LAWI
ENGINEERING

The LAWI *EtaComb®*

Advanced Firing Solutions for Biomass & Waste-to-Energy.

Energize your Waste.

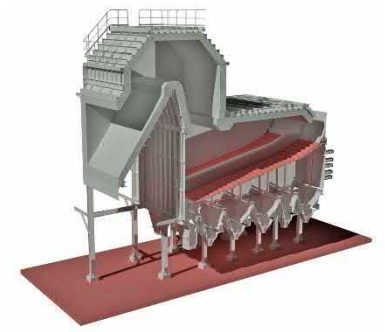
Secure Your Investment.

LAWI EtaComb®
Solid Fuel Firing Solutions

Unsurpassed fuel flexibility – from all kind of biomass to MSW, Industrial Waste, RDF, SRF, etc. Energizing Biomass and Waste since 1996. LAWI EtaComb® - For your perfect boiler island integration.

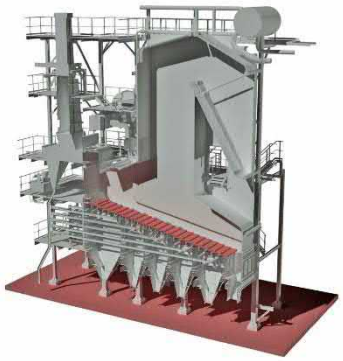
In a world of solid waste utilization such as agricultural biomass waste, biomass waste from the process industry, industrial waste, household waste or even biomass crops, variations in the fuel characteristics are common and unavoidable, and the quality of the fuel is often low. Utilizing such fuels efficiently and guaranteeing high operation reliability requires a great level of hands-on experience together with sophisticated understanding of the thermal process. Our approach of designating the combustion chamber to the combustion process and the boiler to the heat transfer and steam generation allows us to design and build power plants that fully comply with the engineering design data.

This fact enables us to provide our service reliability and efficiency to our clients, even where fuels substantially deviate from the original design specification to secure the economics of the project in all cases. That's the difference - that is what LAWI has been doing in the last decades & what LAWI will be doing in future!



EtaComb® Advance

LAWI's high efficiency multi-fuel combustion system in which the conversion of solid fuels to heat takes place in a controlled and isolated adiabatic combustion. The LAWI EtaComb® Advance is available with different design features and can be applied in various applications and industries.



EtaComb® Direct Firing

LAWI's answer to applications with high calorific value fuels, homogenous single fuels or limited space requirements. The LAWI EtaComb® Direct Firing system is designed to be integrated into steam boilers and thermo-oil boilers and allows a controlled combustion process within or partly within the boiler.

Applicable Fuels

All kind of biomasses (bagasse, EFB, rice husk, cassava, etc.)
Waste wood
Household / Municipal Solid Waste
Refuse Derived Fuels (RDF)
Solid Recovered Fuels (SRF)
Industrial Waste
Sewage Sludge

LAWI Benefits – Why LAWI?

Highest Efficiency through optimal Combustion

The adiabatic LAWI EtaComb® Combustion System with recirculation gas operates with maximum process stability on a very low excess air rate, keeping the oxygen content between 3-4% and guaranteeing complete burn-out of the fuel.

This results in a combustion efficiency of over 98% and CO emissions and unburned hydrocarbons on unsurpassed low rates. The very low excess air rate further leads to low exhaust gas flow rates and consequently minor heat losses, that can increase the overall boiler efficiency to more than 90%

Outstanding Multi-Fuel Application

From the first idea and stretch, the LAWI EtaComb® Combustion System has been designed with the focus to efficiently combust an outstanding range of fuel characteristics allowing highest possible operation flexibility.

With the LAWI EtaComb®, changes in the fuel characteristics – which are typical for any kind of waste fuels – are compensated by its adiabatic design and sophisticated application of recirculation gas. Thus, allowing stable flue gas flow, temperatures and heat transfer even when the fuel characteristics such as moisture or LHV are varying. Even hard-to-burn fuels such as high moisture fuels with water content of up to 65 % and a LHV down to 4,500 kJ/kg can be efficiently utilized with the LAWI EtaComb® Combustion System.

Last but not least, the extraordinary easiness of fuel flexibility allows potential increases in the fuel market prices to be compensated by switching to substitute fuels and therefore increasing overall investment security.

Low Maintenance and high Availability

LAWI's sophisticated German engineering and state-of-the-art heavy duty industrial design standards keep wear and tear on low levels and availability high.

Our proven process stability significantly reduces the thermal stress of the combustion and boiler equipment to minimum levels and therefore increases the lifetime of the equipment. A lifetime no-erosion guarantee of heat exchangers is made possible by the LAWI EtaComb® as well as reduced fly ash design through optimal flue gas velocity and retention time in the post-combustion chamber and boiler radiant chamber.

Combustion System The heart of every biomass and WtE power plants is the combustion – Over the last years of intense R&D we have combined our experience from nearly 30 years of designing multi-fuel combustion systems & incinerators and created the German patented LAWI EtaComb® of today, which was successfully installed in more than 50 projects in different countries across the world.

The LAWI EtaComb® hydraulically driven moving step grate system with grate segments arranged in the form of stairs is especially developed for the operation of different kind of solid wastes of inhomogeneous characteristics. Depending on the lower heating value of the fuel, the grate bars can be cooled using a water-cooling circuit, air cooling, or a combination of both. By selecting the appropriate cooling medium, the thermal and mechanical stress on the grate bars is significantly reduced. Consequently, this improves the plant availability and reduces maintenance costs.

Don't waste your waste.

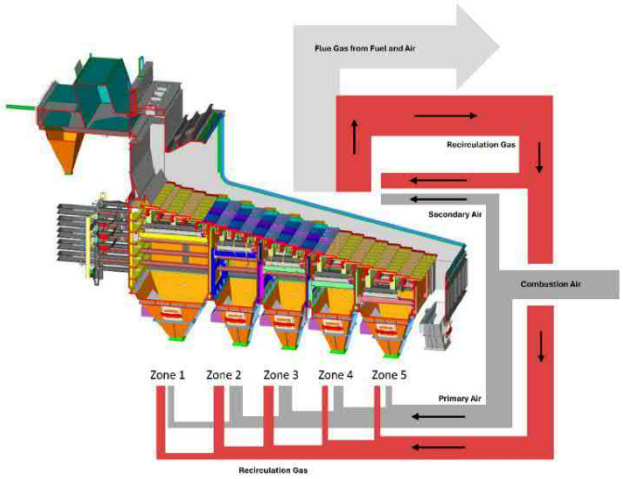
Make profit by utilizing it all.

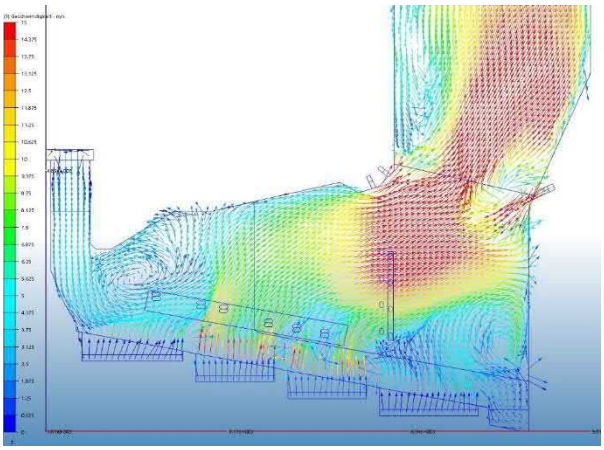
LAWI ADVANTAGES

Outstanding Multi-Fuel Application	▲ Efficiently combusting an outstanding range of fuel characteristics ▲ LHV Range of 4,500 – 26,000 kJ/kg ▲ Fuel moisture content of up to 65 % ▲ Large particle size variation
Highest Efficiency through optimal Combustion	▲ Combustion Efficiency of up to 98% ▲ Oxygen Content between 3-4% ▲ Very low unburnt content in ash, TOC <3% ▲ Overall Boiler Efficiency of more than 90%
Low Emissions	▲ Very low CO and VOC emissions ▲ Very low NOx emissions
Low Maintenance & high Availability	▲ sophisticated German engineering ▲ state-of-the-art heavy duty industrial design standard
Investment Security	▲ Reliable technology even for the most heterogeneous solid fuels ▲ Stable & consistent returns on investment

LAWI Flue Recirculation Gas System provides recirculated flue gas to combustion chamber to allow controlled and evenly distributed combustion at all stages. The LAWI EtaComb® operates on optimal air supply level with a very low excess air rate keeping the oxygen content 3-4 %.

This results in combustion efficiency over 98 % because CO emissions and unburned hydrocarbons are kept at very low rates. The very low excess air rate further leads to low exhaust gas flow rates and consequently minor heat losses that can increase the boiler efficiency up to 90 %.





Fuel Dosing System The LAWI fuel dosing provides a reliable and fully automated system, which allows trouble-free processing of feedstock into the combustion. This fuel dosing system is hydraulically driven, which allows independent feeding of each grate lane. It allows proceeding a wide range of feedstock and lead to full fuel control during the power plant operation.

3-Lane Fuel Dosing System

2-Lane Fuel Dosing System with Fuel Pusher

LAWI Moving Grates

The LAWI moving step grate design with multiple independent zones and a sophisticated zone-independent air distribution system allows a sufficient mixture of the fuel with air in each zone – from drying at the beginning of the grate, to the main combustion zone in the center of the grate and to the slag burnout at the end of the grate. The operation mode of the moving grates can be adjusted in relation to burning behavior as well as fuel size and bulk density.

Apart from the grate bars, the grate consists of grate carriages, support rollers, guiding tracks, guiding rollers, separation walls with moving grate base frame and casing as well as temperature and position instrumentation.

Grate movement is controlled by timer and piston position control via proximity switches.

LAWI Air-Cooled Moving Grate

LAWI Water-Cooled Moving Grate

Combustion efficiency

Boiler efficiency

Electric efficiency (gross)

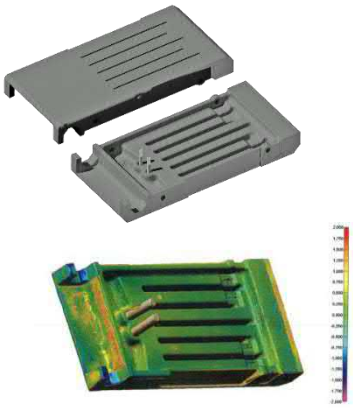
Essential Characteristics of the Air- & Water-Cooled Grate Bars

Air-Cooled Grate Bars

- Grate bars material with chromium content >26% and heat resistant up to 1200°C
- Grate bar width 150 mm, with lateral air slots
- Thermal grate load up to 0,75 MW/m2
- Smooth incineration due to high air gap ratio (6%) with dense air gap distribution with distance of 75 mm
- Low pass through of dust between the grate bars due to precisely defined air slots

Water-Cooled Grate Bars

- Grate bars material with chromium content >26% and heat resistant up to 1200°C
- Grate bar width 300 mm, with lateral air slots
- Thermal grate load up to 1,5 MW/m2
- Smooth incineration due to high air gap ratio (6%) with dense air gap distribution with distance of 60 mm
- Low pass through of dust between the grate bars due to precisely defined air slots
- Cooling water tubes are casted into the grate bar
- Pressure of water-cooling up to 10 bar



LAWI EtaComb® Product Features

Automated Radar-Controlled Fuel Dosing System
Fire Protection System
Moving Step Grate
Air & Gas Supply System
Refractory & Adiabatic Design
Post-Combustion Chamber
Advanced Automation System – LAWI EtaLogic®

Advance Combustion Control & LAWI EtaLogic® Process Optimization

The LAWI advanced combustion and boiler control system is particularly designed by LAWI for efficient and adaptable operation for a fully automatic operation and the result of decades of experience in the design of solid fuel firing and boiler systems.

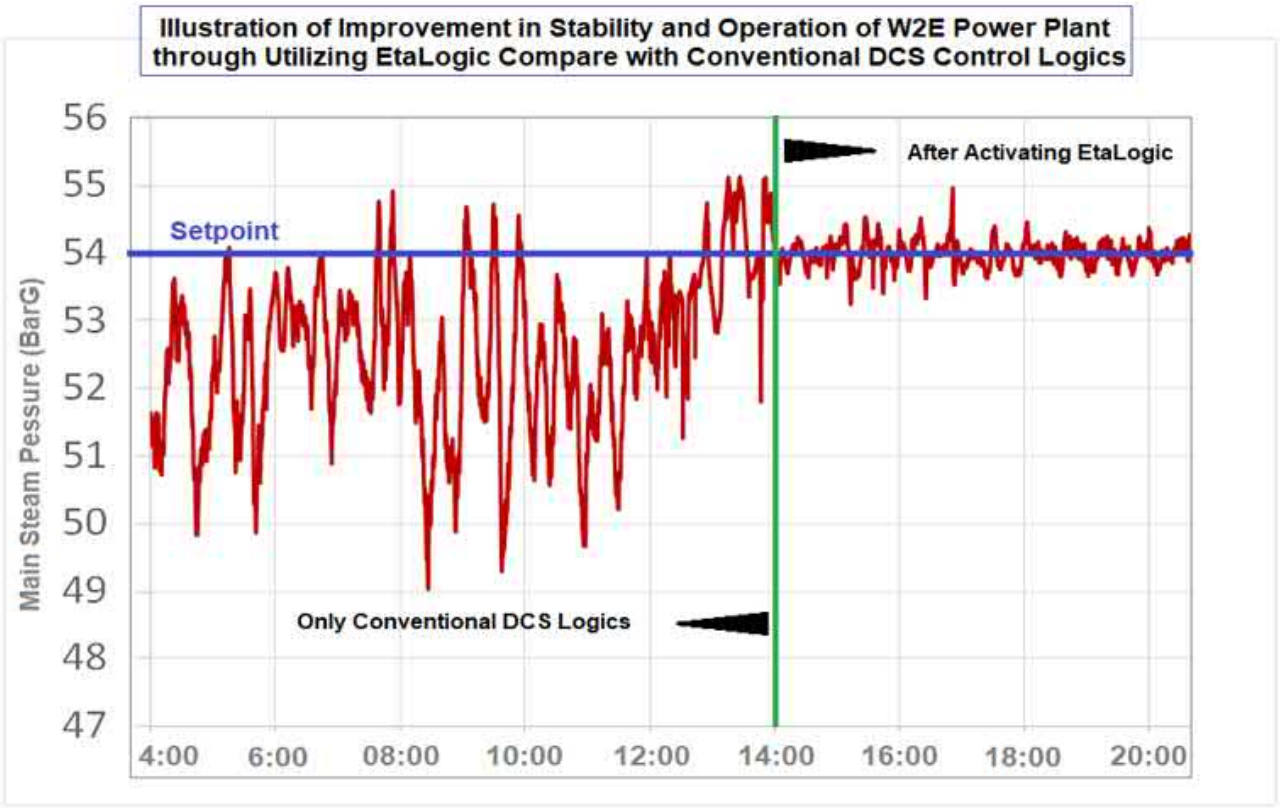
The LAWI control systems are specially developed for biomass combustions and incineration processes with the purpose of increasing reliability, stability and simplicity of operation of the plant. The control logics are based on advanced MPC adaptive controllers and apply the operators experience into a multi-dimensional (AI) control concept.

Together with the LAWI EtaLogic® process optimization system, the entire combustion and boiler process is stabilized at the setpoint values allowing the plants achieve highest level of stable, reliable and efficient operations with minimized need for manual interference even if fuel compositions are not constant.

The LAWI EtaLogic® optimization systema can also easily be integrated into existing power plants via direct communication with the existing DCS.

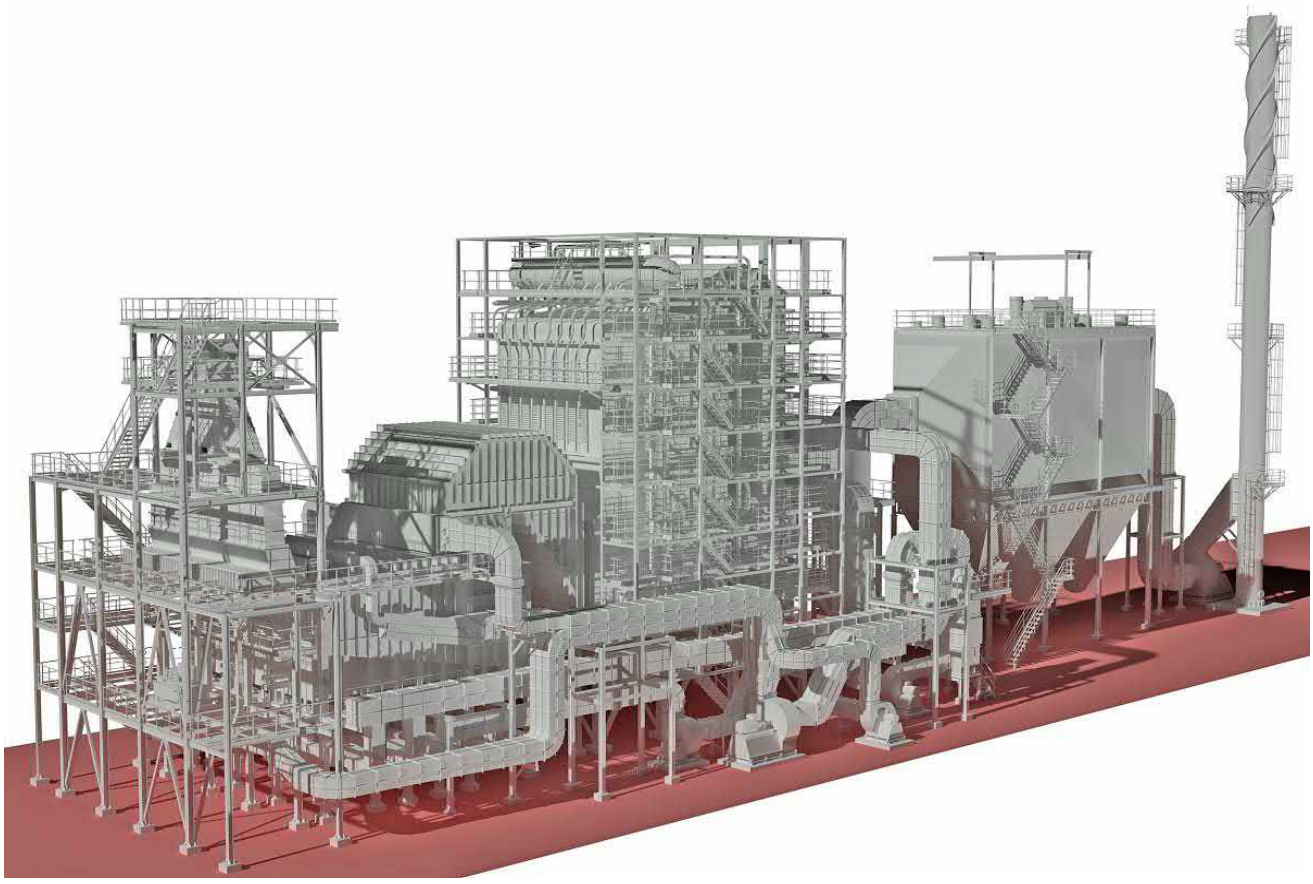
Renewable Power Plant Technology | Biomass & Waste to Energy | Engineered in Germany

25 +	50 +	100 %	445 MWe
Years of experience	Realized power plant projects	Projects successfully completed	Total installed capacity



Range of Application & Experience of LAWI Boiler Islands

	Biomass-to-Energy	*Waste-to-Energy*
Firing Capacity	20-120 MWth	10-60 MWth
Boiler Capacity Steam Output	approx. 20 -130 tph	10-65 tph
Power Generation	5-30 MWe	3-15 MWe
Saturated Steam	Yes	Yes
Superheated Steam	up to 515°C, 95 bar(a)	up to 450°C
Combustion Temperature	850-1,100°C	950-1,100°C
Oxygen Content (Flue Gas)	3-6% wet	3-6% wet
LHV Range	4.5-20 MJ/kg	7.5-26 MJ/kg
Fuel Moisture Range	up to 65%	up to 65%



LAWI EtaPlant® - Selected References

MULTI-FUEL BIOMASS POWER PLANT - 28MW$_e$

LAWI EtaComb®
COD: July 2020

Design Fuel: Rice Husk, Wood Chip, Bagasse, Wood Bark
Location: Suphan Buri, Thailand

TECHNICAL PROJECT DATA
Firing Design Capacity: 93.7 MW$_{th}$
Steam Boiler Design Data: 115 tph
68 bar(a), 485 °C
Generator Capacity: 28 MW$_{el}$

LAWI SCOPE OF SUPPLY: Overall Power Plant Basic Engineering, Owner's Consultant (Techn.), EP of LAWI EtaComb® 1000 with 6-lane adiabatic combustion system with post-combustion chamber, LAWI EtaLogic® Control & Optimization System

SRF & INDUSTRIAL WASTE POWER PLANT – 16.6 MW$_{th}$

LAWI EtaComb®
COD: June 2022

Design Fuel: Industrial Waste, SRF
Location: Yeoncheon, Korea

TECHNICAL PROJECT DATA
Firing Design Capacity: 16.6 MW$_{th}$
Steam Boiler Design Data: 20 tph
19 bar(a), 211 °C

LAWI SCOPE OF SUPPLY: Detail design & engineering of LAWI EtaPlant® boiler island, EP of LAWI EtaComb® with water-cooled moving grate, LAWI EtaLogic® control & optimization system (PLC)

BIOMASS POWER PLANT - 6MW$_e$

LAWI EtaPlant®
COD: June 2014

Design Fuel: Multi Fuel with Gliricidia as design fuel
Location: Mahiyangana, Sri Lanka

TECHNICAL PROJECT DATA
Firing Design Capacity: 27.5 MW$_{th}$
Steam Boiler Design Data: 32.9 tph
68 bar(a), 485 °C
Generator Capacity: 6 MW$_{el}$

LAWI SCOPE OF SUPPLY: Overall plant basic engineering, EP of LAWI EtaComb® 300 incl. fuel conveying and ash handling system, Owner's technical consultant.

….. to see further successful projects out of our extensive reference list visit **www.lawipower.com**

Consult with us and find out more about:

- **LAWI's flagship combustion system: the *EtaComb® - Advance***
  the ultimate multifuel furnace with optimal combustion & emission control.

- **LAWI's air cooled and water-cooled moving grate systems**
  your steps to a complete burn out of almost all high & low calorific solid fuels

- **LAWI's model predictive process optimization: The LAWI EtaLogic®**
  getting the world's best operator into your power plant - 24/7. Always assuring stable & efficient operation with minimum manual intervention

- **The LAWI EtaPlant® boiler islands**
  German designed solid fuel fired boiler technology. Reliably producing stable & efficient energy outputs with minimum shutdown times

- **LAWI's excellent track record and references**
  We are awaiting you: Come, consult us and visit our refence sites to convince yourself….

….. www.LAWIPOWER.com

or contact us directly sales@de.lawipower.com

LAWI EtaComb®
Firing Systems

LAWI EtaPlant®
Boiler Islands

LAWI EtaLogic®
Plant Optimization

LAWI Engineering &
Consultancy

LAWI Engineering GmbH
Siemensstr. 8
24118 Kiel
Germany

LAWI Engineering (Thailand) Co. Ltd
PLEX Bangna 90/177-178, Moo 15, Bang Na -Trad Road
Samutprakarn 10540
Thailand

info@de.lawipower.com