Glass Manufacturing Industry Council

and

U.S. Department of Energy's Industrial Technology Program".

Sustainability Study of US and European Glass Industry
Carbon Constraints and Energy

December 2007

OPENING STATEMENT

Over the period of October 1 - November 30, 2007 a series of questions were submitted to leaders in both the US and the European Glass Industry. The focus of the questionnaire and this paper giving the results of the survey is to offer the Glass Manufacturing Industry Council/GMIC as well as the Industrial Technology Program /ITP in Glass within the USDOE with an understanding of where the glass industry within the US presently stands with respect to issues around sustainability and in particular with respect to carbon constraints and its future implications on the glass industry as well as the anticipated issues in the industry around energy costs and availability. The time frame of the questions was mainly directed at the next 1-3 and/or 5-10 years. Some of the questions asked collectively where the glass industry membership would be willing to work together on issues around sustainability, carbon constraints and energy costs and availability. In addition the questions also attempted to try to get a feeling for how the US glass industry felt about programs within the ITP-Glass area and where areas of common interest between ITP-Glass, GMIC and the Glass Industry might exist for future collective cooperation.

This study is different from other recent work done for ITP-Glass in that it also considers a large body of responses from European Glass Leaders. In a sense this realizes two aspects: First GMIC is now opening its membership to all global glass manufacturers. And second the issues of sustainability within the glass industry that arise from carbon constraints and the costs of energy and its availability are issues that will require global considerations if best solutions are to be found.

In the initial phase surveys were sent to 12 individuals who represented companies in the US who were involved extensively in glass manufacture and in two cases with supplying important items to the glass industry. Of these twelve, seven decided to participate and did so with extensive answers to the questions. Two companies cared enough to respond why they could not cooperate at this time but had an interest in the study. In one case due to organizational changes the person who would have answered the questions was leaving the company. In the second case the company did want to participate but was in an extensive internal study of their position on sustainability, carbon constraints and life cycle analysis of their products and felt since they had not reached a final corporate policy they could not supply answers to the questions until that was completed next year. Unfortunately funding for this project was only provided until the end of 2007. Three companies never replied to the questionnaire in any form despite several follow ups within those companies.

In addition to seven US glass industry leaders there were five European leaders in the global glass industry who volunteered to provide responses to the questionnaire and, although they were based in Europe, in several cases they also represent US companies that their parent companies own or else they supply to the US glass industry. In fairness almost all the US glass manufacturers who replied also own glass making facilities globally.

In an attempt to convey the information from the questionnaires and their responses two tactics have been used:

1. An Executive Summary has been written that follows this Opening Statement. It is believed this will supply the main points of interest to many readers.

2. However to provide more detail the questionnaire has been reproduced after the Executive Summary. After the Introduction each question is given and then an attempt to provide a synopsis of responses under each question has been made as well as an attempt to give a Summary for each question. To provide even more detail under each question the responses from the US Industry participants are first given and then a solid black line is drawn _____ and European responses are given separately.

EXECUTIVE SUMMARY

The survey began with asking for agreement or not on the definition of sustainable manufacturing as

"**the creation of manufactured products that use non-polluting processes; conserve energy and natural resources; and make products which create economic value and are safe within both the workplace and the community where made and are safe to use**".

Most responses agreed with the definition but one or two respondents argued it was too non-specific as non-polluting implies zero emissions and that was possibly idealistic. One respondent agreed in essence with the definition but felt for the glass industry that the definition should include an emphasis on use of recycling materials as the glass industry needs to be moving toward large reuse of its glass products. More use of glass as a recycled material also saves energy and hence also helps reduce carbon emissions. Another respondent also agreed in essence with the definition but felt that it was lacking a positive message and that it could be improved if a stress was put upon positive aspects of glass manufacture. To do this the definition should be made broader and incorporate a total LCA/Life Cycle Analysis for glass products since many of these products can be shown to be positive overall in their carbon footprint if their energy savings are also accounted in an LCA.

POSSIBLE ACTION ITEM FOR GMIC:

Consider having the GMIC Exec Committee adopt a sustainable manufacturing definition that debates non-polluting and also considers a more positive role by the glass industry in both life cycle analysis as well as glass cullet recycling.

With regard to carbon constraints almost all US respondents felt there would be major carbon constraint legislation in 5-10 years and a majority felt it would be seen in 1-3 years. (Warren: what's the difference "most" and "majority"?) Europe is of course already experiencing carbon constraint legislation and Europe fears the problems in glass making will become more challenging with increasing carbon constraints.

It should be noted that there is some division within the glass industry that both GMIC and ITP-Glass must consider in collective action discussions. Many manufacturers see a very positive opportunity for their products (insulation, higher value flat glass products coated to save energy, new lighting products, solar opportunities etc,) but a number of glass manufacturers are fearful

there could be a significant shutdown of manufacturing plants in the US as well as Europe. There was a particular concern among the glass container sector.

The problem of sustainability in the glass industry is also broader than just carbon constraints. Of possible equal concern for many is availability of natural gas and its costs. Water availability was also listed as a concern, especially for those involved in global operations. Emissions including NOX and dust were mentioned. And many felt the biggest issue will be to get a level world-wide playing field so they can have fair competition against imports.

Continuing with more specific comments on energy availability and cost almost every manufacturer sees this as a major issue now and expect the problem to only get worse over the next 5-10 years. Some propose that allowing importation of LNG will help the problem. And many argue that constraints on carbon must be developed that are realistic in terms of available carbon mitigation technology. Some US companies anticipate they will leave the US for off-shore operations.

POSSIBLE ACTION ITEM FOR GMIC:

The GMIC has tried to have its members develop some collective action in this area but to date has had only limited success. One problem is most glass manufacturers have been reluctant to become involved in energy production, such as coal gasification. It is obvious that GMIC must try to monitor this area as well as possible for its members with its given resources. The GMIC Executive Committee might consider what else it would like GMIC to do in what seems a major problem. If members are not interested in getting involved per se in energy production would they consider collective programs in the other direction e.g. in energy conservation such as cullet and/or batch preheating or other ways to save waste heat. If Glass-ITP were to have funds this might be an area for joint industry-government cooperation. Or perhaps GMIC could help identify other funding sources.

This Executive Summary will not go into detail on various voluntary participation programs companies are using on climate change issues or their inclusion of such information in Annual Reports or on website. The answers are quite variable, especially among US companies, but the reader can read these in the details given later if they so wish.

Most of the rest of this Executive Summary will deal with various roles and ideas for collective action among glass manufacturers. Some of these comments have already made their way into earlier comments in this Summary.

Although a few dissensions were made that it would be hard to do collective action due to the competitive situation within the glass industry, most of the respondents felt a need to pursue further collective actions. Foremost or with first priority were energy saving programs. Already mentioned as a possible action item within GMIC, with or without the possible support of ITP-Glass, was pursuit of new programs to look at preheating cullet and/or batch and other waste energy utilization programs. And there was strong mention of the need for collective action to promote the carbon foot print value of glass products.

POSSIBLE ACTION ITEM FOR GMIC:

If there is sufficient interest in collective action around the carbon foot print value of products then a concern could be that the various companies may get competitive around issues like LCA and how products are rated. GMIC might play two roles:

- First, see if the industries would not try to adopt common LCA protocols or try to work with government agencies so that more national standards might be adopted.

- And second act as a repository to help put out "white papers' etc. that show the value of glass products in saving energy and carbon emissions.

There is interest in some collective action to work with regulators and some interest or realization that glass should work jointly with other industries on ideas to help promote reasonable approaches to carbon mitigation as well as other energy saving programs. The ideas on carbon cap and trade approaches seems to merit this sort of preceding joint work with regulators and others beyond just the glass industry. In addition there seems to be some collective interest for a more universal approach within the glass industry to glass recycling.

There is strong support and comments that government must be a driver to help achieve energy and Green House Gas/GHG reductions by offering incentives via tax policy as well as sponsoring projects with high risk but which could achieve energy reduction breakthroughs.

There were also strong expressions that many felt government does not consult or use industry as a partner and that the US government could be doing more through incentives. There were strong critiques that in particular USDOE has shown a disdain for the glass industry by its reduction of funding in the ITP and that US companies have to go to Europe to get best information on waste heat recovery etc. and there is a question on why the US and European governments are not doing more collaboration, at least on available public information each has obtained , so it could be better shared.

There were many ideas advanced on where technology should go to fill existing gaps and these included in no particular order:

1. Advanced state of the art automation, control and data analysis. Could incentives be offered for wider adoption?

2. A major gap is that the oxygen used in oxy-firing, requires or is dependent on natural gas as a raw material.

3. Explore best ways to recover waste heat.

4. Promote information sharing with Europe (This was strongest from US)

5. We will need monies to advance the refining issues with Submerged Combustion Melting as well as with PlasMelt.

6. Fill the gap in full glass cullet recycling.

7. Operator training course.

8. Research is needed to advance cullet and/or batch preheating to large furnaces beyond 20 ton/day.

9. The whole product value chain for glass products needs better explanation and data on energy and carbon foot prints. We need a central bi-partisanship group to develop guidelines and certification to remove subjectivity.

FINAL ACTION ITEM FOR GMIC:

There is a lot of interest in collective action among respondents but the problem as always is sorting through the many potential opportunities in the glass industry and developing a strategic plan or roadmap that covers best business and technical approaches: some of these can/will be done collectively by the membership, but in some cases a consortium that includes only some members might be better used as a route and then there may be some ideas that may be best left to individual members. If feasible the possible helpful role of ITP-Glass or other government bodies should also be identified to assist with some of the opportunities.

Warren Wolf
December 2007

Survey Questionnaire and Responses with Summaries

Introduction:

As a leader in the glass industry you are being asked to answer a set of questions pertaining to sustainability in the Glass Industry. You can answer these questions and give me the answers in several ways: by email, by phone if you would like me to set up a call with you or you may decide to answer them in writing and then post them to my mailing address. My contact information follows the questions. You do not have to answer all questions and you may elect to exclude a few questions for whatever reason. Please realize all your answers will be held in confidence and we will not identify the people who answer or their affiliation.

Sustainable Manufacturing will be defined as "**the creation of manufactured products that uses non-polluting processes and conserves energy and natural resources and are products which create economic value and are safe within both the workplace and the community where made and are safe to use**"

One major item that will affect sustainable manufacturing within the US is the 2005 Energy Policy Act which seeks a voluntary reduction of energy intensity by 2017 of 25% of the energy intensity contributed by industrial facilities. This is a need to reduce energy intensity by 2.5% a year and the glass industry will be involved as it is the 2nd most energy intensive manufacturing sector after aluminum.

The study is sponsored by The Glass Manufacturing Industry Council (GMIC) as well as The US Department of Energy within their Glass/Industrial Technology Program. The purpose is to provide GMIC with a strategic perspective on what collective actions its members and other associated glass companies believe could be undertaken to help the glass industry deal with sustainability issues. The focus is on actions to be started in next 1-3 years and implemented in next 5-10 years. From the perspective of USDOE and its Industrial Technology Program they hope to understand what role the glass industry feels government should play with respect to assistance and understand the range of options the glass industry is considering for innovation in the area of sustainability.

Questions Pertaining to Sustainability in the Glass Industry

1. **As a Glass Manufacturer do you agree with the definition of sustainable manufacturing? Do you see regulations on global climate change and hence carbon constraints as a major issue for your company in next 1-3 years? Next 5-10 years?**

   - Yes. We see establishment of a global carbon market as necessary to address the climate and we see mandatory GHG regulation in 5-10 years in USA. We can't predict the effects on our manufacturing but we see opportunities to provide technology to mitigate CO_2 emissions.

   - No, too vague. What is non-polluting, zero? Nothing is non-polluting. Work on making it more specific. Carbon constraints will be major US issue in 3 years.

   - Yes, but our products conserve more energy than we use. They are net + on GHG.

   - We see carbon constraints as a major opportunity for our products.

   - Yes, but we need to look beyond manufacturing and do a total carbon foot print of a product. We should be looking at the total value chain including use of our products. On that basis some products should be rated as helping sustainability in total. We see carbon constraint legislation as a potential in 1-3 years but definitely in 5.

   - Yes. We believe carbon constraints are in the next 1-3 year horizon. In 5 years we believe establishing your carbon footprint will be mandatory to stay in the marketplace.

   - Yes. We see certainly 5-10 years on carbon constraints with 1-3 years being only by region or state.

   - No, the definition is environmentally commendable but not practical. Non-polluting is close to possible with electric melting but then you neglect the pollution impact of electricity generation. As a supplier our customers are already saying carbon constraints are a major issue and in 5-10 years we see that the effect will be to close many US glass plants due to carbon constraint legislation.

   - I think the definition should be enlarged by adding that production processes use as much recycled material as possible. I also think carbon constraints will be a challenge to US and Global glass industry.

   - Yes. But you must also include positive aspects of products. Also there is no mention of LCA/Life Cycle Analysis. In Europe LCA is becoming more important. Europe is living now with carbon constraints. If you are larger than 20 metric tonnes/day, you must be part of ETS/Emission Trading Scheme. Economic constraints are expected to increase strongly after 2012 for the third period of EU ETS.

- Yes. I take non-polluting to mean with regard to air, water and soil. In Europe in next 1-3 years the situation is becoming more demanding due to fixed emission caps established by EC/European Commission. And in 5-10 years the industry will face a targeted reduction of 30% in absolute CO_2 figures, not production related by 2020.

- Yes. Europe has faced CO_2 emission trading since 2005 and will face $30/ton of CO_2 after 2012. In the period of 2007-2012 this is among our top 3 issues.

- Yes. It is the basis of our company's environmental policy. We see carbon constraints as a major issue now and in foreseeable future.

SUMMARY:

Despite a few no votes (2) most agree with the definition of sustainable manufacturing. The quibbles were over whether non-polluting can be possible. But dissents were that we should not limit sustainability to just manufacturing and must do a value chain of sustainability that includes product use and for several companies this appears to be an opportunity.

Europe is of course now dealing with carbon constraints and most Europeans fear the problem will become harder with increasing carbon constraints. In US almost all respondents folks felt there would be carbon constraint legislation by 5-10 years and a majority felt 1-3 years. (again, what is difference: "Most" vs. "Majority"?) Many saw opportunities as products undergo carbon foot print analysis but some saw a significant shut down of glass plants as also possible.

Although not specifically in the questionnaire LCA seems to be of higher importance in Europe. Within the US, those who see opportunities are interested in product analysis which would also be an output of LCA work.

2. If carbon constraints are not your major concern on sustainability what is the major concern?

- We do not see sustainability as just a carbon issue. The industry must solve a variety of problems that create economic value and do no harm to the environment. These include water treatment, reliable transportation, reliable power transmission, energy efficient lighting and appliances and reliable healthcare solutions. We are in the business of providing sustainable innovations to address needs of society including the need to mitigate global warming.

- The major fuel for the glass industry is natural gas and its availability and pricing are the major concern.

- We see carbon constraints as a major opportunity.

- Our major concern is not sustainability but getting a level international playing field.

- Second and maybe first is the energy cost issue. We are getting hit on two ends higher fuel costs and then higher transportation costs.

- Water is a big concern for our global operations as well as removing lead and arsenic in special operations.
- NO_X is a big problem and longer term it is foreign imports.

- Shareholder value.
- For Europe it is IPPC/Integrated Pollution Policy Control for next 10 years. Dust is highest problem, then NO_X and then SO_X.
- We think carbon constraints can be solved but will glass containers still be able to compete against other packaging - cans, plastic and paper.
- Tighter emissions under IPPC.

SUMMARY:

The concerns are for the most part scattered with concerns about fuel costs and various pollution regulations as well as foreign and other competition among the major concerns.

3. Do you see energy availability and price as a major concern in next 1-3 years? Next 5-10 years?

- Yes, both short and long term. Constraints on carbon must be developed that are in keeping with available carbon mitigation technology or the effect on energy prices will hurt the economy.
- Natural gas availability and pricing is a concern. Much could be alleviated by LNG importation.
- We see higher energy prices and energy availability as opportunities.
- Yes and Yes.
- Yes, it is a major concern today. In last 4 years energy costs doubled for us and we also began to feel the competition of off-shore manufacturers so we could not increase costs. The next 5-10 years are a pivotal point when we will decide if we will stay in US or move all operations off shore.
- Major concern now. Trying to switch off shore operations to NG/natural gas from oil.
- Yes and Yes

- Yes and we do not see solar etc. as applicable to glass making and so we see a real challenge to the Glass Industry.

- Yes, it is a bigger problem than carbon constraints.

- At the moment the increase has been 75% in last 3 years but that is still too low to justify payback on most energy projects within our 24 month target. The energy cost is a problem but not critical yet for us. In 5-10 years we think it will be a bigger problem and we will also consider using more electrical energy.

- In next 5-10 years there may be a problem getting needed fuel. Costs will be high and will raise at least another 10% due to emission trading.

- Energy price is a greater concern than availability and will be even more of a concern longer term.

SUMMARY:

With maybe one exception almost everyone felt energy costs were a big concern and in a few cases could jeopardize continuation of operations in the US.

4. Is your company participating in any voluntary programs on climate change issues? If so can you state what they are?

- Yes-carbon Disclosure Project, Dow Jones Sustainability Index, and membership in The Business Roundtable Climate Resolve Program and participate in US Climate Action Partnership and Combat Climate Change (3C or Vattenfall) Initiative.

- No

- Yes- we publish our voluntary goals on our website and we are part of EPA'S Climate Leaders.

- Yes- we are members of Energy Star and we publish goals to improve energy efficiency and reduce green house gas emissions.

- No but we are reviewing if we should participate in the Lead Program for recycling glass. We are also looking at ways to recycle our post consumer waste. We believe we will be forced to do post consumer recycling but need to overcome technical issues.

- Yes- we will participate in programs that reduce carbon intensity like the California Climate Registry but we will not join programs requiring absolute numbers.

- Not applicable as we are a glass supplier.

- In Europe we facilitate programs to improve energy efficiency.

- Yes-in 1995-2005 we participated in a European voluntary program on CO_2, NO_X, SO_2 and water consumption. Now we are involved in a CO_2 voluntary agreement for 2004-2007. We are also running programs to achieve 1% energy efficiency per year.

- Netherlands has set up a system of energy benchmarking and target is by 2012 to have all processes in world's 10% most efficient. This is still voluntary.

- We have several voluntary agreements with authorities in Europe. We have to commit to reduce energy consumption and undergo energy audits or do bench marking. We also have our own internal programs to reduce energy consumption in all production processes.

SUMMARY:

The glass industry as a whole is not actively engaged in voluntary programs but all seem aware of them and there is activity ranging from a sense of wanting to study the idea to a high level of activity.

5. Is your company requesting information or including carbon emissions in your Annual reports?

- Yes-We use the World Business Council for Sustainable Development and World Resource Institute. This is the most widely used standard for corporate accounting on GHG emissions. We use 2005 as our base year. We count CO_2 from our utility suppliers facilities.

- Not applicable

- Yes- we publish our results in an annual sustainability report available also on the web.

- No

- No

- Yes- we reference and send to a website where we look at total ecology type numbers including carbon.

- Not applicable

- Not applicable
- Yes
- Yes-In Europe we are obliged to make carbon emissions as part of annual environmental report.
- Yes it is required
- Yes it is required

SUMMARY:

Carbon emission reporting is required in EU countries. In USA, major glass makers were split and three are doing the emission reporting and two are not among those who reported.

6. Do you believe that there are collective actions the glass industry can take together to help alleviate the costs of carbon constraints? What would those be?

- Yes - the industry needs to become an early adopter of technology related to automation and control. The industry needs to look for advanced technology that can help it make the leap in melting and processing.
- Yes - joint development of technology to improve energy efficiency.
- Yes - continue work to reduce melting energy. Convert more energy use to lower carbon sources such as moving from coal generated electric power to more gas sources.
- This may be difficult to do collectively. I think that setting a price on carbon generated in the glass industry will lead to the glass industry being very successful in commercializing technology that reduces GHG emissions and improves energy efficiency. But I don't think this will be done collectively due to the competitive nature of our business and the value that invention of technology brings to a business.
- We believe that glass industry sponsored development programs are a way of the future. We will need to partner with universities and pool our $ to assure future existence. We also need to work jointly with regulatory agencies to achieve the time to develop solutions.
- I think we will need to join larger alliances to have any effect because glass is a small voice in the total carbon area.
- Yes, programs to reduce energy but I am not sure of their success.

- Yes-we do a lot of good work together. In Netherlands we have had good experiences on pre competitive areas such as fundamental research and market studies.

- Must have a world-wide cap and trade system implemented or else it will restrict industries in certain areas unfairly. We must discuss well in advance with authorities the tools that will be put in place to limit carbon emissions.

- We need to work within flat glass industry on advantages of our products to reduce energy consumption in buildings.

- We need to promote energy value of our products such as insulation, light weight composites and energy saving flat glass products. We should be doing a joint paper on total carbon foot print of our products.

- We should be working collectively and with our equipment suppliers on energy saving equipment. The whole glass industry should set up a comprehensive recycling system for glass. We should share the costs of first introduction of new technology.

SUMMARY:

With only a few dissensions there seems to be a global interest in furthering collective action. Energy saving programs seem to be a first priority but there is also interest in collective actions on promoting the carbon foot print value of our products. There is an interest in some collective action to work together with regulators and some interest or realization that glass should do this with more than just their own industry. The ideas on carbon cap and trade approaches also seem to merit some collective interest as does a more universal approach within the glass industry to glass recycling.

7. Do you see a role for the US and other governments to assist or provide incentives in dealing with carbon constraints or energy costs? If so can you describe that role?

- We are supportive of the establishment of a global price for CO_2 through a market based mechanism such as a cap and trade program. The US government may have to seek proposals to mitigate sharp increases in energy cost both for energy providers and consumers.

- The government can support the development and commercialization of technology which reduces energy consumption in manufacturing processes.

- Incentives to reduce risk or improve paybacks will drive more energy savings.

- Yes and first there must be a cost of carbon. Second government grants should be made to qualifying projects which hold promise for breakthrough reductions in energy usage and GHG emissions.

- DOE should be more active in funding joint projects to reduce carbon emissions. But they are going backwards having dropped funding for the glass industry in such projects.
- The US government must work world-wide to level the playing field as we now have favored nations where emission control is ignored.
- Reward companies who do put in new equipment to reduce energy through incentives or cost sharing.
- Put an import tax on products imported to cover the cost of carbon emissions due to transport energy.
- The EPA currently has been a problem by punishing companies who try to use new technology.

- Yes we do this in the Netherlands and these incentives don't all have to be financial but can also include technology transfer.
- R&D must be encouraged in a proper way. In buildings we must all adopt legislation that is progressively more restrictive for new and existing buildings. Taxation must be adopted to encourage use of insulation products.
- Give incentives such as tax reduction for industries that have voluntary agreements to reduce energy. Give financial incentives to building owners who install products to reduce energy.
- A good thing on a voluntary basis may fail but be achieved if people must do it. Examples are for governments to stimulate recycling as well as other sustainability projects.

SUMMARY:

There is a large desire to have government be a driver for achieving energy and GHG reductions by offering incentives via tax policy as well as sponsoring projects where risk is high but chances of achieving energy breakthroughs are possible.

8. Are there positives, negatives or gaps in current government programs for glass industry firms who wish to be more sustainable?

- There is a need for an Energy Star program for containers.
- We have no technical leadership in US and our US company goes to Denmark or Germany to learn about heat recovery. Why doesn't US and Europe work together on many of these issues, especially technical information transfer?

- There are no programs targeted for US glass industry.
- I know of no programs promoting sustainability in US glass industry.
- More incentives should be offered to drive the right choices.
- No comment.
- The industry should be defining its sustainability issues and then using the government as a partner. Instead the government passes legislation and tries to tell companies how to achieve solutions.

- No idea for US.
- No idea for US but in Europe it is too much bureaucracy and permit obligations without considering how they later hinder new technology.
- No comment.
- No comment except governments must consider the rate of implementing reductions etc. so as to not affect economic health.
- No Comment

SUMMARY:

A feeling that governments don't consult industry as a partner and that the US government could do more through incentives and that the US governments and European governments should work together at least on exchange of technical information.

9. Do you think technology will lead the way for the glass industry to meet carbon constraints and energy costs? If so can you identify gaps in the current technology that will need more development or research?

- Technology has to lead the way to meet both carbon constraints and energy costs. The bandwidth energy study done for ITP-Glass showed a number of areas to reduce energy but it was also noted the industry sectors are not willing or not able to adopt state of the art technology including state-of-the-art automation, control and data analysis.
- Technology will definitely be required: Alternative energy sources, less energy intensive methods for both forming and melting.
- Yes, there are many opportunities to reduce energy and GHG emissions.
- Yes but not sure what those gaps are that will need more R&D.

- No not with the current Washington political climate. But some gaps are dependence of oxygen used in oxy-fuel on natural gas as a raw material. The availability and cost of natural gas are not sustainable in future.
- Yes we need more info in US on best ways to recover waste heat and to better share info with Europe.
- A gap in operator training courses.

- Both SCM/Submerged Combustion Melting and PlasMelt are promising but will need $ to advance refining approaches.
- Yes-and gaps are more recycling, batch and cullet preheating, applying oxy-fuel to smaller furnaces and use of waste heat.
- No comment.
- Yes but I do not believe in oxy-firing, as oxygen is driven or made by electricity in Europe and this price will go up in future. Oxy-firing is best for small furnaces but not for container or float sectors. Nuclear is unpopular in Europe. A long tem solution is carbon sequestration.
- Look at whole value chain and in particular look at more recycling in glass.

SUMMARY:

A lot of ideas that almost require a special analysis.

10. Are you willing to work collaboratively on early stages of technology addressing carbon constraints, energy costs and other sustainability issues?

- Yes we have a proven record of doing this.
- Yes we worked collaboratively on SCM and would consider coal gasification.
- No because we are not aware of any collaborative group for these problems.
- Depends-what is nature of collaboration and how are info/results shared.
- Yes.
- Not applicable.
- We are willing to work collaboratively on these problems.

- We are willing to share experiences in Netherlands.
- Yes we would exchange with US but in some cases confidential agreements would be needed.
- No comment.
- Yes but $ are often short.
- Yes we can offer in-kind, data and experience but $ are short.

SUMMARY:

Large interest in collaboration but as always on a case by case basis as details are very important.

11. Many products produced by the glass industry have very positive effects on energy conservation as well as reducing carbon emissions when used. Does your company track such values for its products at this time? If not do you think the glass industry should be advancing more of this positive side of glass manufacturing?

- Not applicable
- We are doing this for our facilities but need to consider our products.
- Yes-we are attempting to develop this but we need a central bi-partisanship group to develop guidelines and certification to remove too much subjectivity.
- Yes and Yes.
- Yes.
- Not applicable.
- The industry has numerous groups that do not advance the common cause.

- We are looking in Netherlands at whole chain in a life cycle analysis.
- We should be preparing white papers and creating reliable data bases to support.
- Yes.

- Yes we need to be more proactive.
- Need to look at total value chain.

SUMMARY:

This seems to be an area of relative strong agreement to do more together.

Warren Wolf

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