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Evaluation of the implementation of best available techniques in IPPC context: an environmental performance indicators approach

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ABSTRACT

In this paper an integrated methodological approach is presented for the evaluation of the implementation of the Best Available Techniques (BAT) in facilities operated under Integrated Prevention Pollution and Control (IPPC) Directive, based on the development and application of a set of sub-indices. An aggregated form of sub-indices that could be used as a composite IPPC facility index is proposed. A sector specific index can be derived from facilities composite indices.

This approach uses environmental performance data from European Polluting Emissions Register (EPER) reports, environmental permits and BAT Reference Documents, and gives a coherent and interesting picture of the degree of BAT implementation and an indication of IPPC obligations fulfilment.

A specific application is demonstrated concerning the paper manufacturing sector in Greece. It is concluded for this sector that there is a measurable discrepancy from the BAT fulfilment obligations and that the most problematic sub-indices are the "Releases to Water" and "Releases to Air".

1. Introduction

An indicator is a variable that supplies information on other variables which are difficult to access. It can be used as bench marker to make possible a better understanding of a complex system so that effective policy or management decisions can be successfully taken [1–3].

Environmental performance measurement can be defined as the measurement of the interaction between an economic activity and the environment. The ability of environmental performance indicators to make an important contribution to environmental management systems has been increasingly recognized by academics and practitioners [4]. Environmental performance indicators are a basic constituent for the monitoring of environmental performance or environmental impacts at a facility level, according to ISO14000 series standards or Environmental Management and Audit Scheme. Thus a remarkable literature concerning the approaches and methodologies for the development of environmental performance indicators can be found. Some of the related published works concern the evaluation of the technology used in industry [5–12]. Kliopova and Kazimieras Staniskis [10] refer to the evaluation of cleaner production performance in Latvian industry, while Johan Thoresen [6] elaborates some aspects related to the construction and use of environmental performance indicators in industrial companies. B. von Bahr et al. [7] stress the data quality issues in cement plants in Sweden, Norway and Finland. Tadeuzs Fijal [12] studies the use of aggregated forms of indicators for the assessment of the environmental performance of facilities.

The aggregation of the environmental performance indicators to create a composite one plays an important role in this study. Recently, composite indicators have been developed and used in the field of the quality of life and environment, mainly for ranking the performance on country level. Specific issues like industrial competitiveness, sustainable development, and technologies innovation are some of the application areas of these indicators [12–18].

The aim of this study is to present and apply a transparent integrated methodology for the evaluation and ranking, on an annual basis, of the BAT implementation in IPPC facilities. The proposed methodology, based on the use of specific environmental performance, simple and composite indicators, provides a useful tool for the rapid assessment of IPPC facilities compliance with the related legislation.

The Greek paper manufacturing sector is used for the application of the proposed methodology and relevant results are presented in this study.

2. The methodological approach

The environmental effects and impacts of the techniques of an IPPC installation are examined during the environmental permitting procedure. The EC legislation requires that the applicant for

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such a permit describes the nature, the quantities and the sources of raw materials, energy, emissions and wastes before the granting of the permit and reports the emissions after granting, on a periodical basis. The Greek government has formulated the environmental permitting procedure on the basis of Environmental Impact Assessment and IPPC Directives [19,20]. For the IPPC facilities, BAT implementation is a fundamental constituent. BAT are considered according to IPPC directive annex IV and analysed in the BAT Reference Documents made by European IPPC Bureau. These texts are updated under the oncoming technological progress.

The methodological approach that is presented in this paper uses environmental performance indicators and indices based on data available from the European Polluting Emissions Register (EPER) reports and the applications environmental permits submitted to the Ministry of the Environment, which is the competent authority for the issuing of such permits. EPER data are reported by the facilities' operators every three years and, from 2007 onwards, they will be submitted every year for the European Polluting Releases and Transfer Register (E-PRTR) purposes [21,22].

Using these data in the frame of the proposed methodology, it is possible to monitor the progress of the BAT implementation by comparing the indicators, after normalization with benchmarks from the BAT Reference Documents or granted environmental permits. Moreover the various facilities of a sector can be ranked according to their BAT implementation, providing a clear picture of their environmental performance.

In accordance with 2003/532/EC Recommendation, the environmental performance indicators category comprises operational performance, management performance and environmental condition indicators. For the proposed methodology only the operational performance indicators are used. They utilise mainly data of emissions, wastes, as well as resource and energy consumptions in relation to annual production or consumption. They are simple ratios of two variables (i.e., total emissions of SO_2 and annual production).

The most important environmental effects and impacts from the operation of an IPPC facility could be divided in different environmental categories, the "Components", depending on the kind of related sector. Having in mind all the above legislation and literature, environmental effects or impacts could be, among others, waste production, resources use, energy consumption, water consumption, water pollution, gaseous emissions, noise levels, soil pollution, green house gases emissions. With the assistance of experts' judgement we can define the most important components for a specific sector.

After having defined a sector environmental profile, we have to select one sub-indicator per component. The selection is carried out by experts' judgement supported, when necessary, by multivariate analyses of available data [1,2,23,24]. These selected sub-indicators are finally normalized by the corresponding BAT benchmarks and transformed to dimensionless component sub-indices SI_c with $c = 1,\ldots,C$ the components for the sector.

BAT benchmarks used in the study, are based on input and output (consumptions and emissions) associated levels (BAT-EALs) given in BREFs . The preparation of the BREFs takes place in the Technical Working Groups of particular sectors and is coordinated by the IPPC Bureau in Seville, Spain. The procedure is accurately defined by the Commission but the results reflect the data and its quality put available for the process and sometimes the bargaining powers of the different parties involved. Data from the approved environmental permits could be used when BAT benchmarks from BREFs are not reliable.

The next steps include the formation of facility composite index ($FINX_f$) with $f = 1,\ldots, F$ the number of the sector facilities, based on the weighted and aggregated component sub-indices and finally the formation of sector index ($SINX_s$), where s the specific sector.

A composite index describing an overall picture of the BAT application on a facility level, must fulfil, among others, the following prerequisites:

- To present an informative and powerful picture for the BAT implementation, not only for ranking.
- Sub-indices are produced through the comparison with BAT benchmarks. "Distance to a reference" is the normalization method because it measures the relative position of a given indicator vis-à-vis a reference point [23].
- The sub-indices used for the formation of the $FINX_f$ are equally weighted, as there is no variation in the importance of each index. It is well accepted that the obligations for all the components are equally legitimate.
- The interactions between the different environmental sub-indices and components should be taken into account while aggregating them.
- The values of the sub-indices should be of the same units and range and the values of the facilities composite indices must not be influenced by very high or low values of some of the sub-indices.
- The robustness of the facility composite index must be evaluated.

At the end of the procedure, the final results are as follows:

- A set of facility component sub-indices for each of the facilities participating in the sector, giving the degree of BAT implementation, and an indication of compliance with IPPC legislation since the BAT is a fundamental element of the IPPC system. The critical value of the sub-indices is 1 (i.e., the value at which the variable equals the BAT benchmark).
- A composite index and the ranking for each of the facilities.
- The sector index giving a unified indication of the progress of the entire sector and the degree of BAT and IPPC implementation.

3. Development of composite indices

3.1. Creation of a database

Official data from EPER (E-PRTR) reporting and environmental permit applications (Environmental Impact Statements in Greece) and approvals are used for the completion of a reliable and representative database.

Collection and processing of data are critical for the quality of the indicators, and the reliability or consistency and completeness should be ensured. The data collecting and processing includes the following steps:

- Collection of data from EPER reports submitted to the competent authority, (These reports include information on quantities of emissions expressed in Kg/y, and annual quantities of products expressed in t/y). In Greece, total emissions per annum are reported for all variables exceeding or not the threshold values.
- If for some reasons it is not possible to get reliable data or data at all, for an installation from the above reports, data can be used from the environmental permits and relative studies.
- Next, we form a table with accepted data ready for use and we develop the under examination variables. These variables are environmental performance indicators.