BEST AVAILABLE TECHNIQUES AND SUSTAINABLE DEVELOPMENT GOALS

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ABSTRACT

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.

Lessons learnt by various countries prove that the BAT concept has potential for a much wider application, going beyond pollution prevention and control. This paper considers opportunities opened up by BAT with respect to achieving several of the Sustainable Development Goals (SDG). These opportunities form a 'BAT flower', petals of which are discussed in the paper.

Internationally, the BAT concept is becoming an effective environmental policy instrument, and is gradually strengthening its position in the development of industrial policy. Stringent BAT requirements do not jeopardise industrial development and economic growth, but help harmonising progress towards SDG 8: Sustainable Economic Growth.

Smart application of BAT requires reduction of pollution and enhanced EE. This also provides for the reduction of greenhouse gas (GHG) emissions though regulatory instruments for climate change mitigation and industrial pollution often are separate, both at the national and international levels. BAT-based programmes for EE enhancement and GHG emissions reduction function in the European Union (EU), the United States (US) and Canada, making BAT a powerful instrument for energy and climate policies used to achieve SDG 13: Climate Action.

Circular economy entails gradually decoupling economic activity from the consumption of finite resources, and designing waste out of the system. BAT require minimisation of waste in all technological processes and provides advice for replacing raw materials by waste in many industrial sectors (metallurgy, construction materials industry, energy

generation, etc.). Thereby BAT contribute towards achieving SDG 12: Responsible Consumption and Production; in particular, through the reduction of releases of chemicals, BAT support target 12.4.

Important results have been achieved within green chemistry due to the application of techniques reducing or eliminating the use or generation of hazardous substances in the design, manufacture and application of chemical products. Increasingly, countries apply green chemistry principles to identify BAT. Chemical products are used in all sectors of the economy; and are crucial for both industrial and rural development, protection of terrestrial ecosystems and prevention of soil degradation.

Implementation of BAT is required by international and regional conventions, such as the Stockholm Convention on Persistent Organic Pollutants, the Convention on Long-Range Transboundary Air Pollution, the Minamata Convention of Mercury and the Convention for the Protection of the Marine Environment of the North-East Atlantic. This helps promote SDG 17: Global Partnership for Sustainable Development.

Keywords: Best Available Techniques, industrial pollution, climate change, energy efficiency, circular economy.

INTRODUCTION. THE FLOWER OF BEST AVAILABLE TECHNIQUES

The goal of achieving sustainable development has come to be almost universally endorsed. Researchers, policy-makers and practitioners have contributed towards improving the sustainable development concept since the 1980s. In 2015, the United Nations Sustainable Development Summit adopted a fundamental document: "Transforming our world: the 2030 Agenda for Sustainable Development" [1], announcing 17 Sustainable Development Goals (SDGs) with 169 associated targets. Long before the adoption of the SDGs, the Best Available Techniques (BAT) concept emerged in the 1960s as a key policy tool to prevent and control industrial emissions and thereby ensure a high level of environmental and human health protection. BAT allow establishing technologically driven emission limit values, based on evidence and multi-stakeholder engagement [2]. In 1996, BAT became the basis for the European Union Directive on the Integrated Pollution Prevention and Control, which later was replaced by the Industrial Emissions Directive (IED, adopted in 2010) [3]. The IED is the main EU instrument regulating industrial pollution, with around 50,000 installations being required to operate in accordance with a BAT-based permit, granted by competent authorities in the Member States.

The lessons learnt on BAT-based permitting in the EU have inspired the development of IED-like legislation in many other jurisdictions as well as the adoption of instruments similar to BAT, such as Best Available Control Technologies, Best Environmental Practices (BEP), and regulations on low or no waste production. The Russian Federation and the Republic of Korea have already developed their own BAT Reference Documents (BREFs), and India and Kazakhstan are in the process of doing so. Other countries choose to apply the BREFs developed by the EU, such as Georgia. Furthermore, many international conventions require the application of such approaches. The widespread introduction of BAT to reduce industrial pollution contributes to progress towards essential SDGs, notably Target 12.4 on the environmentally sound management of chemicals.

The national and international experiences with BAT have also driven discussions on the potential for applying this tool beyond environmental permitting, revealing opportunities for using BAT to contribute towards the achievement of several other SDGs, in particular those related to sustainable economic growth, climate change mitigation, and energy and resource efficient production patterns.

The eight interrelated petals of the 'BAT flower' (Fig. 1) illustrate the policy areas in which BAT might contribute to achieving the SDGs: environmental policy, industrial policy, energy security, climate policy, circular economy, chemical safety, regional co-operation and international conventions.

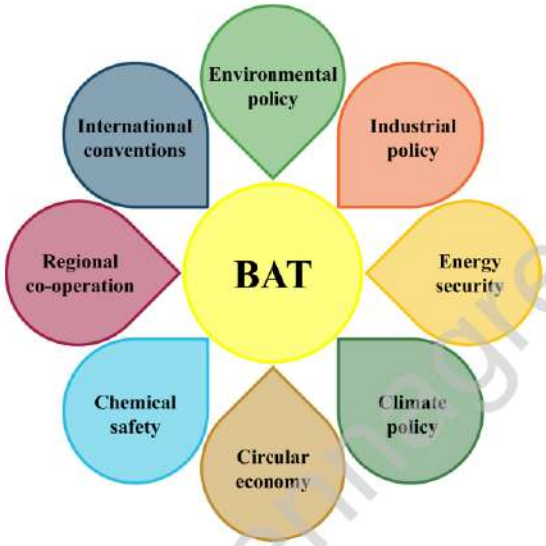

Fig 1. 'BAT flower'

This paper considers some of the opportunities for applying BAT to these areas. It provides examples of how selected countries have acted upon these opportunities, and what the effects were. We realise that the potential for applying BAT is not limited to these eight 'petals', and aim to open a wide discussion with stakeholders developing and applying BAT-related policy instruments around the world. Furthermore, we acknowledge that further research is required to conduct a comprehensive assessment of how BAT contributes towards progress in each of the areas reflected by the 'BAT flower'. While the paper presents relevant examples and success stories where available, it would be necessary to collect additional data and explore new methodologies to carry out an extensive quantitative analysis of how the multiple benefits of BAT materialise in the context of the SDGs.

ENVIRONMENTAL AND INDUSTRIAL POLICY

Economic growth and environmental sustainability are not mutually exclusive. To ensure long-term sustainability, governments must develop balanced policies with win-win outcomes for economic development and environmental conservation [4]. Such policies can help drive business and innovation, alter economic activity towards technologies or tasks that offer better prospects for economic growth and societal welfare, and at the same time reduce pollution and conserve natural resources. BAT form the core element and the 'measurement unit' (a set of narrative and quantitative requirements) of an environmentally friendly industrial policy, which makes sure that industrial and rural modernisation occurs on the basis of technical and managerial

solutions that provide for cleaner and more sustainable economic growth as well as efficient use of energy, water and raw materials. Russia is one of many countries that have implemented an environmental industrial policy to achieve progress towards **SDG 8: Sustainable Economic Growth** [5].

Providing an example of the benefits achieved due to a BAT-based approach, the Pollutant Release and Transfer Register (PRTR) data from Israel for the period 2012-17 demonstrated a significant reduction – between 62 % and 8 %, depending on the pollutant – in air emissions. The reduction is likely resulting from the introduction of BAT-AEL-compliant ELVs in permits over the period 2011-16 (the estimates do not account for changes in economic activity). Another example is Sweden, where BAT-based permitting has been applied to large industrial installations for 50 years. During this time the emissions of Volatile Organic Compounds (VOC) have been reduced by 70 %, particles by 90 %, SO_2 by 97 %, Hg by 99 %, Pb by 99,9 % and Cd by 98 %. While other policies and measures may have contributed towards these considerable improvements, the BAT-based legislation appears to have been of pivotal importance. During the same period, the size of the Swedish economy has grown threefold as well as strengthened its position in relation to other EU Member States, indicating that the introduction of increasingly more stringent environmental requirements for industry appears not to have prevented economic growth.

Furthermore, the member companies of a European Leather Tanning Association have – by introducing BAT – over ten years reduced their water consumption by about 20 % and improved waste recovery to 62 %. By introducing chemical products with low VOC content, they also ensured a 40 % decrease in VOC emissions, equivalent to 10,000 tonnes a year. The resulting societal benefits amounted to EUR 38 million. Finally, thanks to the introduction of BAT for enhanced energy efficiency, the association secured annual savings of EUR 1.9 million and 11,300 tonnes of CO_2 emissions avoided per year, with an estimated EUR 500,000 per annum in societal benefits [6].

ENERGY SECURITY AND CLIMATE POLICY

In the EU, separate pieces of legislation apply to GHG emissions and to industrial pollutants, prescribing an emissions trading scheme to mitigate climate change [7], and BAT-based integrated environmental permitting to combat industrial emissions [3]. Many other jurisdictions have made similar decisions, to avoid duplication of regulation. Nonetheless, high energy efficiency is one of the key criteria in identifying BAT [3], and BAT for various sectors include techniques allowing to reduce emissions of both 'ordinary' pollutants and GHG, reflecting the interlinkages between climate action and the prevention and control of industrial emissions.

BAT-based programmes for **energy efficiency** enhancement and GHG emissions reduction (such as the Energy Star Programme, https://www.energystar.gov/) function both in the EU, the US and Canada, making BAT a powerful instrument for energy and climate policies used to achieve **SDG 13: Climate Action**. The United Kingdom (UK) and the Netherlands use BAT-like instruments to stimulate the introduction of energy-efficient or low-carbon technologies, by maintaining lists of top performing energy saving technologies (known as the Energy Technology List (https://www.carbontrust.com/etl/) in the UK and the Energy List (https://english.rvo.nl/subsidies-programmes/energy-investment-allowance-eia) in the

Netherlands), i.e. BAT for energy efficiency. Companies that install technologies from the lists are entitled to tax deductions.

The EU BREF for Energy Efficiency [8] was specifically mandated for the implementation of the EU Climate Change Programme concerning energy efficiency in industrial installations. The energy efficiency BREF is the only one of its kind, but all EU BREFs developed and adopted after 2011 shall pay specific attention to energy efficiency and energy management systems [9]. For example, the EU BREF for Large Volume Inorganic Chemicals recommends the use of CO_2 for the production of carbamide, to help prevent GHG emissions, while providing an effective fertilizer for agricultural production [9]. And the BAT described in the EU BREF for Cement Production as the "use of waste as fuel and/or raw material" allows to reduce consumption of conventional fuels and GHG emissions. The idea of turning from 'wet' to 'dry' cement production technology was put forward to make this fundamental process less energy intensive, thus contributing towards **energy security**, i.e. "the availability of energy sources at an affordable price", as defined by the International Energy Agency [10]. In the longer term, energy security mainly deals with timely investments to supply energy in line with economic developments and sustainable environmental needs [11]. This is why it is important to become less dependent on conventional fuels and to develop innovative, energy efficient technological processes, as facilitated by the introduction of BAT.

CIRCULAR ECONOMY AND CHEMICAL SAFETY

According to SDG 12, the sustainable management and efficient use of natural resources shall be achieved by 2030 [1], along with a substantial reduction of waste generation. These are the key principles used to turn from a linear to a **circular economy** (Fig. 2). Circular economy entails gradually decoupling economic activity from the consumption of finite resources, and designing waste out of the system. BAT-based policies and programmes require the minimisation of waste in all processes and provide advice for replacing raw materials by waste in many industrial sectors (metallurgy, construction materials industry, energy generation, etc.). Thereby BAT contribute towards achieving **SDG 12: Responsible Consumption and Production**.

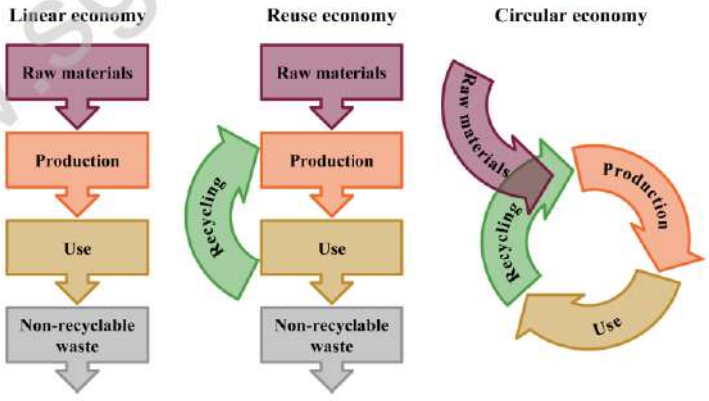

Fig. 2. From linear to circular economy (based on [13])

For example, according to research conducted under the *HAZBREF* project, concerning hazardous industrial chemicals in the EU BREFs, the IED reflects circular economy objectives e.g. by promoting the re-use, recycling and recovery or – where not possible – disposal of waste generated in industrial processes (https://www.syke.fi/

download/noname/%7B6D6D1811-1A1B-4CB8-B46B-358969DD9CC6%7D/146712). Furthermore, the Directive requires that permit applications include a description of measures for prevention, preparation for re-use, recycling and recovery of waste generated by an installation. However, a study commissioned by the European Commission emphasises the need for further measures to be taken in order to better integrate circular economy objectives in the IED. Such measures could include involving experts on circular economy in the Technical Working Groups in charge of developing BREFs, or considering cross-sectoral effects and collaborating with upstream and downstream partners when evaluating candidate BAT [14].

An essential element of achieving a circular economy as well as SDG Target 12.4 on the environmentally sound management of chemicals, is the greening of chemical production processes, through applying techniques that reduce or eliminate the use or generation of hazardous substances. Increasingly, countries apply **green chemistry** practices as BAT in order to *prevent* pollution and waste, in line with the 12 Principles of Green Chemistry (https://www.epa.gov/greenchemistry/basics-green-chemistry #twelve). For example, between 2002 and 2014 in the US pharmaceutical manufacturing industry, the implementation of green chemistry practices formed the major driver of a 58 % decline in toxic chemicals released to the environment, and a 56% decrease in such chemicals being managed as waste, as reported by the US EPA's Toxic Release Inventory [6].

An example of a voluntary industry initiative promoting the implementation of BAT in chemical processes is *Responsible Care*, which aims to continuously improve the environmental, health, safety and security knowledge and performance of technologies, processes and products over their life cycles, to avoid harm to people and the environment (https://cefic.org/our-industry/responsible-care/). BAT serve as a minimum requirement for chemical industries planning to join the initiative. Signatories are further encouraged to go beyond legislative and regulatory compliance.

REGIONAL CO-OPERATION AND INTERNATIONAL CONVENTIONS

The concept of BAT is used in several multilateral environmental agreements related to industrial pollution [13]. For instance, to assist Parties in fulfilling their obligations under the Minamata Convention on Mercury, the United Nations Environment Programme developed a special guidance document on BAT and BEP for industrial sectors and activities potentially emitting mercury as well as for monitoring of mercury emissions (http://www.mercuryconvention.org/Portals/11/documents/forms-guidance/ English/BATBEP_introduction.pdf) [2]. Furthermore, the Gothenburg Protocol to the Convention on Long-range Transboundary Air Pollution requires the implementation of BAT in order to satisfy the obligations concerning the emissions of nitrogen oxides and volatile organic components. Under the Stockholm Convention on Persistent Organic Pollutants, a set of guidelines on BAT and BEP was developed in 2008, to help Parties "promote the development and, where [deemed] appropriate, require the use of substitute or modified materials, products and processes to prevent the formation and release of the chemicals listed in [the Convention's] Annex C" (http://chm.pops.int/ Implementation/BATandBEP/BATBEPGuidelinesArticle5/tabid/187/Default.aspx) [2]. Finally, BAT are also used as an enforcement tool under the Ospar Convention for the Protection of the Marine Environment of the North-East Atlantic, and the Helsinki Convention on the Protection of the Marine Environment of the Baltic Sea Area.

The BAT concept is also applied in some regional co-operation projects. For example, the Nordic Environment Finance Corporation developed a list of 'Barents Environmental Hot Spots' in 2003, referring to major polluters or environmental risk issues (https://www.barentscooperation.org/HS/Background), in collaboration with the Arctic Monitoring and Assessment Programme. In order for an industrial installation to be excluded from the list of Hot Spots, it has to demonstrate compliance with BAT-Associated Emission Levels (BAT-AELs). This approach has lead to, amongst others, major improvements to the environmental performance of two Russian pilot installations: Mondi Pulp and Paper Plant (the Republic of Komi) and Petrozavodsk Municipal Wastewater Treatment Facility (the Republic of Karelia). Both installations developed and implemented BAT-based Environmental Performance Enhancement Programmes over the period 2014-19. As a result, Mondi now complies with both the EU's and the Russian Federation's BAT-AELs for the pulp and paper sector, and Petrozavodsk meets the requirements under the Baltic Marine Environment Protection Commission (Helsinki Commission). These – and eventually other Russian industrial installations – are expected to be excluded from the Hot Spot list thanks to the implementation of BAT. The above examples show how BAT help promoting **SDG 17: Global Partnership for Sustainable Development**.

CONCLUSION

Available examples of the implementation of BAT at the national and international levels, based on regulatory as well as voluntary approaches, suggest that BAT provide a valuable tool for achieving several Sustainable Development Goals. The BAT concept is increasingly recognised internationally, is used in a growing number of countries around the world, and helps to promote global partnerships for sustainable development.

By applying a BAT-based approach, governments can develop policies, legislative requirements and institutions that facilitate sustainable growth and responsible production and consumption patterns, as well as prevent the deterioration of the environment and mitigate climate change. In particular, the criteria and procedures applied to introduce BAT can lay the foundation for, *inter alia*, reducing industrial pollution without hampering economic growth, avoiding the use of hazardous substances and providing chemical safety, consuming natural resources responsibly, minimising waste, recovering and recycling materials, enhancing energy efficiency, recuperating energy and using renewable energy sources where appropriate.

Thus, the BAT concept has potential for application far beyond pollution prevention and control. In this paper, we considered some of the opportunities opened up by BAT with respect to achieving progress towards several of the SDGs. These opportunities form a 'BAT flower', the petals of which will become more varicoloured and bright year by year. Additional research would be necessary to further explore the potential for application of BAT as well as to quantify the benefits provided by BAT in different policy areas, based on a systematic collection of data and a consistent methodology for impact assessment.

DISCLAIMER

The views expressed in this article are the sole responsibility of the authors and do not necessarily reflect the views of the OECD or of the governments of member countries.

REFERENCES

[1] Transforming our world: the 2030 Agenda for Sustainable Development. Resolution adopted by the UN General Assembly on 25 September 2015.

[2] Best Available Techniques (BAT) for Preventing and Controlling Industrial Pollution, Activity 2: Approaches to Establishing Best Available Techniques Around the World, Environment, Health and Safety, Environment Directorate, OECD, 2018.

[3] Directive 2010/75 EU of the European Parliament and of the Council of 24 November 2010 on Industrial Emissions (Integrated Pollution Prevention and Control).

[4] Stafsing L. Environmental regulations, market pressure or own driving force – what are the potentials for Swedish companies to take the lead? Svenskt Naringsliv. 2015. URL: https://www.svensktnaringsliv.se/migration_catalog/Rapporter_och_opinionsmaterial/Rapporter/environmental-regulationspdf_636041.html/BINARY/Environmental%20regulations.pdf.

[5] Skobelev D. Environmental Industrial Policy in Russia: Economic, Resource Efficiency and Environmental Aspects. In: Proc. of the 19th International Multidisciplinary Scientific GeoConference SGEM 2019, vol. 19, iss. 5.3, pp. 291-298.

[6] Best Available Techniques (BAT) for Preventing and Controlling Industrial Pollution, Activity 3: Measuring the Effectiveness of BAT Policies, Environment, Health and Safety, Environment Directorate, OECD, 2019.

[7] Directive 2003/87/EC of the European Parliament and of the Council of 13 October 2003 Establishing a Scheme for Greenhouse Gas Emission Allowance Trading within the Community and Amending Council Directive 96/61/EC.

[8] The Reference Document on Best Available Techniques (BREF) for Energy Efficiency. Joint Research Centre. 2009. URL: https://eippcb.jrc.ec.europa.eu/reference/BREF/ENE_Adopted_02-2009.pdf.

[9] Guseva T. et al. Best Available Techniques, Energy Efficiency Enhancement and Carbon Emissions Reduction. In: Proc. of the 19th International Multidisciplinary Scientific GeoConference SGEM 2019, vol. 19, iss. 5.1, pp. 63-70.

[10] Energy Security in ASEAN+6. IEA, 2019. URL: https://webstore.iea.org/download/direct/2818?fileName=Energy_Security_in_ASEAN%2B6.pdf.

[11] Energy in Sweden 2019. An overview. Swedish Energy Agency, 2019. URL: https://www.energimyndigheten.se/en/news/2019/energy-in-sweden---facts-and-figures-2019-available-now/.

[12] A Circular Economy in the Netherlands by 2050. Government-wide Programme for a Circular Economy, 2016. URL: https://www.government.nl/documents/policy-notes/2016/09/14/a-circular-economy-in-the-netherlands-by-2050.

[13] Best Available Techniques (BAT) for Preventing and Controlling Industrial Pollution, Activity 1: Policies on BAT or Similar Concepts across the World, OECD, 2017.

[14] IED Contribution to the Circular Economy, Anderson, N. et al. (2019). URL: https://circabc.europa.eu/webdav/CircaBC/env/ied/Library/studies/CircularEconomy/IED%20contribution%20to%20Circular%20Economy%20report.pdf.