Results for the Nordic Wind Power

2019-05-15

Appendix to:
Certified Environmental Product Declaration EPD® of Electricity from Vattenfall's Wind Farms
Vattenfall AB

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Background

This appendix describes the environmental impact from Vattenfall's wind farms in the Nordic countries. The purpose is to describe the environmental impacts related to the EPD-certified products offered for electricity customers in the Nordic countries. The numbers presented in this appendix are calculated based on the Nordic wind farms in the selection for the full EPD.

In the Nordic countries, Vattenfall operates wind farms in Sweden and Denmark, whereof 39% is offshore and 61% onshore. In Table 1 below, installed capacity is based on the wind farms in operation by the end of 2017.

Table 1 - *Installed capacity and average generation in Vattenfall's Nordic portfolio (numbers represent Vattenfall's share, pro-rata ownership as per 2017-12-31)*

Country	Installed power 2017-12-31 [MW]		Net Average generation [GWh/year]		Total Net Average generation [GWh/year]
	Offshore	Onshore	Offshore	Onshore	
Denmark	95	243	368	684	1 052
Sweden	120	183	364	487	851
Sum	**215**	**426**	**732**	**1 171**	**1 903**

See locations of the included wind farms in Figure 1.

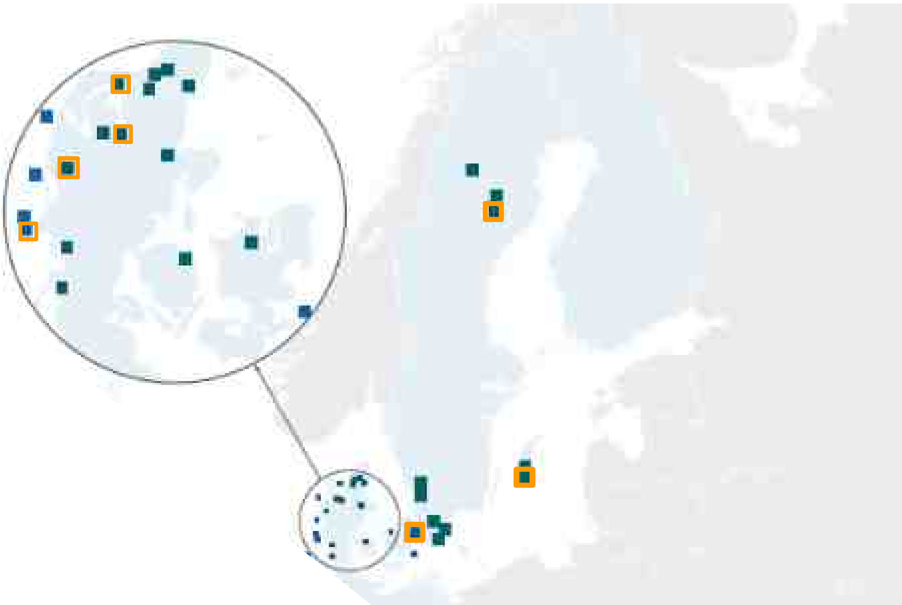

Figure 1 - *The locations of Vattenfall's studied wind farms. Some dots indicate several farms. The farms presented in this EPD® are marked with an orange box. The figure shows the situation by the end of 2017.*

Selected sites – Nordic

To describe impacts from electricity generated in Vattenfall's Nordic wind farms the lifecycle inventory data for the farms in the selection located in the Nordic countries have been used. These inventory data have been used together with an allocation based on the average generation in the Nordic countries to present environmental impact per average kWh of wind power generated in the Nordic countries to calculate the average environmental impact per kWh in the Nordic portfolio. All wind power sites have been grouped with respect to wind conditions expressed as the capacity factor[1], and each group's percentage of the total annual wind power generation was calculated. Studied

1 The capacity factor is determined as follows: (recorded electricity generation, during the year) / (installed capacity x 8 760 h).

wind farms were weighted within each group with respect to actual annual average electricity generation. Se Table 2 below for grouping of farms.

Table 2 - *Grouping of wind farms*

Group	Portion of Vattenfall's Nordic wind power
0 - Offshore, capacity factor >0,250	38,5%
1 - Onshore, capacity factor >0,32	29,5%
2 - Onshore, capacity factor 0,25-0,32	23,7%
3 - Onshore, capacity factor <0,25	8,3%

Selected sites

In Table 3 below the selected wind farms located in the Nordic countries are shown. The selected sites consist of one or more turbines and are located on- or offshore. The capacities vary between 1.5 MW and 3.2 MW. All together the selected turbines generate 63% of Vattenfall's total Nordic electricity from wind power during an average year. The selection has been made to cover as many different types of geography as possible.

In the selection, group 3 (onshore farms with a capacity factor below 0,25) is represented by the Swedish wind farm Stor-Rotliden. There is no Nordic farm in the EPD representing group 3, but since a non-neglectable share of the Nordic generation (8,3%) comes from this group, a representation is needed. That is why construction data for Stor-Rotliden has been selected to represent generation from group 3 (although it actually belongs to group 2). The reason for choosing Stor-Rotliden is that the technology in this wind farm (i.e. wind mill size and turbine capacity) is considered similar to the typical group 3 wind farms in the Nordic portfolio.

The capacity factor for Stor-Rotliden has been adjusted to be representative for group 3, based on average value for the group 3 wind farms in Sweden and Denmark, and the lifetime production recalculated in accordance.
In addition, 5% of the environmental impact has been added to be conservative.

Through the selection of the sites listed in the table below the environmental impact of Vattenfall's wind power portfolio is assumed to be mirrored correctly in this EPD®.

Table 3 – *Selected wind farms*

Group	Wind farm	No. of turbines	Manufacturer	Capacity MW/turbine	Construction year	Net average generation GWh	Location	The plants' portion of Vattenfall's Nordic wind generation 2017 (average)
G 0	Horns Rev 1[1]	79	Vestas	2,0	2002	615 (368)	North Sea, West of Jutland	19,4%
	Lillgrund	48	Siemens	2,3	2007	333	South Sweden, Öresund	17,5%
G 1	Bajlum	5	Siemens	3,0	2013	45	North West Jutland	2,3%
	Sigvards 3	1	Vestas	1,5	2001	4	Näsudden, Gotland	0,2%
	Klim[1]	22	Siemens	3,2	2015	226 (215)	Klim, DK	11,9%
	Lyngsmose	2	Siemens	2,3	2008	13	Central Jutland	0,7%
G 2	Stor-rotliden	40	Vestas	1,8 / 2,0	2010	202	North Sweden, Lappland	10,6%
G 3	*Stor-rotliden[2]*	*40*	*Vestas*	*1,8 / 2,0*	*2010*	*154*	*North Sweden, Lappland*	-

[1] Vattenfall owns 60% of Horns Rev 1 and 95% of Klim. The electricity generation in brackets shows Vattenfall's share.
[2] Stor-Rotliden has been used to represent group 3 as well, but with an adjusted annual production

Data quality

For discussion about methodology and data quality, see the full EPD report.

Results

In the tables below, the results for Vattenfall's Nordic wind power are shown, together with environmental impacts related to the Swedish and Danish electricity distribution grids. The grid loss used in all calculations is set to 5% of generated electricity and is assumed to be compensated for by increased generation in the wind farms. Resource use and emissions related to handling and treatment of the lifecycle waste through incineration or deposition are included in the Ecoprofile, i.e. no crediting has been performed.

Table 4 - *Ecoprofile - resources*

Ecoprofile	Input							
Resources	**Unit/kWh**	**Upstream**	**Core**	**Core - infrastructure**	**Total - generated**	**Down-stream[1]**	**Downstream - infrastructure**	**Total - distributed**
Non renewable material resources								
Aluminum in ore	g	5,2E-05	6,4E-06	2,3E-01	**2,3E-01**	1,1E-02	3,1E-02	**2,7E-01**
Bentonite, clay	g	7,4E-04	8,1E-04	2,8E-01	**2,8E-01**	1,4E-02	2,8E-02	**3,2E-01**
Basalt	g	6,9E-06	1,3E-06	5,5E-04	**5,6E-04**	2,9E-05	1,1E-04	**7,0E-04**
Chromium ore	g	2,0E-05	3,6E-06	4,1E-03	**4,1E-03**	2,1E-04	2,0E-04	**4,5E-03**
Copper in ore	g	2,5E-05	4,5E-06	8,4E-02	**8,4E-02**	4,2E-03	5,0E-03	**9,3E-02**
Dolomite	g	1,3E-04	5,8E-07	7,2E-02	**7,2E-02**	3,6E-03	2,5E-03	**7,8E-02**
Feldspar	g	2,3E-11	2,4E-12	2,4E-06	**2,4E-06**	1,2E-07	6,1E-10	**2,5E-06**
Fluorspar	g	4,1E-05	2,3E-06	1,1E-03	**1,2E-03**	6,1E-05	9,3E-05	**1,3E-03**
Gravel, stone & sand	g	1,5E-02	3,9E-03	1,9E+01	**1,9E+01**	9,3E-01	1,4E+00	**2,1E+01**
Gypsum	g	2,2E-06	8,2E-05	5,5E-03	**5,5E-03**	2,8E-04	2,8E-03	**8,6E-03**
Iron in ore	g	2,4E-03	1,5E-04	5,5E+00	**5,5E+00**	2,8E-01	8,1E-01	**6,6E+00**
Lead in ore	g	1,2E-05	5,9E-07	1,1E-02	**1,1E-02**	5,7E-04	2,7E-04	**1,2E-02**
Limestone	g			1,0E+00	**1,0E+00**	5,2E-02		**1,1E+00**
Magnesium in ore	g	4,8E-06	1,9E-06	8,7E-03	**8,8E-03**	4,4E-04	1,0E-04	**9,3E-03**
Manganese in ore	g	1,8E-05	8,3E-07	4,3E-03	**4,4E-03**	2,2E-04	4,9E-05	**4,6E-03**
Molybdenum in ore	g	4,5E-07	7,7E-08	6,9E-04	**6,9E-04**	3,5E-05	7,6E-05	**8,0E-04**
Neodymium[4]	g		1,5E-15	1,5E-04	**1,5E-04**	7,6E-06	2,4E-13	**1,6E-04**
Nickel in ore	g	1,2E-05	2,4E-06	2,9E-03	**2,9E-03**	1,5E-04	2,0E-03	**5,1E-03**
Olivine	g	5,9E-09	2,1E-11	4,0E-06	**4,0E-06**	2,0E-07	2,7E-09	**4,2E-06**
Salt	g	4,6E-04	3,8E-03	3,4E-01	**3,4E-01**	1,7E-02	5,0E-03	**3,6E-01**
Soil	g	4,8E-06		5,5E+00	**5,5E+00**	2,7E-01		**5,8E+00**
Sulphur in ore	g	2,2E-07	3,9E-09	2,0E-03	**2,0E-03**	1,0E-04	3,6E-07	**2,1E-03**
Tin in ore	g	5,6E-08	1,2E-08	1,6E-05	**1,6E-05**	7,9E-07	5,6E-07	**1,7E-05**
Titanium dioxide	g	2,7E-06	1,5E-06	7,1E-04	**7,2E-04**	3,7E-05	3,7E-05	**7,9E-04**
Zinc in ore	g	2,1E-05	1,0E-06	3,6E-03	**3,6E-03**	1,8E-04	4,2E-04	**4,2E-03**
Zirconium in sand	g	3,3E-07	1,9E-07	2,0E-05	**2,1E-05**	1,2E-06	4,5E-06	**2,7E-05**
Renewable material resources								
Wood	g	8,0E-04	2,2E-04	5,7E-02	**5,8E-02**	3,0E-03	1,3E-02	**7,4E-02**
Non renewable energy resources								
Crude oil (resource)	g	5,6E-02	1,4E-03	9,6E-01	**1,0E+00**	8,2E-02	7,4E-02	**1,2E+00**
Hard coal (resource)	g (DS)[2]	1,2E-02	6,9E-03	2,4E+00	**2,4E+00**	1,2E-01	6,3E-01	**3,1E+00**
Lignite (resource)	g (DS)[2]	3,8E-03	9,4E-04	1,5E-01	**1,6E-01**	8,2E-03	3,9E-02	**2,0E-01**
Natural gas (resource)	g	1,0E-04		4,6E-01	**4,6E-01**	2,3E-02		**4,9E-01**
Nuclear energy (uranium)[5]	g	2,1E-07	3,0E-08	1,3E-05	**1,3E-05**	7,0E-07	1,1E-06	**1,5E-05**

Nuclear energy (primary energy demand) [5]	MJ	1,2E-04	1,7E-05	7,3E-03	**7,5E-03**	3,9E-04	6,4E-04	**8,5E-03**
Peat (resource)	g (DS)[2]	2,7E-05	3,1E-06	3,5E-04	**3,8E-04**	2,2E-05	8,4E-05	**4,9E-04**
Renewable energy resources								
Bio mass	g (DS)[2]	3,0E-03	2,0E-04	3,2E-02	**3,5E-02**	1,8E-03	1,2E-02	**4,9E-02**
Potential energy through hydro turbines	MJ	3,8E-05	6,9E-06	7,5E-03	**7,5E-03**	3,8E-04	9,1E-04	**8,8E-03**
Solar electricity	MJ	1,3E-06	2,5E-08	1,6E-04	**1,6E-04**	7,9E-06	1,4E-07	**1,6E-04**
Wind electricity	MJ	8,6E-06	1,3E-06	7,3E-04	**7,4E-04**	3,8E-05	3,9E-05	**8,2E-04**
Electricity use in the power plant[3]	MJ		3,6E-03		**3,6E-03**	1,8E-04		**3,8E-03**
Water use								
Ground water	g	3,4E-03		4,2E+00	**4,2E+00**	2,1E-01		**4,5E+00**
River water	g	1,7E+00	2,4E-02	2,1E+02	**2,1E+02**	1,0E+01	2,5E+00	**2,2E+02**
Sea water	g	5,6E-03		1,2E+01	**1,2E+01**	5,8E-01		**1,2E+01**
Water, specified natural origin	g	1,2E+00	1,2E-01	1,4E+02	**1,4E+02**	7,3E+00	2,0E+00	**1,5E+02**
Water, unspecified origin	g	3,7E+00	9,9E-01	1,2E+02	**1,3E+02**	6,9E+00	5,0E+01	**1,9E+02**
Use of recycled material								
Aluminum	g			2,2E-04	**2,2E-04**	1,1E-05		**2,3E-04**
Copper	g			1,0E-02	**1,0E-02**	5,0E-04		**1,1E-02**
Steel	g			5,2E-01	**5,2E-01**	2,6E-02		**5,5E-01**
Other input material (agglomeration of app. 50 substances)	g	1,7E-02	5,1E-03	3,2E+00	**3,2E+00**	1,6E-01	5,3E-01	**3,9E+00**

[1] Distribution losses of 5% of generated electricity are included in the downstream column.
[2] DS = dry substance
[3] The electricity used in the wind farm is assumed to also be generated at the wind farm. The environmental impact is accounted for by subtracting the amount of electricity from the reference flow.
[4] Neodymium was not included in the input data before the modelling of 2015, hence the value presented may be an underestimation
[5] Nuclear energy expressed in uranium and primary energy demand are not to be summarized, it is the same amount expressed in g and MJ

Table 5 - *Ecoprofile - emissions*

Ecoprofile	**Output**							
Emissions	**Unit/kWh**	**Upstream**	**Core**	**Core - infrastructure**	**Total - generated**	**Down-stream[1]**	**Downstream - infrastructure**	**Total - distributed**
Environmental impact categories								
Global Warming Potential	g CO_2-equiv. (100 years)	7,5E-02	1,8E-01	12,5	**12,8**	8,2E-01	1,9	**15,5**
Global Warming Potential including biogenic CO2	g CO_2-equiv. (100 years)	7,7E-02	1,8E-01	12,7	**13,0**	8,3E-01	2,0	**15,7**
Acidification Potential	g SO_2-equiv.	4,6E-04	1,0E-03	4,1E-02	**4,22E-02**	2,3E-03	1,1E-02	**5,5E-02**
Photochem. Ozone Creation Potential	g Ethene-equiv.	1,2E-04	8,2E-05	6,1E-03	**6,32E-03**	3,7E-04	1,7E-03	**8,4E-03**
Eutrophication Potential	g Phosphate -equiv.	1,8E-04	2,6E-04	7,2E-03	**7,60E-03**	4,4E-04	5,1E-03	**1,3E-02**
Emissions contributing to given impact categories								
Alkane to air	g	3,8E-07	2,2E-07	1,0E-04	**1,0E-04**	1,1E-05	9,6E-05	**2,1E-04**
Ammonia to air	g	1,4E-05	1,4E-05	1,0E-04	**1,3E-04**	7,1E-06	1,3E-04	**2,7E-04**
Ammonia to water	g	1,7E-06	1,8E-07	2,4E-04	**2,4E-04**	1,2E-05	5,7E-06	**2,5E-04**
Carbon dioxide	g	6,5E-02	1,3E-01	1,1E+01	**1,2E+01**	6,7E-01	1,7E+00	**1,4E+01**
Carbon dioxide (biotic)	g	1,5E-03	1,3E-03	1,9E-01	**1,9E-01**	9,8E-03	1,5E-02	**2,2E-01**
Carbon monoxide	g	1,5E-04	1,2E-03	1,0E-01	**1,1E-01**	6,2E-03	2,7E-02	**1,4E-01**
Carbon tetrachloride (tetrachloromethane)	g	3,1E-08	4,5E-09	6,3E-09	**4,1E-08**	2,1E-09	5,2E-09	**4,9E-08**
Chemical oxygen demand (COD) to water	g	5,6E-04	1,5E-05	2,1E-02	**2,2E-02**	1,4E-03	8,8E-04	**2,4E-02**
Halon 1211	g	1,6E-10	1,8E-11	8,4E-09	**8,6E-09**	4,4E-10	9,6E-10	**1,0E-08**
Halon 1301	g	2,5E-09	7,0E-11	2,1E-08	**2,3E-08**	2,6E-09	3,6E-09	**2,9E-08**
HCFC-22	g	8,2E-08	3,4E-10	6,2E-08	**1,4E-07**	7,4E-09	6,3E-07	**7,8E-07**

Hydrocarbons (unspecified)	g	1,1E-06	5,8E-05	1,2E-03	**1,2E-03**	1,4E-04	1,6E-09	**1,4E-03**
Hydrogen chloride	g	5,6E-06	3,3E-06	2,9E-04	**3,0E-04**	1,5E-05	1,5E-04	**4,7E-04**
Hydrogen sulphide	g	1,7E-07	2,8E-07	2,2E-04	**2,2E-04**	1,1E-05	8,0E-06	**2,4E-04**
Nitrate to water	g	5,2E-05	3,3E-06	3,0E-04	**3,6E-04**	1,8E-05	1,1E-04	**4,9E-04**
Nitrogen oxides	g	1,8E-04	1,3E-03	2,5E-02	**2,7E-02**	1,5E-03	4,3E-03	**3,2E-02**
Nitrous oxide	g	4,3E-06	1,3E-06	4,0E-04	**4,0E-04**	2,0E-05	3,1E-05	**4,5E-04**
NMVOC (unspecified)	g	5,5E-04	4,1E-06	2,2E-03	**2,7E-03**	1,6E-04	2,3E-03	**5,2E-03**
Methane	g	2,4E-04	8,8E-05	2,5E-02	**2,6E-02**	1,3E-03	7,2E-03	**3,4E-02**
Phosphate to water	g	1,3E-05	5,6E-06	2,7E-04	**2,9E-04**	1,6E-05	9,1E-04	**1,2E-03**
Phosphorus to water	g	5,5E-08	9,0E-09	3,9E-05	**3,9E-05**	2,0E-06	7,3E-07	**4,2E-05**
Sulphur dioxide	g	3,0E-04	7,6E-05	2,2E-02	**2,2E-02**	1,2E-03	7,3E-03	**3,1E-02**
Sulphur hexafluoride	g	1,5E-08	1,8E-06	1,3E-05	**1,5E-05**	4,5E-06	2,7E-07	**2,0E-05**
Sulphuric acid	g		1,7E-10	4,4E-04	**4,4E-04**	2,2E-05	2,0E-08	**4,6E-04**
Tetrafluoromethane	g	2,5E-09	4,1E-10	1,1E-05	**1,1E-05**	5,5E-07	2,1E-06	**1,4E-05**
VOC (unspecified)	g	9,3E-07	2,5E-08	2,9E-03	**2,9E-03**	1,5E-04	1,3E-06	**3,1E-03**
Emissions of toxic and other substances to air, water and ground								
Ammonia	g	1,5E-05	1,4E-05	3,4E-04	**3,7E-04**	1,9E-05	1,3E-04	**5,2E-04**
Antimony to air	g	8,8E-09	8,8E-09	8,8E-09	**2,6E-08**	1,0E-08	8,8E-09	**4,5E-08**
Arsenic	g	6,3E-08	3,9E-08	2,4E-05	**2,4E-05**	1,5E-06	5,3E-06	**3,1E-05**
Cadmium to air	g	6,3E-09	1,1E-09	1,2E-06	**1,2E-06**	6,0E-08	8,8E-07	**2,1E-06**
Carbon monoxide (biotic)	g	2,0E-06	1,3E-06	4,2E-04	**4,2E-04**	2,1E-05	7,2E-05	**5,2E-04**
Chromium (VI) to air	g	1,8E-09	3,8E-10	2,1E-08	**2,3E-08**	1,3E-09	2,2E-08	**4,6E-08**
Dioxine to air	g	1,1E-12		4,8E-10	**4,8E-10**	2,4E-11		**5,0E-10**
Lead	g		3,0E-08	1,4E-07	**1,7E-07**	8,5E-09		**1,8E-07**
Mercury to air	g	2,1E-09	1,3E-09	4,3E-07	**4,4E-07**	2,2E-08	9,0E-08	**5,5E-07**
Oil to ground	g	1,8E-04	4,6E-06	2,6E-03	**2,8E-03**	2,4E-04	2,4E-04	**3,2E-03**
Oil to water	g	1,6E-04	1,1E-04	2,5E-03	**2,8E-03**	2,3E-04	2,9E-04	**3,3E-03**
Particles to air	g	1,1E-04	7,5E-05	1,0E-02	**1,0E-02**	5,3E-04	9,8E-03	**2,1E-02**
Polyaromatic hydrocarbons	g	4,3E-08	1,7E-09	5,4E-06	**5,4E-06**	2,8E-07	2,5E-06	**8,2E-06**
C-14 to air	kBq	1,2E-06	6,0E-08	1,8E-05	**1,9E-05**	1,6E-06	2,7E-06	**2,4E-05**
Kr-85 to air	kBq	7,3E-08	1,7E-08	3,6E-04	**3,6E-04**	1,8E-05	6,4E-07	**3,8E-04**
Rn-222 to air	kBq	1,1E-04	1,6E-05	7,6E-03	**7,7E-03**	4,0E-04	6,1E-04	**8,7E-03**

[1]Distribution losses of 5% of generated electricity are included in the downstream column.

Table 6 - *Ecoprofile - Other information*

Ecoprofile	**Output**							
Other information	**Unit/kWh**	**Upstream**	**Core**	**Core - infrastructure**	**Total - generated**	**Down-stream[1]**	**Downstream - infrastructure**	**Total - distributed**
Hazardous waste								
Hazardous waste to disposal	g	4,3E-07		5,5E-02	**5,5E-02**	2,7E-03		**5,7E-02**
Hazardous waste to incineration	g		2,4E-02	1,5E-02	**3,9E-02**	1,9E-03		**4,1E-02**
Radioactive waste								
Volume of deposit for radioactive waste	m^3	8,3E-12	7,3E-13	6,4E-11	**7,3E-11**	7,9E-12	8,7E-11	**1,7E-10**
Waste to recycling								
Aluminium	g			3,3E-02	**3,3E-02**	1,7E-03		**3,5E-02**
Copper scrap	g			4,3E-02	**4,3E-02**	2,1E-03		**4,5E-02**
Lead scrap	g			2,8E-03	**2,8E-03**	1,4E-04		**3,0E-03**
Steel scrap	g			2,4E+00	**2,4E+00**	1,2E-01		**2,5E+00**
Zinc scrap	g			4,2E-04	**4,2E-04**	2,1E-05		**4,5E-04**
Other waste to recycling	g	2,2E-06		7,1E-02	**7,1E-02**	3,5E-03		**7,5E-02**
Other waste								
Waste to disposal[2]	g	2,0E-04		1,9E+01	**1,9E+01**	9,6E-01		**2,0E+01**
Waste to incineration	g		2,4E-02	3,6E-01	**3,8E-01**	1,9E-02		**4,0E-01**
Waste water	g			1,3E-03	**1,3E-03**	6,3E-05		**1,3E-03**

[1] Distribution losses of 5% of generated electricity are included in the downstream column.
[2] Waste to disposal contains consumer waste, waste to landfill and unspecified waste for disposal

For all impact categories the major part of the environmental impact is related to the construction of the wind farms (Core-infrastructure), followed by the construction of the grid. Emissions emanate mainly from the production of steel and other metals used for construction. See

Table 7 below for dominance analysis regarding the four emission impact categories, and Figure 2 for illustration of impacts per lifecycle stage, shown for global warming potential.

Table 7 - *Dominance analysis for selected impact categories*

Dominance analysis	Upstream	Core	Core – infrastructure	Downstream	Downstream – infrastructure	Compensation for distribution losses	Total
Global Warming Potential	0,5%	1,1%	80,6%	1,2%	12,4%	4,1%	100,0%
Global Warming Potential including biogenic CO_2	0,5%	1,1%	80,7%	1,2%	12,4%	4,1%	100,0%
Acidification Potential	0,8%	1,8%	73,5%	0,4%	19,7%	3,8%	100,0%
Photochem, Ozone Creation Potential	1,4%	1,0%	72,8%	0,6%	20,5%	3,8%	100,0%
Eutrophication Potential	1,4%	2,0%	54,7%	0,4%	38,6%	2,9%	100,0%

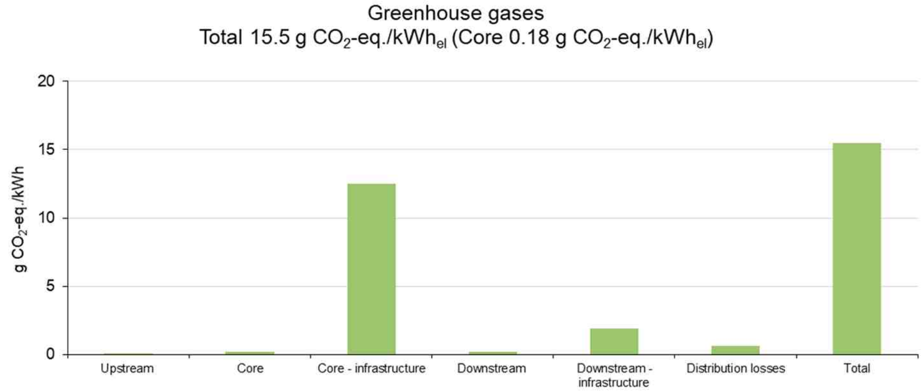

Figure 2 - *Emissions of greenhouse gases, expressed in grams of CO_2-equivalents per kWh*

Differences between the results for Nordic and European wind

The environmental profile for the Nordic part of Vattenfall's wind power are close to the profile for Vattenfall's European wind power portfolio. In **Fel! Hittar inte referenskälla.** below the results are presented side by side to allow for comparison.
Results are shown both including and excluding distribution.

Table 8 - *Differences between the European and Nordic results 2019*

Emissions	Unit	Nordic (excl. distribution)	Nordic (incl. distribution)	European (excl. distribution)	European (incl. distribution)
Environmental impact categories					
Global Warming Potential	g CO_2-equiv. (100 years)	12,8	15,5	12,6	14,5
Acidification Potential	g SO_2-equiv.	0,042	0,055	0,043	0,051
Photochem. Ozone Creation Potential	g Ethene-equiv.	0,0063	0,0084	0,0062	0,0075
Eutrophication Potential	g Phosphate-equiv.	0,0076	0,013	0,0072	0,010
Oil					
Oil to water	g	0,0028	0,033	0,0022	0,0025
Oil to ground	g	0,0028	0,032	0,0022	0,0025

When comparing the results per generated kWh (without distribution), the results are quite equal, only slightly higher for Nordic. The reasons for this is due to technical as well as geographical differences in the different countries. The Swedish onshore wind farms in the selection are for example older and with lower capacity than the European onshore farms. For example, the capacity factor for the European portfolio (annual generation divided by capacity) is 0,391, compared to 0,388 for the Nordic portfolio. The difference between capacity factors is of the same magnitude as the difference in results for CO_2e emissions (1,5%). Other aspects such as differences in inventory data type and quality also affect the results.

The difference is larger when including distribution. This is due to higher impact related to the processes for Downstream - Infrastructure, i.e. the constriction of the grid. The reason is related to geographic and technical differences in the different countries. For example, in Sweden, being a long and narrow country with sparsely populated parts, the amount of infrastructure required per transmitted/distributed kWh of electricity is larger than in UK, Germany and the Netherlands. Hence a larger environmental impact is added per kWh due to construction of the transmission/distribution networks.