Carbon Footprint of Glass Manufacturer: How glasses contribute to the mitigation of the climate change

Guy Van Marcke de Lummen & Shuzo Katsumoto
12 December 2018
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2. AGC Carbon Footprint: CO$_2$ avoided by using glass products

3. Remarks on the METI Guidelines
1. Company Overview
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<table>
<thead>
<tr>
<th><strong>Name</strong></th>
<th>AGC Inc.</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Head Office</strong></td>
<td>Tokyo, JAPAN</td>
</tr>
<tr>
<td><strong>Founded</strong></td>
<td>1907 (As the first sheet-glass producer in Japan)</td>
</tr>
<tr>
<td><strong>Consolidated Subsidiaries</strong></td>
<td>210 including 172 companies overseas</td>
</tr>
<tr>
<td><strong>Employees</strong></td>
<td>Approx. 53,200</td>
</tr>
<tr>
<td><strong>Conglomerate</strong></td>
<td>Mitsubishi Group Company</td>
</tr>
</tbody>
</table>
AGC Group (FY2017 Net sales 14.6 billion USD)

Glass (50%)
- Float flat glass
- Figured glass
- Polished wired glass
- Low-E glass
- Decorative glass
- Fabricated glass for architectural use
  (Heat Insulating/shielding glass, Disaster-resistant/Security glass, Fire-resistant glass, etc.)

Automotive Glass
- Tempered glass
- Laminated glass

Electronics (18%)
- LCD glass substrates
- Specialty glass for display applications
- Cover glass for car-mounted displays
- Display related materials
- Glass for solar power system
- Fabricated glass for industrial use

Display

Chemicals (30%)
- Vinyl chloride
- Vinyl chloride monomer
- Caustic soda
- Urethane

Chlor-alkali & urethane

Fluorochemicals
- Fluorinated resins
- Water and oil repellents
- Gases
- Solvents
- Iodine-related products

Fluorochemicals & specialty chemicals

Electronic Materials
- Semiconductor process materials
- Optoelectronics materials
- Lighting glass products
- Laboratory glass, etc.

Life Science
- Pharmaceutical and agrochemical intermediates and active ingredients
  (including biopharmaceuticals)

Ceramics/Other (2%)
- Ceramic products
- Logistics and financial services, etc.
Global Operation

FY2017 Net sales 14.6 billion USD

The Americas
Sales: 1.68 bn USD (12%)
Employees: 4,400
- Flat Glass
- Automotive Glass
- Electronic Materials
- Chemicals

Europe
Sales: 3.37 bn USD (23%)
Employees: 17,400
- Flat Glass
- Automotive Glass
- Chemicals

Japan / Asia
Sales: 10.1 bn USD (69%)
Employees: 31,400
- Flat Glass
- Automotive Glass
- Display Glass
- Electronic Materials
- Chemicals
- Ceramics

※ Sales composition is calculated without inter-segment sales/transfers.
※ Sales by region is before eliminations and cross regional expenses, therefore, the total amount of sales for geographic segments does not agree with the total sales of the AGC Group.
AGC, an everyday essential part of our world

AGC Products Found in Everyday Living

In a wide range of places and situations, the AGC Group’s diverse products support a safe, pleasant and sustainable society.

Business segments:
- Glass
- Electronics
- Chemical
- Functionals/Other

Construction and Social Infrastructure
AGC provides architectural materials that contribute to the creation of safe architectural spaces and functional materials that improve social infrastructure.

Transportation
AGC’s automotive glass products ensure clear visibility and comfort for drivers and passengers.

Life Science
AGC provides pharmaceutical and medical products with high-performance materials for a variety of medical facilities.

Displays and Optical Equipment
AGC products are used in a variety of applications, from smartphones to medical devices.

Consumer Products
AGC’s consumer products contribute to daily life in various fields, offering innovation and convenience.

Industrial Materials
AGC provides industrial materials and solutions, enabling advancements in various industries.

Your Dreams, Our Challenge
2. AGC Carbon Footprint

$\text{CO}_2$ avoided by using glass products
Carbon Footprint

- **Carbon footprint** is "the total set of greenhouse gas (GHG) emissions caused by an organization, event, product or person." Greenhouse gases can be emitted through transport, land clearance, and the production and consumption of food, fuels, manufactured goods, materials, wood, roads, buildings, and services. (Wikipedia)

- Organisational
  - Emissions from all the activities across the organisation, including buildings’ energy use, industrial processes and company vehicles.

- Product
  - Emissions over the whole life of a product or service, from the extraction of raw materials and manufacturing right through to its use and final reuse, recycling or disposal.

- AGC Concept: take into account **CO₂ avoided** due to the use of products.

  How far does the CO₂ avoided offset the emissions?
Carbon Footprint Methodology: CO₂ Emissions

- Compare CO₂ emitted by all AGC Glass Europe activities to CO₂ avoided thanks to some products during their lifetime
- Carbon footprint
  - Include all sources of CO₂ from natural resources extraction to end of life stage of the products
  - Based on material & energy flow analysis
  - Supported by Life Cycle Analyses of products, materials, and energy
  - Broad perimeter
Perimeter: AGC Glass Europe

• Production of flat glass
• Glass melting furnaces (17 production lines)
• Processing glass for the construction, automotive and industry
  • Coatings for **thermal insulation** and **solar control**
  • High efficiency **Double Glazing** & **Triple glazing**
  • Safety products (laminated, tempered, fire resistant, etc)
  • **Solar applications** (photovoltaic panels, thermal mirrors, etc)
• Glass for energy efficient lighting (O)LEDs
• Industrial products
• Automotive & transport
• Interior
Perimeter: Industrial & distribution network

- Over 100 sites from Spain to Russia
- 1 car out of 4 glazed by AGC
- Nearly 1 building out of 4 with AGC coated glass
- 16,500 people
- €2.4 bn sales (2017)
Material & Energy Flow Analysis
Carbon footprint

**CO2 emissions**

- **GHG Protocol methodology** developed by World Resources Institute (WRI) and World Business Council on Sustainable Development (WBCSD)
- Calculation of all CO₂ emissions of **Scope 1, 2 and 3**.
Carbon footprint

**CO2 emissions**

- Include **all sources** of CO₂ from natural resources extraction to end of life stage of the products
- Based on **material & energy** flow analysis
- Supported by **LCA of products, materials, energy**
- Includes scopes 1, 2 & 3.

<table>
<thead>
<tr>
<th>Emissions</th>
<th>Tonnes CO₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scope 1 Energy and raw material</td>
<td>1 850 000</td>
</tr>
<tr>
<td>Scope 2 Indirect emissions from electricity and steam</td>
<td>360 000</td>
</tr>
<tr>
<td>Scope 3 Energy extraction and supply Raw material production Packaging material Raw material Transport Employees commuting Business travel Waste treatment (transport incl.) Product transport AGC products end of life (Transport incl.)</td>
<td>1 570 000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>3 780 000</strong></td>
</tr>
</tbody>
</table>
Calculation of avoided CO₂

Methodology

- **Methodologies**
  - GHG Protocol for Project Accounting
  - **Guidelines** from the chemical industry for accounting for and reporting greenhouse gas (GHG) emissions avoided along the value chain
  - **ISO 14064-2** Greenhouse gases -- Part 2: Specification with guidance at the project level for quantification, monitoring and reporting of greenhouse gas emission reductions or removal enhancements
  - **METI (2018)** Guidelines for Quantifying GHG emission reductions of goods or services through Global Value Chain
Calculation of avoided CO₂

Methodology

• Definition of the « project activity »

• Perimeter
  - Upstream and downstream effects
  - Direct effects
  - Indirect effects
    - Positive
    - Negative

• Duration
  - Reference Service Life (RSL) of the project.

• Stock or flow
  - Realised lifetime avoided emissions by the products sold during the reference year (flow)
Calculation of avoided CO₂

**Methodology**

- Identify possible “Baseline”
  - Types
    - Static
    - Dynamic
  - Choice of the baseline technology
    - Usual technique
    - Market situation
    - Common practice
    - Best available techniques

- Choose the most **relevant** baseline

- Calculation of the emissions of the **Baseline**
  - **Performance standard**:  
    - GHG/unit of product or service  
    - GHG/unit of time
Calculation of avoided CO$_2$

**Methodology**

- **Quantify GHG reduction**
  - Monitoring
  - Calculation

- **Performance standard**
  - GHG/unit of product or service
  - GHG/unit of time

- **Avoided CO$_2$ = Baseline emissions – Project Activity emissions**
Calculation of avoided CO₂

Methodology

- The **avoided emissions** should be allocated to **value chain**
- Contribution to the value chain by **each actor** must be determined
- Attributing avoided GHG emissions to individual value chain stakeholders can be based on
  - **Production cost** of the project/object (Economic allocation)
  - **Physical-chemical properties** (e.g. mass)
  - **Specific properties** of the product
Many glass products have a **positive impact** on the CO₂ emission during their use because they contribute to energy saving.

- **Insulating & solar control** glass units
- **Solar applications**
  - Photovoltaic panels
  - Mirrors
  - Greenhouses
- **Automotive**
- **Chilled display cabinets/Freezers**
Calculation of CO₂ avoided by IGU

Example

- A window 1 m²; with a U-value of 5.8 W/m².K will conduct 5.8 W of energy per m² for every degree (K) difference in temperature from one side to the other.

- So, if say 20 ºC inside and -1ºC outside (winter), this is a 21ºC difference. This window will have conductivity rate of 5.8 (U-value of window) x the 1 m² area of window x 21 (difference in temperature):
  
  \[ = (5.8 \times 1) \times 21 = 121.8 \text{ W of potential energy loss} \]

<table>
<thead>
<tr>
<th>Replacement of</th>
<th>Heat loss Reduction by</th>
</tr>
</thead>
<tbody>
<tr>
<td>U-value</td>
<td>DG</td>
</tr>
<tr>
<td>Single Glazing</td>
<td>5.8</td>
</tr>
<tr>
<td>Double Glazing</td>
<td>2.7</td>
</tr>
<tr>
<td>Low-e DG</td>
<td>1.1</td>
</tr>
<tr>
<td>Triple Glazing</td>
<td>0.6</td>
</tr>
</tbody>
</table>
Calculation of CO₂ avoided by IGU

EnergyPlus software

• **Whole building** energy simulation software
  • Dynamic simulation with adjustable time step (up to 1 min)
  • Based on external temperature, solar irradiance and wind
  • Accounts for external and internal loads
  • HVAC settings

• Developed by the **US Department of energy** since 1997
  • **Freely available**
  • Open source

• Software recognized by major **green building schemes**
Calculation of CO₂ avoided by IGU

EnergyPlus software

- **Climate data**
  - Data available for 2100 locations around the world
  - Data provided by World Meteorological Organization

<table>
<thead>
<tr>
<th>Climate zones</th>
<th>Locations</th>
</tr>
</thead>
<tbody>
<tr>
<td>CENTRAL MARITIME</td>
<td>Belgium, Denmark, Ireland, Luxembourg, Netherlands, UK, France</td>
</tr>
<tr>
<td>SOUTH CENTRAL</td>
<td>Romania, Bulgaria</td>
</tr>
<tr>
<td>NORTH</td>
<td>Finland, Sweden</td>
</tr>
<tr>
<td>EAST</td>
<td>Russia, Poland, Belarus, Ukraine</td>
</tr>
<tr>
<td>CENTRAL</td>
<td>Czech Rep., Hungary, Slovakia, Slovenia</td>
</tr>
<tr>
<td>SOUTH</td>
<td>Cyprus, Greece, Italy, Malta, Portugal, Spain, Turkey</td>
</tr>
<tr>
<td>CENTRAL CONTINENTAL</td>
<td>Austria, Germany</td>
</tr>
</tbody>
</table>
Building Residential

- **Standard dwelling:**
  - 22 m² glazing
  - Inside Temperature:
    - Heating: 20°C
    - Cooling: No
  - 4 main different types of glazing: Simple, Standard DGU (U-value 2.7), low-e DGU (U-value: 1.1), Triple Glazing (TGU – U value 0.6)
- Reference Service Life: 30 years
- **Baseline:**
  - Renovation (30-75%¹): 80% Simple Glazing - 20% Double standard DG
  - New (25-70%¹): standard double glazing
- **Attribution of avoided CO₂**
  - IGU made by AGC: 100% of avoided CO₂
  - IGU made by processing customer: % of avoided CO₂ based on production cost (share of low-e in total DG cost) and to the coating (60%)

¹. Depending on the region
Building

Calculation of heating/cooling requirement depending on climate data

Comparison with baseline: replacement SGU / DGU

Sales (m²) per climate zone
Losses due to transport & installation
Processing yield of IGU plants

Renovation / New buildings
kWh/m².y saved per zone
Data on domestic heating per country/zone (t CO₂ / kWh)
AGC share

Avoided CO₂ tonnes

Reference Service Life
**Solar**

AGC CO₂ gain = **economic allocation or based on physical properties**

<table>
<thead>
<tr>
<th></th>
<th>PV Panel covers</th>
<th>CSP Solar Tower</th>
<th>CSP Trough</th>
<th>Greenhouses</th>
</tr>
</thead>
<tbody>
<tr>
<td>Associated products</td>
<td>Extra-clear glass</td>
<td>Solar mirrors</td>
<td>Extra-clear glass</td>
<td>Low-e glass</td>
</tr>
<tr>
<td>CO₂ avoided allocation</td>
<td>2.0%</td>
<td>2.2%</td>
<td>1.05%</td>
<td>100%</td>
</tr>
<tr>
<td>RSL</td>
<td>30 years</td>
<td>25 years</td>
<td>25 years</td>
<td>20 years</td>
</tr>
<tr>
<td>Efficiency</td>
<td>80%</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Breakage</td>
<td></td>
<td>0.5%/year</td>
<td>0.5%/year</td>
<td></td>
</tr>
</tbody>
</table>

**Baseline:**
- PV & CSP: conventional electricity production (country level)
- Greenhouse: heat from natural gas without low-e glass
CO₂ emitted vs CO₂ avoided

- **CO₂ avoided** thanks to the use of AGC products during their life time: 30 760 000 tonnes CO₂
- **CO₂ emitted** by all AGEU activities: 3 780 000 tonnes CO₂
3. Remarks on the METI Guidelines
The METI Guidelines

• Released in **March 2018**

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     5.2 Setting what to quantify
     5.3 Setting baseline scenario
     5.4 Scope and contents of quantification
     5.5 Methodology for calculation
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     5.8 Defining the data quality and underlying assumption
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  7. Reporting
  References

AGC’s Remarks on the Guidelines

- **Welcome** the Guidelines providing a basic framework for calculation that can apply to various industries
- **Appreciate** the attention being paid to intermediate products in the Guidelines
- **Could confirm** that our calculation is in alignment with the Guidelines
- **Would be happy** if our calculation is considered as an actual example embodying the Guidelines
To Conclude

As a manufacturer, AGC will keep contributing to the mitigation of the climate change by developing various glasses with low carbon footprint such as:

- Conventional insulating glass
- Newly developed vacuum insulated glass

The vacuum insulated glass offers an insulating performance comparable to that of a triple glazing while being 5 times thinner.
Thank you very much.

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