Sulphur Oxides (SOx) emissions due to capture by limestone
- Higher combustion efficiency as burning particles produce 10x more heat transfer
- Less area required due to high coefficient of convective heat transfer



Fluidized Bed Boiler at SSL Site

#### How Fluidized Bed Combustion (FBC) Works



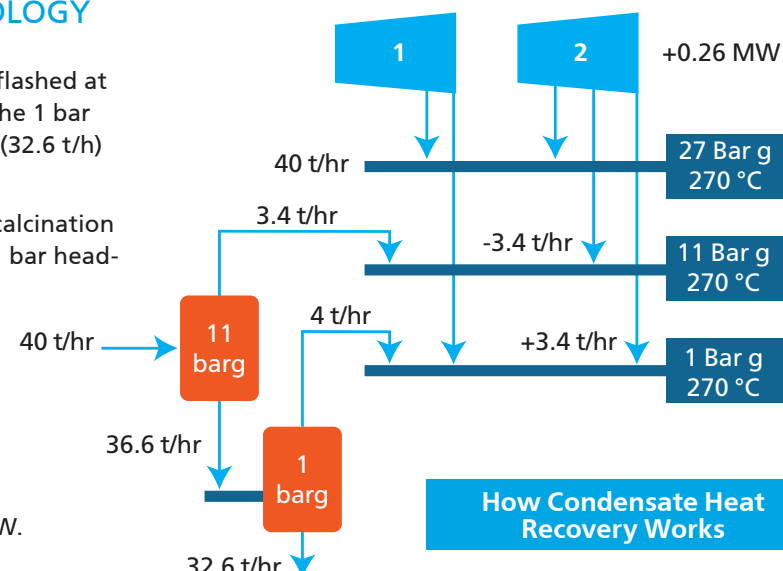
FBC boilers burn coal with low NOx and sulphur dioxide (SO<sub>2</sub>) emissions. Non-combusted coal particles are recirculated and sent to the combustion chamber through the multi-cyclone separator. The multi-cyclone separates flue gas and feeds uncombusted coal back into the combustion chamber. Fly ash is then collected from the combustion chamber. This fly ash is of a higher quality, which SSL has been able to sell for a profit.

### CONDENSATE HEAT RECOVERY TECHNOLOGY

Previously, 27 bar condensate from calcination was flashed at 1 bar. Flashed low pressure steam (7.4 t/h) went to the 1 bar steam header and flashed low pressure condensate (32.6 t/h) went to the condensate tank.

This was designed to flash 27 bar condensate from calcination to 11 bar. Flashed steam (3.4 t/h) now goes to the 11 bar header. This reduced 11 bar steam extraction from the turbine.

The condensate from flash drum at 11 bar now goes to 1 bar flash drum. The total amount of steam flashed at 1 bar is reduced by the same amount (4 t/h). This increases the flowrate from 1 bar extraction of the turbine. As a result, power generation of turbine is increased by 0.26 MW.



How Condensate Heat Recovery Works

## ENERGY EFFICIENCY CASE STUDY

This case study illustrates how investments in energy-efficient technologies helped a Bosnian soda ash manufacturer reduce climate impacts and increase profits.

### THE MANIFOLD BENEFITS OF ENERGY-EFFICIENT TECHNOLOGIES

Soda ash producers can sharpen competitiveness, improve sustainability, and uncover hidden revenue streams by investing in energy-efficient technologies, such as fluidized bed boilers.

Bosnia-Herzegovina is one of the few countries in Europe that still depends heavily on coal. Inefficient legacy technologies, which some industries such as soda ash manufacturers use, aggravate the problem by consuming more energy and resources while causing higher emissions.

#### COMPANY AN ENTERPRISE HINDERED BY OUTDATED TECHNOLOGY

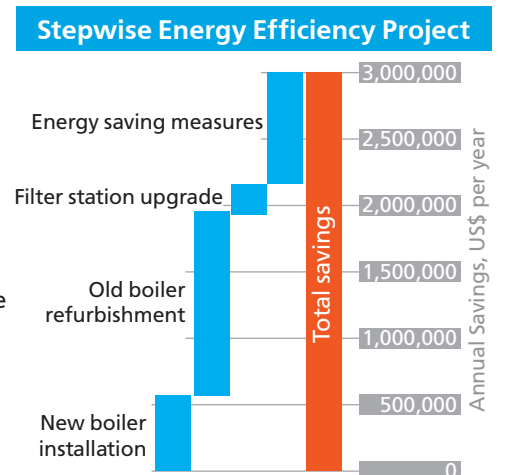
Šiřecam Soda Lukavac (SSL), a marquee chemicals company in the Lukavac region of Bosnia-Herzegovina, was founded in 1893. In time it became a prime source of employment, especially during the socialist era. However, decades of dependency on old machinery based on legacy technologies, as well as inadequate investments, led to mounting losses. Privatized in 2006, it was acquired by řiřecam, a leading glass manufacturer based in Turkey, with IFC funding. IFC also helped the company modernize and upgrade its technology, spurring production to 350,000 tons of soda ash per year. Today SSL is once again a major employer in the region, creating value by sourcing most of its raw materials locally while selling nearly all its products abroad. It now ranks among the country's top exporters.

#### CHALLENGE EXPANDING CAPACITY WHILE CUTTING COSTS AND EMISSIONS

The two main coal-based boilers that SSL had inherited were based on outdated technology and accounted for nearly 80% of the plant's energy consumption. They were inefficient, consumed excessive amounts of coal, and were expensive to maintain. Moreover, the boiler ash contained high levels of unburned coal, due to incomplete combustion, and had to be dumped as waste. This increased operational overheads and caused higher emissions, though within permitted levels, as well as water contamination (since water was used to transport the ash). All these factors adversely impacted the environment. Most crucially for SSL, its existing boilers could not be scaled up. In a bid to boost output, therefore, the company initially decided to replace one of its main boilers with a second-hand boiler based on the same technology. This would have boosted capacity but not addressed SSL's core problems: operational inefficiency, high energy consumption, and high emissions.

#### SOLUTION ADVANCED TECHNOLOGIES REV UP OPERATIONAL AND ENVIRONMENTAL PERFORMANCE

When SSL was considering purchasing a second-hand boiler as part of its upgrade plans, IFC stepped in to recommend a set of resource-efficiency measures. These included investing in a new-generation boiler based on fluidized bed combustion technology and upgrading the filter station. The \$24 million project, which SSL undertook in two phases with IFC's financial support, unlocked \$3 million savings (about 4% cost reduction) and cut emissions by 55-80%, significantly reducing its environmental footprint. The measures also boosted production. The evident results prompted SSL to adopt the same technology for its second boiler.



How did SSL's \$24 million investment help it boost production and unlock \$3 million in annual savings?

In partnership with



# OUTDATED TECHNOLOGIES RAISE OPERATING COSTS AND HURT BOTTOM LINE

Energy-intensive boilers play a key part in soda ash manufacturing. Because of their outdated technology, SSL's main boilers consumed excessive coal and were expensive to maintain. The fly ash from the boilers contained high quantities of unburned coal, making it useless as raw material for a nearby cement plant. Inefficient equipment such as outdated compressor and utility systems meant the plant's energy and water consumption exceeded industry standards. Valuable heat generated in the plant, which could have been recovered, remained untapped because the relevant technologies had not been adopted. All these issues showed up, ultimately, in SSL's performance.

Şişecam is a Turkish industrial group that has been an IFC client for over 40 years. It is among the top 10 glass manufacturers worldwide, with operations in 13 countries. IFC has helped finance the group's international expansion in the Balkans, Bulgaria, Russia and other European countries.

IFC also helped Şişecam Soda Lukavac (SSL) enhance its competitiveness and adopt environmentally friendly technology as part of an effort to safeguard the environment in Bosnia-Herzegovina and spur economic growth in the region. This included recommendations to invest in resource-efficient solutions. Four years later, the IFC team assessed the results and quantified the benefits. This case study is based on the team's findings.

The plant also had a large environmental footprint, primarily in the form of high emissions (though within permitted levels), including sulphur dioxide, nitrous oxide and particulate matter. A detailed IFC study of the hard infrastructure and processes further revealed that SSL had been consuming 16% more energy than the sector average for a plant of its size. Had it adopted best techniques, it could have improved energy consumption by 40%, the study found.

IFC and SSL agreed on key steps to achieve resource optimization, cost and energy savings, and new revenue streams.

Key energy-efficient technologies identified	<ul style="list-style-type: none"><li>• New boiler installation</li><li>• Old boiler refurbishment</li><li>• Filter station upgrade</li></ul>
Other energy-saving measures implemented	<ul style="list-style-type: none"><li>• Condensate Heat Recovery (CHR)</li><li>• Compressed air system rehabilitation</li><li>• Variable speed drives and installation of new motors</li><li>• Installation of expansion tanks</li></ul>

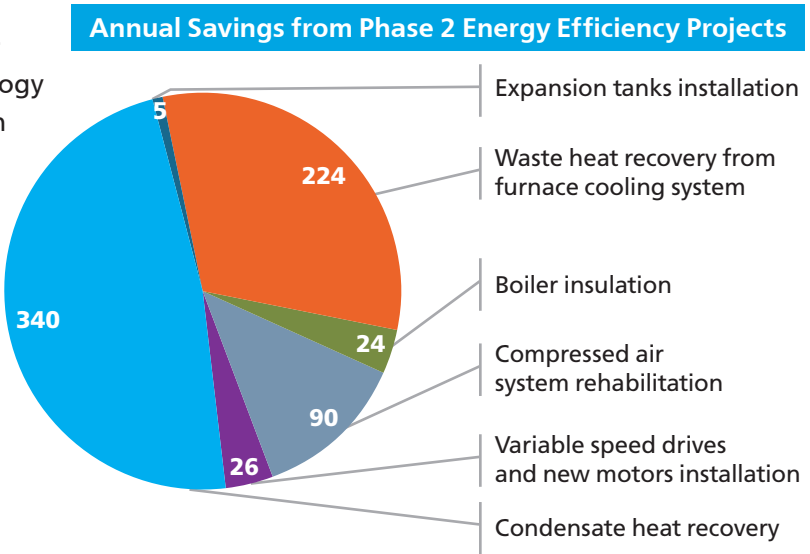
## FLY ASH: FROM WASTE TO INCOME

Seeking to rapidly increase production capacity, SSL considered replacing one of its main boilers with a second-hand unit based on the same outdated technology. IFC recommended instead that it invest in a boiler using fluidized bed combustion (FBC) technology, which was better suited to SSL's business profile and growth plans. FBC technology allows jet-streams of air to mingle with the particulate solid fuel of the boiler (in this case, coal), helping improve combustion and yield more energy per unit of fuel consumed.

Upon installing the FBC boiler, SSL saw immediate and significant gains. In addition to big energy savings, it now sells to a nearby cement plant 450,000 tons of the higher-quality fly ash the new boilers generate, thus earning an income as well as avoiding the substantial waste disposal expenses which it had been incurring. These results persuaded it to adopt the same technology for its proposed second boiler upgrade.

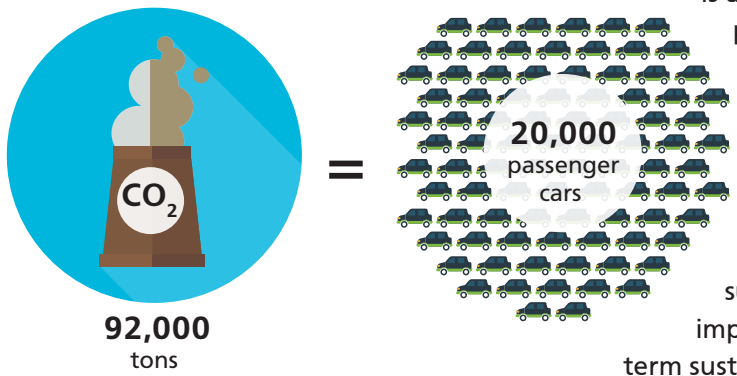
# OUTCOMES: LOWER ENERGY COSTS, REDUCED CLIMATE IMPACTS, NEW INCOME STREAM

SSL has made significant gains by adopting new technology at its plant. Replacing the first boiler and upgrading the second one with FBC technology has boosted boiler efficiency by 11%. Along with the energy savings measures SSL implemented as part of phase two, this has yielded annual energy savings of 261,000 MWh. The new and upgraded boilers consume lesser coal, resulting in \$1.9 million in annual savings while Phase 2 projects help save energy worth \$0.7 million. Selling the higher-quality fly ash, further, generates an income and eliminates the landfill costs SSL had been incurring.



SSL invested \$18 million in energy-saving measures. In addition, IFC recommended \$6 million in capital investments, such as replacing carbonation columns and installing effluent-treatment systems to adjust pH levels. By investing a total of \$24 million in these projects, the company has boosted capacity, lowered energy consumption, and improved resource efficiency, which together yield nearly \$3 million in additional revenue each year.

## Impact of CO<sub>2</sub> Emission Reduction at SSL's Soda Ash Plant



Financial gains, however, are only one aspect of what SSL has achieved by embracing efficient technology. Reducing emissions is an important highlight of the modernization program. By utilizing coal to its fullest potential and implementing other energy-efficiency measures, the plant has reduced carbon dioxide emissions by 92,000 tons annually, the equivalent of 20,000 cars. It has reduced emissions of sulphur dioxide (SO<sub>2</sub>) by 81%, nitrogen oxides (NOx) by 55%, and particulate matter by 76%. These reductions have substantially reduced the plant's adverse climate impact and significantly improved the company's long-term sustainability.

