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Article

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Abstract: BAT-based regulations necessitate defining key environmental issues (KEIs) to focus data collection and discussions on the main topics when establishing best available techniques (BATs) at the sector level. However, Article 14 of the Industrial Emissions Directive (IED) suggests that some significant environmental issues may not be covered by BAT conclusions but still require the implementation of BATs at the local level, even in the absence of defined sectoral BAT references. The IED, along with the associated Commission Implementing Decisions and guides, does not offer guidelines for selecting KEIs at the local level, whether by the competent authority or the operator. To ensure full compliance with the IED by installations under its scope, this paper proposes a methodology for determining KEIs locally. Based on the environmental aspects of the installation, the sensitivity of the environment, and the levels of emissions or consumption, this methodology has been tested on a case study at the plant level to demonstrate its effectiveness. The paper then discusses the contributions and limitations of the methodology and suggests areas for future research. The proposed methodology was tested at the factory level, where it effectively identified and prioritized key environmental issues (KEIs) by focusing on site-specific environmental aspects not covered by sectoral BAT conclusions. The results suggested improved alignment with local environmental challenges, indicating the methodology's effectiveness in capturing key issues that may require immediate action under Article 14 of the IED. This approach provides a practical framework for prioritizing environmental impacts based on local context and regulatory requirements.

Keywords: environmental issues; KEI; best available techniques; industrial emissions ective

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1. Introduction

1.1. General Context

In the context of the zero-pollution ambition and the EU Green Deal [1], industrial environmental regulation and guidance are increasingly focused on identifying best practices, high-performance techniques, and success stories in cleaner production and clean technology experimentation. In recent years, there has been a significant increase in regional, national, and international information exchanges to share findings and feedback, aiming to establish common standards or international agreements [2,3]. Notably, the concept of best available techniques (BATs), which originated from the Integrated Pollution Prevention and Control (IPPC) Directive [4–6], is now widely adopted worldwide to develop effective technology-based environmental regulations [7].

In the European Union (EU), under the Industrial Emissions Directive [8], which succeeded the IPPC Directive, best available techniques (BATs) are sector-tested methods that achieve high overall environmental performance. These techniques are detailed in the

"BAT conclusions" (BATc), a key section of the sectoral Best Available Techniques Reference Documents (BREFs). Published as a Commission Implementing Decision, BAT conclusions are enforceable for industries subject to the IED.

BAT conclusions can be categorized into two types: generic BATs, which apply to the entire sector covered by the BREF (e.g., agro-industries in the *Food, Drink, and Milk* BREF), and specific BATs, which apply to particular subsectors (e.g., breweries in the *Food, Drink, and Milk* BREF). Both types of BATs are designed to address relevant environmental aspects such as nitrogen oxides or volatile organic compounds in air emissions, copper and its compounds in water emissions, noise, and energy consumption. Cleaner production and end-of-pipe techniques are used to target specific environmental aspects identified through environmental impact assessments (EIAs), and installations are regulated by national, regional, or local laws.

The determination and revision of BATs aim to benchmark the best techniques available within each relevant sector across the EU and to set or update regulatory limits based on the performance of these BATs. The goal is to achieve the best environmental performance for targeted aspects while avoiding significant adverse effects, often referred to as "cross-media effects".

BATs are developed based on comprehensive data collection [9] and may also involve the work of specialized subgroups [10]. An essential preliminary step is determining the scope of data collection, particularly identifying the environmental issues for which BATs should be defined, known as key environmental issues (KEIs) [11–13]. Due to constraints of time and resources, BATs cannot cover all activities and environmental issues within an industrial sector [9,14].

In line with the objectives of the 7th Environment Action Programme to 2020, the concept of key environmental issues (KEIs) was established within the framework of the Industrial Emissions Directive (IED) to address the most critical environmental issues. This approach aims to enhance the environmental efficiency of the Best Available Techniques Reference Documents (BREFs) revision process by concentrating efforts on a smaller set of environmental aspects [11]. The Sevilla Process (the European information exchange to elaborate or revise BREFs (Brinkmann, 2019)) must therefore prioritize KEIs, defined as the "*issues for which the BAT conclusions have the highest likelihood of resulting in noteworthy environmental benefits*" [11]. Data are collected from representative sites [9] to establish BATs.

Four criteria were agreed upon at the European level to define KEIs (European Commission, 2016)):

"Criteria (1): the environmental relevance of the pollution (air, water, soil) or generation of waste or consumption (e.g., of *water, energy, materials) caused by the activity or process* concerned, i.e., whether *it may cause an environmental problem;*

Criteria (2): the significance of the activity in terms of number of installations, their geographical spread and their contribution to the total emissions in the EU;

Criteria (3): the potential of the BREF review for identifying new or additional techniques that would further significantly reduce pollution;

Criteria (4): the potential of the BREF review for defining Best Available Techniques Associated Environmental Performance Levels (BAT-AEPLs) that would significantly improve the level of protection for the environment as a whole in comparison with the current emission/consumption levels".

At the beginning of a BREF revision, the Technical Working Group (TWG) members (the Technical Working Group (TWG) is responsible for the development or revision of a BREF; it includes representatives from the European Commission, member states, professional associations, and non-governmental organizations) develop their initial positions, arguing for the inclusion of specific activities and related environmental issues. The scope of the BREF, including activities and KEIs, is agreed upon during the kick-off meeting, considering these initial positions and arguments and documentation provided by stakeholders. Sectoral data are then collected from well-performing sites, and BATs are defined and refined for each KEI throughout the process, culminating in the final meeting.

1.2. Implementation of BATs at Local Level

KEIs and their respective BATs are agreed upon at the European level based on sectoral data collection, industrial feedback, expert judgment and stakeholder compromise. For sectors listed in IED Annex I [8], operators have four years to implement BATs once the BATc is published in the *Official Journal of the European Union* (OJEU) as a Commission Implementing Decision [8]. In France, the implementation of BATs involves two key steps [15]:

(1) Upon publication of the BATc, operators have one year to submit a "review file" to the competent authority. This file compares the performance of the installation and on-site techniques with the relevant BATs and KEIs. It concludes whether the installation complies with BATs or needs upgrades.
(2) The installation must comply with the BATc within four years following their publication, as required by the Directive.

However, as previously mentioned, not all activities have BAT references covering all of their significant environmental impacts in the applicable BATc, leaving no basis for compliance assessment. Article 14.6 of the IED addresses this gap, stating that where BAT conclusions do not cover all environmental effects, the competent authority, after consulting the operator, shall set permit conditions based on the best available techniques, considering Annex III criteria.

Despite this, the BREF does not provide a list of KEIs uncovered by BATc or a method for determining them. The Directive explicitly suggests that, in the absence of European-level BATs, permit conditions should be determined at the local level, not the national one. Therefore, local KEIs should be considered alongside sectoral/European KEIs for which BAT implementation is mandated. Unfortunately, the IED offers no methodological tools for determining KEIs, leaving Article 14.6 open to interpretation.

According to the proportionality principle [16], it would be impractical to implement or demonstrate BAT implementation for all environmental aspects of an installation. As, at the sectoral level, a crucial first step is identifying relevant environmental issues, the technical perimeter can be defined by the IED's definition of an "installation" [14]. Operators must then select the environmental issues requiring BAT implementation in addition to the sectoral KEIs, where comparison of environmental performance against BATs is mandatory.

1.3. Existing Methodologies to Determine KEIs

i. At the sectoral level

In the European framework, there is no official methodology for assessing environmental aspects. The selection of KEIs is typically based on initial stakeholder positions and discussions. A methodology was proposed by [17], based on four criteria defined at the European level (Figure 1), to create a preliminary list of KEIs. This list serves as a foundational element for gathering initial positions and organizing the kick-off meeting for the revision of a BREF [18]. This approach was applied during the Sevilla Process to four industrial sectors undergoing BREF revisions: ceramic manufacturing [19], slaughterhouses [20], smithies and foundries [21], and the textile industry [22].

The methodology involves two steps (Figure 1). First, the criteria (1) are applied to a generic list of environmental aspects (EAs) derived from international agreements and European environmental regulations. The EAs selected after this step undergo further screening in step 2, where the remaining three criteria are applied. If at least one of the four criteria is met, the EA is considered "possibly" a KEI; if two or more criteria are met, the EA is classified as a KEI.

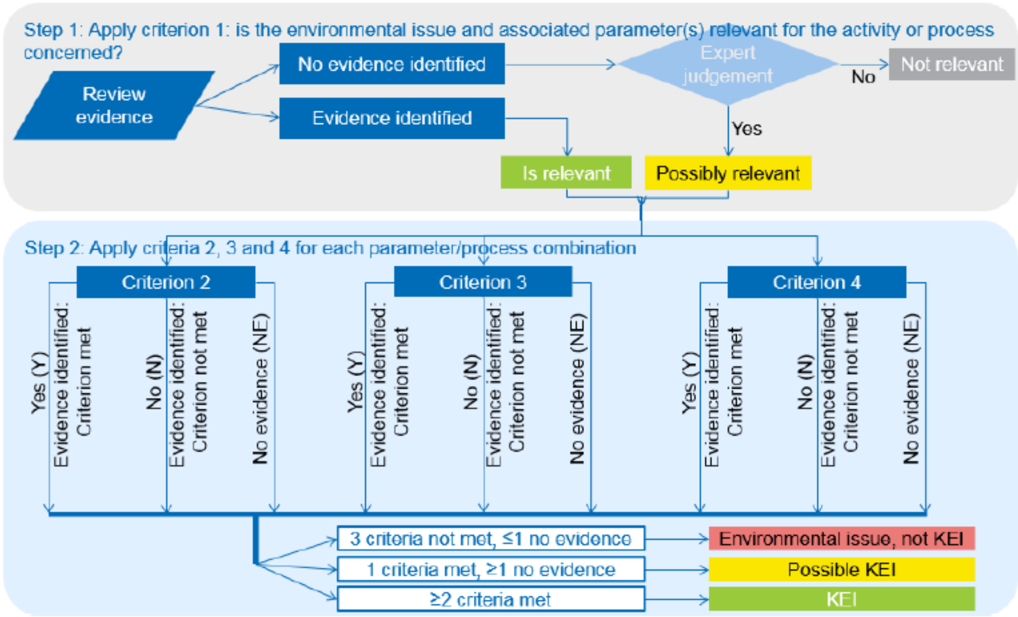

Figure 1. Synoptic of the preliminary determination of KEIs at the European level [17].

This sectoral methodology primarily focuses on the sector's contribution to the existence of an environmental aspect and any technological advancements since the last BREF update [17]. However, such information is often not fully accessible to industrial operators due to competitive concerns, and even if available, gathering and processing it can be time-consuming. Moreover, assessing and quantifying technological progress is challenging. Therefore, this methodology seems ill-suited to addressing local issues.

ii. At the local level

In their literature review, [14] identified two tools for determining key environmental issues at the local level as a preliminary step in BAT assessment methods. The first tool is Material and Energy Flow Analysis (MEFA), which helps identify significant pollutant flows, improvable flows, and key process steps. The second tool is a questionnaire designed to highlight the most sensitive environmental compartments, guiding the prioritization of actions and BAT implementation. However, these tools do not cover all environmental aspects or prioritize them based on risk. Therefore, criteria such as "quantity" and "sensitivity to the environment" could be complemented with an assessment of the intrinsic hazard of each environmental aspect to better gauge potential impacts.

However, the review of BAT assessment methodologies [14] underscored the need for such a methodology and suggested initial approaches for determining KEIs during BAT implementation. This article aims to build on this foundation by developing and testing a methodology to help operators identify KEIs specific to their installations.

iii. Extended research on the evaluation of environmental aspects

Existing methods for assessing environmental aspects fall into three categories: risk assessment-based, life cycle assessment-based, and criterion-based methods [23].

- Risk assessment calculates values related to hazardous phenomena, comparing them to reference values to estimate the frequency, duration, probability, and magnitude of abnormal situations, incidents, or accidents. Some methods, like human risk assessment, also address chronic risks associated with normal operating conditions by estimating daily intake of contaminants and potential health effects. Methods for managing polluted soils also fall into this category.
- Life cycle assessment (LCA) methods are used to compare products or processes based on their global environmental impacts (midpoints or endpoints). For a single object of study, reference values are needed to determine impact acceptability, which

are often unavailable since global impacts are challenging to quantify and should be minimized. LCA identifies global impacts but does not pinpoint the specific environmental aspects causing these impacts.

- Criterion-based methods are used in environmental management systems (EMSs) and accidental risk assessments are used to establish criticality matrices. These methods qualitatively rate environmental aspects or hazards based on various criteria to prioritize them and determine appropriate risk management actions.

The objective of the methodology is to identify and prioritize the significant environmental aspects of KEIs irrespective of risk acceptability. Risk-assessment and criterion-based methods were reviewed to identify principles and criteria for KEI identification (see Supplementary Material Table S1). To contextualize the application of this methodology, a case study at a French industrial site subject to the IED was conducted. This case provides a practical demonstration of the methodology's effectiveness in identifying KEIs that require action at the local level, in line with Article 14 of the IED.

2. Materials and Methods

2.1. Methodology Development

The development of the methodology to determine and prioritize KEIs required several steps. First, it was necessary to define what constitutes a KEI at the local level. Next, a basic list of environmental aspects was established to narrow down the scope for KEI selection. Finally, appropriate criteria for identifying local KEIs were identified, along with a suitable aggregation method to support decision-making.

iv. What is a KEI at the local level?

Given the European definition of a KEI as "issues for which BAT conclusions are most likely to lead to significant environmental benefits", KEIs used for comparing an installation's performance to BATs cannot be defined the same way. At the BREF revision stage, KEIs are not defined with the same objective; they are determined at the sector level with the goal of delineating data collection and BATc scope. In contrast, at the local level, KEIs are used to ensure that BATs address the main environmental issues of the site, as required by Article 14.6 of the IED. After the publication of a BATc in the *OJEU*, KEIs, whether sectoral or local, become the issues for which BAT implementation must be demonstrated and, if necessary, lead to site conformity.

At the European level, BATs are determined for specific KEIs or groups of KEIs, typically related to air, water, or soil emissions, and resource consumption such as that of water, energy, or raw materials [17]. BATs focus on technical solutions designed to prevent, capture, or treat pollutants and waste [24]. Thus, BATs are set to reduce specific emissions or resource usage, rather than addressing broader environmental impacts like human toxicity or abiotic material depletion [25]. Local KEIs are defined as environmental aspects specific to a particular site that require action to comply with BAT standards but are not covered by sectoral BAT conclusions. Unlike sectoral KEIs, which are determined at a broader industry level and included in the BREFs, local KEIs focus on unique site-specific environmental challenges that are not addressed by the generic or specific sectoral BATs. This distinction is particularly important under Article 14 IED, which mandates that competent authorities, in consultation with operators, establish permit conditions to address significant environmental aspects not covered by BAT conclusions. Local KEIs thus fill the regulatory gap left by sectoral BATs, ensuring that industrial sites address all pertinent environmental aspects, particularly those that may not be universally relevant across the sector but for the environmental performance of the specific installation.

Additionally, emission limit values (ELVs) are set at national and local levels for each pollutant based on BATs, reinforcing the use of the "environmental aspects approach" to remain consistent with BAT processes.

It is important to note that BATs address only normal operating conditions and chronic risks. The Industrial Emissions Directive does not cover accidental risks such as explosions, fires, or spills [26], for which specific methods [27,28] and regulations [29,30] already exist.

v. Inventory of environmental aspects

All environmental assessment methods include an inventory phase to identify and list the environmental aspects that need assessment. This inventory is guided by the objectives of the method, which are derived from the definition of KEIs. KEIs should be selected as the most significant environmental aspects among those presenting chronic risks.

Public and private projects likely to significantly affect the environment are governed by Directive 2011/92/EU, which sets specific requirements for development consent procedures. An environmental impact assessment (EIA) is conducted for each project to assess its environmental acceptability and address significant impacts with prevention, reduction, or compensation measures. Environmental aspects are regulated through the environmental permit of the site, including emission limit values (ELVs) and monitoring measures. All IED installations are subject to Directive 2011/92/EU, which means [31]:

- Existing installations should already have a permit ensuring that their environmental and health impacts are acceptable and regularly monitored;
- Installations in the design phase must undergo an environmental permit application process where the competent authority assesses the expected impact.

The EIA inventories all environmental aspects and determines which need regulation and control through clean-up techniques, ensuring compliance with regulations. While it identifies and assesses these aspects, it does not rank or classify them.

The IED, through Directive 2010/75/EU, enforces stricter measures to ensure that major environmental issues and industries are regulated with the highest standards, considering current technical and economic capabilities. IED installations are required to achieve the performance defined at the European level. This is the core of BATs: the most effective measures for KEIs. KEIs are not all the environmental aspects needing control but are a subset requiring enhanced action. The environmental permit provides a comprehensive list of environmental aspects to assess. For installations still under design, the EIA serves this purpose.

vi. Choice of criteria

As previously mentioned, the determination of KEIs at the local level cannot follow the same principles as at the sectoral level. Therefore, different criteria must be used at the local scale to identify an environmental aspect as a KEI for a given installation, based on information available to industrial operators. Specifically, the search for criteria was oriented towards existing regulatory obligations for operators.

Given that risk acceptability alone cannot be the sole criterion for selecting KEIs—since an installation must ensure this acceptability to operate—other, more discriminative criteria are needed. Various methods exist for assessing environmental aspects with different objectives (e.g., risk assessment, life cycle assessment). The indicators used in these methods were reviewed and analyzed to identify the most relevant criteria for determining KEIs. Details on these criteria, indicators, and associated methodologies are provided in Supplementary Material Table S1.

The goal of determining KEIs at the local level is to identify environmental aspects that, while controlled and acceptable, are still likely to have significant impacts. This method is not intended to replace other regulatory (e.g., EIA, human health risk assessment) or voluntary approaches (e.g., ISO 14001). Specifically, it does not aim to:

- Assess the installation's performance or the level of control over environmental aspects and impacts, or detect malfunctions;
- Evaluate the environmental and/or health acceptability of environmental aspects;
- Determine the share of pollution attributable to the installation;
- Assess the potential for the improvement of environmental aspects.

These elements can help in identifying KEIs. However, an environmental aspect (EA) being acceptable for the environment does not preclude it from being a KEI, nor does regulatory compliance guarantee that an EA cannot be a KEI. Regulatory compliance and environmental acceptability do not necessarily equate to the absence of impact.

Based on the methods reviewed (see Supplementary Material Table S1), three criteria were selected for identifying KEIs based on information directly available to operators—without requiring additional environmental measurements or expert intervention:

- Hazardousness to population and biodiversity;
- Environmental sensitivity;
- Quantification of the environmental aspect.

Given that regulatory procedures are already time-consuming and costly, the goal was to develop a method that is both easy to implement and objective, without incurring additional costs for operators while allowing for the quick identification of major environmental issues.

For the "hazardousness to population and biodiversity" criterion, several indicators were repeatedly found in the methods studied (see Supplementary Material Table S1):

- Regulatory Compliance: This is an easy and mandatory element to assess. Since regulations are designed to protect the environment and human health, any infringement indicates a potential impact. Therefore, this indicator is retained.
- Priority Substance Lists: Substances listed as carcinogenic, mutagenic, reprotoxic, endocrine-disrupting, and/or bioaccumulative, as well as those with national, European, or international objectives (e.g., substances contributing to ozone layer depletion), are significant. Their presence in such lists is retained.
- Nature of Effects: The lists indicate the nature of the effects. While precise exposure level calculations are needed for assessing the significance of effects, this indicator can be useful for other environmental aspects, such as noise.
- Other Indicators: Indicators such as hazard quotients or individual risk excess are typically calculated during human health risk assessments, which are complex and part of environmental impact assessments (EIAs). Hence, these are not included in this method.

Retaining the indicators of regulatory compliance and presence on priority substance lists allows for (1) focusing on substances requiring maximum vigilance, (2) addressing not only substance-type EAs but also others, and (3) assessing the level of biosphere protection at the local level.

Concerning the "Environmental Sensitivity" Criterion:

- Lack of Measurement Data: Operators often do not have regular environmental measurements, making it challenging to assess exceedances of Predicted No Effect Concentration (PNEC) or Environmental Quality Standards (EQSs). Furthermore, determining the specific contribution of the installation to these exceedances is difficult.
- Qualitative Information: Qualitative data on environmental sensitivity (e.g., discharges into already sensitive areas where EQSs are exceeded) can be used. This information is typically available in regional planning documents, Environmental impact assessments (EIAs), etc., and can provide useful context for assessing environmental sensitivity.
- Characterization of Populations/Sensitive Species: While important, characterizing populations or sensitive species does not effectively discriminate between EAs. Instead, it provides a broader view of environmental priorities, which is not the focus here.
- Regulatory Management Values: Determining exceedances of regulatory values generally requires soil quality investigations, typically conducted during baseline reports [32]. Therefore, this indicator is not retained.

Concerning the "Quantification of the Environmental Aspect" Criterion:

- Substance Quantity: The amount of a substance consumed or emitted alone does not indicate the priority of an EA. Comparison elements and thresholds are necessary to assess its significance. Without such thresholds, this indicator is less effective.
- Benchmarking: Comparing emissions from other sites within the same group may not be useful if the facilities are similarly designed and operated. This method is also not applicable to Small and Medium Enterprises (SMEs). Thus, this indicator is not retained.
- Contribution to EU Emissions: The degree of an activity's contribution to EU emissions or consumptions can be sourced from the E-PRTR database. This indicator is retained as it provides relevant information on the environmental impact.
- Frequency of Exposure: The frequency of environmental exposure is not considered a key factor in determining KEIs, as BATs address chronic risks and normal operating conditions. This criterion may only be relevant if activities occur unevenly throughout the year.

Exclusion of the "Technico-Economic Aspects/Technological Advances" Criterion:

The criterion "technico-economic aspects/technological advances" was not retained for the following reasons:

- Complexity and Accessibility: This criterion involves extensive research and complex cost calculations for each environmental aspect, and the necessary information is not always accessible to operators.
- Lack of Thresholds: There are no established thresholds for each and every pollutant to determine acceptable costs, making it difficult to set clear criteria.
- Subjectivity and Expertise: Most indicators under this criterion require expert judgment or are influenced by the technical and economic capacities of the company, introducing subjectivity.
- Impact-Based Prioritization: The priority of an environmental aspect should be based on its environmental and health impact rather than associated costs. The determination of KEIs should precede the BAT comparison stage, which focuses on improving performance from both environmental and techno-economic perspectives.

vii. Rating scale and calculation of the final score

Environmental evaluation often consists of a qualitative assessment comprising three (low–medium–high) to five (negligible–low–medium–high–major) main levels to characterize environmental aspects for each criterion [33–35]. Regarding the available information on the criteria that were chosen to characterize KEIs, a scale of three to four levels was adopted in the methodology (Table 1).

Table 1. Rating scale for each criterion.

Criterion	Scoring	Assessment Modality
Criterion 1: Hazardousness	0 (for noise)	The EA is negligible
	1	The EA is not hazardous or does not exceed the ELVs
	2	The EA should be limited or reduced regarding its toxicity and/or ELVs are sometimes exceeded
	3	The EA should be eliminated regarding its toxicity, and/or ELVs are often or always exceeded
Criterion 2: sensitivity	1	The environment is not sensitive to the presence of the EA
	2	The environment is moderately sensitive to the presence of the EA
	3	The environment is intolerant to the presence of the EA

Table 1. *Cont.*

Criterion	Scoring	Assessment Modality
Criterion 3: quantity	0	The quantity of the EA is null or not quantifiable
	1	The quantity of the EA is quantifiable
	2	The quantity of the EA is significant
	3	The quantity of the EA is important

Some observations can be made regarding the assessment modalities. On one hand, it is acknowledged that the intrinsic impact potential of an environmental aspect (EA), such as toxicity or eutrophication potential, can never be zero. On the other hand, the methodology aims to identify KEIs to guide the implementation of BATs. This raises the question of whether trace quantities of highly toxic pollutants should necessitate BATs. To maintain proportionality, it was decided that these substances would be subject to prevention or reduction measures and regulation, even if they are not quantified in the assessment. Therefore, a "0" score was incorporated into criterion 3.

The final assessment score is derived from multiplying the scores of the three criteria, rather than adding them. This approach accounts for the multiplier effect of the criteria on the environment, as multiplication is a common practice in environmental assessments [36,37]. Results should be analyzed in the context of their environmental impacts. The threshold for classifying an EA as a KEI was set to the maximum score for one criterion, which is 3 in this methodology. This approach also allows for the use of the "0" score to exclude EAs that are present only in trace amounts, which are unlikely to have significant environmental impact.

2.2. Methodology

The methodology for determining key environmental issues (KEIs) involves three consecutive steps, as illustrated in Figure 2. These steps are detailed in the following sub-paragraphs.

Figure 2. Main steps of the methodology.

viii. Step 1: Inventory of environmental aspects

As previously mentioned, an environmental impact assessment (EIA) serves as the foundation for inventorying environmental aspects that may become key environmental issues (KEIs). According to the European Parliament and Council (2011) [38], "the environmental impact assessment shall identify, describe and assess, in an appropriate manner and in light of each individual case, the direct and indirect significant effects of a project on the following factors: (a) population and human health; (b) biodiversity; (c) land, soil, water, air, and climate; (d) material assets, cultural heritage, and the landscape; (e) the interaction between these factors".

The selection of relevant environmental aspects begins with defining the technical perimeter of the installation to ensure that only the environmental aspects directly associated with the site's operations are considered. According to the Industrial Emissions Directive (IED), an 'installation' is defined as "a stationary technical unit within which one or more activities listed in Annex I are carried out, and any other directly associated activities on the same site which have a technical connection with the activities carried out on that site and which could have an effect on emissions and pollution". This definition shapes our approach to delineating the technical perimeter by including primary operational areas as well as any auxiliary processes or infrastructure that may contribute to environmental impacts, such as energy production, wastewater treatment, and storage facilities.

Within this defined perimeter, environmental aspects are identified based on their connection to site-specific activities and their potential to affect air, water, soil, human health, and biodiversity. Aspects are selected through a systematic review of operational processes, focusing on emissions, resource consumption, and waste generation that occur within the perimeter. For instance, air emissions from combustion processes, water discharges from treatment facilities, and hazardous waste outputs from production lines are assessed as part of this inventory. An environmental impact assessment (EIA) serves as the primary source for identifying these aspects, as it provides a comprehensive overview of potential impacts across different environmental media. However, certain challenges exist with using an EIA as a sole source, particularly regarding localized or emerging issues that may not be fully captured. To address this, the methodology also allows for supplemental data sources, regulatory requirements, and operator insights to ensure a thorough assessment of all environmental aspects pertinent to the defined perimeter.

However, not all environmental aspects identified in the EIA may be relevant for KEI determination, as the entire site might not fall under the scope of the Industrial Emissions Directive (IED). Therefore, it is essential to first define the technical perimeter for the application of best available techniques (BATs) to ensure that only the environmental aspects within this defined area are selected.

It is also important to note that demonstrating the implementation of best available techniques (BATs) is mandatory for the environmental aspects (EAs) referred to in the BAT conclusions (BATc) applicable to the installation. There are two types of EAs to consider:

- Sectorial EAs: These include all environmental aspects addressed by the BATs (both generic and specific to the sub-sector) outlined in the Best Available Techniques Reference Documents (BREFs) relevant to the installation. For BREFs revised since 2012, these are the environmental issues targeted by one or more BATs specified in the BATc. As the BREFs are still in their initial versions, this encompasses all environmental aspects mentioned in the BREF for the specific activity. Sectorial EAs are automatically considered as KEIs.
- Local EAs: These are environmental aspects listed in the environmental permit of the site or, if not available, in the impact study, and are not sectorial EAs. They must be related to the technical perimeter covered by the IED. Unlike sectorial EAs, not all local EAs will necessarily be classified as KEIs. Their significance needs to be assessed to determine whether they qualify as KEIs.

Excluded from this inventory are:

- Key Process Parameters: Such as pH, volume of water discharged, emission rate, ejection speed, C/N ratio, oxygen rate, etc. These parameters are used to ensure that discharges are managed according to prescribed conditions, rather than representing full environmental aspects.
- Soil Pollution: This excludes the spreading of aqueous effluents.
- Vibrations, Light Emissions, and Visual Impacts: These areas have limited regulatory frameworks at present.

The deliverable of Step 1 is a matrix that lists the environmental aspects (EAs), categorized by the relevant part of the technical perimeter, the applicable BREFs, and the impacted environmental sphere. Table 2 illustrates an example of how this matrix is structured.

Table 2. Example of matrix listing the EAs for each part of the technical perimeter.

Installation	Relevant BREF	Impacted Environmental Medium	Type of Environmental Impact	EAs Identified in the Applicable BREFs or Regulation or in the EIA
Installation of…	FDM	Water resource (the environmental medium "Water resource" only concerns the water body in which the installation withdraws water) (water withdrawals)	Resource depletion	Water consumption
		Water (receiving environment) (the environmental medium "Water (receiving environment)" only concerns the water body in which the installation dicharges its wastewater)	Toxic or eutrophic substances	COD
				Cu
				Nitrates
		Air	Toxic substances	SO_x
				…
			Greenhouse gasses	CO_2, CH4
				…
			Odor nuisance	Odor
			…	…
		Vicinity	Noise pollution	Noise
	ICS	Water (receiving environment)	Toxic or eutrophic substances	AOX
				…
			Microbiological pathogens	Legionella pneumophila

Each environmental aspect (EA) is inherently tied to its environmental medium. For instance, if a pollutant appears in multiple environmental media, it represents distinct EAs for each medium. For example, mercury (Hg) detected in air constitutes one EA, while mercury detected in water represents a separate EA. Despite the pollutant being the same, each instance is assessed separately due to its different environmental impact and regulatory context. Thus, EA_1 would be "Hg in air" and EA_2 would be "Hg in water".

ix. Step 2: Assessment of environmental aspects

The methodology for assessing the significance of environmental aspects (EAs) uses three key criteria:

- Criterion 1: Hazardousness for the Population and Biodiversity. This criterion evaluates the potential danger an EA poses to human health and ecosystems. It includes questions on regulatory compliance and the presence of priority substances, as well as the known effects of these substances.
- Criterion 2: Sensitivity of the Environment. This criterion assesses how susceptible the environment is to the EA, based on available qualitative information such as regional planning documents or environmental impact studies. It considers factors like existing environmental quality and the potential for adverse effects.
- Criterion 3: Quantification of the EA. This criterion involves evaluating the quantity of the EA and its contribution to environmental burdens. It looks at benchmarks like emissions data, relative contribution to EU totals, and other relevant quantitative measures.

In line with practices suggested by the European Commission for EMAS [39], these criteria are broken down into several closed questions designed to assess all selected indicators. The answers to these questions are scored from 0 to 3, with the final score for each criterion being the highest score obtained across the questions. This approach ensures that the most significant impact is considered for each criterion [33]. A regulatory watch should be maintained to update these questions and assessment methods as needed, ensuring that the criteria remain relevant and accurate. The final score for each criterion is denoted as shown in Table 3.

Table 3. Assessment criteria and associated scores.

Criterion	Score Name	Score Code
Criterion n° 1: hazardousness for the population and biodiversity	Hazard score	ScH
Criterion n° 2: sensitivity of the environment	Sensitivity Score	ScS
Criterion n° 3: quantification of the EA	Quantity score	ScQ

Criterion 1: Hazardousness for the population and biodiversity

Criterion 1 evaluates the potential hazardousness of each environmental aspect (EA) with respect to both population health and biodiversity. This criterion covers:

- Toxicity: localized harmful effects;
- Global/Indirect Effects: broader environmental impacts, such as ozone depletion.

The assessment is conducted through three specific questions:

- Question 1: Regulatory Compliance
    - Objective: Assess whether the installation complies with emission limit values (ELVs). If emissions exceed these limits, it indicates a need for reduction measures.
    - Score Interpretation: lower scores are given for better compliance, reflecting lower hazardousness.
- Question 2: List of Hazardous Substances
    - Objective: determine if the EA is listed as a hazardous substance subject to limitations, reductions, or elimination objectives at national, international, or European levels;
    - Score Interpretation: A higher score reflects that the EA is recognized as particularly hazardous and thus requires stringent controls.
- Question 3: Noise Pollution
    - Objective: specifically for noise pollution, assess the recorded noise levels;
    - Score Interpretation: scores are based on the measured levels of noise, with higher scores indicating greater impact.

Note that not all questions apply to every environmental medium. The questions relevant to each medium are detailed in Table 4. This approach ensures a comprehensive evaluation of an EA's potential harm, considering both direct and indirect effects on human health and biodiversity.

The assessment methods for each question are detailed in Table 5 and are based on European and national regulations, as well as guidelines developed by competent industrial regulatory authorities.

After answering all applicable questions for a given EA under Criterion 1 (see Table 4), the most penalizing score among the responses to Questions 1, 2, and 3 is assigned to Criterion 1 for that EA (ScH). Thus, ScH can be 0, 1, 2, or 3.

The evaluation results for Criterion 1 are presented in an EA rating matrix (Table 6), which shows the scores for each question and the final ScH for each EA. The highest penalizing score among all questions applied to an EA determines its score for Criterion 1.

Table 4. Environmental media and associated questions for criterion 1.

Environmental Medium	Question 1: Monitoring and Compliance with Regulation	Question 2: Lists of Priority Substances	Question 3: Noise Level of the Installation
Water resource	X	NC	NC
Water (receiving environment	X	X	NC
Air	X	X	NC
Neighborhood (Noise)	X	NC	X

X: rate. NC: not concerned.

Table 5. Assessment modalities for each question.

Score Attributed to the EA for Each Question	Question 1: Proportion of Non-Compliances (Depending on Monitoring Frequency)	Question 2: Hazardous Substances	Question 3: Noise Levels
0	/	/	Audible (0 to 60 dB)
1	EA not monitored or regulated. If it is regulated, non-compliances are less than 10% of the measures	The substance is not part of any priority substances list	Bearable (60 to 85 dB)
2	11 to 40% of non-compliances	The substance is listed with an objective to limit or reduce its emissions to the environment	Hazardous (85 to 90 dB)
3	More than 41% of non-compliances	The substance is listed with an objective to eliminate its emissions to the environment and/or to be substituted by another one	Painful (>90 dB)

Table 6. Rating matrix for criterion 1.

Environmental Medium	EA	Question 1	Question 2	Question 3	Hazard Score ScH
Water resource	EA 1	Score X1	NC	NC	= ScoreX1
Water (receiving environment)	EA 2	Score X2	Score Y2	NC	= Max(ScoreX2; ScoreY2)
	EA 3	Score X3	Score Y3	NC	= Max(ScoreX3; ScoreY3)
Air	…	…	…	NC	…
Neighbourhood (Noise)	EA n	Score Xn	NC	Score Z1	= Max(ScoreXn; ScoreZ1)

Criterion 2: Sensitivity of the environmental medium

Criterion 2 assesses the sensitivity of each environmental medium to each EA. This evaluation is conducted using a sensitivity matrix, which includes one or more questions for each environmental medium. For example, Table 7 illustrates the sensitivity matrix for the EA “Odour”, which falls under the “air” environmental medium. In this case, only one question is associated with this EA, and it has three possible assessment modalities. The most penalizing score among all responses to the relevant questions for the EA is assigned as its score for Criterion 2 (ScS).

Table 7. Example of assessment for the EA "odour".

Question	Assessment Modalities	References
In the last 5 years, have there been any complaints about odors from the facility? Has the inspector ordered an odor survey or has an odor monitoring plan/nose jury been set up by the operator?	1: It was not considered necessary to carry out or prescribe an odor study on the site and no complaints were made. 2: The operator has voluntarily implemented an odor monitoring plan on its site and/or at least one complaint has been made about odors generated by the facility 3: The odors generated by the facility have been the subject of complaints, as a result of which tighter measures have been added to the environmental permit of the site	Letters received from the competent authority or complainants Site documentation, regulation of the site

Criterion 3: Priority level

This criterion evaluates the priority level of each environmental aspect in quantitative terms. Similarly to the other criteria, one or more questions are posed based on the type of environmental aspect (e.g., water consumption, substance emissions, odors, noise). The evaluation methods are drawn from relevant regulations. Table 8 provides an example for assessing substance emissions.

Table 8. Score attribution for criterion 3.

Proposition	ScQ	References
The substance is not released from the installation or is released in trace amounts. In the case of land application, the pollution removal factor for the substance concerned is greater than or equal to 80%.	0	Applicable national Emission Limit Values (ELV)
The discharge is quantifiable, but the flows emitted are lower than the "cut-off flows" of the relevant national regulation (e.g., French decree of 2/2/98 or equivalent) or there is no cut-off flow. In the case of the substance spreading, the pollution elimination coefficient is between 60 and 80%.	1	
The "cut-off flows (Cut-off flow = flow threshold above which the emission limit values of the integrated decree (2/2/98) or the applicable sectoral decree, depending on the sectors subject to the integrated decree or not, apply)" of the relevant national regulation (e.g., French decree of 2/2/98 or equivalent) by which the plant is concerned are exceeded. In the case of the substance spreading, the pollution elimination coefficient is strictly less than 60%.	2	
Reporting thresholds on E-PRTR are exceeded (= operator has to report consumption/emissions for EA).	3	E-PRTR reporting threshold

The results for criterion 3 are displayed in a rating matrix (Table 9). This matrix assigns a score to each environmental aspect (EA) based on the relevant environmental medium. The quantification score for an environmental aspect is equal to the ScQ of the applicable topic and can range from 0 to 3.

Table 9. Rating matrix for criterion 3.

Environmental Medium	EA	ScQ
Water resource (water withdrawals)	EAx	ScQx
Water (receiving body)	EAy	ScQy
	EAz	ScQz
Air	…	…
	…	…
Vicinity	…	…

x. *Selection of KEIs*

After determining the three scores (ScH, ScS, and ScQ) for each environmental aspect, these are multiplied to obtain an overall score (ScG) (Figure 3A), ranging from 0 to 27. This global score helps to determine whether an environmental aspect qualifies as a local KEI (Figure 3B). For sectoral KEIs derived from BREFs, demonstrating BAT implementation is mandatory. These sectoral KEIs automatically receive a score of 30. Consequently, the final overall score (ScG) can range from 0 to 30 points.

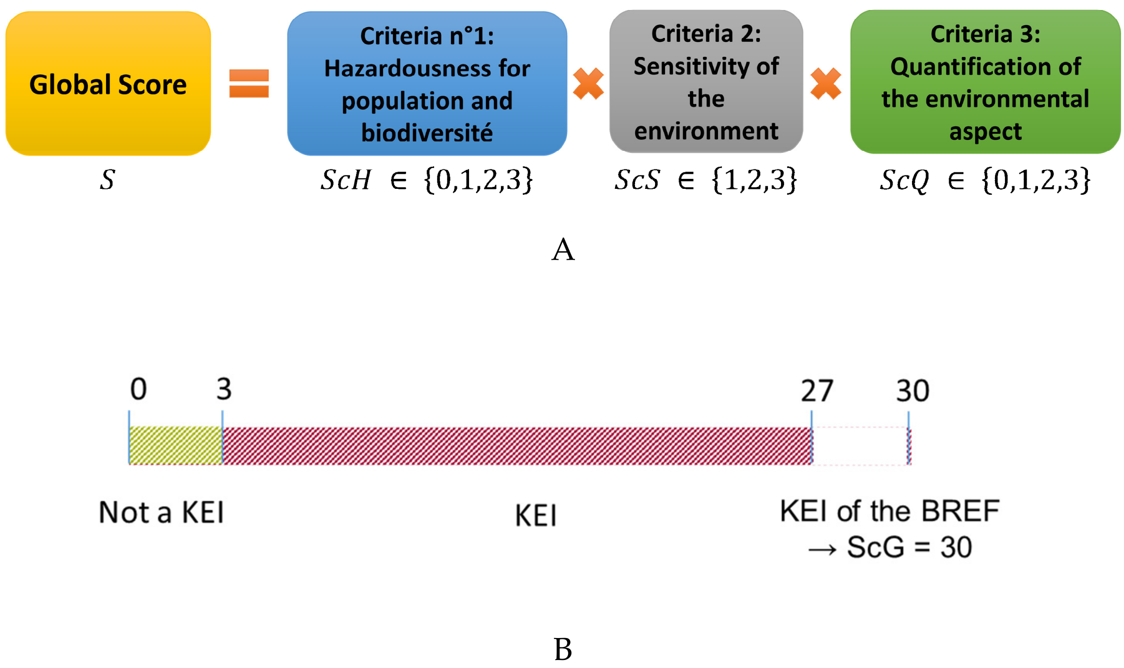

Figure 3. Selection procedure of KEIs. (**A**): equation for the assessment of the global score, (**B**): score scale.

An environmental aspect (EA) is classified as a key environmental issue (KEI) if its overall score (ScG) is ≥ 3. A score of 3 indicates that the EA has achieved the maximum score on at least one criterion and has not been nullified by a score of 0 on another criterion. This implies that the EA is:

- Dangerous to the population and/or biodiversity, even at low concentrations;
- Significant in terms of environmental degradation given its current state;
- Produced in very large quantities or poorly managed.

A maximum score in any of these areas is considered significant, warranting exploration of reduction measures for the EA. The final step of the methodology provides a list of KEIs for the installation. The summary matrix of scores for all EAs across the three criteria, and their overall ScG, is presented in Table 10, highlighting the EAs identified as KEIs.

Table 10. Matrix presenting environmental aspects and their ScD, ScS, ScQ, and ScG scores and prioritized list of KEIs.

Environmental Medium	EA	Criterion 1	Criterion 2	Criterion 3	ScG	KEI ≥3 Yes <3 No
Water resources (withdrawals)	EA1	ScH1	ScS1	ScQ1	= ScH1xScS1xScQ1	Yes/No
water (receiving medium)	EA2	ScH2	ScS2	ScQ2	= ScH2xScS2xScQ2	…
	…	…	…	…	…	…
Air	…	…	…	…	…	…
…	EAn	ScHn	ScSn	ScQn	= ScDnxScSnxScQn	…

The environmental aspects (EAs) are categorized into three groups based on their overall score (ScG):

- Non-KEIs: EAs with a score less than 3 are not considered KEIs. There is no requirement for the demonstration of BATs (best available techniques) for these EAs.
- Local KEIs: EAs with a score between 3 and 27 are classified as local KEIs. BATs must be implemented for these issues, with priority increasing with higher scores. EAs with the lowest scores may be excluded from the KEI list following discussions with the competent authority.

Mandatory KEIs: EAs with a score of 30 are covered by the BAT conclusions applicable to the installation. The operator must demonstrate the implementation of BATs for these KEIs.

3. Results

The methodology was applied to a French IED site whose primary activity is associated with the FDM BREF (due to confidentiality issues, the case study was anonymized and can unfortunately not be more detailed). The BAT conclusions for this BREF were published in the *Official Journal of the European Union* on 4 December 2019.

The installation was defined according to the IED's ('installation' means a stationary technical unit within which one or more activities listed in Annex I or in Part 1 of Annex VII are carried out, and any other directly associated activities on the same site which have a technical connection with the activities listed in those Annexes and which could have an effect on emissions and pollution) "installation" criteria and was divided into four sections corresponding to the applicable BAT conclusions:

- FDM1: The main agri-food activity covered by the "*Food, Drink and Milk*" (FDM) BREF;
- FDM2: Another agri-food activity on site covered by a different section of the FDM BAT conclusions;
- LCP: A biomass boiler covered by the "*Large Combustion Plants*" (LCP) BREF;
- ICS: The cooling towers covered by the "*Industrial Cooling Systems*" (ICS) BREF.

For confidentiality reasons, the company will be named ENT1 in the remainder of the article.

3.1. Inventory of Environmental Aspects

The analysis of the BAT conclusions applicable to the ENT1 plant, along with the site's environmental permit, allowed for an inventory of environmental aspects (EAs). In total, 69 EAs were identified:

- FDM1 Section: 19 EAs identified, 11 of which are from the FDM BREF;
- FDM2 Section: 4 EAs identified, 1 of which is from the FDM BREF;
- LCP Section: 27 EAs identified, 9 of which are from the LCP BREF;
- ICS Section: 18 EAs identified, none of which are from the ICS BREF.

For the 21 EAs derived from the BREFs, an overall ScG score of 30 is automatically assigned, indicating that these EAs are all considered KEIs.

3.2. Assessment of Environmental Aspects

xi. Criterion 1

→FDM1 section:

In the FDM1 section, the assessment yielded the following results:

- Two EAs have an ScD of 3:
  - VOCs (Volatile Organic Compounds), including acetaldehyde, which is classified as CMR (carcinogenic, mutagenic, reprotoxic) Category 2B;
  - Acetaldehyde, specifically known for its significant health risks.
- One EA has an ScD of 2:
  - TSS (Total Suspended Solids) in water, which is regulated under Annex II of the Order of 17 July 2009 concerning measures to prevent or limit the introduction of pollutants into groundwater.

→FDM2 section:

For the FDM2 section, the analysis of the four EAs identified in the air revealed the following:

- Dust, SOx, and NOx: Each has an ScD of 2. These EAs are regulated by European Union Air Quality Standards (EUAQSs).
- VOCs: Assigned an ScD of 3. The specific VOCs emitted include phenols, acetaldehyde, acrolein, furfuraldehyde, and formaldehyde. These substances are classified as either CMR (carcinogenic, mutagenic, reprotoxic), SVHC (Substance of Very High Concern), PBT (Persistent, Bioaccumulative, Toxic), or vPvB (very Persistent, very Bioaccumulative). The high ScD score is supported by past non-compliances with emission limit values (ELVs), with VOCs and SOx exceeding limits 45% and 12% of the time, respectively, over the last 5 years.

→LCP section:

For the LCP section, the analysis of the 14 EAs in the air resulted in the following hazard scores:

- Four EAs have an ScD of 2, as they are regulated by European Union Air Quality Standards (EUAQSs). These include carbon monoxide (CO), oxides of nitrogen (NOx), sulfur dioxide (SOx), and dust. Notably, CO has a non-compliance rate of 38%.
- Ten EAs have an ScD of 3, reflecting high hazard scores. These include:
  - Eight EAs regulated by international treaties or regulations aimed at their reduction, such as PAHs, dioxins and furans, cadmium, mercury, arsenic, lead, chromium, cobalt, and nickel. Specific PAHs released include naphthalene, acenaphthene, fluorene, phenanthrene, and fluoranthene. These substances are classified as CMR, SVHC, PBT/vPvB, or POPs (Persistent Organic Pollutants).
  - Two EAs with detected non-compliances: NH3 and PAHs, with non-compliance rates of 75% and 46%, respectively, over the past 5 years.

All other EAs in this section are deemed insignificant for Criterion 1, with a ScD of 1.

→ICS section:

In the ICS section, where no specific limit values are defined in the environmental permit for cooling tower discharges, reference values are taken from the ministerial order of December 14, 2013, which applies to installations under the registration regime for classified installations for environmental protection.

The hazard scores (ScD) for the 10 EAs in this section are as follows:

- Six EAs have a ScD of 3:

    - Three EAs are non-compliant with emission limit values (ELVs), with non-compliance rates reaching up to 57% for phosphorus and AOX and 100% for total nitrogen.
    - Three EAs include CMR substances such as phenols, chromium, and chloroform, with chloroform being classified as a priority hazardous substance.
- Four EAs have an ScD of 2, as they are covered by the Order of July 17, 2009, which addresses measures to prevent or limit the introduction of pollutants into groundwater.

All other EAs are considered insignificant for Criterion 1, receiving an ScD of 1.

xii. Criterion 2

For Criterion 2, the ScS scores are assigned to each environmental aspect (EA) based on the sensitivity of the impacted environmental domain, regardless of the specific BAT section it belongs to. The sensitivity matrix for the local environment of the ENT1 plant is detailed in Supplementary Material Table S2. According to this matrix:

- Eight EAs received an ScS of 3:
    - Air Emissions: odor, VOCs, SOX;
    - Wastewater: BOD5, TSS, COD, total nitrogen, total phosphorus;
- Three EAs received an ScS of 2:
    - Air Emissions: dust, NOX, PAHs.

The direct environment of the site does not exhibit significant sensitivity to the remaining EAs, and thus they are not considered significant for Criterion 2 (ScS ≤ 1).

xiii. Criterion 3

$\rightarrow$FDM1 section

In the FDM1 section, the ScQ scores for various environmental aspects (EAs) are as follows:

- Five EAs have an ScQ greater than 1:
    - VOC Emissions, Acetaldehyde Emissions, and Water Consumption: these EAs are reported on E-PRTR and receive an ScQ of 3;
    - Dust: the emission limit value (ELV) for dust is 5.75 kg/h, exceeding the cut-off mass flow of 1 kg/h specified by the decree of 2 February 1998, resulting in a ScQ of 2;
    - Noise: An acoustic impact study from 13 September 2018 shows that four regulated point sources are influenced by the site. The measured noise levels ranged between 45 dB(A) and 70 dB(A), leading to an ScQ of 2 for noise.
- Other EAs:
    - TSS, BOD5, COD, total nitrogen (Total N), total phosphorus (Total P), and NTK (Kjeldahl Nitrogen): The level of control of spreading for these EAs is considered "excellent," with a pollution elimination coefficient $\geq 97\%$ as per the decree of 21 December 2007. Consequently, these EAs receive an ScQ of 0.

$\rightarrow$FDM2 section

In the FDM2 section, the ScQ scores for the identified environmental aspects (EAs) are as follows:

- Three of the four EAs have an ScQ greater than 1:
    - VOC Emissions: reported on E-PRTR, resulting in an ScQ of 3;
    - Dust: with an ELV of 1.8 kg/h, exceeding the cut-off mass flow of 1 kg/h specified by the ministerial decree of 2 February 1998, leading to an ScQ of 2;
    - NOx: the ELV is 41 kg/h, surpassing the cut-off mass flow of 25 kg/h set by the ministerial decree of 2 February 1998, resulting in an ScQ of 2.
- The remaining EA has an ScQ of 1.

$\rightarrow$LCP section

In the LCP section, the ScQ scores for the identified environmental aspects (EAs) are as follows:

- Four out of twenty-eight EAs have an ScQ greater than 1:
    - VOC Emissions and Water Consumption: both reported on E-PRTR, resulting in an ScQ of 3;
    - Noise: The acoustic impact study dated 13 September 2018 shows that four regulated point source zones are influenced by the site. The noise level was measured at between 45 dB(A) and 70 dB(A), leading to an ScQ of 2.
    - NH3: With an ELV of 220 g/h in the environmental permit, exceeding the cut-off mass flow of 100 g/h specified by the decree of 2 February 1998, resulting in an ScQ of 2.
- The remaining EAs have an ScQ of 1.

→ICS section

In the ICS section, 1 out of 14 EAs has an ScQ greater than 1: Noise. According to the acoustic impact study dated 13 September 2018, four regulated point source zones are affected by the site. The noise level measured during the campaign was between 45 dB(A) and 70 dB(A), resulting in an ScQ of 2.

xiv. Selection of KEIs

In the case of the ENT1 plant, a total of 40 KEIs from the 69 environmental aspects (61%) were identified (Table 11).

Table 11. EAs for each section and their respective ScG, selection of KEIs. In grey, the KEI selected.

ScG\Section	FDM1	FDM2	LCP	ICS	Total EAs	Conclusion
0	1	0	0	4	5	Not KEI
1	4	0	9	5	18	Not KEI
2	1	0	0	5	6	Not KEI
3	0	0	7	4	11	KEI
6	1	0	1	0	2	KEI
8	1	0	0	0	1	KEI
9	0	0	1	0	1	KEI
27	3	0	0	0	3	KEI
30	11	1	10	0	11	KEI
Total	22	1	28	18	69	/

Of the 40 KEIs identified, 22 KEIs are derived from BREFs, 18 KEIs are local. Additionally, 27 of these 40 KEIs (which represents 64%) lack complete BAT references (BATs and BAT-AE(P)Ls). This includes 9 sectoral KEIs and 18 local KEIs. The grey in the table correspond to the KEI selection with a global score upper than 3.

4. Discussion

4.1. Genericity of the Methodology

The methodology for determining KEIs evaluates environmental aspects (EAs) using three criteria based on French national and local regulations, as well as regional planning documents. The application of this methodology has demonstrated its ability to effectively rank EAs within the BAT technical perimeter, providing a score range from 0 to 27 (or 30 for KEIs derived from BREFs), thus facilitating the discrimination and prioritization of environmental issues. The methodology has several advantages: it relies on information already available to industrial operators, is adaptable to regulatory changes and local assessments, and incorporates site-specific performance and environmental sensitivity. It is user-friendly, replicable, and theoretically objective due to regulatory thresholds, though this needs to be verified through testing with multiple evaluators. However, some limitations have been identified. For waste, the methodology could be adapted by modifying criterion 1, but criteria 2 and 3 are less suitable. Reporting thresholds on E-PRTR can be used for criterion 3, but there is a lack of intermediate evaluation methods. Criterion 2 is not well suited for waste evaluation; local recycling opportunities could be incorporated into criterion 1 or, possibly, criterion 2. Regarding energy and raw material consumption, there are no strict limit values or direct hazard indicators. The renewable nature of resources could be integrated into criterion 1, while local sensitivity could be qualitatively assessed in criterion 2. Actions taken by the company in energy transition and decarbonization could be reflected in criterion 3. Energy and water consumption are generally addressed by BREFs, making an additional local methodology unnecessary for KEI selection.

4.2. The Concept of KEI and the Concept of Risk

Risk assessment typically follows a source–pathway–receptor diagram [40,41]. The effects of an environmental aspect depend not only on its intrinsic harmfulness but also on the quantities involved, the state of the environment, and the sensitivity of living beings affected by the pollution. It is important to note that an environmental aspect being classified as a KEI does not necessarily imply that the values currently achieved by the operator are unacceptable in terms of environmental and health risks. An EA may be a KEI due to its intrinsic toxicity or its potential to contribute to environmental degradation (such as Global Warming Potential or resource scarcity), even if the installation is in compliance with regulations and the environment is not degraded. The absence of risk does not preclude an EA from being classified as a KEI. Given that the rationale behind the IED is performance at site boundaries, regardless of impact, an impact calculation would be inappropriate for the objectives of this methodology, as the lack of impact does not negate the need for BAT implementation. Conversely, significant risks or impacts might justify a comparison of BATs. According to French regulations, the competent authority may require a demonstration of BAT implementation if recurrent non-compliance with ELVs is observed.

Furthermore, as previously mentioned, it is generally easier for an operator to measure material and energy flows than to calculate impacts [42]. This limitation is acceptable when the goal is to assess and improve the degree of control over environmental aspects. However, it is insufficient when deciding on site establishment or regulatory relaxation.

Considering these factors, a set of criteria has been established to qualitatively assess the priority of each EA, and consequently the need for BAT implementation. Environmental aspects that are not KEIs but are still significant are generally regulated, addressed, and managed without requiring a demonstration of BAT implementation. These are considered environmental issues but not key environmental issues.

4.3. Life Cycle Assessment as a Perspective?

Several authors agree that risk assessment (EIA), life cycle assessment (LCA), and multi-criteria analysis methods used for selecting significant environmental aspects (EAs) in the context of environmental management systems have different but potentially complementary objectives [23,43–45]. LCA, in particular, is a standardized method that integrates a vast amount of quantitative information and produces reproducible results. However, it is not suitable on its own for determining key environmental issues (KEIs) because it only considers material and energy flows, excluding other EAs that might lead to pollution as defined by the Industrial Emissions Directive (IED) [8]. Furthermore, while LCA can characterize the impact of a process step or product life stage, it is challenging to pinpoint the exact EA causing an identified impact.

The major benefit of LCA lies in its ability to complement the KEI list with broader global issues increasingly addressed in BREF reviews, such as decarbonization and the circular economy [46,47]. Decarbonization and the circular economy focus on specific environmental aspects, like greenhouse gasses (CO_2, CH_4, N_2O, H_2O) and resource consumption, which are feasible to track. However, other global issues, such as aquatic toxicity, are more challenging to address as regulations focus on specific pollutants rather than their broader environmental impacts.

In practice, LCA is not widely used in regulatory frameworks due to several factors. Different practitioners may use varying assumptions, leading to inconsistent results. Additionally, LCA is time-consuming, costly, and complex. Although extensive databases exist, there are still gaps in characterization factors for all industrial processes. If LCA were made more practical and widely adopted, it could add value to industrial environmental management and the implementation of BATs, especially for areas where regulatory analysis lacks sufficient methods. As [43] suggested for EMS, adapting LCA to KEI selection could enhance the integrated approach by encompassing a wider range of EAs.

4.4. Generalization and Integration with Complementary Approaches?

While this methodology has been applied to a single case study (with a second case study undertaken but not presented here due to confidentiality constraints), expanding its application to other industrial sectors and sites is crucial to evaluate its adaptability and generalizability. Future research could apply the methodology across diverse industries, such as chemical manufacturing, energy production, and waste facilities, where environmental impacts differ significantly in terms of pollutant types, resource consumption, and waste generation. Testing across these varied sectors would enable the methodology to capture unique environmental challenges and allow for sector-specific adjustments, ensuring effective prioritization of site-specific environmental issues. The current methodology's qualitative approach to prioritizing environmental aspects could also be enhanced by integrating elements from risk assessment and environmental performance evaluation (EPE). Risk assessment focuses on identifying and mitigating specific hazards based on potential impacts to human health and ecosystems, often through a source–pathway–receptor model. While risk assessment is effective for managing acute risks, it may not account for the broader environmental aspects that are significant for regulatory compliance and sustainability. By combining risk assessment criteria with the site-specific focus of this methodology, it would be possible to prioritize issues that pose both immediate and long-term risks at a particular site. Environmental performance evaluation (EPE), as defined in standards such as ISO 14031, could also complement this methodology by providing a framework to monitor and assess environmental performance over time. EPE emphasizes the use of key performance indicators (KPIs) to track progress in areas such as emissions reduction, waste management, and resource efficiency. By integrating KPIs from EPE into the KEI prioritization process, the methodology could benefit from a more structured approach to tracking improvements and adjusting priorities as environmental performance evolves. For instance, sites could use KPIs to assess the effectiveness of implemented measures, revisiting and refining their KEI priorities based on performance outcomes.

Comparing this methodology to other established approaches reveals its unique contribution to site-specific environmental management. Unlike sectoral BAT-based methods, which provide generalized guidelines for entire industries, our methodology allows for a tailored assessment that captures environmental issues unique to specific installations, in alignment with Article 14 of the IED. This localized focus makes it particularly valuable for industrial sites with complex environmental interactions that may not be sufficiently addressed by sector-wide standards.

5. Conclusions

The methodology developed for identifying key environmental issues (KEIs) proves to be a valuable tool for evaluating environmental aspects in the context of applying best available techniques (BAT). By combining national, local, and regional regulatory criteria, this approach enables the prioritization of environmental aspects based on their significance and potential impact. The application of this methodology to an industrial site subject to the IED has demonstrated that environmental aspects can be assessed robustly, allowing for better decision-making in environmental management.

The results show that the methodology is effective in discriminating and prioritizing environmental aspects, with scores ranging from 0 to 27, and up to 30 for KEIs derived from

BREFs. The use of evaluation criteria indicates that the methodology can capture the complexity of environmental impacts while remaining adaptable to regulatory changes and local specifics. The 40 KEIs identified, with 22 from BREFs and 18 being local, underscore the relevance of this approach for a comprehensive assessment of environmental risks.

However, certain limitations of the methodology need to be acknowledged. Aspects related to waste, energy and raw material consumption, and soil pollution require specific adaptations to better reflect their management and impact. For example, waste is not fully covered by the current criteria, and the methodology could benefit from considering its recycling potential. Similarly, resource consumption could be assessed by accounting for their renewability and environmental impact.

The approach of the methodology relies on qualitative criteria to assess the priority of environmental aspects, but it does not replace quantitative evaluations such as impact studies or life cycle assessments (LCAs). These three methodologies provide complementary information on the environmental challenges faced by industrial sites, enabling a better understanding of their impacts. While LCA provides a standardized and reproducible approach for assessing global impacts, it has limitations when it comes to precisely targeting the environmental aspects responsible for those impacts. Nevertheless, integrating elements of LCA into the methodology could enrich the evaluation by adding global dimensions such as decarbonization and circular economy.

In conclusion, the methodology offers a robust framework for selecting KEIs based on accessible regulatory and local data. It allows for a consistent and adaptable evaluation tailored to the specifics of each industrial site. Suggested adaptations for aspects not fully covered and the practical implications of the approach highlight the need for continuous improvement to better address contemporary environmental challenges. Future research could focus on integrating quantitative methods and expanding evaluation criteria to cover additional environmental aspects, further enhancing the relevance and effectiveness of the methodology.

Supplementary Materials: The following supporting information can be downloaded at: https://www.mdpi.com/article/10.3390/cleantechnol6040080/s1, Table S1: Methods studied for the elaboration of the method to select KEIs; Table S2: Sensitivity matrix of the case study E1.

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