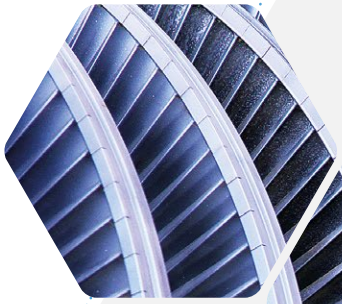
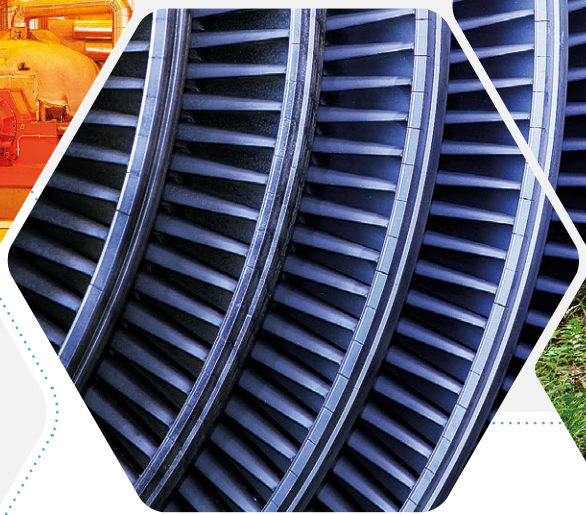
PIONEER OF BIOFUEL PLANTS, PRODUCER OF COMBINED HEAT AND POWER










VASKILUODON VOIMA

Vaskiluodon Voima

Pioneer of biofuel plants, producer of combined heat and power

THE MANKALA OPERATING MODEL

- The company sells the electricity and heat it produces to its shareholders at cost price
- The shareholders pay the company's expenses in proportion to their share of ownership
- It is not the goal of a Mankala company to make a profit or pay dividends
- The owners reap the benefits by using the energy produced or by selling it

Over **40 %** of electricity in Finland is produced under the Mankala Principle, at cost.

VASKILUODON VOIMA OY produces electricity and district heating at two separate power plants. One is located on the island of Vaskiluoto in Vaasa and the other by Lake Kyrkösjärvi in Seinäjoki. Together these power plants produce approximately 2% of the whole country's electricity demand per year. The district heating they produce covers more than 60% of the demand in Vaasa and 90% of the demand in Seinäjoki.

As its fuel, Vaskiluodon Voima uses domestic wood biomass, energy peat and coal. The company has also adopted globally innovative technologies that allow it to substitute coal with biomass. Both the power plants have also achieved lower flue gas emissions than the current limits set for them, which are valid until 2020.

Vaskiluodon Voima is owned in equal shares by EPV Energia Oy and Pohjolan Voima Oy. The company produces electricity at cost price for its shareholders according to the Mankala Principle.

COMBINED HEAT AND POWER
Electricity **1,2–2,5 TWh/a** › **District heating 800 GWh/a**

The Vaasa power plant

The forerunner of biomass utilisation

A gasification plant that is the first of its kind in the world

THE VAASA POWER PLANT uses coal and domestic biomass as fuel. It produces 900–1,700 GWh of electricity a year, and the district heating it produces covers more than 60% of the demand in Vaasa.

The power plant has an advanced biomass gasification plant built next to it, the first of its kind in the world. It gives the plant the ability to replace about a third of the coal used with domestic biomass, reducing its carbon dioxide emissions by the amount discharged by approximately 70,000 cars.

At a low output, the Vaasa power plant can also be used entirely without coal. In such instances, its fuel is a gas produced from biomass and peat.

TECHNICAL DETAILS

- **Boiler:** once-through boiler
- **Desulphurisation plant:** based on the wet scrubbing technique; uses limestone as alkaline sorbent and produces gypsum as a by-product
- **Denitrogenation:** Low-NOx burners and Overfire Air (OFA) system
- **Turbine:** A three-casing turbine with extractions for district heating and an air-cooled generator
- **Biomass gasification plant:** a 140 MW bio gasifier and a woodchip dryer
- **Fuels:** Wood biomass, energy peat, coal
- **Electric power (nett):** 230 MW
- **District heating output:** 175 MW
- **Electricity production:** 0.9–1.7 TWh/a
- **District heating production:** 450 GWh/a

TREATMENT OF BY-PRODUCTS

- **Gypsum:** 5,000–10,000 tonnes/a, 100 % utilisation
- **Ash:** 50,000 tonnes/a, 100 % utilisation

The Seinäjoki power plant

HEATING THE CITY AND PROVIDING EMPLOYMENT

Energy from local biofuels and energy peat

THE SEINÄJOKI POWER PLANT uses local renewable biomass and peat as fuel. It generates 400–800 GWh of electricity, and its district heating covers up to 90% of the demand in Seinäjoki.

Fuel is acquired from several small private suppliers in the region, which means that the power plant's direct employment effect annually is 265 person-workyears. At the same time, approximately MEUR 25 per year goes into the region's economy.

TECHNICAL DETAILS

- **Boiler:** Circulating fluidised bed boiler, natural circulation and a reheater
- **Fuels:** Wood biomass, peat
- **Desulphuration:** Not necessary when using peat and biofuels
- **NOx removalo:** Separate NOx removal is not necessary
- **Turbine:** condensing turbine with extractions for district heating
- **Electric power (nett):** 120 MW
- **District heating output:** 100 MW
- **Electricity production:** 0.4–0.8 TWh/a
- **District heating production:** 350–450 GWh/a

TREATMENT OF BY-PRODUCTS

- **Ash:** 20,000 t/a, 100% utilisation

THE SEINÄJOKI POWER PLANT

Domestic fuels

LOCAL ENERGY FROM MIRES AND FORESTS

THE DOMESTIC FUELS used by Vaskiluodon Voima are procured from the Ostrobothnia and South Ostrobothnia regions, within a radius of about 100 kilometres from the plant. To ensure large enough deliveries and transport routes that are as short as possible, we use several fuel suppliers.

The domestic fuels are procured within a radius of about **100** kilometres from the plant.

Biomass

Woodchips
- Forest residue chips(branches, tops)
- Stem wood chips
- Stump wood chips

By-products of the woodworking industry
- Sawdust
- Bark

Recycled wood
- For example, wood chips made from industrial packaging materials

Peat

PEAT IS PRODUCED with a milling method where the sun and wind dry the peat on the surface of the peat field. In areas where peat is produced, the washing of solids into waterways is minimised. The water is also treated locally and efficiently in field ditches and underground outlet channels, to sediment excluders and surface runoff areas to clean it.

Of all the peat soil in Finland, 0.6% is utilised for peat production, which covers 6% of the whole country's energy consumption. In total, peat provides employment of more than 10,000 person-workyears in Finland and brings the economy over MEUR 500 per year.

Ash for earthworks

THE BY-PRODUCTS CREATED THROUGH ENERGY PRODUCTION ARE UTILISED 100%

VASKILUODON VOIMA creates 70,000 tonnes of ash per year. This by-product is excellent for earthworks. Ash makes the ground structure of an earthwork project lightweight, strong and frost resistant. Using ash is also more cost-effective than substituting natural materials.

Because ash hardens and becomes a denser, well-bearing structure, it is used in particular in the foundations of roads and parking areas.

Sites in Ostrobothnia where ash generated by Vaskiluodon Voima has been used:

- Duudson Activity Park's car park in Seinäjoki
- Seinäjoki's eastern bypass
- Jukajan Saha's storage ground for fuel wood in Laihia
- Torkkola wind power farm's roads and storage ground in Vaasa
- The trotting track next to the Power-park theme park in Härmä, Kauhava

Vaskiluodon Voima creates about **80,000** tonnes of ash and gypsum per year as a by-product.

Gypsum for building walls

AS THE VAASA power plant also uses coal as fuel, this creates some 5,000–10,000 tonnes of gypsum per year as a by-product. The amount of gypsum generated depends on the amount of coal used and its sulphur content.

Gypsum is created in the desulphurisation plant for flue gases, which utilises the wet scrubbing technique using limestone as an alkaline sorbent. All the gypsum produced is taken to a gypsum board factory where it is transformed into boards for buildings.

COMBINED HEAT AND POWER

Great efficiency with less fuel

BOTH OF THE Vaskiluodon Voima power plants produce combined heat and power (CHP), which uses less fuel and makes the plants highly efficient. Plants that generate only electricity create waste heat as a by-product, but with combined heat and power it can be directed to the heating network for the region's homes.

The energy generation processes of the Vaasa and Seinäjoki plants are almost identical despite the different proportions of fuels. The process in Seinäjoki does not require a desulphurisation plant or a biomass gasification plant.

ENERGY PRODUCTION PROCESS

› The following double page illustrates the power plant's energy production process.

STEAM POWERS THE TURBINES – THE RESULT IS HEAT AND POWER

THE POWER PLANT PRODUCES energy through a water and steam process. High-pressure steam causes the turbine's blades and shaft to turn, transferring this rotational power to the generator's rotor, thus creating electricity. District heating water is heated by the steam obtained from the turbine's steam extractions, and district heat is created.

The circulation of water and steam in turbine and boiler plants:

1. The feed water is pumped from the feed water tank to the boiler's feed water heaters and evaporator where the water boils and becomes steam.
2. From the evaporator, the steam is led to high-pressure superheaters where it is further heated and then continues to the high-pressure turbine (**HPT**).
3. From the high-pressure turbine, the steam is taken back to the boiler's reheater and continues from there to the intermediate-pressure turbine (**IPT**).
4. From the intermediate-pressure turbine, the steam is led to district heat exchangers and the remaining steam is directed through the low-pressure turbine (**LPT**) and on to the condenser where it condenses back into water.
5. From the condenser water is pumped back into the feed water tank and from there it continues its circulation.

THE VASKILUOTO 2 POWER PLANT PROCESS

DESULPHURISATION PLANT

Flue-gas desulphurisation

- When using coal, flue gases are cleaned in the desulphurisation plant.
- The cleaning process creates gypsum which is salvaged and utilised.
- The cleaned flue gases are led out into the atmosphere.

BOILER PLANT

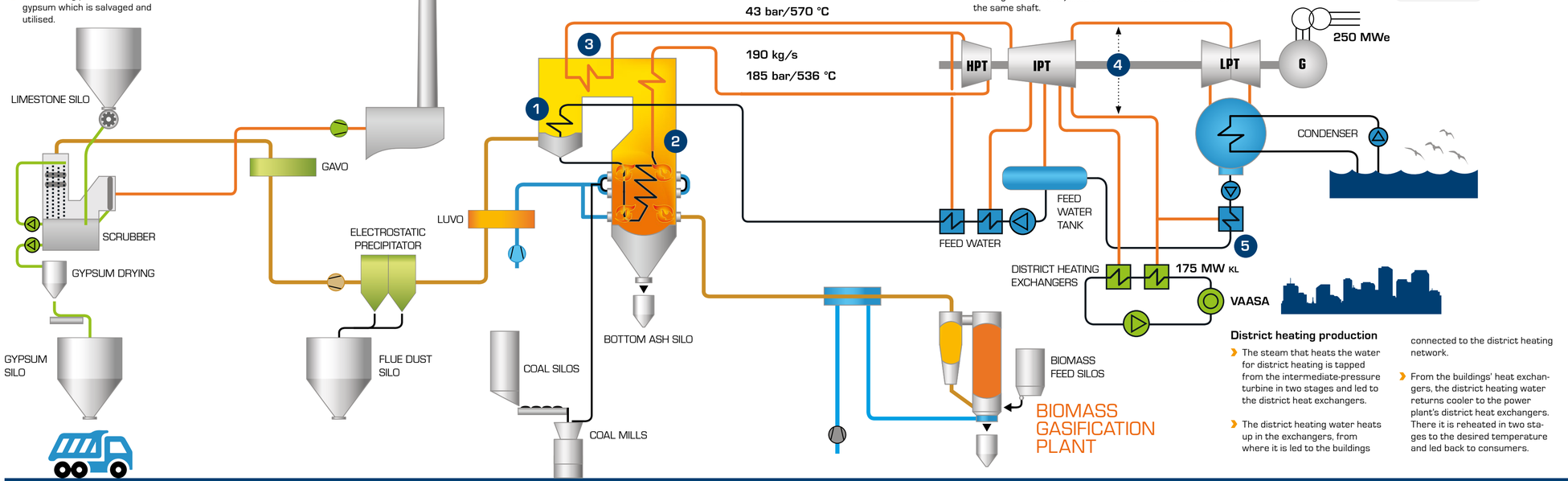
Fuel feeding

- The fuel is fed either directly into the boiler – or in Vaasa, also via the biomass gasification plant.

TURBINE PLANT

Electricity production

- The rotors of the high-pressure, intermediate-pressure and low-pressure turbines and the rotor of the generator are joined to the same shaft.
- Steam rotates the turbine's rotor and, as a result, the generator produces electricity for the electrical network.



District heating production

- The steam that heats the water for district heating is tapped from the intermediate-pressure turbine in two stages and led to the district heat exchangers.
- The district heating water heats up in the exchangers, from where it is led to the buildings connected to the district heating network.
- From the buildings' heat exchangers, the district heating water returns cooler to the power plant's district heat exchangers. There it is reheated in two stages to the desired temperature and led back to consumers.

COMBINED HEAT AND POWER

VASKILUODON VOIMA OY
+358 10 505 5200

Head office, administration
Kirkkopuistikko 0, 65100 Vaasa, Finland

Seinäjoki power plant
Sevontie 1, 60200 Seinäjoki, Finland

Vaasa power plant
Reininkatu 1, 65170 Vaasa, Finland

www.vv.fi

VASKILUODON VOIMA

VASKILUODON VOIMA