TOWARDS SMARTER ENERGY PRODUCTION

- Hydro power's role in Solar Economy
- Nuclear power's role in Solar Economy
- Combined heat and power's role in Solar Economy

Hydro power's role in Solar Economy

Hydropower is the most common and proven renewable energy technology and plays an important role in global power generation. In 2011, Fortum generated 21.0 terawatt-hours (TWh) of hydropower contributing to 29% of the company's total electricity production.

Hydropower is the most common and proven renewable energy technology and plays an important role in global power generation. CO_2-free and renewable hydropower is one of the key solutions in mitigating climate change and in the saving of scarce natural resources. Hydropower draws its essential energy from the sun, which drives the continuous hydrological cycle. According to the International Energy Agency (IEA), hydropower represents more than 90% of all global renewable energy production and continues to prevail as one of the most viable sources of new generation in the future energy system – Solar Economy.

In the Nordic electricity market, hydropower plays a key role in balancing the production and consumption of electricity. Hydropower plant start-up, regulation and shutdown is quick, and water stored in the reservoirs helps to balance the fluctuations in consumption. Hydropower's role in balancing production and consumption will be emphasised in Solar Economy, where an increasingly bigger share of electricity is produced with, e.g., wind and solar power. It also provides an option to store energy and to optimise electricity generation. Hydropower is both part of the traditional energy system and a major production technology in Solar Economy.

Fortum's hydropower

Fortum has a proven track record of efficient and sustainable hydropower production in Sweden and Finland. The company is one of the biggest hydropower producers and has long-term experience in the planning, refurbishing, operation and maintenance of hydropower plants in the Nordic countries.

About one third of Fortum's annual electricity production is based on hydropower. The share varies every year based on the hydrological situation. Fortum's hydropower capacity in the Nordic countries is nearly 4,700 MW with 260 fully- or partly-owned hydropower plants in Sweden and Finland. More than 80% of plants are located in central Sweden. The plants with the largest capacity are situated on the Dalälven, Indalsälven, Ljusnan and Vuoksi, Kemijoki and Oulujoki rivers.

Hydropower refurbishments continued in 2011

In 2011, Fortum generated 21.0 TWh of hydropower in the Nordic countries. Also the implemention of the long-term refurbishment programme of existing hydropower capacity continued.

In 2011, hydropower refurbishment projects were completed at the Montta plant in Finland, and at the Edsforsen, Eldforsen, Bergvik and Järpströmmen plants in Sweden. These refurbishments will result in additional annual electricity production of about 32 gigawatt-hours (GWh). Refurbishment projects generally result in positive impacts on environment, as the modern technology allows increasing efficiency without increasing adverse environmental effects. Most of refurbishment measures are carried out inside the hydropower plant (replacement of existing turbines etc). Furthermore, they increase safety and decrease environmental risks, e.g., oil leakage due to a smaller volume of oil in new turbines. For example, the amount of hydraulic oil in Montta was decreased thanks to the environmentally safe runners. Also new self-lubricated guide vane bearings were mounted.

Fortum also continued preparations for participating in the tendering process for hydropower concessions in France.

2.7

MILLION FRIES AND FISH

In 2011, Fortum stocked 2.7 million fries and fish in the Nordic rivers, lakes and the sea as a compensation measure of hydropower production for the fish population and fishing.

Climate change adaptation studied within hydropower

In addition to climate change mitigation, Fortum is also taking measures to adapt its operations to climate change. In 2011, a study regarding the impacts of climate change on hydrology in rivers with Fortum's hydropower in Sweden and Finland was finalised. The study analysed the changes in hydrology on Fortum's hydropower production and identified measures needed to adapt to hydrological changes.

On the grounds of the climate scenarios studied, the timing of inflows is changing in Finnish and Swedish rivers. Some changes are being implemented in inflow forecasting due to increasing winter inflows and decreasing spring inflows. Historical discharge duration curves as well as discharge duration curves for the future will be considered in invest-

FORTUM'S HYDROPOWER PLANTS IN SWEDEN AND FINLAND

ment planning. In the future, studies are needed to estimate how individual dams need to be adapted to climate change.

Hydropower non-compliances down to zero

The licence conditions for Fortum's hydropower plants and lake regulation define the limits for surface water levels and flow variations in the watercourse. The permits also define obligations to prevent and to compensate for environmental impacts.

Rapidly changing weather conditions or malfunctions in hydropower plants can lead to non-compliances of water regulation licences. In 2011, the number of non-compliances in Fortum's hydropower plants was zero due to careful operation and improved maintenance.

The main compensation measure for the fish population and fishing is to release young fish into rivers, lakes and the sea. During 2011, Fortum stocked about 346,000 salmon and trout and about 1,800,000 pike perch, grayling and lavaret fry in Finland. In Sweden, the fish stocking and release was about 540,000 young salmon and trout. Other compensation measures for the fish population are fish ladders, the catch and transport of fish to spawning areas and a combination of these.

Key impacts of hydropower

The most significant impact of hydropower on the environment results from the construction phase of plants and dams. Hydropower may alter a river system and riverside, including its course and natural flows. The key environmental aspects are related to the impact on river habitats due to the damming of watercourses.

Annual regulation of lakes and short-term regulation of rivers affects the surface water levels and flows. This impacts the aquatic environment and other use of watercourses.

Fortum is actively financing and participating in the research of hydropower impacts and the mitigation measures in Sweden and Finland.

Attention to nature and other uses of water

As a consequence of damming, there has been a significant decrease in the habitats suitable for migratory and local fish needing rapids for breeding. In most cases, dams have also prevented migrations to breeding areas in rivers and back to the sea or lake. This has impacted also the populations of mussel species depending on salmonoids. Improving the natural reproduction of local and migratory fish in hydropower rivers as well as the development of fish farming are the focus of extensive research at Fortum both in Sweden and Finland. The main areas of this research include possibilities to restore spawning and breeding areas, enhancing migration to these areas and back to the sea or lake, and possibilities to improve fish farming in an effort to enhance smolt survival. In addition, and as part of the research, actual measures and plans are also being implemented.

The winter drawdown and low water levels of regulated lakes in springtime affect spawning grounds. Low water levels in springtime have negative impacts on recretional use of watersystems.

Safety improvements of hydropower plants and dams

Fortum works systematically to improve the safety of its hydropower plants and dams. In 2011, Fortum's dam safety activities in Finland included periodical and annual dam safety inspections and monitoring of the dams, improvement studies of safety arrangements and feasibility studies of the dam renovations at the Imatra and Peltokoski power plants. A major accident risk evaluation project was started in 2011 and aims to develop a systematic way of analysing the most crucial risks in power plants.

Voluntary measures in water regulation

Fortum regulates many rivers and lakes in Sweden and Finland for hydropower production, but in some cases regulation also serves other purposes, such as recreational use and flood control. Hydropower permits regulate how flows are allowed to fluctuate. In some cases, based on ecological motivations, so-called minimum flows have been determined to ensure a continuous water perimeter meaning that the flow is never allowed to fall below a set minimum level. It can be adjusted over time so that it reflects the variations of the natural flow, but at a lower water level.

Fortum has co-operated with authorities and local interest groups to voluntarily agree on water levels or flows to improve the environment and facilitate other uses of the water systems. To support recreational use during summer, voluntary target values for water levels are set for many lakes. These values are more stringent than those specified in the permits.

Voluntary measures for fishing and other recreational use are carried out in co-operation with municipalities and local authorities. The Oulujoki multiple use agreement originally signed in 1998 is a good example of such voluntary measures. It is also important to enable other economic uses of water, such as professional fishing and the tourist industry.

In 2011, Fortum implemented several voluntary measures in water regulation. The normal regulation of Lake Vuokkijärvi in Finland was temporarily changed during the very dry spring season in order to reach the voluntary target value for the water level. In winter 2011, the annual drawdown of the water level of Lake Runn in Dalarna, Sweden, was postponed in order to enable ice skating on the lake. The water regulation of the Skifsforsen power plant in Vansbro (Vanån and Dalälven) was changed in order to make a swimming competition possible.

Case:

Mitigating effects of hydropower in Oulujoki

Fortum participates in several research projects to mitigate the environmental impacts of hydropower. The projects include, e.g., migratory fish routes, smolt migration to the sea, fish restocking as well as enhancing the habitat for fish and endangered fresh-water pearl mussels.

One of the projects is headed by the Finnish Game and Fisheries Research Institute. It helps to choose the most effective measures for fish management and to plan improvements in rivers with hydropower. Several interesting case studies are being carried out on the Oulujoki, Iijoki, Kemijoki and Kymijoki rivers. Fortum is funding the project with EUR 150,000 and uses its own expertise to support the research. In the project, habitat modelling is being applied to fish migration studies. Planning of the mouth of the fish way, the attraction flows as well as upstream and downstream migration can be simulated with the model and improvement measures can be developed.

Fortum is also working with many stakeholders to improve the recreational use of the water systems. The most important local partners in the Oulujoki area include municipalities, local environmental and fishery authorities, and fishermen. The key form of long-term collaboration in the region is Oulujoki multiple use programme. The programme aims to facilitate mobility and fishing in the water system and to restore habitats and improve landscaping. Annual funding for the programme is EUR 300,000, of which Fortum's share is 45%.

Nuclear power's role in Solar Economy

Nuclear power provides climate-benign, reliable and large-scale supply of electricity at a competitive and predictable costs. In 2011, Fortum generated 24.9 terawatt-hours (TWh) of nuclear power contributing to 34% of the company's total electricity production.

Nuclear power is an important part of the global solution to mitigate climate change and to provide a reliable, large-scale supply of electricity at competitive and predictable costs. Nuclear power production does not result in greenhouse gas emissions or air pollutants, and it has low greenhouse gas emissions over its full life cycle. In a life-cycle comparison, the carbon dioxide emissions of nuclear power are at about the same level as those of wind, hydro and solar power. The sustainable use of nuclear power requires the continuous improvement of nuclear safety and a long-term solution for nuclear waste.

Nuclear power accounts for 14% of global electricity production and 28% in the EU. After the Fukushima accident in March 2011, new investments in nuclear will be more challenging because of the increased investor risks, challenges in financing new projects and expected new safety measures. In 2011, a number of countries, including Germany, Italy, Switzerland and Belgium, started to reconsider their standpoint towards nuclear power. Germany decided to close down all its nuclear power plants by 2022.

Despite the uncertainty prevalent in a few countries, advanced nuclear energy is expected to prevail as an important technology in the transition towards Solar Economy. Nuclear power as a CO_2-free energy technology will be needed for a long time, and its efficiency can be increased significantly in combined heat and power mode. The use of uranium energy content can also be improved considerably.

The development of small- and medium-sized reactors is an interesting future trend. Over the years, the size of nuclear reactors has grown to more than 1,600 megawatts (MW), corresponding with the logic of having a centralised power production infrastructure with large power plants. Smaller units would potentially reduce capital costs and shorten construction time.

94.3 % AVAILABILITY

Loviisa nuclear power plant's load factor, 94.3%, is very high by international comparison. The plant was in full production throughout the operation cycle, except for a short production break at Loviisa unit 1.

Fortum's nuclear power

Nuclear power plays an important role in Fortum's climate-benign energy production. Fortum operates the Loviisa nuclear power plant in Finland and is a co-owner in eight reactors in Finland and Sweden. Fortum owns 26% of Teollisuuden Voima Oyj (TVO) operating Olkiluoto nuclear power plant in Finland and in Sweden Fortum is a co-owner in Forsmark and Oskarshamn nuclear power plants through its holdings in Forsmarks Kraftgrupp AB (26%) and OKG AB (46%).

Based on Fortum's calculations, annually six million tonnes of CO_2 emissions are avoided by producing electricity at the Loviisa nuclear power plant instead of production in a coal condensing power plant. Operating a nuclear power plant requires technology know-how and detailed safety specifications and monitoring. In 2011, nuclear power accounted for 34% of Fortum's total electricity production.

Increasing safety and availability

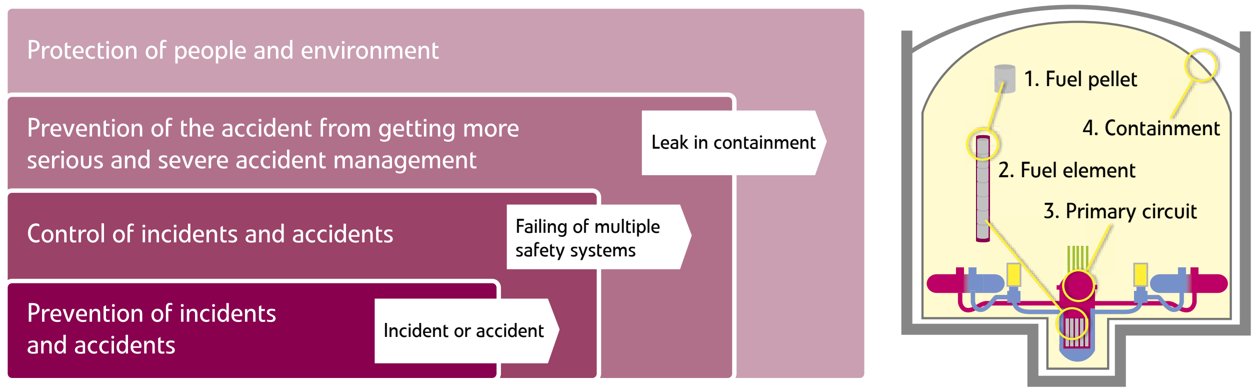
In 2011, Fortum generated 24.9 terawatt-hours (TWh) of nuclear power in the Nordic countries. The company continued the capacity upgrades at the Forsmark and Oskarshamn nuclear power plants in Sweden. Moreover, Fortum decided to participate in the financing of the bidding and engineering phase of TVO's (Teollisuuden Voima Oyj) fourth nuclear unit at Olkiluoto, Finland, with a stake corresponding to Fortum's share in TVO. The bidding and engineering phase commenced in December 2011.

2011 was a safe and good production year at Fortum's Loviisa nuclear power plant. There were no nuclear or radiation incidents reaching the International Nuclear Event Scale (INES) of significant events. The load factor describing Loviisa power plant's availability was 94.3 %, which is very high by international comparison, and the plant was in full production throughout the operation cycle, except for a short production break at Unit 1. The Loviisa power plant produced 8.06 TWh of electricity, which is about 10% of total electricity production in Finland.

The low- and intermediate-level waste repository in connection with the Loviisa power plant has been expanded in the volume of about 15,000 cubic metres. The expansion increases the temporary storage capability of maintenance waste, which improves the waste sorting possibilities and reduces the amount of waste to be disposed of. The expansion of the repository will be taken into operation in spring 2012.

As the renewal of the Loviisa power plant automation progresses, the operating staff will have improved opportunities for training and practicing in the new training simulator building. The building was completed in February 2011 and the installation of the simulator systems began in September. It is estimated to be ready for use in early 2012.

KEY ELEMENT OF NUCLEAR SAFETY MANAGEMENT IS THE MULTILAYER PROTECTION CALLED "DEFENCE IN DEPTH"



Stress tests and other safety evaluations topical in 2011

Nuclear safety, and especially preparedness for extreme external events, became a major concern in the European Union after the Fukushima nuclear accident. To make nuclear safety more transparent, the EU decided in May 2011 to carry out nuclear safety stress tests.

Safety evaluations were carried out in Loviisa and on Fortum's eight co-owned reactors in Sweden and Finland. The stress test addresses the safety of the nuclear power plant in conjunction with an earthquake, flood, weather phenomena, and loss of heat sink. It also assesses the operation of the organisation in case of a severe accident and how the plant is technically equipped to manage that.

The conclusions indicate that the design basis criteria for external events and related safety margins are robust enough at all Fortum's plants. Measures for further safety improvements will be implemented within the Loviisa nuclear power plant's normal annual investment programme. The improvements will not have an impact on the availability of the power plant. The Swedish and Finnish radiation safety

Safety evaluations were carried out in Loviisa and on Fortum's eight co-owned reactors in Sweden and Finland.

The conclusions of safety evaluations indicate that the design basis criteria for external events and related safety margins are robust enough at all Fortum's nuclear power plants.

authorities have given external conclusions for all Fortum's nuclear plants, see the statements at www.stuk.fi and www.stralsakerhetsmyndigheten.se.

In addition to stress tests, the national Radiation and Nuclear Safety Authority in Finland has carried out its own national safety evaluation in cases of power loss, exceptional weather and environmental conditions. No need for immediate safety improvements was identified. Fortum submitted a more detailed study and action plan regarding these issues in Loviisa in December 2011. In Sweden, a national coordination group led by the Swedish Radiation and Nuclear Safety Authority was established for stress tests.

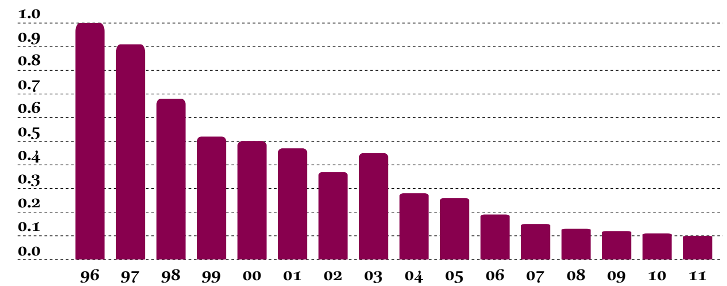
Key impacts of nuclear power

The key environmental, health and safety aspects of nuclear power are related to the thermal load of cooling water, nuclear waste management, nuclear safety and the risk of a nuclear accident.

Thermal load of cooling water

During 2011, 1,437 million cubic meters of cooling water was used in Loviisa, and the thermal load into the sea was 16 TWh. According to temperature measurements, the cooling water has increased the temperature of surface water by 1–2 °C within a distance of 1–2 kilometres from the discharge point.

RELATIVE DECREASE IN THE PROBABILITY OF A SEVERE REACTOR ACCIDENT AT THE LOVIISA NUCLEAR POWER PLANT AS A RESULT OF SAFETY IMPROVEMENTS [1)]



[1)] *The effect of severe weather conditions in shutdown states included from 2003 onwards*

Nuclear waste management in Loviisa

The waste generated during the power plant's operation is treated either in conventional (non-radioactive) or in radioactive waste management. Conventional waste is generated in, for example, the transporting of goods, in office work and in food preparation. Radioactive waste is categorised by source and original purpose into either low-, medium- or high-level waste. The low- and medium-level waste is disposed of in a waste repository built 110 metres deep in the bedrock of Hästholmen in Loviisa.

During 2011, the new waste-drum measurement equipment and the modernised facilities for the handling of metal waste were commissioned, and the repository was expanded to increase the temporary storage capacity of maintenance waste. The project of the handling systems for liquid waste continued and is planned to be completed by 2014.

Final disposal of nuclear waste

In Finland and Sweden, the legal nuclear companies are responsible for the management and final disposal of nuclear waste. All nuclear waste created must remain in the countries where generated. Globally, Swedish and Finnish nuclear companies are in the frontline in implementing geological final repository of spent nuclear fuel. The spent nuclear fuel from the Loviisa and Olkiluoto nuclear power plants in Finland is handled by Posiva Oy, which is owned by Fortum and TVO. Spent nuclear fuel will be placed in the final disposal repository in Eurajoki. Posiva Oy will submit the construction licence application to the Ministry of Employment and the Economy in 2012.

In Sweden, the Swedish Nuclear Fuel and Waste Management Company (SKB) implements the final disposal of the spent nuclear fuel from the existing plants. In March 2011, SKB submitted the application for the construction of a final disposal repository and encapsulation facility. The repository is planned at Forsmark, in the Östhammar municipality.

Fortum bears economic liabilities related to nuclear waste. Read more on page 98 in this report and on pages 89–90 in Financials 2011.

Improving nuclear safety is a continuous process

The management of nuclear safety is based on the principle of multiple isolation, parallel safety measures, systematic maintenance and modernisation, as well as continuous training. Improvement of nuclear safety at the Loviisa nuclear power plant has been a systematic process throughout the operation of the plant. The implementation of the safety measures has constantly decreased the probability of a severe reactor accident.

In 2011, the technical safety improvements at Loviisa included installation of new mesh for the containment sump strainers and the new independent air-cooled diesel generator that can replace an emergency diesel generator of both units.

Case:

Nuclear safety – an essential part of Fortum's research and development

A significant part of Fortum's research and development (R&D) activities focuses on nuclear power, aiming at first-class nuclear safety, nuclear waste management and good fuel economy. In 2011, more than half of Fortum's EUR 38 million R&D expenditure was used for nuclear energy research. In addition to its own research programmes, Fortum participates in national research programmes in Finland and Sweden.

Fortum has improved the safety of the Loviisa power plant extensively since the plant started its operations. As a result, the management of severe accidents has improved significantly.

In spring 2011, the nuclear accident in Fukushima raised a lot of concern about nuclear safety globally. After the accident, Fortum immediately started additional safety assessment in Loviisa. The assessment found that, regarding evaluated external events, the Loviisa power plant's design basis is proper and the existing technical solutions and safety margins are sufficient. Based on the assessment, however, Fortum identified some possibilities to further improve safety by, e.g., securing seawater cooling with air cooling, and securing of the fuel pond cooling in case of exceptionally long lasting accident situations.

In Finland, the nuclear power company bears the responsibility for the management of the radioactive waste produced in its own nuclear power plants. Fortum and TVO (Teollisuuden Voima Oyj) cooperate in the final disposal of high-level radioactive waste so that the long-term safety requirements can be met. As part of the study, a research space, ONKALO (cavity), at Olkiluoto is mined underground (about –400 m) in the bedrock. The bedrock is examined to ensure the safe final disposal of high-level waste. It is estimated to be ready by 2020.

Combined heat and power's role in Solar Economy

Combined heat and power (CHP) production is a significant technological solution to increase energy and resource efficiency in areas with demand for heat, like in the Nordic countries and Russia. In 2011, the share of CHP in Fortum's total power generation was 29% and in heat production 71%.

Thermal energy covers the production of electricity in CHP plants and in condensing power plants, as well as the production of heat in CHP plants or heating plants. CHP integrates the production of heat and electricity in a single process. Thermal energy production is the most common global electricity production method, while CHP is most advanced in areas with high demand for heat, like in the Nordic countries and Russia.

As an energy generation process, CHP is flexible in regard to fuels. This means that a CHP process can be applied both to renewable and fossil fuels. The specific technologies employed and the efficiencies they achieve will vary, but in every situation CHP offers the capability to make more efficient use of primary energy resources. CHP could also be utilised in connection with nuclear power.

Resource efficiency driving CHP

Due to increasing scarcity of global natural resources, resource efficiency – both in production and in energy use – will be further emphasised in the transition towards Solar Economy. Because traditional fuel combustion will still be required for a long time, efficiency is a key tool in reducing the environmental burden.

CHP will play an important role in enhancing resource efficiency, as it substantially increases primary energy efficiency. Almost 90% of the energy in CHP can be utilised. The heat generated during power production is utilised in district heating or as steam for industrial processes. CHP also reduces the environmental burden.

90 % ENERGY EFFICIENCY

Up to 90% of the primary energy can be utilised in CHP production, which is one of the focus areas in Fortum's strategy. CHP plays an important role in enhancing resource efficiency and mitigating climate change.

Fortum's CHP production

Fortum has extensive experience in CHP production in Finland, Sweden, Russia, Poland, the Baltics and the UK. Fortum operates 20 CHP plants in Europe and eight mostly gas-fired CHP plants in Russia. In 2011 the share of CHP plants in Fortum's total power production was 29% and of total heat production 71%.

The company provides district heat in almost 90 cities, including Stockholm, Sweden; Espoo, Finland ; Wroclaw, Poland as well as in Russia in Chelyabinsk and Tjumen areas, where it is the leading district heating supplier. A significant share of Fortum's district heat is produced in CHP plants. Fortum also produces heat and steam for industry in CHP plants.

Fortum produces electricity and heat from a diverse range of fuels: in Europe from natural gas, coal, oil, biomass, peat and waste-derived fuels, and in Russia from natural gas and coal.

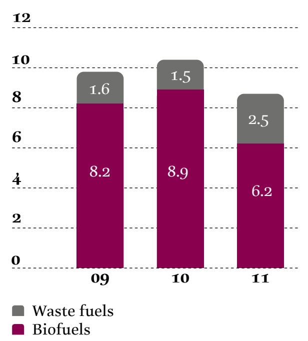
Fortum is also the leader in the Nordic countries in the use of waste-to-energy production in CHP. Energy recovery forms an integral part of sustainable waste management and simultaneously reduces the amount of waste otherwise deposited to landfills.

Bio-based CHP – even a more sophisticated solution

Bioenergy (electricity and heat produced from biofuels and biomass) as a renewable energy source and, to a large extent, as a local fuel has an important role in today's energy system and in the transition towards Solar Economy. Bioenergy is considered an important tool in mitigating climate change, because bioenergy is CO_2-neutral when taking into account its life cycle. The advantages of bioenergy are further improved when used in conjunction with CHP. The use of local bioenergy reduces dependence on imported fuels and supports local economies by employing people.

At Fortum, sustainable fuel procurement and fuel supply chain management are emphasised. In 2011, Fortum compiled guidelines and actions to improve the traceability and sustainability of bioenergy used in energy production. In Fortum's view, all bioenergy should be ecologically, socially and economically sustainable when purchased and used for energy production.

USE OF BIOFUELS AND WASTE FUELS IN FORTUM'S ENERGY PRODUCTION 2009–2011, TWh



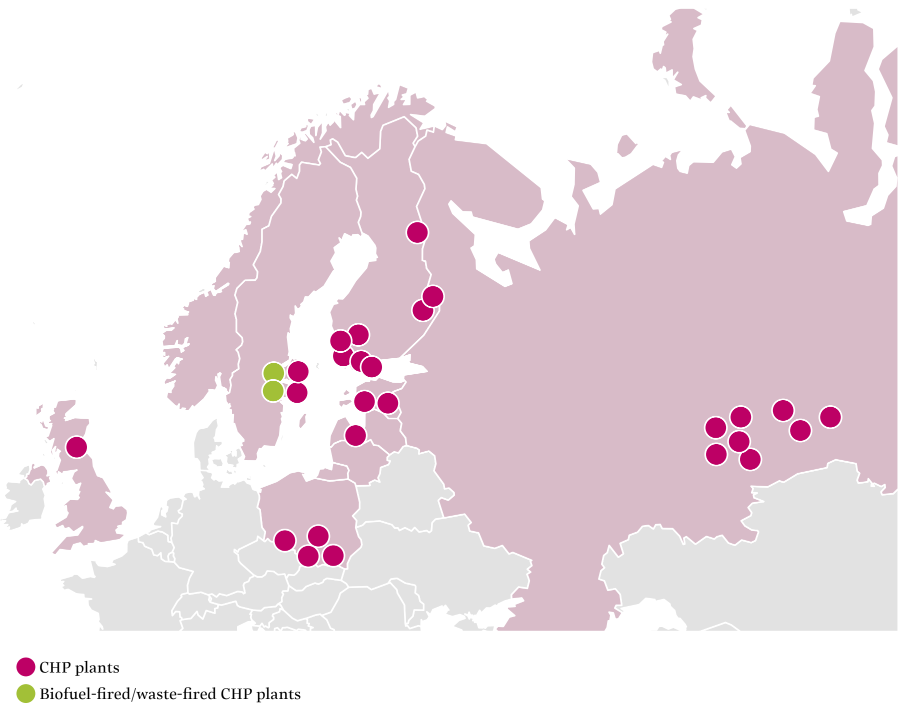
In 2011, Fortum used a total of 6.2 terawatt-hours (TWh) of biofuels, mostly in CHP and heat production. Biofuels are used as solid biomass and liquid biofuels in co-combustion with other fuels.

Advancing CHP production in 2011

In 2011, Fortum commissioned around 600 MW of new CHP capacity in Russia. Read more on Fortum's CHP investments on pages 28 and 62–64.

Fortum has also several biofuel-fired CHP plants under construction: in Klaipeda, Lithuania, in Brista, Sweden, and in Järvenpää, Finland. Increasing the use of bioenergy in co-combustion with coal using gasification or bio-torrefaction

FORTUM'S CHP PLANTS IN 2011



Case:

Raising the efficiency of heat distribution in Russia

As the fourth largest global heat producer, Fortum brings proven expertise and technologies to the Russian heat sector. In November, Fortum commenced the first phase of the integrated district heating project, Chelyabinsk Heat Ring.

Fortum operates 370 km of district heat network in Chelyabinsk. The heat losses in the existing network are high, up to 60%, whereas ,e.g., in Espoo, Finland, the corresponding figure is 20%.

The project changes the way heat is delivered to homes and businesses across the city. The Ring makes it possible to use the most efficient heat production plants depending on the heat loads. The installation of metering and regulation allows consumers themselves to regulate heat consumption. When finished, by 2017, the efficiency of the heat supply in this city of one million residents in the southern Urals area will increase by some 30%. The efficiency increase will generate savings of up to EUR 60 million annually.

In Tyumen, the second largest heat market for Fortum Russia, the company completed the automated metering system that ensures transparency in heat transfer between the trunk and distribution networks. More than 150 stations have been installed to enable the online collection of information about the status of the trunk networks.

was studied at many plants during 2011 and permit applications have been submitted to the authorities for increased use of biomass.

Key impacts of CHP

CHP is based on the combustion of fuels and resulting in emissions and environmental burden. The most significant environmental impacts of thermal energy production are related to flue-gas emissions, emissions to water, and wastes and by-products.

Emissions to air

The most significant environmental impact from fossil fuel combustion in CHP is CO_2 emissions and their impact on global warming and climate change. Energy production and use are the main source of global greenhouse gas emissions.

The combustion of fuels results in emissions of sulphur dioxide (SO_2), nitrogen oxides (NO_x) and particle emissions. Particles and heavy metals are harmful for the environment and also pose a health risk. Sulphur dioxide and nitrogen oxides have an impact on acidification. These emissions are reduced by flue gas cleaning and are controlled in power plant-specific environmental permits.

In 2011, Fortum continued preparations for the investments needed to fulfil the new emissions requirements set by the Industrial Emissions Directive (IED) from 2016 onwards in the EU countries. The IED tightens the emissions requirements for practically all Fortum's thermal power plants in the EU. Plant-specific feasibility studies and cost estimates were carried out during 2011. A more precise cost effect of the new requirements, however, will become clear after the plant-specific permit conditions have been defined during the next few years.

Waste and waste water

The waste generated from thermal energy production mainly consists of various kinds of ash, bottom slag and gypsum created as a by-product of the desulphurisation process. In Fortum's European operations, waste and by-products are utilised and recycled as efficiently as possible. In Russia, ash is stored in basins, because there is no demand for ash usage, and the wet ash handling makes utilisation more difficult.

The impacts of thermal energy production on water systems are mainly caused by the thermal loads of cooling waters, the release of solids, and nitrogen, phosphorus and heavy metal emissions. CHP is an effective way of reducing the thermal load on water systems. This also reduces the need for cooling water.

Case:

Finland's biggest hybrid plant taps into geothermal heat and bioenergy

Fortum has built Finland's biggest geothermal- and bioenergy-based hybrid plant for S-Group's logistics centre in Sipoo. Virtually all the heating and cooling energy needed by the huge logistics centre is produced with renewable energy. It is also Finland's biggest geothermal site. The hybrid plant utilises geothermal energy to produce the baseload energy for the logistics centre for as much of the operating time as possible. Heat pumps utilise solar energy that has been absorbed in the ground. The increased need for heating during winter is supplemented with wood pellets. Heavy fuel boilers are reserved for peak consumption situations only.

The fibre optics-based real-time monitoring system installed in the geothermal field is used to acquire research information about the behaviour of the geothermal field. If the heating needs of the logistic centre were covered with heavy fuel oil, it would generate 6,400 tonnes of CO_2 emissions annually. By comparison, the GeoBio hybrid plant reduces emissions by 95%, i.e., about 6,100 tonnes per year.

The plant was built and is owned by Fortum Energiaratkaisut Oy, which was divested in the beginning of 2012.