More product benchmarks in the EU ETS

Feasibility study

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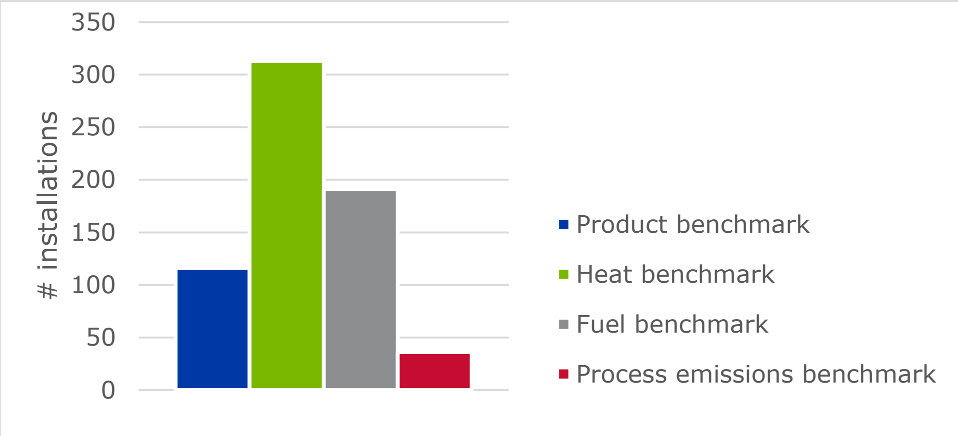
Summary

Since the start of the third trading phase of the EU ETS, the free allocation of emission allowances takes place using a combination of benchmark approaches: product benchmarks and three fall-back benchmark approaches (heat, fuel and process emissions benchmarks). While the fall-back approaches are true fall-backs in terms of free allocations (covering 22%, 6% and 1% respectively of free allocations in the Netherlands), they are the dominant allocation approaches for the majority of installations in the Netherlands, as displayed in Summary figure 1.



Summary figure 1: Number of ETS installations in the Netherlands dealing with a particular benchmark approach for allocation of free allowances. The number of installations covered by a product benchmark is limited compared to the heat and fuel benchmark (note: one installation can be covered by multiple benchmark types).

The use of product benchmarks is relatively straightforward to apply for companies. In contrast, if one of the fall-back benchmarks is used, administrative costs to companies increase significantly, in particular related to the heat benchmark which requires the monitoring of parameters which are usually not monitored by companies. An increased use of product benchmarking could thus reduce the administrative burden. The research question of this study is therefore defined as follows:

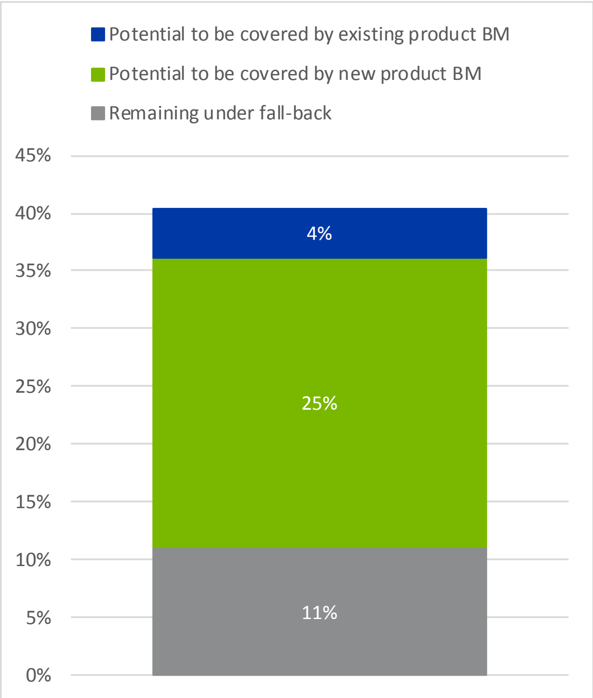
What is the feasibility of extending the use of product benchmarks in the EU ETS?

The increased use of product benchmarks can be implemented by two tracks:
Track 1: Enlarging the scope of currently existing benchmarks.
Track 2: Increasing the number of product benchmarks.

This analysis focused on 14 sectors, in which 183 installations (78%) deal with a fall back benchmark, covering 6.3 MtCO_2 of free allocation (24%) by the heat benchmark and 2.1 MtCO_2 of free allocation (8%) by the fuel benchmark.

Overall, using both tracks, we estimate that a maximum of around **73%** (133 out of 183) of Dutch ETS installations in the 14 sectors analysed may no longer have to deal with a fall-back benchmark and can be fully covered by a product benchmark instead. This is **29%** of all Dutch ETS installations eligible for free allocation, as shown by Summary figure 2. Hence, this would mean a significant reduction of the administrative complexity related to the fall-back benchmarks.

In terms of allocation, an estimated **67%** (5.6 $MtCO_2$ out of 8.4 $MtCO_2$) of free allocation in the 14 sectors could potentially shift from the fallback to the product benchmark approach. This conclusion is based on a detailed analysis of the feasibility of track 1 and 2 in 14 selected sectors. From this analysis we can conclude that track 2 offers the biggest wins, but needs most effort.



Summary figure 2: The share of Dutch ETS installations eligible for free allocation and covered by a fall back benchmark is 40%. A significant share (29%) could be brought under a product benchmark approach, indicated by the blue and green areas.

Track 1: In the best case, nineteen installations could move to 100% use of existing product benchmarks, involving 242 $ktCO_2$ of allocation

Enlarging the scope of existing product benchmarks has a relatively large potential for three sectors: paper, bricks & tiles, and organic chemical products. In these sectors a total of nineteen installations have the majority of allocation (typically 90% or more) occurring via a product benchmark and just a limited amount (typically 10% or less) via fall-back benchmarks. Typically, these are auxiliary processes just outside the scope of the product benchmark. We estimate the feasibility of bringing these processes within the scope of product benchmarks is relatively high, especially for paper and bricks & tiles.

A small follow-up study would be required to identify how the re-definition of product benchmarks should work in practice. We note that in the three sectors mentioned, numerous different product benchmarks are used, which may imply an adaptation of up to ten product benchmarks. Although this may sound quite cumbersome, in practice it may be the addition of some auxiliary processes. How this would affect product benchmark values is a question that also needs follow-up attention. If successful, the allocation going from fall-back to product benchmark would amount to 242 $ktCO_2$.

Track 2: At maximum, 43% of installations covered by a fall-back approach could move to 100% use of product benchmarks, involving 5.4 $MtCO_2$ of allocation.
Based on specific characteristics of each sector and a sectoral feasibility assessment along seven benchmarking criteria, we identified seven sectors with a high potential for additional product benchmarks, five sectors with a medium, and two sectors with a relatively low potential for new product benchmarks, as depicted in Summary table 1.

From this analysis, we estimate that new benchmarks have the maximum potential to remove fall-back benchmarks for 114 installations (i.e. 43% of installations covered by a fall-back approach), and to shift the allocation of 5.4 $MtCO_2$ from the fall-back to the product benchmark approach. These are relatively big wins, in terms of reducing administrative complexity. Therefore, it is recommended to start exploring the scopes and data collection needs for new product benchmarks in the 8 high potential sectors identified. This analysis has been done by means of expert judgement, based on the detailed characteristics of the sectors and the feasibility assessment identified in Section 3. For the organic basic chemicals sector a more detailed assessment at installation level has been carried out.

Almost 50 installations would **remain dealing with a fall-back benchmark**, covering 2.7 $MtCO_2$ of allocation. An open question is whether this amount can be simplified by other means, e.g. by shifting the heat benchmark allocation to the fuel benchmark, or going to a grand-fathering approach. This would be an interesting option for simplification of the EU ETS, deserving further study beyond the scope of this report.

High feasibility	Medium feasibility	Low feasibility
Beer manufacturing Organic chemicals Plastics Fertilizers Asphalt Bricks and tiles Sugar	Natural gas production Paper and paperboard Processed Potatoes Starch production Inorganic chemicals	Oils & fats Dairies

Summary table 1: Feasibility of developing new product benchmarks for a selection of sectors.

Recommendations

Finally, we provide the following recommendations for next steps:

- Identify how to re-define product benchmarks in the paper, bricks & tiles, and organic chemical products sectors in practice. In addition, identify how this would affect the product benchmark values and how new benchmark values (if needed) can be derived. We recommend to closely involve the relevant sector organisations in this effort.
- Start exploring the scopes and data collection needs for new product benchmarks in the seven high potential sectors identified.
- Explore the impact of removing the heat benchmark on the administrative complexity of the EU ETS, and the related impact on cost effectiveness and the incentive to reduce emissions.

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1 Introduction

The Dutch Ministry of Infrastructure and Environment is exploring the possibilities of simplifying the implementation burden and administrative procedures of the EU Emissions Trading System (EU ETS). The Ministry requested the Dutch Emissions Authority (NEA) to study in particular how the implementation burden and administrative procedures for companies can be reduced. The lowering of this so called 'red tape' as a result of ETS regulation can increase the effectiveness of the ETS as policy instrument and can further strengthen its acceptability.

Recently, the NEa published their findings on simplifying the ETS. One of the concrete measures proposed is to increase the use of product benchmarks. The NEa asked Ecofys to assess the possibilities of more product benchmarks in the EU ETS. With its ample experience in developing benchmarking approaches in several ETSs around the world, Ecofys happily accepted this request.

1.1 Research question

An increased use of product benchmarks in the calculation of free allocation to industries is an option that could reduce the administrative complexity of the EU ETS. Since the start of the third trading phase of the EU ETS, the free allocation of emission allowances takes place using a combination of benchmark approaches: product benchmarks and three fall-back benchmark approaches: the heat, fuel and process emissions benchmarks[1]. Experience with the allocation in phase III shows that the use of product benchmarks is relatively straightforward to apply for companies. In contrast, if one of the fall-back benchmarks is used, administrative costs to companies increase significantly.

In particular the use of the heat benchmark results in complexities, because the activity levels (i.e. daily, monthly or annual net heat consumption) that need to be reported are in most cases not monitored by companies. On top of that, the required activity level can be the sum of many of diverse, complex heat flows. An increased use of product benchmarking could thus reduce the administrative burden and the central research question of this study is therefore:

- *What is the feasibility of extending the use of product benchmarks in the EU ETS?*

[1] This study assumes the reader to have basic knowledge on the allocation methodologies in the EU ETS. For more information, we refer to the documentation that can be found on the website of the European Commission (http://ec.europa.eu/clima/policies/ets/cap/allocation/index_en.htm)

1.2 Methodology

The extension of the use of product benchmarks can be achieved in two ways:

1. Creation of new product benchmarks for activities that are currently covered by fall-back approaches.
2. Extension of the scope of existing product benchmarks.

To systematically analyse the available possibilities, we took the following approach:

Step 1: Mapping current situation
The first step is to get an overview of the use of product versus fall-back benchmarks, and the different combinations. This is done by mapping the flows of free allocation per benchmark (i.e. per sub-installation) to companies and sectors. This data is not available publicly, and therefore we rely on a confidential dataset provided by the NEa covering all Dutch ETS installations. Obviously, it would be best to base the analysis on data for the whole EU ETS given the European-wise scope of the scheme. However, for the purpose of this study, the Dutch scope is deemed to be a good starting point for a first analysis of possible additional benchmarks. It is not further studied how representative the data-set is for the situation in the EU ETS as a whole, but it can be expected that some of the sectors studied are more important in the Netherlands as compared to the rest of Europe whereas on the other hand, other sectors might be more important Europe-wide, but marginal in the Netherlands.

The dataset received from the NEa has not been checked or modified. An exception is the sector code according to the NACE revision 2.0. This code has been completed in case it was missing, or has been corrected in case of obvious mistakes (i.e. a NACE rev 1.1 code is used instead of the NACE rev 2.0 code) to make sure a good classification into sectors was possible. Based on the available data, the current situation for the Netherlands is mapped, in particular in terms of big wins and quick wins in terms of the number of installations that could be brought from the fall-back to the product benchmark approach. Based on this overview, a long list of sectors is created which could be the most logical candidates for an extended product benchmark approach in terms of number of installations and emission totals.

Step 2: Identification of (theoretical) options
The long list is discussed with the NEa and based on qualitative observations and expert judgment a short list with around fifteen sectors is produced for which more product benchmarks may be feasible. Sectors are selected based on: number of installations in the sector covered by a fall-back benchmark, amount of emissions covered by fall-back benchmarks, and homogeneity of processes and/or products. While a basic understanding of sectors and the main production processes was required for this first selection, the feasibility of more product benchmarks is only assessed in more detail in the next step.

Step 3: Feasibility of options
For the short listed sectors, the feasibility of creating additional product benchmarks for the ETS was assessed using the following criteria:

Homogeneity of processes within sector
For the creation of a benchmark, it is important that the production processes in the sector are similar. If a wide range of different production routes and different combinations of process options exist, the benchmarking will be significantly more difficult.

Homogeneity within product(s)
The homogeneity of products within a product benchmark is of importance, because if the products are rather heterogeneous with many different product specifications that also influence the emissions intensity, companies will argue that their product requires a separate product benchmark to account for these differences in intensity.

Exchangeability fossil fuels/electricity
For some processes, different technologies exist that use different energy carriers. It is not fair to benchmark only one of the energy carriers, because this results in extremely low energy consumption when another energy carrier is used. Therefore, all energy carriers that are used for the production need to be benchmarked. In order to determine the free allocations, the electricity share in energy consumption is deducted from the total calculated allocations. As this benchmark method requires additional data, the exchangeability of fossil fuels and electricity as energy carriers is included as a criterion for feasibility assessment.

Data availability at relevant level
In order to create a benchmark, sufficient data is needed. This data needs to be present with the correct product boundaries and scope and on the relevant level (installation-level). The data can either be collected or be present in existing public sources.

Benchmark experience in sector
If a sector has experience in benchmarking energy or climate performance, this is beneficial for developing a new benchmark.

Tradability of intermediates
If intermediate products can (and are) traded within the sector (or even between sectors), the best way to account for this is to create another benchmark for the intermediate product. If a lot of intermediate products exist within a sector, this negatively impacts the feasibility of creating a product benchmark.

Step 4: Conclusions
The results of the previous steps are brought together and recommendations for further steps are made.

1.3 Study limitations

This study intends to do a quick scan on the feasibility of additional product benchmarks in selected studies. Due to time constraints the number of potentially interesting sectors had to be limited, which means that some sectors with potential (e.g. salt, iron & steel) have not been investigated.

The study should not be interpreted as an attempt to develop in any detail benchmark methodologies for the sectors concerned or to give a decisive answer on whether or not product benchmarks for the sectors could be developed. There is a lot to say about benchmarking and multiple factors play a role. Only a more detailed look into the sectors concerned could shed light on how possible benchmark approaches for the sectors could look like.

2 Overall results

2.1 The use of different benchmarks for free allocation to Dutch ETS installations

As the preferred benchmarking methodology the product benchmark is applied in the Netherlands for the vast majority of covered emissions. In total, about 70% of total free allocation in the Netherlands is provided by the product benchmark. The heat benchmark accounts for about 22% of free allocation, the fuel benchmark for 6% and the process emissions benchmark (or rather: approach) is responsible for 1% of free allocations (Figure 1).

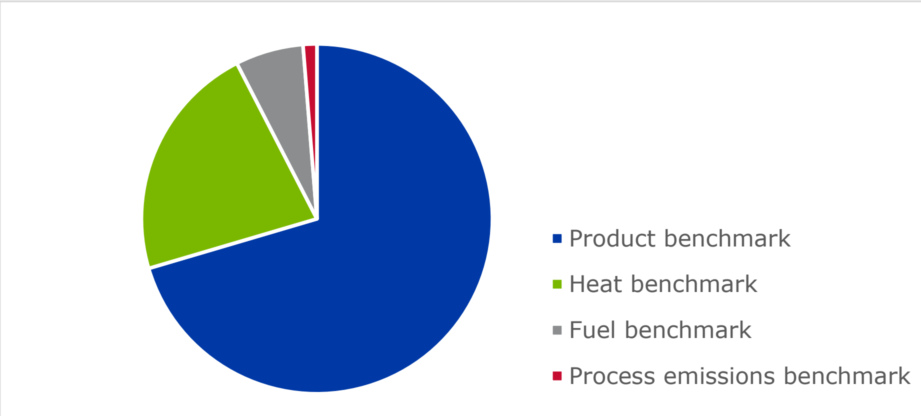


Figure 1: Share of preliminary free allocations provided by different benchmarks.

In terms of number of ETS installations covered by these benchmarks, the picture drastically changes: 116 installations deal with a product benchmark, while more than 300 installations are covered by a heat benchmark and 191 installations by the fuel benchmark, i.e. more than the product benchmark (Figure 2). Note that one installation can be subject to multiple benchmark methods. The assessment covered 510 ETS installations in the Netherlands.

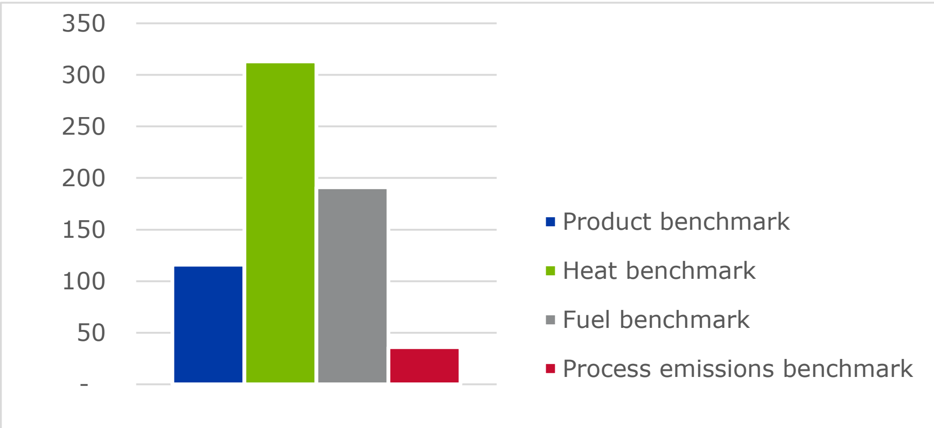


Figure 2: Number of installations covered by a particular benchmark.

Thus, while the fall-back approaches (heat, fuel, process emissions benchmarks) are true fall-backs in terms of free allocations, they are the dominant allocation approaches for the majority of installations in the Netherlands. This situation also holds at the sectoral level: the heat benchmark has been applied in 64 sectors (NACE codes), the fuel benchmark in 48 sectors, and the product benchmark in 19 sectors (Figure 3). These observations are expected to be similar at EU level.

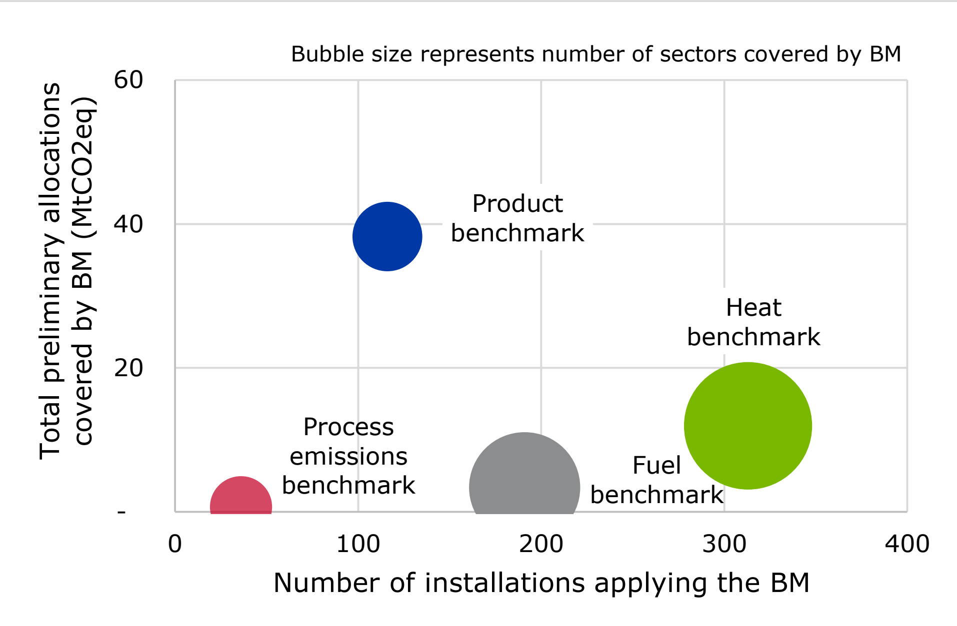


Figure 3: The heat and fuel benchmark are the dominant allocation approaches for the majority of installations and sectors.

2.2 Potential for enlarged product benchmarks

When it comes to increasing the role of product benchmarks, two approaches can be distinguished:

1) Enlarging the scope of currently existing benchmarks.
2) Increasing the number of product benchmarks.

This section deals with the options related to point 1.

Enlarged product benchmarks could be implemented in two ways:

1) The scope of the product benchmark could be enlarged by redefining the activities that are subject to the product benchmark e.g. by including relatively small, auxiliary activities that were formerly not included.
2) The product definition could be modified, for example by using a more general or inclusive unit of product.

We note that in both cases, it could well mean that the value of the product benchmark may need to be revisited, in order to account for the enlarged scope or revised product definition. This impact is not further analysed in this report.

Per definition, enlarging the use of existing product benchmark fits only those sectors where product benchmarks are already used and where a relatively small amount of allocation occurs via the fall-back benchmarks. Enlarging the scopes of these benchmarks could then result in quick wins.

The number of installations in which a fall-back approach is used next to a product benchmark appears to be limited to 52 installations in the Netherlands, with the majority of the cases (32) found in three sectors:

- 1712 – manufacture of paper and paperboard;
- 2332 – Manufacture of bricks, tiles and construction products, in baked clay;
- 2014 – manufacture of organic basic chemicals.

The other 20 cases are scattered across various sectors with just one or two cases per sector.

This means that the gains from extending the use of existing product benchmarks should focus on the three sectors listed above.

Overall result: in the best case, nineteen installations could move to 100% use of product benchmarks, involving 242 ktCO_2 of allocation.
Enlarging the scope of existing product benchmarks has a relatively large potential for three sectors: paper, bricks & tiles, and organic chemical products.
In these sectors a total of nineteen installations have the majority of allocation (typically 90% or more) occurring via a product benchmark and just a limited amount (typically 10% or less) via fall-back benchmarks. Typically, these are auxiliary processes just outside the scope of the product benchmark.
We estimate the feasibility of bringing these processes within the scope of product benchmarks is relatively high, especially for paper and bricks & tiles.
A small follow-up study would be required to identify how the re-definition of product benchmarks should work in practice. We note that in the three sectors mentioned, numerous different product benchmarks are used, which may imply an adaptation of up to ten product benchmarks. Although this may sound quite cumbersome, in practice it may be the addition of some auxiliary processes. How this would affect product benchmark values is a question that also needs follow-up attention. If successful, the allocation going from fall-back to product benchmark would amount to 242 ktCO_2.

1712 – Paper and paperboard
The twelve installations in the paper sector that have a combination of product and fall-back benchmarks can be split into two categories:

- For four installations about 90% of the allocation is covered by one or more product benchmarks. For these installations an extension of the use of product benchmarks to 100% is deemed to be feasible and deserves further study beyond the scope of this report. If successful, the allocation going from fall-back to product benchmark would amount to X ktCO_2.

- For eight installations the product benchmark covers only between 10-20% of the allocation. These installations most likely produce different products compared to the current benchmarks, thus they may be better served with a new product benchmark (see section 2.3).

2332 – Bricks and tiles

Ten installations in the bricks and tiles sector have a combination of product and fall-back benchmarks which can be split into two categories:

- For eight installations between 70% and 95% of the total allocation is covered by one or more product benchmarks. For these installations an extension of the use of product benchmarks to 100% is deemed to be feasible and deserves further study beyond the scope of this report. If successful, the allocation going from fall-back to product benchmark would amount to about 16 $ktCO_2$.
- For two installations the product benchmark covers less than 20% of the allocation. These installations most likely produce different products compared to the current benchmarks, thus they may be better served with a new product benchmark (see section 2.3).

2014 – Organic basic chemicals

The ten installations in the organic basic chemicals sector that have a combination of product and fall-back benchmarks can also be split into two categories:

- For seven installations more than 90% of the total allocation is covered by one or more product benchmarks. For these installations an extension of the use of product benchmarks to 100% is deemed to be feasible and deserves further study. If successful, the allocation going from fall-back to product benchmark would amount to about 207 $ktCO_2$.
- For two installations the product benchmark covers around X% of the allocation, and for one installation the product benchmark covers between X and X% of the total allocation.
  It is unlikely that the fall-back allocations can be covered by extending the scope of the benchmarks. For these installations the feasibility of a new product benchmark should be studied (see section 2.3).

Table 1: Impact on allocation and complexity for installations if scope of existing product benchmarks is enlarged.

NACE	Sector	Number of installations in sector	Number of installations in sector with fallback benchmark	Nr of installations added fully under product BM	Allocation to be shifted to product BM (ktCO2)	Share of fall-back allocation (%)
2014	Manufacture of other organic basic chemicals	39	25	7	207	6%
2332	Manufacture of bricks, tiles and construction products, in baked clay	40	22	8	16	23%
1712	Manufacture of paper and paperboard	19	9	4	X	X%

2.3 Potential for new product benchmarks

When it comes to increasing the number of product benchmarks the aim is to select non-benchmarked products which are covering a relatively large amount of allocation and/or are affecting many installations, i.e. big wins. Potentially big wins can be found in those sectors with either a large amount of installations or a large amount of allocations covered by fall-back approaches.

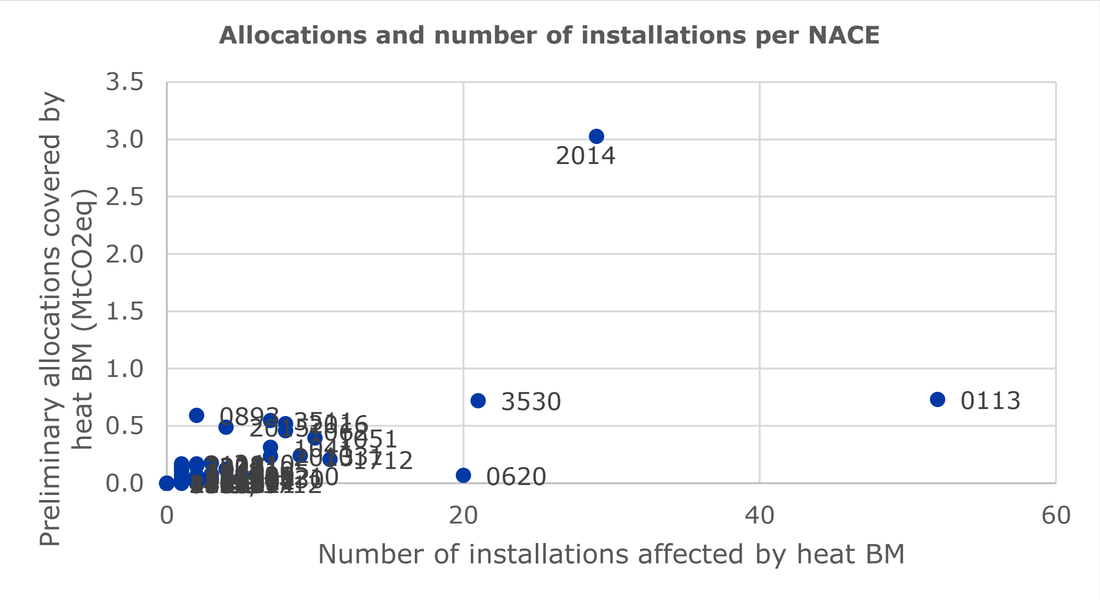


Figure 4: Overview of sectors mapped for allocations and number of installations covered by the heat benchmark. A zoom of the bottom-left area is provided in the next figure.

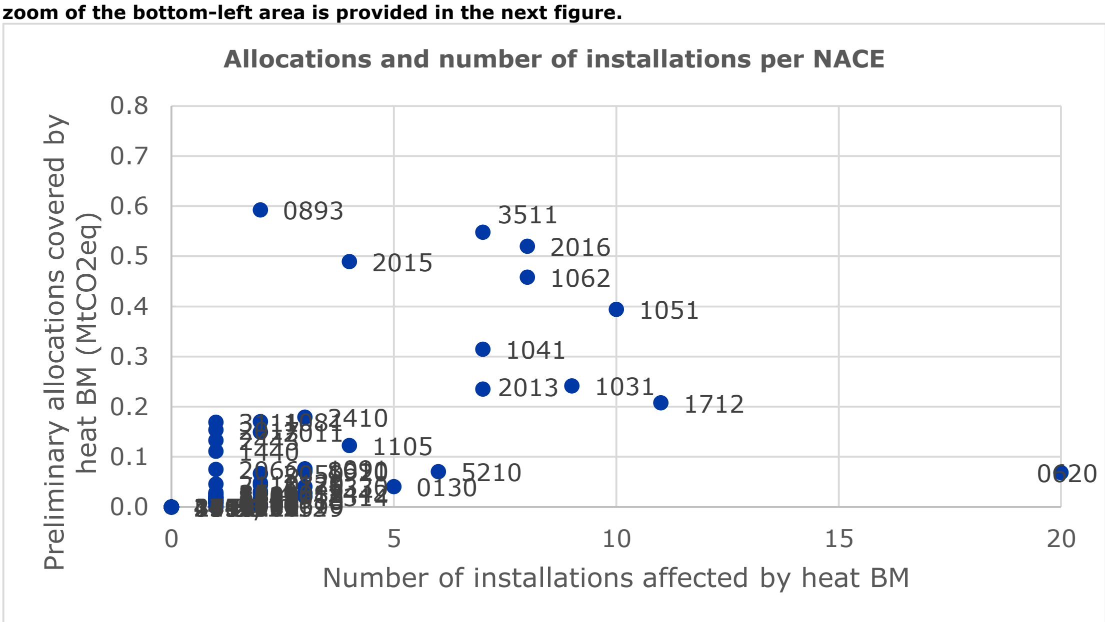


Figure 5: Zoom of previous Figure. The NACE codes in the bottom-left area represent many small installations in scattered sectors and are not the focus of this study.

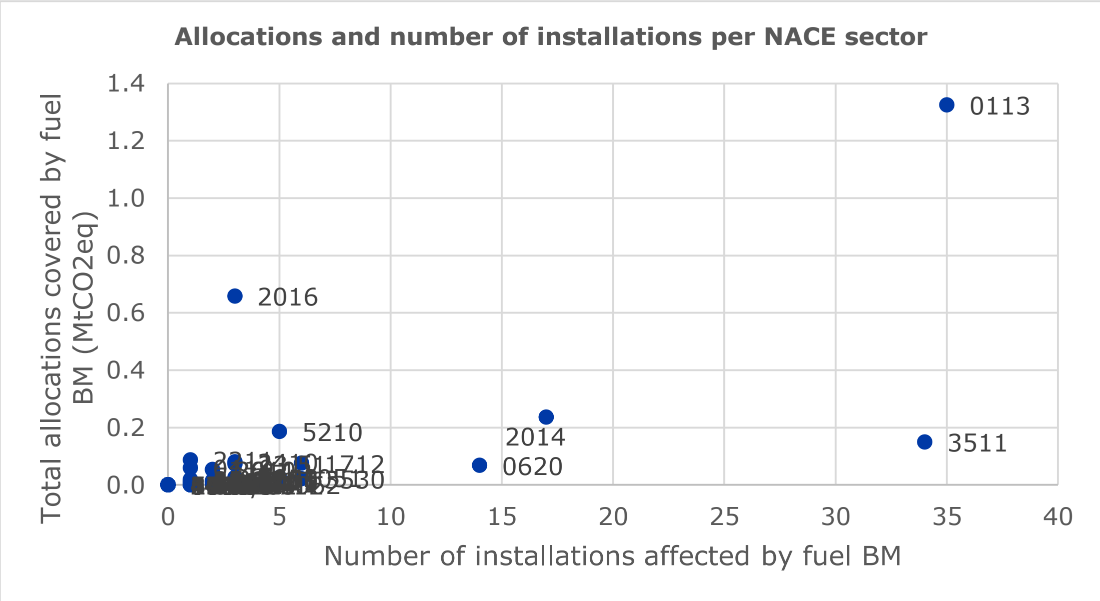


Figure 6: Overview of sectors mapped for allocations and number of installations covered by the fuel benchmark. The NACE codes in the bottom-left area represent many small installations in scattered sectors and are not the focus of this study.

The results mapped in Figure 4 to Figure 6, form a long list of sectors from which a short list is selected for further analysis, based on the criteria in Chapter 1.2.

Selected sectors

Table 2 (next page) shows the short-listed sectors that are included in this feasibility assessment. Per sector, the number of installations out of the total that are (at least partially) covered by the heat benchmark and/or the fuel benchmark are shown. Furthermore, the preliminary allocations that are covered by these respective benchmarks are shown; they are considered to be the most reliable proxy for emissions from these sub installations.

Table 2: List of NL sectors included in feasibility assessment and their allocation characteristics

NACE	Sector	Number of installations in sector	Number of installations covered by			Preliminary allocations (ktCO_2) covered by		
			Product BM	Heat BM	Fuel BM	Product BM	Heat BM	Fuel BM
0620	Extraction of natural gas	36	X	X	X	X	X	X
2399	Manufacture of other non-metallic mineral products n.e.c.	35	X	X	X	X	X	X
2014	Manufacture of other organic basic chemicals	39	X	X	X	X	X	X
2332	Manufacture of bricks, tiles and construction products, in baked clay	40	X	X	X	X	X	X
1712	Manufacture of paper and paperboard	19	X	X	X	X	X	X
1051	Operation of dairies and cheese making	10	X	X	X	X	X	X
1031	Processing and preserving of potatoes	9	X	X	X	X	X	X
2016	Manufacture of plastics in primary forms	8	X	X	X	X	X	X
1062	Manufacture of starches and starch products	8	X	X	X	X	X	X
1041	Manufacture of oils and fats	7	X	X	X	X	X	X
2013	Manufacture of other inorganic basic chemicals	7	X	X	X	X	X	X
2015	Manufacture of fertilisers and nitrogen compounds	12	X	X	X	X	X	X
1105	Manufacture of beer	4	X	X	X	X	X	X
1081	Manufacture of sugar	2	X	X	X	X	X	X

Overall result of feasibility assessment

Based on ETS installations and sub-installations in the Netherlands, 14 NACE sectors have been short-listed for the feasibility assessment based on the number of installations and the share of allocation covered by the heat and fuel benchmark. The selected sectors are scored on the criteria specified in Chapter 1.2. Table 3 summarizes the results of the feasibility assessment.

Table 3: Feasibility of developing product benchmarks.

Sector	1105	2014	0620	2399	2332	1712	1051	2016	1031	1062	1041	2013	2015	1081
Criterion	Beer	Organic Chem	Gas production	Asphalt	Bricks	Paper	Dairies	Plastics	Potatoes	Starch	Oils & fats	Inorganic Chem	Fertilizers	Sugar
Homogeneity within sector	+	-	0	+	-	-	-	-	0	+	-	-	-	+
Homogeneity within product(s)	0	+	-	+	+	0	0	+	0	0	-	+	+	0
Complexity of energy flows	0	-	-	0	+	+	-	-	0	?	?	?	+	0
Data availability at relevant detail level	0	+	0	+	+	+	-	+	0	0	-	+	+	0
Benchmark experience in sector	+	+	-	-	0	0	0	+	+	-	-	0	+	+
Tradability of intermediates	+	+	+	0	+	-	-	+	0	-	-	0	-	-
Cost impact for companies	+	+	0	0	-	-	-	+	0	+	0	0	+	+

"+" indicates a favourable situation for benchmarking

"-" indicates a non-favourable situation for benchmarking

"0" indicates neither a favourable nor a non-favourable situation

Based on this result it is possible to define a category of sectors for which a high, medium and low feasibility of further product benchmarking is expected (Table 4). The classification is done by assigning values to each score in the tables above and by summing these values. As this involves some subjective, arbitrary weighting, the classification shown should be seen as indication to guide further decision making.

Table 4: Expected feasibility of developing new product benchmarks.

High feasibility	Medium feasibility	Low feasibility
Beer manufacturing Organic chemicals Plastics Fertilizers Asphalt Bricks and tiles Sugar	Natural gas production Paper and paperboard Processed Potatoes Starch production Inorganic chemicals	Oils & fats Dairies

Crucial is what impact it would have to develop new benchmarks in the high and medium feasibility category. This has been estimated by means of expert judgement, based on the detailed characteristics of the sectors and the feasibility assessment and issues identified in Section 3.
For the organic basic chemicals sector a more detailed assessment at installation level has been carried out, to refine the estimate.

In total, new benchmarks have the potential to remove the fall-back benchmarks at in total 114 installations, and to shift the allocation of 5.4 $MtCO_2$. This is on the condition that new benchmarks are developed with broad scopes, covering basically all activities within the relevant installations, a condition that should be tested in follow-up work.

Together with the enlarged product benchmarks, this would result – on paper – in an estimated 70% (133 out of 190) of installations that no longer have to deal with a fall-back benchmark and are fully covered by a product benchmark instead. This would mean a significant reduction of the administrative complexity related to the fall-back benchmarks.

In terms of allocation, an estimated 62% (5.6 $MtCO_2$ out of 9.2 $MtCO_2$) of allocation would shift from the heat benchmark to the product benchmark.

3 Feasibility assessment per sector

In this Chapter the feasibility to apply more or larger product benchmarks within sectors is assessed for a selection of sectors.

3.1 NACE 0620 – Extraction of natural gas

Sector ETS characteristics

NACE	Sector	Number of installations in sector	Number of installations in sector with fallback benchmark	Number of installations covered by			Preliminary allocations (ktCO2) covered by		
				Product BM	Heat BM	Fuel BM	Product BM	Heat BM	Fuel BM
0620	Extraction of natural gas	36	36	X	X	X	X	X	X

The extraction of natural gas sector has 36 ETS installations in the Netherlands. The 55 sub-installations in this sector only consist of the fuel benchmark (X sub installations) and the heat benchmark (X sub installations). Thus, there are no product benchmarks applicable in this sector.

Understanding of underlying processes
Gas is extracted from the subsurface using specially drilled wells called producing or operating wells.

Homogeneity within sector – Medium
The natural gas extraction sector is relatively homogeneous as it consists of only one activity: extracting gas.

Homogeneity within product(s) - Low
Extracted gas may differ from one installation to the other in terms of calorific value and by-products (for instance associated natural gas liquids). This influences related emissions. The number and type of by-products also differs. As a consequence, a benchmark of emissions per unit of gas extracted may be easy to develop but may not be considered as fair, because of the diversity of products or production sites.

Note that emissions are also largely dependent on the pressure in the gas field, which is related to the amount of gas still inside. An old, low pressure gas field needs much more energy to extract a unit of gas volume, than a new, high pressure field.

Complexity of energy flows –High

The energy for most of the processes in this sector can be supplied by multiple energy carriers. However some fields are far offshore and use fuel/heat for compression, as they may not be connected to the power network, see (Ecofys & Entec, 2009).

Data availability at relevant detail level –Medium

Whereas figures for total emissions are known, it is complicated to measure emissions from sub-processes and therefore difficult to allocate emissions to sub-installations and sub-processes.

Benchmark experience in sector – Low

A number of studies have assessed the feasibility of a benchmark for the gas extraction sector, including Solomon[2] and (Ecofys & Entec, 2009) and have concluded that feasibility for developing a good benchmark approach is low. On the other hand, in the Californian ETS a product benchmark for natural gas liquid extraction exists, with a value initially set as 0.0146 allowances/barrel of natural gas liquids produced (California Air Resources Board, 2011).

Tradability of intermediates – Low

There are no intermediates.

Cost impact for companies–Medium

Any reliable benchmark system would require collection of data at the level of sub-processes to allocate emissions to products and by-products etc. This can be cumbersome and given the lack of such a system, difficult to develop.

Which information is needed next?

The spread in emissions per unit of gas produced would be a good indication as of the relevance of having a benchmark for this sector.

3.2 NACE 2399 – Manufacture of other non-metallic mineral products n.e.c.

Sector ETS characteristics

NACE	Sector	Number of installations in sector	Number of installations in sector with fallback benchmark	Number of installations covered by			Preliminary allocations (ktCO2) covered by		
				Product BM	Heat BM	Fuel BM	Product BM	Heat BM	Fuel BM
2399	Manufacture of other non-metallic mineral products n.e.c.	35	34	X	X	X	X	X	X

[2] http://solomononline.com/benchmarking-performance/natural-gas-processing-plants-bm/

The sector "Manufacture of other non-metallic mineral products n.e.c." consists mainly of relatively small asphalt producing installations. Also included is stone wool manufacturing, which is already covered by a product benchmark. Therefore, considerations below are relevant mainly for asphalt.

- X installations are covered by a product benchmark only;
- X installations are fully covered by the fuel benchmark;
- X installations are covered by a combination of fuel and heat benchmark.

Understanding of underlying processes

Asphalt is produced in stationary plants (preparing ingredients) and in a mobile mixing plant. It is possible to produce up to 800 tons per hour. The average production temperature of hot mix asphalt is between 150 and 190°C, which depends however on the mixture produced. The asphalt mixing process consists of heating and drying aggregates which then are mixed with filler and bitumen. The mixed asphalt is then transferred directly to waiting delivery trucks or to silos for short-term (surge) storage or for up to 48 hours long-term storage before loading into trucks for transportation to the paving site.

Homogeneity within sector – High

As stated above, the "Manufacture of other non-metallic mineral products n. e. c." sector consists of asphalt, and of stone wool which already has a product benchmark. Therefore, the sector homogeneity can be considered high.

Homogeneity within product(s) - High

Products manufactured by asphalt plants are largely homogeneous. There are mainly two types of plants producing asphalt: mobile plants located at roadworks locations (mixing) and plants producing asphalt ingredients dispatching to local mobile plants. The production process generally consists of mixing ingredients and heating them in order for liquid bitumen to bind components together. A low range in energy use/tonne related to product types can be expected.

Complexity of energy flows – Medium

Production processes are fossil fuel based (production at temperature between 150 and 180°C). However, storage is sometimes electricity based, and new production processes such as the "warm mix" and "cold mix" with lower temperatures may be more suitable to usage of electricity.

Data availability at relevant detail level – High

In this sector, total consumption per ETS installation and tonnage of manufactured product are the relevant metrics. They are readily available.

Benchmark experience in sector – Low

The sector has little to no experience of benchmarking. In the Californian ETS, a product benchmark for lager beer is under development (California Air Resources Board, 2013).

Tradability of intermediates – Medium

Tradability of intermediates is medium if component preparation is also in the benchmark's scope: asphalt consists of different components that are produced at one location, and shipped to mixing locations. In that case, two or possibly more benchmarks would be needed, unless if there is no trade between different companies (then having only one benchmark for final product would be possible). If the scope of the benchmark is limited to only mixing operations: tradability is then low.

Cost impact for companies - Medium

While data requirement would not be very high, as only annual energy sourcing data and annual volume data are required, emissions per installation are low, so that costs of developing a benchmark would be relatively high if expressed per unit of emissions.

Which information is needed next?

Initially, a simple benchmark curve would give a confirmation/indication of homogeneity of the sector.

3.3 NACE 2014 – Manufacture of other organic basic chemicals

Sector ETS characteristics

NACE	Sector	Number of installations in sector	Number of installations in sector with fallback benchmark	Number of installations covered by			Preliminary allocations (ktCO2) covered by		
				Product BM	Heat BM	Fuel BM	Product BM	Heat BM	Fuel BM
2014	Manufacture of other organic basic chemicals	39	25	X	X	X	X	X	X

The other organic basic chemicals industry (NACE 2014) in the Netherlands is represented by 39 ETS installations with a total of 72 sub-installations.

- X installations are fully covered only by a product benchmark;
- The other X installations are covered by one or more fall-back sub installations:
  - X installations are covered by a combination of a product benchmark and a fall-back benchmark;
  - X installations are covered by a heat benchmark only;
  - X installation is covered by the fuel benchmark only;
  - X installations are covered by a combination of fall-back benchmarks.

X% Of the preliminary allocations to this sector are covered by the product benchmark, X% by the heat benchmark, X% by the fuel benchmark, and X% by the process benchmark (all carbon leakage).

Understanding of underlying processes
The organic basic chemicals sector is a large sector producing a wide variety of products with different production processes. Ecofys describes these products and related production processes in its 2009 EU ETS sector report for the chemical industry (Ecofys, 2009).

Homogeneity within sector - Low
The other organic basic chemistry sector includes a wide range of different chemical products.

Homogeneity within product(s) - High
As stated above, most of the free allocation to this sector is already under the product benchmark. However, the selection of products within this sector was based on the 80/20 principle (20% of products account for 80% of emissions), not on the feasibility of benchmarking the other products. This means that some products that are currently under a fall-back benchmark could be put under the product benchmark.
The chemicals that are produced in this sector are homogeneous. As they are produced as bulk goods, very limited variation in packaging exists.

Potentially interesting products to benchmark are those with the highest shares of emissions beyond the products that are already benchmarked. The products responsible for relatively large amounts of allocation via the fuel and heat benchmark in the Netherlands (for Europe this might be different) have been analysed by means of a quick scan into the methodology reports of the NACE 20.14 ETS installations.
Based on this quick scan, products that could be benchmarked based on their homogeneity are:

- Propylene oxide (four installations: three fully, one partially covered);
- Caprolactam (one installation partially covered);
- Butadiene (two installations partially covered);
- Ethanol/alcohol (three installations partially covered).

Propylene oxide puts three installations fully under the product benchmark. The other identified products cover (large) parts of the majority of the other installations, but heterogeneous downstream processes or secondary products subsist. Two installations produce heterogeneous or special chemical products for which no product benchmark is deemed to be feasible.

Complexity of energy flows – High
The energy for most of the processes in this sector can be supplied by multiple energy carriers.

Data availability at relevant detail level – High
Because of the nature of the chemical industry, most processes are measured in detail. As a result of this, companies within this sector have sufficient data available. The level of detail of this data is expected to be sufficient for the purpose of creating a product benchmark.
As a result of the quantity of available data, reliable proxies can be created. It is however unlikely that such proxies are necessary, because energy consumption is generally measured directly.

Benchmark experience in sector – High
The chemical industry is very experienced with benchmarking. Examples of this are (Ecofys, 2009), (IEA, 2009) and (UNIDO, 2010). Commercial benchmark companies in this sector are for example PTA and Solomon.

Tradability of intermediates – High
As a result of the homogeneity within products, intermediate products can easily be traded in this sector.

Cost impact for companies – Low
Cost impact for creating benchmarks is estimated to be low to medium from company perspective, considering the benchmarking experience and data availability on the one hand, and the complexity of handling intermediates and avoiding benchmark overlaps on the other hand.
The administrative costs for data collection at the start of a new trading phase is estimated to be reduced by several days per company compared to the current practice. For annual monitoring of activity levels, the time savings per company are estimated to be a few days per year.

Which information is needed next?
Benchmark or best-practice values could be collected from literature. Furthermore, the scope of the new product benchmarks could be drafted based on literature and existing product benchmarks (i.e. to avoid overlap). Next step would be to engage in stakeholder consultation with the chemical industry.
In addition, enlarging the scope of current benchmarks should be further investigated as there are:

- X installations with less than 5% of free allocation provided by the heat benchmark next to the applicability of a product benchmark; and
- X installations with less than 5% of free allocation provided by the fuel benchmark next to the applicability of a product benchmark.

3.4 NACE 2332 – Manufacture of bricks, tiles and construction products, in baked clay

Sector ETS characteristics

NACE	Sector	Number of installations in sector	Number of installations in sector with fallback benchmark	Number of installations covered by			Preliminary allocations (ktCO2) covered by		
				Product BM	Heat BM	Fuel BM	Product BM	Heat BM	Fuel BM
2332	Manufacture of bricks, tiles and construction products, in baked clay	40	22	X	X	X	X	X	X

The bricks and tiles sector (NACE 23.32) in the Netherlands consists of 40 ETS installations. The majority (X) is already fully covered by one or more product benchmarks. For the remaining installations (X) allocation characteristics are as follows:

- X installations are covered by a fuel and process emissions benchmark;
- X installations are covered by both a product benchmark and a fuel benchmark and/or process emissions benchmark. Allocation is provided via these benchmarks by X%, X% and X% respectively.

Two installations receive allocation via the fuel benchmark responsible for less than X% of their total allocation.

Understanding of underlying processes

After extraction from quarries, the clay raw material is laid out in order to obtain a homogeneous mixture. The clay is prepared in several stages. It is stockpiled, then crushed to attain the required grain size and finally stockpiled again for several days or even months. The shaped clay product is first dried in order to reduce its moisture content and then loaded into kilns for firing. Drying and firing are the most energy-intensive steps of the production process and it is the step where process emissions may occur.

Homogeneity within sector – Low

The sector covers the production of many different products. Among these, the products with high emissions and large volumes have already been benchmarked. Fall back allocations cover parts of the production processes that are not covered by a product benchmark, as well as products that are not covered by the already existing benchmarks, i.e. specialty products.

Homogeneity within product(s) - High

Within product groups, homogeneity is relatively high with raw material preparation, baking and drying processes very similar for each given product group.

Complexity of energy flows – Low

Ovens used in this sector are fuel based, using to a very large extent natural gas, with biomass playing a marginal role. This process is energy-intensive and requires high temperatures. While energy flows are not complex, exchangeability with electricity is low.

Data availability at relevant detail level –High

Data availability should be relatively good. Emissions are mainly related to the fuel consumption during the drying and firing stages, which are the most energy-intensive steps of the production process. These emissions are well documented.

Benchmark experience in sector – Medium

Experience with benchmarking for the bricks, tiles and construction products in baked clay sector is available due to the development of benchmarks for phase III. Nevertheless, experience remains low especially for the smaller companies and installations.

Tradability of intermediates – Low
Most products are only traded as final products, with the exception of some ceramic spray powders, which is a speciality product.

Cost impact for companies – High
Emissions per installation in the bricks, tiles and construction products in baked clay sector are very low, therefore benchmark costs per unit of emissions are relatively high.

Which information is needed next?
Better information is needed on what is covered by the fall back allocations:

- For non-covered products (in which case additional benchmarks might be an option);
- For left-over processes (in which case the system boundaries of the existing benchmarks could be slightly upgraded).

3.5 NACE 1051 – Operation of dairies and cheese making

Sector ETS characteristics

NACE	Sector	Number of installations in sector	Number of installations in sector with fallback benchmark	Number of installations covered by			Preliminary allocations (ktCO2) covered by		
				Product BM	Heat BM	Fuel BM	Product BM	Heat BM	Fuel BM
1051	Operation of dairies and cheese making	10	10	X	X	X	X	X	X

The dairies sector (NACE 10.51) in the Netherlands consists of ten installations.

- No product benchmarks are applied in this sector currently;
- X installations are fully covered by the heat benchmark;
- X installations are covered by a combination of the heat and fuel benchmark.

Understanding of underlying processes
In order to achieve the desired end-product specifications of dried milk or whey, the water content of the product is to be reduced drastically (~90% water content to 2%). During the process no other components of the milk or whey are to be removed as these make up the value and desired characteristics of the end product. Several stages of water evaporation, or product condensing, make up the drying process.

Homogeneity within sector – Low
In the dairy sector a wide range of milk-based products is produced: milk, yogurt, whey, cheese, milk powder, etc. In terms of production processes, or factories, it appears that some dairies are simple, others are complex (milk-only, spray-drying only, cheese makers only versus full range of dairy products).

Homogeneity within product(s) - Medium

Homogeneity within products can be considered to be medium: once well-defined and dis-aggregated, products can be considered fairly similar although within each product group (e.g. milk) several varieties and differences will exist (e.g. full milk, semi-skimmed milk, skimmed milk, buttermilk). This could be overcome by benchmarking the dominant variety (e.g. semi-skimmed milk) or by neglecting these differences if they are not significant in terms of emissions.

Complexity of energy flows – High

Many operations can be run using heat and power driven technologies. Many cooling and heating operations may be used at different stages of the process. The choice for these different steps is mainly energy-use related; the preferred technology to evaporate water is a function of the remaining water content. For this reason, companies typically apply a combination of technologies in series to come to the lowest-energy requirements.

Data availability at relevant detail level – Low

Many intermediates must be identified taking different routings through the operations to yield different products, and data availability at this disaggregated level is low. Developing a proxy can be done using nameplate efficiencies per unit operations, or using data collection from single-purpose dairies for a specific unit operations, and using these unit-benchmarks for benchmarking. This might even be similar to the CWT (CO_2 weighted tonne) approach like in refineries. Volume throughput per unit operations is well available because of the high importance of traceability in the food sector in general. Actual energy/power use monitoring data are available at installation and plant level, while availability varies for data within plants.

Benchmark experience in sector – Medium

Experience of benchmarks in the dairies and cheese making sector is mainly based on proxies. In the California ETS ten dairy products are considered for product benchmarking (California Air Resources Board, 2011) and several benchmark curves are available (California Air Resources Board, 2014).

Tradability of intermediates - High

Simple dairies cheese makers and powder plants (e.g. Veghel/Beilen) source liquid streams from other facilities. The inflowing liquid string will e.g. be plain milk, having been benchmarked as a separate final product too. Issues may nonetheless arise when allocating for milk powder, since the starting material for that product might be the raw milk, or a densified intermediate incoming from other factory. As a result, benchmarks should be disaggregated.

Cost impact for companies – High

Data intensity for developing new benchmarks is high, regardless of the type of benchmark that is designed. Applying the benchmarks (many benchmarks) will be based on final and intermediate products that are to most extent already monitored. Therefore this should be easier to monitor than the application of the heat and fuel benchmarks today, which will result in a few days savings per year per installation.

Which information is needed next?

The most feasible way forward seems to be the development of proxy unit-benchmarks. To develop this further, information is needed on single-purpose dairies.

3.6 NACE 1712 – Manufacture of paper and paperboard

Sector ETS characteristics

NACE	Sector	Number of installations in sector	Number of installations in sector with fallback benchmark	Number of installations covered by			Preliminary allocations (ktCO2) covered by		
				Product BM	Heat BM	Fuel BM	Product BM	Heat BM	Fuel BM
1712	Manufacture of paper and paperboard	19	9	X	X	X	X	X	X

The manufacture of paper and paperboard sector (NACE 17.12) in the Netherlands consists of nineteen ETS installations. The minority (X) is fully covered by one or more product benchmarks. For the remaining X installations allocation characteristics are as follows:

- X installations are covered by a product benchmark and heat benchmark;
- X installations are covered by a product benchmark and fuel benchmark;
- X installations are covered by a combination of product, heat and fuel benchmarks.

The share of allocation provided by the product, heat and fuel benchmark for these installations is X%, X% and X%. X installations receive allocation via the heat benchmark responsible for less than X% of their total allocation. X installations receive allocation via the fuel benchmark responsible for less than X% of their total allocation.

Understanding of underlying processes

The papermaking process can be divided into three distinct elements:

- Pulping, where the wood or recovered paper is broken down into its component elements so that the fibres can be separated. Its main steps are cleaning and bleaching as well as washing and drying.
- Papermaking, where auxiliary chemicals and additives are added to the pulp before being mixed with water. The wet paper is then squeezed between a series of presses where its water content is lowered to about 50%. It then passes around a series of cast-iron cylinders, heated to temperatures in excess of 100ºC, where drying takes place. Here the water content is lowered to between 5% and 8%, its final level.

Homogeneity within sector – Low

Homogeneity within the paper and paperboard sector is low, as a wide variety of products are being manufactured. Among them, the products with high emissions and large volumes have already been benchmarked. Fall back allocations are left-overs for parts of the production processes not covered by the product benchmarks and for products that are not covered by the already existing benchmarks, i.e. speciality products.

Homogeneity within product(s) - Medium
Within product groups, homogeneity is relatively high with preparation, paper making and drying phases. However, the raw material may differ (pulp or recovered paper), and this can cause complexities for benchmarking.

Complexity of energy flows – Low
Installations of the paper and paperboard sector are fuel based, with low possibility for switching to electricity.

Data availability at relevant detail level – High
Installations are well monitored and processes are well documented.

Benchmark experience in sector – Medium
Experience for benchmarking in the paper and paperboard sector is available, however experience is still low especially for smaller companies.

Tradability of intermediates – High
Trade with pulp as an intermediate product represents the main difficulty for benchmarking in the paper sector. The level of integration and the basic raw material (pulp only, pulp and paper, or paper based on recycled paper) differ widely causing an issue for adequate benchmarking.

Cost impact for companies – High
Emissions per installation in the paper and paperboard sector are very low, therefore benchmark costs per unit of emissions are relatively high.

Which information is needed next?
Better information is needed on what the fall back allocations cover:

- For non-covered products (in which case additional benchmarks might be an option): this is applicable to the majority of the installations in the Netherlands.
- For left-over processes (in which case the system boundaries of the existing benchmarks could be slightly upgraded): this would be relevant to X out of nineteen installations in the Netherlands.

3.7 NACE 1031 – Processing and preserving of potatoes

Sector ETS characteristics

NACE	Sector	Number of installations in sector	Number of installations in sector with fallback benchmark	Number of installations covered by			Preliminary allocations (ktCO2) covered by		
				Product BM	Heat BM	Fuel BM	Product BM	Heat BM	Fuel BM
1031	Processing and preserving of potatoes	9	9	X	X	X	X	X	X

The processed potatoes sector (NACE 10.31) in the Netherlands consists of nine ETS installations. None of these installations are covered by a product benchmark.

- X installations are fully covered by a heat benchmark;
- X installations are covered by a heat and fuel benchmark.

Understanding of underlying processes

Two of the main potato-based products are (1) French fries (chilled & frozen pre-fried fries) and (2) flakes and granulates, whose main production steps are as follows. First, the washing of the potatoes takes place in drum or flotation washers, the peeling is generally done by steam peeling. Then, the manufacturing of both products consists in essence of slicing the raw material to an appropriate size, followed by blanching. The production process subsequently becomes different for French fries and flakes and granulates.

Large potatoes are used for potato fries production. The potatoes are cut using motor-driven knives and then blanched using steam or water of about 60-85ºC. Several blanching stages may be used. At the drying stage conveyor driers are often used in large installations. The fries are then fried at 160-175ºC, before being frozen using fluidised bed or belt freezers.

For flakes and granulates, after the washing, de-stoning and cutting, the product is blanched with potable water after which the sliced/cut potatoes are chilled. Then the product is steam cooked and mashed after which additives are added and the mash is dried. The dried mash is then grinded after which more additives might be added prior to the packaging of the product.

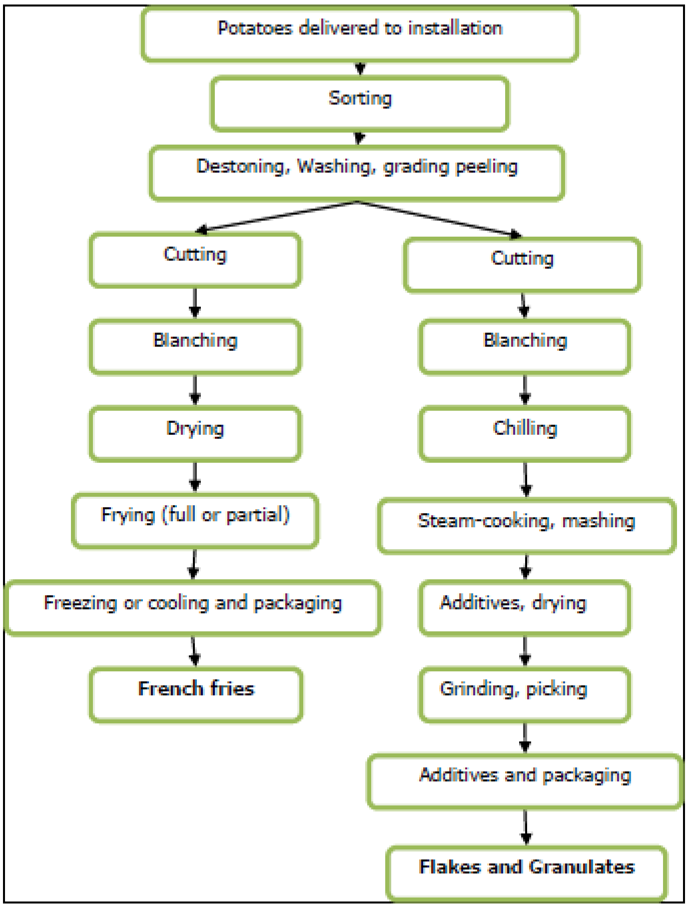


Figure 2: Main production route for French fries and Flakes and Granulates. (Source French fries: EC IPPC Reference Document on Best Available Technologies in the Food, Drink and Milk Industries, 2006)

Homogeneity within sector – Medium

Plants in this sector consist of producers producing French fries or potato flakes and of producers producing crisps. Thus, roughly three product categories can be distinguished. The by-products of these different categories are the same (potato starch), otherwise the main products are distinctive to the separate types of operators.

Homogeneity within product(s) - Medium

The processing of potatoes is an industry producing highly differentiated end-products. Some potato based products have such differentiating market characteristics that they can be viewed as separate industries, for example frozen potatoes vs crisps. Furthermore, potato products can range from frozen potatoes for further use to cut potatoes, fried and seasoned for direct consumption. It is therefore important to set the system boundaries such that the stage where companies differentiate (e.g. cooling on or off-site, production specification at the end of the production line) is excluded from the benchmark definition.

Complexity of energy flows – Medium
Frying technologies are traditionally using vegetable oil that can be heat- or electricity-driven.

Data availability at relevant detail level – Medium
Experience shows that energy and volume data is available at plant level. Most producers produce a single product per plant, which simplifies data collection.
Plants that produce multiple products do not monitor per production line. In these cases, energy allocation based on single product plants is possible. It is also possible to generate single-product facilities for product benchmarking and apply those also at mixed facilities. However the energy synergy effects of mixed facilities is then lost.

Benchmark experience in sector –High
The sector was benchmarked in the Californian cap and trade system (California Air Resources Board, 2014). The sector has experience with collecting energy performance data in Europe, as it was added to the carbon leakage list in 2014, based on a quantitative assessment.

Tradability of intermediates – Medium
By-products like starch may end up as cattle feed, but also as feedstock in a dedicated potato starch plant. However amounts concerned are small compared to overall volume.
Frozen products are stored on site premises, or with 3rd party logistics service providers. Since a major part of energy use is in cooling, this intermediate trade is relevant to consider. Third party warehousing is typically not in ETS scope.

Cost impact for companies – Medium
Volume and energy data at site level can be sufficient to collect without too high efforts.

3.8 NACE 2015 – Manufacture of fertilisers and nitrogen compounds

Sector ETS characteristics

NACE	Sector	Number of installations in sector	Number of installations in sector with fallback benchmark	Number of installations covered by			Preliminary allocations (ktCO2) covered by		
				Product BM	Heat BM	Fuel BM	Product BM	Heat BM	Fuel BM
2015	Manufacture of fertilizers and nitrogen compounds	12	8	X	X	X	X	X	X

The fertilizers sector (NACE 20.15) in the Netherlands consists of twelve installations.

- X installations are fully covered by a product benchmark;
- X installations are covered by a combination of the heat and fuel benchmark;
- X installations are only covered by the heat benchmark.

Understanding of underlying processes
For nitrogen-based fertilizers, the largest product group, the process starts by mixing nitrogen from the air with hydrogen from natural gas at high temperature and pressure to create ammonia. Approximately 60% of the natural gas is used as raw material, with the remainder employed to power the synthesis process.

Homogeneity within sector – Low
A large variety of products are classified in this sector, therefore, homogeneity is low.

Homogeneity within product(s) - High
Production processes are standardised, products are homogeneous. Benchmarks for most important products are sufficient to cover most emissions.

Complexity of energy flows – Low
Electric process routes such as electrolyse are not yet fully proven or not yet economical. Short or mid-term implementation of these is not to be expected. Steam methane reforming will probably remain the dominating way to produce ammonia in decades to come.

Data availability at relevant detail level – High
Monitoring of fuel use and emissions is good, therefore data availability is high.

Benchmark experience in sector – High
Companies have become used to the concept via the ammonia and nitric acid benchmarks.

Tradability of intermediates – High
Intermediate chemical products are typically traded. As a result, product benchmarks need to be developed for individual intermediate products.

Cost impact for companies– Low
This is an energy intensive sector with high emissions per installations. As monitoring is good, the cost impact for companies is low.

Which information is needed next?
Better information is needed on the products that are covered by the fall back allocations. Since these allocations are not combined with product benchmarks, this should relate to non-covered products for which additional benchmarks might be an option.

3.9 NACE 1062 – Manufacture of starches and starch products

Sector ETS characteristics

NACE	Sector	Number of installations in sector	Number of installations in sector with fallback benchmark	Number of installations covered by			Preliminary allocations (ktCO2) covered by		
				Product BM	Heat BM	Fuel BM	Product BM	Heat BM	Fuel BM
1062	Manufacture of starches and starch products	8	8	X	X	X	X	X	X

The starch sector (NACE 10.62) in the Netherlands consists of eight ETS installations. None of these installations is covered by a product benchmark.

- X installations are fully covered by a heat benchmark;
- X installations are covered by a heat and fuel benchmark.

Understanding of underlying processes

Starch products in the Netherlands are manufactured from processed potatoes. After several steps of cleaning, starch slurry is obtained through a separation process. A final refining phase results in modified starches.

Homogeneity within sector – High

Starch products are homogeneous. It should be noted nonetheless that while some plants may produce starch, others also produce derivatives. It should be further studied whether starch in other European countries is produced from wheat and or corn with a different emissions profile.

Homogeneity within product(s) - Medium

Starch is a homogeneous product, but derivatives are not. It is important to set system boundaries so that the product step where companies differentiate (for instance cooling on or off-site, production specification at the end of the production line) is excluded from the benchmark definition. Alternatively, different benchmarks should be developed for some of the derivatives.

Complexity of energy flows – Low/Medium/High

Unknown.

Data availability at relevant detail level – Medium

The sector seems to be dominated by heating processes. Given the size of the individual installations, individual heat consuming processes might not be well monitored.

Benchmark experience in sector – Low

Starch benchmarks exist, but are focused on plants using corn or wheat as feedstock. The benchmark is further subdivided in the following sections: 1) Corn wet milling, 2) Wheat milling (wet process), 3) Starch slurry processing, and 4) Refinery. The starch slurry processing benchmark is further subdivided into a) Starch drying, b) Starch modification, and c) Starch pregelatinization. The refinery benchmark deals with the production of various starch sugars such as glucose/fructose syrups, maltodextrines, dextrose etc.

Tradability of intermediates – High

Benchmarks should be defined at the appropriate level as tradability of intermediates (i.e. starch derivate produces) is high. The scope of the benchmark should be limited to the transformation process from potato to starch. Separate benchmark scopes should cover the processing from starch to derivatives.

Cost impact for companies – Low

Emissions per installation are relatively high, therefore costs should be relatively limited, especially for simple starch producers. Cost might be higher for producers of derivatives products.

Which information is needed next?

More information would be needed on the energy requirements of the production steps (electricity/ fuel exchange), and on the levels of data availability. It should also be further studied whether starch in other European countries is produced from wheat and or corn with a different emissions profile.

3.10 NACE 1041 – Manufacture of oils and fats

Sector ETS characteristics

NACE	Sector	Number of installations in sector	Number of installations in sector with fallback benchmark	Number of installations covered by			Preliminary allocations (ktCO2) covered by		
				Product BM	Heat BM	Fuel BM	Product BM	Heat BM	Fuel BM
1041	Manufacture of oils and fats	7	6	X	X	X	X	X	X

The oils and fats sector (NACE 10.41) in the Netherlands consists of seven ETS installations. None of these installations is covered by a product benchmark.

- X installations are fully covered by a heat benchmark;
- X installations are covered by a heat and fuel benchmark.

Understanding of underlying processes

In general, fat and oil undergo four processing steps:

- Extraction by rendering, mechanical pressing or solvent extraction;
- Neutralization, where impurities are removed by treating fats at 40º to 85ºC with caustic soda (sodium hydroxide) or soda ash (sodium carbonate);
- Bleaching: Heated oil (~85ºC) may be treated with various bleaching agents to remove undesired colour material in the oil;

- Deodorization.

Homogeneity within sector – Low
Homogeneity within the sector is low, as many different types of raw materials are used (vegetal such as sunflower seeds, colza, cotton-seeds, soya, etc. and animal fats and oils), and their state and form at the end of the process vary (crude or refined, oil, oilcake or other fractions).

Homogeneity within product(s) - Low
Products may be of different grades and quality, therefore homogeneity within products is low.

Complexity of energy flows – Low/Medium/High
Unknown.

Data availability at relevant detail level – Low
Installations in this sector are moderately emission intensive. As the homogeneity within the sector as low, it can be expected that detailed energy or emissions data per product may not be available.

Benchmark experience in sector – Low
Protein meal and fat is a product category distinguished in the Californian ETS for product benchmarking (California Air Resources Board, 2014). Ecofys is not aware of any further benchmarking experience in this sector.

Tradability of intermediates – High
Intermediates of different grades, concentrations etc. can be traded.

Cost impact for companies – Medium
Emissions per installations seem to be medium to low, so that costs for benchmarks may be medium to high.

Which information is needed next?
Exchangeability of the fuel and electricity is not known.

3.11 NACE 2016 – Manufacture of plastics in primary forms

Sector ETS characteristics

NACE	Sector	Number of installations in sector	Number of installations in sector with fallback benchmark	Number of installations covered by			Preliminary allocations (ktCO2) covered by		
				Product BM	Heat BM	Fuel BM	Product BM	Heat BM	Fuel BM
2016	Manufacture of plastics in primary forms	8	5	X	X	X	X	X	X

The manufacture of plastics sector (NACE 20.16) in the Netherlands consists of eight ETS installations.

- X installations are covered by a product benchmark (S-PVC/hydrogen) in combination with one or more fall back benchmarks;
- X installations are fully covered by a heat benchmark;
- X installations are covered by a heat and a fuel benchmark;
- X installations are covered by a heat and a process emissions benchmark.

Understanding of underlying processes
The production of plastics shows a large overlap with the organic chemicals sector. Many companies producing these plastics are as company classified as organic chemicals (20.14), not as plastic manufacturers, yet they do make plastics.

Homogeneity within sector – Low
Homogeneity in the plastics in primary forms sector is low, as there are many different products.

Homogeneity within product(s) - High
Homogeneity within products is high, as products are typically produced in a similar way by all companies.

Complexity of energy flows – High
Similar to the organic chemicals sector, the energy for most of the processes in this sector can be supplied by multiple energy carriers.

Data availability at relevant detail level – High
For companies producing plastics in their primary form, energy costs are often relatively high in relation to the value of the products. As a result, these companies normally have good availability of data at a detailed level.

Benchmark experience in sector – High
All large companies producing primary plastics know the concept of benchmarking and for some commodity plastics (like PE and PP) commercial benchmark studies exist.

Tradability of intermediates – Low
Plastics in primary form are produced from standard raw materials via one process step. Intermediates are not traded.

Cost impact for companies – Low
The cost impact for companies is low as the emissions per unit of product are relatively high and the production process is straightforward.

Which information is needed next?

Information is needed to determine the precise overlap of plastics in primary form with organic chemicals, so as to identify which plastics could be subject to new benchmarks. Also the exchangeability of fuel and electricity is not clear yet.

3.12 NACE 2013 – Manufacture of other inorganic basic chemicals

Sector ETS characteristics

NACE	Sector	Number of installations in sector	Number of installations in sector with fallback benchmark	Number of installations covered by			Preliminary allocations (ktCO2) covered by		
				Product BM	Heat BM	Fuel BM	Product BM	Heat BM	Fuel BM
2013	Manufacture of other inorganic basic chemicals	7	5	X	X	X	X	X	X

The inorganic chemicals sector (NACE 20.13) in the Netherlands consists of seven ETS installations. None of these installations is fully covered by a product benchmark.

- X installations are covered by a product benchmark in combination with a heat benchmark;
- X installations are fully covered by a heat benchmark;
- X installations are covered by a heat and fuel benchmark;
- X installations are covered by heat, fuel and process emissions benchmarks.

Understanding of underlying processes

The inorganic basic chemicals sector is a large sector producing a wide variety of products with different production processes. Ecofys describes some of these products and related production processes in its 2009 EU ETS sector report for the chemical industry (Ecofys, 2009).
It is important to note here that some of the products manufactured by this sector are also produced by companies that are classified in other NACE sectors.

Homogeneity within sector – Low

Many different products are classified within this sector, leading to a low homogeneity within the sector. Products covered are for instance metallic halogenates, phosphates, sulphur, etc.

Homogeneity within product(s) - High

Production processes are typically standardised, therefore homogeneity within products is high.

Complexity of energy flows – Low/Medium/High

Unknown.

Data availability at relevant detail level – High
Data availability is usually high in this sector. For some products, energy intensity values from BREF documents may provide a reasonable proxy or starting point for a benchmark value.

Benchmark experience in sector – Medium
Benchmark experience depends on the product. While there is some benchmark experience for some products (hydrogen peroxide and sulphuric acid for instance), it is lacking for other products.
The benchmark for hydrogen peroxide covers the production of hydrogen peroxide via the anthraquinonoid auto-oxidation process. To arrive at a fair comparison of energy consumption, corrections have been introduced to account for any on-site use of crude hydrogen peroxide and to account for differences in product concentrations.

The benchmark for sulphuric acid covers the production of 'virgin' sulphuric acid from elemental sulphur via the S-burning Contact process. Products can either be concentrated sulphuric acid, oleum or SO_3 export gas. The process may produce steam as well as power as an utility export.

Tradability of intermediates – Medium
While production processes can be well defined, trade with intermediates may result for some products in the need to disaggregate the benchmark significantly.

Cost impact for companies – Medium
With relatively high data availability and emissions per installations in the medium range, the cost impact for companies should be in the medium range as well.

Which information is needed next?
More information is needed for the products covered by the fall back benchmarks. For example, silicon carbide is residing in this sector, which would as a product be a good candidate for a benchmark. Yet, further identification of relevant products for benchmarking would be needed.

3.13 NACE 1105 – Manufacture of beer

Sector ETS characteristics

NACE	Sector	Number of installations in sector	Number of installations in sector with fallback benchmark	Number of installations covered by			Preliminary allocations (ktCO2) covered by		
				Product BM	Heat BM	Fuel BM	Product BM	Heat BM	Fuel BM
1105	Manufacture of beer	4	4	X	X	X	X	X	X

The brewery industry (NACE 1105) in the Netherlands is represented by four installations with a total of nine sub installations. All four breweries have X sub installations (fuel and heat BM), some which have an additional sub-installation that is used for malting activities on site, which is a different process and which has a different CL status (the malting sector is in NACE 1106). X% of the preliminary allocations to this sector was covered by the heat benchmark and X% was covered by the fuel benchmark.

Understanding of underlying processes
Brewing and packaging are very typically two separate production steps, with identifiable product and energy flows. They both account for around 50% of energy consumption (European Commission, 2006).

Homogeneity within sector - High
Although different types of beer exist, the bulk of beer production is pilsner. As most of the other beer types are produced in lower quantities in the ETS breweries, the brewing process is considered homogeneous, which makes it possibly feasible to benchmark multiple different beers with a single product benchmark.

Homogeneity within product(s) - Medium
Within the beer product category, there is significant variation in energy consumption as a result of packaging differences. The main packaging categories are: bottled beer, keg beer, canned beer, and cellar beer. As packaging accounts for around 50% of energy consumption (European Commission, 2006), this significantly impacts energy consumption. The question is whether the different packaging configurations form sufficient ground to distinguish different products. The simplest approach from an administrative point of view would be to provide a benchmark based on volumes of packaged beer.

Complexity of energy flows - Medium
Breweries are equipped with a central utility department which may operate combined heat and power (CHP) or partly import heat from third parties. As mentioned above, some breweries have on-site malting installations, but they are outside the scope of a brewery benchmark. Choices in brewing, filtration and packaging equipment cause different fuel/power ratios between breweries.

Data availability at relevant detail level - Medium
Being a food industry, breweries have very well-structured tracking and tracing procedures, as a result of which product flow data is abundant. Breweries will have access to energy (heat and power) monitoring data for at least the brewing and packaging steps separately. Within these steps, data availability will vary. The BREF document for food, drink and milk industries provides energy consumption ranges on the relevant detail level (European Commission, 2006). Machinery in use typically has reliable nameplate energy use. This means that reliable proxies for energy use at relevant detail level can be constructed.

Benchmark experience in sector - High
The beer industry has some experience with benchmarking their energy performance. KWA performed benchmark studies for the global beer manufacturing industry (Worldwide Brewing Alliance, 2011).

Tradability of intermediates - Low
Within the beer industry, intermediates are not commonly traded. Beer may be transported in bulk to third party packaging companies. We consider that this route can be comparable to cellar beer operations in terms of energy intensity.

Cost impact for companies - Low
Cost impact for creating benchmarks based on industry data is estimated to be low from company perspective, considering the benchmarking experience and data availability.
The administrative costs for data collection at the start of a new trading phase is estimated to be reduced by several days per company compared to the current practice. For annual monitoring of activity levels, the time savings per company are estimated to be a few days per year.

Which information is needed next?
The next step would be to define the possible scope of a beer benchmark, in particular related to packaging step. The amount of beer transported in bulk would be an important indicator in this regards.

3.14 NACE 1081 – Manufacture of sugar

Sector ETS characteristics
The sugar sector (NACE 10.81) in the Netherlands consists of X installations covered by a heat and fuel benchmark. Further details cannot be disclosed for confidentiality reasons.

Understanding of underlying processes
Sugar can be produced by beet sugar processing and cane sugar refining. In Europe only the first route is used. First, a pulp is produced from the sugar beet, from which a raw juice is drawn off. The beet pulp is processed separately into pellets for livestock feed and other products. The raw juice is processed into sugar through several filtration and centrifugation steps and a final drying step.

Homogeneity within sector – High
All companies in Europe produce sugar out of sugar beet.

Homogeneity within product(s) - Medium
Although the overall process is the same, there is diversity in terms of by-products use (sell or use on-site to generate electricity) and in terms of some of the raw materials used. Also, some installations may include lime kilns and care should be taken not to get overlap with the lime benchmark.

Complexity of energy flows – Medium
Some installations produce electricity on-site which may lead to complexities when determining a benchmark.

Data availability at relevant detail level – Medium
Given the experience with benchmarking in the past, it can be expected that most of the data should be available. Limitations can be expected for the production of intermediate products (and associated emissions) and the production of on-site electricity.

Benchmark experience in sector – High
The sugar sector has experience with benchmarking, following a study done by Entec[3]. In the Californian ETS a product benchmark for granulated-refined beet sugar is under development, covering all energy flows within beet sugar refineries, including by-products.

Tradability of intermediates – High
Various by-products such as biomass residues can be processed on-site, but can also be sold and site-specific circumstances and preferences. This means either these processes should be excluded from the benchmark or separate benchmarks for some of the remaining process steps should be prepared. This will increase the complexity of the benchmarking exercise.

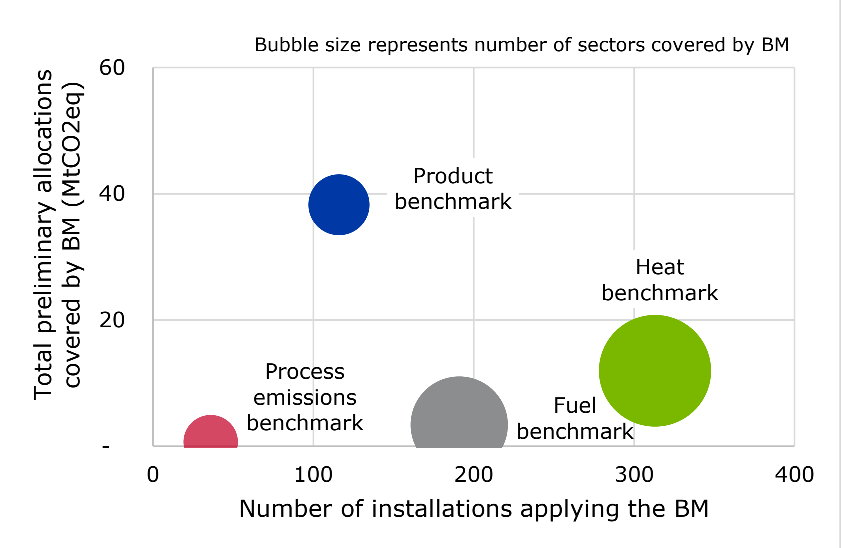
Cost impact for companies – Low
Sugar beet companies are quite emission intensive, meaning benchmark development is relatively cheap per unit of emissions.

Which information is needed next?
A follow-up study could be dedicated to the question how to account for by-products (included or excluded), on-site electricity production, and lime production. Further research would also be needed.

[3] See the reference made in: http://www.eurosugar.org/pdf/etsbench.pdf

4 Conclusion

The majority of free allocation of allowances to Dutch ETS installations is provided by one of the 52 product benchmarks. Yet, the heat and fuel benchmarks are the benchmark approaches most frequently applied by ETS installations in the Netherlands (Conclusion figure 1).



Conclusion figure 1: The heat and fuel benchmark are the dominant benchmark approaches for the majority of installations and sectors in the Netherlands

The increased use of product benchmarks can be implemented by two tracks:

1) Enlarging the scope of currently existing benchmarks.
2) Increasing the number of product benchmarks.

This analysis focused on 14 sectors, in which 183 installations (78%) deal with a fall back benchmark. 6.3 $MtCO_2$ of free allocation (24%) is provided by the heat benchmark and 2.1 $MtCO_2$ of free allocation (8%) by the fuel benchmark.

Overall, using both tracks, we estimate that a maximum of around **73%** (133 out of 183) of Dutch ETS installations in the 14 sectors analysed may no longer have to deal with a fall-back benchmark and can be fully covered by a product benchmark instead. This would mean a significant reduction of the administrative complexity related to the fall-back benchmarks.

In terms of allocation, an estimated **67%** (5.6 $MtCO_2$ out of 8.4 $MtCO_2$) of allocation could potentially shift from the heat or fuel benchmark to the product benchmark. This conclusion is based on a detailed analysis of the feasibility of track 1 and 2 in 14 selected sectors. From this analysis we can conclude that track 2 offers the biggest wins, but needs most effort.

Relatively quick but small wins can be obtained by increasing the scope of existing product benchmarks (track 1). The conclusions on the two tracks are detailed below.

Track 1: In the best case, nineteen installations could move to 100% use of exsting product benchmarks, involving 242 ktCO_2 of allocation
Enlarging the scope of existing product benchmarks has a relatively large potential for three sectors: paper, bricks & tiles, and organic chemical products. In these sectors a total of nineteen installations have the majority of allocation (typically 90% or more) occurring via a product benchmark and just a limited amount (typically 10% or less) via fall-back benchmarks. Typically, these are auxiliary processes just outside the scope of the product benchmark. We estimate the feasibility of bringing these processes within the scope of product benchmarks is relatively high, especially for paper and bricks & tiles.

A small follow-up study would be required to identify how the re-definition of product benchmarks should work in practice. We note that in the three sectors mentioned, numerous different product benchmarks are used, which may imply an adaptation of up to ten product benchmarks. Although this may sound quite cumbersome, in practice it may be the addition of some auxiliary processes. How this would affect product benchmark values is a question that also needs follow-up attention. If successful, the allocation going from fall-back to product benchmark would amount to 242 ktCO_2.

Track 2: At maximum, 114 installations could move to 100% use of product benchmarks, involving 5.4 MtCO_2 of allocation.
Based on specific characteristics of each sector and a sectoral feasibility assessment along seven benchmarking criteria, we identified seven sectors with a high potential for additional product benchmarks, five sectors with a medium, and two sectors with a relatively low potential for new product benchmarks.

From this analysis, we estimate that new benchmarks have the maximum potential to remove fall-back benchmarks for 114 installations, and to shift the allocation of 5.4 MtCO_2 from the fall-back to the product benchmark approach. These are relatively big wins, in terms of reducing administrative complexity. Therefore, it is recommended to start exploring the scopes and data collection needs for new product benchmarks in the 8 high potential sectors identified.

Almost 50 installations would **remain dealing with a fall-back benchmark**, covering 2.7 MtCO_2 of allocation. An open question is whether this amount can be simplified by other means, e.g. by shifting the heat benchmark allocation to the fuel benchmark, or going to a grand-fathering approach. This would be a simple and interesting option, which would deserve further study which is beyond the scope of this report.

Finally, we provide the following **recommendations** for next steps:

- Identify how to re-define product benchmarks in the paper, bricks & tiles, and organic chemical products sectors in practice. In addition, identify how this would affect the product benchmark values. We recommend to closely involve the relevant sector organisations in this effort.

- Start exploring the scopes and data collection needs for new product benchmarks in the eight high potential sectors identified.
- Explore the impact of removing the heat benchmark on the administrative complexity of the EU ETS, and the related impact on cost effectiveness and the incentive to reduce emissions.

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