GLOSSARY

Acidification, AP :

Chemical alternation of the environment, resulting in hydrogen ions produced more rapidly than they are dispersed or neutralized. Occurs mainly through fallout of sulfur and nitrogen compounds from combustion processes. Acidification can be harmful to terrestrial and aquatic life.

Eutrophication, NP :

Enrichment of bodies of water by nitrates and phosphates from organic material or surface runoff. This increases the growth aquatic plants and may induce the development of alga blooms that deoxygenates water and smother aquatic life.

Global warming potential, GWP :

Index used to translate the level of emissions of various gases into a common measure to compare their contributions to the absorption by the atmosphere of infrared radiation. GWPs are calculated as the absorption that would result from the emission of 1 kg of a gas to that of the emission of 1 kg of carbon dioxide over 100 years.

Life cycle assessment, LCA :

A management tool for appraising and quantifying the total environment impact of products or activities over their entire lifecycle of particular materials, processes, products, technologies, services or activities. Lifecycle assessment comprises three complementary components : inventory analysis, impact analysis and improvement analysis.

Ozone depletion potential, ODP :

Index used to translate the level of emissions of various substances into a common measure to compare their contributions to the breakdown of the ozone layer. ODPs are calculated as the change that would result from the emission of 1 kg of a substance to that of emission of 1 kg of CFC-11 (a freon).

Photochemical ozone creation, POCP :

Index to translate the level of emissions of various gases into a common measure to compare their contributions to the change of ground-level ozone concentration. POCPs are calculated as the change that would result from the emission of 1 kg of a gas to that of the emission of 1 kg of ethylene.

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Environmental Product Declaration

AC machine type AMG
in the 500-5000 kVA power range

ABB

Organisational framework

Manufacturer

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The division AC Machines of ABB Automation in France is part of ABB's Automation Technology Products segment. The company develops, manufactures and markets electrical machines for customers world-wide and is within the ABB Group responsible for several key products groups, including low and high voltage AC machines and generators.

Environmental management

The ISO 14001 international environmental management standard has been implemented and the Champagne-sur-Seine factory has been certified since 1998. Lifecycle assessment is applied continuously to all product development.

The Champagne-sur-Seine factory was awarded the ISO 9001 quality certificate in 1992 in recognition of its commitment to maintaining the high quality of its product.

Product description

AMG generators have axle heights ranging from 400 mm to 630 mm. The range of rated output is 500 kVA – 8 000 kVA, and voltages from 380 V up to 11 500 V. Typical applications of the AMG generators include gas/diesel engine, marine auxiliary generating sets and shaft generators etc…

Material for the product is used according to the following table:

	kg/product		kg/ kVA	
Type of materials	AMG 450	AMG 630	AMG 450	AMG 630
Electrical steel	2678	9340	2.97	2.17
Other steel	2336	6197	2.60	1.44
Copper	529	1035	0.59	0.24
Insulation material	17	213	0.02	0.05
Impregnation resin	24	125	0.03	0.03
Paint	11	51	0.01	0.01
Solvent	6	28	0.01	0.01

The AMG 450 of 900 kVA and the AMG 630 of 4300 kVA have been chosen as the extremes of the range when calculating the Life Cycle Assessment. For machines in-between these limits the environmental impact may be interpolated.

Environmental performance

The data and calculations are in accordance with the Product Specific Requirements (PSR) for Rotating Electrical Machines dated April 2000, which specify the following baselines for the LCA calculation.

Functional unit

The functional unit for LCA is 1 kVA of rated output power.

System boundaries

The lifecycle assessment covers all environmental aspects for extraction and production of raw materials, manufacturing of main parts, assembly of the machine, transportation and use of the product, dismantling, fragmentation, disposal and recycling scrap at the end of the product's life. It includes consumption of material and energy resources as well as emissions and waste generation.

Calculations are based upon an estimated lifetime of 25 years when operating 6500 hours per year. A French mix of energy has been used to calculate energy consumption during use and disposal.

The operational point chosen for the usage phase is 900kVA, 900 rpm and efficiency 94.6 % for AMG 450 and 4300 kVA, 1500 rpm and efficiency 96.1 % for the AMG 630. The operational point will actually vary considerably dependent upon the specific application.

Allocation unit

The factor for allocation of common environmental aspects during manufacturing (such as manufacturing waste) is calculated as the rated output power of the power of the product in relation to the total annual production volume of the factory.

Resource utilisation

	Manufacturing phase Unit/kVA		Usage phase Unit/kVA		Disposal phase Unit/kVA	
	AMG 450	AMG 630	AMG 450	AMG 630	AMG 450	AMG 630
Use of non-renewable resources						
Copper (Cu) kg/kVA	0.59	0.26	0.00	0.00	-0.54	-0.22
Iron (Fe) kg/kVA	5.62	3.39	0.00	0.00	-3.62	-1.82
Manganese (Mn) kg/kVA	0.01	0.01	0.00	0.00	0.00	0.00
Uranium (U) kg/kVA	0.00	0.00	0.08	0.06	0.00	0.00
Coal kg/kVA	6.03	3.78	2032.31	1444.87	-3.62	-1.82
Natural gas kg/kVA	0.69	0.54	142.92	99.90	0.08	0.02
Oil kg/kVA	0.83	0.54	213.02	151.44	-0.26	-0.10
Use of renewable resources						
Hydro power MJ/kVA	0.08	0.11	0.00	0.00	0.00	0.00

Energy consumption and losses	kWh / product						kWh / kVA					
Energy form	Manufacturing phase		Usage phase		Disposal phase		Manufacturing phase		Usage phase		Disposal phase	
	AMG 450	AMG 630	AMG 450	AMG 630	AMG 450	AMG 630	AMG 450	AMG 630	AMG 450	AMG 630	AMG 450	AMG 630
Electrical energy	3 700	17 710	6 678 647	22 685 744	265	556	4.11	4.12	7 421	5 276	0.29	0.13
Heat energy	3 030	14 480	-	-	301	581	3.37	3.37	-	-	0.33	0.14

The average French electricity mix is defined as being 1.6 % gas, 14.3 % hydro, 74.4 % nuclear, 2.1 % oil, 6.7 % stone coal and 0.6 % lignite coal. The average European electrical energy is defined as being 10 % gas, 15 % hydro, 36 % nuclear, 10 % oil, 19 % stone coal and 10 % lignite coal. The resultant resource utilisation is shown in the table above.

Waste	kg/kVA	
	AMG 450	AMG 630
Hazardous waste after manufacturing phase		
Oil emulsions	0.01	0.01
Barrier water	0.02	0.02
Hazardous waste after usage phase		
Various	0.00	0.00
Regular waste (to landfill)		
During manufacturing phase	0.07	0.07
At disposal phase	0.20	0.40

The classification data for emissions are as below :

Environmental effect	Equivalent unit	Manufacturing phase		Usage phase		Total life cycle	
		AMG 450	AMG 630	AMG 450	AMG 630	AMG 450	AMG 630
Global warming potential GWP	Kg CO2/kVA	24.89	16.18	3760	2673	3776	2685
Acidification potential AP	Kmol H+/kVA	0.004	0.002	0.734	0.522	0.737	0.524
Eutrophication NP	Kg O2/kVA	0.354	0.228	46.52	33.07	46.80	33.27
Ozone depletion potential ODP	Kg CFC-11/kVA	0.000	0.000	0.000	0.000	0.000	0.000
Photochemical oxidants	Kg ethylene/kVA	0.023	0.014	0.832	0.592	0.855	0.605
Potential POCP							

Additional qualifying factors

Recycling and disposal

The main parts of the product can be recycled. Some parts need to be fragmented into separate different types of material. A list of the parts and components that can be fragmented and recycled can be obtained from the manufacturer. See references.

Usage phase in relation to the total

It must be noted that the environmental impact during the usage phase is the most important one. As example, the GWP of the usage phase is approximately 100 times greater than the GWP of the manufacturing phase.

Category of impact	Usage in % of total	
	AMG 450	AMG 630
Global warming GWP	99.58 %	99.55 %
Acidification AP	99.59 %	99.62 %
Eutrophication NP	99.40 %	99.32 %
Ozone depletion ODP	-	-
Photochemical oxidants POCP	97.31 %	97.85 %

References

- 3BFRA TE 001 rev A, LCA report
- PSR 2000:2 for Rotating Electrical Machines
- 3BFRA TE 002 rev A, Recycling and Disposal
- MSR 199:2 requirements for Environmental Product Declarations, EPD from the Swedish Environmental Management Council

The above-mentioned documents are available upon request.