Standing Committee of the European Glass Industries
Comité Permanent des Industries du Verre Européennes

CPIV Position Paper on the ECOFYS report on CO2 Benchmarking in industry

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1 Executive summary

CPIV, the Standing Committee of the European Glass Industries, has reviewed the ECOFYS study "Developing benchmarking criteria for CO_2 emissions" which was commissioned by DG ENVIRONMENT in the framework of the Emission Trading Scheme (ETS) and published beginning of March on the Commission's website.

In this paper, CPIV expresses its views on the report.

Prior the report's publication, there was little contact with experts from our industry or with independent experts on benchmarking and glass-technology. Two meetings took place between CPIV and the Fraunhofer Institute, but these were generally focused on general principles, and not on precise figures as found in the report. Moreover, no draft version of the report was submitted to CPIV before final publication.
CPIV regrets this and is looking forward to an effective consultation process to complete the report by facilitating the proper exchange of information that is needed to ensure that the study will reflect a fair image of the reality of glass production in Europe and ensures that glass technology issues are properly addressed.

Overall, the conclusions in chapter 10 set out a practical way forward. The authors acknowledge that "It is clear, though, that within the scope of this project, no approach is developed that is fully ready for implementation". However the report then goes on to develop unsatisfactory benchmarks. Despite this, the four general steps put forward in the conclusion are appropriate and should be supported, namely:

1. Comprehensive definition of products for which benchmarks can be applied and their link to sector classification
2. Application of recommended allocation principles to all these products
3. Set-up of stakeholder involvement process
4. Detailed assessment of data requirements and pilots to test data availability

Further work is thus needed to better define the glass sectors, and to correct some wrong assumptions or values in the report.

The effect on allocation, and hence the potential costs to which industry is exposed is considerable, and therefore the benchmarking exercise should not be undertaken lightly.

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2 Presentation of CPIV

CPIV is the umbrella association of several glass federations:

- FEVE, the European Container Glass Federation
- GLASS FOR EUROPE, the European Flat Glass Federation
- APFE, the European Continuous Filament Glass Fibres Association
- ESGA, the European Special Glass Association
- EDG, the European Domestic Glass Association

CPIV represents more than 1.000 companies (this figure includes glass processors who are not covered by the ETS) and ca. 162.000 workers. The size of the glass companies range from small furnaces (SME) to big multinationals present in several countries.

The European glass industry is very diverse and covers a variety of very different types of products and technologies, including bottles & jars, flat glass, continuous filament glass fibres (not to be confused with mineral glass wool), flaconnage, tableware, mineral wool, optical fibres and special glass (cathode ray tube, glass for televisions and monitors, lighting glass, optical glass, laboratory and technical glassware, borosilicate and glass ceramic (cookware), etc). The product ranges that the glass industry can produce are very diverse ranging from tiny jewellery products to huge swathes of architectural flat glass for buildings. The only real common factor among these industries is that they all need a furnace to make their products. The raw materials they need, the size and type of furnace, the amount of energy needed, the type of fuel used, the amount of cullet that can be used, the length of time needed to melt and produce a finished product varies considerably from one sector to another.

In 2007, the total EU 27 glass production reached a volume of 37.5 millions of tonnes, making the EU 27 the largest glass producer in the world. The production value amounted to some € 39 billions.

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3 Background

The revised ETS directive foresees for Phase III two allocation mechanisms:

1. Auctioning for the power sector and for non-exposed sectors (for these latter, a gradual introduction from 20% to 100% is foreseen between 2013 and 2027)
2. Benchmarking as a means to distribution of a proportion of free allowances for exposed sectors (and also non-exposed sectors during the transitional phase)

The Commission has contracted a consultant (Ecofys, in cooperation with Fraunhofer Institute for Systems and Innovation Research, and Öko-Institute) to further develop the knowledge base to be used in setting EU wide benchmarks under the ETS.

The report has been published on the Commission's website beginning of March (http://ec.europa.eu/environment/climat/emission/pdf/benchm_co2emiss.pdf). It aims to derive criteria for an allocation methodology for the EU Emission Trading Scheme based on benchmarking for the period 2013 – 2020. Four pilot sectors have been selected: iron and steel, pulp and paper, lime and **glass**.

There was little contact with experts from our industry or with independent experts on benchmarking and glass-technology. Two meetings took place between CPIV and the Fraunhofer Institute, but these were rather focused on general principles, and not on precise figures as found in the report. Moreover, no draft version of the report was submitted to CPIV before final publication.

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4 Summary of the Ecofys / Fraunhofer report for glass

The table below summarizes the main findings of the Ecofys/Fraunhofer report for the three sub-sectors studied, namely container glass (bottles and jars), flat glass and continuous filament glass fibres.

	Container Glass	**Flat Glass**	**Continuous filament Fibres**
[GJ / tonne molten glass]	3.35 (gas-fired)	5.4 (oil-fired)	8.75 (gas-fired)
Cullet percentage (%)	85%	10%	0%
Correction for cullet percentage (85% for container, 10% for flat, and 0% for fibres) [GJ / molten tonne glass]	3.10	5.24	8.75
Furnace/total site	79%	83%	79%
Whole site [GJ / tonne molten glass]	3.92	6.31	10.94
Based on 5% of electricity [GJ / tonne molten glass]	3.73	6.00	10.40
[T CO_2 / tonne molten glass] from combustion (Natural gas : 56 kg CO2/GJ)	0.209	0.336	0.582
[T CO_2 / tonne molten glass] from Process	0.016	0.088	0.12
[T CO_2 / tonne molten glass] (total)	0.225	0.424	0.702
Yield or packed ratio (%)	90%	70%	70%
[T CO_2 / tonne net glass]	**0.250**	**0.606**	**1.003**

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5 Overarching remarks

5.1 Further consultation with glass experts is needed

Prior the report's publication, there was little contact with experts from our industry or with independent experts on benchmarking and glass-technology. Two meetings took place between CPIV and the Fraunhofer Institute, but these were generally focused on general principles, and not on precise figures as found in the report. Moreover, no draft version of the report was submitted to CPIV before final publication.
CPIV regrets this and is looking forward to an effective consultation process to complete the report by facilitating the proper exchange of information that is needed to ensure that the study will reflect a fair image of the reality of glass production in Europe and ensures that glass technology issues are properly addressed.

We appreciate that the authors recognize that there are confidentiality-issues in the sector and sub-sectors.

But despite this there are a lot of available data and sector knowledge to be drawn upon. Also since the start of the study a lot of data have been gathered by third-party fiduciaries and still are being gathered. The revision of the BREF has made important contributions to the process as well. Finally of course there are some very good independent glass-experts who could be consulted.

5.2 No consideration is given to the average performance of the 10% best performers as stated in the revised directive

The revised ETS directive states in Article 10 (11) 2 "In defining the principles for setting ex-ante benchmarks in individual sectors or sub-sectors, the starting point shall be the average performance of the 10% most efficient installations in a sector or sub-sector in the Community in the years 2007-2008. The Commission shall consult the relevant stakeholders, including the sectors concerned".
The approach by Ecofys does not take this point into account, what is normal as the report was written before the end of the co-decision procedure in December 2008. They start from the best furnace in the BREF and add (sometimes unrealistic) assumptions regarding fuel and cullet usage.

CPIV is of the opinion that, when determining the average performance of the 10% best performers, it must be guaranteed that the database from which this figure is derived is correct, comprehensive and validated. Careful consideration should be paid to outliers and/or abnormal production conditions as mistakes and misconceptions are always possible. Very specific or non-typical installations must be excluded from the 10% most efficient installations in order to draw a representative benchmark.

5.3 Not all the glass industry can be benchmarked

The report recognises that some glass production (essentially special glass) can not be benchmarked because only a few plants in Europe produce these kinds of products and because of the diversity of product types, glass compositions and qualities in these sectors. The possibility for benchmarking is also questionable for tableware. In the BREF, it is mentioned that there are only 19 installations in the production range > 100 tpd (tonnes per day). Most of the smallest installations should be either already below the current ETS limit (20 tpd) or below the future threshold (25kt CO2 yearly). It is also mentioned in the BREF that "the domestic glass sector is very diverse in its products and the processes utilized. Products range from bulk consumer goods to high value leads crystal decanters and goblets and scientific or technical applications. Product forming methods include manual methods (blowing pipes and cutting) and completely automated machines." So a statistical approach requiring a comparison of a large number of apparently similar installations is not easy to apply in processes such as these e.g. tableware /domestic glass, etc…
The possibility for benchmarking is also questionable for flaconnage: the number of companies in Europe is very low (in particular for luxury perfume and cosmetics products) and we can find in these companies a lot of differences (quality requirements, goods, formula of glass, downstream activities…).

A fair solution for plants which can not be benchmarked is therefore needed.

5.4 Forcing operators to switch to natural gas has far-reaching implications

Principle 7 recommends not using fuel-specific benchmarks for individual installations.

In the glass industry, heavy fuel oil and natural gas are widely used and interchangeable. While CPIV fully recognizes the need to curb CO_2 emissions, it is of the opinion that simply promoting gas (by prescribing it as the benchmark fuel) without looking at other important issues is not a reasonable approach. Other factors should also be taken into account:

- Security of supply: forcing all operators to switch to gas makes Europe more dependent upon one energy source, and reduces the security of supply in all Member States.
- The global CO_2 emissions: heavy fuel oil is a residue of the crude oil after gasoline and the distillate fuel oils are extracted through distillation. Its commercial uses are limited, and the glass industry remains one of the few industries which can burn it. Forcing operators to switch to gas will limit the markets for this product, which will then probably be incinerated or shipped outside the EU, with no benefit on the global CO_2 emissions. To reduce overall CO_2 it is necessary also to consider emissions to the environment as whole from the adoption of a particular technology and not in isolation at installation level. This principle is enshrined in the IPPC Directive.
- The energy efficiency: whilst a gas-fired furnace emits less CO2 than an oil-fired furnace, its energy efficiency is lower. Operators are required to consider energy efficiency as part of IPPC.
- The choice for the operator: the choice of the fuel is a strategic decision. Today, operators can switch (for example) from heavy fuel to gas depending on the price of

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these fuels thus helping to maintain competitiveness; one of the key subjects of this debate.

Moreover, it is unfair to penalize operators in countries where natural gas is simply not available. The consequences of causing closure of plant in those countries could be to wreck the recycling infrastructure and increase imports because the collected waste glass cannot be recycled anymore without glass production in these areas.

CPIV therefore strongly recommends that an average fuel mix should be used instead of opting for only natural gas.

5.5 Figures from national EU ETS benchmarks are not correctly quoted in the report.

The authors of the Ecofys report have compared their findings with benchmarks used in different Member States for allocation during Phase II of the Emission Trading. But incorrect figures are presented.

For Germany, for instance, the authors quote a figure for container glass of 0.28 kg CO2/T glass. However, process emissions have not been included, and the correct figure is 0.33 kg CO2/T glass.

For the UK, the factor quoted forms only part of the calculation. The new entrants' benchmarks in the UK for container and flat glass were based on a linear regression of the fossil fuel consumption against packed output. This produced the equation of a straight line in the form of $y = mx + c$. "m" is the variable factor, 0.33 for container, 0.55 for flat, but there is then the "no-load fuel" factor ("c") of 3,967 tonnes for container and 42,096 tonnes for flat. (The latter regression was based on limited data). There is an additional allowance of 0.1106 tonnes CO2/tonne packed for process emissions ("decarbonisation") in the container sector; the flat glass factor includes both fuel and process emissions. Hence the algorithm will yield a considerably greater emissions allowance than would result from merely multiplying the packed tonnes by a single emission factor, as implied in the report. (There was a further issue relating to yield or pack/melt ratio, which need not be considered here).

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6 Specific remarks for the container glass industry

The EU is the largest producer of container glass in the world.
The EU container sector is the largest sector, representing 60% of the total EU glass production. European Container glass is a premium packaging that is the material used for exports of high value added products like food, wines, spirits and perfumes. And it is the number one user and buyer of all Europe's recycled glass.
The Container glass industry produces bottles and jars for food and drinks as well as perfume bottles and cosmetic containers as well as glass for pharmaceuticals and for tableware.
At EU level the container glass industry is represented by FEVE (www.feve.org).

In addition to the overarching comments set out in this paper, FEVE Members would like to add the following sectoral specific comments:

6.1 Three separate benchmarks are needed for the container glass industry

The report does not take into account the diversity of the container glass industry, which is composed of three sectors (bottles & jars, flaconnage and tableware). These sectors are different in terms of production (separate Prodcom codes[1]), energy consumption, their ability to incorporate external cullet (i.e. = recycled glass) and pack to melt ratio. Their energy consumption and CO_2 emissions are therefore fundamentally different, and separate benchmarks should be designed.
Moreover, the split between furnace energy and overall energy used in a production plant (mainly downstream processes) varies also greatly between the sub-sectors (from 80% for bottles and jars to 45% for tableware and flaconnage).

6.2 Oxy-fuel furnaces can not be the reference for the container glass industry

Oxy-fuel furnaces are furnaces where the air for the combustion is replaced by pure oxygen. Although this type of furnace represents only a small fraction of the whole container glass industry (and is generally used for small furnaces), the consultant has chosen to select a large oxy-fuel furnace as the starting point of its energy-efficiency analysis (without mentioning it explicitly in the report).

However, oxygen needs to be produced and this process requires energy. This energy has been neglected by the consultant, which leads to a fundamental methodological error.

[1] This is clearly acknowledged in principle n°5 from the Ecofys report: "Principle 1 leaves the definition of "the same product" open. Criteria that can be used to establish the number products to distinguish include the availability of the relevant production data and the difference in emission intensity between the different products. same product" open.

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In any case, an oxy-fuel furnace is not representative of the European container glass production and CPIV does not recommend it as an initial or significant point of reference. Moreover, TNO benchmark studies show that oxy-fuel furnaces are not the most overall energy efficient solution (1999 and 2003 TNO reports).

6.3 Cullet (recycled glass) should receive special treatment

Cullet is the term for recycled glass. Cullet incorporation in a glass furnace tends to reduce the energy consumption and the CO_2 emissions of a glass furnace. Glass producers are therefore continually trying to maximize the amount of cullet they put in the furnace. However, on page 98, taking the high end (3%) of the quoted energy saving range (2.5 – 3.0% for each 10% of cullet), is considered unjustified in many cases from glass industry's experience, particularly at higher cullet levels.

Still on Page 98, last paragraph: the "cullet share" assumed for container glass is much too high. It may be possible to achieve this level for green glass, but not for brown and particularly clear cullet, which are not as freely available (especially in some countries like the UK). Colour separation at the source is therefore crucial !
The choice of cullet target percentage must reflect reality in each Member State and not an aspirational value, particularly as the industry has in practice no control over the supply of cullet to the market or indeed its ultimate destination.

The possibilities of post-consumer cullet recycling in flaconnage and tableware production are very limited for evident quality reasons. For these sub-sectors only internal cullet is recycled, not post-consumer cullet because this would negatively impact the quality of cosmetic bottles, flaconnage and tableware products.

Moreover, cullet availability is not comparable in all Member States. While France and Germany for instance achieve high recycling rates, other Member States are lower for infrastructure reasons. Finally, there are many logistic issues concerning waste glass recycling that have not been addressed at all.

CPIV is of the opinion that a sound benchmark for the glass industry should take into account:

- the possibility that each glass sector has to effectively recycle cullet (e.g. not to impose an unrealistic 85% cullet incorporation for the whole container glass industry as proposed in the Ecofys report)
- the cullet availability (including the technical requirements needed for re-incorporation) across Europe.

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6.4 Process emissions need to be corrected

Process emissions are emissions coming from the raw materials (carbonates decompose in the furnace and give rise to CO_2 emissions). There is a direct and straightforward relationship between the quantity of normal raw materials put into the furnace and the process CO_2.
The Ecofys report acknowledges the process CO_2, but the values given are not correct (for container glass, 0.016 T CO_2/T glass is too low a figure and needs to be corrected).
Something of the order of 0.11 - 0.12 tonne CO_2/tonne molten glass (based on 40 % average glass recycling in the batch) would be more realistic, and in line with some national new entrants' algorithm.

CPIV proposes to take for container glass (bottles and jars) the value used in the French National Allocation Plan which is cullet dependent:

$$\text{Process } CO_2 \text{ (kg } CO_2\text{/T molten glass)} = (100 - S) \times 1.76;$$

where S is the cullet percentage in the batch

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7 Specific remarks for the flat glass industry

ECOFYS Study considers the following value as benchmark for flat glass production: 0.606 T CO_2 per tonne of **glass packed**. They consider that a **gas fired furnace** is the benchmark and use the CO_2 emission factor for natural gas (56 kg CO_2 / GJ) as the benchmark. A cullet use of 10% is considered together with production yield of 70%.

7.1 Cullet use

Ecofys assumes a cullet share of 10%.
*In the flat glass sector, **20 %** is more a reasonable share of cullet use than 10%*[2].

7.2 Melting energy

Ecofys consider 5.4 GJ/T melted glass as the most efficient energy consumption. The example taken is the FG 1 Cross-fired Regenerative, Oil (<2 %S), 600 tonnes per day, 1^o NO_x (FENIX), 1998 data from the Glass BREF[3].

Ecofys consider 10% of cullet as the benchmark value and considers that 10 % of cullet gives a reduction of energy consumption of 3%. They thus reduce the 5.4 GJ/T by 3% i.e. 5.24 GJ/T. That means that they consider that this furnace was not using any cullet.

The value taken from the example in the BREF on Glass manufacturing (i.e. 5.4 GJ/T) is a very special case and by no means represents a benchmark value. According to the resolution adopted by the parliament on December 17th, 2008[4] *in defining the principles for setting ex-ante benchmarks in individual sectors or sub-sectors, the starting point shall be the average performance of the 10% most efficient installations in a sector or sub-sector in the Community in the years 2007-2008. Currently, the average performance of the 10% most efficient of all gas-fired furnaces based on statistics available to Glass for Europe is **5.98 GJ/T melted glass**. This figure refers to a furnace running with 20% of cullet.*

7.3 Total energy consumption

Ecofys considers that the melting energy represent 83 % of the total energy used in the plant[5]. Then the total energy used is 6.31 GJ/T melted glass.

[2] IPPC BREF Document on Glass Manufacturing, 2001 and Glass for Europe data.
[3] Example FG1 in the IPPC BREF Document on Glass Manufacturing, 2001, p 252.
[4] European Parliament legislative resolution of 17 December 2008 on the proposal for a directive of the European Parliament and of the Council amending Directive 2003/87/EC so as to improve and extend the greenhouse gas emission allowance trading system of the Community (COM(2008)0016 – C6-0043/2008 – 2008/0013(COD))
[5] IPPC Draft Reference Document on Best Available Techniques in the Glass Manufacturing Industry, September 2008.

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Ecofys also consider that 5 % of the total energy use is electricity, leaving 6.00 GJ/T melted glass of fossil energy.

*Following previous comments, the energy benchmark is: 5.98 * 0.95 / 0.83 = **6.84 GJ/T** melted glass, instead of 6.00 GJ/T.*

7.4 CO_2 equivalent

Ecofys considers that a gas fired furnace is the benchmark and use the CO_2 emission factor for natural gas i.e. 56 kg CO_2/GJ. The Ecofys equivalent CO_2 benchmark for energy equals 0.336 tonne CO_2 per tonne melted glass.

*Taking 6.84 GJ/T melted glass the CO_2 equivalent equals **0.383 tonne CO_2 per tonne melted glass**.*

Ecofys indicate that the CO_2 originated from the raw material being 0.088 T CO_2 per T melted glass.

This value is obviously too low. Taking the typical composition of float glass given in the revised IPPC Bref document[6], one calculates a value of 0.209 Tonne of CO_2 per tonne of melted glass:

Glass Component (see footnote 6)	Percentage	Equivalent carbonaceous raw material	Tonne raw material per tonne melted glass	Equivalent CO_2 T/T melted glass
Sodium oxide (Na_2O)	13.6 %	Na_2CO_3	0.2325	0.0965
Calcium oxide (CaO)	8.6 %	$CaCO_3$	0.0518	0.0228
Magnesium oxide (MgO)	4.1 %	$CaMg(CO_3)_2$	0.1875	0.0895
Total			0.4718	**0.2088**

*Taking into account 20 % of cullet, the overall CO_2 emission coming from the raw material is 0.2088 * 0.8 = **0.167 Tonne CO_2 per Tonne melted glass**.*

7.5 Production Yield

Ecofys considers a production yield of 70 % for the calculation of the packed glass compared to melted glass.
The IPPC BREF Document on Glass manufacturing gives a figure of 80 %[7].

[6] IPPC Draft Reference Document on Best Available Techniques in the Glass Manufacturing Industry, September 2008. Table 2.5, page 54.
[7] IPPC BREF Document on Glass Manufacturing, 2001.

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7.6 Final CO_2 Benchmark value

Ecofys calculate a total CO_2 benchmark value of 0.606 Tonne of CO_2 per tonne of packed glass: (0.336 + 0.088)/0.7 = **0.606 Tonne CO_2 per tonne of packed glass.**

With all the above comments the CO_2 benchmark value must be: (0.383 + 0.167) = ***0.55 Tonne CO_2 per tonne of melted glass glass*****.**

Considering 80 % of production yield, the final benchmark value becomes:
0.55 / 0.8 = ***0.688 Tonne CO2 per tonne of packed glass****.*

8 Specific remarks for the continuous filament glass fibres industry

The data in the table for the average of the Fiber Glass Industry are not a correct representation of the actual use of the various forms of energy delivered. 8.75 GJ/tonne glass for melting is an understatement and is incorrect. It is strongly recommended to combine the melter and the forehearths for energy consumption and present the fossil fuel consumption and the electrical energy delivered separately. Benchmarks done for the industry and own internal data point at significantly different, higher electrical energy use vs fossil energy for the product in total, so the assumption of 5 % is totally wrong as well as the total energy used. In the production of fiber glass the larger portion of fossil fuel is used in the melter and forehearth area, for electricity it is in general different. This affects the estimation/calculation of tons CO2 / Ton of glass and the estimation of ton CO2 per ton saleable product. Both the furnace/total site ratio and the line efficiency are therefore not correct. Based on industry data the direct CO2 from fossil fuel and process emissions from furnace and forehearths for molten glass is around 80% of that of the total glass as molten and the correct line efficiency to saleable glass packed is higher. Basing the benchmark on the melter and refiner emissions with correct factors to saleable glass is the right approach.
It is strongly recommended to develop a benchmark through the involvement of known experts in the Industry.

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9 Conclusions

Overall, the conclusions in chapter 10 set out a practical way forward. The authors acknowledge that “It is clear, though, that within the scope of this project, no approach is developed that is fully ready for implementation”. However the report then goes on to develop unsatisfactory benchmarks. Despite this the four general steps put forward in the conclusion are appropriate and should be supported, namely:

1. Comprehensive definition of products for which benchmarks can be applied and their link to sector classification
2. Application of recommended allocation principles to all these products
3. Set-up of stakeholder involvement process
4. Detailed assessment of data requirements and pilots to test data availability

Further work is thus needed to better define the glass sectors, and to correct some wrong assumptions or values in the report.

The effect on allocation and the distribution of allocation, and hence the potential costs to which industry are exposed is considerable, and therefore the benchmarking exercise should not be undertaken lightly.

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