

Enhancing environmental performance: A method for identifying and prioritizing Key Environmental Issues in industry

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Supplementary material

Table S1. Methods studied for the elaboration of the method to select KEIs

Criterion	Indicator	Sources
Technico-economic aspects / technological advances	Additional reduction possible in the event of a change of technique	(Grammont et al., 2009; Karr et al., 2013, 2011a, 2011b)
	Importance of the economic effort to be made, investment and operating costs, investments to be planned to comply with the standards coming into force soon	(Grammont et al., 2009; Karr et al., 2013, 2011a, 2011b) (Personne, 1998; Personne and Brodhag, 1998b)
	Potential for identifying new or additional techniques that would further significantly reduce pollution	(Ricardo Energy and Environment et al., 2018a)
	Potential for defining BAT-AELs that would significantly improve the level of protection for the environment as a whole in comparison with the current emission levels	(Ricardo Energy and Environment et al., 2018a)
	Costs of compliance, cost of fines in case of non-compliance	(Personne, 1998; Personne and Brodhag, 1998b) Poder, 2006
Hazardousness for the population and biodiversity	Regulatory compliance (current and future regulation), control of the impact	(Puig et al., 2015) Poder, 2006 (Personne, 1998; Personne and Brodhag, 1998b) (Pons and Gaucher, 2018)
	Presence or absence of the substance in priority / regulatory lists and positioning in these lists	(Grammont et al., 2009; Karr et al., 2013, 2011a, 2011b)
	Carcinogenic, mutagenic, reprotoxic, endocrine disrupting substances	(ECHA, 2020) (Grammont et al., 2009; Karr et al., 2013, 2011a, 2011b)Bordeaux
	Persistent, Bioaccumulative, Toxic substance	(ECHA, 2020) (Grammont et al., 2009; Karr et al., 2013, 2011a, 2011b)
	Importance and nature of the actual or potential effects associated with the aspect studied and which may affect the environment	Topuz 2011 Moroncini 2018 Prats 2008 2011

Criterion	Indicator	Sources
	Severity / Acceptability of the impact	Puig 2015 Poder, 2006 Seiffert 2008 Piet 2017 Topuz 2011
	Performance degradation over time	(Personne, 1998; Personne and Brodhag, 1998b)
Environmental sensitivity	Number of exceedances of environmental quality standards or of Predicted No Effect Concentration	Bordeaux
	Limited availability of a resource	(Personne, 1998; Personne and Brodhag, 1998b)
	Stakeholder's complaints	(Puig et al., 2015) Poder, 2006
	Presence of residents, sensitive areas (bathing area, nature reserves...)	Moroncini 2018 Prats 2008 2011
Quantification of the environmental aspect	Quantity of substance / waste emitted or of resource consumed	(Puig et al., 2015) (ECHA, 2020) Poder, 2006 Bordeaux
	Frequency or probability of environmental exposure to the aspect	(Puig et al., 2015) Poder, 2006 Seiffert 2008 Piet 2017 Topuz 2011 (ECHA, 2020) Moroncini 2018 Prats 2008 2011
	Contribution of the activity or process to the aspect / impact	(Ricardo Energy and Environment et al., 2018a) Topuz 2011 (Pons and Gaucher, 2018) (Grammont et al., 2009; Karr et al., 2013, 2011a, 2011b)
	Duration of the environmental aspect / Temporal scale	(Puig et al., 2015) Poder, 2006
	Extent of the impact / Spatial scale	(Puig et al., 2015) Poder, 2006 Seiffert 2008 Piet 2017

Table S2. Sensitivity matrix of the case study E1

		Criterion 2: Sensitivity of the environment				Case study E1		
1	2	3	4	5	6			
Environmental medium	Subdomain	Type of EAs targeted	Questions	Possible answers and associated scores	Information sources	Information on the site	EAs concerned at site level	Attributed score for each EA
Water resource (withdrawals)	Groundwater body	Water consumption	If the water body from which withdrawals are made is a groundwater body, how is it rated in terms of available quantity and exposure to drought?	1 : Good quantitative status 2 : / 3 : Bad quantitative status	Water basin planification document National databases and cartography	Groundwater codes : HG207, HG218 Good quantitative status	Water consumption	1
	Surface waters	Water consumption	Si la masse d'eau dans laquelle sont effectués les prélèvements est une masse d'eau superficielle, celle-ci est-elle sujette à des phénomènes de sécheresse ? If the water body from which withdrawals are made is surface water, how is it rated in terms of available quantity and exposure to drought?	1 : The water body is not subject to drought phenomena 3 : The water body is subject to drought phenomena	Water basin planification document National databases and cartography Environmental Impact Assessment			

		Criterion 2: Sensitivity of the environment				Case study E1		
1	2	3	4	5	6			
Environmental medium	Subdomain	Type of EAs targeted	Questions	Possible answers and associated scores	Information sources	Information on the site	EAs concerned at site level	Attributed score for each EA
Water (receiving environment)	If the aqueous discharges are carried out in a surface water body	Substances	<p>Is the receiving water body downgraded (in terms of chemical or ecological status) by the analyzed EA or does the discharge induce a risk of not achieving the good chemical or ecological status of the water body?</p> <p>In the absence of such information, has an exceedance of environmental quality standards been observed through environmental monitoring?</p>	<p>1 : Very good or good chemical status</p> <p>2 : Medium chemical status</p> <p>3 : Very bad or bad chemical status</p>	<p>Water basin planification document</p> <p>National databases and cartography</p>			Not concerned

		Criterion 2: Sensitivity of the environment				Case study E1		
1	2	3	4	5	6			
Environmental medium	Subdomain	Type of EAs targeted	Questions	Possible answers and associated scores	Information sources	Information on the site	EAs concerned at site level	Attributed score for each EA
		Substances or thermal releases	<p>Is the site located in or near a protected area?</p> <p>If so, is the reduction/removal of emissions of the parameter part of the quality objectives for this type of area?</p>	<p>1 : Wastewater is not released in a protected area</p> <p>2 : Wastewater is released near a protected area (1 km)</p> <p>3 : The area in which wastewater is released is protected</p>	Registers of protected areas (shellfish waters, fresh waters, bathing waters, drinking water catchment areas, areas sensitive to eutrophication...)			Not concerned
	If the aqueous discharges are routed to a collective wastewater treatment plant	Substances	Is the installation connected to a wastewater treatment plant ?	1: Aqueous discharges are routed to a collective wastewater treatment plant	Environmental Impact Assessment			Not concerned

Criterion 2: Sensitivity of the environment						Case study E1		
1	2	3	4	5	6			
Environmental medium	Subdomain	Type of EAs targeted	Questions	Possible answers and associated scores	Information sources	Information on the site	EAs concerned at site level	Attributed score for each EA
	If the aqueous discharges are carried out in a groundwater body (infiltration) or if the wastewater and / or sludge are spread	Substances	Is the infiltration or the spreading carried out on a sensitive area to eutrophication ?	<p>1 : Aqueous effluents are not discharged into an area sensitive to eutrophication or a priority action area related to eutrophication</p> <p>2 : Aqueous effluents are discharged into an area sensitive to eutrophication but not a priority action area related to eutrophication</p> <p>3 : Aqueous effluents are discharged into a priority action area related to eutrophication</p>	Registers of areas subject to eutrophication	Wastewater or sludge is spread on an area sensitive to eutrophication.	N total, P total	2

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1	2	3	4	5	6			
Environmental medium	Subdomain	Type of EAs targeted	Questions	Possible answers and associated scores	Information sources	Information on the site	EAs concerned at site level	Attributed score for each EA
		Substances	<p>Is the chemical status of the receiving water body downgraded by the EA or does the discharge induce a risk not to reach chemical quality objectives for the given water body ?</p> <p>In the absence of such information, has an exceedance of environmental quality standards been observed through environmental monitoring?</p>	<p>1 : Etat chimique bon ou la masse d'eau n'est pas déclassée par le paramètre en lui-même</p> <p>2 : /</p> <p>3 : Etat chimique mauvais dû au fait que la masse d'eau est déclassée par le paramètre</p>	National or territorial public databases and planification documents	Two concerned water bodies : HG207 and HG218	No parameter retained	1

		Criterion 2: Sensitivity of the environment				Case study E1		
1	2	3	4	5	6			
Environmental medium	Subdomain	Type of EAs targeted	Questions	Possible answers and associated scores	Information sources	Information on the site	EAs concerned at site level	Attributed score for each EA
		Substances	<p>L'infiltration ou les épandages sont-ils réalisés à proximité d'une zone protégée ?</p> <p>Si oui, la réduction / suppression des émissions du paramètre fait-elle partie des objectifs de qualité pour ce type de zone ?</p>	<p>1 : Wastewater / sludge is not spread in a protected area</p> <p>2 : Wastewater / sludge is spread near a protected area (1 km)</p> <p>3 : The area in which wastewater / sludge is spread is protected</p>	Registers of protected areas (shellfish waters, fresh waters, bathing waters, drinking water catchment areas ...)	<p>Shellfish water : no</p> <p>Bathing water : no</p> <p>Closest drinking water catchment point : 2,5 km</p>	BOD ₅ , COD, TSS, total nitrogen, total P	3

Air	Emissions (channelled or diffuse)		Is the area covered by an atmosphere protection plan or other planning document to improve air quality? If yes, is the substance covered by this document?	<p>1 : The area is not covered by an atmosphere protection plan or another territorial planning document or the substance is not covered by the planning document covering the zone.</p> <p>2 : The area is covered by an air protection plan or another air quality planning document, the substance is covered but does not exceed limit values, or it is classified as a likely to exceed the limit value.</p> <p>3 : The area is covered by an atmosphere protection plan (or other), the substance is mentioned and the limit values in the environment are exceeded.</p>	Territorial (Regional, local) planning documents	Limit values are exceeded for COVNM and Sox, they are likely to be exceeded for PM10, NOx and PAHs	PM10, COVNM, SOx, NOx, PAHs	PM10 : 2 COVNM : 3 SOx : 3 NOx : 2 PAHs : 2
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1	2	3	4	5	6			
Environmental medium	Subdomain	Type of EAs targeted	Questions	Possible answers and associated scores	Information sources	Information on the site	EAs concerned at site level	Attributed score for each EA
	Odour		Over the past 5 years, have there been any complaints about odors emanating from the facility? Has an odor study been prescribed by the competent authority or has an odor monitoring plan / nose panel been implemented by the operator?	<p>1 : It was not considered necessary to carry out or prescribe an odor study on the site and no complaints were lodged.</p> <p>2 : At least one complaint has been lodged concerning odour nuisance generated by the installation.</p> <p>3 : The odour nuisance generated by the installation has been the subject of complaints, following which additional measures have been prescribed.</p>	<p>Complaints</p> <p>Documentation of the site, additional regulatory dispositions recently taken or about to be</p>	A draft amendment to the environmental permit is underway to prescribe additional measures regarding odors.	Odour	3

		Criterion 2: Sensitivity of the environment				Case study E1		
1	2	3	4	5	6			
Environmental medium	Subdomain	Type of EAs targeted	Questions	Possible answers and associated scores	Information sources	Information on the site	EAs concerned at site level	Attributed score for each EA
Vicinity	Noise		Over the past 5 years, have there been any complaints about the noise generated by the installation? Has a noise study been prescribed by the competent authority or has an odor monitoring/nose panel plan been put in place by the operator?	<p>1 : It was not considered necessary to carry out or prescribe a noise study on the site and no complaints were lodged.</p> <p>2 : At least one complaint has been lodged concerning the noise pollution generated by the installation.</p> <p>3 : The noise pollution generated by the installation has been the subject of complaints, following which additional measures have been prescribed.</p>	<p>Complaints</p> <p>Documentation of the site, additional regulatory dispositions recently taken or about to be</p>	No	No parameters retained	1