

INDALSÄLVEN

A journey along one of Sweden's magnificent rivers

THE WATERS OF INDALSÄLVEN HAVE A WILL OF THEIR OWN. FROM THE JÄMTLÄND MOUNTAINS VIA LAKE STORSJÖN AND STORSJÖBYGDEN, ALONG THE DEEP, FORESTED VALLEYS OF MEDELPAD FLOWS INDALSÄLVEN. VILDHUSSEN'S ATTEMPT TO CREATE A LOGGING CHANNEL SILENCED THE MIGHTY STORFORSÉN FALLS FOR ALL ETERNITY.

BUT THE RIVER'S RELENTLESS, WINDING JOURNEY HAS CONTINUED TO THE GULF OF BOTHNIA AND KLINGERFJÄRDEN OUTSIDE SUNDSVALL.



THE HISTORIC JOURNEY — FROM THE ICE AGE TO THE FUTURE .

About 12,000 years ago, the inland ice receded. The climate grew successively warmer and Scandinavia, entombed under three kilometres of ice for tens of thousands of years, would soon burgeon forth. The inland ice melted quickly, retreating to the point when, after only a couple of thousand years, eternal winter was replaced by a new landscape. Meltwater followed ancient furrows, eroding mountains and transforming the face of the land. The water deposited fertile soil along the river valleys. And where the ice had released its grip, people lost no time in finding new grounds in which to hunt and gather.

The first inhabitants, hunters and gatherers, lived well on the plentiful game and fish. Soon, they also learned to farm the fertile river valleys and, eventually, that the power of the rivers could be harnessed. Waterpower was utilized as early as the 1200s. Gristmills and sawmills

were built, logs were floated downstream and the rivers became vital for transport. But their most important contribution to the development of society had yet to be realized.

With the late industrial revolution came large-scale use of electricity. For centuries, only a tiny fraction of the kinetic energy from the rivers had been utilized. Then, at the turn of the last century, engineers began to see the enormous potential of hydropower. In 1910, Sweden's first hydropower plant, Olidan, on the Göta River, began to supply power for industry and the railway. That signalled the start of the development of our rivers. Today, hydropower accounts for nearly half of Sweden's total electricity demand. In the future, hydropower will continue to play an important role, perhaps the most important role, as a renewable energy source.



The rapid melting of the inland ice contributed to the formation of river valleys and enriched the soil. For thousands of years, the rivers have played an important role in the development of society. The power of the river, once used for log driving, now accounts for nearly half of our total electricity demand.

WATER IS ON A NEVER-ENDING JOURNEY.

Waterpower is a sensible way of using a natural eco-cycle. Water vapour, which forms when the sun warms the lakes and oceans, rises to the higher, colder layers of air, where it condenses and forms clouds. When the clouds move in over the land, they release their burden in the form of rain or snow. That rain and snow is what keeps our rivers flowing. On its journey to the coast, we take advantage of the water's potential energy. Still within the eco-cycle, the water returns to the lakes and the sea, and the process begins again. Hydropower comes from a renewable source and makes use of Nature on Nature's terms.

ENERGY DEMAND CONTROLS PRODUCTION.

Electricity from large-scale production cannot be stored, but must be used the instant it is produced. That is why we control hydroelectric generation with the help of reservoirs.

During the spring and early summer when the snow melts, and even during the autumn when it rains more often, huge volumes of water are stored. We can then use this water to produce electricity during the winter months, when power demand is greatest and the rivers receive no inflow from precipitation. In a river that has been developed for hydro production, water levels are controlled very carefully. The release of water from reservoirs is determined by energy demand in accordance with regulations establishing water levels and flow rates.

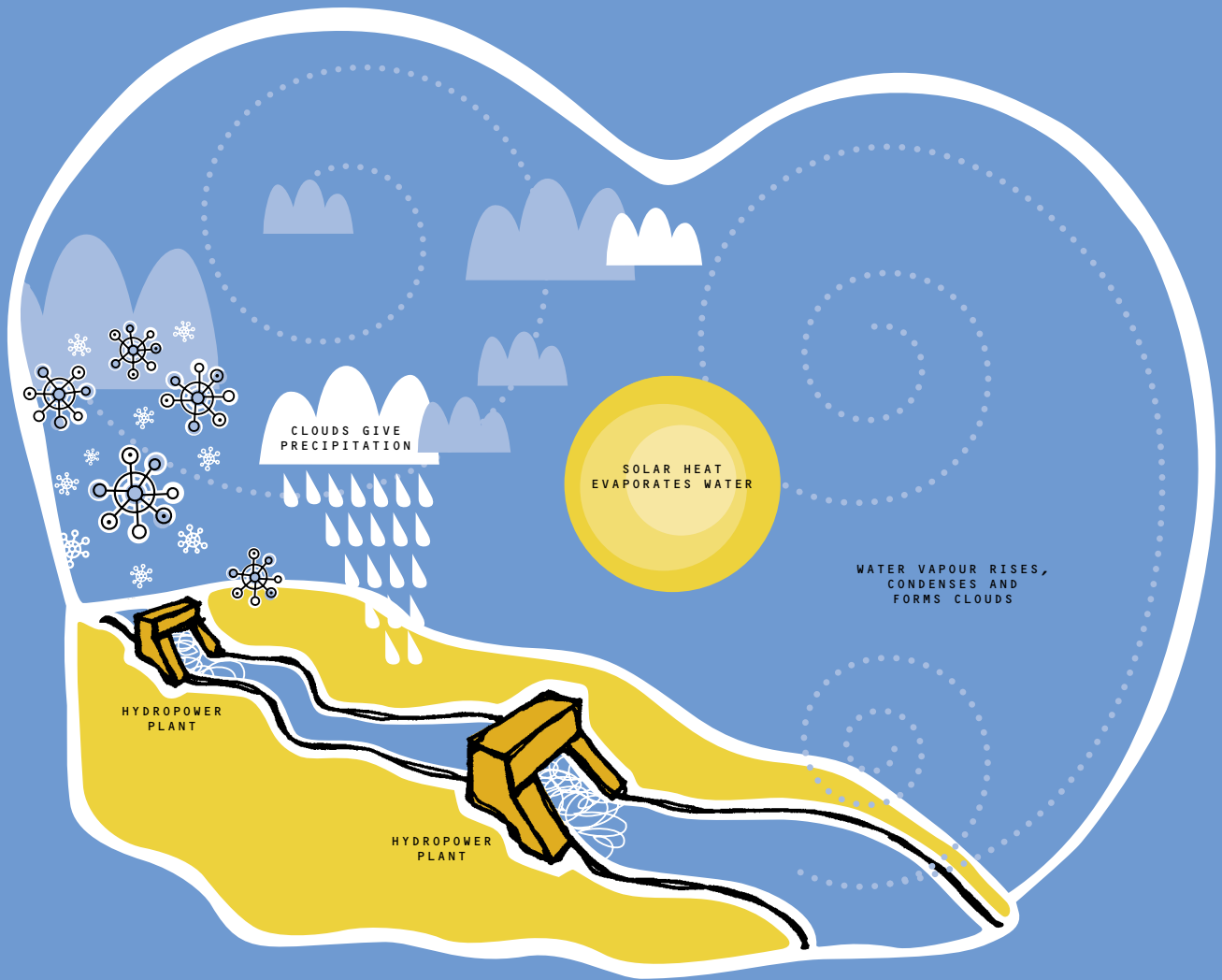
FOR VATTENFALL, THE ENVIRONMENT COMES FIRST.

Hydropower is a green energy source that does not harm the air we breathe or the water in our rivers. The process creates no hazardous wastes and no emissions are discharged to the air or water. Even so,

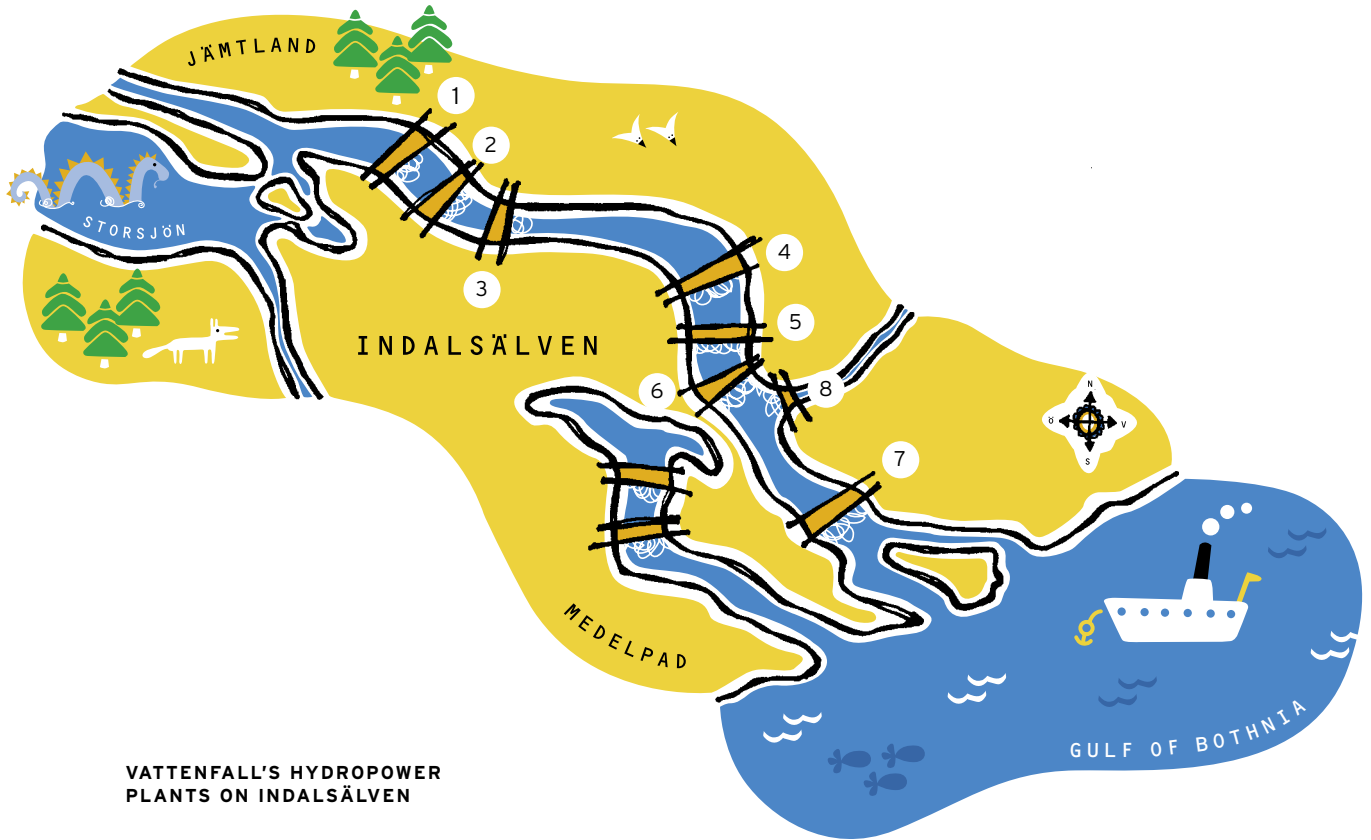


Average annual rainfall in Sweden is between 600 and 700 mm. Abisko, on the other hand, gets about 300 mm of rain per year, which is about the same as the Gobi Desert.

hydropower production does give rise to a certain degree of environmental impact. The power stations, dams and reservoirs that are essential for utilizing the power of rivers have a great impact on the flora and fauna, both upstream and downstream. The natural reproduction of salmon species is disrupted. Vattenfall is therefore working to minimize the environmental impact caused by hydropower production. Salmon ladders have been built to help the fish bypass the dams. Vattenfall also releases around 1.3 million salmon and sea trout smolt annually in order to maintain the balance of growth. Today, environmental aspects are given very careful consideration when hydro stations are renovated or enlarged. Together with other power companies, Vattenfall is also involved in several projects of which the aim is to reduce environmental impact on our regulated waterways.



THE WATER CYCLE IS ETERNAL. THE SOURCE OF ALL LIFE.
BY USING NATURE ON NATURE'S TERMS, WE HAVE ACCESS TO A
SUSTAINABLE, RENEWABLE ENERGY SOURCE.



VATTENFALL'S HYDROPOWER PLANTS ON INDALSÄLVEN

- | | |
|---------------|---------------|
| 1 Midskog | 5 Hölleforsen |
| 2 Näverede | 6 Järkvissle |
| 3 Stugun | 7 Bergforsen |
| 4 Stadsforsen | 8 Sillre |



HYDRO TALK

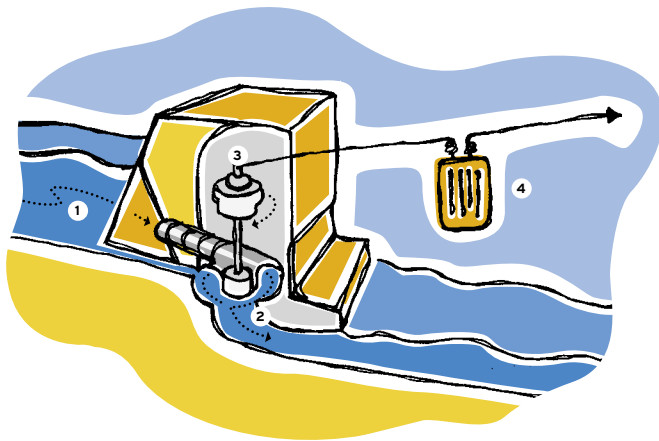
How much energy does it take to light a 60-watt light bulb for 24 hours, to vacuum for one hour, or to watch a full-length film on TV?

Look at your household electrical appliances. Somewhere you'll find a label stating power requirement (in watts). If you multiply the power in kW by the number of hours you use the appliance, you get the total power requirement (in kWh).

Example: 60W light bulb for 24 hours:
 $0.006 \text{ kW} \times 24 = 0.144 \text{ kWh}$.

THE ENERGY JOURNEY — FROM RIVER TO CUSTOMER.

The amount of energy that can be converted is directly related to two factors: head and flow. Head is the difference in height between the water surface above and below the dam. Flow is the amount of water passing the turbine per unit of time. Since power is the product of head and flow, a higher head and a higher flow give a higher output. The energy utilized is referred to as potential energy. Quite simply, we make use of the height difference between two water surfaces to drive a turbine, which in turn drives a generator. The generator converts mechanical kinetic energy from the turbine into electricity. A transformer steps up the voltage and the electricity can be distributed around the country.



1. Reservoir

Water is dammed up to create higher head and for storage, so that power production can be controlled.

2. Turbine

On its way to the lower level below the dam, the water passes through a turbine. The turbine shaft, driven by the flowing water, drives a generator.

3. Generator

The generator converts mechanical energy from the rotating turbine shaft into electricity.

4. Transformer

In order for the transmission lines to carry the electricity efficiently over long distances, the low generator voltage is increased to a higher transmission voltage by a step-up transformer.



VATTENFALL'S HYDROPOWER PLANTS ON INDALSÄLVEN

Station	Starting year	Normal annual prod. GWh	Max. output MW
Midskog	1944	725	150
Näverede	1955	318	64
Stugun	1956	181	41
Stadsforsen	1939	825	139
Hölleforsen	1949	720	148
Järkvissle	1959	434	88
Bergeforsen*	1955	735	168
Sillre	1987	28	11

* Part ownership by Vattenfall

GWh = Gigawatt hours

MW = Megawatts

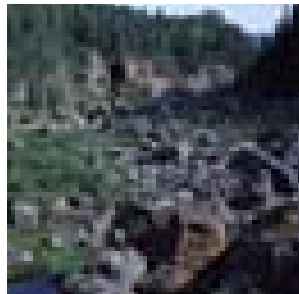
In all, there are 31 hydropower plants on Indalsälven, of which Vattenfall owns eight.

YOUR OWN JOURNEY OF DISCOVERY ON INDALSÄLVEN.

The mountains of Jämtland, which give rise to Indalsälven, are also a source of many other fabulous nature experiences and attractions. Tännforsen, protected as a natural history and conservation area, is one of them. The water cascades down 30 metres of rapids to culminate in one of Sweden's mightiest waterfalls. On sunny summer days, the mist over Tännforsen lights up with a beautiful rainbow. In winter, the sight is just as magnificent when motion is frozen in ice, as if time stands still. Further along, just a few hundred metres from the nearest community, is Stugun, a popular mountain upon which all kinds of adventurers test their nerve and their climbing skills. Indalsälven is a typical woodland river that runs from Stadsberget down towards the coast through a deep valley in which forestry and agriculture have shaped the character of the rural landscape. On your journey to the coast, be sure to visit Krångede Hydropower Museum, where you can learn about the hydro pioneers' situation and see a newly renovated logging sluice and the world's longest photo exhibit.



Tännforsen is magnificent, summer and winter.



Döda fallet, the Dead Falls of Storforsen - Vildhussen's work.



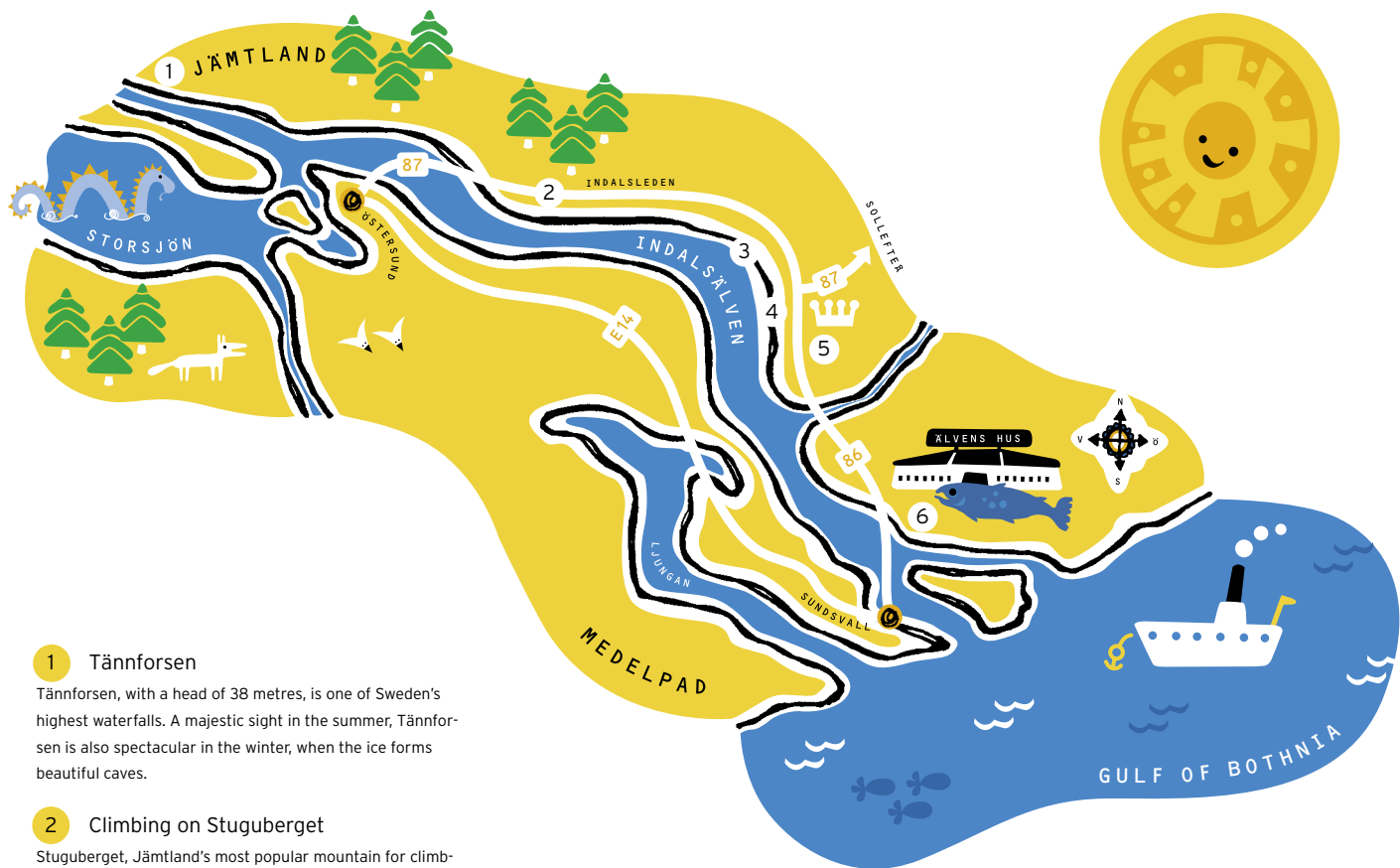
An unusual attraction, the **Thai Pavilion**.



Salmon farming at the **Bergeforsen freshwater aquarium**.

NORRLAND MEETS THE EAST

Logging has played an important role in the history of Indalsälven, just as it has on Sweden's other northern rivers. An attempt to create a channel to bypass the imposing Storforsen Falls had disastrous consequences. Magnus Huss, also called Vildhussen, became known as the man who silenced Storforsen and created Döda Fallet - the Dead Falls. Your visit will be a fascinating experience. But perhaps the most extraordinary sight is the Thai Pavilion in Utanede. Amid the pine and spruce stands a remarkable and unique structure, a building that commemorates Thai king Chulalongkorn's 1897 trip along Indalsälven. Near the end of Indalsälven's journey lies the Bergeforsen power station. Nearby, 400,000 salmon and sea trout smolt are produced each year and released into the river. At the salmon farm at Bergeforsen, which is one of Sweden's largest, you can also see salmon and sea trout swimming around in an enormous freshwater aquarium.



1 Tännforsen

Tännforsen, with a head of 38 metres, is one of Sweden's highest waterfalls. A majestic sight in the summer, Tännforsen is also spectacular in the winter, when the ice forms beautiful caves.

2 Climbing on Stuguberget

Stuguberget, Jämtland's most popular mountain for climbing, with over one hundred trails and approaches, is a must for adventurers, thrill-seekers or anyone looking for a challenge. The nearest village is just a few hundred metres away.

3 Krångede Hydropower Museum

See what living conditions were like for the hydropower pioneers in the early days of the last century. Walk along the renovated logging sluice, view the world's longest photo exhibit and visit a log driver's cabin down by the river.

4 Döda Fallet, the Dead Falls at Storforsen

Magnus Huss's attempt to create a channel to bypass Storforsen ended in disaster. Today, Döda Fallet continues to fascinate visitors.

5 The Thai Pavilion

In Utanede, just south of Bispgården, an unexpected structure rises up in the forest. The Thai Pavilion commemorates Thai king Chulalongkorn's 1897 trip with Swedish king Oscar II along Indalsälven.

6 Bergeforsen salmon farm and power plant

Near the mouth of the river lie Bergeforsen salmon farm and power station. Each year, Vattenfall stocks Indalsälven with about 50 tonnes of salmon and sea trout from one of Sweden's largest fish farms. See the fish at close range in the freshwater aquarium.

VATTENFALL'S JOURNEY — FROM HYDRO PIONEERING TO HIGH-TECH GENERATION.

As early as 1909, Vattenfall was producing electricity from the Trollhätte Canal and waterworks. Sweden's growing industries, railways and cities had an insatiable hunger for inexpensive energy. The power stations at Porjus, Olidan and Älvkarleby were built mainly to supply the railways with electricity. This was the start of hydropower development and a major step forward for Swedish industry.

HYDRO, NUCLEAR AND WIND POWER.

Today, by means of hydro, nuclear and wind power, as well as with fossil fuels, biofuels and waste, Vattenfall produces both electricity and district heat. In Sweden, hydro and nuclear energy are the basis of electrical power production. We operate three nuclear power stations and about a hundred hydropower plants. With forty wind-power plants, we are one of Sweden's largest producers of wind-generated electricity.



ONE OF EUROPE'S LEADING ENERGY COMPANIES.

Deregulation has enabled Vattenfall to expand its market area over a large part of Europe. Our goal is to become one of Europe's leading power producers. We have the capacity and know-how to supply our customers with energy, mainly electricity and heat, that is economical, makes good sense environmentally and is tailored to individual needs. We give our customers value for money by providing energy for quality of life, heat, light, comfort, safety and security, with reliability and good resource management. Now and in the future.

EFFICIENCY AND ENVIRONMENT.

We are making an ongoing effort to improve efficiency and the environment in our production facilities, always keeping human health and wellbeing, working environment and safety in focus. Vattenfall works in compliance with recognized environmental management systems.

Our customers can now choose to take delivery of environmentally friendly electricity from our renewable power sources. We guarantee that 95% of this electricity is from hydropower sources and 5% is from wind power. We also offer VattenEi EPD, which means that the electricity is produced on the Lule and Ume Rivers. EPD stands for Environmental Product Declaration.

We are committed to the environmentally sound development of future energy alternatives and to making Vattenfall the customers' number-one choice where both economy and environment are concerned.



POWER YOU CAN RELY ON



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