Ministry of Environment
and Food of Denmark
Environmental
Protection Agency

Resource efficiency in industries

Via conclusions on Best Available Techniques (BAT) under Industrial Emissions Directive

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Contents

Foreword **5**

Summary **6**

Sammenfatning **7**

1. Project background and scope **8**
1.1 Scope 8

2. Screening of existing market based regulatory framework and examples on how to include resource efficiency **9**
2.1 Taxes 10
2.1.1 Example: Energy tax 10
2.1.2 Example: Energy efficiency in energy intensive industry 11
2.1.3 Example: Waste tax 11
2.2 Tradable allowance system 12
2.2.1 Example: Tradable allowances in the fishing industry 12
2.2.2 Example: EU Emission Trading Scheme 12
2.2.3 Example: US EPA, Emission Reduction Credits 13
2.3 Subsidies 13
2.3.1 Example: Energy from renewable resources 13
2.3.2 Example: Danish EPA's funding for eco-innovation 13
2.3.3 Example: Projects to develop waste into a by-product funded by the Danish Business Authority 14
2.4 Take back systems 14
2.4.1 Example: Deposit and return system on drink cans and bottles 14
2.4.2 Example: take back of Nespresso capsules 14
2.5 Transparency 14
2.5.1 Example: Carbon Disclosure Project 15
2.5.2 Example: Global Reporting Initiative (GRI) G4 standard for reporting 16
2.6 Eco-labels 17
2.6.1 Example: Eco-label criteria 17
2.6.2 Example: Energy labelling of buildings 19
2.6.3 Example: Energy labelling of products 19
2.7 Energy audits 20
2.7.1 Example: Mandatory Energy Audits in major enterprises 20

3. Screening of existing rule based regulatory framework and examples on how to include resource efficiency **21**
3.1 Environmental permits 22
3.1.1 Examples of resource efficiency in environmental permits 22
3.2 Waste and eco-design regulation 24
3.2.1 Executive order on Waste 24
3.2.2 The WEEE Directive (& RoHS Directive) 24
3.2.3 The Eco-design Directive 25

3.3 Energy efficiency regulation ... 26
3.3.1 Example: The Building Regulations ... 26
3.3.2 Fuel efficiency of cars ... 26

4. Approaches and examples on using BAT to regulate resource efficiency ... 28
4.1 Cross-media aspects ... 29
4.2 Input ... 29
4.2.1 Examples from BAT conclusions ... 29
4.2.2 Examples from regulation ... 31
4.2.3 Key Performance Indicators KPI ... 32
4.2.4 Substituting virgin material with recycled material ... 33
4.2.5 Review and record ... 34
4.3 Production ... 35
4.3.1 Examples from BAT conclusions ... 35
4.3.2 Examples from regulation ... 36
4.3.3 Minimum efficiency ... 38
4.3.4 Good housekeeping ... 38
4.3.5 LEAN ... 39
4.3.6 Resource management ... 39
4.3.7 Audit and improve ... 40
4.3.8 Resource efficiency upon procurement and design ... 41
4.3.9 Retrofitting existing equipment ... 41
4.3.10 Reporting publicly ... 41
4.4 Output ... 42
4.4.1 Examples from BAT conclusions ... 42
4.4.2 Examples from regulation ... 44
4.4.3 Segregation ... 44
4.4.4 Recycling of waste streams ... 45
4.4.5 Assessing value ... 45
4.4.6 Assessing value and turning waste into by-products ... 46
4.5 Cross-cutting ... 47
4.5.1 Environmental management ... 47
4.5.2 Resource efficiency in BAT AEL ... 47

Conclusion ... 49
Target group ... 49
Data availability ... 49
Lifespan of a BREF document ... 49
Scope ... 49
Potential resource efficiency improvements to BREF ... 49
Feasibility of the exemplified BAT conclusions ... 49
Global or local resource issues ... 50
Severity ... 50

References ... 51

Foreword

This project has been carried out by NIRAS based on a tender from the Danish Environmental Protection Agency.

The EPAs purpose with the project is to identify generic approaches to incorporate resource efficiency in BAT conclusions and thereby stimulate the development of resource efficient technology.

The project period is from November 2013 to December 2014.

Summary

This report is the product of a mapping of resource efficiency in regulation and an analysis of generic approaches to implement resource efficiency in BAT conclusions.

Market based as well as rule based type regulation was screened for examples of approaches of regulating resource efficiency. The identified examples are briefly described.

Examples of resource efficiency in other regulation and the contributions from interest groups and organisations were used to identify generic approaches for resource efficiency regulation which has been exemplified in 18 inspirational examples of BAT conclusions.

Cross-media aspects, barriers and alternatives were considered for each of the generic approaches. Based on these the feasibility of the different exemplified BAT conclusions were divided into three categories: most feasible, depending on the industry and least feasible.

The scope of the BREFs is limited to the production site, and does only to a limited extent regulate the incoming materials' upstream environmental impacts as well as the material streams after they have left the production site. Resource efficiency, however, is not only achieved at the production site, but also further up- and downstream in the material streams. The scope of this project is within the limits of BREF but takes the entire value chain into consideration. Thus, the approaches identified in this project enable resource efficiency outside the scope of BREF.

This report shows that several approaches, to ensure resource efficiency, already exist in BREF. It also shows that there is a potential to improve the, already known, BAT conclusions to make them more oriented at, or accommodating of, resource efficiency. The, already general, BAT conclusion on the environmental management system might be oriented at resource efficiency by specifying consumption of input material as a parameter to monitor. Focus on cross-media aspects, when establishing the BAT AEL, could prevent BAT AELs that do not accommodate resource efficiency.

Sammenfatning

Denne rapport er produktet af en kortlægning af regulering af ressourceeffektivitet og en analyse af generelle metoder rettet mod forbedring af ressourceeffektivitet, der kan indgå i BAT konklusioner.

Både markedsbaseret og lovbaseret regulering blev inkluderet i eksempelsamlingen af metoder til at regulere ressourceeffektivitet. De identificerede eksempler er kort beskrevet.

Eksemplerne fra eksisterende regulering og bidrag fra interessenter og organisationer blev brugt til at identificere generelle metoder, at regulere ressourceeffektivitet, hvilket har resulteret i 18 inspirationseksempler på, hvordan ressourceeffektivitet kan indgå i BAT konklusioner.

For samtlige inspirationseksempler er der overvejet, hvilke barrierer og alternativer der er og der er overvejet mulige 'cross-media' effekter. Baseret på overvejelserne om barrierer, alternativer og 'cross-media' er der lavet en opdeling af inspirationseksemplerne i tre kategorier: de mest gennemførlige, gennemførlighed afhænger af branchen, og de mindst gennemførlige.

Anvendelsesområdet for en BREF er begrænset til produktionsanlægget, og berør kun i begrænset omfang de indkommende materialestrømmes miljøpåvirkning eller materialerne efter de har forladt produktionsanlægget. Ressourceeffektivitet opnås dog ikke kun i produktionsanlægget, men også i materialestrømmens værdikæde. Anvendelsesområdet i dette projekt er i overensstemmelse med anvendelsesområdet for BREF, men det tager højde for materialernes miljøpåvirkning i hele værdikæden, og derfor er der også medtaget inspirationseksempler, der muliggør ressourceeffektivitet i materialets værdikæde udenfor BREF'ernes anvendelsesområde.

Denne rapport viser, at der findes adskillige metoder til at forbedre fokus på ressourceeffektivitet i de allerede eksisterende BREF'er. Rapporten viser også, at der er potentiale for at forbedre allerede kendte typer af BAT konklusioner, så de bedre tilskynder hensyn til øget ressourceeffektivitet. Den tværgående BAT konklusion om miljøledelse kan rettes mere mod ressourceeffektivitet ved at specificere forbrug af ressourcer som en parameter, der skal monitoreres. Øget fokus på 'cross-media' aspekter vedrørende ressourceeffektivitet i udfærdigelsen af BAT konklusioner, kan også medvirke til at BAT AEL ikke bliver en hæmsko for ressourceeffektivitet.

1. Project background and scope

Focus in the BREF documents has until now primarily been on emissions, emission reduction and, to a lesser extent, resource efficiency. The focus on emissions and emission reduction in BREFs has influenced the development of techniques for cleaner production. The Danish Environmental Protection Agency (EPA) wishes to stimulate the development of techniques that also promote resource efficiency.

This report presents examples of regulation of resource efficiency, primarily from Danish regulation, in chapters 2 and 3. In the course of this project, representatives from interest groups and organisations, such as representatives from industry sectors, the Danish society for nature conservation (DN), the confederation of Danish industry (DI), the Danish agriculture and food council (LF) and the Danish EPA, have contributed with ideas on how resource efficiency could be a larger part of future BREFs as well as considerations on how suited these approaches are for implementation in BAT conclusions.

The examples of resource efficiency regulation and the contributions from interest groups and organisations were used to identify generic approaches for resource efficiency regulation. These have been exemplified in 18 inspirational examples of BAT conclusions.

The balance between stimulating development of increased resource efficiency in techniques covered by the BREF, while not burdening the affected companies with BAT conclusions without a significant effect on resource efficiency, must be maintained. A possible consequence of not complying with BAT conclusions is an order to shutdown operation.

The approaches for resource efficiency regulation are presented in chapter 4 along with barriers for realising the approach in a BREF context, alternative methods of achieving the same objective and cross-media considerations, such as whether the approach will create a negative or positive impact on another aspect of resource efficiency.

Representatives from industries affected by BREF documents were invited to read and add their comments to the approaches for resource efficiency regulation through BREF. These, and comments from the previously mentioned interests groups, were integrated into chapter 4.

1.1 Scope

The scope of the BREFs is limited to the production site, and does only to a limited extent regulate the incoming materials' upstream environmental impacts as well as the material streams after they have left the production site. Resource efficiency, however, is not only achieved at the production site, but also further up- and downstream in the material streams. The scope of this project is within the limits of BREF but takes the entire value chain into consideration. Thus, the approaches identified in this project enable resource efficiency outside the scope of BREF.

2. Screening of existing market based regulatory framework and examples on how to include resource efficiency

In this and the following chapter an overview of the existing framework and regulations impacting on resource efficiency in Denmark (and to some extent other countries) is presented along with examples of how the regulation is manifested.

The market based regulation builds on the premise that businesses will try to lower their operation costs and present the business in the best possible way to investors. In this context, a broad interpretation of the market is used and in some cases examples could arguably also be located under the rule based regulation, but to avoid redundancy an example will only appear in one chapter.

Examples of market based regulation are taxes on energy, tradable allowances, subsidies to improve technology and compulsory transparency. Additionally, there are other market based drivers that encourage eco-efficiency such as investors' and costumers' demand for responsible businesses and products.

Figure 1 illustrate how each of the regulation mechanisms in the following text currently relates to businesses.

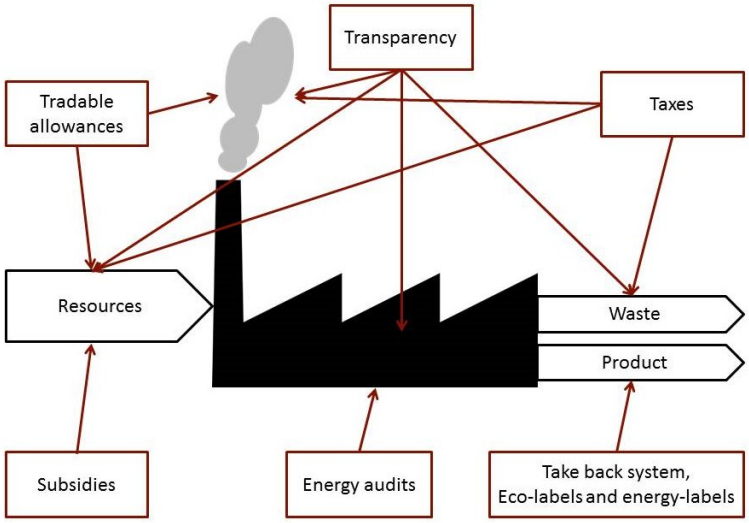

FIGURE 1 ILLUSTRATION ON WHICH AREAS OF A BUSINESS THE MARKET BASED REGULATION MECHANISM DESCRIBED IN CHAPTER 2 RELATES TO.

2.1 Taxes

Placing tax on externalities is a way of internalizing them, creating an incentive for better management of the resources.

Taxes are generally regulated on a national level and thus differ from country to country – though some energy taxes are subject to standardized levels within the EU according to the Energy Taxation Directive. Because of a need to ensure that Danish businesses do not suffer from unfair conditions compared to their neighbours there is a barrier for how well the taxes can reflect the cost to the environment for the resources spent or services used.

Examples of taxes are tax on energy, water and waste.

2.1.1 Example: Energy tax

Denmark introduced energy tax on electricity and oil in 1977, in response to the first Oil Crisis, which caused Denmark to rethink its energy policy (up until then, Denmark had been a net importer of oil, despite large reserves in the North Sea) (Danish Energy Agency, 2012). The energy tax has been increased several times in the past decades and gradually expanded to encompass various sources of energy, such as coal, natural gas and most recently renewable energy (Danish Energy Agency, 2012).

Denmark has one of the lowest "pure" prices on energy, compared to its neighboring countries, Energy tax in Denmark is relatively high and Denmark holds the unofficial title of European Champion on energy taxation, with taxes and levies accounting for roughly 56 % of the total energy price per kWh in 2012 (Danish Energy Association, 2012).

Denmark has improved the energy efficiency in manufacturing continuously over the past decades. This is reflected by a decrease in manufacturing's final energy consumption combined with growth in GDP, meaning that manufacturing's output and energy consumption has been, at least partially, decoupled (Danish Energy Agency, 2012).

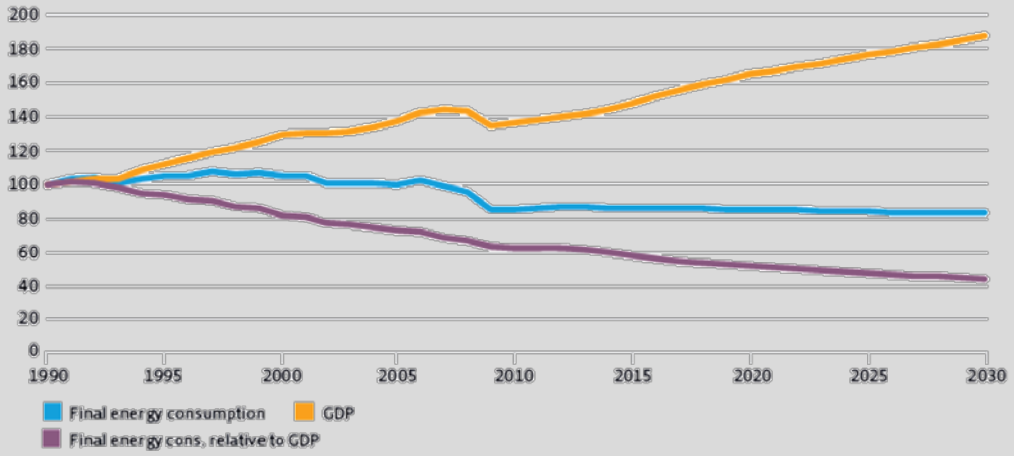

FIGURE 2 INDEXED DEVELOPMENT IN GDP FINAL ENERGY CONSUMPTION IN DANISH INDUSTRY (1990=100). SOURCE: (DANISH ENERGY AGENCY, 2012)

In the period 2000-2013, the energy efficiency of Danish businesses' has increased by roughly 21 %, corresponding to an annual increase of 1.8 % (Danish Energy Agency, 2016). This is well above the EU average increase in businesses' energy efficiency of 15 %, corresponding to an annual increase of 1.2 % (Odysse-Mure, 2015)

Whether this discrepancy is the result of energy taxation is a matter of some debate, as the effect

of energy taxes and levies is hard to measure. Numerous studies conducted on the Danish energy tax regime suggest that these taxes have contributed to increasing the energy efficiency of Danish businesses, by providing incentives to invest in energy efficient measures (Andersen, 2013). An evaluation of the regime, conducted by the Danish Energy Authority in 2000, also concluded that the so-called Green Tax Package would reduce CO_2 emissions by 3.8 % over its lifetime, of which 2 percentage point was directly attributable to energy taxes, while the remainder of the reduction would stem from tax revenues being reverted back into businesses, as subsidies for investments aimed at improving energy efficiency (Danish Energy Agency, 2000).

In the Danish energy tax regime the taxes are redirected back towards manufacturing through various support programs aimed at improving energy efficiency and this protects Danish businesses' competitiveness. The regime encourages the use of, and investment in, best available techniques through a combined use of the carrot and the stick.

2.1.2 Example: Energy efficiency in energy intensive industry

As part of the tax on CO_2 emissions, energy intensive industry was for a number of years offered an alternative to the extensive increase of production costs caused by the CO_2 tax: A "voluntary agreement" including a number of requirements to be satisfied in order to avoid the major part of the cost of the tax.

The requirements included:

- Operate according to an energy management system approved by a certifying body. The energy management system was to comply with a standard accepted by the Danish authorities
- The energy management system should, mandatorily, include procedures for (among other requirements) energy-conscious purchase of energy consuming equipment
- The enterprise should, mandatorily, keep records on energy consumption in relevant parts of the processes
- Frequent energy audits was to be carried out by consultants approved by the authorities

Energy efficiency measures pointed out by the consultant was to be carried out if the payback time was less than 4 years (as the principal rule).

The basis of this agreement was repealed on 31 December 2013 as it was decided to remove the CO_2-tax on process energy as part of a national growth strategy *"Vækstplan DK*".

2.1.3 Example: Waste tax

In 2010, the field of recyclable waste was liberated, meaning that businesses can choose where they wish to send their recyclable waste fractions. The intention was to create a market and thereby a value for the waste that can be recycled. The economic incentive for businesses to increase the fraction of waste being recycled is the tax imposed on incineration and landfilling – as well as a possible lower handling cost or even a possible income if it is possible to sell the waste. The governmental tax for 1 tonne of waste delivered for incineration is 330 kr. and for landfill is 475 kr. and no tax on waste that can be recycled. Handling costs are additional to the waste tax.

The amount of waste from industry was close to 1,2 million tonnes in 2011 a decrease from 1,3 million tonnes in 2009 (excluding soil). According to the ADS (Waste data system) 73 % of the industry waste was recycled in 2011 while 14 % was incinerated, 5 % landfilled and 7 % received

some sort of special treatment. In 2009, 66 % of the industry waste was recycled. The reason for the increase in the recyclable fraction is that the amount of iron and metal as well as construction waste has increased, which are components that are more easily recyclable.

2.2 Tradable allowance system

In Denmark and the European Union, tradable allowances have been used as a regulation tool for many years to regulate the industrial sector, agriculture and especially the fishing industry. Tradable allowances can be used both on input resources and on output, for example emissions.

Allowances are a market based instrument like taxes, but they work by directly setting the target quantity of a specific product/activity or unwanted substance. With an allowance system it becomes significantly easier to reach a target level in quantities, as the regulating authority doesn't need knowledge of the market and company structure. Therefore, reaching the target becomes a problem for the regulated enterprises and not for the authority.

Taxes and tradable allowances are often perceived as opposite regulating instruments but they can often complement each other, an example could be an allowance system that only covers producers of a significant size and the other producers are covered by a tax.

2.2.1 Example: Tradable allowances in the fishing industry

In the fishing industry, allowances were implemented to reduce the fishing fleet and make it more effective, but also to limit depletion of a natural exhaustible resource.

From a purely economic viewpoint, the allowance system in the fishing industry has been very successful, but it has had significant consequences for the fishing communities which are placed in geographical areas of Denmark with low economic activity and few employment opportunities. These areas are important from a political point of view hence an overall assessment of whether the economic benefits outweigh the costs is difficult. On the other hand continued overfishing would on the longer term result in both environmental deterioration as well as less employment in the fishing industry.

2.2.2 Example: EU Emission Trading Scheme

The emission trading scheme (EU ETS) is another allowance system that Denmark is part of. It is one of the main means of fulfilling the international climate commitment set in the Kyoto Protocol. Denmark has pledged to reduce its total CO2 emissions by 21 % compared to the 1990 level.

Denmark has implemented the EU regulation on emission trading and roughly 380 Danish production units are covered by the CO2 allowance trading scheme. Most of these are generators of power and heat, the rest are industrial enterprises plus a few production units within the offshore sector. Over 10,000 production units are affected by the scheme throughout the EU.

The system is based on a Cap and Trade philosophy which is a balancing act between setting the cap low enough to generate satisfying carbon savings and not setting the cap too low to avoid excessive carbon prices. Adding to that the economic crisis has resulted in an oversupply of allowances because production has decreased drastically, and as the price on allowances is determined by supply and demand this has resulted in a very low market price. This development has meant the ETS has not had the desired effect.

2.2.3 Example: US EPA, Emission Reduction Credits

Similar to the European carbon trading scheme the United States use tradable allowances. As opposed to the "absolute allowances" providing allowances for the entire regulated emission, Emission Reduction Credits (ERC) consist of allowances generated by emission reductions relative to an accepted level.

The prescribed emission limits lies under the National Ambient Air Quality Standards (NAAQS) for certain pollutants (i.e. carbon monoxide, lead, nitrogen dioxide, ozone (VOC), particle pollution and sulfur dioxide) (US EPA). Major new and expanding sources in areas with high air pollution must keep the emissions below the limits of NAAQS.

Any new or expanding sources, exceeding the prescribed limits, could offset their emissions by buying ERC from a source that have obtained ERCs through emission reductions. This is called the offset policy where the ERCs are working as a common currency. Under the offset policy regulation three additional programs were created to govern how the ERC could be stored and spent. The first is the bubble policy that allows aggregated multiple emission points within one facility to count as one single emission source. The second program, called netting, allows facility sources that undergo a modification to avoid a new review of the source if they can demonstrate that the total plant emission would not increase significantly. The third program, called emission banking, manage and store the obtained ERCs in a sufficient manner so the companies could either sell the surplus of their ERCs or use them in the nesting, offset, or bubble programs (T.H.Tietenberg, 1990).

2.3 Subsidies

Taxes and allowances are designed to reduce consumption or emissions of certain materials. The subsidies system is designed to promote technologies or consumption of certain input.

Examples of subsidies are known from the windmill industry and from the Danish Ministry of Environment's funding for eco-innovation.

2.3.1 Example: Energy from renewable resources

Electricity based on renewable sources can get financial aid from the non-profit enterprise Energinet.dk owned by the Danish Climate and Energy Ministry. The aid is financed by an additional fee on the electricity price. The purpose of the financial aid is to promote the expansion of energy from renewable resources and thereby support the Danish environmental- and climate goals.

2.3.2 Example: Danish EPA's funding for eco-innovation

In the annual governmental budget, the Finance Act (Finansloven) for 2012, 2013 and 2014 a sum of money has been earmarked to promote 'green' technologies.

Each year participants apply for funding to carry out projects which e.g. lowers the need for water in production, or increases the yield from raw materials.

2.3.3 Example: Projects to develop waste into a by-product funded by the Danish Business Authority

An example of a project aimed at promoting turning waste into by-projects funded by the Danish Business Authority is the ActionSportGames (ASG), specializing in the development and distribution of hobby equipment, imports the so-called airsoft bullets for toy guns from abroad. AV Pehrsson (AVP), a company that regenerate waste plastics into granules, will explore the possibility of AVP recovering its plastic waste and using it to produce airsoft pellets with the intention to sell the pellets to the ASG. (Danish Business Authority)

2.4 Take back systems

Municipal take back systems are common in Denmark, with drop-off points in every municipality.

The national deposit and return system on drink cans and bottles is a take back system which ensures almost 90% of the cans and bottles covered by the system are recycled.

Private product take back systems have recently become a possibility in Denmark, making it an option for companies to create take back systems for their own products.

2.4.1 Example: Deposit and return system on drink cans and bottles

The Danish deposit and return system on drink cans and bottles is an example of recycling through take back.

Drink cans and bottles are fitted with a sticker with a deposit and return code. This enables a fee added to the price to be paid on purchase and then returned when the can or bottles is returned.

The average returns percentage for one-way packaging in Denmark in 2013 was 89%. (Dansk Retursystem)

The deposit and return system is managed by one privately owned, non-profit company under which producers and importers of certain beverages are registered.

2.4.2 Example: take back of Nespresso capsules

Nespresso in Switzerland has created a take back system for their capsules, which allows for the users of the product to return used capsules when purchasing new ones.

The capsules are separated into an aluminium stream and a coffee grounds stream. The aluminium is melted and used in the production of new capsules and the coffee grounds are used for fertilizer.

2.5 Transparency

Performing well within the area of sustainability is a way to access investors who acknowledge the link between transparency and risk minimisation. In addition businesses face increasing demands from costumers on sustainability performance whether their customers are other businesses or consumers.

Several investors request ESG (Environmental, Social and Governance) data, and downstream companies request e.g. greenhouse gas data and often also other environmental data from their suppliers. Some businesses require that the suppliers have certified environmental or energy management systems. For some businesses having a sustainability report or environmental management system is a term of operating.

It is common practise for larger companies to have a Corporate Social Responsibility (CSR) report, Social responsibility (SR) report or Sustainability report on the environmental performance or performance within social or governance issues.

Sustainability, CSR or SR reports often include measures on environmental data in the production or within the scope of the company's direct influence. The life cycle perspective is often used in such reports, which is seen through policies for responsible sourcing or environmental data for tier 2 or 3 suppliers.

The Danish Financial Statement Act has since 2009 included a paragraph on corporate social responsibility focussed on the management of environmental and social issues such as climate change and human rights. The corporate social responsibility paragraph in the Danish Financial Statement Act was supplemented by Directive 2014/95/EU where the disclosure of non-financial and diversity information by certain large undertakings and groups becomes mandatory in 2015.

2.5.1 Example: Carbon Disclosure Project

The Carbon Disclosure Project is best known for its program on climate change.

The CDP also has a program on water, which includes a questionnaire for companies with a series of question designed to promote awareness on water management. These are a few of the questions from the CDP questionnaire on water:

W1 Context

W1.1 Please rate the importance (current and future) of water quality and water quantity to the success of your organization

W1.2 Have you evaluated how water quality and water quantity affects /could affect the success (viability, constraints) of your organization's growth strategy?

W1.3 Has your organization experienced any detrimental impacts related to water in the reporting period?

W5 Water accounting

W5.1 Please report the total withdrawal, discharge, consumption and recycled water volumes across your operations for the reporting period

W5.2 For those facilities exposed to water risks that could generate a substantive change in your business, operations, revenue or expenditure, the number of which was reported in W3.2a, please detail which of the following water aspects are regularly measured and monitored and an explanation as to why or why not

W5.6 For the reporting period, please provide any available water intensity values for your organization's products or services across its operation

W6 Governance and strategy

W6.1 Who has the highest level of direct responsibility for water within your organization and how frequently are they briefed?

W6.2 Is water management integrated into your business strategy?

W6.3 Does your organization have a water policy that sets out clear goals and guidelines for

action?

W6. 4 How does your organization's water-related capital expenditure (CAPEX) and operating expenditure (OPEX) during the most recent reporting period compare to the previous reporting period?

W8 Targets and initiatives

W8.1 Do you have any company wide targets (quantitative) or goals (qualitative) related to water?

(Carbon Disclosure Initiative, 2014)

2.5.2 Example: Global Reporting Initiative (GRI) G4 standard for reporting

The GRI offers an international standard for reporting on sustainability. Among several topics, such as management practices etc., there are indicators on sustainability.

Resource efficiency related indicators are:

EN1: Report the total weight or volume of materials that are used to produce and package the organization's primary products and services during the reporting period, by:

- Non-renewable materials used
- Renewable materials used

EN2: Report the percentage of recycled input materials used to manufacture the organization's primary products and services.

EN8a: Report the total volume of water withdrawn from the following sources:

- Surface water, including water from wetlands, rivers, lakes, and oceans
- Ground water
- Rainwater collected directly and stored by the organization
- Waste water from another organization
- Municipal water supplies or other water utilities

EN8b:Report standards, methodologies, and assumptions used.

EN9a:Report the total number of water sources significantly affected by withdrawal by type:

- Size of water source
- Whether or not the source is designated as a protected area (nationally or internationally)
- Biodiversity value (such as species diversity and endemism, total number of protected species)
- Value or importance of water source to local communities and indigenous peoples

EN9b:Report standards, methodologies, and assumptions used.

EN10a:Report the total volume of water recycled and reused by the organization.

EN10b: Report the total volume of water recycled and reused as a percentage of the total water withdrawal reported under Indicator G4-EN8.

EN10c: Report standards, methodologies, and assumptions used.

(GRI, 2013)

2.6 Eco-labels

European consumers have had eco-labelling for more than two decades. The eco-label allows consumers to select products which have been produced with the leading standards in responsible production. The eco-labels are in fact the Best Available Technology equivalent for products. The BAT conclusions are now mandatory for companies governed by the Industrial Emissions Directive whereas the eco-labels are voluntary.

The eco-label uses the life cycle philosophy and therefore the criteria the product must meet are based on these five life cycle categories:

- Resources/materials used
- Production
- Distribution and packaging
- Use phase
- Disposal

For each product a set of criteria in these five categories exists, similarly to the BREF documents on each of the sectors. The most relevant categories related to resource efficiency are *Resources/materials used, Production* and *Disposal*.

2.6.1 Example: Eco-label criteria

The criteria in this example are from the criteria document for Notebook computers

Criterion 8 — Recycled content
The external plastic case of the system unit, monitor and keyboard shall have a post-consumer recycled content of not less than 10 % by mass.

Assessment and verification: the applicant shall provide the competent body with a declaration stating the percentage post-consumer recycled content.

Criterion 11 — Design for disassembly
The manufacturer shall demonstrate that the notebook computer can be easily dismantled by professionally trained personnel using the tools usually available to them, for the purpose of repairs and replacements of worn-out parts, upgrading older or obsolete parts, and separating parts and materials, ultimately for recycling or reuse.

To facilitate dismantling:

(a) fixtures within the notebook computer shall allow for its disassembly, e.g. screws, snap-fixes, especially for parts containing hazardous substances;

(b) circuit boards, and/or other precious metal-containing components, shall be easily removable using manual separation methods both from the product as a whole and from specific

components (such as drives) that contain such boards to enhance recovery of high value material;

(c) all plastic materials in covers/housing shall have no surface coatings incompatible with recycling or reuse;

(d) plastic parts shall be of one polymer or be of compatible polymers for recycling and have the relevant ISO11469 marking if greater than 25 g in mass;

(e) metal inlays that cannot be separated shall not be used;

(f) data on the nature and amount of hazardous substances in the notebook computer shall be gathered in accordance with Council Directive 2006/121/EC (1) and the Globally Harmonized System of Classification and Labelling of Chemicals (GHS).

Assessment and verification: a test report shall be submitted with the application detailing the dismantling of the notebook computer. It shall include an exploded diagram of the notebook computer labelling the main components as well as identifying any hazardous substances in components. It can be in written or audio-visual format. Information regarding hazardous substances shall be provided to the competent body in the form of a list of materials identifying material type, quantity used and location.

Criterion 13 — Packaging
Where cardboard boxes are used, they shall be made of, at least, 80 % recycled material. Where plastic bags are used for the final packaging, they shall be made of, at least, 75 % recycled material or they shall be biodegradable or compostable, in agreement with the definitions provided by the EN 13432 or equivalent.

Assessment and verification: a sample of the product packaging shall be provided on application, together with a corresponding declaration of compliance with this criterion. Only primary packaging, as defined in European Parliament and Council Directive 94/62/EC (2), is subject to the criterion.

Another example from the eco-label is from the criteria for small houses, apartment buildings and pre-school buildings.

P5 Use of eco-labelled building products.

Points are awarded for the use of eco-labelled (Nordic Eco-label or EU Eco-label) building products in the Nordic Eco-labelled building. One point is awarded for each product area within which a minimum of 10% of the product requirement is eco-labelled/recycled and two points for a minimum of 30%. Appendix 2 provides examples of product areas.

A total of five points can be scored under P5.

O23 Securing wood and bamboo raw materials from sustainable sources.

This requirement applies to all wood and bamboo-based materials in the building, such as products made of solid wood/bamboo and glulam, veneer and fiber-based products.

Wood and bamboo must not be derived from:

- Protected areas or areas that are treated by a policy with the objective of becoming protected.
- Areas where ownership or rights of exploitation are unclear.
- Illicitly felled trees and/or fiber raw material.
- Ancient virgin forest and forest of high value meriting protection.
- Genetically modified trees or plants.

The house manufacturer shall have a documented procedure describing how operations ensure that the wood or bamboo raw material is supplied from legal, sustainable sources. Nordic Eco-labelling may revoke the license if it is found that wood and/or bamboo raw materials are derived from non-approved environments. A Chain of Custody certificate may be used in the procedure to document the origin of the wood/bamboo raw material.

O32 Containers for sorting household waste

Containers for sorting household waste (at least 3 fractions) must be installed in the kitchen.

(Ecolabel.dk)

2.6.2 Example: Energy labelling of buildings[1]

Most buildings in Denmark must be energy labelled at certain times or at certain intervals. The labelling reflects the building's energy use and provides an overview of possible profitable energy improvements that could be implemented, including their cost and how large savings can be achieved.

The energy labelling is performed by an independent auditor, who calculates the use of energy based on measurements from the building and standard conditions for weather, users, and operating times etc.

Rules about energy labelling differ depending on the size, use and owner of the building.

2.6.3 Example: Energy labelling of products

Energy labelling of products is mandatory across the EU under the auspices of Directive 2010/30/EU. The Directive seeks to inform end-users of a product about how efficiently it uses energy and other limited resources, such as water, providing consumers with a benchmark of how a product relates to other products in the same category with regards to energy consumption. End users are encouraged to choose energy efficient products, which in turn creates an incentive for producers to invest in energy efficient product designs. The labelling scheme applies to products that are either energy intensive (such as home appliances) or affect energy consumption (e.g. windows).

A study conducted by the International Energy Agency (IEA), found that the use of energy labels increased average annual energy efficiency improvement rates for the products covered by the scheme from roughly 0.5 % to 3 % (International Energy Agency, 2015). Furthermore, the study found that the introduction of energy labels had positive effects on job creation, linked to the aforementioned increase in innovation rates, as well as a range of indirect effects, such as savings on national expenditures on healthcare. Overall, the IEA assessed that the benefits of energy labelling outweighs the associated costs by a ratio of 3:1.

[1] BEK no. 673 of 25/06/2012

2.7 Energy audits

2.7.1 Example: Mandatory Energy Audits in major enterprises

EU's Energy Efficiency Directive requires large enterprises to carry out an energy audit at least every four years, with a first energy audit at the latest by December 5th 2015.

The directive does only request the energy audits carried out and does thus not require realization of the recommendations of the audits.

The individual enterprises can – in the Danish implementation of the Directive – be exempted from the required energy audits if they have energy management systems certified according to e.g. ISO 50001 or DS/EN 16247 (1-7).

3. Screening of existing rule based regulatory framework and examples on how to include resource efficiency

The rule based regulation is characterised by specifying a limit to e.g. which levels of emissions are tolerated and giving permits to operate as long as such limits are not exceeded. Limits in environmental permits are often on environmental impacts such as emissions to air, water, levels of noise or smell tolerated.

Measuring whether the emission limits are met can be difficult in some cases. If there is a cause-effect link between emission and input or use of certain technologies, the permitting authority might chose to regulate the input or technology rather than the emission.

Figure 4 illustrate how each of the regulation mechanisms in the following text currently relates to businesses.

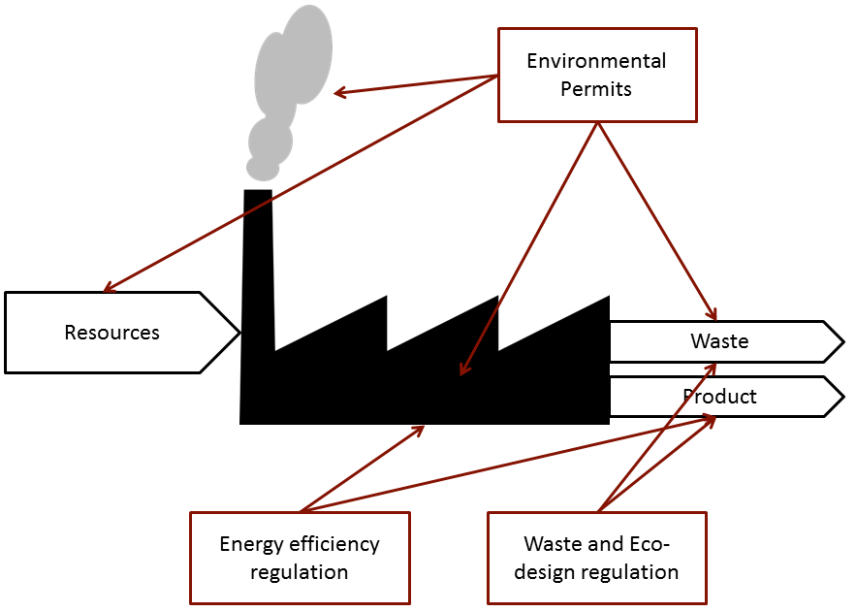

FIGURE 3 ILLUSTRATION ON WHICH AREAS OF A BUSINESS THE RULE BASED REGULATION MECHANISM DESCRIBED IN CHAPTER 3 RELATES TO.

3.1 Environmental permits

The EU Industrial Emissions Directive (IED) covers industrial activities with a major pollution potential and establishes a permit procedure and lays down requirements, in particular with regard to discharges. The objective is to avoid or minimise polluting emissions in the atmosphere, water and soil, as well as waste from specified industrial and agricultural installations, with the aim of achieving a high level of environmental and health protection. IED enterprises must comply with the emission levels (AEL) established in the BAT conclusion for their industry. The BAT AEL are based on the lowest level achievable through the use of BAT, although they are not specific with regard to technique, but rather to the level reached for the particular emission.

In Denmark, further to activities regulated by the IED, manufacturing enterprises defined in Annex 2 of the Execute order on Environmental Permits[2] are also required to acquire an environmental permit before commencing activities. The permit under Annex 2 also contains conditions about the use of BAT. The enterprises in Annex 2 are divided into two groups, having either standard conditions that apply for all, or individual conditions for the enterprises with very specialized productions or trades.

Finally, animal husbandries, including livestock, of a certain size but not as large as the IED husbandries, are also required to acquire an environmental permit under the Animal Husbandry Permit Order[3].

Common for all enterprises requiring a permit, whether under the IED or national legislation, is that the environmental permit contains a range of conditions with regard to emission levels and the use of BAT.

3.1.1 Examples of resource efficiency in environmental permits

In Denmark an environmental permit is required for two types of enterprises: industrial and agricultural – the latter particularly for animal husbandry enterprises. Below are examples of conditions that either aim to improve resource efficiency directly or through an increased awareness of processes and material streams within the enterprise.

3.1.1.1 Example: Environmental permits for industrial companies

For a range of enterprises with similar production processes, a list of standard conditions has been compiled in the executive order of standard conditions. Several of these conditions are based on the assumption that a part of emission control is to account for resource input and output and ensuring efficient process control. Examples of such standard conditions are:

Paragraph 11. G201, Condition 24

"*The operation log/records should contain an account of fuel, regarding both type and amount used.*"

This condition is an indicator of the emissions relating to the use of fuel, but also serves as an indicator of the actual energy use and thereby a regulation of resource efficiency.

Paragraph 16. J205, Condition 8

"*…the ventilation system must be installed with an automatic surveillance alarm for operational irregularities*"

The purpose of this condition is primarily to avoid environmental emissions above the limit value. However, an automatic surveillance alarm at operational irregularities could also indicate

[2] BEK no. 669 of 18/06/2014
[3] BEK no. 1280 of 08/11/2013

a waste of resources and in that way promote an optimised use of resources or energy.

Paragraph 20. K211. Condition 6

"*All areas, containers, bays, and bins in use for waste collection should be clearly labelled so it is obvious where the various types of waste should be stored.*" [the Approval Authorities determines conditions for sorting metals into separate fractions]

By optimising the possibility for sorting metals into separate fractions it is ensured that the waste is easily reused, which is a direct increase in resource efficiency.

3.1.1.2 Example: Environmental permits for agricultural (animal husbandry) industry

Animal husbandry enterprises over a certain size must also apply for an environmental permit, and it is stated in the order[4] that the enterprise must report and document the extent to which it has selected techniques based on the use of the least polluting and resource-consuming technique concerning raw materials, energy, water and other ingredients, production processes and waste generation.

To help the authorities that give the permission, a "condition catalogue" has been published by KL[5] where examples of possible conditions are listed. (KL, 2009) Some of these conditions contain objectives for improving resource efficiency:

"4.5.1. The farm's total consumption of electricity must be reduced with an average of x% each year in the period from 20xx to 20xx.Time-controlled lighting in all stables is installed"

"4.5.2. The farm's total consumption of water must be reduced with an average of x% each year in the period from 20xx to 20xx"

Finally, the Environmental Board of Appeal has in a case of appeal upheld the judgement about a condition that requires an animal husbandry enterprise to replace existing lighting in stables with low-energy bulbs or fluorescent tubes.[6]

3.1.1.3 Example: UK Environmental permit

An environmental permit from April 2014 for the IED company *Navitas Environmental Limited* in Hertfordshire, England is an example of how conditions on energy efficiency, efficient use of raw materials and avoidance, recovery and disposal of wastes produced by the activities.

Energy efficiency

The operator shall:

- Take appropriate measures to ensure that energy is recovered with a high level of energy efficiency and energy is used efficiently in the activities.
- Review and record at least every four years whether there are suitable opportunities to improve the energy efficiency of the activities; and
- take any further appropriate measures identified by a review
- The operator shall provide and maintain steam and/or hot water pass-outs such that

[4] BEK nr 1280 of 08/11/2013
[5] "KL" is the national association of municipalities in Denmark.
[6] 1407. 11.12.2013 – NMK-132-00627 – Landskab, energy.

opportunities for the further use of waste heat may be capitalised upon, should they become practicable.
- The operator shall review the practicability of combined Heat and Power (CHP) implementation at least every 2 years. The result shall be reported to the Agency within 2 months of each review.

Efficient use of raw materials

The operator shall:

- Take appropriate measures to ensure that raw materials and water are used efficiently in the activities;
- Maintain records of raw material and water used in the activities;
- Review and record at least every four years whether there are suitable alternative materials that could reduce environmental impact or opportunities to improve the efficiency of raw material and water use; and
- take any further appropriate measures identified by a review

3.2 Waste and eco-design regulation

3.2.1 Executive order on Waste[7]

The main regulation concerning waste are the following: the executive order on waste and the individual municipalities' regulations.

In the executive order on waste it is stated that waste producing companies must separate their waste at the source and that they must always separate hazardous waste from the non-hazardous waste and it is the municipalities' responsibility to classify the waste as either suitable for recycling or incineration.

The waste hierarchy is stated by the executive order on waste to be:

- Reused
- Recycled
- Recovered
- Disposed

With reusing being the preferred method and disposal the least desirable.

The municipalities are obligated to create a plan for waste management and the companies situated in the municipality must adhere to that regulation.

3.2.2 The WEEE Directive (& RoHS Directive)

Electronic waste contains a range of problematic substances especially heavy metals such as mercury, lead, cadmium, chromium and halogenated substances. The goal is therefore to phase out these substances and substitute them with less harmful substances. (See further on the RoHS Directive below). Furthermore, electronic equipment contains many useful materials that should be reused when producing new electronic equipment. In 1998, the first draft of a directive to prevent and reduce waste from electrical and electronic equipment (EEE) was formulated and subsequently the WEEE Directive (Waste of Electrical and Electronic Equipment) was adopted in 2002, and revised in 2012.

The Directive is based on the producer's responsibility model, which makes producers and importers take responsibility and pay for all lifecycle stages of their products, including disposal. The objective is, on one

[7] BEK no. 1309 of 18/12/2012

hand, to encourage the producer to produce "green" products and, on the other hand, to increase recycling and recovery of products. An aim of the Directive is to encourage the producers to develop and design equipment that will increase phasing out and substitution of unwanted substances, and design equipment that easily can be separated to increase recycling and reusing. Hence the WEEE Directive is focussed on both product design, amounts marketed and disposal of EEE.

Every member state must introduce rules/regulation concerning collection, treatment and utilization of waste from EEE, and ensure implementation of the "producers' responsibility" principle. Furthermore, the directive has set a minimum annual collection rate a minimum rate of 4 kilograms per head of population until the end of 2015. From 2016 the minimum collection rate should be 45% (total weight of collected WEEE expressed as a percentage of the average weight of EEE placed on the market in the three preceding years in that Member State). This rate should further increase and from 2019 it should be at least 65% (or alternatively 86% of WEEE generated on the territory of that Member State). Reaching these goals requires new initiatives to increase collection entailing changing the behaviour of both citizens and enterprises.

The WEEE Directive is supported by the RoHS Directive (Restriction of the Use of Certain Hazardous Substances), which limits and prohibits the use of a number of substances in EEE.

The Directive's requirements from producers and importers:

- Everyone who markets EEE must be registered in the Member States' Producer register.
- Annual reports of marketed, withdrawn (take-back) and treated amounts must be made to the national register.
- All products covered by the Directive must be labelled with the pictorial marking of a crossed-out wheelie bin.
- All expenses regarding management/handling of EEE are held by the producer and collateral must be put up for future handling/management.
- Requirements for eco-design in the WEEE Directive

In special regards to recommendations/requirements about eco-design of products, the recast of the directive states that, eco-design of the product, i.e. the full life cycle, should be encouraged and that this should be done according to the framework of the Eco-design Directive (Directive 2009/125/EC).

3.2.3 The Eco-design Directive

The European Union's Eco-design Directive (Directive 2009/125/EC) establishes a framework to set mandatory ecological requirements for energy-using and energy-related products sold in the EU. Its scope currently covers more than 40 product groups, such as boilers, light bulbs, TVs and fridges, and with the 2009 revision also energy-related products such as windows, insulation materials and certain water-using products.

The overall aim of the Eco-design Directive is to oblige the producers of energy-using and –related products to reduce the energy consumption and other negative environmental impacts (e.g. water use, emissions, and waste) occurring throughout the product life cycle. This is to be done by considering these issues already in the product design phase.

The Eco-design Directive is a framework directive, meaning that it does not directly set minimum ecological requirements. These are adopted through specifically implementing measures (*på dansk: eco-designforordninger*) for each product group in the scope of the Directive, e.g. televisions or household refrigerating appliances (a list of implementing measures (in Danish) can be found at http://www.ens.dk/forbrug-besparelser/apparater-produkter/ecodesign). Implementing measures are based on EU internal market rules governing which products may be placed on the market, and lays down specific criteria for the product's energy use. Manufacturers who begin marketing an energy using or –related product covered by an implementing measure in the EU area have to ensure that it conforms to the energy and environmental standards set out by the implementing measure.

Implementing measures are adopted for product categories that are produced or sold in a quantity of more than 200.000 units a year, that have a significant environmental impact, and which present significant potential for environmental improvement without excessive costs. Member States must ensure that products covered by an implementing measure is in compliance with the measure and bears the CE marking. Furthermore, Member States must also designate authorities responsible for market surveillance[8] (i.e. check product compliance).

The Eco-design Directive is complemented by the Energy Labelling Directive, which establishes a labelling scheme to inform users about the energy efficiency of the energy-using product they are considering.

3.3 Energy efficiency regulation

3.3.1 Example: The Building Regulations

The Danish Building Regulation implements *inter alia* the Energy Performance of Buildings (EPB) Directive and sets criteria for new and existing buildings (e.g. renovations) regarding energy and water consumption. (The Danish Ministry of Economic and Business Affairs, Danish Enterprise and Construction Authority, 2010)

In general terms, it is stated that:

"7.1(1) Buildings must be constructed so as to avoid unnecessary energy consumption for heating, hot water, cooling, ventilation and lighting while at the same time achieving healthy conditions."

Specific criteria are given for the total energy consumption of a building. The criteria are different depending on the intended use of the building, e.g. dwellings, student accommodation, hotels etc. or offices, schools, institutions etc. An example of such a criterion is the energy use of a new building (dwellings, student accommodation, hotels etc.):

"7.2.2(1) In the case of dwellings, student accommodation, hotels etc., the total demand of the building for energy supply for heating, ventilation, cooling, and domestic hot water per m^2 of heated floor area must not exceed 52.5 kWh/m^2/year plus 1650kWh/year divided by the heated floor area."

With regards to water supply installations it is stated that:

"8.4.2.1(6) Plumbing systems must be designed so as to avoid unnecessary water consumption, including waste of water."

3.3.2 Fuel efficiency of cars

EU has established mandatory emission performance standards[9] for new passenger cars in order to reduce CO_2 emissions from cars sold in the European market. Reduced emissions of CO_2 are to be achieved by an increased resource efficiency of the cars, i.e. a lower fuel consumption and better fuel quality. Emission limits are set according to the weight of the vehicle, so that heavier cars are allowed higher emissions than lighter cars, while the overall fleet average is preserved. Only the fleet average is regulated, so manufacturers are still able to produce vehicles with emissions above the limit value provided these are balanced by vehicles below the limit value. The fleet average to be achieved by all new cars is 130 grams of CO_2 per kilometre (g/km) by 2015 – with the target phased in from 2012 - and 95g/km by 2021, phased in from 2020. If the manufacturer's fleet exceeds the limit value an excess emission premium must be paid for each car registered. (European Commission)

[8] In Denmark the responsible authority is the Secretariat for Eco-design and Energy labelling of Products under The Danish Energy Agency.
[9] REGULATION (EC) No 443/2009

Along with the CO_2 emission standards, the regulation also gives incentives for manufacturers to equip vehicles with independently verified innovative technologies or produce vehicles with extremely low emissions (below 50 g/km).

Furthermore, to help drivers choose new cars with low fuel consumption, EU legislation requires that relevant information is provided e.g. by presenting a label showing a car's fuel efficiency and CO_2 emissions along with other specifications.

4. Approaches and examples on using BAT to regulate resource efficiency

Companies will often have an incentive to improve their resource efficiency particularly at central resource flows, as it is an important parameter to reduce costs. However, there are often a number of examples of profitable reduction measures that are not implemented. This chapter explores the possibility of using BAT conclusions to improve resource efficiency in companies.
There are three primary life cycle steps in which approaches to increase resource efficiency have been identified; input, production and output. These form the frame around the suggestions for general BAT conclusions on resource efficiency. Improving the product itself and improving the functional performance per unit of material consumption, energy consumption and emissions is a path not persued in this report, because product design and performance is outside the scope of BREFs, however intelligent product design holds great potential for improving resource efficiency in the products' lifespan.

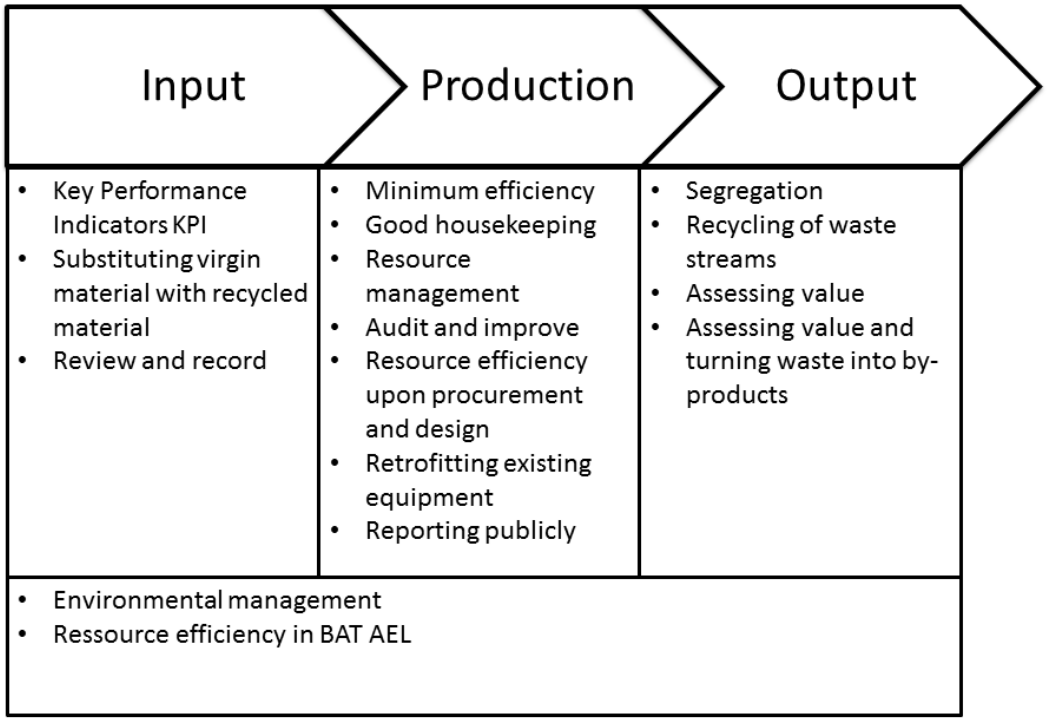

FIGURE 4 ILLUSTRATION OF THE APPROACHES IDENTIFIED FOR REGULATING RESOURCE EFFICIENCY USING BAT CATEGORIZED IN THREE LIFE CYCLE STEPS.

Examples of BAT conclusions from recently revised BREF documents are presented under each approach along with examples from other regulation of resource efficiency in companies.

Each suggestion of a resource efficiency BAT conclusion is accompanied by considerations of barriers to having such a BAT conclusion and alternative ways of achieving the same goal. The barriers and alternatives presented with the exemplified BAT conclusion are themselves examples of barriers and alternatives and do not constitute an exhaustive list.

Some suggestions for BAT conclusions to achieve resource efficiency are broad and cover the approaches in both input, production and output. An example of such a BAT conclusion is resource management, but to avoid redundancy it will only be mentioned once, whereas certain aspects of what might be covered by resource management is brought out when appropriate.

Some inspirational BAT examples fall outside the current scope of BREF. These are included in this chapter nevertheless, as the objective in this report is to present possibilities and inspire the debate on resource efficiency in BREF.

4.1 Cross-media aspects

A general concern with the exemplified inspirational BAT-conclusions is the potential negative cross-media aspect, sub-optimising. Using e.g. one KPI to monitor and potentially lower consumption of a material in one process step could lead to disregard for consumption of another material in the same or different process step. It becomes a prioritisation between two environmental issues e.g. when choosing between low concentration levels of unwanted substances in waste water and lowering water consumption.

Another cross-media aspect is whether resource efficiency requirements in European production companies will lead to relocation of industries to areas outside EU.

A positive cross-media aspect is synergy caused by increased resource efficiency. An example of a synergy arising from increased resource efficiency, is the possibility to lower consumption of an input material and thereby also lowering emissions of unwanted substances or lowering costs while processing the materials.

4.2 Input

The input side can be divided into two overall approaches: minimising input and resource efficient sourcing.

4.2.1 Examples from BAT conclusions

From the BAT conclusion of Tanning of hides and skins and Manufacture of glass are examples of minimising input of chemicals, water and energy.

From the BAT conclusion of Iron and steel production is an example of sourcing water from more sustainable sources and another example of techniques to improve the use of scrap. The purpose of the example with techniques to improve the use of scrap is to reduce emission levels for pollutants, however the techniques are also applicable for maximising the use of scrap metals within the boundaries set up by emission level limits.

Tanning of hides and skins, BAT conclusion no. 2.

In order to minimise the environmental impact of the production process, BAT is to apply the principles of good housekeeping by applying the following techniques in combination:

- minimisation of the use of chemicals to the minimum level required by the quality specifications of the final product;
- (…)

Manufacture of glass, BAT conclusion no. 12.

BAT is to reduce water consumption by using one or a combination of the following techniques:

- reuse of cooling and cleaning waters after purging
- operate a quasi-closed loop water system as far as technically and economically feasible
- minimisation of spillages and leaks
- (...)

Iron and steel production, BAT conclusions no. 12.

BAT for waste water management is to prevent, collect and separate waste water types, maximising internal recycling and using an adequate treatment for each final flow. This includes techniques utilising, e.g. oil interceptors, filtration or sedimentation. In this context, the following techniques can be used where the prerequisites mentioned are present:

- using rainwater whenever possible
- avoiding the use of potable water for production lines
- (...)

Iron and steel production, BAT conclusions no. 7.

In order to achieve low emission levels for relevant pollutants, BAT is to select appropriate scrap qualities and other raw materials. Regarding scrap, BAT is to undertake an appropriate inspection for visible contaminants which might contain heavy metals, in particular mercury, or might lead to the formation of polychlorinated dibenzodioxins/furans (PCDD/F) and polychlorinated biphenyls (PCB).

To improve the use of scrap, the following techniques can be used individually or in combination:

- specification of acceptance criteria suited to the production profile in purchase orders of scrap
- having a good knowledge of scrap composition by closely monitoring the origin of the scrap; in exceptional cases, a melt test might help characterise the composition of the scrap
- having adequate reception facilities and check deliveries
- having procedures to exclude scrap that is not suitable for use in the installation
- storing the scrap according to different criteria (e.g. size, alloys, degree of cleanliness); storing of scrap with potential release of contaminants to the soil on impermeable surfaces with a drainage and collection system; using a roof which can reduce the need for such a system
- putting together the scrap load for the different melts taking into account the knowledge of composition in order to use the most suitable scrap for the steel grade to be produced (this is essential in some cases to avoid the presence of undesired elements and in other cases to take advantage of alloy elements which are present in the scrap and needed for the steel grade to be produced)
- prompt return of all internally-generated scrap to the scrapyard for recycling
- having an operation and management plan
- scrap sorting to minimise the risk of including hazardous or non-ferrous contaminants,

particularly polychlorinated biphenyls (PCB) and oil or grease. This is normally done by the scrap supplier but the operator inspects all scrap loads in sealed containers for safety reasons. Therefore, at the same time, it is possible to check, as far as practicable, for contaminants. Evaluation of the small quantities of plastic (e.g. as plastic coated components) may be required

- radioactivity control according to the United Nations Economic Commission for Europe (UNECE) Expert Group framework of recommendationsEN 8.3.2012 Official Journal of the European Union L 70/71
- implementation of the mandatory removal of components which contain mercury from End-of-Life Vehicles and Waste Electrical and Electronic Equipment (WEEE) by the scrap processors can be improved by:
    - fixing the absence of mercury in scrap purchase contracts
    - refusal of scrap which contains visible electronic components and assemblies.

4.2.2 Examples from regulation

Minimising input or setting a cap on the material consumption has been done using taxes and tradable allowances.

BAT does not reflect the environmental load originating from sourced manufacturing activities outside EU.

The examples of resource efficient sourcing, primarily from the eco-labels for products, show that resource efficient sourcing can be done by having targets for content of recycled material and by using a management approach which focuses on material input choices based on assessments of the environmental impact.

The examples of resource efficiency on the input side focussing on resource efficient sourcing include substituting virgin material with recycled material, choosing raw materials from resource efficient sources, and reviewing and recording if efficiency can be improved or environmental impact lowered if changing to an alternative material.

2.1.1 Example: Energy tax

Putting taxes on energy consumption thus creating an incentive for businesses to reduce their consumption.

2.2.1 Example: Tradable allowances in the fishing industry

Putting a cap on the amount of fish allowed to fish and distributing quotas.

2.2.3 Example: US EPA, Emission Reduction Credits

Setting a tolerated limit of pollution and once limit is reached, all new productions or significant changes to production can only get approval if emissions are lowered elsewhere within the same area.

3.1.1.2 Example: Environmental permits for agricultural (animal husbandry) industry

The farm's total consumption of electricity must be reduced with an average of x% each year in the period from 20xx to 20xx.Time-controlled lighting in all stables is installed"

2.6.1 Example: Eco-label criteria

Criterion 8 — Recycled content

2.6.1 Example: Eco-label criteria

O23 Securing wood and bamboo raw materials from sustainable sources

3.1.1.3 Example: UK Environmental permit

Review and record at least every four years whether there are suitable alternative materials that could reduce environmental impact or opportunities to improve the efficiency of raw material and water use.

4.2.3 Key Performance Indicators KPI

Measuring performance on resource efficiency is a premise for establishing a KPI on resource efficiency, secondly the standardised KPI for the industry sector creates benchmark opportunities.

1 In order to promote resource efficiency BAT is to identify key performance indicators for resource efficiency and monitor these KPI, e.g. yield per tonne of raw material.

Barriers	A barrier for a BAT conclusion that identifies KPIs (or just requests facilities to identify KPIs) is if it is not possible to find a meaningful KPI, e.g. for industries where produced units varies and yield per tonne of raw material therefore varies accordingly.
Alternatives	As an alternative to using binding resource efficiency KPIs in the environmental permit, it might be sufficient to present the industry sector 'Best in class' KPI since it might nudge businesses to achieve a similar level KPI if they are below standard. Examples of such practices are known from the industry organisations, such as the European norm on water to beer ratio. Economic incentives can be a powerful tool, and thus an alternative to promote development of resource efficient technology through BAT is to focus on the market based regulation, by e.g. distributing key indicators of resource efficiency to financial intermediates to improve their possibility of distinguishing between preferred activities and activities below industry average.

2 In order to ensure a minimum level of resource efficiency BAT is to perform as well or better than 'insert KPI on e.g. water and energy'.

Barriers	A barrier for using KPIs for consumption is lack of uniformity in the data. It will have to be based on information from productions sites in the affected industry. Differences in production across an industry might render it impossible to get KPIs with enough validity to be implemented in a BAT conclusion. Companies within the same industry sector might face different requirements from their customers. Companies with customers who have certain requirements (e.g. strict hygiene requirements such as slaughterhouses) might be technically able to be more resource efficient, but may only do so by compromising the requirements set by their customers. Efficiency KPIs are relevant only where quality and performance of the product is not compromised. Building on the data uniformity barrier there is another barrier in the time horizon for BAT KPIs. BAT KPIs will be less dynamic than KPIs specific to the company or to the industry as KPIs through BAT are only updated every 8 years and based on data collected up to several years before the revision begins. Another barrier for using KPIs for consumption via BAT conclusions is the possible conflicts with other regulation. Within a BREF document a KPI on resource efficiency could be in conflict with emission level.
Alternatives	Several alternatives to a minimum resource efficiency requirement exists. KPIs are a common tool within environmental management systems and an alternative to specifying KPIs in BAT/BREF could be to encourage the use of resource efficiency KPIs as part of the environmental management system to companies not already using resource efficiency KPIs. Another alternative is quotas on scarce resources. Several quota systems exists, but they share the method of setting a cap on emission or consumption.

KPIs on resource efficiency are a common tool to manage resources, therefore making it a BAT conclusion will not affect the frontrunner and some of the average performing businesses but primarily target the poor performing businesses.

The applicability of KPI vary across industries. As an example KPIs are more likely to be included in the BREF on Food, Drink, Milk and Fodder, as relevant sector KPIs already exist.

4.2.4 Substituting virgin material with recycled material

The principle of using KPIs as a measure to increase resource efficiency is already mentioned. Elaborating on that, a KPI targeted at sourcing performance might be recycled content fraction or the environmental impact of the input materials chosen.

An example of using a KPI for recycled content in a BAT conclusion might look like this:

3 In order to reduce the consumption of virgin material, BAT is to have a minimum of __% recycled content per produced unit.

The recycled content can be both internal reuse of e.g. water or recycling of an external product, e.g. wood pallets.

Barriers	A barrier of such a BAT conclusion is the risk it poses to the quality of the product. For many industries traceability is a key parameter for choice of input which inhibits the recycling possibilities. Each company is regulated by a number of considerations, both to legislation nationally, in EU and in the countries where products are exported to. Ensuring a potential BAT conclusion with a KPI specifying recycled content which is not in conflict with other legislation affecting the company is a barrier.
Alternatives	Alternatively to focusing on the production to promote use of resource efficient input, focus could be on the product, through product regulation. Eco-labels already present an alternative to resource efficient sourcing in BREF with labels on products with a lower than average environmental impact and is continuously updated. Another alternative which could also be used in combination with a BAT conclusion on recycled content is to promote industrial symbiosis which require takers of waste stream produced in the vicinity.

4.2.5 Review and record

Looking toward the examples of GRI and UNGC a BAT conclusion with the approach to record material consumption is:

4 In order to increase resource efficiency, BAT is to record consumption of renewable resources and consumption of non-renewable resources.

Barriers	Focusing only on renewable and non-renewable can be problematic as some non-renewable resources are worse with regard to environmental impact.
Alternatives	An alternative to recording consumption of resources based on just one or a few given parameters is to review which issues are associated to the resources consumed and record performance relevant to the topical issues.

Inspired by the example from the UK environmental permit, an example of a BAT conclusion reviewing and recording if efficiency can be improved by changing to an alternative material, could look like this:

5 In order to increase resource efficiency BAT is to review and record at least every x years whether there are opportunities to improve the efficiency of raw material and water use. Parameters to take into consideration are: weight and volume, quality, durability, off-cutting and technological lifespan.

Barriers	One barrier is the conflict with the obligation of the environmental management system to continuously improve. It is a recurring step in the environmental management system to assess performance and set new goals.

Alternatives

An alternative to using assessment of the resource efficiency of input material in BREF, governments could tax materials associated with adverse environmental impact higher or lowering taxes on products with a proven smaller environmental impact than average.

Another alternative is to support voluntary systems for resource efficient sourcing or sustainable sourcing, such as supply chain management which is broader than resource efficiency and can potentially improve the environmental impact of the product by looking at environmental hotspots throughout the value chain.

4.3 Production

Optimising yield is an approach that primarily concerns production and only as a derived effect is it aimed at addressing environmental issues, but that in turn means optimising resource efficiency could assist in optimising yield.

Minimising input and optimising production are two sides of the same coin, however optimising production is not only achieved by minimising input, hence minimising input is identified as a separate approach to improve resource efficiency.

A number of examples on how to increase resource efficiency in the production exist both in existing BAT conclusions and in other regulation.

4.3.1 Examples from BAT conclusions

From the BAT conclusion of Tanning of hides and skins, Manufacturing of glass, Iron and steel production and the horizontal BREF on energy efficiency are examples of optimising by: monitoring, regular maintenance, optimising design and selection of technique, review of options, optimising management and control and audits.

Tanning of hides and skins, BAT conclusion no. 2

In order to minimise the environmental impact of the production process, BAT is to apply the principles of good housekeeping by applying the following techniques in combination:

- monitoring of critical process parameters to ensure stability of the production process;
- regular maintenance of the systems for the treatment of effluents;
- (...)

Tanning of hides and skins, BAT conclusion no. 3

BAT is to monitor emissions and other relevant process parameters, including those indicated below, with the given associated frequency and to monitor emissions according to EN standards. If EN standards are not available, BAT is to use ISO, national or other international standards that ensure the provision of data of an equivalent scientific quality.

- measurement of water consumption in the two process stages: up to tanning and post-tanning, and recording of production in the same period. Frequency: At least monthly.
- (...)

Manufacture of glass, BAT conclusion no. 2

BAT is to reduce the specific energy consumption by using one or a combination of the following techniques:

- process optimisation, through the control of the operating parameters
- regular maintenance of the melting furnace
- optimisation of the furnace design and the selection of the melting technique
- Review of options for the reuse of process/washing water
- (…)

Iron and steel production, BAT conclusion no. 6

BAT is to optimise the management and control of internal material flows in order to prevent pollution, prevent deterioration, provide adequate input quality, allow reuse and recycling and to improve the process efficiency and optimisation of the metal yield.

Iron and steel production, BAT conclusion no. 13

BAT is to measure or assess all relevant parameters necessary to steer the processes from control rooms by means of modern computer-based systems in order to adjust continuously and to optimise the processes online, to ensure stable and smooth processing, thus increasing energy efficiency and maximising the yield and improving maintenance practices.

Energy efficiency, BAT conclusion no. 4.

When carrying out an audit, BAT is to ensure that the audit identifies the following aspects:

possibilities to minimise energy use, such as:

- controlling/reducing operating times, e.g. switching off when not in use.
- ensuring insulation is optimised
- optimising utilities, associated systems and processes
- (…)

4.3.2 Examples from regulation

The examples on resource efficiency in production by optimising include: design to avoid unnecessary use, using alarms to survey operational irregularities, resource management, publicly disclosing environmental performance, audits and forced implementation of measures meeting certain criteria, resource considerations at purchase, funding innovation and tradable allowances.

3.3.1 Example: The Building Regulations

Buildings must be constructed so as to avoid unnecessary energy consumption for heating, hot water, cooling, ventilation and lighting while at the same time achieving healthy conditions

3.1.1.1 Example: Environmental permits for industrial companies

Paragraph 16. J205, Condition 8

"...the ventilation system must be installed with an automatic surveillance alarm for operational irregularities"

3.1.1.3 Example: UK Environmental permit

Take appropriate measures to ensure that raw materials and water are used efficiently in the activities;

Maintain records of raw material and water used in the activities;

Review and record at least every four years whether there are suitable alternative materials that could reduce environmental impact or opportunities to improve the efficiency of raw material and water use; and take any further appropriate measures identified by a review

2.5.1 Example: Carbon Disclosure Project and 2.5.2 Example: Global Reporting Initiative (GRI) G4 standard for reporting

Publicly disclosing environmental performance indicators.

2.7.1 Example: Mandatory Energy Audits in major enterprises

An audit reveals concrete methods of improving energy efficiency.

2.1.2 Example: Energy efficiency in energy intensive industry

Energy management and audits including compulsory improvement if payback time is less than 4 years as an alternative to CO_2 tax.

Part of the energy management system is energy-conscious purchasing of energy consuming equipment.

2.3.2 Example: Danish EPA's funding for eco-innovation

Funding for testing new technologies improving environmental performance of industrial production.

2.2.2 Example: EU Emission Trading Scheme

Distributing quotas through market forces to achieve a shared reduction goal for several countries.

4.3.3 Minimum efficiency

Establishing the minimum level of tolerated resource efficiency will force businesses performing worse than the minimum level to get up at an acceptable level of resource efficiency. A BAT conclusion of that nature could look like this:

6 In order to achieve resource efficiency in the production process, BAT is to meet minimum resource efficiency targets, e.g. tonne input material per produced unit or kWh per tonne water pumped etc.

Barriers	A minimum efficiency requirement for production processes have similar barriers as the second BAT conclusion with minimum overall resource efficiency requirements, such as the time span for a BAT conclusion and thereby the minimum efficiency requirement which will only be renewed every 8 years. Another barrier is the variety of production processes, making it complicated to establish meaningful minimum resource efficiency requirements for each production process. Similarly another barrier is accommodation variety over seasons and in production mix.
Alternatives	As an alternative to having a separate BAT conclusion on the minimum efficiency targets, it could be integrated into the BAT conclusion on environmental management.

4.3.4 Good housekeeping

A suggestion for a general BAT conclusion on resource efficiency is derived from the second BAT conclusion for Tanning of hides and skins.

7 In order to optimise resource efficiency of the production process, BAT is to apply the principles of good housekeeping by applying the following techniques in combination:

- Process optimisation, through the control of the operating parameters
- monitoring of critical process parameters to ensure stability of the production process;
- regular maintenance of the systems

Barriers	A barrier for a general BAT conclusion on good housekeeping is that it is a vague requirement and thus difficult to enforce at an environmental inspection.
Alternatives	An alternative to setting a BAT conclusion on good housekeeping is to rely on economic instruments to regulate resource efficiency through optimising operation.

4.3.5 LEAN

An example of using LEAN comes from a production process of painting metal sheets. Initially the process caused an unacceptable level of VOC emissions. Instead of using technologies to clean the air stream before release, a different approach was chosen; preventing any unnecessary process steps. With better logistic management a process step was cut away lowering the required amount of paint needed. The product remained the same.

8 In order to optimise resource efficiency of the production process, BAT is to ensure the production only includes activities contributing to meeting customer requirements, which are documented in a value chain analysis.

Barriers	A barrier for a BAT conclusion implementing the principles of LEAN is that it presumably falls outside the scope of BREF. Another barrier is that it is difficult to enforce.
Alternatives	An alternative to setting a BAT conclusion on LEAN is to rely on economic instruments to regulate resource efficiency through optimising operation which is the current driving force for companies who have implemented LEAN in their production.

4.3.6 Resource management

Resource management entails assessing which important resource related parameters can be used to measure the progress towards the target resource efficiency.

9 In order to increase resource efficiency it is BAT to identify primary consumptions of input material, review and record at least every x years whether there are opportunities to improve the efficiency of raw material and water use, and take any further appropriate measures identified by a review

Documenting the process of identifying consumption hot spots, monitoring and setting reduction targets allows for the authorities to control that the management steps have been taken.

Barriers	A barrier to having resource management in BAT is that the effect of resource management is very dependent on the effort put into implementing and maintaining it.

Alternatives

An alternative to having resource management in BREF is for the controlling authority to ask whether resource efficiency has been considered as part of the company's environmental management system when the relevant authority performs environmental inspections.

Another alternative to having resource management in BREF is regulating the consumption of materials through taxes or (tradable) allowances.

4.3.7 Audit and improve

In addition to resource management, auditing and follow up if the payback time is less than a certain period might be included in BAT, to ensure the management system does not become a bureaucratic box-ticking exercise.

10 In order to increase resource efficiency of the production process, BAT is to conduct a resource audit every x years and implement any suggestions for improvement with a payback time of less than z years.

For a specific sector the BAT conclusion could further specify which options should be reviewed on a regular basis, e.g. combined heat and power for large combustion plants.

Barriers

A barrier to a BAT conclusion on audits of resource efficiency is if the external auditors are not qualified to identify potentials for resource efficiency improvements within the specific processes of the individual facility.

Another barrier to use payback time as a criterion for implementing resource efficient technology is to find an acceptable payback time limit across the industry which will have different financial conditions depending on e.g. the country of operation.

Yet another barrier for audits by third party as part of a BREF is the possible conflict of interests the operation manager faces, because he/she is both responsible for acknowledging possible improvements as part of general operations and facilitating the third party auditor when finding possible improvements. It is likely that the operation manager would prefer to be the one identifying the potential for improvement and thus not enable the auditors to do their work – or even work against the auditor.

Another barrier is, the potentially, additional cost that such a BAT conclusion would place on the affected industry.

Alternatives

An alternative to a BAT conclusion on audits is to make available a resource efficiency catalogue with known techniques that can improve resource efficiency.

Another alternative to a BAT conclusion on audits and implementation if payback time is acceptable, is to rely on the existing environmental management scheme. That will, when used correctly, reveal opportunities to improve or areas where help is needed.

4.3.8 Resource efficiency upon procurement and design

In situations where a technique or piece of equipment needs updating a BAT conclusion specifying resource efficiency is to be considered and it is part of the specification sent to the supplier/manufacturer.

11 In order to increase resource efficiency in production, BAT is to specify resource efficiency as a selection criterion for suppliers and consider alternatives to the technique with better resource efficiency and report.

Barriers	There are two types of barriers: the time consumption and consideration before action and the lack of obligation to act upon the selection criterion or alternatives.
Alternatives	If the company has certified environmental management, the aspect of resource efficiency at the supplier is already covered.

4.3.9 Retrofitting existing equipment

12 In order to increase resource efficiency in production, BAT is to review and record if 'industry-specific technology' is feasible, e.g. retrofitting of pumps, lighting equipment, rinsing equipment etc.

Barriers	Similar to the exemplified BAT conclusion on resource efficiency upon procurement and design a barrier to a BAT conclusion on retrofitting existing equipment is the time consumption and consideration before action, needed to perform the task. Another barrier might be the lack of liquidity or means of financing the investment. Yet another barrier is the lack of ownership, e.g. if the lighting equipment or another piece of equipment is not owned by the same company who is responsible for operation.
Alternatives	An alternative to placing the responsibility of retrofitting the existing equipment on the operating company governments could, through other regulation, promote purchasing of services rather than products, placing the cost of inefficient equipment on the service provider rather than the operating company.

4.3.10 Reporting publicly

13 In order to increase resource efficiency BAT is to publicly disclose resource efficiency performance.

Barriers	A barrier for disclosing resource efficiency performance is the comparability amongst companies. European companies within the same industry are governed by different regulations and supply products with different quality requirements. A company with strict hygiene requirements for their products

	will appear to have a lower resource efficiency. For frontrunners already reporting via the CDP water program or the Global Reporting Initiative reporting on resource efficiency as part of the environmental permit might be as easy as inserting a link to the voluntary report on corporate social responsibility performance if that includes resource efficiency parameters. For businesses not used to public reporting, the reporting might encourage more dedication into resource efficiency improvements, but it could also become a paper tiger.
Alternatives	Reporting on resource efficiency performance is already a voluntary option many companies use. The public reporting is not mandated by authority but instead driven by investor demands. Eco-labels are another market driven alternative to public reporting making it easier for consumers to identify products with fewer environmental impacts. It is already a requirement in the IE directive that the permits and inspection reports are publicly available. An alternative to reporting publicly on resource efficiency is if resource efficiency is instead part of the inspection and subsequently appears in the inspection report.

4.4 Output

Several examples have a life cycle approach some of which are focused on increasing the possibilities for reusing or recycling waste streams by keeping waste streams separate and assessing the possibility for recycling regularly.

The examples found in existing regulation are mainly focussed on improving the possibility for recycling the waste from the production site. An example focussed on the product is included as well which reflects the concept of considering end-of-life in the design of a product.

4.4.1 Examples from BAT conclusions

From the BAT conclusion of Iron and steel production, Tanning of hides and skins and Manufacturing of glass are examples of increasing recycling by: minimising loss and spillage, preventing, collecting and separate waste, reusing internally or processing to recycle externally, maximising the external recycling possibilities if internal recycling is not possible, valorise waste fractions, maximise by-products from waste fractions, and review of disposal options.

Iron and steel production, BAT conclusion no. 8.

BAT for solid residues is to use integrated techniques and operational techniques for waste minimisation by internal use or by application of specialised recycling processes (internally or externally).

Iron and steel production, BAT conclusion no. 9

BAT is to maximise external use or recycling for solid residues which cannot be used or recycled according to BAT 8, wherever this is possible and in line with waste regulations.

Iron and steel production, BAT conclusion no. 12

BAT for waste water management is to prevent, collect and separate waste water types, maximising internal recycling and using an adequate treatment for each final flow. This includes techniques utilising e.g. oil interceptors, filtration or sedimentation. In this context, the following techniques can be used where the prerequisites mentioned are present:

- increasing the number and/or capacity of water circulating systems when building new plants or modernising/revamping existing plants
- centralising the distribution of incoming fresh water
- using the water in cascades until single parameters reach their legal or technical limits
- using the water in other plants if only single parameters of the water are affected and further usage is possible
- keeping treated and untreated waste water separated; by this measure it is possible to dispose of waste water in different ways at a reasonable cost
- (…)

Tanning of hides and skins, BAT conclusion no. 2

In order to minimise the environmental impact of the production process, BAT is to apply the principles of good housekeeping by applying the following techniques in combination:

- segregation of waste streams, where practicable, in order to allow for the recycling of certain waste streams
- review of waste disposal options
- (…)

Tanning of hides and skins, BAT conclusion no. 21

In order to limit the quantities of wastes sent for disposal, BAT is to organise operations on the site so as to maximise the proportion of process residues, which arise as by-products(…).

Tanning of hides and skins, BAT conclusion no. 22

In order to limit the quantities of wastes sent for disposal, BAT is to organise operations on the site so as to facilitate waste reuse, or failing that, waste recycling, or failing that, 'other recovery', (…)

Manufacture of glass, BAT conclusion no. 14

BAT is to reduce the production of solid waste to be disposed of by using one or a combination of the following techniques:

- recycling of waste batch materials, where quality requirements allow for it
- minimising material losses during the storage and handling of raw materials

- recycling of internal cullet from rejected production
- recycling of dust in the batch formulation where quality requirements allow for it
- valorisation of solid waste and/or sludge through appropriate use on-site (e.g. sludge from water treatment) or in other industries
- valorisation of end-of-life refractory materials for possible use in other industries

4.4.2 Examples from regulation

The examples of resource efficiency in the output phase by recycling include: design of production to facilitate separation on waste streams, design for disassembly, taxing waste which is not recycled, funding of projects turning waste streams into by-products.

3.1.1.1 Example: Environmental permits for industrial companies

All areas, containers, bays, and bins in use for waste collection should be clearly labelled so it is obvious where the various types of waste should be stored.

2.6.1 Example: Eco-label criteria

O32 Containers for sorting household waste

2.6.1 Example: Eco-label criteria

Criterion 11 — Design for disassembly

2.1.3 Example: Waste tax

Putting a tax on waste which is not recycled

0

Example: Projects to develop waste into a by-product funded by the Danish Business Authority

4.4.3 Segregation

A premise for most recycling approaches is separation of the waste streams.

Both in production,

14 In order to increase the resource efficiency of the production process, BAT is to segregate waste streams, where practicable, in order to allow for the recycling of certain waste streams.

and in products:

15 In order to increase the resource efficiency of a product, BAT is to label recyclable materials, where practicable, in order to allow for the recycling of certain materials.

Barriers	Separation of waste streams or labelling of recyclable materials must be balanced with the possibilities to recycle the waste stream or material. One barrier to separating waste streams is if the waste streams are at a later stage mixed. Another barrier for a BAT conclusion focussed on segregation of materials within a product at the end-of-life or end-of-life availability is that it often is out of scope for the BREF.
Alternatives	Sorting collectively from several productions, after the waste stream has left the production, can in some cases be a better alternative than segregating the waste streams in the production.

4.4.4 Recycling of waste streams

Assessment of the possibility of recycling internally which is often the case for water e.g. counter current reuse of rinsing water, then external recycling.

16 BAT for waste is to use integrated techniques and operational techniques for waste minimisation by internal use or by application of specialised recycling processes (internally or externally), e.g. water cascades.

(Techniques should be subsequently suggested for the relevant industry)

Barriers	One barrier for recycling of waste is the strict requirements related to the purity and traceability of raw materials. The strict requirements related to the purity and traceability of raw materials make it increasingly difficult to redirect secondary value streams of the core product to its original intended purpose. Another barrier for recycling of waste is in cases where concentrating the waste stream might enable recycling. If the waste stream has a typical BAT AEL concentration value it inhibits the possibility to recycle a concentrated product.
Alternatives	Taxation has proven to be an effective lever on waste reduction. An alternative to waste minimisation via BAT is a European tax on waste and waste water.

4.4.5 Assessing value

Assessing the value of the waste will supposedly, if the assessment shows the waste has some value, lead to a sale of the resource. A general BAT conclusion with an aim of assessing the value of the waste is exemplified below.

17 In order to increase the resource efficiency BAT is to reduce the production of waste e.g. waste water, heat, solid waste to be disposed of by assessing the value of the waste stream and documenting the assessment.

Barriers	One barrier to implement forced assessment of valuing waste streams is if the value of the waste/by-product is close to zero or there is no market to absorb the waste/by-product. Another barrier is redundancy, if too many industries already reuse or recycle all of their waste. National regulation defining "waste", which in other terms could be categorised as a secondary product, act as barrier to dynamically use intermediate value streams for non-core purposes.
Alternatives	An alternative to a BAT conclusion on assessing the value of a waste stream is improving the regional and local planning to promote industrial symbiosis between companies.

4.4.6 Assessing value and turning waste into by-products

In addition to assessing the value of the waste one can explore whether further treatment of the waste will increase the value or usability which might facilitate a sale of the resource. A general BAT conclusion, with the aim of assessing whether value can be added to the waste to make it a by-product instead, is exemplified below.

18 In order to increase the resource efficiency BAT is to reduce the production of waste e.g. waste water, heat, solid waste to be disposed of by assessing the value of the waste stream, the possibility of adding value to the waste stream and the possibility to facilitate reusing or recycling and documenting the assessment.

Barriers	One barrier for a BAT conclusion on assessing the possibility to add value or facilitate recycling to work is the other parameters that apply when a sale of a product is imminent, such as availability of a market. A by-product from processing of meat is subcutaneous fat. With recent development in politics the Russian market is in the time of writting not available for allocation of that by-product, thus the by-product is allocated to resource recovery through biodiesel generation, which is a less attractive application. Another parameter to consider is the shelf-life of a product, making some markets not readily available. Another barrier is the scope of BREF. Assessing the possibility to add value to a product is on the borderline of the scope, if not simply outside the scope of BREF.
Alternatives	Industrial symbiosis based on local or regional planning is an alternative to selling the waste stream as a by-product. This works best if it is supported by a tax on waste disposal as using the waste stream in local businesses or cities would mean saving the cost of waste tax. Although valorising of a resource is a valid tool for incentivising a sale of the waste stream, the valorisation might be a negative value. Selling the waste stream or supplying the waste stream to a treatment facility might be the solution with the lowest environmental impact. The decision to sell or supply

the treatment facility with the waste stream must then be based on non-monetary rewards.

One negative cross-media of selling waste streams is that it might lower the incentive to find an alternative to the waste stream, e.g. power plants selling heat or steam, but might be replaced by wind or solar power which has the same primary product, but doesn't support the by-product supply chain.

4.5 Cross-cutting

4.5.1 Environmental management

The recently revised BREF documents contain a BAT conclusion on environmental management. Having an environmental management system entails monitoring parameters decided by the company based on the guidelines from the reference document on general principles of monitoring. Inputs of resources are not specified as a parameter to be monitored.

Environmental management as BAT could be utilised more towards resource efficiency if specified in the requirements for environmental management. One risk of specifying explicitly that resource efficiency should be part of the environmental management system is that it will have no effect and will be redundant for companies already using the environmental management system effectively.

4.5.2 Resource efficiency in BAT AEL

Focus on resource efficiency during the creation of BAT conclusions and BAT AEL taking into consideration their potential barriers for achieving resource efficiency is another approach to promote resource efficiency via BAT. The BREF for the manufacture of glass has an example of a relationship between an unwanted emission and a more resource efficient input material as seen from Figure 5.

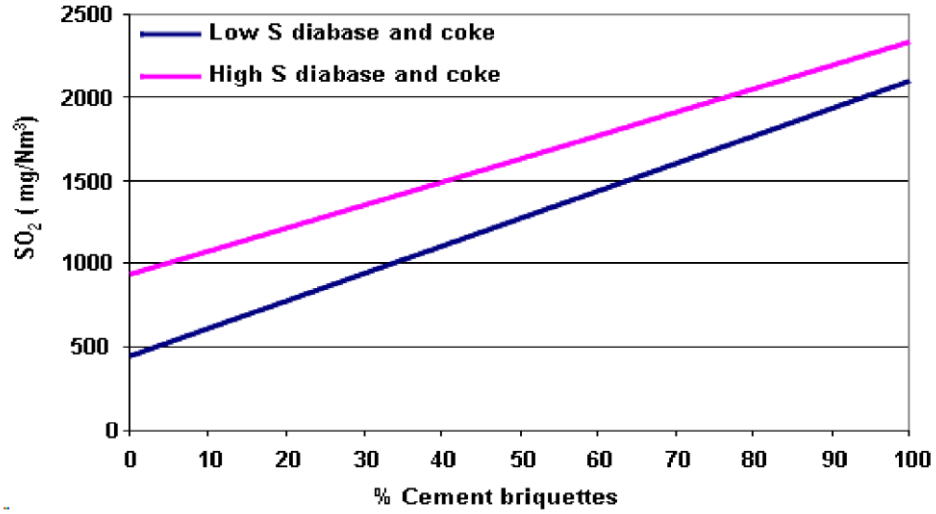

FIGURE 5 EXPECTED CONCENTRATION OF SO2 DEPENDING ON THE PERCENTAGE OF CEMENT BRIQUETTES RECYCLED WITH THE BATCH CHARGE IN THE CUPOLA FURNACE (SOURCE: BREF FOR THE MANUFACTURE OF GLASS, ORIGINALLY (EURIMA SUGGESTIONS, 2007))

An example from the BAT conclusions for manufacture of glass shows how BAT AEL can be constructed to accommodate use of recycled material in Figure 6.

An example of a BAT conclusion which does not accommodate resource efficiency is from the BREF on Tanning of hides and skins, where the BAT AEL values do not include a consideration of water resource efficiency.

An alternative to the differentiated concentration BAT AEL is to create BAT AEL based on the absolute load of the emission. This would make dilution of the pollution an unusable strategy, however in vulnerable areas concentration value limits might still be a necessity.

Another example is from the BREF on production of pulp, paper and board, where at the determination of a level for phosphor emissions from paper and recycled fibres, an initial emission level was suggested which was considerably more strict than the equivalent emission level from virgin fibres. It was ultimately decided to make the emission level less strict, based on the premise that production with an input of recycled fibres performs a task important to society. The agreed-upon emission level for water pollution from paper production based on recycled fibres remained significantly lower than the equivalent for production based on virgin fibres. (Christensen, 2014)

Table 49

BAT-AELs for SO_X emissions from the melting furnace in the mineral wool sector

Parameter	Product/conditions	BAT-AEL	
		mg/Nm^3	kg/tonne melted glass (1)
SO_X expressed as SO_2	***Glass wool***		
	Gas-fired and electric furnaces (2)	< 50 – 150	< 0,1 – 0,3
	Stone wool		
	Gas-fired and electric furnaces	< 350	< 0,9
	Cupola furnaces, no briquettes or slag recycling (3)	< 400	< 1,0
	Cupola furnaces, with cement briquettes or slag recycling (4)	< 1 400	< 3,5

(1) The conversion factors of 2×10^{-3} for glass wool and $2,5 \times 10^{-3}$ for stone wool have been used (see Table 2).
(2) The lower levels of the ranges are associated with the use of electric melting. The higher levels are associated with high levels of cullet recycling.
(3) The BAT-AEL is associated with conditions where the reduction of SO_X emissions has a high priority over a lower production of solid waste.
(4) When reduction of waste has a high priority over SO_X emissions, higher emission values may be expected. The achievable levels should be based on a sulphur balance.

FIGURE 6 TABLE 49 FROM THE BAT CONCLUSIONS FOR MANUFACTURE OF GLASS, WITH HIGHLIGHTED BAT-AELS FOR DIFFERENT INPUT MATERIAL.

Conclusion

Target group
Some examples from current regulation on resource efficiency are targeted at the first movers such as the examples on transparency: the GRI, CDP and, other examples show what is the tolerated level such as the environmental permits targeted at the slower movers. Thus, the approaches for including resource efficiency in BAT are not 'one size fits all'. Some approaches are suitable in specific industry sectors.
The target group for resource efficiency BAT conclusions should be agreed upon as part of the revision of the BREF. In addition, it should be considered whether the effect of resource efficiency in BAT/BREF is large enough, within the target group, to compensate for the additional bureaucracy and potential costs placed upon the already resource efficient companies.

Data availability
The BAT conclusions are based on data from the companies covered by the BREF. Companies will likely be more reluctant to share data on resource consumption and efficiency parameters as these data are more business sensitive than emission data. Although the handling of BREF data aims at ensuring confidentiality, the risk of a data leak is a deterrent for businesses to supply sensitive data to a third party.

Lifespan of a BREF document
The BREF documents will be revised every 8 years and the BAT conclusions will be based on data collected in the revision. The timespan of the BREF document and the BAT conclusions make the BAT conclusions a non-dynamic tool for regulating resource efficiency. Development of resource efficiency, in different industries, will happen faster within market based regulation, e.g. when scarcity of resources result in higher prices.

Scope
The scope of BREF is a limiting factor in choice of approach for resource efficiency regulation which is often based on a life cycle perspective. To compensate for the limitation in the scope of BREF the approaches are modified to at least ensure that resource efficiency is not counteracted in a life cycle perspective. One approach that ensures resource efficiency is not counteracted in a life cycle perspective is the example from the manufacture of glass BREF, where concentration values varies according to the input material, thereby not preventing the use of recycled material as an input stream. Regulating product design is out of the scope of BREF, however resource efficiency can be improved by intelligent design and focus on functional performance.

Potential resource efficiency improvements to BREF
This report shows that several approaches for resource efficiency already exist in BREF. It also shows that there is potential to improve the already known BAT conclusions in order to make them more oriented towards, or accommodating of, resource efficiency. The, already general, BAT conclusion on environmental management system might be oriented at resource efficiency by specifying consumption of input material as a parameter to monitor. Focus on cross-media aspects, when establishing the BAT AEL, could prevent BAT AELs that do not accommodate resource efficiency.

Feasibility of the exemplified BAT conclusions
Based on the identified barriers, listed under the exemplified BAT conclusions, the feasibility of the exemplified BAT conclusions have been evaluated and divided into three feasibility categories: most feasible, feasibility depends on the industry and least feasible.

TABLE 1 FEASIBILITY OF THE EXEMPLIFIED BAT CONCLUSIONS

Feasibility	Exemplified BAT conclusions
Most feasible	• Review and record •
Feasibility depends on the industry	• Resource management • Resource efficiency upon procurement and design • Retrofitting existing equipment • Environmental management • Resource efficiency in BAT AEL • Key Performance Indicators KPI • Minimum efficiency • Good housekeeping • Reporting publicly • Segregation • Recycling of waste streams • Assessing value
Least feasible	• Substituting virgin material with recycled material • LEAN • Audit and improve • Assessing value and turning waste into by-products

Global or local resource issues

This report is based on the premise that industries should improve their resource efficiency. A consideration, when resource efficiency is to be implemented in a BREF document, is the prioritisation on which resource efficiency measures should be applied. There are different types of resources: renewable, non-renewable, resources from recycled materials, energy-crops, which could be food. Each of these resources have different environmental issues associated with them. Some resources are only problematic due to scarcity e.g. water but, because scarcity of a resource can be a local problem, making a European binding BAT conclusion to use it efficiently may be a burden without environmental gains for companies located in areas where the resource is plentiful.

Severity

If the BAT conclusions are not met, it could result in the company being forced to shut down. The severity of the consequence of not meeting the BAT conclusion demands the BAT conclusions are of a nature that deals with pressing environmental issues in an effective manner. The discussions of the exemplified BAT conclusions show that there are still several considerations to be made before they can be applied in a BREF document.

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Resource efficiency in industries

Pollution prevention in the industry is - among other ways - regulated by conclusions on which environmental protection can be achieved by using best available techniques, BAT. The mapping of BAT traditionally focuses on emission reduction and to a lesser extent resource efficiency in the industry. If it is a wish to stimulate resource efficiency via BAT conclusions, it should be clarified what it takes. There is a risk that too tight or too one-sided BAT conclusions may have an opposite effect if the industry doesn't find them acceptable or achievable. In the worst case there is a risk of disturbing competitive power. Possibilities for stimulating resource efficiency via BAT and via other forms of legislation are illustrated in the report as well as risks to avoid. The target group is experts from industry and authorities participating in the EU work of BAT conclusions under the Industrial Emissions Directive or transpose BAT conclusions in reviews and environmental permits.

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