

# BIOMASS COMBUSTION BOILERS



Dear Customer,

Allow me to begin with a quote from Tomáš Baťa, one of this country's greatest visionaries: "We have simply been lent our lives with the obligation of giving back more for the benefit of posterity." This is what our business has been trying to achieve step by step. Indeed, if a company wants to stand out, it should first start with itself and the members of its staff who possess the greatest know-how and chance of every success.

Step TRUTNOV offers the latest advances in biomass boilers with an emphasis on economic return and fundamental environmental care. It is my belief that you will be impressed by this example of our work and be willing to meet to discuss new projects, thereby contributing to further development of this green technology. Only then can we proudly say that one day our joint thoughts, visions and ideas have helped improve the living standards of future generations.

Libor Pavlíček, MBA  
CEO & Chairman of the Board of Directors

## AWARDS WE HAVE RECEIVED



# BIOMASS COMBUSTION BOILERS

## ⊙ GENERAL DESCRIPTION OF THE BOILERS

As a common feature, each type of boiler system consists of a combustion chamber placed above an overfeed stoker, underfeed stoker or a solid grate, and a vertical or horizontal exchanger. There is also a water-tube membrane combustion chamber. During instances of lower capacity, the chamber is only cooled by combustion air. The front part includes an inlet fuel neck. The fuel is forced via a hydraulic or

screw feeder above the front part of the grate. The inlet neck is heated by hot water, whereby which the fuel undergoes pre-drying.

The boilers are supplied with all fittings, including insulation and metal sheeting. Ashes can be cleared from the boiler at the end of the grate by a screw conveyor. Flue gases flow out of the combustion chamber into a vertical/horizontal flue gas section of the boiler. The flue gas outlet from the exchanger can be tailored to the location of the boiler room according to individual plans.



**1/** An example of reference boiler plants for burning whole bales of straw, hay, flax, pressed paper boxes, etc. can be found in Častrov u Pelhřimova. In addition to the Gold Product Award of Česká stavební akademie [Czech Construction Academy], Step TRUTNOV is the holder of **Gold Stevie® Award 2012**, Bronze **Stevie® Award 2013** and others.



**2/** Wood chips



**3/** Round bales of hay



**4/** Rectangular bales of straw or hay

## BOILERS FOR BURNING WHOLE BALES OF STRAW

rapeseed & cereal straw | hemp | Uteusha energy sorrel  
Type and capacity range: **STEP-KS 100 ÷ 1 000 kW**

## BOILERS

Two basic types exist that enable whole bales of any plant product to be burnt without prior splitting and cutting: biomass boilers with the power output ranging from 100 to 1,000 kW, which can burn bales in a vertical position, and biomass boilers of outputs ranging from 600 to 5,000 kW, where whole bales of straw, hay and other plant-based fuel is incinerated in a horizontal position, whilst other options include warm-water, hot-water, steam or hot-air boilers and provide the possibility of generating electricity.

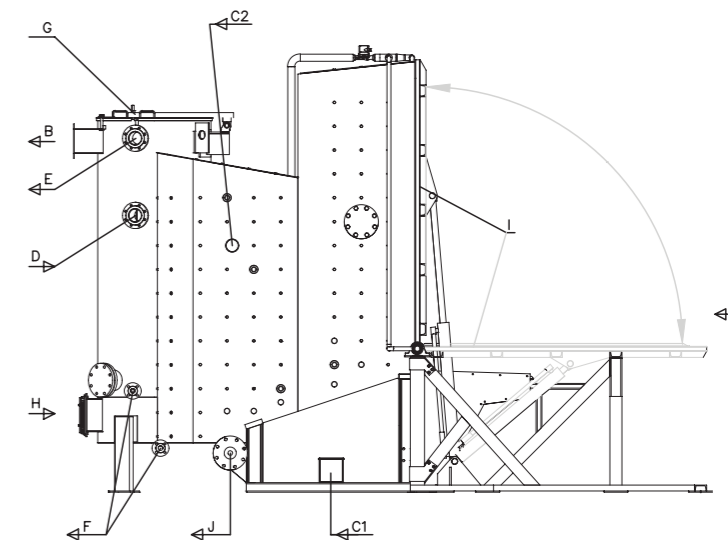
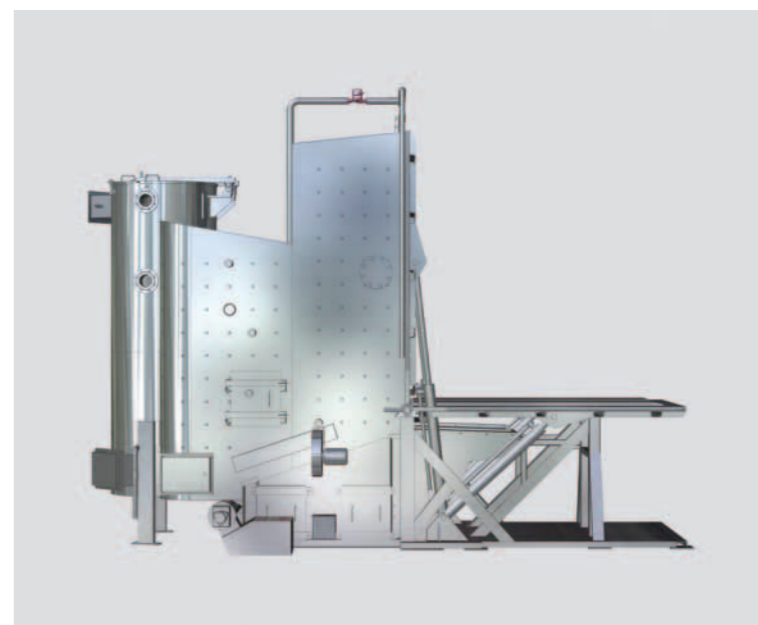
### BOILERS FOR STRAW BALES, CAPACITY RANGE 100 TO 1 000 KW

STEP-KS BOILER PARAMETERS; WARM-WATER TYPE						
Boiler capacity	kW	100	175	350	600	1,000

## ⊙ BOILER CLASSIFICATION ACCORDING TO FUEL

The catalogue describes the company's boilers by fuel type. The first part includes new and completely unique boiler designs, allowing whole bales of plant biomass to be burnt without splitting or cutting them first, which saves electricity in the order of tens of kW per hour compared to types requiring bales to be split. This new method for firing whole bales has proven useful, especially recently, when there is an increased interest in energy plants based on burning techniques. For agriculture, this chiefly involves burning hay that is harvested from permanent grasslands and pastures. Incinerating whole bales also permits the use of fuels such as bales of maize straw, flax and others that can be baled, with existing agricultural technology, whilst still in the field once the crops have been harvested. These types of fuel have yet to be exploited due to a lack of mid-capacity boiler designs that would allow such materials to be burnt while complying with emission limits.

The company also offers boilers for burning wood waste, such as wood chips, mixed sawdust and wood shavings as well as grain of cereals.

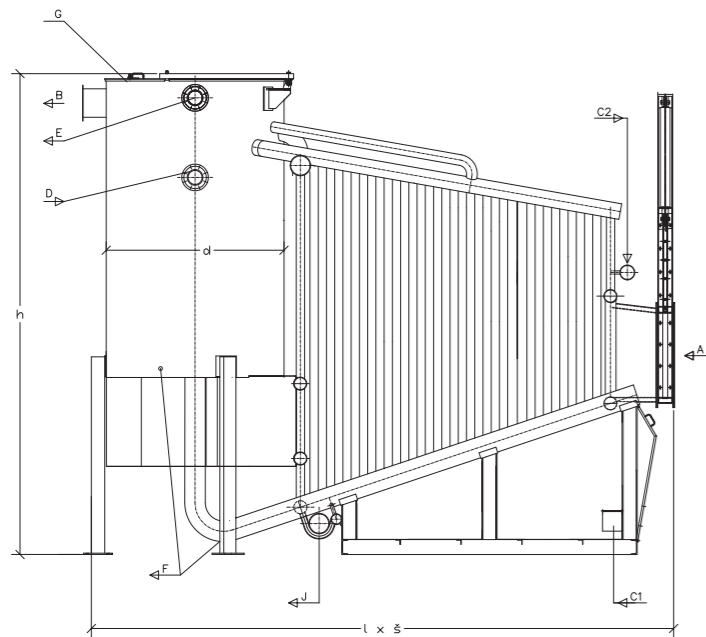


### CAPTIONS

- A** Fuel input
- B** Flue gas outlet
- C1** Combustion air inlet (primary)
- C2** Combustion air inlet (secondary)
- D** Heating water inlet
- E** Heating water outlet
- F** Draining
- G** Gate (tube cleaning)
- H** Inspection door
- I** Tilting cover
- J** Ashes output

# BOILERS FOR BURNING WHOLE BALES OF STRAW

rapeseed & cereal straw | hemp | Uteusha energy sorrel  
 Type and capacity range: **STEP-KS 600 ÷ 5 000 kW**



## ☉ FUELS

In terms of fuel utilisation, the boilers form two groups according to type of biomass:

- 1/ Boilers for a mixture of sawdust, edgings, bark, wood chips, wood waste, peats, fermented mixtures and others.
- 2/ Boilers for burning bales of rapeseed, cereal and maize straw, hemp, hay, Uteusha energy crop and others.

## CAPTIONS

- A Fuel input
- B Flue gas outlet
- C1 Combustion air inlet (primary)
- C2 Combustion air inlet (secondary)
- D Heating water inlet
- E Heating water outlet
- F Draining
- G Gate (tube cleaning)
- J Ashes output



# BOILERS FOR BURNING WOOD CHIPS

mixtures of sawdust | strips | bark | shavings | forest or industrial wood chips, et.  
 Type and capacity range: **STEP-KB 600 ÷ 5 000 kW**

## BOILERS OF 600 TO 5 000 kW CAPACITY

STEP-KS + STEP-KB BOILERS PARAMETERS; WARM-WATER TYPE

Capacity	kW	600	1,000	1,500	2,000	2,500	3,000	4,000	5,000
Length	m	4,9	5,4	5,8	6,2	6,5	6,8	7,2	7,6
Width	m	2,1	2,1	2,1	2,1	2,5	2,5	3,0	3,0
Height	m	4,5	4,5	4,7	5,1	5,4	5,7	6,1	6,5
Weight	kg	12,400	13,200	14,000	14,800	16,500	18,400	20,900	24,100



## ☉ TRANSPORT OF FUEL

1/ For baled biomass boilers, there are several options of fuel transport design, one of which using a belt conveyor and overfeed stoker. Both of the devices are located in the fuel depot. The operator puts each bale of straw on the belt conveyor, using, for example, a fork lift truck. The conveyor feeds the bales onto the overfeed stoker that is fitted with a sensor monitoring the presence of a straw bale, which in turn gives a command to stop the feeding motion of the conveyor belt once the filling operation has been completed. Each time before the bale is inserted into the boiler, a water-cooled closure is automatically first opened and then closed immediately once the bale has been inserted. The whole process of inserting the fuel into the boiler, as well as its subsequent feeding into the furnace, is fully automated and based on the requirements of custom-built boiler operating systems. This method of feeding a whole bale into the boiler chamber can save a considerable amount of electricity, making it unnecessary to split straw bales, an operation required by recent boiler technologies that used to amount to dozens of kW per hour.



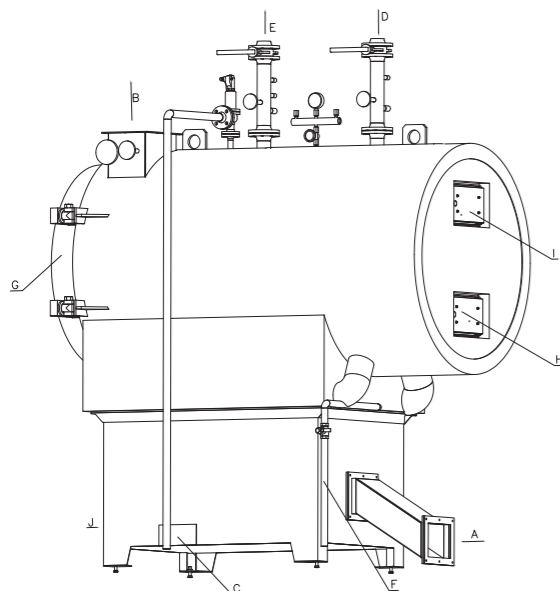
# BOILERS FOR BURNING WOOD CHIPS

mixtures of sawdust | strips | bark | shavings | forest wood chips et.  
Type and capacity range: **STEP-KB 100 ÷ 1 000 kW**

## BOILERS FOR WOOD CHIPS, CAPACITY RANGE 100 TO 1 000 kW

STEP-KB BOILER PARAMETERS; WARM-WATER TYPE

Boiler capacity	kW	100	190	300	400	500	600	800	1,000
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### ⊙ TRANSPORTING FUEL

2/ In boilers with lower outputs, bales of biomass are fed into the open boiler gate by hand or using a simple mechanism. In mixtures containing sawdust, strips, bark, wood chips, shavings etc., the transport of the fuel from the silo is employing the alternating motion of an axial feeding bar fitted with a large number of conveyance wedges. The feeding bar is driven by a hydraulic cylinder. Within hydraulic feeders, i.e. transporting fuel using pistons, the machinery operates on the same principle as that of carrying the fuel out of the silo, which is incorporated into the control circuit of the boiler.

#### CAPTIONS

- A Fuel input
- B Flue gas outlet
- C Combustion air inlet (primary/secondary)
- D Heating water inlet
- E Heating water outlet
- F Draining
- G Gate (tube cleaning)
- H Inspection door I
- I Inspection door II
- J Ash collection door

# HAND-STOKED BOILERS FOR SMALL BALES OF BIOMASS

straw | hay | flax and energy crops  
Type and capacity range: **STEP-KC 100 and 190 kW**

### 1/ Use

This equipment for biomass combustion (burning whole round/rectangular bales of straw) is designed to heat small buildings (industrial facilities, municipal heating plants, agricultural buildings, operational premises, etc.). The furnace can also be adapted for burning pieces of wood.

### 2/ Type of boiler

The boilers are available as warm-water type boilers and operate at maximum working pressure 2.0 bar, while the maximum working temperature is 100°C.

### 4/ Boiler layout STEP-KC 190 kW



### 6/ Operation and control

#### STEP-KC 100 kW

Combustion in the boiler is controlled by a draught controller (direct-acting thermostatic valve), which controls the valves supplying combustion air into the furnace. Inlet openings with these valves supplying combustion air are located at the top and bottom of the front door. The boiler comes with a cooling device in case of overheating.

#### STEP-KC 190 kW

Combustion in the boiler is based on forced exhaust and/or combustion air supply. The boiler is equipped with an operating temperature controller, which, once the preset values of water temperature (90 °C) have been reached, closes the inlet openings for the combustion air supply. The boiler comes with a cooling device in case of overheating.

### 3/ Boiler layout STEP-KC 100 kW



### 7/ Fuel

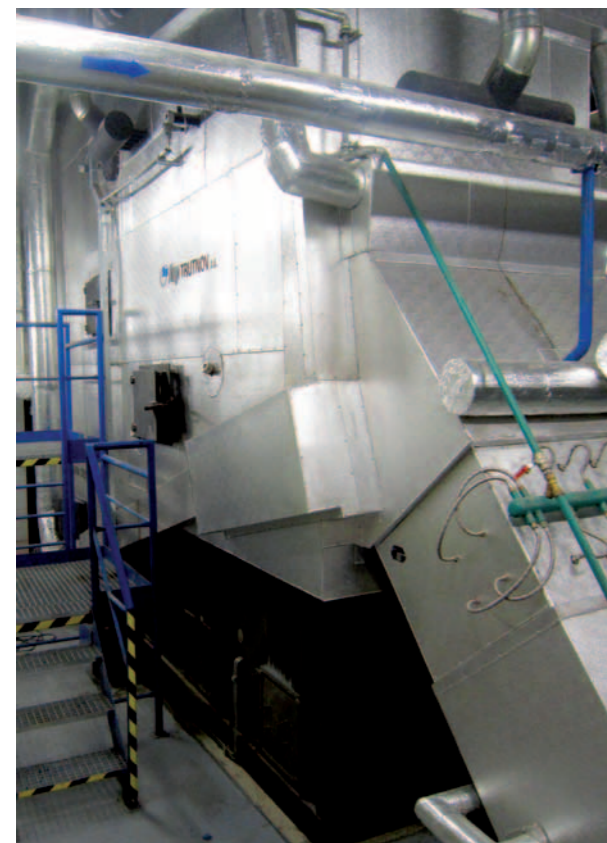
The boilers can burn straw as well as wood. Specification of straw: round/rectangular bales of straw (rapeseed straw, wheat straw, hemp straw, Uteusha energy crop), max. humidity 16%, low to medium compression. Burning sawdust and shavings is not recommended, instead automatic boilers should be used for such materials.

### ⊙ CONTROL AND REGULATION

In automated boilers, the boiler output is regulated automatically and continuously scanned. It is determined by the value of the combustion chamber vacuum, as well as by the number of batches of fuel fed into the combustion chamber depending on the temperature of the boiler output's water. The slave fan is controlled according to a frequency converter depending on the oxygen level in the flue gas (this applies to boilers with higher outputs). The exhaust fan placed on the flue gas outlet controls the vacuum set in the chamber, based on the frequency converter.

### 5/ Boiler description

The STEP-KC boiler consists of a water-cooled furnace with a cylindrical combustion chamber and a vertical flue gas exchanger (KC 100) and a horizontal exchanger (KC 190). In the front part of the boiler are circular gates that permit bales of straw to be manually stoked easily into the combustion chamber. The flue gas outlet is located at the top of the rear part. The boilers come with mandatory fittings, insulation and metal sheeting.



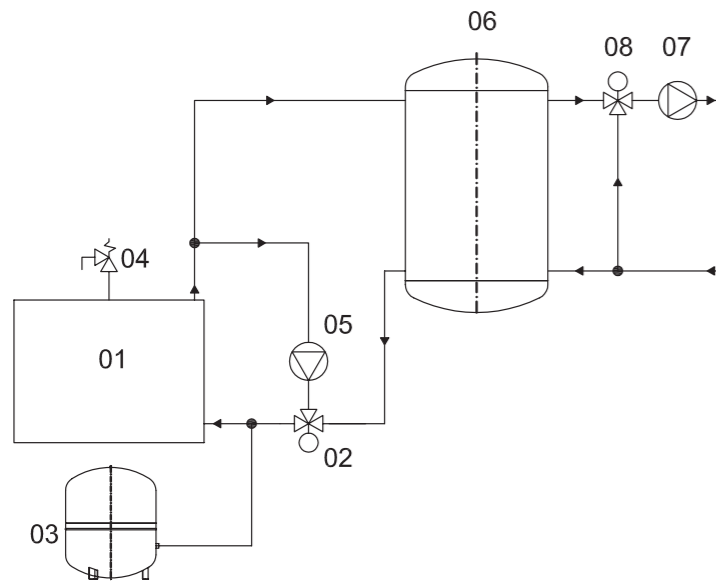
**8/ Clearing ash and cleaning**

Ash is collected from the furnace manually via the open front door using an ash scraper and loaded into a container and put aside. When burning straw, ash removal from the furnace is recommended every 7-10 days.

**9/ Instructions for installation**

The boiler comes with instructions for installation, operation and maintenance, describing everything in detail. The manufacturer recommends installing a storage reservoir as part of the heating system (see Recommended boiler mounting diagram).

**STEP-KC BOILER MOUNTING DIAGRAM - CLOSED EXPANSION VESSEL**



**BOILER OPTIONS AND USE**

Boilers are manufactured depending on the capacity required and form of fuel/biomass requested by the client; the basic types include warm-water boilers, hot-water boilers and steam boilers, which may or may not feature steam super heaters. Such biomass boilers can be used not only to produce heat, but also to generate electricity. In addition, a hot-air type can be designed for combustion chambers. The types of biomass boilers listed above are principally used for heating buildings with large heating demands, like industrial facilities, district heating, municipal heat plants, agricultural buildings, hotels, premises, etc. Small-size (100-190 kW) boilers fed manually find application at farming homesteads, hotels, etc.

**CAPTIONS**

- 01 STEP-KC boiler
- 02 Flue gas exchanger
- 03 Closed expansion vessel
- 04 Safety valve  $p_o = 2.0$  bar
- 05 Boiler circuit pump
- 06 Storage reservoir
- 07 Circulation pump
- 08 Mixing valve

**ADDITIONAL TECHNICAL INFORMATION**

The thermal efficiency of automatic boilers is 85-90% at a flue gas temperature of 175 to 180°C. In warm-water boilers, the output temperature ranges up to 110°C at a normal pressure of 6 bar, while in hot-water and steam boilers it is based on the specifications for the same. Fuel consumption is generally 45 kg per 100 kW for wood chips with moisture of up to 40%; the fuel consumption for straw is 29 kg per 100 kW and a water content of up to 20%.

**BOILERS WITH AN ELECTRICITY GENERATION OPTION**

For all types of biomass listed above the output parameters of steam or hot water produced by industrial boilers can be adapted for combined generation of heat and electricity. These can be project specific, according to local operating conditions, but only projects with year-round use of heat can be effective. The sale and use of electricity from renewable sources has been increasingly promoted in a number of countries around the globe.

**TECHNOLOGY FOR GENERATING ELECTRICITY FROM BIOMASS**

Generating electricity from biomass presents an attractive technology in terms of economy for combined heat and power generation. Generally speaking, it is one of the possible variants of using energy of biomass as a renewable source.

**The application of biomass boilers and technology to generate electricity - principles:**

- 1/ Combined production of electricity and steam for one's own use
- 2/ The use of waste heat for one's own consumption

Three possible solutions for combined production of electricity and heat from biomass - STEP CC (Condensing cycle). Lower power output of sources shall be treated per case.

The quantity of electricity produced	STEP-CC 500 kW <sub>el</sub>	STEP-CC 1,000 kW <sub>el</sub>	STEP-CC 1,500 kW <sub>el</sub>
<b>Step steam boiler</b>			
Installed capacity of the steam boiler (kg of steam per hr)	6,400	2 × 6,400	2 × 6,400
Design pressure of the steam boiler (bar)	16	16	32
Total electric power output on terminals (kW)	585	1,170	1,500



## TECHNOLOGY FOR GENERATING ELECTRICITY FROM BIOMASS

### Biomass-fired steam boiler

The boilers are made of two main separate units - a combustion chamber with a hydraulic grate including new walls, and a steam heat exchanger. The drums of the steam boiler generate saturated steam, its rated pressure being 16-30 bar. The boilers are designed with errand-type operation once per 4 hours or as per local circumstances.

#### Combustion

The boiler combustion system is controlled by an I&C system regulated by computer on the basis of achieved sensed and measured quantities of the heating medium, data from the flue gas oxygen sensor, temperature and vacuum in the heating chamber.

#### Removal of ashes

Ash is transported out of the boiler in its bottom part by a hydraulic conveyor positioned across the boiler, spontaneously falling into a bulk conveyor from which it is unloaded into the container.

### Technology to generate electricity (steam turbines, steam engines)

Technology assemblies for generating electricity from biomass making use of saturated steam of preset input parameters are supplied on transporting frames as fully-assembled units that comprise a steam turbine / steam engine and a generator with accessories.

### CC unit for converting residual energy of steam into electrical energy

The CC unit technology is used for utilising the residual heat to generate electricity. The residual steam going out from the engine/turbine is applying the residual low-pressure steam to produce additional electric power, i.e. serves as a steam condenser. Thermal energy that cannot be used any further is cooled in outdoor air-cooled condensers.

### Machinery

The machinery part of the boiler room and water treatment unit consist of the following technologies: fuel management equipment with a device feeding biomass into the boiler/boilers; complete steam biomass-fired boiler; electricity generation technology (steam turbine/engine) supplied on a transportable frame; Condensing Cycle to utilise the residual energy of the steam for converting into electrical energy; water feed technology and pressure vessel for degassing feed water; condensate management; interconnecting steam and condensate piping; water treatment equipment; valves, feed and circulation pumps; and other equipment necessary for the boiler room and engine room to operate.

### Electricity generation technology - control system and electrical part

The control system and the operator workstation are connected to each device from the controlled and monitored technology. The system is thus providing oversight of other autonomous control systems of steam boilers, steam engine/turbine generator, and CC unit generator.

### Flue gas extraction and purification

Flue gas purification is carried out in separators so as to achieve compliance with emission limits applicable at the site of installation of the power plant boilers.



## EXAMPLES OF REFERENCES

#### Zemcheba s.r.o. Chelčice, South Bohemian Region, CZ

A boiler plant (power output: 2 x 4.2 MW) to burn whole square bales of straw for generating power

#### Cidem Hranice a.s., Cetris, CZ

A wood chips boiler; power output: 1,930 kW

#### Seva – Flora s.r.o., Valtice, CZ

A boiler to burn whole round bales of straw; power output: 190 kW

#### Astur Straškov a.s., Vodochody, CZ

A boiler to burn whole square bales of straw; power output: 190 kW

#### Tespo – topenářské centrum s.r.o., Šumperk, Agritec Šumperk, CZ

A boiler to burn whole bales of straw; power output: 195 kW

#### Petr Houdek, Šluknov, CZ

A boiler to burn whole bales of straw; power output: 195 kW

#### Starkon Jihlava CZ a.s.

Two 190 kW boiler plants to burn whole round bales of hay

#### Slatina nad Zdobnicí - Zemědělské družstvo Zdobnice a.s. (a farm), CZ

An 800 kW boiler to burn whole square bales of hay

#### Zemědělské družstvo Rosovice u Dobříše (a farm), CZ

A 190 kW boiler plant to burn whole round bales of hay at a farm co-operative

#### Oldřichov v Hájích u Liberce, CZ

A 190 kW boiler plant to burn whole round bales of straw

#### Krivany, SK

A wood chips boiler; power output: 350 kW

#### Popovice u Dolního Bukovska - Drůbežárny Dynín (a poultry farm), CZ

A 700 kW boiler to burn whole square bales of straw

#### Častrov u Pelhřimova, CZ

A 600 kW boiler fuelled by square bales of straw

#### Step TRUTNOV a.s. (company premises), CZ

A 1,000 kW boiler to burn whole square bales of straw

#### Format s.r.o., Švedlár, SK

Two 220 kW boilers to burn wood chips

#### Bechyně, CZ

A 3,500 kW boiler to burn whole bales of straw

#### JB Adams boiler plant, England, the U.K.

A 1,000 kW boiler that can burn bales of straw, Miscanthus, or even cereal straw or wood chips

#### Zemědělský podnik Kely (a farm), CZ

Two 190 kW boilers to burn whole round bales of straw

#### Bouzov, CZ

A 2,700 kW boiler and a 1,000 kW boiler, both of them to burn wood waste

#### Florcenter Olomouc, CZ

A full delivery of a boiler room to burn whole bales of straw, power outputs: 1,600 kW and 2,000 kW

#### Kněžice, CZ

A full delivery of a boiler room to burn biomass (wood chips), power output: 400 kW, and bales of straw, power output: 800 kW

#### Valašská Bystřice, CZ

A 1,500 kW boiler to burn wood chips

#### Zemědělské družstvo Hluk (a farm co-operative), CZ

A 600 kW boiler to burn whole square bales of straw

#### Fitmin a.s. Helvíkovice, CZ

A 1,270 kW boiler to burn biomass

#### Rokytnice v Orlických Horách, CZ

A 1,000 kW boiler and two 2,500 kW boilers, each of them to burn wood chips



Container biomass boiler

## OUR ACTIVITIES

Step TRUTNOV was founded in 1990. As a result of many years of experience, it offers a broad portfolio of products ranging from pressure vessels to biomass-fired boilers. The company has its own production facilities, office premises, and production shops. The main activity of the company is the manufacture, supply and assembly of industrial, 100 kW through to 5 MW biomass boilers, giving the possibility of generating electricity. These products of strategic dominance are of great importance in terms of financial savings where the customer may cut their costs to a considerable extent compared with other commodities available in the market.

Another company's business is the production and supply of top technology in the field of pressure vessels such as heat exchangers, air tanks, water heaters, storage reservoirs for liquids or other materials, filters, equipment for water treatment plants, distributors, collectors, and many others. All such products can be made of either carbon or stainless steel as desired by the customer.



Production halls



### Company headquarters

Step TRUTNOV a.s.  
Na Příkopě 17  
110 00 Praha 1  
Czech Republic

GPS: 50°5'7.904"N, 14°25'30.188"E

### Production plant location

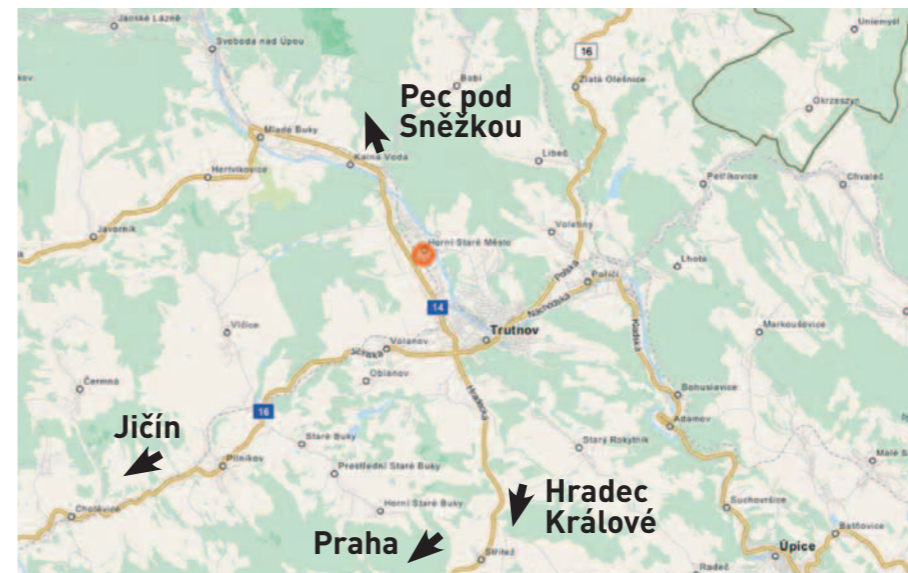
Horská 695  
541 02 TRUTNOV 4  
Czech Republic

GPS: 50°34'48.666"N, 15°53'27.935"E

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