BIOFUEL PLANTS WITH A CAPACITY UP TO 20 MW
WELCOME TO JERNFORSEN

Our company has supplied bioenergy solutions to nearly 1000 satisfied customers across Europe for generations.

Our high standards, strong commitment and extensive knowledge will ensure the quality of your facility.

A large part of our customers are from the district heating sector and from the sawmill industry. A segment we have invested in during the last decade is smaller cogeneration plants (up to 5 MWe). The construction of pellet plants and turnkey projects are also a common feature of our everyday life.

We have worked closely with the Swedish university, Linné-universitetet, for almost 20 years. Our combustion system is continuously developed in collaboration with scientists and experts to meet increasingly stringent environmental requirements, and also to be able to offer you a facility with the market’s lowest operating cost.

We hope you find the following pages interesting, and we look forward to proposing the right energy solution for you.
Good environmental choice
From an environmental point of view biofuels are considered the most environmentally friendly fuels. There are no contaminants in natural wood and the ashes can be returned back to nature and thereby help to reduce fertilization.

Furthermore, biofuels are considered carbon neutral. The carbon dioxide produced during the combustion is taken up and bound by new plants in the plant lifecycle instead of contributing to the greenhouse effect.

Economy
Biofuel is the energy of the future as it makes local jobs possible, anything ranging from forest workers to the operations staff in the boiler rooms.

In Sweden alone, bio energy provides more than 24 000 jobs. Biofuels also provide tax revenue through an improved balance of trade.

The energy of the future
There are limited resources of oil and gas on our Earth but by using biofuels as a renewable energy source we are able to replace oil and gas in an environmentally conscious manner. Much of the electrical energy currently used by both industries and households can be replaced by green electricity from bioenergy.

In Sweden alone, bioenergy accounts for nearly 35% of our energy usage and it is increasing every year.

SOME STRONG ARGUMENTS FOR INVESTING IN BIOENERGY
IT IS NO COINCIDENCE THAT WE ARE THE BEST AT WHAT WE DO

High quality standards, the latest technology developments and passionately engaged engineers and service technicians.

A plant from Jernforsen is the most obvious choice for most of our customers ...

and the best part is that it is still true even after the plant has been in operation for decades.
A reliable plant
We consistently choose high quality components and can, therefore, build a plant that provides high reliability with high availability!

This results in longevity of our plants and the lowest operating costs for our customers.

Committed employees
Thanks to the great commitment of our employees, who also possess the best competence in combustion technology, we can always offer the most optimal solutions.

We are involved from the beginning of the project, either as sub-contractors for our part of the boiler plant, or as a turnkey contractor. We are then responsible for all subcontractors such as the construction workers, electrical and pipe fitters.

The advantage for our customers is that the project becomes easier to handle since there is only one party to deal with. We always feel very passionate about what we do.

Technological development
We are regarded as the company at the forefront of technology development thanks to our extensive experience and constant desire to improve.

Having close contact with our customers gives us the possibility to take in viewpoints from different operating conditions, which in turn leads to a continuous development of our energy system.

The combustion system
Sizeable grates, the development of our air system combined with a long combustion time result in generating the lowest emissions. This means that we meet the regulatory requirements for NOx, CO and dust.

Our development cooperation with Växjö University also contributes to the continuous development of our combustion system. In addition to low emissions it provides the advantages of high efficiency and world-class operating costs.

Automation and control systems
We can always optimize our system due to the fact that we have our own staff within automation and control. In addition, we always use the latest technology in order to fine-tune and optimize the combustion.

With modern technology and the communication possibilities available today, we can provide our customers support at any time of the day. Today we are able to remotely control the entire plant.

The service organization
The service organization is well developed. Whether the customer chooses to sign a service agreement or contact us when needed, we have the resources necessary to be there when the customer needs it the most.

Our combustion system is not tied to any particular control system but is adapted entirely to the customer’s needs.
The energy systems can be divided into three categories CHP, district heating and industrial plants.

We have through our extensive experience developed systems to optimize the solutions to meet your needs and requirements, anything ranging from fuel qualities to the operation-specific data required in your particular system.

Regardless of what energy system you need, the plant is built around the combustion equipment.

At the core of the combustion is our moving grate system. The grates are controlled by a forward movement, which moves the fuel forward gradually as it burns.

At the end of the process there is a final combustion of the ash prior to being transported to the ash container. In connection with the grate movement we also add air, primary and secondary, so as to optimize the combustion before it goes into the pressure vessel. The hot gas is now ready to be transformed into the energy that best fits your process - Which depends on what process you have.
Our combustion system is optimized for a CHP plant. A high pressure boiler is attached to our furnace and can, depending on the steam need, produce steam up to 25 tonnes / h and 480 °C in one or two stages.

The boiler design is our own and it is optimized to meet the technical data in balance with the investment cost.

The high pressure steam is led to the turbine, which can be a one or two stage turbine, depending on your needs. The system is optimized depending on the choice of back pressure or condensation design.
DISTRICT HEATING

Many of our customers are district heating operators where efficiency and environmental constraints are the key factors for low operating costs. In these systems we try to, in most cases, build in a flue gas condenser to increase the efficiency of the plant.

The advantage of this is low emissions and if the regulatory requirements are extremely high then we can also supplement these facilities with further flue gas cleaning equipment to meet the needs.

Like in the other systems, the combustion equipment is fundamental and it is developed in the same robust and reliable manner as in the other systems.
SAWMILLING AND PROCESSING INDUSTRIES

The stringent requirements of the sawmill and processing industries put extremely high demands on the equipment to be designed to withstand the harshest environments.

Our systems are robustly built in order to always have high availability with only scheduled stops for service and maintenance.

We have especially focused on developing fuel-handling systems that can handle the extreme fuel qualities that may occur in this industry, in order to eliminate unplanned downtime of the plant.
Drying Plant

For more than 25 years we have delivered combustion systems for dryers where our customers dry everything from sawdust for pellet production to grass which is pelleted and used during winter as livestock feed.

Our drying plants are designed to either provide the drying systems with hot raw gas between 300-500°C or to steam systems that supply belt dryers or converted drum dryers with energy. In this case the demands are high on the final dried product that it is of an evenly dried quality e.g. before being pelleted.

Our combustion system is part of the same series as the other energy systems, but in these applications the requirements are a little different on the temperature control of the hot gases. This means that our control systems play an important role in the design of a drying plant.
THE EMISSION REQUIREMENT FROM THE AUTHORITIES HAS BEEN TIGHTENED DRAMATICALLY IN THE LAST 10 YEARS

This means that we at Jernforsen also provide equipment for flue gas cleaning for our plants. This is done through three different technologies in order to meet our customers’ financial needs and the regulatory requirements.

### MULTICYCLONE

This technology consists of a mechanical separation in which the coarsest particles are separated. By using the centrifugal force that is generated in each small cyclone, the particles are hurled against the wall and thus separated from the flue gas.

The efficiency is high, but separating the finest particles is extremely difficult since the weight of each particle is too small to be separated from the flue gas.

The operating cost is extremely low since the cyclone is completely mechanical apart from the dust lock under the cyclone.

Depending on the type of fuel we can treat dust levels down to 150 mg/Nm³.

### ELECTROSTATIC PRECIPITATORS

Plants placed near urban areas demand an additional purification step in addition to the multicyclone in most cases.

The gases are led into a large chamber and by reducing the velocity as well as charging the fine particles electrically with negative voltage from the electrodes; a movement is created towards the positive pole, which consists of the discharge electrodes. The dust particles are thus stuck on the electrodes, which are cleaned through the process of a hammer hitting the electrodes causing the particles to fall to the bottom of the electrostatic filter for further transportation to the ash container.

Our electrostatic filters have high separation efficiency, high operational availability and good service spaces. They are best used where the dust requirements are between 10-150 mg/Nm³.

### FLUEGAS CONDENSATION

In collaboration with several leading suppliers of fluegas condensation, we can offer an integrated solution for those situations when this technology is appropriate.

In this process the remaining energy in the fluegas is used. It is passed through a scrubber, which is used to both recover the energy in the fluegas and as a washer to reduce the level of particles.

The energy is transferred via a heat exchanger to other systems while the dust is separated from the water through water treatment.

Depending on the conditions, the heat recovery can be about 25% of the boiler capacity and the dust emission down to about 30 mg/Nm³.
Ever since the inception in 1984, the electrical design and programming have been performed in-house. Our electrical engineers and programmers follow the progress of the projects starting at the very beginning with sales support and all the way up to the final installation.

However, the commitment does not stop here but continues throughout the lifetime of the plant in the form of troubleshooting support and advice. The feedback we get helps us build up experience and an invaluable knowledge base within the company.

WE OFFER LIFETIME SUPPORT AND GUIDANCE FOR THE PLANT
We continually pursue high safety, good accessibility and user-friendly interfaces for the operational staff. Jernforsen holds a certificate of internal control of safety circuits for our boilers, in compliance with European PED Module B + D.

CONTROL SYSTEMS

From having only done the control systems for our own boilers, we can today commit ourselves to making complete control systems for entire plants and boiler rooms. We can also provide consultative assistance in the design and planning of the layout of the systems for both hot water and steam.

The control systems we use are mainly:
- Mitsubishi, Melsec serie Q
- Siemens, Simatic S7 300
- ABB, AC 800M
- ABB, Freelance AC 800 F

OPERATING SYSTEMS

The operating interface mostly consists of an operating computer today. The operating systems in these computers are, in most cases, Citect Scada, but we can also offer other systems such as iFIX and WinCC (Siemens). In those cases where the ABB Freelance is used as a control system, the operating system of the computer is also ABB Freelance, because it is a so called DCS system.

For the smaller plant, an operator panel could be an alternative to an operating computer. Here we mainly offer Beijer Electronics or Siemens panels.
OUR WORKFLOW IS A WELL-TRIED PROCESS

We offer a quality assured workflow, well tested over decades regardless if you choose a hardware or turnkey contract.

Contact
When you contact us, our sales organization will give you a presentation of the layout and time-table for the project.

Project meetings
A number of project meetings take place, where we go through all the stages step by step with the customer.

These meetings give our clients the opportunity to discuss their needs and to take part of the technical skills of our project managers and designers.

Construction and assembly
Our engineers always focus on the best reliability and longevity. There is no skimping on material costs or capacity!

Time plan
From the time the construction starts and onwards the time plan obviously varies depending on the capacity and the technology of the facility. On the next page parts of the time plan for a Swedish district heating plant, 8 MW are shown. In this specific case, the plant was operational after just over 1 year.

Start-up
One of Jernforsen’s strengths is a well-planned and effective start-up. Only three weeks are needed to become operational, which means:

1. Function test
   Inspection of all parts and pairings. Inspection and testing of the automation and control system.

2. Refractory drying
   Gradual start-up/heating of the furnace.

3. Initial start-up
   The entire process is co-ordinated and run e.g. together with the district heating system the plant has been connected to.

   The plant is now in operation and at an appropriate time in the following 2-4 weeks an inspection takes place. A performance test is carried out to ensure the efficiency (MW) and the environmental requirements.
TIME PLAN

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Planning machine</td>
<td>40 days</td>
<td>8/8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Construction</td>
<td>31 days</td>
<td>1/9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engine Bearing Lift-in</td>
<td>5 days</td>
<td>20/4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>- Assembly</td>
<td>10 days</td>
<td>1/6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Delivery of automation equipment</td>
<td>2 days</td>
<td>18/6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complementary Mechanical equipment</td>
<td>15 days</td>
<td>31/8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>External electrical components, Assembly</td>
<td>5 days</td>
<td>18/6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Process piping, Prefabrication</td>
<td>20 days</td>
<td>13/4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Electricity, Process electricity</td>
<td>30 days</td>
<td>15/6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Function test</td>
<td>10 days</td>
<td>17/8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Refractory drying</td>
<td>4 days</td>
<td>31/8</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trimming</td>
<td>25 days</td>
<td>4/9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Trial operation, performance test</td>
<td>30 days</td>
<td>15/10</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Final inspection, takeover</td>
<td>2 days</td>
<td>15/12</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heat generation bio boiler</td>
<td>74 days</td>
<td>4/9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

TURNKEY CONTRACT

At Jernforsen we are focusing more and more on providing our customer with an overall solution.

Jernforsen offers turnkey deliveries. During 15 years of successful operation Jernforsen has delivered some 50 plants where we have been responsible for land, construction, process piping and electrical works up to the complete plant.

Jernforsen delivers turnkey plants, which are based on system solutions with optimal technology, function and economy up to an operational facility with a performance guarantee. 25 years of experience in project coordination ensures this.

Jernforsen is responsible for all coordination at both the planning and execution stage; and you, the customer, will already know at the start what the final cost will be.

Moreover, a turnkey contract means that the duration of the project is reduced substantially, the consultant costs are minimized and the risk of a "slip through the net" is removed since the coordination responsibility rests entirely with Jernforsen.
Since the combustion technologies are constantly evolving we also have a separate department for the exchange of control systems. A tremendous advantage for our customers when it is time for your plant to be upgraded.

Having visited you we can offer a quote for a new control system for your plant and plan changes with you on the spot. – We do everything in every situation to minimize the downtime.

We look forward to a long-term cooperation the day you choose Jernforsen. Therefore it is particularly important to us that our service organization is always available for you, whether it is Monday morning or Christmas Eve.

**SUPPORT & SERVICE**

Our service organization has many years’ experience of inspection, service and technical support.

Since we have gathered all the service skills within Jernforsen we can always provide maximized service to our customers.

Each technician has a fully equipped service truck with spare parts so that each service and inspection is as effective as possible, in order to have the highest possible availability at your plant.

Most of our components are standard and are available in stock for immediate delivery. The parts that need to be custom made are produced in-house usually on the same day as your order.
I had no prior experience of this kind of plant and it was a tough start, lightening struck during the start-up phase. At that point the electrical work was not yet finished as the electrician had not yet grounded the plant. The lightening strike therefore resulted in some of the automation being wiped out and the plant stopped.

I called Jernforsen’s Electrical Engineer Håkan at 8 in the evening. He was at his son’s football practise, but he answered the phone anyway and helped us troubleshoot. The plant was operative again after a few hours.

Jernforsen has given us very good service and taught us how to operate the plant in the best way.

CUSTOMER REVIEWS

"The customer support at Jernforsen is exceptional!

We have had several different solutions over the years but never before experienced the high standards that Jernforsen delivers. As a result of the close contact we have had with the project leader in the mechanical and electrical department, we have never lacked assistance or support.

On a special occasion, we had to call on a Saturday night at 3:15am to ask a question regarding our control system which had received a blow in an autumn storm. I received a very rapid response, and the system was restored already at 3:45am. Unbelievable .... what dedication!

Working with a company that you know possesses the skills and that always responds when asked, is a huge security for us who operate the plant. I am pleased we decided to use Jernforsen when we invested in a new plant.”

Per Johan Johansson,
Lessebo district heating, Sweden

Whenever we have a problem and call Jernforsen, there is always a pleasant and experienced person who gives us tips and advice. This service is extremely valuable to us running the plant and we have learned an incredible amount from the people at Jernforsen.

We have been running the plant for seven years now, and we have not had any unexpected shutdowns. We only need to shut down the boiler for three weeks in July for inspection and maintenance. Jernforsen also supply spare parts very quickly. If we make the order one day, the package will be delivered in the mail in Charlottenberg the next.

We hardly ever need to do any maintenance, which proves that we have a solid and reliable facility.

Eidskog Nutrition Service KF is very pleased with Jernforsen as a supplier of our 5 MW bioplant. I have really learned a lot from Jernforsen’s professional team during these ten years the plant has been in operation.”

Roald Bodding, Eidskog district heating, Norway
“As one of the largest investors in the biofuel-based heating

we feel confident using Jernforsen Energy Systems as a supplier of fuel handling and combustion equipment for Elmeverket in Älmhult. Our experience is that Jernforsen’s construction and operation meet our high standards. It is also clear that the employees at Jernforsen are very accustomed to dealing with this type of project. Their expertise and professionalism will benefit us for many years to come.

Our regulatory requirements and their own environmental goals here in Älmhult are ambitious and it is one of the reasons that we chose Jernforsen, as well as their substantial reference list of facilities that meet the requirements from authorities and customers."

Magnus Emanuelsson, E-on
“I have been working together with Jernforsen for setting up the pellet production factory of Latgran in Kraslava (Latvia).

Jernforsen was responsible for supply of wood biomass combustion furnace, steam generation system, as well as fuel and material handling equipment.

Support and cooperativeness have been experienced during all phases of the project, starting with general layout configuration, erection of the plant during toughest winter conditions in 2011, putting plant in operation, training of personal and final commissioning. All the faults of any kind (minor in our case) have been acknowledged and fixed in shortest possible time.

Engineers of Jernforsen still keep an eye on the major combustion processes in the furnace remotely and advice the operators if needed. They know how to get energy out of woody biomass in most efficient way!”

Ilmars Kass, project manager, SIA Latgran
Authorized Dealer:

Biomass Systems Supply
P.O. Box 1835 * Chico, CA  95927
Toll Free: 877-474-5521
Office: 530-893-2444