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Factors Affecting the Use of Best Available Techniques and the Impact on Business Sustainability

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ABSTRACT

This study investigates the application of the best available techniques (BAT) in enterprises. The article also analyzes the different approaches of the BAT, clearly stating how to apply the BAT and the conditions for using the BAT. The article also identifies and measures the factors affecting the application of BAT in enterprises. In addition, the paper also analyzes and measures the influence of BAT and other factors on the sustainable development of enterprises. The article shows that if using the BAT technique as an alternative technique while not needing to invest more in machinery and equipment, and resources, only changing the way of operation and processing process, enterprises can increase the level of environmental protection, make use of waste to complete the closed process, reduce costs, and increase profits. From that, the article proves that BAT is the best technique to prevent or reduce emissions and environmental impacts; businesses must use BAT if their activities are installations or manufacturing, export, and processing enterprises. The authors collect data from 192 manufacturing enterprises in six industries. The main data analysis method of this study is the structural equation modeling method (SEM). The article used AMOS software to evaluate and measure the influence of each factor on the application of BAT in the enterprise and the impact on the sustainability of the enterprise. BAT research has shown that the rational use of resources is essential. Measuring and recording information through the evaluation of techniques used in production also shows that we are disrupting the ecological environment without recreating it. We live by capital, not by added value, so environmental protection is necessary.

KEYWORDS

Best Available Techniques (BAT), Cleaner Production (CP), Environmental Management Accounting (EMA), Environmental Management System (EMS), Information Exchange Forum (IEF)

1. INTRODUCTION

The principle of best available techniques (BAT) is laid down by the European integrated pollution prevention and control (IPPC) directive no. 96/61/EC, have become important issues to be addressed in various fields around the world. Currently, many companies in the world have been researching to apply BAT. To better understand the techniques of BAT, a survey was carried out in France to develop a

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method for evaluating different techniques when applying BAT. The Best Available Techniques (BAT) concept first emerged in the 1960s. It primarily serves as a tool for preventing industrial pollution and setting conditions for Integrated Environmental Permits for larger industrial installations. BAT include technological, technical and managerial solutions aimed to prevent or control pollution and provide for high resource and energy efficiency (EE) of production processes and minimisation of waste (Hjort, M., Skobelev, D., Almgren, R., Guseva, T., & Koh, T., 2019).

The article mentions the effectiveness of applying BAT - a tool and method to manage the environmental management system, which is one of the most important directions to ensure ecological safety (Silvestri, L., Palumbo, E., Traverso, M., & Forcina, A., 2021).

This paper aims to study the role of BAT in environmental management accounting (EMA), and the factors affecting the application of BAT in manufacturing enterprises in Vietnam. Since then, the article also identifies and measures the influence of BAT and other factors on the sustainable development of enterprises. After verifying the results, we will recommend the use of the BAT method to develop EMA systems in manufacturing enterprises. The article asserts that ecological safety is extremely important for the development and operation of any business operating for profit and always wishing to enhance its competitiveness. The article also proves that not only profitability and operational efficiency are important for businesses, but ecological safety is equally important. The article also shows that introducing BAT technology into the production process related to an environmental protection system will minimize the negative impacts on the environment and the population.

2. LITERATURE REVIEWS

Several works have studied the basic theory of the BAT concept, process technology, equipment, technical methods as well as other environmental protection methods related to BAT.

Nowadays, environmental protection is one of the urgent and global issues. The negative impact of human activities on the natural environment is increasing at an alarming rate every year, in some cases reaching catastrophic levels. One of the most important natural safety indicators in modern society is ecological security, which protects the vital needs of people, society, and the environment from the negative effects of economic and other man-made activities. Due to the continuous deterioration of the environmental situation, there is a need to increase environmental safety regulations at the government level. Environmental control and environmental monitoring are important issues in an organization. Their objective is to check compliance with environmental regulations, environmental safety standards, and regulations (Guseva, T. V., Begak, M. V., Molchanova, Y. P., Averochkin, E. M., & Vartanyan, M. A., 2014)

At the end of the last century, there was a shift in environmental values and their relationship with the global environmental crisis and with society's perception of the urgency to limit the negative impact of businesses, an economic group in the field of industry and agriculture for the environment. The change in the environmental research paradigm due to the opening of the concept of BAT has contributed to limiting the consumption of natural resources to protect future generations (Morokishko, V., Volosatova, A., Ilina, V., Vertyshev, S., & Malkov, A., 2022, July).

The application of these techniques in an improved system, allows reducing the amount of material and emissions reducing the impact. The combination of those tools has confirmed to be a very good option for process evaluation considering sustainability criteria. The Impact Assessment has permitted to compare the base case scenario showing a reduction of the impacts by the selected Best Available Techniques (Zapelloni, G., Rellán, A. G., & Bugallo, P. M. B., 2019).

The Best Available Techniques include the latest and most effective technologies for different operations, processes, and ways of working, complying with environmental permits, and protecting the environment (Lizunkov, V. G., Morozova, M. V., Zakharova, A. A., & Malushko, E. Y., 2021)

There are quite a few types of BAT that have been used in countries such as the Russian Federation, Korea, and the European Union use BAT; the United States uses the Best Available Control Technology, India uses the Best techno-Economically Available Technology, the People's Republic of China uses Using Available Technologies, New Zealand using Best Practical Options (Barthe, P., Chaugny, M., Roudier, S., & Delgado Sancho, L., 2015).

The corporate environmental regulations are based on the concept of BAT as defined in the European Union in 1996 by Directive 96/61/EC «Integrated pollution prevention and control». This Directive deals with the relationship between industrial technologies and their impact on the environment. It was later replaced by Directive 2008/1/EC on pollution prevention and control, followed by Directive 2010/75/EC «On industrial emissions and or discharges (integrated pollution prevention and control)». International experience on BAT implementation in industrial production, reviewed based on EU Directives, is the basis for the formation and development of the concept of BAT in Russia. Directive 2010/75/EC regarding BAT, deals with issues such as pollutant reduction/discharge, energy efficiency, resource conservation, waste reduction, treatment and recycling, and systems. effective waste management. The Act of the Federal Agency on Technical Regulation and Metrology from December 3-d (2014) N°192 in Russia opened the Russian Bureau of BAT, whose main activity is to develop BAT technical guidelines. The development of the manuals is based on the guidance of the European working groups as well as on the analysis of resource efficiency and environmental performance of enterprises. At the same time, the handbook on BAT ETS 4 was developed and produced taking into account the peculiarities of the Russian manufacturing industries. This manual contains descriptions of production processes, equipment, technical methods, methods of minimizing negative impacts on the environment and improving energy efficiency, and methods of conserving resources in the ceramic industry. Currently, there are about 30 manuals related to BAT in Russia (Dijkmans, R., 2000).

The issue of implementing BAT in terms of technology is discussed not only in the production of products but also in the design, maintenance, establishment, and operation of the business. The scientists also point out that the technology used may need to be developed at a scale that allows deployment in the right industries in a manner that ensures a cost-benefit relationship to achieve the goal of protection. environmental protection. This development aims to assist local authorities in implementing best-in-class environmental technology in waste management to minimize negative impacts on the environment. (Ergunova, O., Skuratov, A., Pozdeeva, O., & Kindaev, A. Y., 2019, March)

Currently, there are several environmental safety tools such as Best Practical Means, and Best Practical Environmental Options that are widely used to accomplish environmental protection goals. Russian scientists and specialists say that currently there is a lack of criteria to classify cases that have negative impacts on the environment. Some businesses are not willing to adopt BAT because it only leads to improved environmental performance but is not economically viable.

The Russian Federation has approved common methods of environmental protection for several industries – that is, methods and tools of the environmental management system. These issues are necessary for the development and implementation of environmental protection policies. The environmental aspect is a key concept in EMS that enables the connection of business activities and interactions with the environment, including the following (Ibáñez-Forés, V., Bova, M. D., & Azapagic, A., 2013):

- Emissions of pollutants into the atmosphere;
- Discharges of pollutants into water bodies;
- Waste formation;
- Consumption of energy, raw materials

The main principle of EMS is to prevent pollution and continuously improve the environment as well as to implement an environmental management system periodically to promote overall environmental performance. This process is accomplished by setting environmental objectives, allocating resources, and assigning responsibilities, in particular, developing and implementing environmental programs. Environmental management programs to promote the monitoring and control of environmental policy implementation in industries include the selection, justification, and measurement parameters mainly because For the development and testing of EMS-related tasks, it is necessary to have a performance evaluation system. (Neuwahl, F., Cusano, G., Benavides, J. G., Holbrook, S., & Roudier, S. (2019).

The effectiveness of the EMS is to ensure the development, implementation, and compliance of the basic procedures necessary for aspects of environmental management including performance standards for each phase, and action in the field in case of deviation from the standard.

The most important component of effective environmental management practices and enhanced EMS implementation is the principle of pollution prevention. This principle is the most effective and sometimes the only possible one because it is an effective measure to prevent negative environmental impacts by interfering with the process itself (the cause of the impact). . Pollution prevention methods are often effective and cost-effective. After all, firstly, they involve aspects such as material selection, process control, recycling, material handling, etc (Tikhonova, I., Guseva, T., Averochkin, E., & Shchelchkov, K., 2021).

3. THEORETICAL FRAMEWORK OF RESEARCH

3.1 The Framework of BAT

Control procedures operate based on the BAT principle to determine emission critical values or the lowest levels of emissions that are economically feasible for the business. Those are the limits that any business wishing to establish a business must disclose before receiving the certificate of incorporation. Furthermore, every decade, some industries need to reassess their practices to update their procedures in the future. Evaluation of self-assessment can be based on a comparison of their current performance with the calculated performance based on BAT.

To implement BAT, the Information Exchange Forum (IEF) has been opened, including members who are technical centers and associations of the state and non-governmental organizations (NGOs). The role of the IEF is to collaborate and plan the exchange of information and to evaluate and validate the results of the exchange through the BREF (BAT reference document) (Laforest, V., 2008). The European IPPC Bureau (EIPPCB), in close cooperation with the IEF, organized the exchange of BAT information. The EIPPCB drafted the BREF based on the recommendations of technical groups from technical members of member states, and industrial and NGO experts. They provide data, information, and examination of manuscripts produced by the EIPPCB.

The BAT principle is defined by the European directive 96/61EC 24 September 1996 on Integrated Pollution Prevention and Control (IPPC) and is considered the most advanced and effective principle in the development of activities to limit emissions and to reduce emissions and impact on the environment in general (Directive 1996)

The terms “best”, “available” and “techniques” are understood as follows (Karavanas, A., Chaloulakou, A., & Spyrellis, N., 2009):

- ‘Techniques’ includes all the technologies used and how they are designed, built, maintained, and operated.
- ‘Available’ techniques means techniques developed at a scale that permits industrial deployment under technically and economically feasible terms, taking into account the costs and benefits of the technology used or produced in the business.
- ‘Best’ means the most effective in achieving a high level of environmental protection in general

This principle, largely inspired by French regulation, is integrated at the European level through the industrial licensing process of each profession. The goal of BAT is to achieve unity and be associated with environmental protection based on using BAT. It builds on an integrated environmental approach and considers environmental impact, public health, and risk to the industry. Businesses are required to explain and justify their environmental impacts. The BAT also allows industrialists to have a holistic view of their impacts, encouraging them to develop preventive measures in their industrial zones (Aida 2006; Lucas 2000; Ordonnance 2000).

'Best available techniques (BAT) are the best available techniques to prevent and minimize emissions and environmental impact. Areas that need to use BAT such as oil refineries, food factories, BREF for intensive production in agriculture, pig raising, and BREF for the garment industry...

The European Commission has produced guidance documents on the BAT or BREF notes. They contain best practices (BAT) for installation(Schorcht, F., Kurti, I., Scalet, B. M., Roudier, S., & Sancho, L. D., 2013).

3.2 General BAT Conditions

General BAT conditions can be seen as good practice and applied in many areas without a specific standard that can be used in any environment. Some general conditions of BAT are as follows:

For the European Union, the issues covered in the EU-BREF are:

- Environmental Management Systems (EMS)
- Monitoring requirements – including efficiency
- General environmental and combustion performance
- Energy efficiency general techniques and requirements
- Water usage techniques and emissions to water
- Waste management techniques, including prevention
- Noise emission techniques

For South Korea: The issues covered in the K-BREF are:

- Environment Management System (EMS)
- Monitoring
- Environmental and Combustion Performance
- Energy efficiency
- Diffuse emissions from unloading, storing, and handling fuels and additives
- Water pollution discharge and water consumption
- Management of Waste, by-products, and residues
- Noise emissions
- Prevention of soil and groundwater pollution
- Plant design and decommissioning

For the World Bank, the issues outlined in the EHS Guideline for TPP are cross-referenced (Section 1.0) to the IFC General EHS Guideline (IFC, 2007), which covered general aspects that go beyond the installation site specificities, such as site selection and project development (Garbarino, E., Orveillon, G., & Saveyn, H. G., 2020).

3.3 Specific BAT Approaches to Key Environmental Issues (KEIs) Control

Several parameters influence the choice of BAT such as fuel type, emission level, and the type of plant used to reduce emissions (IFC, 2017). In some cases, national regulations focus on emissions and performance rather than technical issues. Here are some KPIs controlled in some countries.

Table 1. Availability of specific BAT approaches to control KEIs in the BREFs submitted

BAT Reference Document	Specific BAT for KEI Control
China	The GATPPC document identified technical approaches usable in the sector.
European Union	The EU-BREF includes techniques specified as BAT.
India	No – KEI control technologies are not specified in the CBPC documents
Japan	The BAT table sets out efficiency target requirements only
Korea	The K-BREF includes techniques specified as BAT
United States	No - Control Technologies is not specified in the regulations. The best available technologies used as the basis for standards in regulation are noted in supporting decision documents found in the docket. Other documents and resources describe available technology and mitigation approaches
World Bank	The EHS Guideline identifies the technical approaches for the sector

Source: Dellise, M., Villot, J., Gaucher, R., Amardeil, A., & Laforest, V. (2020)

3.4 Environmental Management Accounting via BAT

Lucarelli (2003) said that "Environmental Management Accounting (EMA) provides a more holistic approach to management accounting by emphasizing cost issues related to the environment and wasted raw materials. One of the goals of the EMA is to influence decisions regarding an organization's financial and environmental performance. Since then the tools for management accountants to do this are BAT and cleaner production (CP). Moreover, Laforest, V. (2008) believes that the promotion and implementation of environmental goals and policies can be easily achieved by applying EMA in manufacturing enterprises. In terms of environmental costs, studies have shown that the initial estimated environmental costs are much lower than the actual costs. The cost that can be identified is very small, mainly the cost of waste treatment and disposal. The majority of sunk and unrecognized costs.

The potential benefits of EMAs to businesses include (Laforest, V., 2008):

- Accuracy level:
  - Used as a basis for the management and use of energy flows, and materials (quantity, type, location of waste burial ...)
  - Identify, estimate, allocate and reduce costs
- More accurate and complete information to:
  - Support for the establishment and participation in charity activities, cost-effective programs to implement environmental balancing
  - Measure and report environmental performance.

3.5 BAT and the Implementation of Cleaner Production

BAT and CP represent a preventive environmental approach to reduce pollution at the source. These two concepts are more or less similar. The biggest difference is that the solution at the end of the pipeline (such as a wastewater treatment plant…) can be BAT but not CP. CP is the continuous use of industrial processes or products to increase efficiency and reduce the impact on people and the environment. The process assessment is not a one-time process but is carried out continuously and is regularly enhanced and adjusted.

An optimal approach is needed to drive CP implementations. Furthermore, as mentioned above, the CP approach is not static but evolving, following a system of continuous improvement. Once the assessment has been performed, the results must be monitored, evaluated, and applied. This will

provide feedback to promote innovation, as a premise for application in new areas of CP. This process repeats to form a closed circle. The figure below shows a closed circle of the continuous improvement process (Laforest, V., 2008).

The ISO 14001 Standard's method for environmental management systems (EMS) for environmental management systems has more or less the same structure as the figure below. In practice, an EMA system can be obtained with the application of industry-based add-ons to help with environmental governance – EMS. Which, CP and more specifically BAT can provide added value for EMS based on the root of environmental issues (Tikhonova, I., Guseva, T., Averochkin, E., & Shchelchkov, K., 2021)

Each step in the process is critical to the success of CP. BAT implementation needs to be monitored and measured. Procedures are needed to monitor performance and progress toward goals and to ensure compliance with the law. This helps to improve the position of the business by identifying new management commitments based on improved results. The BAT has changed dramatically over time as the BAT guidelines are updated regularly, about every 5 years to absorb the latest technologies, and cultural and economic changes (Laforest, V.,2008)

3.6 Considerations for the Selection of BAT

According to Appendix 4 of the IPPC directive, the selection of BAT can be based on 12 considerations shown in the table below. However, care should be taken as these considerations are relatively unclear for the choice of technology to be applied (De Chefdebien, H., 2001). In the cement, textiles, and surface treatment of metals and plastics industries, the determination and selection of BATs do not seem to be based on scientific indicators, IPPC-based indicators or criteria rather than on standards. European Union country broad and industry-wide standards.

Figure 1. Adopted approach to BAT and cleaner production

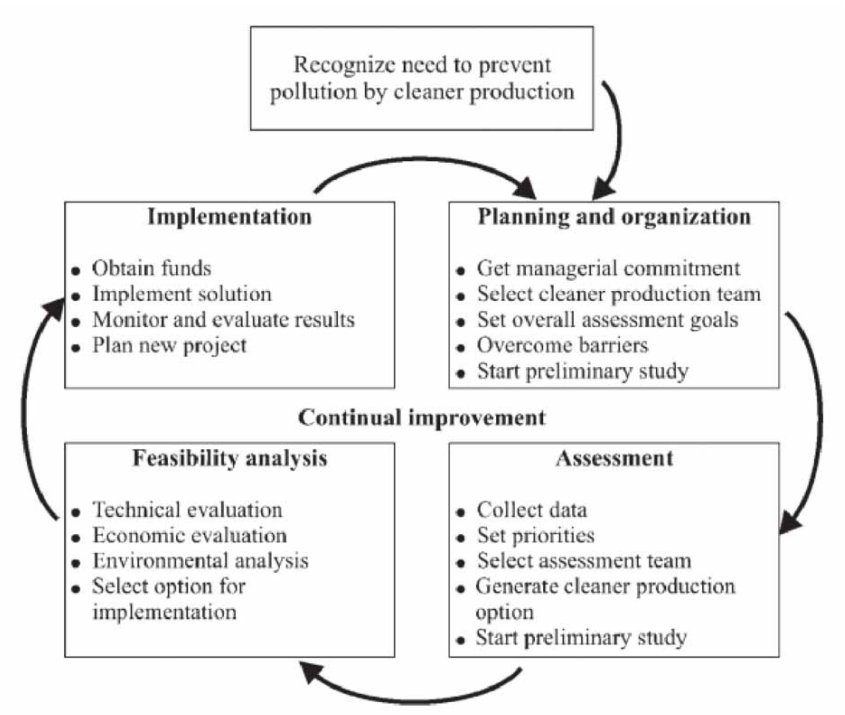


Table 2. Considerations for the selection of BAT

1. Use of low-waste technology
2. Use of less hazardous substances
3. Furthering the recovery and recycling of substances generated and used in the process, and of wastes, where appropriate
4. Comparable processes, facilities, or methods of operation which have been tried with success on an industrial scale
5. Technological advances and changes in scientific knowledge and understanding
6. Nature, effects, and volume of the emissions concerned
7. Commissioning dates for new or existing installations
8. Length of time needed to introduce the BAT
9. Consumption and nature of raw materials (including water) used in the process and their energy efficiency
10. Need to prevent or reduce to a minimum the overall impact of the emissions on the environment and the risks to it
11. Need to prevent accidents and minimize the consequences for the environment
12. Information published by the Commission according to Article 16 (2) or by international organizations

Source: Bréchet and Tulkens (2009)

To apply the BAT and complete the EMA, an environmental impact assessment is necessary. To do so, the first step is to build a multi-dimensional environmental assessment system. The second step is to evaluate the associated costs and physical and monetary factors that go into the EMA system. The method applied is aimed at identifying environmental standards based on IPPC. There is a need for a tool that can provide information on materials used, wasted materials, percentage of wasted materials, energy used, etc. This tool is also necessary to prevent contamination in the mold. IPPC framework and BAT implementation.

Each business' BAT licenses will indicate which BAT the business needs to use, or the business can set emission limit values (ELV) or other environmental standards based on BAT.

If the enterprise does not use BAT, it is necessary to provide a level of environmental protection corresponding to the BAT and clearly explain how it operates to the governing body. If the technology you provide does not provide the same environmental protection, but you want to demonstrate that it is appropriate in terms of benefits and costs, you need to provide evidence of a risk assessment. and benefit-cost analysis.

An enterprise will only be licensed for activities that do not comply with the BAT-associated emissions levels (AELs) if it can be demonstrated that the costs of achieving the BAT are not commensurate with the environmental benefits. Those reasons should be:

- Due to geographical and local environmental conditions
- Due to the technical characteristics of the area (the impact of reduced emissions of this substance leading to increased water use or other emissions in the area…)

Conditions of this type are called 'applying for a derogation' (Geldermann, J., & Rentz, O., 2001).

3.7 Applying BAT in Some Industry

3.7.1 Reduce Energy Consumption

Reducing energy consumption in production is one of the measures to apply BAT. In some manufacturing industries when applying BAT, the following technical solutions can be implemented to apply BAT:

- Modernize the kiln and drying unit
- Recovery of excess heat from the furnace, especially from the cooling zone. In this case, the excess heat from the kiln can be directed to a dryer to dry raw materials or semi-finished products.
- Optimize the shape, size, and structure of the kiln and dryer to increase the efficiency of the heating and drying process.

3.7.2 Reduce Air Pollution

According to BAT, to reduce polluting waste into the air, the following technical solutions should be applied:

- Performing technological activities that cause dust to accumulate in a closed volume
- Equipment of mixers, crushers, and feeders with protective covers and exhaust installations
- Application of storage bins of the corresponding capacity, level sensors with cut-offs and filters for cleaning the dusty air displaced at filling of the bunker;
- Remove the dusting material using closed conveyors;
- Reduction of leakages and elimination of their sources, sealing of installations.

3.7.3 Reduce Emissions to the Environment

According to BAT, to reduce emissions to the air (carbon monoxide, nitrogen oxides, sulfur, volatile organic compounds, etc.), technical solutions such as:

- Optimized fuel combustion to reduce carbon monoxide and nitrogen emissions oxide, which controls excess air for the complete combustion of the fuel;
- Reduce heating temperature and maximum heating time
- Optimized firing mode by adjusting temperature rise rate
- Replace the materials used in the production process
- Reducing the supply of pollutants, in particular being able to use raw materials with low levels of sulfur and nitrogen, fluorine, and chlorine

3.7.4 Reduces Wastewater Formation

According to BAT, to reduce the formation of wastewater, it is necessary to use the following technological solutions:

- Prevent water leakage in the whole water supply system by installing an automatic valve and water meter
- Installing a system to collect wastewater from different stages of the production process and technological processes at the place where they are formed;
- Water reuse, especially water reuse, after appropriate treatment;
- Use a wastewater treatment system (if necessary, depending on the characteristics of the industry).

4. RESEARCHING THE FACTORS AFFECTING THE APPLICATION OF BAT IN ENTERPRISES

4.1. Research Sample

We surveyed 192 businesses through a questionnaire to identify and measure the factors affecting BAT adoption in Vietnam using AMOS data analysis software. Survey respondents are representatives of the company's board of directors, technical experts, production workers, accountants, and corporate governance experts. The survey and data collection period is from Mars 2022 to May 2022. The main data analysis method of this study is the structural equation modeling (SEM) method with AMOS - SPSS. Based on the empirical rule of Hair et al. (2010), for an estimator, the minimum sample size required for this study is $n > 8 \times$ the number of variables $= 8 \times 24 = 192$. From there, we choose a sample size of $n = 192$.

Table 3.

No.	Scope of Activity	Number of Firms	Proportion
1	Plastic packaging	22	11,5%
2	Steel manufacturing	40	20.8%
3	Fertilizer	30	15.6%
4	Rubber processing	17	8.9%
5	Mineral	28	14.6%
6	Food processing	55	28.6%
	Total	192	100%

4.2. Identify and Measure the Factors Affecting the Adoption of BAT in Enterprises

4.2.1 Research Model and Research Hypothesis

According to several previous studies, the application of BAT depends on factors such as the environmental management system, the effectiveness of the EMS system, the facilities of the enterprise, the production technology of the enterprise, and the point of business leaders on the environment. (Ergunova O, Lizunkov V, Blaginin V, Politsinskaya E, 2018; Guseva T V, Molchanova Ya P, Averochkin E M, Vartanian M A 2014). At the same time, the article also proves that the application of BAT affects the accounting information of enterprises.

4.3 Research Hypotheses

H1: Environmental management affects the application of BAT
H2: Effectiveness of EMS affects the application of BAT
H3: Enterprise facilities affect the application of BAT
H4: Production technology affects the application of BAT
H5: Perspectives of business leaders affect the application of BAT
H6: Environmental management affects the sustainability of the business

Figure 2. Model of research

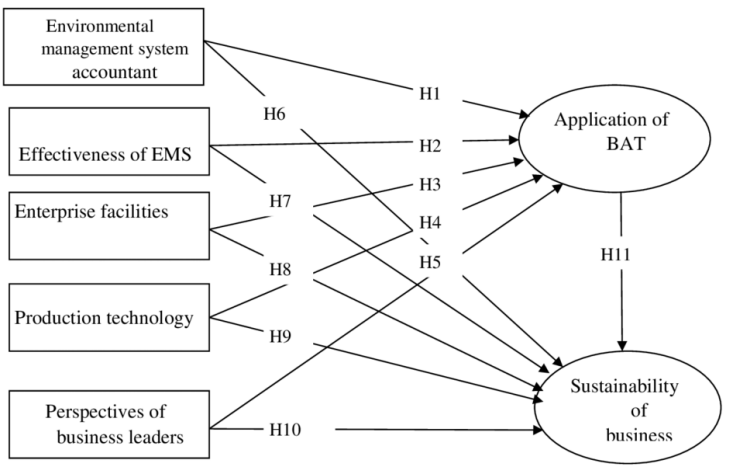


Table 4. Variables affecting the application of BAT and the level of sustainability of the business

	Environmental Management System (EMS)
1	Environmental regulations (EMS1)
2	Environmental management tools (performance measurement, evaluation, and monitoring (EMS2)
3	Sanctions for handling (EMS3)
	The effectiveness of environmental management accounting (EMA)
4	Implement and comply with necessary basic procedures related to environmental management accounting (ÉMA1)
5	Develop a system of appropriate norms and estimates (EMA2)
6	Performance standards for each stage (EMA3)
7	Develop principles to prevent pollution (EMA4)
	Enterprise facilities (EF)
8	Methods to minimize the negative impact on the environment (EF1)
9	Ways to improve energy efficiency (EF2)
10	Methods of conserving resources in production (EF3)
11	Manuals, technical documents (EF4)
	Production technology (TE)
12	Methods and techniques for designing, constructing, maintaining, and operating (TE1)
13	Clean production process (TE2)
14	Discharge engineering (TE3)
15	Product features (TE4)
	Perspectives of business leaders on environmental issues (BL)
16	Exchange of information between industrialists and regulators (BL1)
17	Focus on EMS (BL2)
18	Sustainable development goals and environmental protection (BL3)
	Best available techniques (BAT)
19	Technical improvements (BAT1)
20	Feasibility of application (BAT2)
21	Effectiveness of the application (BAT3)
	Sustainability of the business (SB)
22	Economic sustainability (SB1)
23	Social sustainability (SB2)
24	Environmental sustainability (SB3)

H7: Effectiveness of EMS affects the sustainability of the business
H8: Enterprise facilities affect the sustainability of the business
H9: Production technology affects the sustainability of the business
H10: Perspectives of business leaders affect the sustainability of the business
H11: Best available techniques (BAT) affect the sustainability of the business

Table 5. KMO and Bartlett's test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.875
Bartlett's Test of Sphericity	Approx. Chi-Square	2805.325
	Df	276
	Sig.	.000

4.3.1 Factors Affecting the Application of BAT and Sustainability in Business

After running the command Dimension Reduction – Factor, the results showed that: the coefficient KMO = 0.875>0.5, sig = 0.000 <0.05, so the model is satisfactory. There are 5 groups of factors that converge and have cumulative loadings at 66.648%>50%, which showed that the independent variables explained 66.648% of the dependent variable.

Pattern Matrix rotation matrix is used to analyze factor confirmatory in AMOS software, to see whether the elements are convergent and discriminant.

The results of Regression Weights (Table 6): EMS (Environmental Management), EF (Enterprise facilities), and BL (Perspective of business leaders) have an impact on BAT (sig < 0.05), so the hypotheses H1, H3, and H5 are accepted. The variables EMA (Effectiveness of environmental management accounting), and TE (Production technology) do not affect BAT (sig>0.05) so hypotheses H2 and H4 were rejected. Similarly, variables EMA, EF, independent variables BAT (Best Available Techniques), and TE have an impact on SB (Sustainability of business) (sig < 0.05), so hypotheses H7, H8, H9, and H11 are accepted. EMS and BL have no impact on the dependent variable SB (sig > 0.05). Hypotheses H6 and H10 were rejected.

Of the three variables that affect BAT, the order of effects is EMS (0.371), EF (0.336), and BL (0,220). Of the four variables that affect SB, the order of effects is BAT (0.389), TE (0.358), EF (0.229), and EMA (0,227).

5. DISCUSSION AND CONCLUSION

From the above research results, we can conclude the following:

Why does environmental management accounting not affect the best available techniques?

Environmental management accounting (EMA) is a tool used to integrate environmental management into an organization's overall management accounting system. It primarily focuses on identifying, measuring, and managing the costs and benefits of ecological performance. On the other hand, the Best Available Technique (BAT) is a regulatory concept used to set environmental standards for specific industries or activities. BAT is based on the most effective and advanced techniques available for controlling pollution, and it is used to determine the environmental performance standards that industries must meet. While EMA and BAT are both essential tools for environmental management, they serve different purposes and operate on different levels. EMA primarily provides information to the organization to improve its environmental performance, while BAT focuses on setting standards and regulations for industry-wide environmental performance. Therefore, while EMA can help organizations identify areas where they can improve their environmental performance, it does not directly affect the development or implementation of BATs. BATs are typically developed based on technical and scientific criteria and are influenced by various factors, including economic feasibility, technical feasibility, and environmental impact. The implementation of BATs is usually required by law or regulations, and environmental regulatory agencies typically monitor and enforce compliance.

Table 6. Pattern matrix

	Factor						
	1	2	3	4	5	6	7
EF2	.861						
EF1	.831						
EF4	.803						
EF3	.778						
TE4		.923					
TE3		.796					
TE1		.756					
TE2		.711					
EMA2			.844				
EMA1			.809				
EMA3			.632				
EMA4			.556				
BAT2				.851			
BAT3				.851			
BAT1				.795			
EMS2					.845		
EMS1					.803		
EMS3					.702		
SB2						.848	
SB3						.804	
SB1						.726	
BL1							.936
BL3							.715
BL2							.616

Extraction Method: Principal Axis Factoring.
Rotation Method: Promax with Kaiser Normalization.
a. Rotation converged in 7 iterations.

Why does production technology have no impact on the best available techniques?

Production technology can impact identifying and implementing the best available techniques (BAT) for achieving environmental protection. However, the relationship between production technology and BAT is not always straightforward. BAT refers to the most effective and advanced techniques demonstrated to be the most economically and technically viable for achieving a high level of environmental protection. Regulators typically determine the identification and implementation of BAT based on the specific characteristics of the sector, process, or regulated activity. Production technology can impact the identification and performance of BAT in several ways, including Technical feasibility, economic feasibility, and innovation... However, it is also important to note that production technology is not the only factor influencing the identification and implementation of BAT. Other

Table 7. Regression weights: Group number 1 - Default model

			Estimate	S.E.	C.R.	P	Label
BAT	<---	EF	.348	.093	3.742	***	
BAT	<---	TE	-.025	.095	-.263	.792	
BAT	<---	EMA	-.106	.124	-.851	.395	
BATCH	<---	EMS	.439	.111	3.954	***	
BATCH	<---	BL	.225	.094	2.393	.017	
SB	<---	EF	.211	.092	2.290	.022	
SB	<---	TE	.328	.092	3.569	***	
SB	<---	EMA	-.239	.118	-2.022	.043	
SB	<---	EMS	-.014	.110	-.130	.896	
SB	<---	BL	-.018	.090	-.199	.843	
SB	<---	BAT	.348	.091	3.832	***	

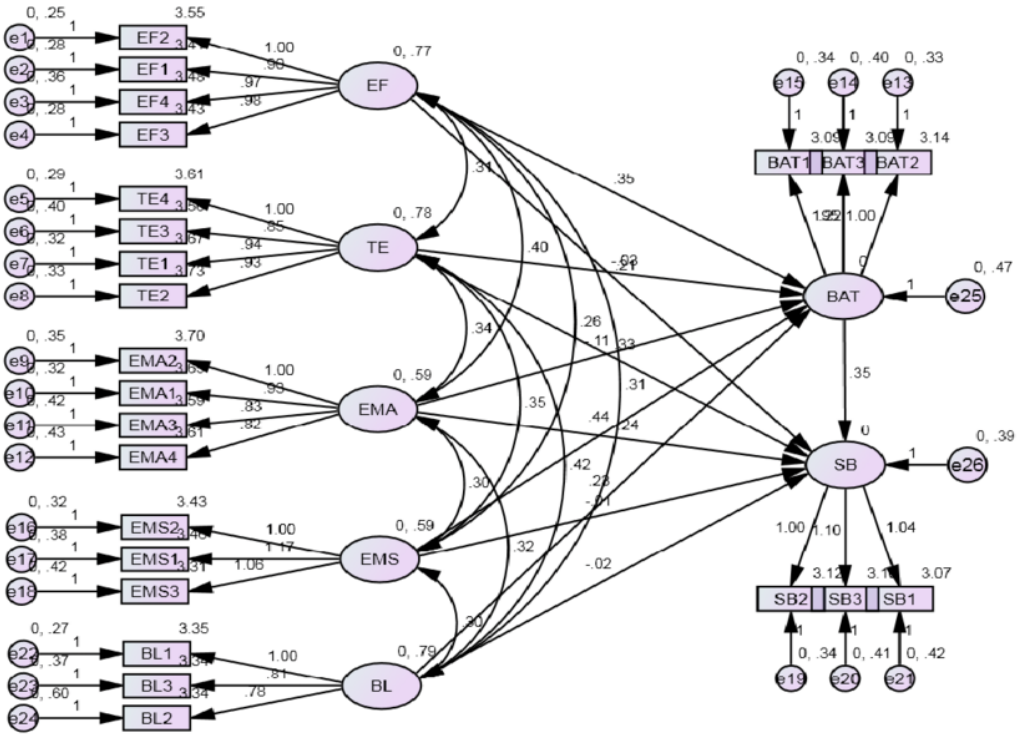
Table 8. Standardized regression weights: Group number 1 - Default model

			Estimate
BATCH	<---	EF	.336
BATCH	<---	TE	-.024
BATCH	<---	EMA	-.089
BATCH	<---	EMS	.371
BATCH	<---	BL	.220
SB	<---	EF	.229
SB	<---	TE	.358
SB	<---	EMA	.227
SB	<---	EMS	-.014
SB	<---	BL	-.019
SB	<---	BAT	.389

factors, such as the availability of raw materials, local environmental conditions, and regulatory frameworks, also play a role in determining the most effective and feasible techniques for achieving environmental protection.

Moreover, BAT is not necessarily tied to a specific production technology or process. Instead, BAT is determined based on the most effective and advanced techniques demonstrated to be the most economically and technically viable for achieving a high level of environmental protection, regardless of the specific production technology or process being used. Therefore, while production technology can impact the identification and implementation of BAT, it is not the only or primary factor determining BAT's effectiveness. Other factors are also crucial in determining the most effective techniques for achieving environmental protection. In summary, production technology can impact the identification and implementation of BAT. Still, this relationship is complex and depends on many factors, including the geography and characteristics of enterprises in Vietnam.

Figure 3. The influences of factors on the application of BAT and the sustainability of the business



Why does the environmental management system have no impact on the sustainability of the business? Environmental management systems (EMS) are designed to help organizations manage their environmental impacts by identifying and addressing environmental risks and opportunities. While EMS can contribute to improving the environmental sustainability of a business, they alone do not necessarily guarantee the company's sustainability as a whole. Sustainability is a broader concept encompassing environmental, social, and economic factors. It refers to the ability of a business to operate in a way that meets the needs of the present without compromising the ability of future generations to meet their own needs. In addition to managing their environmental impacts, sustainable businesses also consider social and economic factors, such as human rights, labor practices, and financial stability. While EMS can help businesses to manage their environmental impacts, they do not necessarily address the broader social and economic factors that are also important for achieving sustainability. For example, a business with an effective EMS may still face social responsibility challenges, such as labor practices or human rights issues.

Similarly, an environmentally sustainable business may still struggle with financial stability or economic viability. Therefore, while EMS can contribute to improving a company's environmental sustainability, they alone do not necessarily ensure the sustainability of the business as a whole. Achieving sustainability requires a broader approach that considers environmental, social, and economic factors, and addresses them comprehensively and comprehensively.

Why do business leaders' perspectives on environmental issues did not impact business sustainability? Business leaders' views on environmental issues can impact a business's sustainability, but they alone do not necessarily guarantee sustainability. Sustainability requires a comprehensive and integrated approach that addresses environmental, social, and economic factors. While the

attitudes and perspectives of business leaders are essential in shaping the direction and priorities of a business, they may not always align with the broader sustainability goals of society or the needs of future generations. For example, a business leader may prioritize short-term financial gains over long-term environmental or social benefits, which may not align with sustainability goals.

Furthermore, business leaders' perspectives may not always reflect the diverse views and needs of stakeholders, such as customers, employees, and communities. For example, a business leader may prioritize the interests of shareholders over the interests of other stakeholders, which may not align with sustainability goals that require the consideration of all stakeholders. Therefore, while business leaders' perspectives are essential in shaping the direction of a business, they alone do not necessarily ensure sustainability. Achieving sustainability requires a comprehensive approach that addresses environmental, social, and economic factors and considers the perspectives and needs of all stakeholders.

It can be concluded that, in addition to other environmental protection methods, BAT is a very effective system of techniques used in production enterprises to protect the ecological environment. Nowadays, many types of BAT have been developed, which can be applied to product manufacturing industries. The optimal implementation of an environmental management system such as BAT in industries will allow controlling the causes and conditions of impact of environmental aspects, will lead to the solution of the problem of prevention, and (or) reduce the negative impact of the business on the environment, i.e. ensure environmental protection.

Practice shows that the environmental management system serves as a triggering mechanism in production, in which the search and application of pollution prevention methods occupies an important position. Factors such as business facilities, environmental management tools, and business leaders' views on environmental protection have a great influence on the application of BAT. In addition, factors such as the facilities of the business, the effectiveness of environmental management accounting in the enterprise, production technology, and Best Available Techniques themselves play an important role in the sustainable development of the business.

During the past decades, the concept of best available techniques (BAT) has evolved as a reference point for setting environmental permit conditions. As all environmental regulations, BAT-based permit regulations can potentially act as a driver or as a barrier for greening global value chains and for implementation of sustainable supply chain management and circular economy. Whether they will effectively act as a driver or as a barrier for these, depends on if and how up- and downstream activities are considered in the determination of BAT at the sector level on the one hand, and on the way BAT are implemented at the installation level on the other hand. In existing methods for determination of BAT at the sector level, the focus of the assessment is generally on the sector under consideration, without explicit or systematic consideration of up- and downstream activities (Huybrechts, D., Derden, A., Van den Abeele, L., Vander Aa, S., & Smets, T., 2018).

CONFLICTS OF INTEREST STATEMENT

The authors certify that they have NO affiliations with or involvement in any organization or entity with any fi nancial interest (such as honoraria; educational grants; participation in speakers' bureaus; membership, employment, consultancies, stock ownership, or other equity interest; and expert testimony or patent-licensing arrangements), or non-fi nancial interest (such as personal or professional relationships, affi liations, knowledge or beliefs) in the subject matter or materials discussed in this manuscript.

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