TOWARDS A GREENER FUTURE WITH SWEDISH WASTE-TO-ENERGY
THE WORLD'S BEST EXAMPLE

Torsviksverket in Jönköping, which was commissioned in 2006, incinerates 20 tons of waste every hour.
Photo: Anders Arvidsson

W A S T E – T O – E N E R G Y

Each Swede produces just over 500 kg or half a ton of household waste every year. Thanks to the efficient waste management in Sweden, the vast majority of this household waste can be recovered or reused. Only four per cent is landfilled.

Just over two millions ton of household waste is treated by waste to energy in Swedish plants every year. These plants incinerate a similar quantity of waste from industries as well. Waste incineration provides heat corresponding to the needs of 810,000 homes, around 20 per cent of all the district-heating produced. It also provides electricity corresponding to the needs of almost 250,000 homes. International comparisons show that Sweden is the global leader in recovering the energy in waste.

Waste to energy is a well-established source of energy in Sweden. The first incineration plant started operation in. During the later part of the 1940s, the district-heating network was expanded in connection with the extensive construction of new buildings following the Second World War. During the 1970s, the major expansion of waste incineration plants started.

Sweden has had strict standards limiting emissions from waste incineration since the mid-1980s. Most emissions have fallen by between 90 and 99 per cent since then thanks to ongoing technical development and better waste sorting.

Swedish waste to energy is an environmental, financial, safe and stable contribution to the country's energy supply.

ENVIRONMENTAL BENEFITS OF WASTE TO ENERGY

Waste to energy is a recovery method that provides a significant part of Europe's energy needs. One example of this is that around 50 million tons of waste are processed through incineration every year throughout Europe. This corresponds to the heat requirements for the populations of Sweden, Norway, Iceland, Finland, Denmark, Estonia, Latvia and Lithuania. In Sweden alone, waste incineration generates as much energy as 1.1 million cubic metres (m^3) of oil, which reduces carbon dioxide (CO^2) emissions by 2.2 million tons per year. This is as much CO^2 as 680,000 petrol-powered cars emit in a year.

The EU's rules for waste management, the so-called waste hierarchy, state that we should initially strive to avoid creating waste at all. The following stages are re-use, material recycling, other recycling – e.g. energy recovery – and finally disposal.

The volume of waste produced in society is affected by many different factors and is largely dependent on the economic situation. By using resources effectively, changing patterns of consumption and prolonging product lifetimes, it is possible to reduce the volume of waste.

Several European studies have shown that countries with a high proportion of material recycling also have a high proportion of energy recovery from waste. Thus, there is no conflict between the different methods. In Sweden, just under 50 per cent of household waste is material-recycled; a slightly smaller proportion goes to waste to energy. Only four per cent of household waste is sent to landfills.

Waste should be managed based on its properties, and this means that there is no standard solution for choosing the treatment method. The different methods – material recycling, biological treatment, and waste to energy – must be combined to achieve the best results. The choice of treatment method varies based on type of waste, local and geographical conditions and how well the waste is source separated. When all the factors are considered, the objective is the optimum environmental and social benefit.

The waste generated by households, industries and other activities reflects our consumption habits. Hazardous substances found in commodities and products persist when the products become waste. This places tough demands on all waste management, so that harmful substances are not spread. During incineration, many harmful substances break down and the residual substances are bound in ash, which makes them easier to control, handle and recycle.

Landfilling of organic waste has been forbidden in Sweden since 2005. Waste incineration has largely replaced landfills as a processing method, and emissions of the greenhouse gas methane from landfills has thus fallen dramatically. The waste sector reduced emissions of greenhouse gases by 34 per cent during the years 1990-2006. A forecast from Klimatberedningen (the Climate Committee), appointed by the Swedish parliament and government, calculated that emissions will fall by 76 per cent during the years 1990-2020.

Since the mid-1980s, incineration capacity has trebled and energy production has increased five-fold, while emissions have fallen by almost 99 per cent..

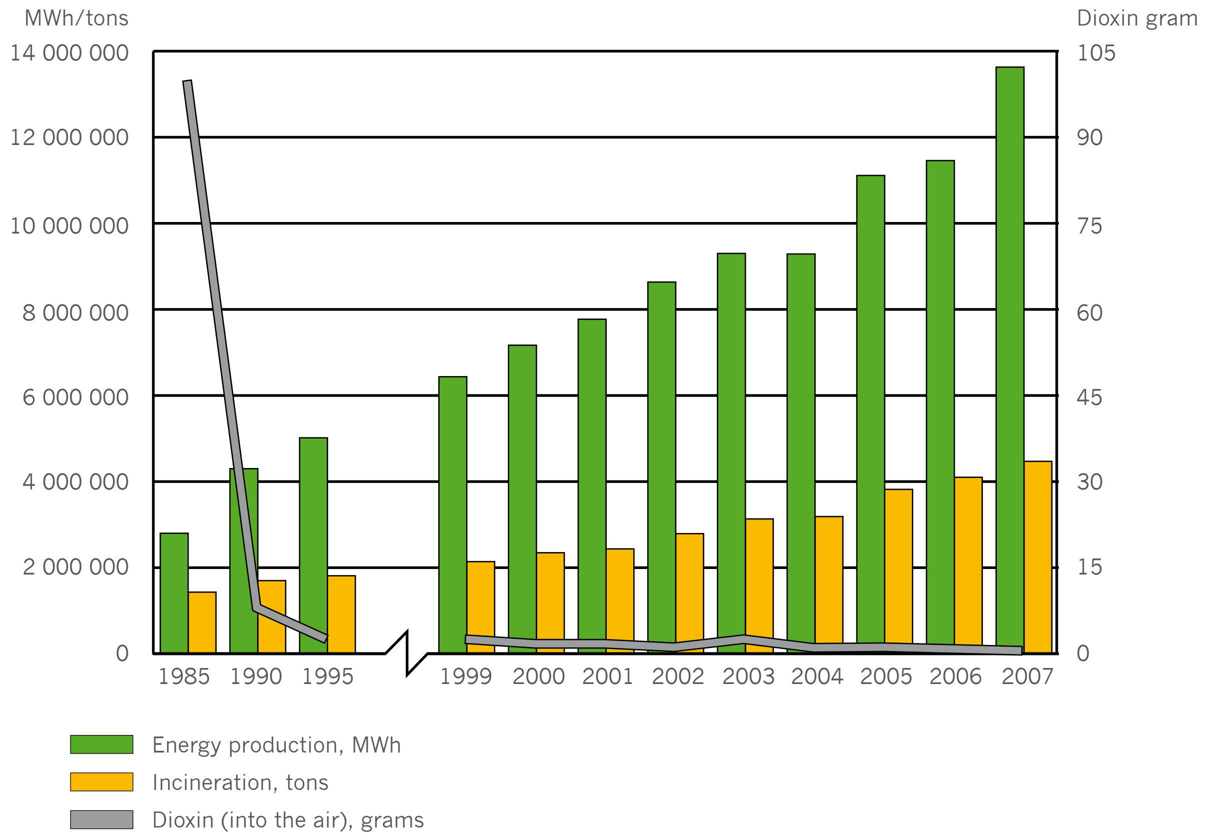
FACTS: ENVIRONMENTAL PERMITS

In order to operate a waste to energy plant, as with other environmentally-hazardous activities, a permit is required in accordance with the Swedish Environmental Code. The permit is issued by the County Administrative Board or the Swedish Environmental Court. This is preceded by an investigation, where the municipal environmental councils, local residents and the public are able to offer their opinions. Prior to the investigation, the business operator must submit an environmental impact report that describes the environmental impact of the plant in detail. This should include issues relating to emissions into the air and discharges into water, noise and transport. When assessing the activity, account must be taken of the local situation, alternative solutions and localisations.

FACTS: LESS EMISSIONS – MORE ENERGY

- The waste sector will reduce its emissions of greenhouse gases by 76 per cent during the years 1990-2020, according to the Climate Committee's forecast.
- Waste incineration in Sweden produced as much energy in 2007 as 1.1 million m³ of oil, which reduces CO2 emissions by 2.2 million tons per year, as much as 680,000 petrol-powered cars emit in a year.
- Despite waste incineration increasing, emissions have fallen. For example, emissions of heavy metals from waste incineration into the air have fallen by almost 99 per cent since 1985. In addition, the total emissions of dioxins from all of the country's waste incineration plants have fallen from around 100 g to less than 1 gram during the same period.

INCINERATION, ENERGY PRODUCTION AND DIOXIN INTO THE AIR FROM WASTE INCINERATION 1985-2006



REDUCTION IN EMISSIONS

	1985	2007	Change
Dust (ton/year)	420	24	- 94.3%
HCl (ton/year)	8,400	60	- 99.3%
SOx (ton/year)	3,400	196	- 94.2%
NOx (ton/year)	3,400	2,101	- 38.2%
Hg (kg/year)	3,300	36	- 98.9%
Cd (kg/year)	400	6	- 98.5%
Pb (kg/year)	25,000	51	- 99.8%
Energy production (MWh)	2,800,000	1,2151,270	334.0%
Processed waste (ton)	1,432,100	4,470,690	212.2%

WHY SWEDEN HAS BEEN SO SUCCESSFUL

Sweden is the global leader when it comes to dealing with and recycling waste. Waste management is being continuously developed and is the result of long-term, patient work, not least on the part of municipalities and their companies in cooperation with private players. This has required risk-taking in order to develop new technology and the courage to make large, but necessary, infrastructure investments. This has given inhabitants a good level of service and increased recycling. In order to bring this about, well-functioning cooperation between and within municipalities has been necessary.

Swedish waste management has three categories of players with responsibility for waste. It is the local municipalities who are responsible for household waste, the producers who are responsible for their respective product groups, and industry/the business community when responsibility for waste does not fall on the two others.

The Swedish municipalities' responsibility for household waste constitutes a prerequisite for development of long-term sustainable waste management. During the 2000s, development has been driven by the interplay between private, state and municipal companies and plants. Constructing a new plant involves high investment costs and there must, therefore, be a market for the heat produced. The developed district-heating network in Sweden has been a guarantee of that. District-heating has a long tradition in Sweden; the first district-heating network was taken into use back in 1948.

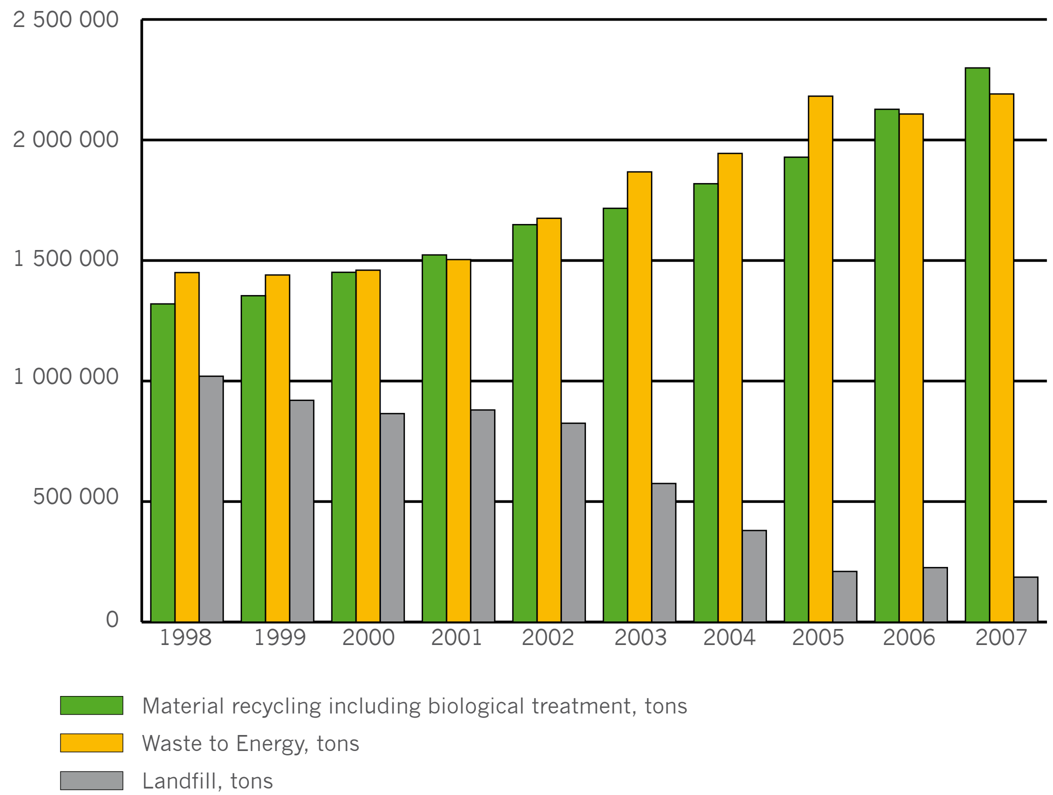
Avfall Sverige – Swedish Waste Management has had a profound influence on the development through joint research and development projects and the exchange of experience between plants.

From having been mainly a sanitary problem where waste would have been disposed of in order not to spread sickness and disease, waste management has become a symbol of environmental work. In order to reduce the presence of waste and the danger associated with it, as well as to increase reuse, recovery and utilisation of waste, the responsibility for waste needs to be regulated. In addition, a number of different controls – financial and informative – are required in order to strive towards the agreed objectives for waste management.

For some waste categories, special legislation has been issued. The aim has been, among other things, to reduce resource wastage, to limit emissions of hazardous substances or to phase out the use of certain substances that have no part in a ecocycle society. Special legislation applies, for instance, to electrical waste and batteries.

EU decisions determine the framework for Swedish waste management. The Swedish parliament's environmental objectives provide the overall, governing objectives for the environmental aspect of waste management. A number of laws and other control measures introduced during the 2000s have deliberately moved waste management away from landfills towards material and energy recovery instead.

TREATMENT METHODS FOR HOUSEHOLD WASTE 1998-2007



Some examples of laws and control measures that apply to the waste field:

- The Environmental Code, which came into force on 1 January 1999
- The EU landfill directive was adopted in 1999
- The tax on waste for landfills (SEK 250/ton) was introduced in 2000
- The ordinance on landfilling of waste was introduced in 2001
- A ban on landfilling of sorted combustible waste was introduced in 2002
- The landfill tax was raised to SEK 370/ton in 2003
- A ban on landfilling organic waste was introduced in 2005
- The landfill tax was raised to SEK 435/ton in 2006
- All landfills must have fulfilled the requirements of the 2008 landfill directive in order to be able to continue to receive waste.
- The Framework Directive 2008.

At the same time, a number of other rules to regulate waste incineration have been introduced:

- An ordinance on waste incineration was introduced in 2002.
- An ordinance and regulation about waste incineration came into force in 2005.
- A tax on household waste for incineration was introduced on 1 July 2006. The tax payable is dependent on whether the incineration plant liable to pay tax produces electricity, and if so, how effectively. For plants without electricity production, the tax is around SEK 500/ton, which then falls with increasing electricity production. If electricity production is effective, the tax is around SEK 100/ton.
- BREF 2006.

The legislation involves, among other things, tighter controls for emissions into the air and discharges into water, and the tax on household waste for incineration was introduced to increase biological treatment, as well as increase plastics recycling.

In addition to these examples, there are over one hundred laws and ordinances that apply to issues related to waste management.

FACTS: THE WASTE FRAMEWORK DIRECTIVE 2008

- The EU's new waste framework directive is based on a strategy for prevention and material recycling of waste. Member states must work to sever the link between economic growth and increased quantities of waste.
- The five stages of the waste hierarchy introduced as a priority scheme for handling waste are introduced in the framework directive. The five stages are waste prevention, reuse, material recycling, other recycling – e.g. energy recovery – and finally disposal. Member states must apply the management option that provides the best environmental benefit, but can deviate from the hierarchy for technical, economic or environmental reasons.
- Member states must introduce the new framework directive for waste in their legislation. As Sweden already has a high level of waste legislation, the effects of the new framework directive will probably be less than in many other EU countries.
- Efficient energy recovery now counts as recycling.

THE REGULATIONS – A FEW EXAMPLES

Landfill tax

The waste framework directive

The waste incineration directive

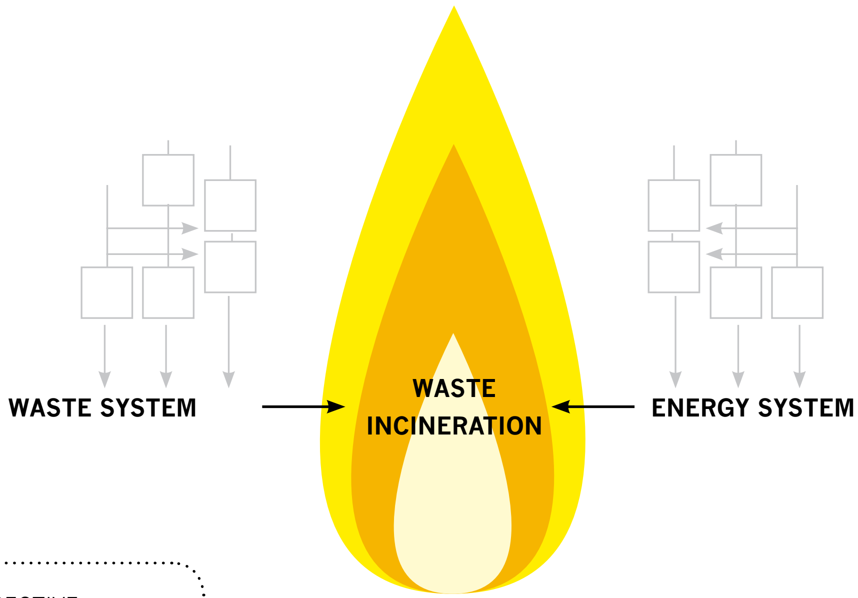
Control measures for biological treatment

Standardisation of solid recovered fuels

Landfill ban on organic waste

The landfill directive

Landfilling by dispensation



Green certificates

Waste incineration tax

Change in energy and environmental taxes

Combined heat and power taxation

Green tax reform

FACTS: THE WASTE INCINERATION DIRECTIVE

The EU's directive on waste incineration was introduced in Sweden in 2002. It has applied to all member states since 2006. The aim of the directive is to prevent or limit the negative impact on the environment from waste incineration, specifically from pollution due to emissions into the air, ground or water.

In order to guarantee environmentally-sound management, the directive contains a number of requirements in terms of the technical design of incineration plants. It also contains a number of emission limit values that must not be exceeded. The technical requirements and limit values were introduced, in part, to prevent waste being transported to countries within the EU with lower environmental requirements

The introduction of this directive also led to a number of Swedish plants being rebuilt to fulfil the new requirements.

FACTS: BEST AVAILABLE TECHNOLOGY

Best Available Technology (BAT) is a concept often used in various contexts. The EU has produced descriptive reference documents (BREF) on what is considered BAT within various sectors. The documents have been produced through the exchange of information between the EU, suppliers, plant owners and others in a process regulated by EU legislation. Currently, there are around 25 different BREF documents linked to various sectors, and a few more are currently in preparation.

Waste incineration has its own, extensive BREF documentation with a good overview of the various technologies currently available. The document also specifies expected normal performance expressed in, for instance, energy consumption.

In order for a technology to be considered a BAT, it must not only be efficient, but the costs associated with it must also be reasonable in proportion to performance.

The document can be downloaded from http://eippcb.jrc.ec.europa.eu/pages/FA ctivities.htm.

W A S T E   A S   F U E L

Recovering energy from waste exploits a resource that would otherwise be wasted. At the same time, it is important that waste has been source separated. It must not contain hazardous waste, batteries, light bulbs or other electrical waste. Nor should it contain packaging or newspapers. These should be sorted out and left for material recycling. Metal should also be removed, as metal is a raw material with a very high recycling value. Metals can also cause problems in the incineration process with unnecessary wear and unforeseen operational stoppages at the plant as a result. Plaster should also be removed. Plaster, which is a chemical compound containing calcium and sulphur, provides no energy. The sulphur in waste is a burden on flue-gas cleaning and that is, therefore, one reason for not leaving plaster in combustible waste.

Around 50 per cent of the waste treated in Swedish waste to energy plants is household waste. The rest is waste from industries and other commercial activities. Waste from industries and other activities often contains sorted fractions with a more homogeneous composition, but the fractions differ significantly from various activities.

Household waste sent for incineration varies slightly depending on which municipalities the plant has signed agreements with. Normally, waste sent for incineration is source-separated combustible household waste. Requirements for fuel properties are set for other waste supplied to the plants. The waste should, for instance, not have too high a moisture content or contain material that is unsuitable for incineration. Random testing and inspections when the waste is received at the plant help to ensure that the requirements are fulfilled.

FACTS: SORTED FUEL

- Household waste must be source separated. Hazardous waste, batteries, light bulbs and other electronic waste must always be taken to the municipality's collection point. Take metal, glass, plastic, paper, newspapers and food waste – where possible – for material recycling. Other household waste can best be used for energy recovery through incineration.
- 50 per cent of the waste treated in Swedish waste to energy plants is household waste. The rest is waste from industries and other activities.
- The plants carry out quality checks of the incoming waste in order to ensure that unsuitable material has not been sent for incineration.

In 2006, the combined heat and power (CHP) plant for waste fuel at Korstaverket in Sundsvall became operational.
Photo: Torbjörn Bergkvist

THE WASTE ROUTE THROUGH A MODERN PLANT

This is an example of a modern plant. All plants are designed according to local conditions.

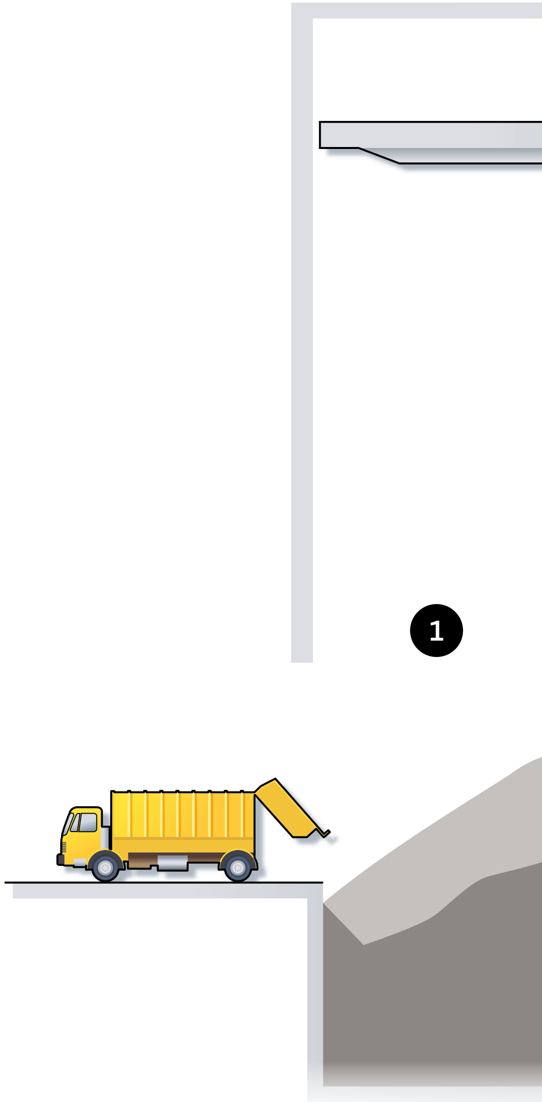
1.
The waste arriving at the plant must be weighed and quality-checked. The combustible waste is tipped down a bunker. This is often designed to hold several days of waste deliveries in order, for instance, to be able to cope with long weekends. The bunker in one of Sweden's largest plants contains 12,000 m^3 waste.

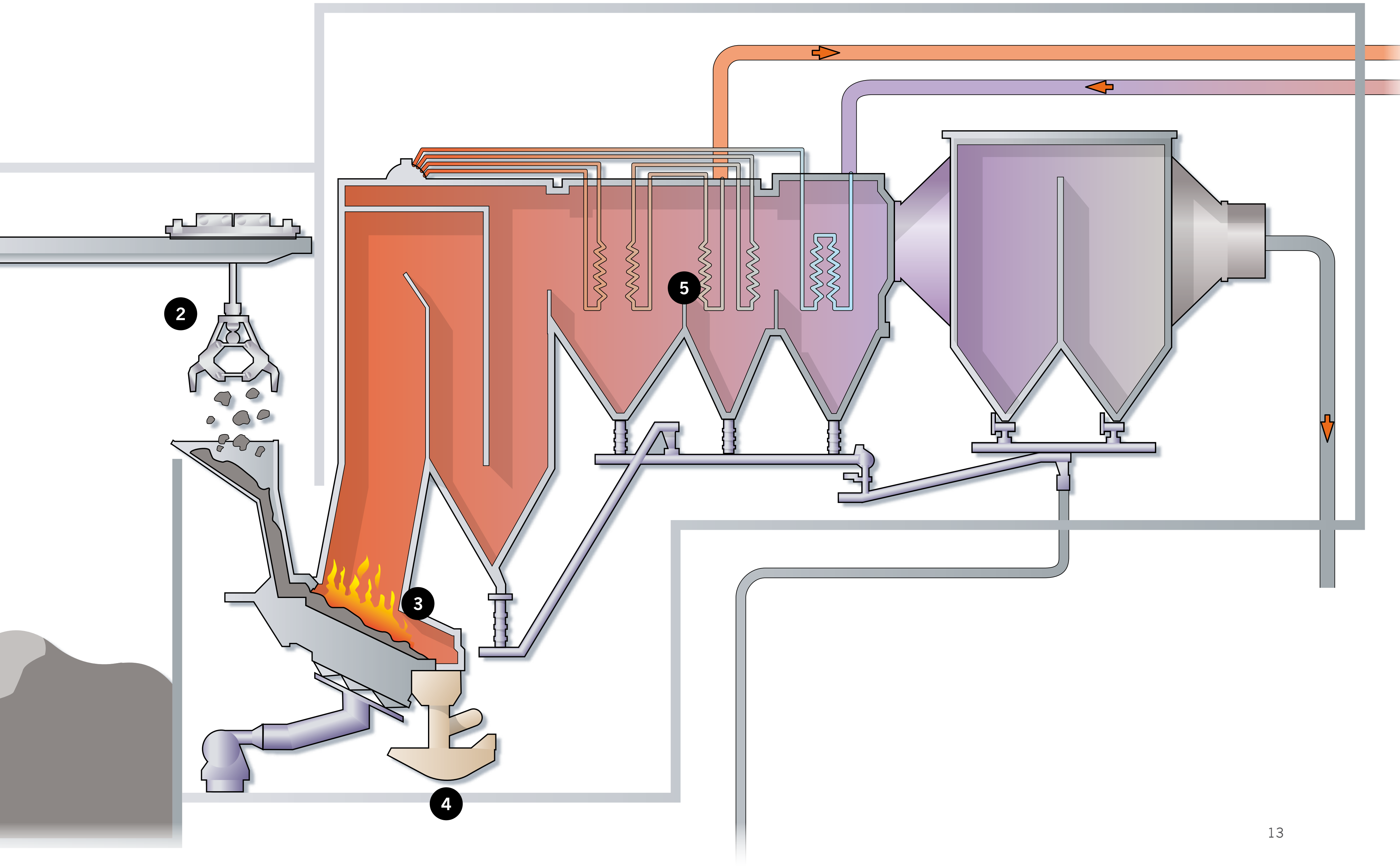
2.
An overhead crane controls the grab bucket and the waste is released into the feed hopper, from where it is fed into the furnace. The overhead crane mixes the waste in the bunker before transferring it to the feed hopper. In order to ensure even, controlled incineration, it is also important that the feed from the feed hopper into the furnace takes place in a well-controlled way.

3.
In the furnace, the temperature is normally around 1,000 degrees C, and no fuel other than the waste is required. The waste burns under a stream of air before dropping onto a bed or grate. The hot flue gases rise upwards. There is often also an oil burner in the furnace which is used to start and stop the furnace.

4.
All combustible material is consumed. What is left is known as 'slag'. The slag drops down into a water-filled trough and is transported to be sorted and recycled.

5.
The actual furnace contains long welded pipes. The total length can be tens of kilometres long. There, the furnace water is circulated and heated to steam by the hot flue gases. The greater the pressure and temperature of the steam, the greater potential for electricity production. At the same time, increased pressure and temperature also lead to a greater risk of corrosion and increased maintenance costs.

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6.
Due to the high temperature and steam pressure, it is possible to recover electricity, cooling and heat. The superheated steam is transported to the turbine, which then drives the generator.

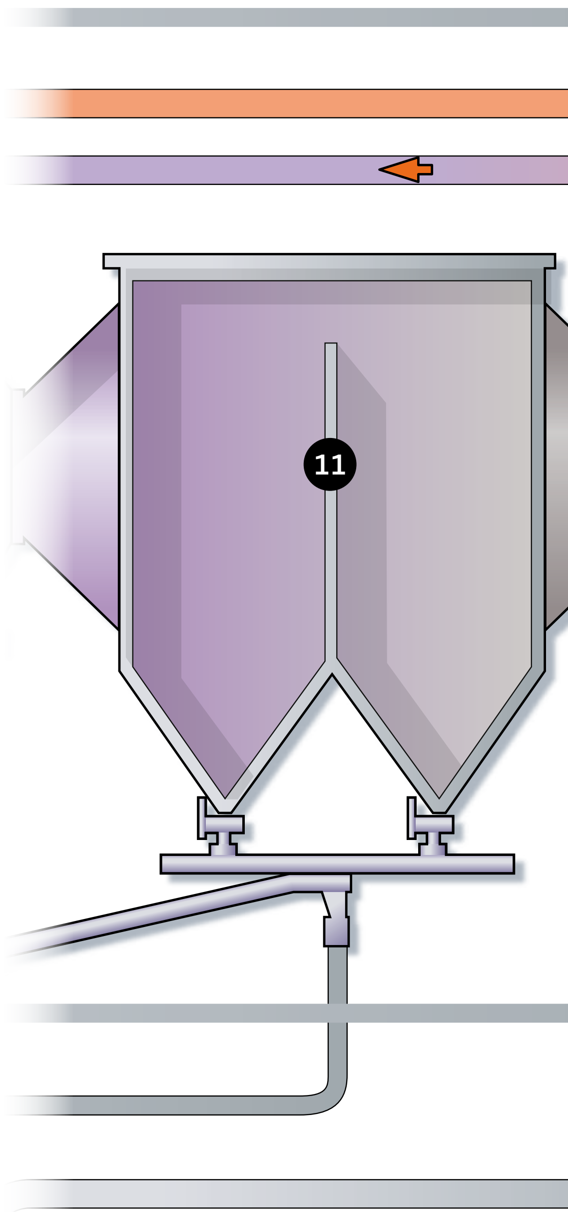
7.
In the generator, the movement of the turbine is transformed into electrical power, which is delivered to the electricity network.

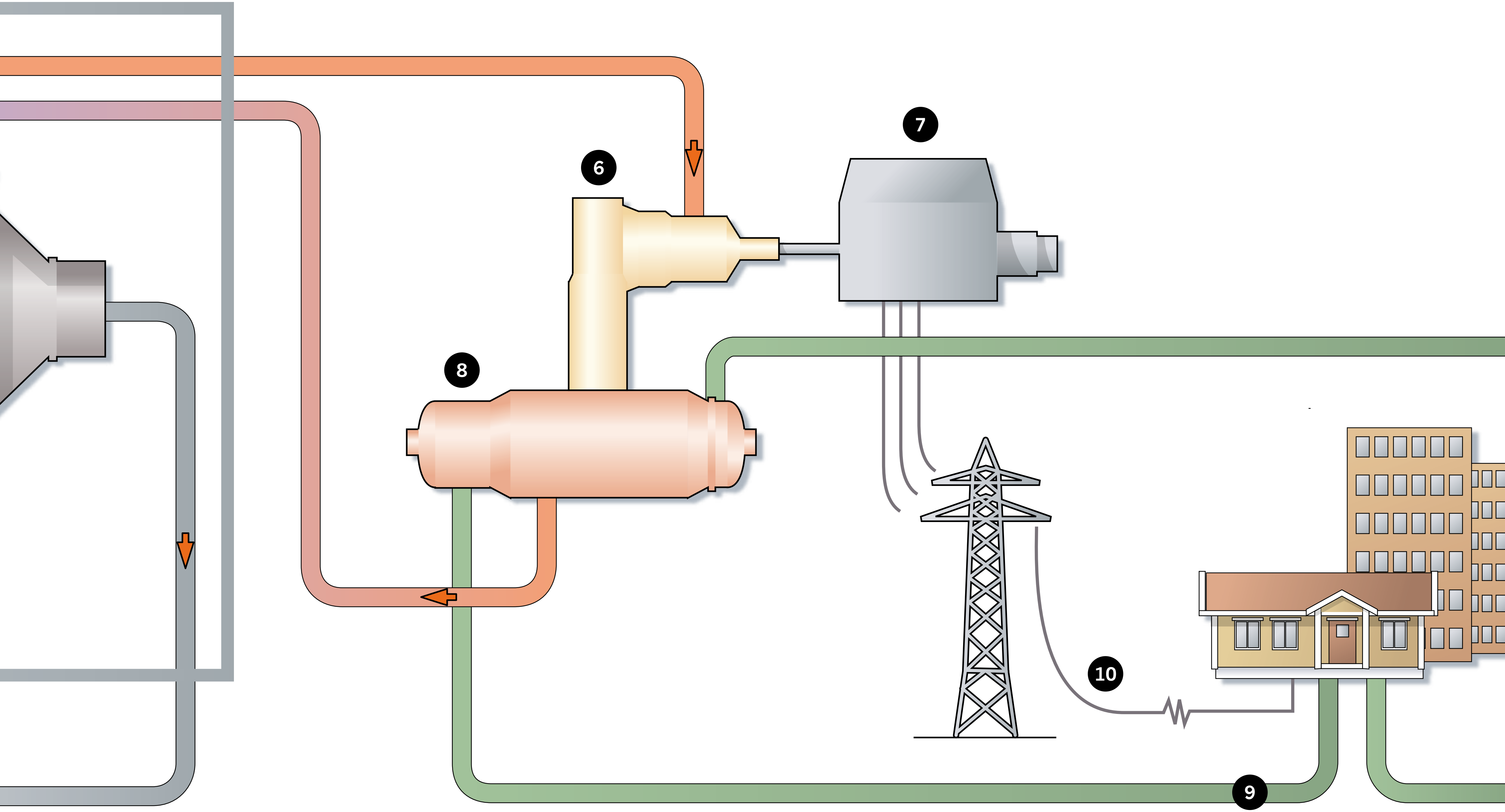
8.
Once the steam has passed through the turbine, it still contains a lot of energy, which is used as district-heating. In a heat exchanger, a condenser, heat is transferred from the steam to the water in the district-heating network. The steam is condensed into water and pumped back to the furnace.

9.
The heat produced by Swedish waste to energy plants corresponds to heat demands of 810,000 homes. The hot district-heating water is distributed via well-isolated pipes out to customers. The temperature of the water varies between 70 and 120 degrees, depending on the external temperature. The water is then transferred back to the plant to be reheated. District-cooling is based on the same principle as district-heating, but instead of providing heat, it provides cooling. Cold water is distributed in a pipe network and cools the air in the ventilation system. The water is then transferred back to the production plant to be cooled again.

10.
Electricity from waste to energy plants in Sweden corresponds to the domestic requirements of 250,000 homes.

11.
Once the energy has been extracted from the waste, the flue gases are cleaned. First, they pass through an electrostatic percipitator, where most of the dust is removed. Here, electrodes give the dust particles a negative electric charge. The particles then stick to large metal plates that are positively charged. The dust particles are shaken from the plates, collected at the bottom, and then transported to an ash silo.





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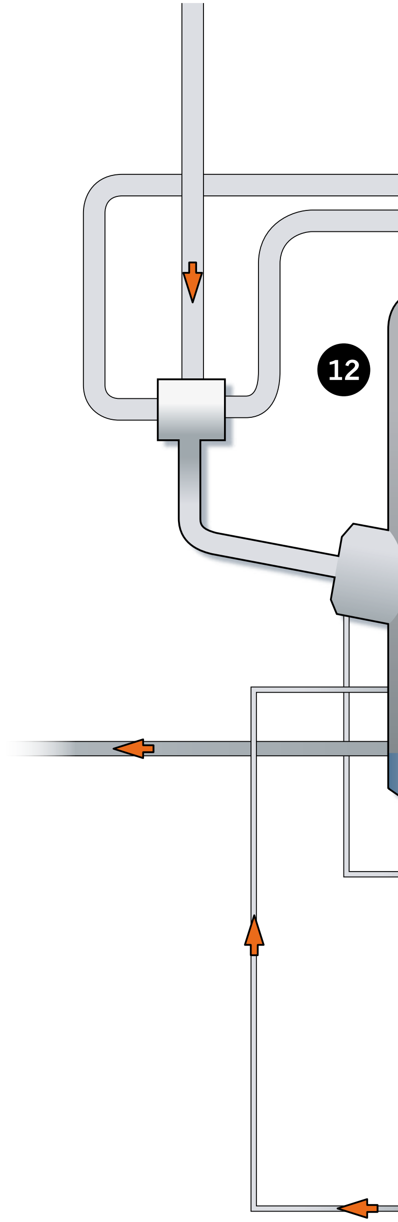
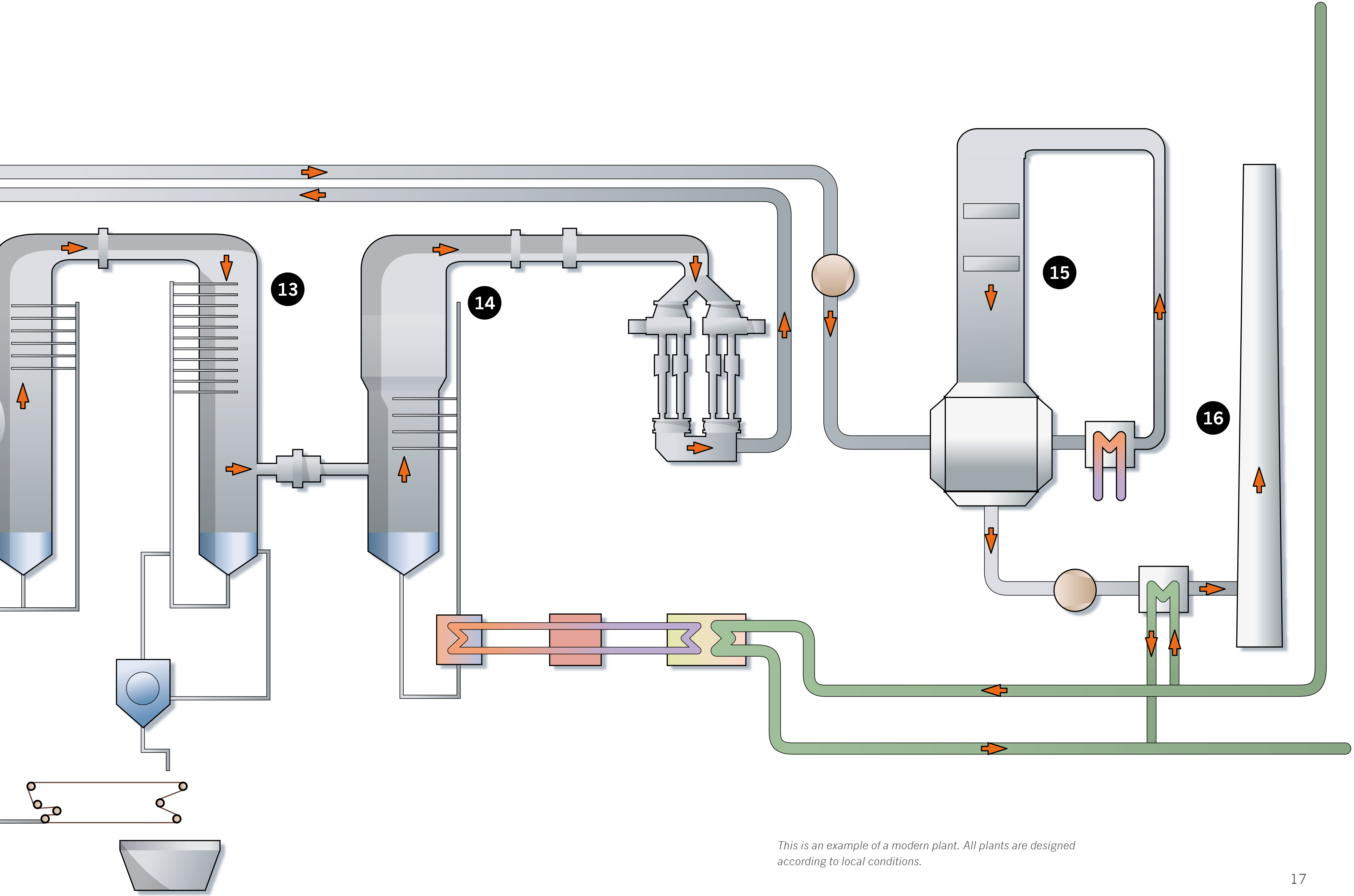
12-14.
The next stage of cleaning involves washing the flue gases with water. This is done in towers, known as scrubbers. Nozzles spray a fine mist of water over the flue gases. The water contains various substances, such as lime, which reacts with the gas and cleans it. In the first scrubber, heavy metals and acidic substances are washed out. The next scrubber removes sulphur dioxide, with the third condensing any moisture remaining in the gas. Heat is extracted from the condensed water using heat pumps.

15.
The final stage of the cleaning process is a catalytic converter. This reduces the nitrous oxides and functions in principle in the same way as a catalytic converter in a car. The flue gases pass through a fine porous, ceramic material and, to achieve optimum effect, an ammonia water solution is added. The nitrous oxides, which have an acidifying effect, are then converted into nitrogen. 79 per cent of air consists of nitrogen. Another common method is to reduce the nitrous oxides using SNCR or Selective Non Catalytic Reduction.

16.
The cleaned gas is fed out through the chimney. Harmful substances have been removed, and what is released is, in principle, only carbon dioxide and water.





This is an example of a modern plant. All plants are designed according to local conditions.

17.

Much of the pollution that was previously contained in the flue gas has ended up in the water from the scrubbers. This water undergoes a number of cleaning treatments. With the help of various chemicals, heavy metals, among other things, are precipitated and form a sludge that sinks to the bottom of the largest tank, from where it is drained.

18.

The pH of the water is adjusted and the water is filtered through a sand filter and a carbon filter before it is released.

19.

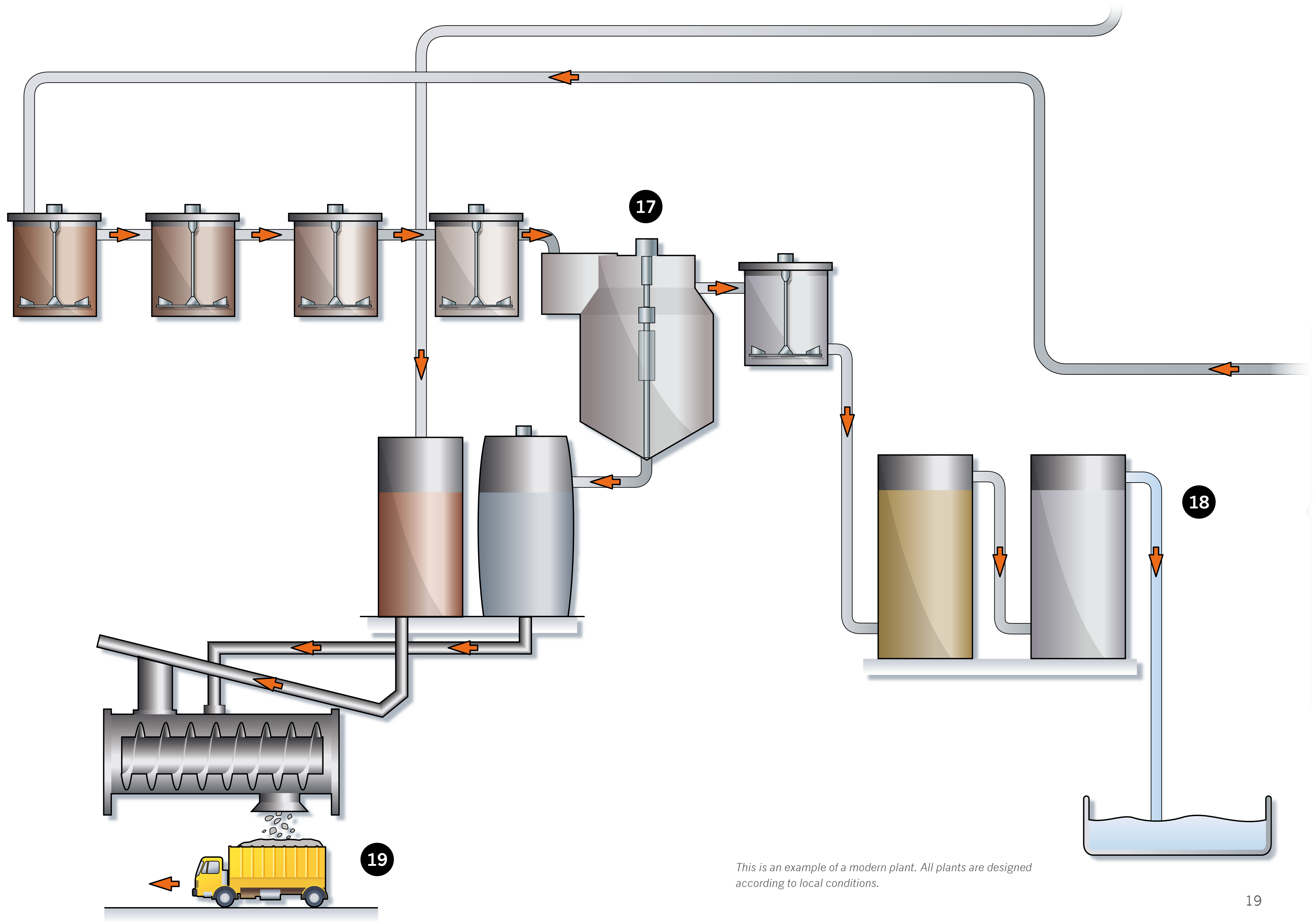
The sludge from the water purification process is dealt with and finally stored in a safe way.

FACTS: RESIDUES FROM WASTE INCINERATION

During waste incineration, residues form as slag, also called bottom ash, and there are also residues from flue gas cleaning. The quantities of each residue largely depend on which incineration technique is applied – grate-firing or fluidised bed – but the average in Swedish is around 15 per cent by weight of slag and just under 5 per cent by weight of flue gas residue. The slag consists of the non-combustible material in the waste and contains, among other things, metals that are separated and recycled. Through screening and storage, a fraction known as slag gravel is recovered. This has excellent properties for construction purposes. The slag gravel can be used instead of natural gravel for constructing roads and car parks, for instance. Residues from flue gas cleaning consist of ash, which is separated by a filter, or sludge, which is separated in the wet cleaning stages. These residues often have a higher content of heavy metals than slag, but they are hard bound and therefore must normally be dealt with by landfilling. The residues are basic, as a result of lime being used during flue gas cleaning, and they can, therefore, also be used to neutralise acidic waste. In some cases, the dry residues are also used to refill and stabilise mines.

FACTS: FLUIDISED BED BOILERS

There are two dominant techniques for waste incineration in Sweden, the grate-firing technique, represented in the plant description here, and the fluidised bed technique. There are different types of fluidised bed boilers. Common to them all is that incineration of waste takes place in a sand bed instead of on one or more smaller inclined/moving bases, grates. Air is blown in from underneath, causing the sand to lift. The waste is then fed in, forms a good mixture and is incinerated. The sand makes it easier for the air to be distributed evenly, which provides better incineration, provided the waste is also distributed evenly. In order for the sand not to wear out the flue gas cleaning, it is separated before the flue gas continues on to the other cleaning processes. Choice of flue gas cleaning is independent on whether it is a grate-firing or fluidised bed furnace is used. Fluidised bed boiler are normally characterised by good incineration and excellent environmental performance. However, this technique is significantly more sensitive to the quality of the waste entering the furnace, which, in turns, means that it places much greater demands on the fuel being pre-processed before it is incinerated. Extensive fuel preparation is, therefore, required for a fluidised bed boiler. This involves trying to remove as much of the metal as possible, as well as crushing the material so that it has a size of around 10x10 cm. The fuel preparation process can be right next to the boiler, but the waste can also be supplied to the incineration plant pre- treated, as per requirement specification.



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HEAT, ELECTRICITY AND COOLING

Energy recovery from waste incineration has increased dramatically over the last few years. In 2007, almost 13.7 TWh energy was recovered through waste to energy, an increase of 19 per cent compared with the year before. That energy is divided between 12.2 TWh heat and 1.5 TWh electricity. That is equivalent to the domestic electricity demands of almost 250,000 normal-sized homes and heating for 810,000 homes. A small amount of the energy is now also being used to provide district-cooling.

DISTRICT-HEATING

District-heating is produced by heating water and then pumping it into district-heating pipes to homes, offices, hospitals, industries, schools or other premises. The district-heating pipes are buried in the ground and well-insulated. The temperature of the hot water entering the district-heating network normally varies between 70 and 80 degrees C, but at low external temperatures, the water temperature may be as high as 100 to 120 degrees C. The temperature of the water in the pipe back to the plant is normally between 45 and 55 degrees C. A district-heating unit, connected to the district-heating network via two pipes, is installed at the user's end. The unit contains two heat exchangers, one for hot water for the taps and one for the radiators. The hot water, which is used in the house, and the district-heating water, then circulates in two different systems. The cooled district-heating water goes back to the district-heating plant to be reheated.

ELECTRICITY

Water is heated to steam at a high temperature and under high pressure, which makes it possible to produce electricity and heat simultaneously, known as combined heat and power production (CHP). The steam is fed into a steam turbine, which drives an electricity generator. Once the steam has passed the turbine, there is still some energy left, which is used as district-heating. Electricity is a high-value form of energy that can easily be used for a number of different jobs. Electricity can also be transported long distances very easily.

DISTRICT-COOLING

District-cooling is based on the same principle as district-heating, but instead of providing heat, it provides cooling. Cold water is distributed in a pipe network and cools the air in the ventilation system. The water is then transferred back to the production plant to be cooled again. The temperature of the water being sent out to the properties is around six degrees and the return water is around 16 degrees. District-cooling is mainly used in larger properties such as shopping centres, industries, schools, hospitals and workplaces with heat-generating computers and technical equipment.

The emissions from a larger plant, with high demands for cleaning, are significantly less than these what would be produced if each house was heated by its own boiler without a cleaning system.

THE FUTURE

Sweden in general, and Swedish waste incineration in particular, is at the forefront when it comes to dealing with waste in an effective, environmentally-sound way. In order to retain our leading roll, we will work hard to further improve management throughout the chain. The improvement work is long-term and ongoing, with the overall aim of limiting the negative environmental effects caused by today's consumer society.

The amount of waste produced in Sweden has increased over the last 30 years. Total processed household waste in 1975 was 2.6 million tons. In 2007, this amounted to 4.2 million tons. The most dramatic increase occurred during the 2000s. Development so far has largely been governed by economic growth. There is a strong link between economic growth, consumption and the amount of waste generated. However, in accordance with the EU's new waste framework directive, which will be introduced in Sweden by December 2010, waste minimisation must be given top priority in the so-called 'waste hierarchy'. Member states must therefore sever the link between economic growth and increased waste volumes. However, forecasts currently still point to increased volumes of waste, viewed over the longer term.

Development and legislation with the EU and within Sweden are important factors for the future. New legislation or other control measures may affect the rules of the game for both the energy and waste sector. Flexible waste management, with a suitable combination of treatment methods, is the key to effective and environmentally-sound development, as the conditions will change as a result of changes in control measures or waste volumes.

During the 2000s, several control measures have been introduced in Sweden in order to reduce landfilling. In order to meet this objective, all other treatment capacity has increased dramatically for both household waste and other waste. In 2000, the processing capacity for combustible and organic waste was around 2.7 million tons per year. This increased to 4.9 million tons per year in 2007 and is estimated to reach 5.9 million tons per year in 2012. Of this, incineration accounts for 5.1 million tons per year and biological processing for 0.8 million tons per year. The waste to energy contribution to the country´s electricity supply have increased many times over.

How capacity will be developed in the future depends heavily on the volumes of waste, as well as on development within other treatment methods. Older plants will gradually be replaced by new ones, and capacity will be adapted according to the need for both treatment capacity and electricity and heat.

Efficient Waste to Energy, which, due to the new waste directive, must now be counted as a method of recycling throughout the EU, will continue to be an important part of the infrastructure for both the waste and energy sector within the foreseeable future.

Korstaverket in Sundsvall.
Photo: Torbjörn Bergkvist

IInterior pictures from Sysav combined heating and power plant in Malmö, which was commissioned in 2003. The plant was extended in 2008.
Photo: André de Loisted

I N T E R N A T I O N A L L Y

Waste to energy is mainly used in Europe. However, the country with the most waste incineration plants is Japan.

Modern waste management is moving away from landfills to material recycling and energy recovery. This is also true internationally, even if landfills are still the most common method of processing waste. Waste incineration is also an increasingly popular means of recovering energy. Forecasts show that waste incineration with energy recovery will increase dramatically throughout the world over the next few years, from 200 million tons per year in 2007 to around 240 million tons in 2012. Europe still dominates, but Asia and even North America are planning expansion of capacity. Expansion of the incineration capacity in Europe will increase, according to forecasts, by around 11.5 million tons by 2013. The size of the plants varies significantly. The majority of European plants have a capacity of between 100,000 and 200,000 tons per year, while the plants in the USA have a capacity of 350,000 tons per year on average.

A survey of how waste is used for energy recovery from a European perspective shows that Sweden is the country that recovers the most energy from each ton of waste in the waste to energy plants.

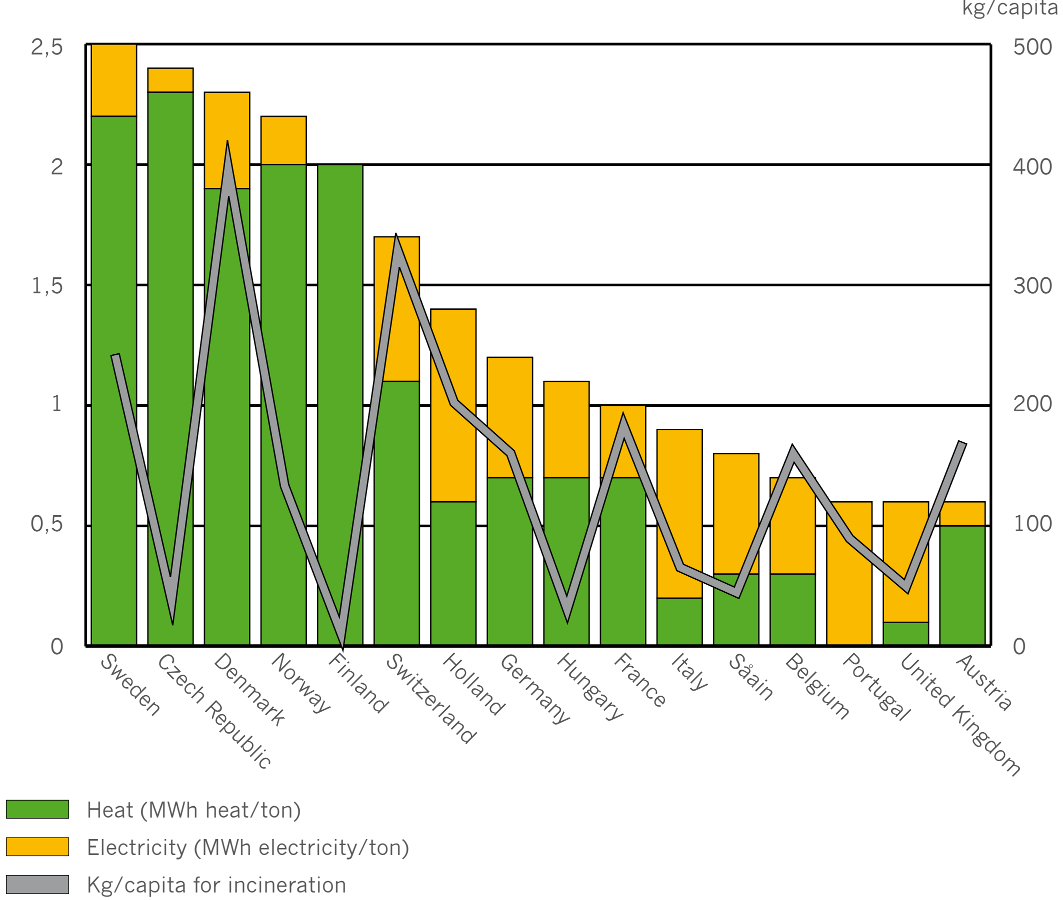
FACTS: PLANTS AROUND THE WORLD

Globally, there are more than 2,500 incineration plants, divided as follows:

- approx. 2,000 in Asia,
- approx. 460 in Europe
- approx. 100 in North America
- around ten in the rest of the world.

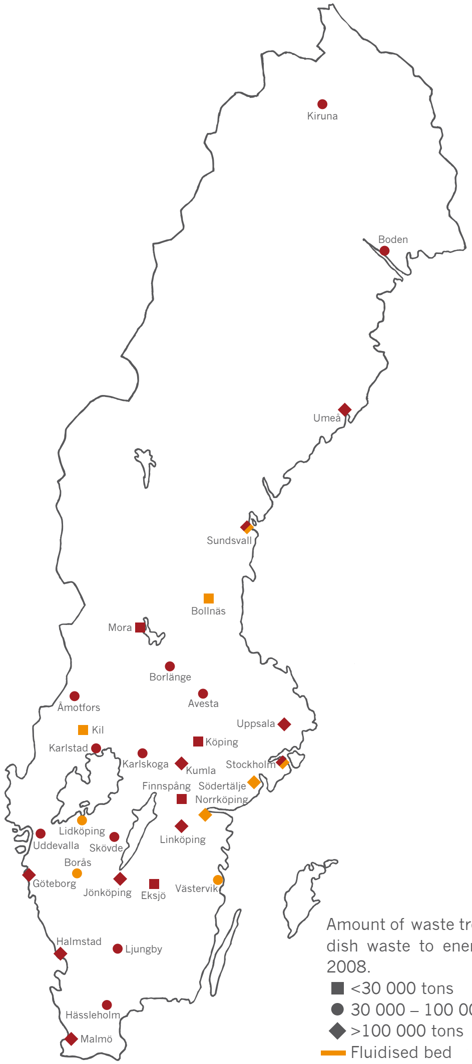
Modern architecture is featured in incineration plants in both Sweden and internationally. These are the plants in Spokane, Rouen and Vienna.

ENERGY RECOVERY PER TON HOUSEHOLD WASTE 2005



The Nordic countries extract the most energy from waste through incineration. Sweden recovers more than any other country. The pictures show the incineration plant in Trondheim, Norway, and Gärstadverket in Linköping (bottom picture) Photo: Åke E:son Lindman.

PLANTS IN SWEDEN



Amount of waste treated in Swedish waste to energy plants in 2008.

- ■ <30 000 tons
- ● 30 000 – 100 000 tons
- ◆ >100 000 tons
- Fluidised bed
- Grate

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