RAINPOWER
Norwegian technology for clean energy
OUR HISTORY IN BRIEF

1873: Kværner produces its first turbine

1908: Kværner exports the first hydropower turbine to New Zealand

90 % of all hydropower turbines in Norway are supplied by Kværner

10 % of all the hydropower turbines in the world are supplied by Kværner

1993: Kværner is awarded the Tianhuangping pump turbine contract

1975: Kværner is awarded the first contract for the Aurland 3 pumped-storage power station

1996: Kværner is awarded the contract for extensive upgrade work of unit 1 at Aurland 3 pumped-storage power station

1997: Kværner is awarded a contract to deliver eight
turbines to the Three Gorges power plant in China

1999: Kværner’s hydropower technology is sold to General Electric

2000: Our employees start work on runner replacement for the Guri hydropower plant in Venezuela

2003: Our employees start work on the Yixing turbine contract

2005: NLI buys Sørumsand Verksted from General Electric

2007: NLI acquires General Electric’s hydropower operations in Norway and founds Rainpower

2008: Rainpower restarts the export of hydropower turbines from Norway

2008: Rainpower Hangzhou Company Ltd. is established

2008: Rainpower buys the Oslo business Hymatek AS

2009: Rainpower is awarded the contract for extensive upgrade work of unit 2 at Aurland 3 pumped-storage power station

2009: Rainpower Small Hydro is established

2009: Rainpower decides to enter the generator technology market

2010: Rainpower Sweden AB is established

2010: Rainpower Kristinehamn AB is established

2010: Rainpower Turkey is established

2010: Rainpower Peru is established

2011: Rainpower Switzerland is established

2011: Rainpower North America is established
Increased focus on the environment and clean air has led to increased focus on clean, renewable energy sources. In Europe today there is rapid development and expansion of new energy sources such as wind and sun. However, sun and wind cannot work alone. Wind power plants produce electricity only when it is windy, and solar power requires sunshine. Users still ask for electricity after the wind has dropped. Hydropower is the only form of renewable energy that can be stored and can be connected and disconnected instantly when output is needed. In this way hydropower is taking on a new role. From being a principal supplier of electricity it is also becoming a supplier of peak power that is switched on when other renewable energy sources cannot cover the market’s needs. Hydropower reveals its strength when supply is at its lowest, need at its greatest and price at its highest.

Hydropower’s ability to deliver when prices are high also advances the development of hydropower solutions such as pumped-storage power plants. When prices are low, water is pumped up into the reservoirs, and when prices are high, electricity is generated and sold to the market.

Renewable energy sources play an increasingly important role in the energy supply worldwide. Rainpower recognizes this possibility and puts more and more emphasis on the development of new turbines with high effect.

By replacing old turbines with state-of-the-art technology, we can increase the energy generated at power stations considerably. These possibilities have lead to the establishment of new subsidiary companies in promising markets such as Sweden, Peru, Switzerland, Turkey and Canada. Our company in China continues to be crucial to our business development in Asia.

Hydropower is becoming more and more valuable as a partner for new renewable energy sources on the grid. In Rainpower we have the technology, the expertise, the staff and the willingness to exploit these opportunities!
Rainpower is a strong technologically driven corporate group supplying water turbines and generators with all related equipment for the production of clean electricity. The product range includes total solutions for new power plants and equipment for the service and upgrading of existing power plants. Rainpower provides the whole value chain from the development of technical solutions to putting the plant into operation. The Group’s activity is concentrated on product development, engineering services and production of turbines and electromechanical system solutions. Primarily we deliver a variety of products and services, engineering services, manufacture, assembly and testing in the field of renewable energy. We have long experience of managing large and small hydropower projects at home and abroad.

Our workforce of 340 has a unique expertise in turbine and generator technology. They have been involved in some of the largest and most prestigious projects in the world, such as the Three Gorges Dam project on the Yangtze River in China, the Guri project in Venezuela and pumped-storage developments including Tianhuangping and Yixing in China and Aurland 3 in Norway.

We have state-of-the-art technology for high and medium-head turbines and for pump turbines and complete governing equipment for all types of turbines and inlet valves. We are at the forefront in excitation and turbine governing systems as well as automation for small hydro.
Rainpower delivers
Proprietary technology

Low to medium head Francis turbine *Storm*
The new generation of Francis turbines uses world-class technology and is marketed under the name Rainpower *Storm*. The development work was completed in 2010 and the Chinese-built Zangmu power station will be equipped with turbines based on this technology.

High head Francis turbine *Hurricane*
A new generation of high head Francis turbines is being developed. The laboratory tests show very good results. Our Francis turbine suited for high head will be marketed under the name Rainpower *Hurricane*.

High head Pelton turbine *Blizzard*
Pelton turbines are suited for high head and low flow and are most commonly used in high head sites above 300 metres and in the small hydro segment. Rainpower is one of the leading suppliers of Pelton technology in the world. A new generation of Pelton turbines optimizing all components is being developed and marketed under the name Rainpower *Blizzard*.

Low head Kaplan turbine *Gale*
Rainpower is developing proprietary Kaplan technology to succeed in markets across the world where flow is more important than head. This new technology will be branded Rainpower *Gale*.

Reversible pump turbine *Tornado*
In the range of 50 to 700 metres Rainpower provides single-stage pump turbines that are adapted to the specific characteristics of each pump storage plant. Pumped-storage hydroelectricity is today the only economic and flexible means of storing large amounts of excess energy. We have started the development of proprietary technology for pump turbines that will be marketed under the name Rainpower *Tornado*.

Generator refurbishment and service
Rainpower has established a service unit in Västerås in Sweden that will work closely with the Norwegian and international centres of excellence for generators and provide the necessary technical support to maintenance and refurbishment projects and to new generator projects both within Norway and Sweden and beyond.

Control systems, governors and excitation systems
Rainpower aims to be the market leader in Norway within equipment for voltage regulation and turbine governing of hydropower turbines and generators. We deliver static and brushless excitation systems, electronic turbine governors and oil pressure systems, unit controllers, synchronizing units and control systems for small hydro as well as a service portfolio for the entire range. All our products are based on our hardware and software, developed in-house, bringing value to our customers by simplifying training, maintenance, support and reducing spare part requirements.

Valves
Rainpower delivers large inlet valves with a high degree of adaptability to satisfy the requirements and wishes of the customer. Special valves for bypass flow, pressure relief and others can also be delivered. Our highly skilled engineering staff will optimize the valves to fit the specific plant data to meet all customer requirements. Standard purchased valves are also offered when bundled together with other Rainpower products.

Rainpower has developed a new control system for spherical inlet valves that is based on water hydraulics. The solution is very compact and cost effective. Modified standard valves are utilized, and all control valves are connected to blocks inside the control desk.

Gates and penstock
Rainpower is a professional supplier of gate and penstock for the Norwegian and the international market.

We are in the process of building up a department which will be able to deliver a comprehensive range of equipment for the water passage - from head water reservoir to the main inlet valve ahead of the turbine, as well as bypass system and draft tube gates for the turbine.
Complete delivery process
- electromechanical packages and turnkey plants
- standard designed equipment as well as tailor-made solutions
- dynamic analysis
- complete installation and commissioning globally
- consultant services and project development
- unit control and high voltage systems
- system expertise based upon the complete range of Rainpower technology

Design
Our hydraulic designers have developed a new generation of turbines with world-class performance. Every hydropower project is unique, and each turbine is tailor-made and optimized to obtain the highest possible efficiency level over the specified operational range in head and flow, combined with good cavitation and stability behaviour.

As a supplier of electromechanical systems, we must understand the operational conditions for the plant and its role in the network, including control and protection philosophy. We design the power plants with our focus on production, availability, minimum risk and maximum safety.

Site project management, supervision, installation and commissioning
Rainpower has highly skilled and experienced staff handling supervision, installation and commissioning associated with our complete portfolio.

Rainpower maintains its focus on maintenance for power stations. Skilled technicians are available at short notice when required. A service telephone line has been set up and is manned 24/7 (+47 992 81 700).

Small Hydro
Rainpower measured the efficiency of a 3 MW Francis turbine that was delivered to Dauremål power station in Åfoten, Sogn og Fjordane County, in December 2010. The model tests from the turbine laboratory in Trondheim were good, but the finished turbine showed even higher efficiency at best point. The test result exceeded our expectations for such a small machine. The same tests were done on the project Bjørndalen in August 2011 with the same good result. This demonstrates that we have first-class technology giving us a unique position for the important business area of small hydro and it gives us an invaluable basis for further improvement of the technology.

Our turbine laboratory
The Rainpower turbine laboratory in Trondheim is an experienced supplier of hydraulic model tests and plays a vital role in the development of our turbine technology. Located on the campus of the Technical University of Norway (NTNU), it has long had excellent cooperation with the scientific staff of the University.

Our turbine laboratory and our development department are important parts of the Norwegian hydropower cluster. The skilled workforce has a great deal of experience of engineering, production, assembly, calibration, testing, geometric measuring and documentation of hydraulic models. All tests are performed according to the most recent international standards for model testing. In addition, the laboratory performs field measurements of hydraulic data, mechanical characteristics and geometry. The technical equipment is also excellent and Rainpower is proud of our world-class laboratory.

Feedback from customers during the final model tests has been without exception extremely positive, regarding both the quality of the tests themselves and their implementation.
Our hydraulic designers have developed a new generation of turbines with world-class performance.
Hydropower workshop and service department

Rainpower has a clear goal to be the leading and preferred supplier for rehabilitation, service and upgrading of hydropower plants.

Rainpower Sørumsand Verksted is recognized by customers as one of the best hydropower workshops in the world. It plays a central role in service, refurbishment and upgrading projects in Norway and abroad.

We carry out rehabilitation of all mechanical parts in a hydropower plant. The workshop delivers stainless steel Francis runners and fully assembled Pelton injectors where the strictest requirements for material quality, geometric tolerances, workmanship, process control and documentation are met.

In addition to the manufacturing mandate at Rainpower Sørumsand Verksted, the production expertise at the workshop is central in securing the quality of Rainpower’s extensive sourcing of mechanical components from qualified suppliers globally.

The workshop and the service department offer maintenance, refurbishment, installation and new deliveries to existing power stations. The organization is structured to deliver effective, flexible and prompt services. We have wide experience and great expertise in all aspects of the value chain from design, project management, purchasing, production and logistics, to installation and commissioning.

Close cooperation between service engineers and workshop personnel, upon which a successful service or refurbishment project depends, is the trademark of the execution of our services. The proximity of engineers to the workshop as well as their direct customer interaction creates the flexibility needed to ensure efficient execution of projects, where long service life can encounter unforeseen operating situations.
Rainpower
Hangzhou Company

The background for Rainpower’s expansion in China was the need for competitive prices for production and engineering services.
China has a strong hydropower supply industry and has been the world’s largest hydropower market for the last 15 years. Through its predecessors Rainpower has around 20 years’ experience of delivery of equipment and engineering services from China.

The main task of the engineering department in Rainpower Hangzhou Company is to prepare drawings for the manufacturing of Rainpower products and components. When manufacturing takes place in China, it is beneficial to have Chinese engineers with good knowledge of Rainpower’s solutions and design criteria for turbines, generators and valves.

The normal division of engineering work between Norway and China is for concept design to be undertaken in Norway. Engineers from China are present in Norway during the last phase of concept design and at the start of detailed design and ensure the best possible transfer of the work.

Our Chinese engineers have good product knowledge and this gives them an important role in the quality control of products supplied from China. They also often participate in the acceptance tests at suppliers in China together with the team of quality supervisors that follows up the production on daily basis.

After three years in operation Rainpower Hangzhou has grown to more than 40 employees and we have experienced design engineers for turbines, valves and generators.

At the same time Rainpower Technology has been able to develop new technology that can be sold all over the world and we see this as an opportunity to further extend our business here in China, Asia and Oceania by building up a sales and project office in Hangzhou.

The plan is that Rainpower Hangzhou will partly support Rainpower Norway with sales of larger complex projects in this region and partly work with sales of smaller projects for full execution locally. In the Asian hydropower market the Kværner name is still very strong. Many customers have already been in contact with us and they are positive towards Rainpower starting up sales activity in this region.
An increasing number of the Rainpower orders come from international customers. In 2010 the company therefore decided to establish several subsidiaries abroad.

Rainpower Kristinehamn AB
Rainpower sees enormous potential in the Swedish hydropower market due to both the EU demand for 20 per cent renewable energy by 2020 and also growing opposition to nuclear power. Our subsidiary company Rainpower Kristinehamn AB was established towards the end of 2010. Rainpower also entered a cooperation agreement with the engineering firm KTAB in Kristinehamn. Together they will form an expert and fully integrated provider of hydropower technology and services in the Swedish market.

Rainpower Sweden AB
In 2010 Rainpower felt it was time to invest in proprietary generator technology. In order to ensure a position at the forefront, a technology centre was established in Västerås. This subsidiary has the skills, construction experience and practical know-how needed to enable Rainpower to develop modern and efficient generators.

This department will work closely with Norwegian centres of excellence for generators and provide necessary technical support to maintenance and refurbishment projects and to new generator projects in all Rainpower markets.

A service unit for generators has also been established in Västerås with special focus on the Swedish market.

The department has also built up a strong expertise in excitation systems and will be able to offer excitation equipment from Rainpower Hymatek to the Swedish market.

Rainpower Peru S.A.C.
Rainpower has had an excellent order intake through the Quitarasca and Chevez projects in Peru and recognizes that there is enormous market potential in the region. To strengthen our presence in South and Central America we created the company Rainpower Peru S.A.C. in Lima in Peru. This new company will be our hub for the Latin-American region and in addition to monitoring existing projects, it will focus on marketing, sales, project execution and service for the whole of this dynamic region.

Rainpower Hydro Enerji ve Ticaret Limited Sirketi
Turkey has experienced enormous economic growth in recent years and needs more energy. The country puts great emphasis on developing its renewable energy sources. Rainpower has had considerable success in Turkey. Against tough international competition we have won large contracts relating to new power plants. The new office in Istanbul will follow up existing projects and provide a sales office in this promising market.

Rainpower North America
Rainpower North America Inc. was established in June 2011 with its head office in Oakville, Ontario and a satellite office in Vancouver, British Columbia. The company focuses on marketing, sales, project execution and service for North American customers.

Rainpower Switzerland
Switzerland is a key market for Rainpower in which the company has been awarded several very important orders. In a country with existing highly developed hydropower, Swiss
utilities still continue to develop new projects with increasing technical complexity. Rainpower participates actively in finding solutions to use renewable energy efficiently and sees great opportunities in the establishment of a sales and project office with local engineering and manufacturing capabilities. The aim is to efficiently provide local content for the new projects and give expert support related to existing power plants by delivering quick response and secure short outage periods.

Rainpower is growing and an increasing number of the orders originate from international customers.
Recent references

Quitaracsa: a new power plant in Peru with Pelton Blizzard turbines
Rainpower will supply two Rainpower Blizzard Pelton 56 MW turbines with control valves and two 65.9 MVA generators and associated fittings to the Quitaracsa project, owned by Enersur in Peru. The power plant is situated 500 km northeast of Lima. Rainpower is the lead consortium partner together with the Italian company STE Energy and has responsibility for all electromechanical equipment for the power station, dam and waterway.

Chevez: a new power plant in Peru with Pelton Blizzard turbines
Empresa de Generación Eléctrica Cheves S.A. (SN Power in Peru) has commissioned Rainpower to supply equipment to the Cheves power station, which is situated near Churin, northeast of Lima. The order covers project management, design, purchasing and installation as well as two of Rainpower’s own Blizzard design 87 MW Pelton turbines with runners, two ball valves, two turbine governors and Rainpower Hymatek excitation equipment. In addition Rainpower will supply cooling systems and other mechanical equipment. On this project Rainpower is working with ABB, Canada and the French company Jeumont Electric.

Aslancik: a new power plant in Turkey with Francis Storm turbines
The Turkish energy company Aslancik Electrik Uretim Anonim Sirketi has awarded Rainpower a contract for supply to the power station Aslancik, which is situated on the Black Sea coast near to the town of Trabzon in Anatolia. Rainpower’s involvement includes project management, design, purchasing and installation as well as two 60 MW Francis turbines with Rainpower Storm runners, two gate valves, two Rainpower Hymatek turbine governors, cooling systems and other mechanical equipment. Rainpower is also the consortium lead partner in this project which is being carried out with Koncar in Zagreb, Croatia, and Alstom Grid in Ankara, Turkey.

Tussa: new small hydro plants in Norway with Pelton Blizzard turbines
In December 2010 an agreement was also entered into with Tussa Energi to supply four small plants in Standal, Viddal, Dalegjerdet and Draura in Sunnmøre in Western Norway. This order consists of four vertical Pelton turbines with penstock, main control valves and generators. The four small power plants will provide 5000 households with clean and renewable energy. An additional contract was awarded to Rainpower early 2011 consisting of complete electrical balance of plant and automation systems to the same power plants.

Statkraft Energi AS: eight electronic governors and nine oil pressure systems
Towards the end of 2010 Rainpower entered into an agreement with Statkraft Energi AS for the delivery of eight electronic turbine governors and nine oil pressure systems for seven Statkraft plants. The contract is one of the biggest ever signed in Norway for the delivery of turbine governors.

Rendalen 2: turbine, main valve and turbine governors
Rainpower is in the process of executing the Rendalen 2 project for Eidsiva Vannkraft AS. The turbine to be supplied will produce 100 MW, suitable for a head of 185 metres. Rainpower will also supply the main valve and turbine governors and carry out installation and commissioning. For the waterway Rainpower will supply 140 metres of penstock, with a diameter of 3.8 metres, butterfly valves, draft tube gates, vertical gate and valve into the settling chamber with pipes. The delivery will be completed in October 2012.
Robiei: an upgrade project with reversible pump turbines in Switzerland
Rainpower has entered into an agreement with the Swiss energy producer Ofima for the delivery of equipment to the Robiei power plant. The contract comprises pump turbines and a Francis turbine with equipment, replacement of the electromechanical equipment at the plant, as well as four reversible pump turbines suitable for a head between 284 and 395 meters, with maximum effect of 41 MW. One Francis turbine is adapted to a head between 270 and 390 meters, with maximum effect of 27 MW. The deliveries include inlet and outlet valves, as well as oil pressure systems. Due to the large variations in head, Rainpower will perform model testing of two different turbine runners. The project will be carried out in a consortium with Alstom in Switzerland, who supply generators/motors and the inlet valves for the pump turbines.

Svartisen: upgrading of power station
Rainpower has delivered the complete turbine, main valve and turbine governor as well as excitation system. Rainpower has also supplied the 350 MW turbine generator.

Ausland II: revision of turbine 1
Early March 2011 Rainpower entered into a contract with E-Cho Energi for the revision of turbine I of the Aurland II hydropower station. This Francis turbine of 72 MW was delivered by Kværner in 1972. The customer required a supplier with competence and capacity to complete revision work specified both related to mechanical equipment and generator. The revision work was successfully completed in late July.

Råtan power station: replacement of governor system
Rainpower in Kristinehamn was elected to replace the governor system in the Råtan power station in Sweden. The contract involves delivery of two complete hydraulic governor systems and new electronic regulators. Råtan power station was built in 1968 and has two generators with a capacity of 60 MW. Normal annual production is 227 GWh and the head is 61 metres.
Rainpower locations

NORWAY

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<th>Location</th>
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<tr>
<td>Kjeller</td>
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<tr>
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SWITZERLAND

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NORTH AMERICA

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PERU

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SWEDEN
Kristinehamn  Low head turbine projects
Västerås  Generator projects

TURKEY
Istanbul  Sales & Project office

CHINA
Hangzhou  Supply & Engineering
Sales & Project office