

Summary of Vattenfall AB's Certified Environmental Product Declaration of Electricity from the river Lule älv S-P-00001, 1998-02-01, updated 2002-03-01.

MANUFACTURER

Vattenfall AB Vattenkraft is responsible for the generation of electricity on the river Lule älv. Vattenfall AB Vattenkraft is a part of Vattenfall AB, SE-162 87 Stockholm, Sweden. Phone: +46-8-739 50 00; fax: +46-8-37 77 95; <http://www.vattenfall.se>. Vattenfall AB Vattenkraft has been certified in accordance with ISO-14001 since 1999, and certain installations are registered in the EMAS system.

THE PRODUCT AND FUNCTIONAL UNIT

Vattenfall AB Vattenkraft owns all 15 hydropower plants on the river Lule älv. These plants have a total installed capacity of 4350 MW and generate 13.6 TWh in an average year. The approximately 10 reservoirs on the river allow the generation to follow the load curve, and electricity can be delivered without backup sources. The functional unit is 1 kWh of electricity delivered to the main grid during the reference year, 2000.

ENVIRONMENTAL PERFORMANCE

The EPD[®] system, managed by the Swedish Environmental Management Council, is based on ISO TR 14025, Type III environmental product declarations. The relevant governing documents in hierarchical order are: PSR 1998:1, rev 1, MSR 1999:2, ISO 14025, ISO 14040-43, and ISO 13600.

SYSTEM BOUNDARIES

The EPD[®] contains two phases, *generation* and *use* (PSR). The use phase is mainly qualitative and comprises transmission and distribution of 1 kWh electricity. The assumed lifetimes are 60 year for the machines and 100 years for the dams.

The power plants at Seitevare, Harsprånget, Porsi and Boden, with their respective storage reservoirs, have been inventoried with respect to construction and operation. Dismantling has not been included since the pace of reinvestment is such that the entire plant is renewed during its assumed lifetime. The chosen plants have a third of the installed capacity and generate a third of the electricity on the river. The plants are representative for the entire river as their climate, geography, technology and construction year all vary. Different functions are also covered since one long-term and two short-term storage reservoirs are included. Compared to the earlier version of this EPD[®], one more station has been included, Porsi. The reason is that new technology was installed there in 2001. The importance of this technology substitution will assert itself at the next updating of this EPD[®]. The complete certified declaration also includes descriptions of risks, biodiversity impacts and land use, in accordance with PSR.

The generation phase

A very short summary of inventoried data is presented below.

Category Resource use	Unit/kWh	Input
Non-renewable materials:		
Copper in ore	g	0.00492
Gravel and sand	g	13.8
Iron in ore	g	0.153
Limestone	g	0.565
Rock	g	35.9
Soil	g	20.8
Renewable materials:		
Wood, moist	g	0.0271
Non-renewable energywares:		
Coal,oil, natural gas	kWh	0.000197
Uranium in ore	g	$4.05 \cdot 10^{-6}$
Renewable energywares:		
Bio fuels	g	0.00647
Hydropower	kWh	0.000137
Use of recycled materials:		
Metal scrap	g	0.0451
Water use*	g	2.13
Materials from the technosphere (aggregation of app. 50 substances)	g	0.00946

*This does not include the water passing through the turbines.

Emissions

Total emissions, emissions caused by inundation and weighted totals for the entire river are presented below.

Emission	Unit/kWh	Total Seitevare	Total Boden	Total Har- språnget	Total Porsi	Inun- dation	Total for the river Lule älv
		Relative share of the total weighted valaue for the whole river.					Weighted figure
		17.4%	10.1%	47.1%	25.4%		
GHGs	g GWP eq (100 year)	0.531	0.819	0.809	1.40	4.30	5.21
Ozone-depleting gases	g CFC-11 eq. (20 year)	$4.10 \cdot 10^{-9}$	$8.13 \cdot 10^{-9}$	$8.94 \cdot 10^{-9}$	$11.9 \cdot 10^{-9}$		$8.76 \cdot 10^{-9}$
Acidifying substances	mole H ⁺	$1.02 \cdot 10^{-4}$	$1.24 \cdot 10^{-4}$	$1.13 \cdot 10^{-4}$	$2.12 \cdot 10^{-4}$		$1.37 \cdot 10^{-4}$
Gases contributing to the formation of ground-level ozone	g ethene- eq.	$1.52 \cdot 10^{-4}$	$1.64 \cdot 10^{-4}$	$1.48 \cdot 10^{-4}$	$2.60 \cdot 10^{-4}$		$1.79 \cdot 10^{-4}$
O ₂ -consuming/eutrophying substances	g O ₂	0.0216	0.0208	0.0188	0.0382	2.92	2.94
Toxic substances:							
Antimony (Sb)	g	$2.62 \cdot 10^{-10}$	$5.27 \cdot 10^{-10}$	$2.40 \cdot 10^{-10}$	$3.40 \cdot 10^{-10}$		$2.98 \cdot 10^{-10}$
Arsenic	g	$4.90 \cdot 10^{-8}$	$7.65 \cdot 10^{-8}$	$12.6 \cdot 10^{-8}$	$8.50 \cdot 10^{-8}$		$9.70 \cdot 10^{-8}$
Dioxin	g	$5.16 \cdot 10^{-15}$	$6.97 \cdot 10^{-15}$	$12.2 \cdot 10^{-15}$	$6.68 \cdot 10^{-15}$		$9.06 \cdot 10^{-15}$
Oil to water	g	$2.73 \cdot 10^{-5}$	$4.00 \cdot 10^{-5}$	$2.24 \cdot 10^{-5}$	$6.62 \cdot 10^{-5}$		$3.62 \cdot 10^{-5}$
PAH	g	$1.66 \cdot 10^{-8}$	$4.05 \cdot 10^{-8}$	$3.87 \cdot 10^{-8}$	$5.35 \cdot 10^{-8}$		$3.88 \cdot 10^{-8}$
Deposition of phosphorus in river sediment	g					$1.90 \cdot 10^{-3}$	$1.90 \cdot 10^{-3}$

Other information	Unit/kWh	Input	Output
Toxic waste, fuel-related: Highly radioactive waste products	g		1.37*10 ⁻⁶
Toxic waste, non fuel-related	g		0.0423
Material to recycling: Crushed concrete	g		0.00014
Metal scrap	g		0.0514
Land use:	m ²	0.00023	
Out of which inundated area	m ²	0.000154	

Noise

The most notable noise outdoors is the sound from water running through above-earth power plants. The noise levels are, however, lower than before development.

Conclusions

The major share of the environmentally relevant emissions are connected to the construction of, and re-investment in, plants and dams. Emissions of GHGs and eutrophying substances are, however, mainly caused by the inundation. The greenhouse effect is minor, by international comparison, since no methane is generated at these latitudes.

Differences to the earlier EPD® version

There are several differences between the present EPD® and the earlier version, certified in 1999. There are several reasons for this, e.g. new assessment methods, new information regarding the lifetime of dams, extended inventories and some added accounting.

The use phase

The use phase (PSR) for the product consists of transmission and distribution of electricity, plus the extra production caused by transmission losses in the grid. The life cycle of the grid consists of construction, operation and dismantling. The transmission corridors have a demonstrated positive impact on biodiversity.

LAND USE AND IMPACT ON BIODIVERSITY

Vattenfall's Biotope Method[©] analyses the impact on biodiversity as a direct consequence of the utilisation of land and water for economic activities. Affected areas are categorised into Critical biotope, Rare biotope, General biotope and Biotope loss.

The four studied power plants, with their respective storage reservoirs, together occupy and area of 10 350 hectares. The main part of this, 9 840 hectares, are reservoirs. A total of 6 900 hectares have been inundated in connection with dam construction and reservoir establishment. The table below shows the changes to biotope categories caused by the construction of the four plants.

Biotope Category	Before		After		Difference	
	ha	m ² /kWh	ha	m ² /kWh	ha	m ² /kWh
Biotope loss	0	0	6 896	1.5*10 ⁻⁴	6 896	1.5*10 ⁻⁴
Critical biotopes	5 797	1.3*10 ⁻⁴	0.9	2.0*10 ⁻⁸	-5 796	-1.3*10 ⁻⁴
Rare biotopes	983	2.2*10 ⁻⁵	1.6	3.6*10 ⁻⁸	-981	-2.2*10 ⁻⁵
General biotopes	3 571	7.9*10 ⁻⁵	3 454	7.7*10 ⁻⁵	-117	2.6*10 ⁻⁶

Compilation of biotope changes for the four power plants on the river Lule älv.

RISK INVENTORY AND OTHER INFORMATION

See chapter 5 in the complete EPD® documentation, reference 1.

INFORMATION

This is a very short summary of the material that has been certified. The complete documentation is presented with a step-wise and user-friendly methodology.

REFERENCES TO THE COMPLETE DOCUMENTATION

1. Vattenfall AB Generation's Certified Environmental Product Declaration for electricity from the river Lule älv.
2. Ume och Lule älv, teknik och miljö. *Bilaga till Vattenfall AB Elproduktions Certifierade Miljövarudeklaration för el från Ume älv* som kan beställas från Vattenfall. Only in Swedish.

VALIDITY

EPD® S-P-00001, which has been re-certified in accordance with the rules for the EPD® system, is valid until the 1st of March, 2005.

ACCREDITED CERTIFYING BODY

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