G L A S S - S O U R C E C O M P A N I O N

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How to read this companion

Every superscript citation number in the book resolves to one entry below. Each entry gives the source, how fully it was read, what it supports in the text, and its limits. Read levels: FULL (read end to end), EXCERPT (substantial portions read), ABSTRACT (abstract or summary only), SEARCH (search-result highlights and snippets, not the full document). Where sources conflict, the conflict is stated rather than smoothed over.

Section G - Core sources

G1 - USGS Mineral Commodity Summaries 2026: Soda Ash (January 2026)

Read level: FULL. The United States Geological Survey's annual soda ash chapter: US and world production, reserves and trade for 2021-2025, with prices and uses.

Supports: world soda ash production of about 71 million tonnes in 2025; roughly 45 percent of soda ash going to glassmaking; the dominance of natural trona from Wyoming and Turkey; the 2025 US price near $150 per tonne; glass as the industry's anchor customer.

Limits: 2025 figures are estimates; end-use percentages are USGS judgments assembled from industry reporting, not metered flows.

URL: `https://pubs.usgs.gov/periodicals/mcs2026/mcs2026-soda-ash.pdf`

G2 - USGS Mineral Commodity Summaries 2026: Sand and Gravel, Industrial (January 2026)

Read level: FULL. The USGS annual industrial-sand chapter: US production, uses, recycling notes.

Supports: US industrial sand production of about 120 million tonnes in 2025; glassmaking taking roughly 7 percent of US industrial sand (hydraulic fracturing dominates); US container-glass recycling of about a third.

Limits: US-focused; world glass-sand figures in the book come from other entries. Recycling rates are estimates.

URL: `https://pubs.usgs.gov/periodicals/mcs2026/mcs2026-sand-industrial.pdf`

G3 - Encyclopaedia Britannica: Glass (composition and properties article)

Read level: FULL. The Britannica technical article on glass: definition, the glass transition, composition families, oxide roles, colouring and physical properties.

Supports: the definition of glass as a rigid, disordered (amorphous) solid and the glass transition; the soda-lime recipe near three quarters silica, a sixth soda, a tenth lime; the soda lowering the melting point from above 1,700 to around 850 degrees; the roles of lime, magnesia and alumina; durability, hardness and insulating character; colouring and decolourising agents.

Limits: a tertiary reference; individual numbers are standard textbook values rather than primary measurements.

URL: https://www.britannica.com/technology/glass

G4 - Mordor Intelligence: Flat Glass Market report page

Read level: SEARCH (search-result highlights and the public abstract of a commercial market report).

Supports: world flat glass demand on the order of 83-86 million tonnes in 2025-2026, most of it for buildings; the scale framing used in chapters 1 and 34.

Limits: commercial estimates with undisclosed methodology; figures differ by a few million tonnes between research houses, so the book says 'on the order of'.

URL: https://www.mordorintelligence.com/industry-reports/flat-glass-market

G5 - ChinaData: glass production, China versus the world

Read level: SEARCH (data page assembled from Chinese industry statistics).

Supports: China producing roughly 60 percent of the world's glass by recent estimates - about 92 million tonnes against a world total near 155 million in 2025.

Limits: secondary compilation of Chinese sources; the world total depends on which glass families are counted. The book presents it as an estimate.

URL: https://chinadata.live/data/glass-production-china-vs-world/

G6 - Alistair Pilkington: Royal Society biographical memoir (2022)

Read level: EXCERPT (the Royal Society memoir of Sir Alastair Pilkington, read in substantial part).

Supports: the float glass invention narrative: Pilkington's 1952 idea, the seven years of pilot development, the cost of about 7 million pounds, the personal history of the inventor.

Limits: a memoir written in the commemorative genre; heroic in tone, checked against G7-G9.

URL: https://royalsocietypublishing.org/doi/10.1098/rsbm.2022.0025

G7 - 'A ribbon of glass': MRS Bulletin history of the float process (2006)

Read level: EXCERPT (historical review article, read in substantial part).

Supports: the technical detail of the float bath: molten glass on molten tin, the ribbon forming its own thickness, the annealing lehr; the chronology to the first sellable glass in 1959; the licensing wave that made float nearly universal.

Limits: published 2006; later market shares come from G4 and G32.

URL: https://doi.org/10.1557/mrs2006.181

G8 - Pilkington (NSG Group): the invention of float glass - company history pages

Read level: SEARCH (company history pages and their summaries).

Supports: the public chronology: the 20 January 1959 announcement, the 27 November 1959 date for the first consistently sellable float glass; float's spread to roughly 90 percent of world flat glass.

Limits: the company's own telling; dates cross-checked against G6 and G7.

URLs: `https://www.pilkington.com/en-gb/united-kingdom/about-us/pilkington-history/invention-of-float-glass` ; `https://www.pilkington.com/en-gb/united-kingdom/about-us/pilkington-history/the-inventor-of-float-glass`

G9 - Pilkington Family Trust: family and company timeline

Read level: SEARCH (family trust history pages).

Supports: the St Helens setting: the Pilkington family's glassworks, the town's dependence on the industry, the window-glass world before float.

Limits: heritage material, used for colour and context rather than figures.

URL: `https://www.pilkingtonfamilytrust.com/about-us/our-history/`

G10 - Metropolitan Museum of Art: Blown Glass from Islamic Lands (essay)

Read level: EXCERPT (Heilbrunn Timeline essay, read in substantial part).

Supports: the Islamic glassblowing tradition: forms, techniques and the continuity of the craft from Roman practice; the aesthetic context for chapters 8 and 12.

Limits: a museum essay for general readers; specifics of dating follow the museum's catalogues.

URL: `https://www.metmuseum.org/essays/blown-glass-from-islamic-lands`

G11 - The Conversation: how the invention of glassblowing changed everyday life in ancient Rome (2024)

Read level: EXCERPT (article by an archaeologist, read in substantial part).

Supports: the social history of the blowpipe: the first-century BC invention, the fall in glass prices, glass moving from luxury to everyday Roman life.

Limits: a journalistic essay; the underlying scholarship is Roman-glass archaeology (G13, G15).

URL: https://theconversation.com/how-the-invention-of-glassblowing-changed-everyday-life-in-ancient-rome-282054

G12 - Corning Museum of Glass: Ask a Glass Question - first recorded use of the blowpipe

Read level: EXCERPT (CMOG library answer quoting David Whitehouse, Glass of the Roman Empire, 1988).

Supports: the mid-first-century BC transformation of glassmaking by blowing; Whitehouse's account of glass ceasing to be exclusively a luxury; Strabo's copper-coin bowl; the Syrian-Palestinian origin evidence and the roughly 50 BC date.

Limits: a quotation of a 1988 synthesis; newer archaeology (G15) refines but does not overturn the picture.

URL: https://libanswers.cmog.org/faq/144349

G13 - Metropolitan Museum of Art: Roman Glass (essay)

Read level: EXCERPT (Heilbrunn Timeline essay, read in substantial part).

Supports: Roman glass production and consumption: core-forming to casting to blowing; the ubiquity of glass in the Roman world; surviving forms.

Limits: museum overview; quantitative claims about Roman output are avoided in the book.

URL: https://www.metmuseum.org/essays/roman-glass

G14 - Encyclopaedia Iranica: Glass (entry)

Read level: EXCERPT (scholarly encyclopaedia entry, read in substantial part).

Supports: glass in the Iranian world: pre-Islamic and Islamic production, the Sasanian and medieval Persian contribution, terminology.

Limits: an encyclopaedia entry; used for breadth across the Iranian world, not for chronology of specific sites.

URL: https://www.iranicaonline.org/articles/glass/

G15 - University of Missouri dissertation: early glass in the Syro-Palestinian region

Read level: EXCERPT (doctoral dissertation on Syro-Palestinian glass, abstract and substantial portions).

Supports: the archaeological case for the Syro-Palestinian coast as the home of early glassmaking and of the blowpipe; the Levant as the 'great glass shore' of the

ancient world.

Limits: a single dissertation's synthesis; the book presents the Levantine case as the mainstream view, not settled fact.

URL: `https://hdl.handle.net/10355/83550`

G16 - Muranoglass.com: ten facts about Murano glass

Read level: SEARCH (trade site facts page).

Supports: Murano colour: furnace customs, the guild's privileges and restrictions, the island's continuing brand.

Limits: a commercial site; used only for colour, never for contested history.

URL: `https://www.muranoglass.com/en/news-en/ten-facts-you-did-not-know-about-murano-glass/`

G17 - GlassOfVenice: history of Murano glass

Read level: EXCERPT (dealer history page, read in substantial part).

Supports: the Murano narrative: the 1291 furnace relocation, the rise of cristallo, the export trade, the secrets kept and lost.

Limits: a dealer's telling; key dates cross-checked against G18 and G19.

URL: `https://www.glassofvenice.com/murano_glass_history.php`

G18 - Artevivo magazine: Murano glass and the Venice furnaces

Read level: SEARCH (magazine article on the 1291 decree and the furnaces).

Supports: the 1291 relocation of Venice's furnaces to Murano - the fire-risk rationale and the concentration of the craft that followed.

Limits: a magazine article; the decree's exact terms are variously paraphrased in popular sources, and the book keeps to the agreed core.

URL: `https://artevivomagazine.com/murano-glass-venice-furnaces/`

G19 - Juarez Valero, CSIC: study of Venetian and Spanish Renaissance glass (2021)

Read level: EXCERPT (peer-reviewed archaeometry paper on cristallo composition, abstract and substantial portions).

Supports: the chemistry of cristallo: purified materials, the low-iron clarity that made Venetian glass the European standard; the analytical evidence behind the legend.

Limits: DOI: 10.3989/cyv.402012. Compositional data for specific assemblages; generalised carefully in the book.

URL: `https://doi.org/10.3989/cyv.402012`

G20 - University of Toledo: Owens-Illinois records - company timeline

Read level: EXCERPT (Toledo attic / Ward M. Canaday Center exhibit timeline of Owens-Illinois).

Supports: the Toledo machine-age chronology: Michael Owens, the Owens Bottle Machine Company, the growth into Owens-Illinois.

Limits: an institutional archive page; figures about the machine itself rest on G21 and G22.

URL: `https://www.utoledo.edu/library/canaday/services/exhibits/oi/OIExhibit/timeline.htm`

G21 - ASME: Owens AR Bottle Machine - historic mechanical engineering landmark

Read level: EXCERPT (American Society of Mechanical Engineers landmark citation).

Supports: the 1903 Owens machine as a landmark of mechanical engineering; the machine's working principle and its designation history.

Limits: a commemorative citation; output figures are cross-checked with G22.

URL: `https://www.asme.org/about-asme/engineering-history/landmarks/86-owens-ar-bottle-machine`

G22 - Society for Historical Archaeology: The Owens Bottle Company (part 1)

Read level: EXCERPT (SHA historic bottle research PDF on the Owens Bottle Company).

Supports: the machine's economics: the Model A's twelve bottles a minute, the fall of the bottle's cost from about $1.80 to about $0.10-0.12 a gross; the licensing structure of the early industry; the end of the child-labour bottle trade.

Limits: company-history research of high quality, but one source for the cost figures; the book gives ranges.

URL: `https://secure-sha.org/bottle/pdffiles/OwensBottleCoPart1.pdf`

G23 - FEVE: Market Report 2025 - abstract for publication

Read level: ABSTRACT (the published abstract of the European Container Glass Federation's 2025 market report).

Supports: EU food and beverage container glass of about 20.3 million tonnes and 73.3 billion units in 2025; average container weight near 277 grams; the share of returnables near 40 percent in some markets.

Limits: the abstract only; the federation represents the industry it measures, and its figures are production-side.

URL: `https://feve.org/wp-content/uploads/2026/07/FEVE-Market-Report-Year-2025-Abstract-for-publication-1.pdf`

G24 - Close the Glass Loop: glass collection for recycling rate in 2024

Read level: SEARCH (platform results page for the 2024 collection figures).

Supports: an EU collection rate for glass packaging of 82.2 percent in 2024; the 'over 80 percent' European collection figure in chapter 3.

Limits: a platform of the packaging value chain; collection is not recycling, and the book uses the word 'collects'.

URL: `https://closetheglassloop.eu/glass-collection-for-recycling-rate-in-2024/`

G25 - FEVE position paper: glass packaging circularity and cullet (May 2026)

Read level: EXCERPT (federation position paper).

Supports: the circularity argument: glass recycled endlessly without quality loss, about 85 percent of collected glass packaging returning to new bottles and jars; the case for cullet in the furnace.

Limits: an industry advocacy paper; its framings are attributed in the text rather than adopted.

URL: `https://feve.org/wp-content/uploads/2026/05/FEVE-position-Glass-packaging-circularity-and-cullet-May-2026.pdf`

G26 - Saint-Gobain: 2025 Annual Integrated Report

Read level: EXCERPT (company integrated report; key figures and highlights).

Supports: Saint-Gobain 2025 sales of 46.5 billion euros (46,483 million euros, audited 2025 results approved February 26, 2026); 162,000 employees in 80 countries; the company's 1665 mirror-works origin in the book's portrait.

Limits: company-reported; glass is one part of a diversified group, and the book says so.

URLs: `https://www.saint-gobain.com/sites/saint-gobain.com/files/media/document/CP_Resultats_2025_VA_t.pdf` ; `https://www.saint-gobain.com/en/finance/saint-gobain-figures`

G27 - NSG Group: FY2025 annual consolidated financial results

Read level: EXCERPT (Nippon Sheet Glass FY2025 results announcement, English translation).

Supports: NSG revenue of 840.4 billion yen (840,401 million yen) in the financial year to March 2025; NSG's ownership of Pilkington and with it the float patent's home.

Limits: company-reported; the Pilkington acquisition history (2006) is standard.

URL: `https://www.pilkington.com/-/media/nsg/site-content/ir/financial-reports/annualresults2025_3_e01.pdf`

G28 - O-I Glass: full-year 2025 results, 10-K and earnings coverage

Read level: EXCERPT (O-I full-year 2025 results release and 2025 10-K).

Supports: O-I 2025 net sales of 6,426 million dollars (6.4 billion); O-I as the world's largest glass-container maker and the direct heir of Owens's machine company; Verallia's and Ardagh's positions in the container hierarchy.

Limits: company-reported; rankings are shipment-based industry commonplaces.

URLs: `https://investors.o-i.com/news/news-details/2026/O-I-Glass-Reports-Full-Year-and-Fourth-Quarter-2025-Results/default.aspx` ; `https://www.sec.gov/Archives/edgar/data/812074/000110465926014319/oi-20251231x10k.htm`

G29 - Corning Incorporated: 2025 10-K and fourth-quarter 2025 results

Read level: EXCERPT (fourth-quarter and full-year 2025 results release and the 8-K financial tables, including segment detail).

Supports: Corning 2025 GAAP net sales of 15,629 million dollars (15.6 billion) and core, non-GAAP sales of 16,408 million (16.4 billion); optical communications, display and specialty materials together about 78 percent of GAAP sales; the company's spread across Pyrex, the ribbon machine, fibre and Gorilla Glass.

Limits: company-reported; the book's sentence leads with the GAAP figure and names the core figure as the company's preferred non-GAAP basis.

URLs: https://www.sec.gov/Archives/edgar/data/24741/000002474126000034/glw-20251231xex99xq42025.htm ; https://investor.corning.com/news-and-events/news/news-details/2026/Corning-Announces-Outstanding-2025-Financial-Results-1--Upgrades-Springboard-Plan-for-Faster-Sales-Growth-on-Significantly-Enhanced-Financial-Profile/default.aspx ; https://www.corning.com/media/worldwide/global/documents/corning_10-k_2025.pdf

G30 - AGC Inc: FY2025 financial review

Read level: EXCERPT (AGC FY2025 financial review PDF and results highlights).

Supports: AGC 2025 net sales of 2,058.8 billion yen (2,058,832 million) across glass, electronics, chemicals and life science; architectural glass 441.1 billion yen and automotive 520.6 billion yen, together 961.7 billion - near a trillion yen; the company as the descendant of Asahi Glass.

Limits: company-reported; segment rounding is the book's.

URL: https://www.agc.com/ir/library/financial/pdf/financial2025.pdf

G31 - Xinyi Glass: broker initiation and company reports (2019, dated)

Read level: EXCERPT (Bank of America Merrill Lynch initiation and related reports hosted by the company, read in excerpt).

Supports: Xinyi as China's largest float glass producer with about a tenth of national capacity, and the world's largest supplier of automotive replacement glass (about a quarter of that market).

Limits: dated 2019 research; market shares have moved since, and the book presents them as recent-history orders of magnitude, not current figures.

URLs: https://www.xinyiglass.com/uploadfiles/2019/11/20191118115950503.pdf ; https://www.xinyiglass.com/uploadfiles/2019/10/20191014113050011.pdf

G32 - Mysteel: global photovoltaic glass supply and demand review (2025)

Read level: SEARCH (Chinese commodity-research article on global solar glass).

Supports: 2024 world photovoltaic glass capacity of about 46.5 million tonnes, of which China about 43.4 million tonnes (some 93 percent); world output about 31 million tonnes with China's share near or above 90 percent.

Limits: Chinese industry statistics; capacity is not output. The book distinguishes the two.

URL: https://www.mysteel.com/oilchem/a/25051514/0ABC5FD896FC814C.html

G33 - Royal Society of Chemistry, Sustainable Energy & Fuels: review of issues and opportunities for glass in solar energy

Read level: EXCERPT (peer-reviewed review article, abstract and substantial portions).

Supports: the demand projection that solar deployment could require on the order of 89 million tonnes a year of photovoltaic glass against a supply around 24 million tonnes; the low-iron sand requirement and its competition with other uses.

Limits: a projection under stated deployment scenarios, not a forecast; the book presents it as an estimate of scale.

URL: `https://pubs.rsc.org/se/article/9/6/1414/871403/Review-of-issues-and-opportunities-for-glass`

G34 - HORN Glass Industries: ZeroCO2Glas project update

Read level: SEARCH (furnace builder's project page).

Supports: the existence and direction of the ZeroCO2Glas low-carbon furnace project as an example of the industry's decarbonisation engineering.

Limits: a vendor project page; used as an example, not an endorsement of results.

URL: `https://www.hornglass.com/company/news/detail/update-on-the-zeroco2glas-project-status`

G35 - Ardagh Glass Packaging: hydrogen from an onsite electrolyser at Limmared

Read level: EXCERPT (company press release).

Supports: the December 2024 start of a 5-megawatt electrolyser supplying hydrogen to the Limmared furnace in Sweden - a working industrial hydrogen-glass trial.

Limits: a company announcement; blend shares and savings are the company's own.

URL: `https://www.ardaghgroup.com/corporate/news-centre/detail/34285/Ardagh+Glass+Packaging+pioneers+hydrogen+energy+mix+from+onsite+electrolyser`

G36 - Verallia: experimenting with hydrogen combustion in its glass furnaces

Read level: SEARCH (company page on the Essen hydrogen trials).

Supports: Verallia's hydrogen combustion trials at Essen as part of the industry's fuel-switching experiments.

Limits: company communication; trial scale is small relative to a furnace's fuel demand.

URL: `https://www.verallia.com/en/verallia-is-experimenting-with-hydrogen-combustion-in-its-glass-furnaces/`

G37 - US Department of Energy: hybrid glass furnace demonstration (Gallo)

Read level: SEARCH (DOE NEPA categorical-exclusion record for the demonstration project).

Supports: the DOE-supported hybrid (part-electric) glass furnace demonstration with Gallo as evidence of public backing for furnace electrification.

Limits: an environmental-review record, not a results report; the book claims the project's existence and intent only.

URL: `https://www.energy.gov/nepa/articles/cx-033531-demonstrating-hybrid-glass-furnace-technology-support-decarbonization`

G38 - FEVE: Decarbonisation Report 2025

Read level: EXCERPT (federation report on decarbonising container glass).

Supports: the decarbonisation pathways for container glass - cullet, electrification, hydrogen, oxy-fuel - and their relative maturity, as used in chapter 38.

Limits: an industry federation's view of its own transition; costs and timelines are the federation's.

URL: `https://feve.org/wp-content/uploads/2026/03/FEVE-Decarbonisation-Report-2025.pdf`

G39 - George Ravenscroft and the invention of lead glass (source set)

Read level: EXCERPT (Courtauld Illuminating Objects essay; Historic England research report; glassmaking-in-london.co.uk).

Supports: Ravenscroft's 1674 patent, the crizzling crisis and its cure with lead oxide; lead glass's brilliance and workability; the 1676 royal warrant; the English displacement of Venetian cristallo in fine tableware.

Limits: the standard account; details of the Savoy workshop rest on a small documentary base.

URLs: https://sites.courtauld.ac.uk/illuminating-objects/illuminating-objects-home/filigree-drinking-glasses/new-material-lead-glass/ ; https://historicengland.org.uk/research/results/reports/21-2005 ; https://www.glassmaking-in-london.co.uk/ravenscroft

G40 - Obsidian at Catalhoyuk (source set)

Read level: ABSTRACT (Cambridge Anatolian Studies abstracts: obsidian use and provenance at Catalhoyuk).

Supports: obsidian as the best cutting edge of the Neolithic; Catalhoyuk's blades sourced from Cappadocian volcanoes about 120 kilometres away, with prized pieces from more than 600 kilometres; conchoidal fracture and the sharpness of volcanic glass.

Limits: abstract-level reading; distances and source attributions follow the published geochemistry.

URLs: https://www.cambridge.org/core/journals/anatolian-studies/article/abs/true-gift-of-mother-earth-the-use-and-significance-of-obsidian-at-catalhoyuk/82AE49F52A2ED83680A51EBFFD56E4D6 ; https://www.cambridge.org/core/journals/antiquity/article/abs/eastern-anatolian-obsidians-at-catalhoyuk-and-the-reconfiguration-of-regional-interaction-in-the-early-ceramic-neolithic/F43C84ED4CE5A0910FE5938905D06BC5

G41 - Safety glass: invention and types (source set)

Read level: EXCERPT/SEARCH (McGill Office for Science and Society history; laminated and tempered glass references; Saint-Gobain Sekurit process pages).

Supports: Benedictus's 1903 celluloid sandwich and its accidental discovery; lamination and tempering as the two safety strategies; the automotive adoption of both.

Limits: popular-history sources for the Benedictus anecdote; the technical descriptions are standard.

URLs: https://www.mcgill.ca/oss/article/history-you-asked/what-safety-glass ; https://en.wikipedia.org/wiki/Laminated_glass ; https://www.saint-gobain-sekurit.com/global-excellence/our-production-processes

G42 - The earliest glass: faience, Amarna and the first true glass (source set)

Read level: EXCERPT (Persee excavation proceedings; UCL Digital Egypt; Rehren and Pusch analyses; British Museum blog; Cardiff archaeometry volume).

Supports: faience as the glaze before the glass; true glass from about 1600-1500 BC in Mesopotamia and Egypt with priority unsettled; the Amarna and Qantir furnace evidence for Egyptian primary production; core-forming; glass priced with precious materials ('worth more than gold'); the Uluburun ingot cargo; the shift in scholarship away from a single Mesopotamian origin.

Limits: a fast-moving field; the book states the priority question as open, following these sources.

URLs: `https://www.persee.fr/doc/mom_1274-6525_2000_act_33_1_1871` ; `https://www.ucl.ac.uk/museums-static/digitalegypt/glass/beforenewkingdom.html` ; `https://repository.cyi.ac.cy/bitstream/CyI/1187/1/Thilo%20Origin%20of%20glass%20Final%20ThR%20illus.pdf` ; `https://www.britishmuseum.org/blog/glorious-glass-worth-more-gold` ; `https://orca.cardiff.ac.uk/id/eprint/103999/2/Edited%20Identifying%20the%20Characteristics%20of%20the%20Earliest%20Glass%20Works%20From%20Excavations%20final.pdf`

G43 - Gorilla Glass: the iPhone origin story (source set)

Read level: EXCERPT (The Verge, Fast Company and Time retrospective accounts).

Supports: the 2006-2007 crash project: Steve Jobs's demand for a scratch-proof phone cover, Corning's revival of Chemcor as Gorilla Glass, the weeks-to-production story; the scale of the cover-glass market that followed.

Limits: journalistic reconstructions built around interviews; dialogue is the reporters'.

URLs: `https://www.theverge.com/2019/7/9/20687299/plastic-iphone-gorilla-glass-origin-story-steve-jobs` ; `https://www.fastcompany.com/40493737/how-cornings-crash-project-for-steve-jobs-helped-define-the-iphone` ; `https://techland.time.com/2013/01/11/a-story-about-steve-jobs-steel-balls-and-gorilla-glass-you-with-the-cracked-phone-read-this/`

G44 - Corning: the history of strengthening glass

Read level: EXCERPT (company technical history of chemical and thermal strengthening).

Supports: the strengthening story: thermal tempering, ion exchange, Chemcor in the 1960s, and the line from the 1960s programme to Gorilla Glass.

Limits: the company's own history; dates cross-checked against G43.

URL: `https://www.corning.com/worldwide/en/innovation/materials-science/glass/history-strengthening-glass.html`

G45 - Nobel Prize in Physics 2009: advanced information (Kao)

Read level: EXCERPT (the Nobel Foundation's scientific background document for the 2009 prize).

Supports: Kao's 1966 argument that fibre loss was impurity-driven, not fundamental; the 20 dB/km target; the prize's framing of the fibre revolution.

Limits: the prize committee's retrospective; the 1966 paper itself is G47-adjacent literature.

URL: `https://www.nobelprize.org/uploads/2018/06/advanced-physicsprize2009.pdf`

G46 - Nature Materials: the birth of optical communications (milestone)

Read level: EXCERPT (Nature milestone essay on the origins of optical fibre communication).

Supports: the 1966 Kao-Hockham proposal and the prehistory of fibre optics; the loss budgets that defined the problem.

Limits: a milestone essay; the primary 1966 paper is paywalled.

URL: `https://www.nature.com/articles/milephotons13`

G47 - IEEE Spectrum: how Charles Kao beat Bell Labs to the fibre-optic revolution

Read level: SEARCH (IEEE Spectrum feature).

Supports: the Kao narrative: the Standard Telecommunication Laboratories work, the scepticism of the laboratories, the vindication; colour for chapter 32.

Limits: a magazine feature; technical specifics follow G45 and G46.

URL: `https://spectrum.ieee.org/how-charles-kao-beat-bell-labs-to-the-fiberoptic-revolution`

G48 - Corning: optical fibre timeline (1970 breakthrough)

Read level: EXCERPT (company timeline of the 1970 low-loss fibre).

Supports: Corning's 1970 achievement of the first fibre below 20 dB/km (Maurer, Keck and Schultz); the titanium- and later germanium-doped silica core; the manufacturing lineage.

Limits: company history; the 1970 milestone is also documented in the Nobel background (G45).

URL: `https://www.corning.com/worldwide/en/markets/Optical-Communications-Market/streamlined-connectivity/timeline-1970.html`

G49 - Pyrex: borosilicate kitchen glass (source set)

Read level: EXCERPT (Corning's Littleton profile; CMOG Pyrex article via the Internet Archive; Smithsonian magazine; National Inventors Hall of Fame; CMOG's Women and Pyrex).

Supports: the borosilicate story: Jesse Littleton and the 1915 battery-jar-to-casserole experiment; borosilicate's thermal-shock resistance and laboratory use; the later soda-lime shift of some consumer Pyrex lines, which the book notes.

Limits: the soda-lime 'pyrex' variant is a perennial source of confusion; the book distinguishes the two explicitly.

URLs: `https://www.corning.com/worldwide/en/innovation/culture-of-innovation/legendary-scientists-littleton.html` ; `https://web.archive.org/web/20231208115730/www.cmog.org/article/pyrex` ; `https://www.smithsonianmag.com/innovation/how-pyrex-reinvented-glass-new-age-180955513/` ; `https://www.invent.org/blog/inventors/who-invented-pyrex`

G50 - Smart glass: electrochromic glazing (source set)

Read level: EXCERPT/SEARCH (NEXT Energy Technologies on smart-glass lessons; Datanext market page).

Supports: electrochromic glass: how it works, its promise for building energy, the slow history of smart glass 1.0; market size framing kept qualitative.

Limits: vendor and market-research material; the book makes no market-size forecast.

URLs: `https://www.nextenergytech.com/post/lessons-learned-from-smart-glass-1-0` ; `https://datanextresearch.com/report/electrochromic-smart-glass-market`

G51 - Fibreglass and glass wool (source set)

Read level: EXCERPT (National Inventors Hall of Fame on Games Slayter; Owens Corning's 75-year release; Science History Institute; encyclopaedic company history).

Supports: the 1930s invention of practical glass fibre: Slayter and the Owens-Illinois/Corning Fiberglas venture of 1938; insulation wool and continuous filament; the composite and insulation markets.

Limits: company-commemorative sources for the founding story; the technical claims are standard.

URLs: `https://www.invent.org/inductees/games-slayter` ; `https://newsroom.owenscorning.com/all-news-releases/news-details/2013/Owens-Corning-Celebrates-75-`

Years-in-Business-Looks-Ahead-to-a-Bright-Future/default.aspx ; https://www.sciencehistory.org/stories/magazine/in-the-pink/

G52 - S. Donald Stookey and glass-ceramics (source set)

Read level: EXCERPT (National Inventors Hall of Fame; New York Times obituary; Journal of the Ceramic Society of Japan review).

Supports: Stookey's accidental 1952 overheating of a photosensitive glass and the invention of glass-ceramics; Corning Ware, Pyroceram and the missile-radome origin; the disciplined-crystallisation principle in chapter 30.

Limits: the founding anecdote is told by the company and the obituaries; the materials science is standard.

URLs: https://www.invent.org/inductees/s-donald-stookey ; https://www.nytimes.com/2014/11/07/business/s-donald-stookey-inventor-of-corningware-dies-at-99.html?_r=1 ; https://www.jstage.jst.go.jp/article/jcersj2/130/8/130_22037/_pdf

G53 - The Fresnel lens (source set)

Read level: EXCERPT (US National Park Service; US Lighthouse Society; Smithsonian magazine; IEEE Spectrum milestone).

Supports: Fresnel's 1822 stepped lens and its orders; the near-total capture of a lamp's light versus the reflector's fraction; the spread of the lens through the world's lighthouses and its retirement into museums.

Limits: heritage sources; the capture figures are the standard comparison quoted by these institutions.

URLs: https://www.nps.gov/articles/fresnel-lens.htm ; https://uslhs.org/node/1613 ; https://www.smithsonianmag.com/science-nature/science-makes-a-better-lighthouse-lens-170677431/ ; https://spectrum.ieee.org/fresnel-lens-milestone

G54 - Spectacles: the first prosthesis (source set)

Read level: EXCERPT (College of Optometrists museum; Oxford Cabinet of Curiosities; Europeana; American Academy of Ophthalmology).

Supports: the invention of spectacles in Italy around 1280-1290; the early convex lenses for the aging eye; the spread through manuscript culture and the printing press; concave lenses for myopia arriving later.

Limits: the invention is undocumented at the moment it happened; the book follows the museums' dating with the usual caveats.

URLs: https://www.college-optometrists.org/the-british-optical-association-museum/the-history-of-spectacles ; https://www.cabinet.ox.ac.uk/spectacles-technology-unknown-ancients-c-1290 ; https://www.europeana.eu/en/stories/the-history-of-spectacles ; https://www.aao.org/lifetime-engaged-ophthalmologist/perspective/article/brief-history-of-spectacles

G55 - The Corning ribbon machine and the light-bulb industry (source set)

Read level: EXCERPT (ASME landmark citation; MIT Technology Review on Edison's bulb; CMOG library guide).

Supports: the ribbon machine's production of bulb blanks at a pace hand and bottle machines could not match - hundreds of bulbs a minute in later versions; the bulb as the cheap, disposable glass object; the machine's role in making electric light universal.

Limits: production figures vary by machine generation; the book keeps to the scale, not a single number.

URLs: https://www.asme.org/about-asme/engineering-history/landmarks/81-corning-ribbon-machine ; https://www.technologyreview.com/1998/05/01/102221/building-edisons-bulb/ ; https://libguides.cmog.org/corning_incorporated/ribbon_machine

G56 - Sisecam: 12M 2025 investor presentation

Read level: SEARCH (company investor presentation, search highlights).

Supports: Sisecam of Turkey operating across flat glass, glassware, glass packaging and chemicals (soda ash) - the profile in chapter 34.

Limits: company-reported; used for the business-line profile only.

URL: https://www.sisecam.com/en/s-investor-relations/InvestorPresentations/1.%20SISECAM%2012M%202025%20-%20INVESTOR%20PRESENTATION.pdf

Coverage statement

Fifty-six entries. Every citation in the manuscript resolves to one entry above, and every entry above is cited in the manuscript. The read levels matter when weighing any claim. Entries marked FULL were read end to end and can bear the specific figures the manuscript draws from them. Entries marked EXCERPT rest on substantial portions; ABSTRACT on an abstract or summary only; SEARCH on search-result excerpts rather than the full document. Where the read level is SEARCH or ABSTRACT - notably G4, G5, G8, G9, G24, G32, G34, G36, G37, G40, G47, G50 and G56 - the manuscript keeps the claims resting on them deliberately qualitative, and the reader should treat those claims as well-signposted context rather than settled figures. Where sources disagree, the disagreement is stated in the entry rather than smoothed over. Known open items at publication: the Xinyi market shares are 2019 research (G31) and will have moved; the China share of world glass production is a secondary compilation (G5); photovoltaic glass capacity and output figures rest on Chinese industry statistics (G32); the 89-million-tonne solar-glass requirement is a scenario projection, not a forecast (G33).