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[22] 2021 EPD Vattenfall Nordic Hydropower, Environmental Product Declaration Vattenfalls Nordic Hydropower <https://portal.environdec.com/api/api/v1/EPDLibrary/Files/fc28fbf0-21fa-47fc-ab0b-08d8c11ab8a5/Data>

3.9 Electricity generation from natural gas

Description of the activity

Construction or operation of electricity generation facilities that produce electricity using natural gas.

The economic activities in this category could be associated with several NACE codes, in particular D35.11 [Production of electricity] and F42.22 [Construction of utility projects for electricity and telecommunications] in accordance with the statistical classification of economic activities established by Regulation (EC) No 1893/2006.

(similar to 4.7 Climate change mitigation DA, but instead natural gas as fuel)

Substantial contribution to pollution prevention and control

The activity complies with all of the following criteria:

1. Acidification potential

Pending decision on the threshold level (see Rationale for details):

Threshold Options:

The life-cycle emissions of pollutants contributing to the acidification potential are lower than...

- **0.05**
- **0.15** (possible exemption: wind power does not have to demonstrate achievement of this threshold)
- **0.10**

... kg SO₂ eq per 1 MWh of electricity output to the power grid or to directly connected customers. The calculation of the acidification potential includes all pollutants relevant for the activity, in particular NO_x, SO₂ and NH₃.

2. Photochemical ozone creation potential:

The life-cycle emissions of pollutants contributing to the photochemical ozone creation potential are lower than **0.05** kg C₂H₂ eq per 1 MWh of electricity output to the power grid or to directly connected customers. The calculation of the photochemical ozone creation potential includes all pollutants relevant for the activity, in particular CO, NO_x and relevant VOCs.

3. Eutrophication potential:

The life-cycle emissions of pollutants contributing to the photochemical ozone creation potential are lower than **0.05** kg PO₄³⁻ eq per 1 MWh of electricity output to the power grid or to directly connected customers. The calculation of the eutrophication potential includes all pollutants relevant for the activity, in particular NO_x, NH₄⁺, N, PO₄³⁻, P and COD (chemical oxygen demand).

4. Particulate matter PM10:

The life-cycle emissions of PM10 are lower than **0.05** kg/per 1 MWh of electricity output to the power grid or to directly connected customers.

5. Fine particulate matter PM2.5:

The life-cycle emissions of PM10 are lower than **0.02** kg/per 1 MWh of electricity output to the power grid or to directly connected customers.

6. Activity-specific criteria:

Emissions are within or lower than the emission levels associated with the best available techniques (**BAT-AEL**) ranges set out in the latest relevant best available techniques (BAT) conclusions, including the best available techniques (BAT) conclusions for **large combustion plants**³⁶¹. **No significant cross-media effects occur.**

For combustion plants with thermal input greater than 1 MW but below the thresholds for the BAT conclusions for large combustion plants to apply, emissions are below the emission limit values set out in Annex II, part 2, to Directive (EU) 2015/2193 of the European Parliament and of the Council³⁶².

Methodology for calculation of criterion 1. Acidification potential, 2. Photochemical ozone creation and 3. Eutrophication based on one of the following:

- Life-cycle environmental impacts are calculated using Commission Recommendation 2013/179/EU or, alternatively, using ISO 14025:2010 and ISO 14040:2006 and ISO 14044:2006. Lifecycle environmental impacts are third party verified in according with the procedure described in ISO 14044.

Do no significant harm ('DNSH')

(1) Climate change mitigation	<i>This criterion is not in the scope of this call for feedback.</i>
(2) Climate change adaptation	DNSH as set out in <u>Appendix A of Annex 1 to the Commission Delegated Regulation (EU) .../...supplementing Regulation (EU) 2020/852.</u>

³⁶¹ Commission Implementing Decision (EU) 2017/1442 of 31 July 2017 establishing best available techniques (BAT) conclusions, under Directive 2010/75/EU of the European Parliament and of the Council, for large combustion plants (OJ L 212, 17.8.2017, p. 1).

³⁶² Directive (EU) 2015/2193 of the European Parliament and of the Council of 25 November 2015 on the limitation of emissions of certain pollutants into the air from **medium combustion plants** (OJ L 313, 28.11.2015, p. 1).

(3) Sustainable use and protection of water and marine resources	DNSH as set out in <u>Appendix B of Annex 1 to the Commission Delegated Regulation (EU) .../...supplementing Regulation (EU) 2020/852.</u>
(4) Transition to circular economy	The activity assesses availability of and, where feasible, uses equipment and components of high durability and recyclability and that are easy to dismantle and refurbish.
(6) Protection and restoration of biodiversity and ecosystems	DNSH as set out in <u>Appendix D of Annex 1 to the Commission Delegated Regulation (EU) .../...supplementing Regulation (EU) 2020/852.</u>

Rationale

On the choice of activities (i.e. different technologies) for power generation

The selection includes **activities** for which the conducted analysis shows that they are **in principle capable of fulfilling the proposed TSC**. Depending on the pending decision which SC threshold is selected for the Acidification Potential, not for all proposed activities, evidence was found that they could fulfil the TSC; however, due the available data for life-cycle pollutant emissions are limited, so when in doubt, the activities in question were included in the proposal (e.g. power from geothermal energy).

Nevertheless, other activities (technologies) are not included in the proposal. Power generation using liquid fuels (oil) and biomass were not included because the available data range showed their performance concerning the pollution objective is, by far, insufficient to achieve with the proposed SC thresholds. Therefore it appears unrealistic that currently any aligned assets exist that could be invested in. Hence, these activities are not proposed for the taxonomy.

Both combined heat and power generation (**CHP, cogeneration**) and power generation without heat utilisation are included.

On the criteria for substantial contribution (SC)

For all power generation activities, the same **overarching thresholds for five pollution criteria** are proposed. They address the most significant air pollutant emissions resulting from these activities in the European Union at present. These five criteria cover **life-cycle** emissions, i.e. the value chain until the generated power is delivered to the grid (or to directly connected customers), which includes direct emissions during electricity generation and indirect emissions from upstream stages (fuel production and transport), construction of the power generation facilities and production of the required components.

For **some of the activities, additional criteria** are proposed, to account for environmental specificities of the activity, or to ensure that EU legal requirements, which apply to direct instead life-cycle emissions, are also fulfilled. (These were taken from the DA Climate change mitigation criteria for DNSH concerning the Pollution objective of these activities.)

The proposed **SC threshold levels** result from the analysis of life-cycle pollution data from scientific publications and recent Environmental Product Declarations (EPDs), covering power generation using different technologies.

In the available data sources, the pollutants are either reported by substance (e.g. NO_x, SO₂, ...) or partly combined to **metrics per type of environmental impact** (e.g. the acidification potential, which covers NO_x and SO₂ and, depending on the methodology, some further acidifying substances which are emitted at lower levels in power generation).

The proposed criteria use the approach of grouping pollutants based on their environmental impact. This choice allows for a lower number of criteria and is already applied in the market, for example due to its application in the EPD methodology for power generation.

The methodology for splitting the emissions between the power output and the heat output, which is required because only the power output of the **CHP** plants is covered by the activities, is proposed in analogy to the Annex II of the Energy Efficiency Directive.

Rationale for choosing the proposed SC criteria and thresholds:

1. Acidification potential (kg SO₂ eq per MWh)

Includes SO₂ and NO_x (and depending on methodology, further pollutants)

Very significant parameter because current emissions from electricity generation are very high. The proposed conversion factors are based on Hauschild & Wenzel, 1998.

Pending decision on the threshold level of Acidification potential:

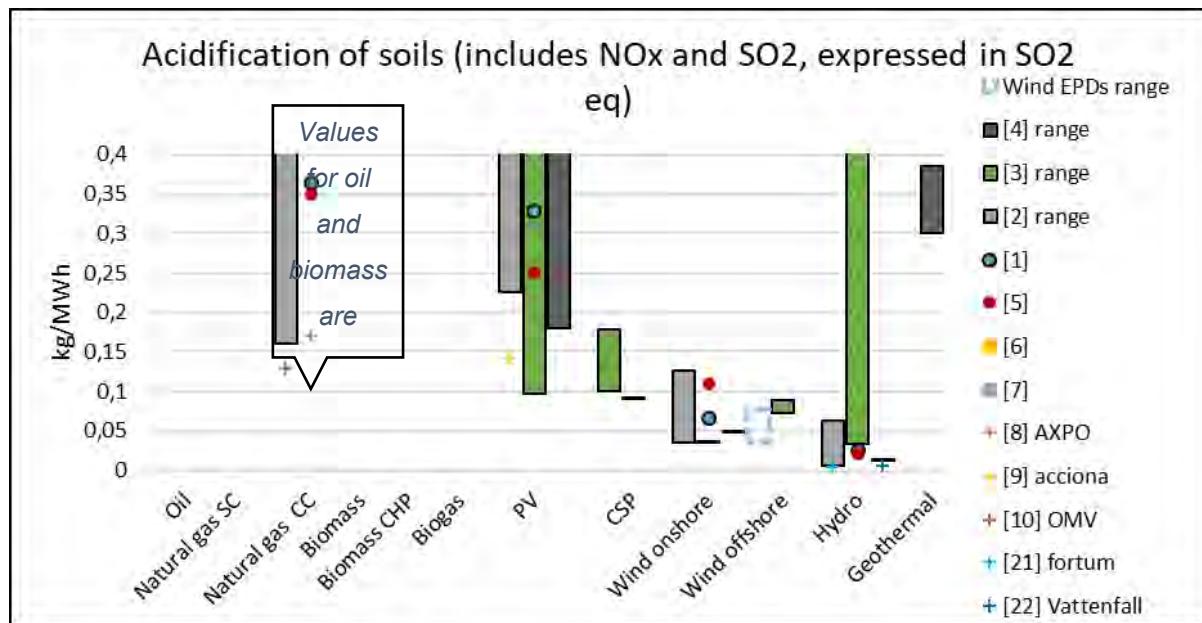
Threshold Options (all expressed in kg SO₂ eq per MWh):

a) 0.05

b) 0.15

c) 0.10

The result of the data analysis is shown in the following chart, the arguments for each of the three threshold levels are presented after the chart.



[1] to [7] represent data from scientific publications (filled circles and range bars), [8]-[22] represent EPDs (with [11-20] wind power EPDs shown as blue dashed range), [10] Represents NO_x and SO_x data from emission compliance monitoring & measurement from the power plant and internally calculated pollution data (NO_x/SO_x) from upstream gas field operation (based on officially reported fuel consumption for gas field operation) from the fuel provision part.

Arguments for the three threshold options:

a) 0.05

This threshold is achieved by a part of literature data (representing somewhat older data) and part of recent wind plant data as well as all recent and part of older hydropower; (currently) not achieved by PV/CSP, geothermal and natural gas.

Arguments in favour of this threshold:

- Pro:
Evidence is robust that it is possible to generate power by wind power and hydropower at this performance level (i.e. the threshold does not represent a single best performing plant, but is achieved by a range of plants, as shown by different literature sources and recent EPDs).
- Pro:
This is the most ambitious threshold choice. The PSFs Headline Ambition Level for the Objective “Pollution Prevention and Control” sets 2030 as the target year for preventing and eliminating pollution. Power plants and infrastructure have a long lifetime, roughly 30 – 100 years. So the current criteria proposals will cover physical infrastructure which will still be largely in operation by 2030 and thus is relevant for achieving the 2030 target. Based on the assessment carried out, it is not possible to fully prevent or eliminate pollution for power generation. However, by this threshold choice, the taxonomy highlights the strongest (currently possible) contributing performing activities to the Headline Ambition.
- Pro:
In the area of pollution, the Green Deals is very ambitions and specifies “Zero Pollution” at the EU’s target. Likewise, the EC recently published the “Zero pollution action plan”. Therefore is appropriate to set the pollution threshold in the taxonomy, which is a voluntary and transparency instrument, to the most ambitions threshold choice.
- Pro:
This level is achievable by wind onshore, wind offshore and hydropower, thus not limited to a single technology. (Possibly also soon achievable by PV/CSP due to rapid technology development and reduction of coal-related pollution in power generation for component production process.)

-
- Pro:
To set this threshold, for which in none of the activities (technologies) every plant achieves this level, gives incentives to some activities to improve.

b) 0.15

This threshold is achieved by all of analysed wind energy data, most hydropower (all of the recent EPDs), CSP and the best PV and the best performing gas (CC gas plants).

Arguments in favour of this threshold:

- Pro:
This level can be achieved by more technologies, e.g. best-performing gas power plants, therefore more assets included
- Pro:
The initial Ramboll study has assessed a high improvement opportunity for the sector energy production and distribution. Identified improvement opportunities for achieving high improvement potential are related to technical and (post-)combustion modification and NO_x/SO_x removal processes. Having the acidification threshold set at 0.15 would give the opportunity for high performing CCGT with low pollution impact from upstream fuel provision to deliver substantial positive environmental impact on the basis of life-cycle considerations.
- Pro:
It gives incentives for gas power plants (CCGT: combined-cycle gas turbine) and gas-fired CHP, so they reduce their pollution, in a way that they could contribute to EU objectives.

On the proposed, possible option of exempting wind power from demonstrating SC in case of the threshold level of 0.15:

At this threshold level, wind power could be exempted from proving threshold compliance, because based on the analysed data, it appears that all wind power will achieve this performance level.

c) 0.10

This threshold is achieved by all of recent wind energy (EPD) and all of recent hydropower data (EPDs, they are existing/old power plants); some CSP and some of PV (1 recent plant not), not by gas.

Arguments in favour of this threshold:

- Pro: “compromise solution” between 0.05 and 0.15.

2. Photochemical ozone creation potential: 0.05 kg C₂H₂ eq per MWh

The proposed threshold is achieved by geothermal, hydro (except 1 source), wind, CSP, most PV, partly by biomass, most natural gas CC.

This parameter covers in particular CO, NO_x and VOCs (volatile organic compounds). VOCs are classified into the following categories: alkanes, halogenated HCs, alcohols, ketones, esters, ethers, olefins,

acetylenes, aromatics and aldehydes.

3. Eutrophication potential: 0.05 kg PO₄³⁻ eq per MWh

The proposed threshold is for PV possible to achieve, achieved by most hydro, achieved by all wind and geothermal as well as CSP; partly achieved by gas CC and PV. The proposed conversion factors are based on Heijungs et al. (1992).

4. PM₁₀: 0.05 kg/per MWh

The proposed threshold is achieved by all wind, all hydro, most gas CC, all EPDs plants.

5. PM_{2.5}: 0.02 kg/per MWh

The proposed threshold is achieved by almost all wind, all hydro, PV most recent data, gas CC.

6. Activity-specific criteria

These parameters, which have been set for DNSH for some of these activities in the Delegated act on climate change mitigation, dealing with specific issues only relevant for certain technologies (e.g. anti-fouling paint and biocides for ocean energy technologies), or to ensure current EU legal minimum environmental performance (e.g. for direct emissions, achieving the BAT-AEL ranges where applicable), **are proposed in addition to the five common overarching SC criteria.**

In the case of power generation from natural gas, the criteria from the activity “4.7 Electricity generation from renewable non-fossil gaseous and liquid fuels” of the climate change mitigation DA were used, because they cover the same legislation that also applies to natural gas-fired power plants (BAT, Medium combustion plant directive).

Pollutants considered, but not included in proposal

Metals and metalloids (As, Cd, Pb; Hg) and PAH: would have been relevant for biomass, but power generation is not proposed as an activity for other reasons (see above); poor data availability for life-cycle emissions of these pollutants was noted.

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<https://portal.environdec.com/api/api/v1/EPDLibrary/Files/5b6257c3-4b17-48b6-b974-c05a93cf2c67/Data>

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3.10 Electricity generation from renewable non-fossil gaseous fuels

Description of the activity

Construction or operation of electricity generation facilities that produce electricity using gaseous of renewable origin. This activity does not include electricity generation from the exclusive use of biogas (see Section 4.8 of this Annex). (as in 4.7 Climate change mitigation DA, but without liquid fuels)

The economic activities in this category could be associated with several NACE codes, in particular D35.11 [Production of electricity] and F42.22 [Construction of utility projects for electricity and telecommunications] in accordance with the statistical classification of economic activities established by Regulation (EC) No 1893/2006. (as in Climate change mitigation DA)

Substantial contribution to pollution prevention and control
