



AGC Obekon

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Environmental Product Declaration

In accordance with ISO 14025 and EN 15804 for :

High Performance Architectural Coated Glass



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1.0 DOCUMENT INFORMATION

Program	The International EPD® System EPD International AB Box 210 60 SE-100 31 Stockholm Sweden www.environdec.com info@environdec.com
Product Category Rules (PCR)	PCR 2012:01 Construction Products and Construction Services, Version 2.33, 2020-09-18
Product Group Classification	UN CPC 37113
PCR Review Conducted by	Martin Erlandsson, IVL Swedish Environmental Research Institute, martin.erlandsson@ivl.se
Independent third-party verification of the declaration and data, according to ISO 14025:2006	<input type="checkbox"/> EPD Process Certification <input checked="" type="checkbox"/> EPD Verification
Third party verifier	Professor Vladimír Kocí Approved by: The International EPD® System
Procedure for follow-up of data during EPD validity involves third party verifier	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Geographical Scope	The information collected comes from the Kingdom of Saudi Arabia factory producing Coated Glass.



2.0 INTRODUCTION

This report contains the environmental performance of the coating process of High Performance Architectural Coated Glass by Al Obeikan AGC for Glass LLC. This Environmental Product Declaration (EPD) has been developed using the Life Cycle Assessment (LCA) methodology. The environmental impact values calculated are expressed to 1 m² of glass coating.

The assessed life cycle includes all phases in the coating process of High-performance Architectural Coated Glass in a “Cradle to Gate with options” scope. This LCA covers from the supply of Clear Raw and Tinted Raw Glass, extraction & production of materials like Silver, Silicon Aluminum, Tungsten Nickel Chrome, Carbon etc. and all other coating processes up to the distribution of final product to the customer.

This EPD has been conducted according to the program operator regulations and it has been verified and registered in The International EPD System. The EPD regulation is a system for the international use of Type III Environmental Declarations, according to ISO 14025:2010. Not only the system, but also its applications, is described in the Programmer’s Product Category Rules (PCR). This report has been made following the specifications given in the European standard EN 15804:2012+A2:2019.

The direct and indirect emissions and the corresponding environmental impacts calculated in the life cycle assessments and reported in this EPD include, amongst other, the calculation of the environmental impacts to air, land and water, according to the selected Product Category Rules.



3.0 GENERAL INFORMATION



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In 2016 AGC Glass Europe and Obeikan Glass Company formed a strategic partnership serving increasing demand of high-performance coated glass for construction sector in Middle East and Africa market. Conglomerate join forces bring out outstanding products of solar control, high performance and spectrally selective glass.

The state-of-art coater with 72 sputtering positions is designed, built and operated by AGC INTERPANE (Germany) - worldwide market leader in coating industry with numerous references and vast international experience. AGC Obeikan Glass coating facility is located in Yanbu Royal Commission industrial area at the west coast of kingdom of Saudi Arabia.

The alliance between AGC and Obeikan represents a unique opportunity to develop local production and commercial presence aimed at offering high-performance glass solutions to the most recent norms and building trends.

The coater in use has been designed and manufactured according to the AGC most advanced design and technology. Moreover, it is fully benefiting from AGC expertise in term of product development, respect of norms and standards and operational excellence.

The Belgium-based AGC Technovnovation Center monitors the quality of all coated glass manufactured on the Yanbu coater to ensure that they meet European and international standards. Based in Louvain-la-Neuve (Belgium), AGC Glass Europe develops processes and distributes flat glass for the construction (external glazing and interior decorative glass), the

automotive (original and replacement glass) and the solar sectors. It is the European branch of AGC, the world's largest producer of flat glass.

The AGC Obeikan Glass range of high-performance coated glass products for comfort and energy control deliver concrete solutions that offer you the right combination of solar and thermal performance. Aesthetically, products can meet any requirement: transparent or colored glass, neutral or reflective, toughened, laminated or silkscreen printed.

The standard dimensions of the glass panes are: basic dimensions PLF and DLF; PLF length of 450–600cm, DLF length of 180–366cm, and width of the two basic dimensions from 280–330cm.

Located in the Yanbu Royal Commission industrial area on the west coast of the Kingdom of Saudi Arabia, AGC Obeikan Glass provides customers across the Middle East and North Africa faster access to advanced products and services, utilizing superior industrial infrastructure and expedient access to well-connected seaports and land transport.

AGC Obeikan magnetron coated glass range

SOLAR CONTROL	LOW EMISSIVITY	SOLAR CONTROL & LOW EMISSIVITY (Ag1)	SOLAR CONTROL & LOW EMISSIVITY (Ag2)
<ul style="list-style-type: none"> Sunlux Shadow 14 Sunlux Shadow 20 Sunlux Shadow 32 Sunlux Gold (NEW) Sunlux Chroma Blue, Bronze, Green Sunlux DarkChroma Dark Blue, Dark Green, Dark Grey <p><i>On clear substrate</i></p>	<ul style="list-style-type: none"> Iplus Solid Iplus AS Energy Light <p><i>On clear substrate (optionally on Iplus)</i></p>	<ul style="list-style-type: none"> Stopray Smart 18 Stopray Smart 30 Stopray Smart 51 <p><i>On clear & tinted substrate</i></p>	<ul style="list-style-type: none"> Stopray Ace-30T Blue, Bronze, Grey Stopray Vision-40T Stopray Vision-51T Stopray Vision-62T (TBD) Stopray Vision-72T Stopray Titanium-34T <p><i>On clear substrate (exception – Titanium-34T)</i></p>



3.1 Analyzed Product

The assessed system in this Environmental Product Declaration (EPD) comprises the full life cycle of High-performance Architectural Coated Glass by Al Obeikan AGC for Glass LLC in its factory in Kingdom of Saudi Arabia. The assessment has been done using the production data from January – December 2020.

SI No	Product Name
1	Sunlux BlueChroma
2	Sunlux BronzeChroma
3	Sunlux GreenChroma
4	Sunlux Dark BlueChroma
5	Sunlux Dark GreyChroma
6	Sunlux Dark GreenChroma
7	Sunlux Orion
8	Sunlux Orion on Bronze
9	Sunlux Orion on Green
10	Sunlux Orion on Grey
11	Sunlux Shadow 14
12	Sunlux Shadow 20
13	Sunlux Shadow 32
14	iPlus Solid on Clear
15	iPlus Solid on Green
16	iPlus Solid on Bronze
17	iPlus Solid on Grey
18	Energy Light
19	iPlus AS
20	Stopray Smart 18
21	Stopray Smart 30
22	Stopray Smart 30 on Bronze
23	Stopray Smart 30 on Green
24	Stopray Smart 30 on Grey
25	Stopray Smart 51
26	Stopray Smart 51 on Bronze
27	Stopray Smart 51 on Green
28	Stopray Smart 51 on Grey
29	Stopray BlueAce-30T
30	Stopray BronzeAce-30T
31	Stopray GreyAce-30T

32	Stopray Vision-36T
33	Stopray Vision-40T
34	Stopray Vision-51T
35	Stopray Vision-72T
36	Stopray Titanium-34T

Products are either cut to customer requirements or supplied in standard sizes for further processing by customer. Standard dimensions of the coated glass include;

Thickness 3mm to 12mm and Sizes of glass: range between 3210mm x 6700mm

Between this ranges, AGC supply as per customer requirement.

50 to 60% - standard size - 3210mm x 2250mm

25 to 30% - JUMBO size - 5100mm x 3210mm

Balance 10 to 15% - only special size according to customer request.

3.2 Product Applications and/or Characteristics

Optical & Energetical (Opto-Energetic) properties of AGC-OBEIKAN products.

Configuration		EN 410			AMERICAN STANDARD					EN 410		
		Tv D ₂ °	g, EN-410	SC	U _{winter}	U _{summer}	SC	SHGC	RHG	LR _{out} D ₂ °	LR _{in} D ₂ °	U
Non Ag coating, Anti Solar (Low LT, Low ShC)												
Sunlux Chroma Bronze	on clear	16	23	0,26	2,43	2,55	0,30	0,26	207	15	13	2,5
Sunlux Chroma Blue	on clear	21	25	0,29	2,40	2,52	0,32	0,28	224	21	32	2,5
Sunlux Chroma Green	on clear	22	28	0,32	2,47	2,59	0,37	0,32	250	25	17	2,6
Non Ag coating, Anti Solar (Low LT, Low ShC)												
Sunlux Orion Clear	on clear	36	37	0,43	2,57	2,70	0,46	0,40	310	27	14	2,7
Sunlux Orion Green	on green	30	25	0,29	2,57	2,70	0,33	0,28	227	20	14	2,7
Sunlux Orion Bronze	on bronze	20	27	0,31	2,57	2,70	0,36	0,31	248	11	14	2,7
Low E, 1x Ag coating, High LT, High ShC, often combined with a Sunlux product.												
Iplus Solid pos.3	on clear	70	66	0,76	1,80	1,80	0,73	0,64	476	10,7	11	1,8
Solar Control, 1x Ag coating, Moderate – Low LT, Low ShC, more selective than Sunlux. LowE effect.												
Stopray Smart 51	on clear (Obeikan)	51	35	0,4	1.667	1.616	0.376	0.327	250	26	17	1.6
Stopray Smart 51	on bronze (MST)	29	23	0,26	1.667	1.616	0.270	0.235	183	11	16	1.6
Stopray Smart 51	on green (MST)	42	25	0,29	1.667	1.616	0.282	0.245	190	19	17	1.6

↑ LT ↑ SF ↑ ShC Thermal isol. ↑ ShC ↑ ShC Energy «Rg»«Rc» Thermal Isolation
 Balance

The Coated Glass conforming to EN 410, EN 673 and American Standards (NFRC 100, NFRC 200 & NFRC 300) Performance requirements. All detail performance can be found on

<https://agc-obeikanglass.com.sa/products>

3.3 Declared Unit

The Declared Unit of the Life Cycle Assessments is 1 m² of glass coating at the gate of the customer.

All direct and indirect environmental impacts, as well as the use of resources, are reported referred to this unit. This EPD presents separately the environmental impacts associated to the LCA of all the High Performance Architectural Coated Glass analyzed in this EPD.

3.4 System Boundaries

This EPD covers all product stages from “Cradle to Gate with options”, this means that process in the life cycle from raw materials extraction, production and transport to final customers are included. Use and final disposal is not included in this LCA.

Al Obeikan AGC for Glass LLC buys the raw materials Clear Raw Glass, Tinted Raw Glass, Silver, Carbon etc. from external suppliers. From this point, Al Obeikan AGC for Glass LLC controls all the coating process: Glass loading, Delonization of Water, Washing, Drying, Coating, Grafix power spray for interleaving, Stacking and Packing.

The procedures that are not controlled by the company, but are included in this environmental study, are:

- The extraction and production of fuels.
- The production of electricity.
- The production of the machinery, buildings, and vehicles.

All related direct and indirect environmental impacts related to these elements have been calculated and were included in the LCAs in this EPD.



Possible scopes of the LCA defined in the European standard EN 15804:2012+A2:2019 are:

Production Stage			Construction Process Stage		Use Stage						End of Life Stage					Resource Recovery Stage
Raw Materials	Transport	Manufacturing	Transport	Construction Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational Energy Use	Operational Water Use	De-construction Demolition	Transport	Waste Processing	Disposal	Reuse Recovery Recycling Potential
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D
X	X	X	X	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

X = Included, ND=Module not declared, NR= Module not relevant

Modules from A5 to D are not included (X refers to considered stage; NR refers to not relevant stage and ND to not declared stage).

Upstream Processes (A1: Raw Material Supply): Production for each product starts with mainly transported from GCC Countries and some locally sourced. ‘Raw material supply’ includes raw material extraction and pre-treatment processes before coating.


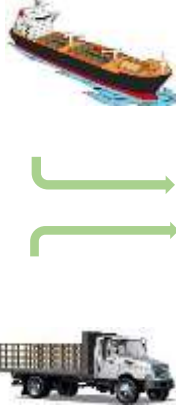




Core Processes (A2: Transportation, A3: Manufacturing and A4: Transport): Transport is relevant for delivery of raw materials to the plant (Clear Raw Glass, Tinted Raw Glass, Silver, Carbon etc.) and the transport of materials within the plant. Glass Coating Process starts with Glass loading, De Ionization of Water, Washing, Drying, Coating, Grafix power spray for interleaving, Stacking and Packing.

All coated glass products are distributed to customer’s sites.

3.5 Product Stages

A simplified model of the coating and distribution process is described in the following diagrams, enumerating the main activities included in the system boundaries. The process and facilities are also linked to the phases of the product life cycle (A1-A4) The first phase in the LCA is the coating of High-performance Architectural Glass. Al Obeikan buys the Clear Raw Glass, Tinted Raw Glass, Silver, Carbon & chemicals, etc. and other raw materials from different suppliers from different parts of the world (A1-A2). Glass loading, Delonization of Water, Washing, Drying, Coating, Grafix power spray for interleaving, Stacking and Packing (A3).

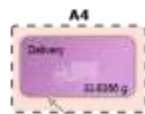
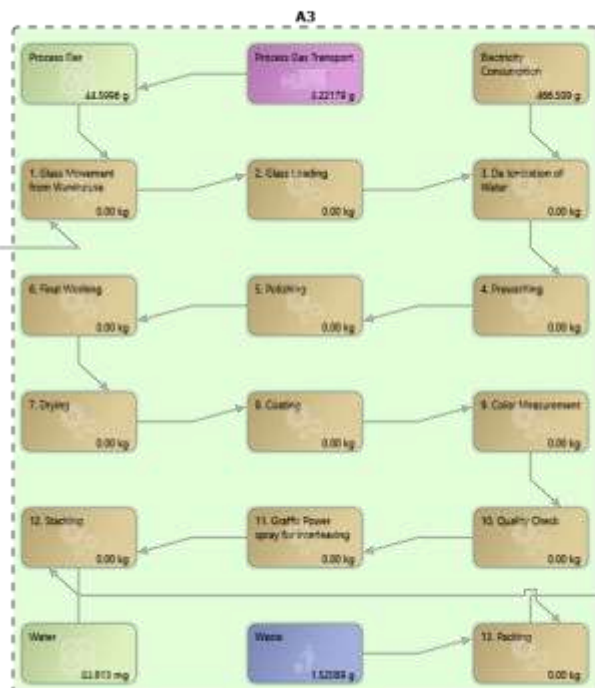
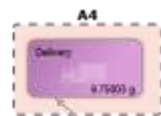
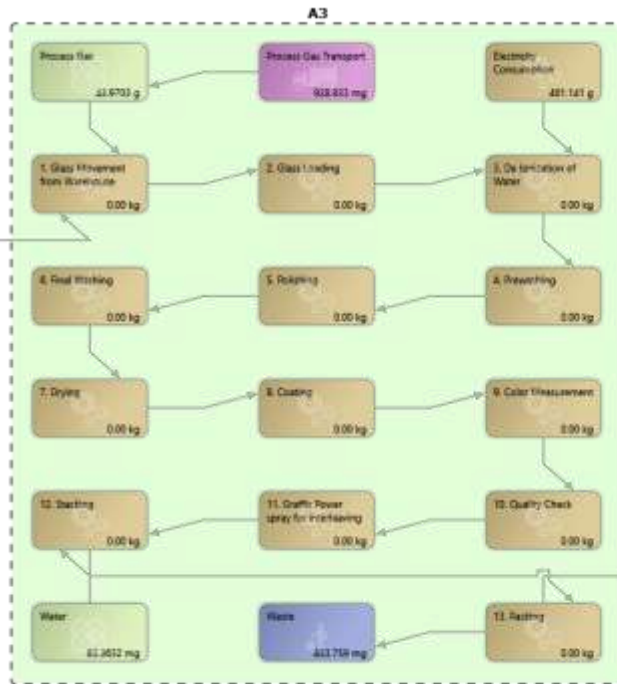
The High Performance Architectural Coated Glass is distributed to customers around the world (A4). In this EPD environmental impacts are reported by Architectural Coated Glass type of product.

Scope of this Life Cycle Assessment 'Cradle to Gate with Options'					
A1 Raw Materials Production	A2 Transport raw materials	A3 Manufacture	A4 Distribution	USE	Recovering and Recycling
					
Raw Materials and Chemicals	Transport from supplier by Road & Sea	Loading, washing, coating, inspection, unloading, packing etc	Transport to customers by trucks	NOT DECLARED	NOT DECLARED

The following diagram designed using Air.e LCA software shows an example of the materials, fuels consumption, energy consumption, transports and other elements and procedures included in the assessments.



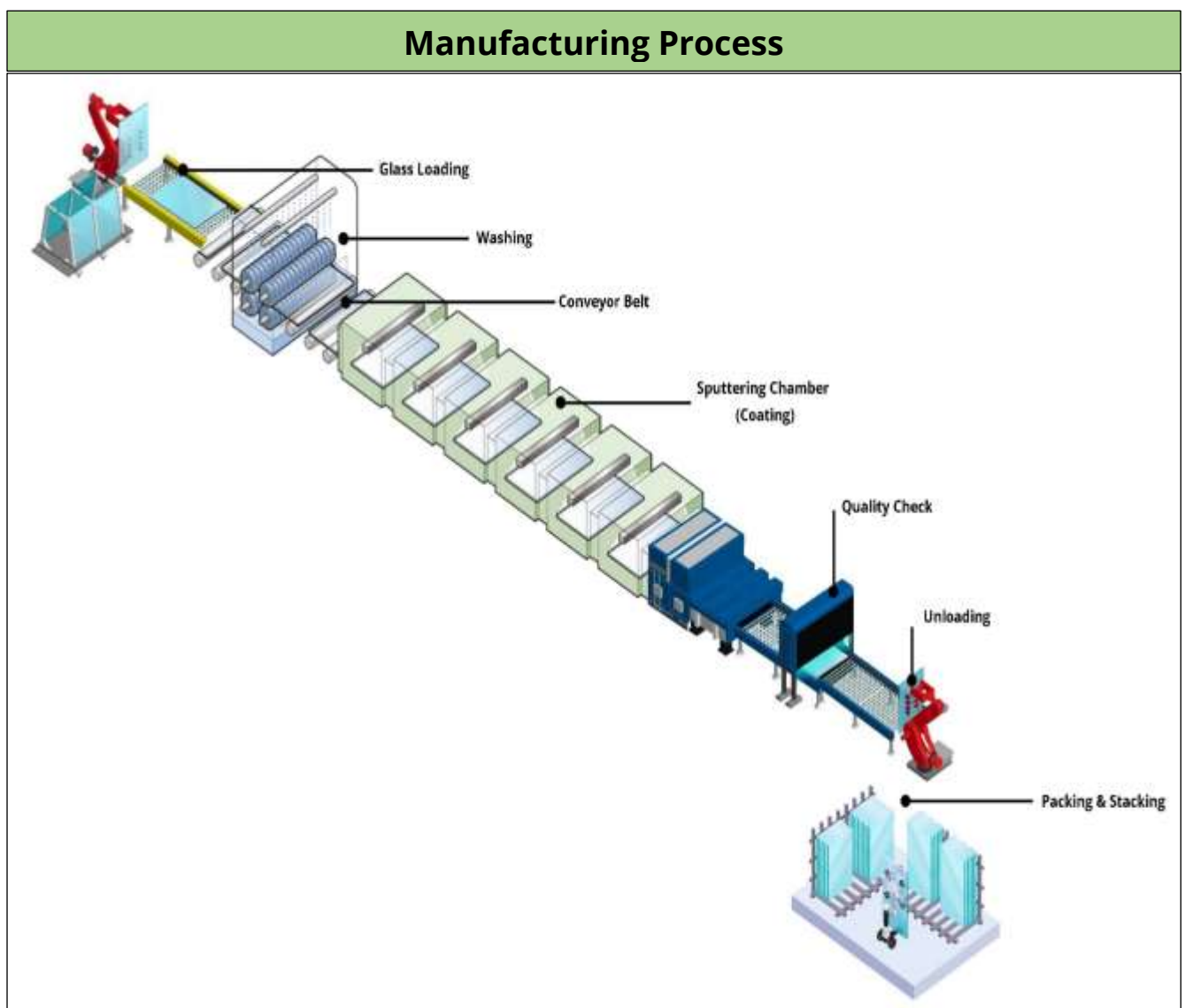
Example of Life Cycle Assessments



The following diagram is a more detailed description of the A3 phase.

The glass is washed in clean, deionized water with a pH of 7 (± 1) and conductivity of $<30 \mu\text{S}/\text{cm}$. No hard particles (such as calcium) or acidic/detergent agents should be present in the water used for washing and rinsing as these may damage the coating.

Coatings consist of optically transparent nanoscopic layers sputtered onto glass via magnetron sputtering. The layers are deposited onto the glass substrate in sputtering chambers which are under vacuum. A high voltage magnetron ignites a plasma creating energetic ions of inert gases. The energetic ions forcefully collide with the target ejecting target atoms which deposit onto the glass substrate. The coated glass is then packaged and sent to customers. Our coating process has the features of **Plasma Diagnostics, Uniformity Optimization, Expert Systems, Coating defect analysis and material characterization and Vacuum Checking.**



3.6 Sustainable Practices

Al Obeikan AGC for Glass LLC has obtained Cradle-to-Cradle certification (Bronze level) for their magnetron coated glass for its range of solar control & low emissivity (2Ag) products. Further AGC Obeikan Glass committed to:

- Reduce energy consumption used for heating and air conditioning by producing high performance coated glass.
- Produce high performance products which score builder to gain LEED points, achieving a better rating for Green Sustainable Building.
- Use safe and ecologically intelligent materials that help to preserve the environment.
- Deliver products with improved environmental performance throughout their entire lifetime, including the recycling stage.

3.7 Content Declaration

Materials	Percentage
Silver	22.16%
Silicon Aluminum	66.38%
Tungsten Nickel Chrome	2.72%
Carbon	3.27%
Titanium Zinc Oxide	3.63%
Aluminum and Zinc Oxide	1.81%
Other Chemicals	<1%

3.8 Substances listed in the “Candidate List of SVHC”

The High Performance Architectural Coated Glass does not contain substances which exceed the limits for registration with the European Chemicals Agency regarding the “Candidate List of Substances of Very High Concern for authorization”.

4.0 TECHNICAL INFORMATION

4.1 Calculation Methodology

This EPD represents a Type III Environmental Declarations according to ISO 14025:2006. The Life Cycle Assessment (LCA) has been developed following the ISO 14040 International Standard. The environmental impacts calculation method reported in this EPD follow the CML-IA, Baseline Version 4.8, 2016. The report has been done following the specifications given in the European standard EN 15804:2012+A2:2019.

4.2 Emission Factors

Emission factors and environmental impacts of elements in life cycles that are not directly controlled by Al Obeikan AGC for Glass LLC (Clear Raw Glass, Tinted Raw Glass, Silver, Carbon, Electricity, Fuels Production, etc.) have been analyzed using external studies and external emissions factors databases like Ecoinvent due to the lack of direct data. The next paragraphs describe the calculation rules and criteria applied in the calculation of the environmental performance of this type of elements in the LCA.

Raw Materials and Chemicals

Datasets from Ecoinvent 3.6 with emission factors raw materials for High Performance Architectural Coated Glass has been characterized to adjust them to the characteristics of manufacturing of Al Obeikan AGC for Glass LLC suppliers or countries where suppliers are located.

Datasets from Ecoinvent 3.6 with emission factors for generic chemicals have been characterized to adjust them to the characteristics of the products manufactured by Al Obeikan AGC for Glass LLC suppliers

Electricity

A specific dataset with the Life Cycle Inventory (LCI) corresponding to the electricity mix in Saudi Arabia in 2020 has been developed by GCAS for this LCA.

Transport to the construction site stage - A4

The High Performance Architectural Coated Glass is provided to customers all over the world. To create a scenario of the A4 phase, all the plasters sold from January to December 2020 has been analyzed as representative of the international transport. The transport means are international cargo ships and 3.5-7.5t & >32t trucks, as described in the following table.

Scenario	Parameter	Units	Value Per functional unit
A4 – Cargo Ship	Vehicle type used for transport	Transoceanic cargo ship	n/a
	Vehicle load capacity	Kg (dw)	50,000
	Fuel type and consumption	Litres of heavy fuel oil per km	0.24
	Distance to construction site	Km	See detailed table
	Capacity utilization	%	See detailed table
	Bulk density of transported products	Kg/m ³	n/a
	Volume capacity utilization factor	n/a	1
A4 - Truck	Vehicle type used for transport	>32t truck, 3.5-7.5t truck	n/a
	Vehicle load capacity	Kg	25,000
	Fuel type and consumption	Litres of diesel per km	0.38
	Distance to construction site	Km	See detailed table
	Capacity utilization	%	See detailed table
	Bulk density of transported products	Kg/m ³	n/a
	Volume capacity utilization factor	n/a	1

For every destination, the total amount of products delivered to customers has been taken to account according to the following detailed table:

Means of Transport	Destination	Distance	% FU
Cargo Ship	Chile – San Antonio	11273 nm	0.00092
	Egypt – Alexandria	885 nm	0.1345
	Indonesia – Jakarta	5171 nm	0.0079
	Lebanon – Beirut	905 nm	0.0214
	New Zealand – Auckland	10168 nm	0.0143
	New Zealand – Lyttleton	10652 nm	0.0042
	New Zealand – Nelson	10396 nm	0.0028
Truck	Jordan – Amman	969.3 km	0.0487
	Bahrain – Manama	1493 km	0.0354
	KSA – Dammam	1444.2 km	0.0882
	KSA – Jizan	1023 km	0.0068
	KSA – Jeddah	331.7 km	0.0829
	KSA – Khamis Mushait	1000.4 km	0.0485
	KSA – Madinah	223 km	0.0009
	KSA – Al Qassim	678 km	0.0085
	KSA – Riyadh	1046.7 km	0.1904
	KSA – Sudair	115.4 km	0.0032
	KSA – Tabuk	654.1 km	0.0028
	KSA – Taif	459.7 km	0.0156
	Kuwait	1346.5 km	0.0439
	Palestine	318 km	0.0048
	UAE – Abu Dhabi	1992.7 km	0.0383
	UAE – Dubai	2088.9 km	0.0373
	UAE – Jebel Ali	2050 km	0.0026
	UAE – Ras Al Khaimah	2197.9 km	0.0820
UAE – Sharjah	2113.5 km	0.0613	

4.3 Calculation Rules

Version 3.10.0.6 of software Air.e LCA™ with Ecoinvent™ 3.6 database has been used for LCA modeling and impacts calculations.

Annual Statistics 2020 reports from Saudi Arabia Electricity Company have been used to create the model of electricity mix in the country.

Minor components are not directly related to the product, with less than 1% impact, such as office supplies, has been excluded from the assessment.

All transports of components have been included in the LCA considering real distances travelled by materials used from January 2020 to December 2020. Transport of raw materials needed to produce High Performance Architectural Coated Glass is estimated in a global scale according to Ecoinvent™ criteria. Main means of transport have been included for materials purchases. As exact port locations are not known in detail, transport distances have been calculated from a one of the ports in the country of origin to the factory. Operation in port has also been excluded.

Road distances calculated using Google Maps. Maritime distances calculated using Marine Traffic Voyage Planner.

Cut-off rules: more than 99% of the materials and energy consumption have been included. The Polluter Pays Principle and the Modularity Principle have been followed.

4.4 By Products Assignment

There are no By Products in this Environmental Product Declaration. Hence, no allocation had to be applied.


5.0 ENVIRONMENTAL PERFORMANCE

5.1 Potential Environment Impacts

In the following tables, the environmental performance of the declared units “1 m² of glass coating” are presented for the Al Obeikan AGC for Glass LLC product totalized and for every sub-phase of the life cycles.

During the assessment it was not evident to distinguish the differences in the consumption of electricity, water, diesel, raw material and chemicals during the manufacturing process of the different types of High Performance Architectural Coated Glass. Hence, the calculation is based on total production vs total consumption against production of each product.

Environmental impacts are calculated using the CML-IA, Baseline Version 4.8, 2016.

 Global Warming Potential (GWP100) (kg of CO2 equivalent)				
	A1 & A2 Raw Manufacture, Chemicals and Transport	A2 Manufacturing Process	A3 Delivery	Total
Sunlux BlueChroma	0.50	0.51	0.01	1.02
Sunlux BronzeChroma	0.49	0.48	0.38	1.35
Sunlux GreenChroma	0.50	0.52	0.01	1.03
Sunlux Dark BlueChroma	0.50	0.57	0.01	1.08
Sunlux Dark GreyChroma	0.48	0.53	0.01	1.02
Sunlux Dark GreenChroma	0.63	0.72	0.13	1.48
Sunlux Orion	0.81	0.54	0.26	1.61
Sunlux Orion on Bronze	1.24	0.55	0.33	2.11
Sunlux Orion on Green	1.12	0.63	0.91	2.66
Sunlux Orion on Grey	2.66	0.63	0.92	4.22
Sunlux Shadow 14	1.73	0.64	0.94	3.30


Sunlux Shadow 20	0.59	0.51	0.03	1.13
Sunlux Shadow 32	1.47	0.61	0.75	2.83
iPlus Solid on Clear	0.47	0.51	0.00	0.98
iPlus Solid on Green	0.47	0.51	0.00	0.97
iPlus Solid on Bronze	0.46	0.51	0.00	0.97
iPlus Solid on Grey	1.12	0.54	0.27	1.93
Energy Light	0.53	0.53	0.02	1.07
iPlus AS	0.54	0.51	0.06	1.11
Stopray Smart 18	0.68	0.53	0.16	1.37
Stopray Smart 30	0.48	0.51	0.02	1.00
Stopray Smart 30 on Bronze	1.77	0.58	0.53	2.89
Stopray Smart 30 on Green	1.08	0.54	0.26	1.88
Stopray Smart 30 on Grey	3.14	2.35	1.09	6.58
Stopray Smart 51	0.73	0.61	0.06	1.40
Stopray Smart 51 on Bronze	1.08	0.62	0.07	1.77
Stopray Smart 51 on Green	10.97	2.50	1.18	14.65
Stopray Smart 51 on Grey	0.83	0.58	0.04	1.45
Stopray BlueAce-30T	0.59	0.55	0.03	1.17
Stopray BronzeAce-30T	1.16	0.77	0.16	2.09
Stopray GreyAce-30T	0.61	0.57	0.04	1.21
Stopray Vision-36T	0.62	0.57	0.04	1.23
Stopray Vision-40T	0.63	0.55	0.03	1.21
Stopray Vision-51T	0.70	0.60	0.05	1.35
Stopray Vision-72T	0.53	0.53	0.02	1.08
Stopray Titanium-34T	0.54	0.51	0.03	1.08



Ozone Depletion (mg CFC-11 equivalent)


	A1 & A2 Raw Manufacture, Chemicals and Transport	A3 Manufacturing Process	A4 Delivery	Total
Sunlux BlueChroma	0.05	0.04	-	0.09
Sunlux BronzeChroma	0.05	0.04	-	0.09
Sunlux GreenChroma	0.05	0.45	-	0.09
Sunlux Dark BlueChroma	0.05	0.05	-	0.10
Sunlux Dark GreyChroma	0.05	0.05	-	0.09
Sunlux Dark GreenChroma	0.06	0.07	-	0.13
Sunlux Orion	0.07	0.04	-	0.12
Sunlux Orion on Bronze	0.14	0.04	-	0.18
Sunlux Orion on Green	0.30	0.05	-	0.35
Sunlux Orion on Grey	0.30	0.05	-	0.35
Sunlux Shadow 14	0.14	0.05	-	0.19
Sunlux Shadow 20	0.05	0.04	-	0.09
Sunlux Shadow 32	0.12	0.05	-	0.17
iPlus Solid on Clear	0.05	0.04	-	0.09
iPlus Solid on Green	0.05	0.04	-	0.09
iPlus Solid on Bronze	0.05	0.04	-	0.09
iPlus Solid on Grey	0.12	0.04	-	0.17
Energy Light	0.05	0.05	-	0.09
iPlus AS	0.05	0.04	-	0.09
Stopray Smart 18	0.06	0.04	-	0.11
Stopray Smart 30	0.05	0.04	-	0.09
Stopray Smart 30 on Bronze	0.20	0.05	-	0.25

Stopray Smart 30 on Green	0.12	0.04	-	0.16
Stopray Smart 30 on Grey	0.36	0.32	-	0.68
Stopray Smart 51	0.05	0.06	-	0.11
Stopray Smart 51 on Bronze	0.13	0.06	-	0.19
Stopray Smart 51 on Green	1.53	0.35	-	1.88
Stopray Smart 51 on Grey	0.10	0.05	-	0.15
Stopray BlueAce-30T	0.05	0.05	-	0.10
Stopray BronzeAce-30T	0.06	0.08	-	0.15
Stopray GreyAce-30T	0.05	0.05	-	0.10
Stopray Vision-36T	0.05	0.05	-	0.10
Stopray Vision-40T	0.05	0.05	-	0.10
Stopray Vision-51T	0.05	0.06	-	0.11
Stopray Vision-72T	0.05	0.05	-	0.09
Stopray Titanium-34T	0.06	0.04	-	0.10


 Acidification g SO2 equivalent.				
	A1 & A2 Raw Manufacture, Chemicals and Transport	A3 Manufacturing Process	A4 Delivery	Total
Sunlux BlueChroma	4.48	1.54	0.03	6.06
Sunlux BronzeChroma	4.47	1.43	1.35	7.25
Sunlux GreenChroma	4.48	1.65	0.03	6.17
Sunlux Dark BlueChroma	4.48	2.04	0.03	6.55
Sunlux Dark GreyChroma	4.46	1.70	0.05	6.21
Sunlux Dark GreenChroma	6.83	3.06	0.45	10.35
Sunlux Orion	9.64	1.71	0.93	12.28

Sunlux Orion on Bronze	21.37	1.76	1.15	24.27
Sunlux Orion on Green	52.71	2.14	3.25	58.09
Sunlux Orion on Grey	52.99	2.15	3.28	58.42
Sunlux Shadow 14	23.73	2.16	3.34	29.23
Sunlux Shadow 20	5.12	1.56	0.11	6.79
Sunlux Shadow 32	19.91	2.04	2.69	24.63
iPlus Solid on Clear	4.27	1.54	0.01	5.82
iPlus Solid on Green	4.35	1.54	0.01	5.90
iPlus Solid on Bronze	4.34	1.54	0.01	5.89
iPlus Solid on Grey	18.71	1.72	0.97	21.40
Energy Light	4.66	1.72	0.05	6.44
iPlus AS	5.41	1.58	0.21	7.19
Stopray Smart 18	7.56	1.64	0.58	9.78
Stopray Smart 30	4.50	1.54	0.06	6.10
Stopray Smart 30 on Bronze	33.19	1.29	1.96	37.00
Stopray Smart 30 on Green	18.04	1.71	0.91	20.66
Stopray Smart 30 on Grey	78.25	14.60	3.88	96.73
Stopray Smart 51	6.14	2.28	0.22	8.64
Stopray Smart 51 on Bronze	20.23	2.37	0.25	22.85
Stopray Smart 51 on Green	276.75	15.65	4.20	296.60
Stopray Smart 51 on Grey	13.95	2.04	0.15	16.15
Stopray BlueAce-30T	5.11	1.89	0.10	7.10
Stopray BronzeAce-30T	11.40	3.43	0.56	15.38
Stopray GreyAce-30T	5.29	1.96	0.13	7.38
Stopray Vision-36T	5.36	1.97	0.13	7.46
Stopray Vision-40T	5.35	1.88	0.10	7.32

Stopray Vision-51T	5.89	2.18	0.19	8.26
Stopray Vision-72T	4.70	1.74	0.06	6.50
Stopray Titanium-34T	5.97	1.56	0.12	7.65


 Eutrophication g of (PO₄)³⁻ equivalent				
	A1 & A2 Raw Manufacture, Chemicals and Transport	A3 Manufacturing Process	A4 Delivery	Total
Sunlux BlueChroma	1.06	0.14	0.01	1.21
Sunlux BronzeChroma	1.05	0.13	0.35	1.53
Sunlux GreenChroma	1.06	0.17	0.01	1.24
Sunlux Dark BlueChroma	1.06	0.25	0.01	1.32
Sunlux Dark GreyChroma	1.04	0.18	0.01	1.23
Sunlux Dark GreenChroma	1.34	0.47	0.12	1.93
Sunlux Orion	1.69	0.18	0.24	2.12
Sunlux Orion on Bronze	2.95	0.19	0.30	3.44
Sunlux Orion on Green	6.49	0.29	0.84	7.62
Sunlux Orion on Grey	6.49	0.29	0.85	7.63
Sunlux Shadow 14	3.44	0.29	0.87	4.60
Sunlux Shadow 20	1.17	0.15	0.15	1.34
Sunlux Shadow 32	2.98	0.26	0.70	3.94
iPlus Solid on Clear	1.02	0.14	-	1.17
iPlus Solid on Green	1.03	0.14	-	1.17
iPlus Solid on Bronze	1.03	0.14	-	1.17
iPlus Solid on Grey	2.65	0.19	0.25	3.09
Energy Light	1.09	0.18	0.01	1.29

iPlus AS	1.16	0.15	0.05	1.37
Stopray Smart 18	1.43	0.17	0.15	1.75
Stopray Smart 30	1.05	0.14	0.01	1.21
Stopray Smart 30 on Bronze	4.28	0.23	0.50	5.01
Stopray Smart 30 on Green	2.57	0.18	0.24	2.99
Stopray Smart 30 on Grey	7.60	2.93	1.01	11.53
Stopray Smart 51	1.35	0.30	0.06	1.70
Stopray Smart 51 on Bronze	2.75	0.32	0.06	3.13
Stopray Smart 51 on Green	30.61	3.16	1.09	34.86
Stopray Smart 51 on Grey	2.07	0.25	0.04	2.36
Stopray BlueAce-30T	1.17	0.22	0.03	1.41
Stopray BronzeAce-30T	1.88	0.55	0.15	2.57
Stopray GreyAce-30T	1.20	0.23	0.03	1.47
Stopray Vision-36T	1.21	0.24	0.03	1.48
Stopray Vision-40T	1.19	0.21	0.03	1.43
Stopray Vision-51T	1.30	0.28	0.05	1.63
Stopray Vision-72T	1.10	0.18	0.02	1.30
Stopray Titanium-34T	1.21	0.15	0.03	1.39

 Photochemical Ozone creation (mg ethane equivalent)				
	A1 & A2 Raw Manufacture, Chemicals and Transport	A3 Manufacturing Process	A4 Delivery	Total
Sunlux BlueChroma	140.49	78.55	0.61	219.65
Sunlux BronzeChroma	140.43	74.16	23.93	238.52
Sunlux GreenChroma	140.49	83.02	0.61	224.12

Sunlux Dark BlueChroma	140.49	98.54	0.61	239.64
Sunlux Dark GreyChroma	140.61	84.92	0.87	226.40
Sunlux Dark GreenChroma	198.51	138.97	8.00	345.48
Sunlux Orion	267.00	83.33	16.42	366.75
Sunlux Orion on Bronze	563.11	84.77	20.31	668.20
Sunlux Orion on Green	1.35	95.69	57.32	154.36
Sunlux Orion on Grey	1351.80	95.88	57.91	1505.59
Sunlux Shadow 14	611.24	96.18	58.95	766.37
Sunlux Shadow 20	154.65	155.99	78.93	312.51
Sunlux Shadow 32	514.19	92.73	47.45	654.41
iPlus Solid on Clear	135.81	78.42	0.20	214.43
iPlus Solid on Green	138.10	78.43	0.21	216.74
iPlus Solid on Bronze	137.89	78.42	0.20	216.52
iPlus Solid on Grey	496.78	83.57	17.18	597.53
Energy Light	144.43	85.68	0.97	231.08
iPlus AS	163.83	79.49	3.72	247.04
Stopray Smart 18	216.29	81.45	10.20	307.93
Stopray Smart 30	141.65	78.46	0.99	221.31
Stopray Smart 30 on Bronze	857.01	90.41	33.68	981.10
Stopray Smart 30 on Green	480.24	83.24	16.11	579.58
Stopray Smart 30 on Grey	2227.17	597.89	68.59	2893.66
Stopray Smart 51	177.16	107.76	3.88	288.81
Stopray Smart 51 on Bronze	538.07	111.46	4.37	653.90
Stopray Smart 51 on Green	6997.53	639.71	74.12	7711.35
Stopray Smart 51 on Grey	379.97	98.52	2.66	481.15
Stopray BlueAce-30T	154.28	92.30	1.84	248.42

Stopray BronzeAce-30T	332.11	153.51	9.92	495.54
Stopray GreyAce-30T	157.78	95.24	2.23	255.25
Stopray Vision-36T	164.65	95.72	2.29	262.66
Stopray Vision-40T	173.31	91.83	1.78	266.93
Stopray Vision-51T	171.50	103.95	3.38	278.82
Stopray Vision-72T	145.32	86.30	1.05	232.67
Stopray Titanium-34T	178.55	79.01	2.13	259.69

 Depletion of Abiotic - Element (g of Sb equivalent)				
	A1 & A2 Raw Manufacture, Chemicals and Transport	A3 Manufacturing Process	A4 Delivery	Total
Sunlux BlueChroma	2.99	0.15	-	3.14
Sunlux BronzeChroma	2.99	0.06	-	3.05
Sunlux GreenChroma	2.99	0.15	-	3.14
Sunlux Dark BlueChroma	2.99	0.16	-	3.15
Sunlux Dark GreyChroma	2.99	0.15	-	3.14
Sunlux Dark GreenChroma	2.99	0.18	-	3.17
Sunlux Orion	2.99	0.15	-	3.14
Sunlux Orion on Bronze	3.02	0.15	-	3.18
Sunlux Orion on Green	3.08	0.15	-	3.24
Sunlux Orion on Grey	2.92	0.15	-	3.07
Sunlux Shadow 14	2.93	0.15	-	3.29
Sunlux Shadow 20	2.99	0.15	-	3.14
Sunlux Shadow 32	3.02	0.15	-	3.17
iPlus Solid on Clear	2.99	0.15	-	3.14

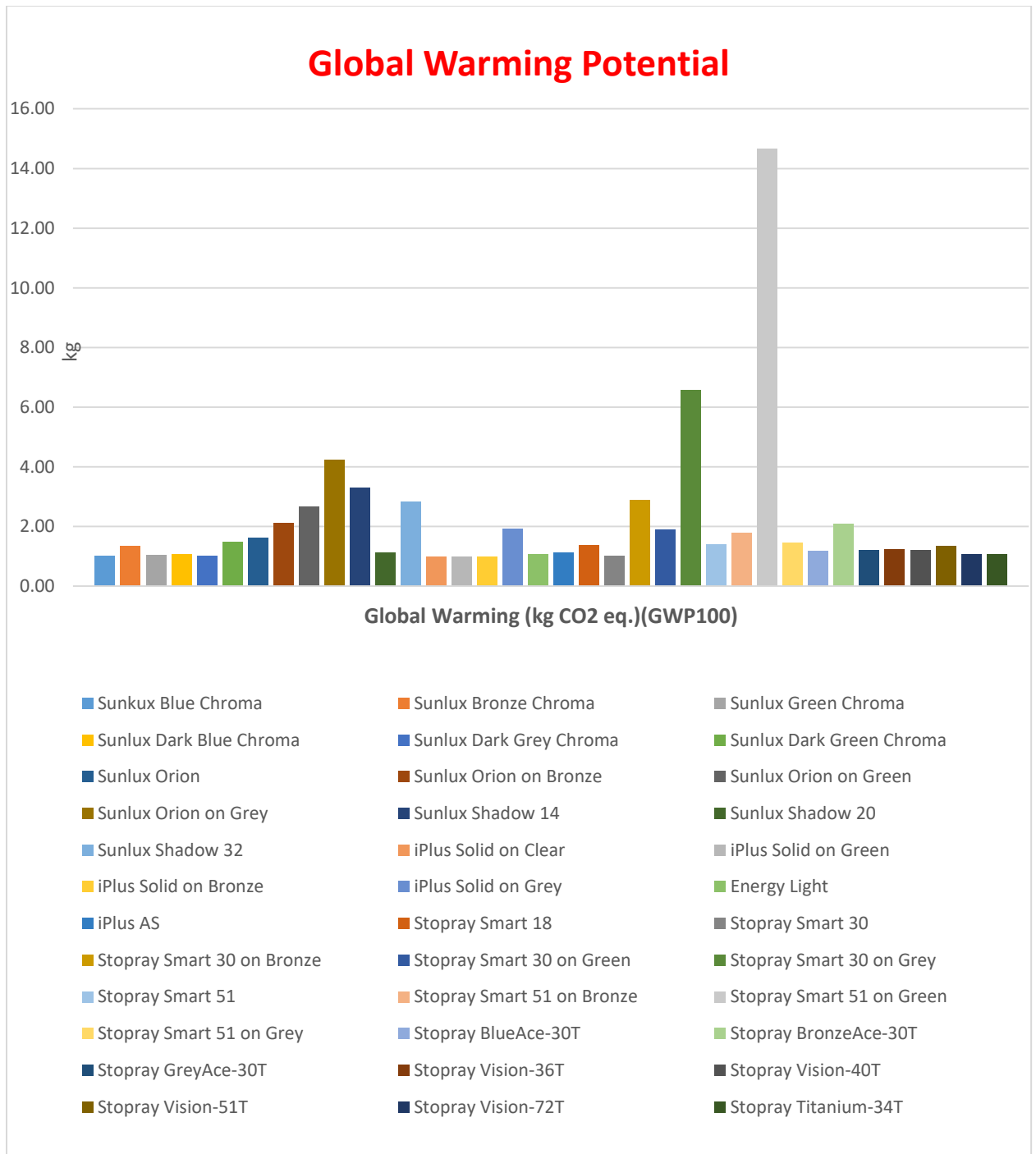
iPlus Solid on Green	2.99	0.15	-	3.14
iPlus Solid on Bronze	2.99	0.15	-	3.14
iPlus Solid on Grey	3.01	0.15	-	3.16
Energy Light	2.99	0.15	-	3.14
iPlus AS	2.99	0.15	-	3.14
Stopray Smart 18	2.99	0.15	-	3.14
Stopray Smart 30	2.99	0.15	-	3.14
Stopray Smart 30 on Bronze	3.05	0.15	-	3.20
Stopray Smart 30 on Green	3.01	0.15	-	3.16
Stopray Smart 30 on Grey	3.16	0.39	-	3.55
Stopray Smart 51	2.99	0.16	-	3.15
Stopray Smart 51 on Bronze	3.02	0.16	-	3.18
Stopray Smart 51 on Green	3.54	0.41	-	3.95
Stopray Smart 51 on Grey	3.01	0.16	-	3.16
Stopray BlueAce-30T	2.99	0.15	-	3.14
Stopray BronzeAce-30T	3.00	0.18	-	3.18
Stopray GreyAce-30T	2.99	0.16	-	3.14
Stopray Vision-36T	3.00	0.16	-	3.15
Stopray Vision-40T	3.02	0.15	-	3.17
Stopray Vision-51T	2.99	0.16	-	3.15
Stopray Vision-72T	2.99	0.15	-	3.14
Stopray Titanium-34T	2.99	0.15	-	3.14



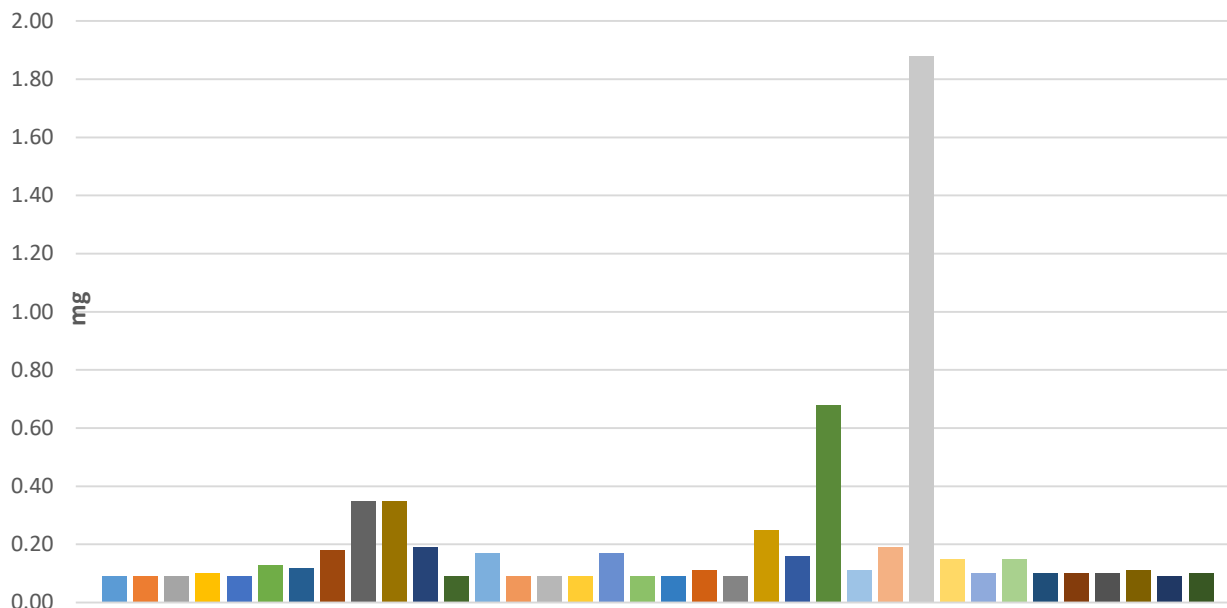
Depletion of Abiotic – Fossil MJ net calorific value

	A1 & A2 Raw Manufacture, Chemicals and Transport	A3 Manufacturing Process	A4 Delivery	Total
Sunlux BlueChroma	6.06	8.36	-	14.41
Sunlux BronzeChroma	6.07	8.05	-	14.12
Sunlux GreenChroma	6.06	8.56	-	14.62
Sunlux Dark BlueChroma	6.06	9.27	-	15.32
Sunlux Dark GreyChroma	6.09	8.65	-	14.73
Sunlux Dark GreenChroma	6.99	11.08	-	18.06
Sunlux Orion	8.04	8.51	-	15.55
Sunlux Orion on Bronze	13.02	8.56	-	21.58
Sunlux Orion on Green	25.86	8.89	-	34.75
Sunlux Orion on Grey	25.75	8.90	-	34.65
Sunlux Shadow 14	13.28	8.90	-	22.18
Sunlux Shadow 20	6.21	8.37	-	14.58
Sunlux Shadow 32	11.77	8.80	-	20.58
iPlus Solid on Clear	6.00	8.36	-	14.36
iPlus Solid on Green	6.05	8.36	-	14.41
iPlus Solid on Bronze	6.05	8.36	-	14.40
iPlus Solid on Grey	11.93	8.52	-	20.44
Energy Light	6.10	8.68	-	14.78
iPlus AS	6.45	8.39	-	14.83
Stopray Smart 18	7.26	8.45	-	15.71
Stopray Smart 30	6.10	8.35	-	14.47
Stopray Smart 30 on Bronze	17.86	8.67	-	26.55

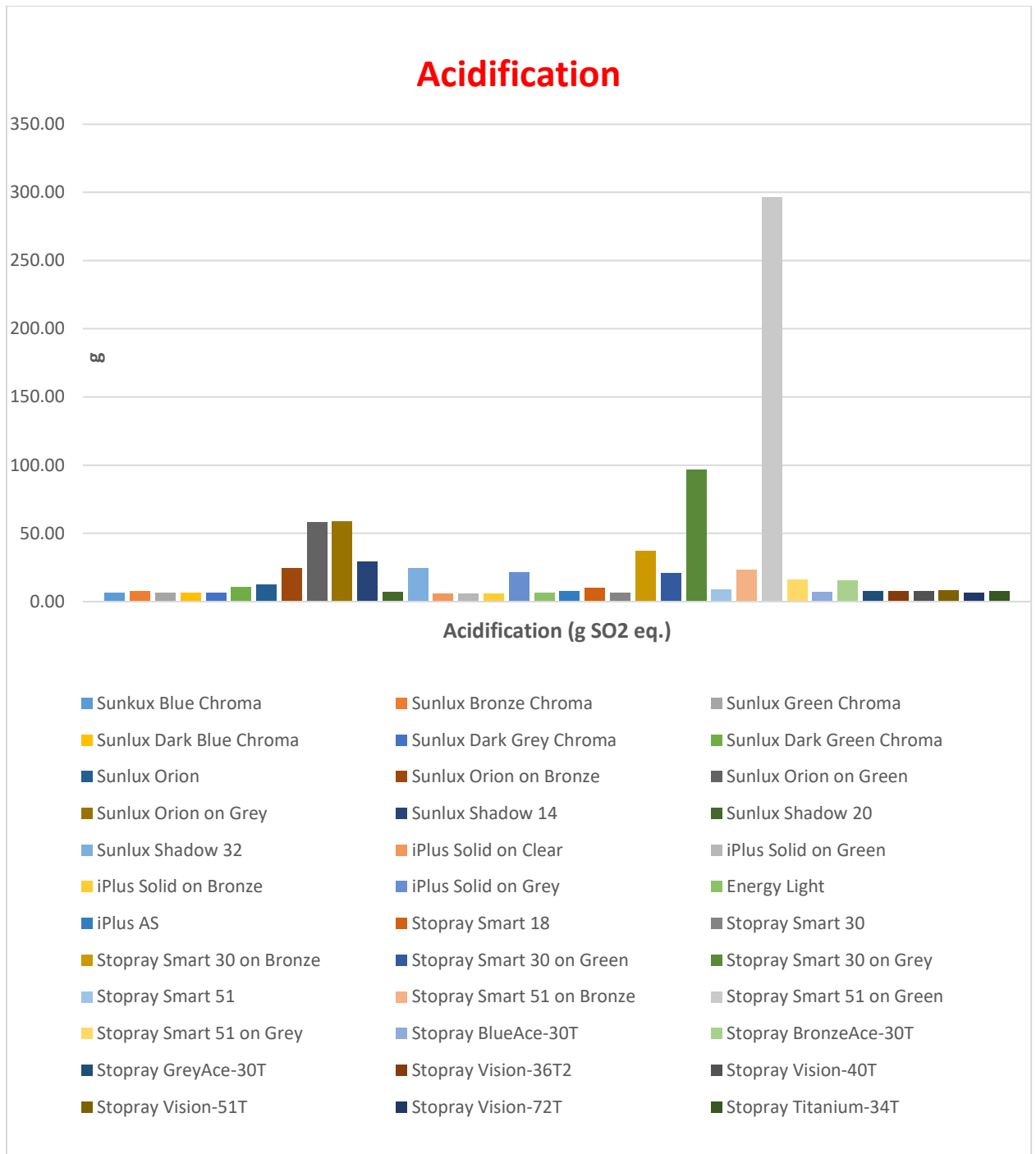
Stopray Smart 30 on Green	11.66	8.51	-	20.17
Stopray Smart 30 on Grey	30.24	31.69	-	61.93
Stopray Smart 51	6.47	9.67	-	16.14
Stopray Smart 51 on Bronze	12.72	9.84	-	22.56
Stopray Smart 51 on Green	120.47	33.57	-	154.04
Stopray Smart 51 on Grey	10.09	9.26	-	19.35
Stopray BlueAce-30T	6.21	8.98	-	15.19
Stopray BronzeAce-30T	7.26	11.73	-	18.99
Stopray GreyAce-30T	6.23	9.11	-	15.34
Stopray Vision-36T	6.33	9.13	-	15.46
Stopray Vision-40T	6.82	8.96	-	15.78
Stopray Vision-51T	6.40	9.50	-	15.90
Stopray Vision-72T	6.11	8.71	-	14.82
Stopray Titanium-34T	6.72	8.37	-	15.09



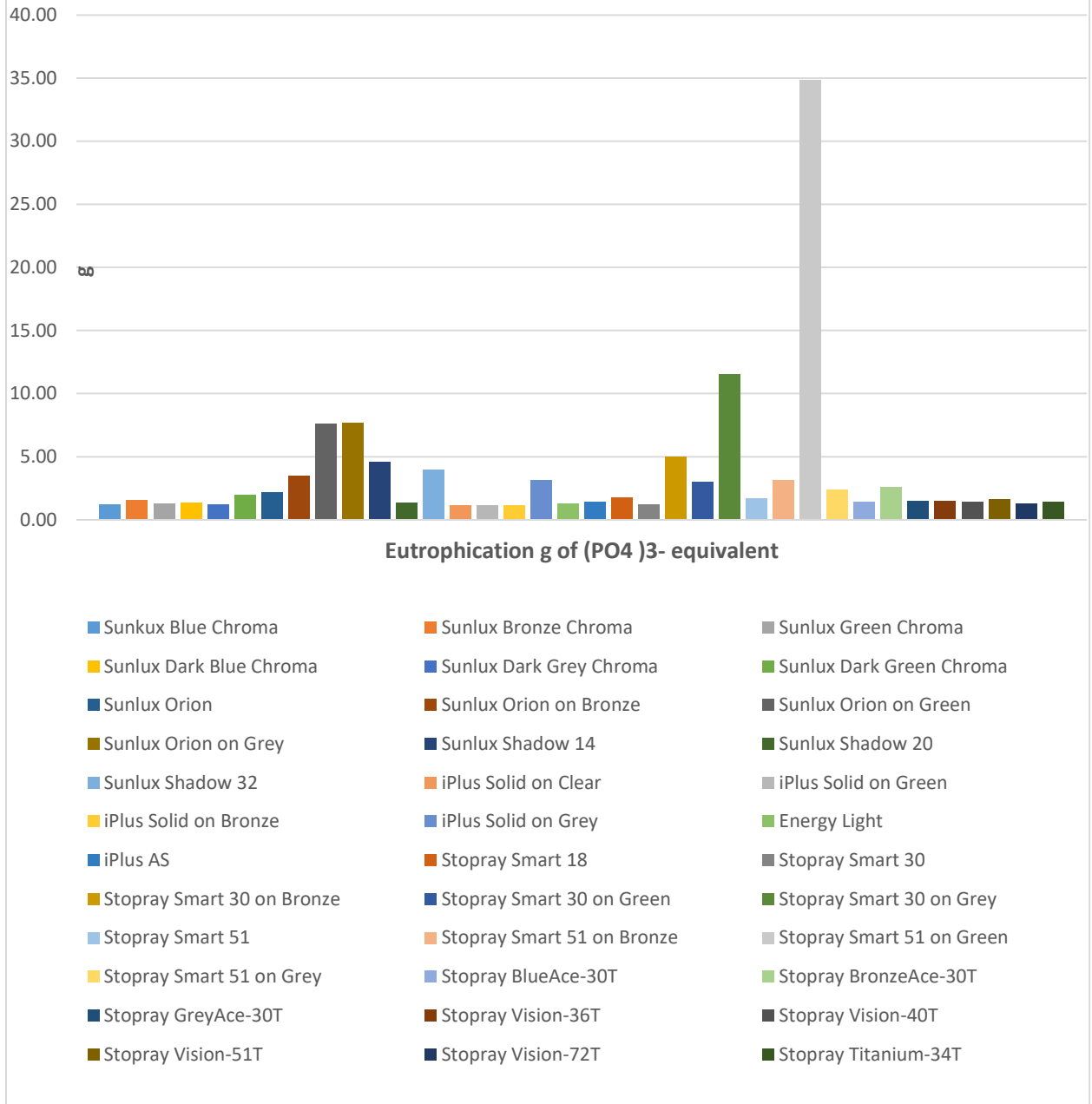
Ozone Depletion

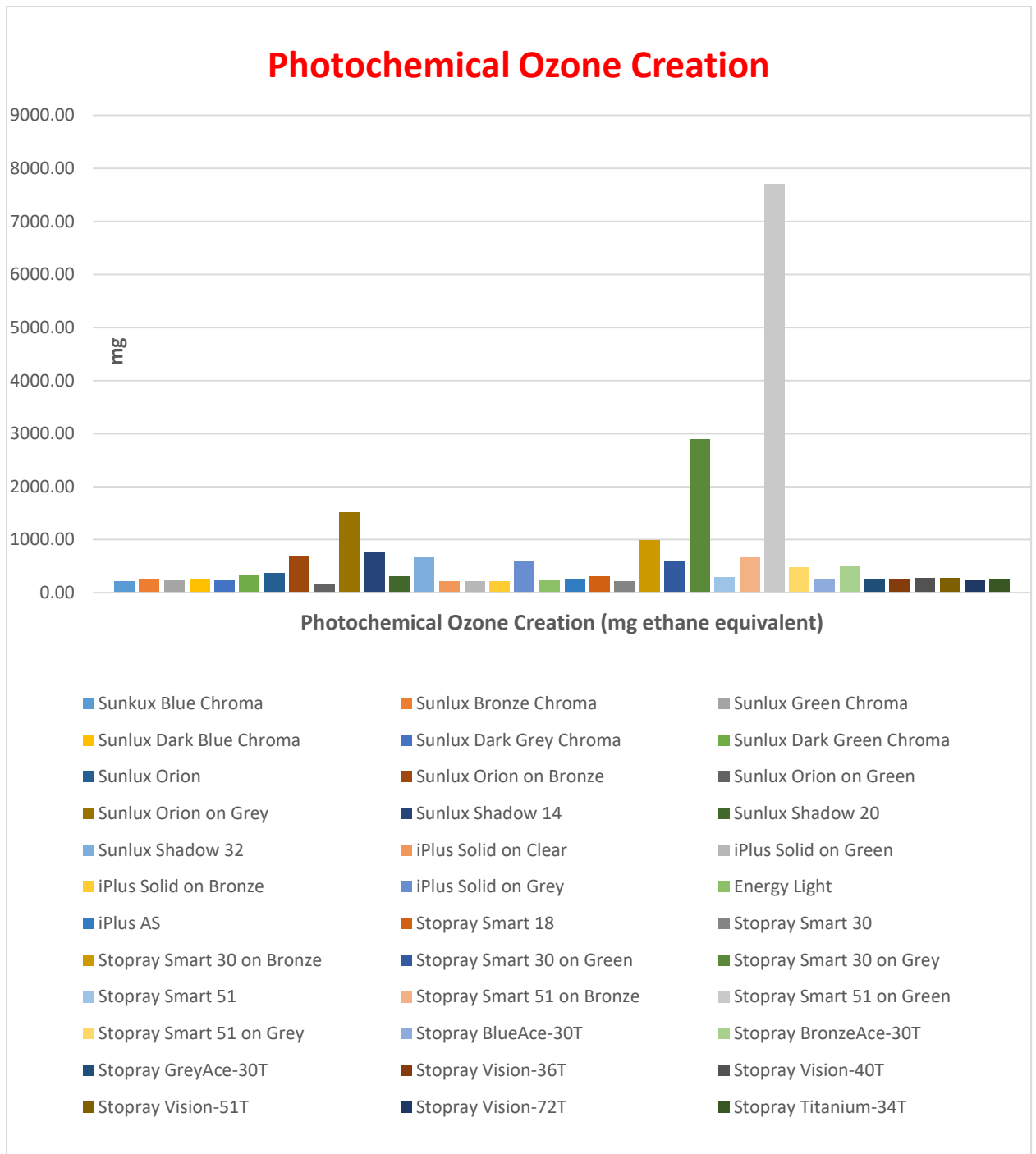


- | | | |
|------------------------------|------------------------------|-----------------------------|
| ■ Sunkux Blue Chroma | ■ Sunlux Bronze Chroma | ■ Sunlux Green Chroma |
| ■ Sunlux Dark Blue Chroma | ■ Sunlux Dark Grey Chroma | ■ Sunlux Dark Green Chroma |
| ■ Sunlux Orion | ■ Sunlux Orion on Bronze | ■ Sunlux Orion on Green |
| ■ Sunlux Orion on Grey | ■ Sunlux Shadow 14 | ■ Sunlux Shadow 20 |
| ■ Sunlux Shadow 32 | ■ iPlus Solid on Clear | ■ iPlus Solid on Green |
| ■ iPlus Solid on Bronze | ■ iPlus Solid on Grey | ■ Energy Light |
| ■ iPlus AS | ■ Stopray Smart 18 | ■ Stopray Smart 30 |
| ■ Stopray Smart 30 on Bronze | ■ Stopray Smart 30 on Green | ■ Stopray Smart 30 on Grey |
| ■ Stopray Smart 51 | ■ Stopray Smart 51 on Bronze | ■ Stopray Smart 51 on Green |
| ■ Stopray Smart 51 on Grey | ■ Stopray BlueAce-30T | ■ Stopray BronzeAce-30T |
| ■ Stopray GreyAce-30T | ■ Stopray Vision-36T | ■ Stopray Vision-40T |
| ■ Stopray Vision-51T | ■ Stopray Vision-72T | ■ Stopray Titanium-34T |

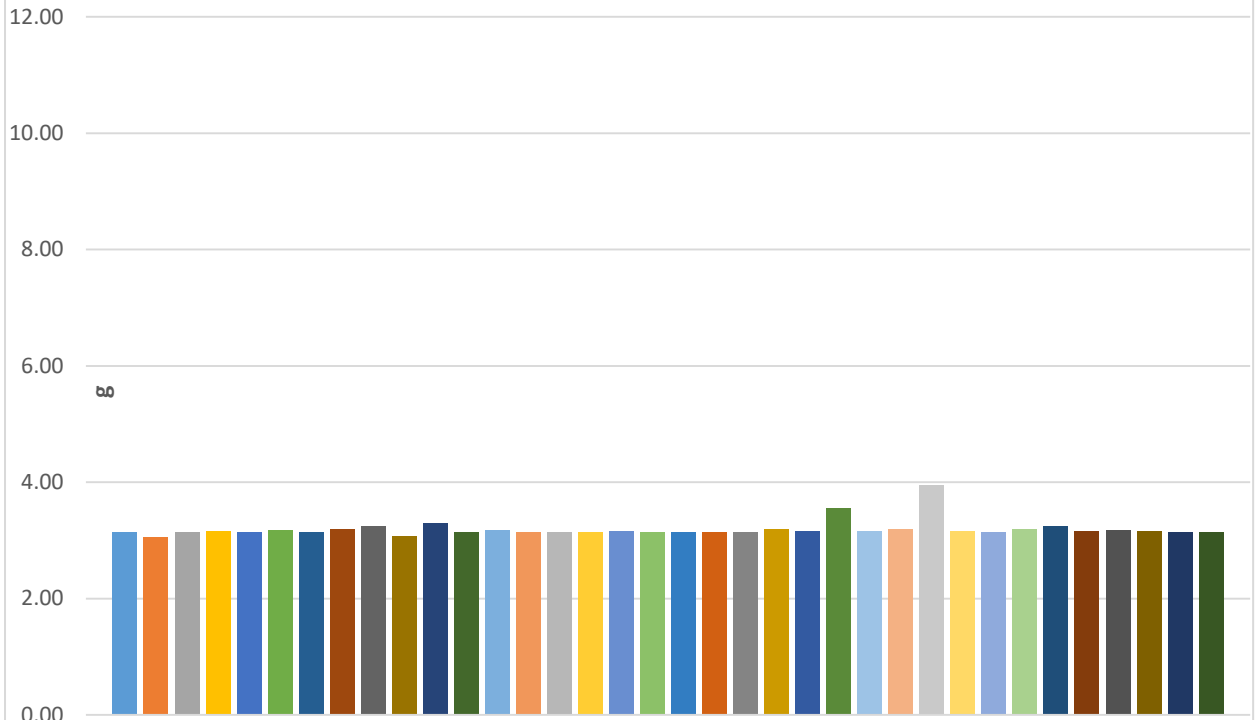


Eutrophication



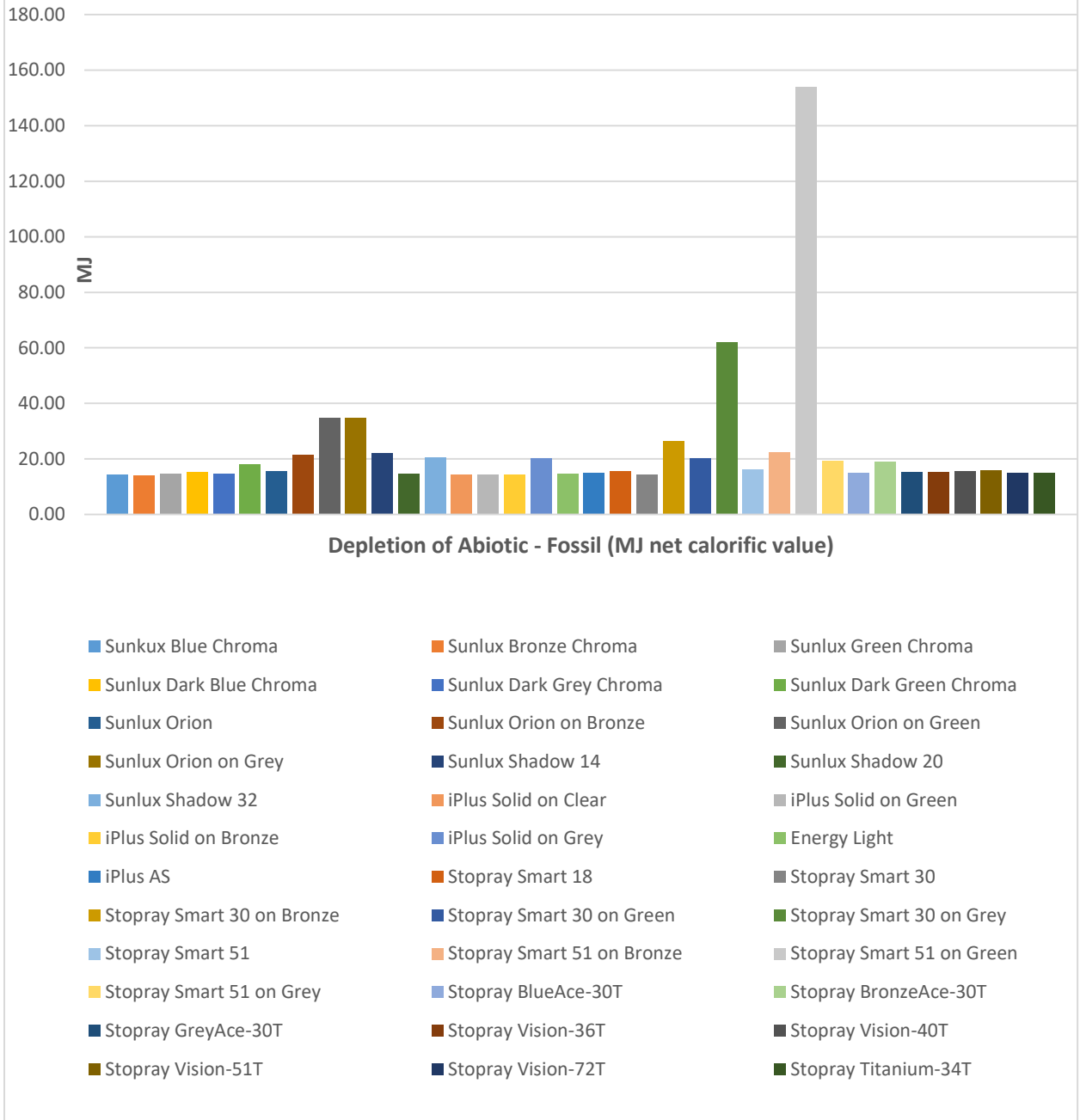


Depletion of Abiotic - Element




- Sunkux Blue Chroma
- Sunlux Bronze Chroma
- Sunlux Green Chroma
- Sunlux Dark Blue Chroma
- Sunlux Dark Grey Chroma
- Sunlux Dark Green Chroma
- Sunlux Orion
- Sunlux Orion on Bronze
- Sunlux Orion on Green
- Sunlux Orion on Grey
- Sunlux Shadow 14
- Sunlux Shadow 20
- Sunlux Shadow 32
- iPlus Solid on Clear
- iPlus Solid on Green
- iPlus Solid on Bronze
- iPlus Solid on Grey
- Energy Light
- iPlus AS
- Stopray Smart 18
- Stopray Smart 30
- Stopray Smart 30 on Bronze
- Stopray Smart 30 on Green
- Stopray Smart 30 on Grey
- Stopray Smart 51
- Stopray Smart 51 on Bronze
- Stopray Smart 51 on Green
- Stopray Smart 51 on Grey
- Stopray BlueAce-30T
- Stopray BronzeAce-30T
- Stopray GreyAce-30T
- Stopray Vision-36T
- Stopray Vision-40T
- Stopray Vision-51T
- Stopray Vision-72T
- Stopray Titanium-34T


Depletion of Abiotic - Fossil



5.2 Energy Resources

	<p style="text-align: center;">A3 Manufacturing</p>
Use of RENEWABLE primary energy fuels excluding renewable primary energy resources used as raw materials	2.69e+5
Use of RENEWABLE primary energy fuels used as raw materials	<0.01
Total use of RENEWABLE primary energy fuels (primary energy and primary energy fuels used as raw materials)	2.69e+5


Data in J, net calorific value

	<p style="text-align: center;">A3 Manufacturing</p>
Use of NON- RENEWABLE primary energy fuels excluding non- renewable primary energy resources used as raw materials	3.46e+7
Use of NON-RENEWABLE primary energy fuels used as raw materials	<0.01
Total use of NON-RENEWABLE primary energy resources (primary energy and primary energy resources used as raw materials)	3.46e+7


Data in J, net calorific value

5.3 Use of Resources

The following resources use assessment refers to the production phases and do not include the distribution phase (A4).

	<p style="text-align: center;">A3 Manufacturing</p>	<p style="text-align: center;">Description</p>
Use of secondary material	<0.01	-


Data in Kg

	A1-A4 Total use of water
Total Amount of water used in indirect way	1.003
Total amount of water used direct way	21032

Data in m3

5.4 Waste Disposed

The waste disposal assessment refers to the production phases (A1-A3), distribution phase (A4) is not included.

	A3 Manufacturing	Description
Hazardous waste disposed	<0.01	No hazardous waste disposed
Non-hazardous waste disposed	6.15e+6	Paper/plastic bags, paper cups, plastic/paper sheet/small wooden pieces etc...
Radioactive waste disposed	<0.01	No nuclear energy used

Data in Kg

5.5 Other output flows

The following output flows assessment refers to the production phases (A1-A3), distribution phase (A4) is not included.

	A3 Manufacturing
Components for re-use (Kg)	0
Materials for recycling (Kg)	543050
Materials Recycled In-house (Kg)	0
Materials for energy recovery (MJ)	0
Exported energy (MJ)	0

6.0 MANDATORY STATEMENTS

Explanatory material can be obtained from EPD owner and/or LCA author. Contact information can be found below. The verifier and The Program Operator do not make any claim or present any responsibility about the legality of the product.

The EPD owner has the sole ownership, liability, and responsibility for the EPD. EPDs within the same product category but from different programmes may not be comparable. EPDs of construction products may not be comparable if they do not comply with EN 15804.

7.0 CONTACT INFORMATION

<p>EPD Owner</p>	<p>Mr. Arulaazhi Ramanathan Production Manager Al Obeikan AGC for Glass LLC Dubai, UAE Tel: (+966) 55 507 5220 Email: arulaazhi.sr@agc-obeikanglass.com.sa www.agc-obeikanglass.com.sa</p> 
<p>LCA Author</p>	<p>Neil Beski Altun, Architect – Sustainable Design GCAS Quality Certifications P.O.Box 65561, Dubai, UAE www.gcasquality.com info.dubai@gcasquality.com</p> 
<p>Verifier</p>	<p>Professor Vladimír Kocí LCA Studio Šárecká 5,16000 Prague 6 - Czech Republic www.lcastudio.cz</p>

8.0 REFERENCES

LCA Report: Life Cycle Inventory of Al Obeikan AGC for Glass LLC

Software: Air.e LCA rev. 3.10.0.6 www.solidforest.com

Main database: Ecoinvent 3.6 www.ecoinvent.org

Geographical scope of the EPD: Kingdom of Saudi Arabia

Normative: ISO 14040:2006 "Environmental management -- life cycle assessment -- principles and framework"; ISO 14044:2006 "Environmental management -- life cycle assessment -- requirements and guidelines"; ISO 14020 "Environmental Labelling: General Principles"; ISO 14025:2006 "Environmental labels and declarations -- type III environmental declarations -- principles and procedures" and EN 15804.
