



**Towards an
International Year of Glass
in 2022**

Promoted by



International Commission on Glass

ICG



ICOM international committee for museums and collections of glass

GLASS



History is full of milestones, turning points where advances in glass stimulated change:

- 3500 years ago, glass beads & jewellery
- 3000 years, exquisite Egyptian bottles for expensive perfumes;
- As BC became AD, glass-blowing gave intricate, collectable objects;
- A millennium ago, glass windows flooded our sacred buildings with light, elaborate goblets celebrated dynasties, decorated mosque lamps spoke of a patron's generosity.

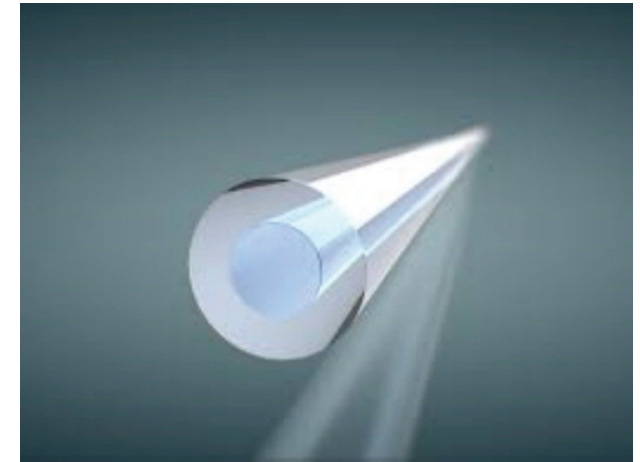
- Now we view the world through glass – our phone screens - glass fills our architectural skyline, solar panels and glass-reinforced wind turbines blades dominate renewable energy markets, and glass is integrated into the fine arts.

Scientific endeavour has also relied on glass:

- Galileo's telescope opened our eyes to the wonders of the cosmos;
- microscopes let us study cells and microbes and so understand diseases;
- light bulbs enabled reading and night-working,
- glass valves ushered in electronics,
- and now optical fibres are the hidden network behind the world-wide web.

Glass is the sustainable tool supporting

our developed society. Appropriately ancient writers equated the glassblower's breath with the wisdom of the philosopher Seneca. Some suggest we now live in '**The Glass Age**'.



Glass optical fibre preform

Milestones to be celebrated in 2022:

- 670th anniversary of first depiction of eyeglasses in a painting;
- 200 years of Fresnel Lenses in coastal lighthouses;
- 100 years since glass discovered in King Tutankhamun's Tomb;
- 100 years of the German Society of Glass Technology (DGG);
- 70th anniversary of the Pilkington patent for *Float Glass*;
- 60 years of the Studio Glass Movement;
- 45th anniversary of Anderson, Mott & Van Vleck's Nobel prize (glassy materials).

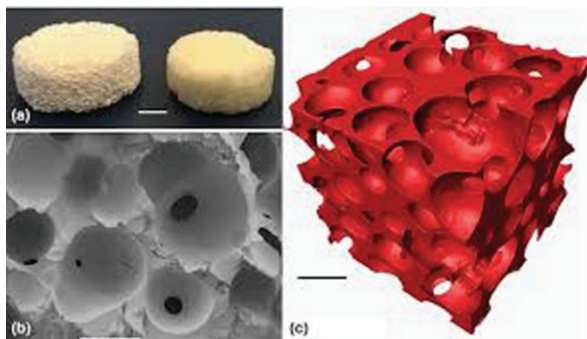


United Nations building in glass

Our vision

Our vision for a United Nations International Year of Glass (IYoG2022) is to celebrate the past, present and future of this transformative material by:

- Demonstrating its role in advancing civilization throughout recorded history.
- Organizing international festivals, with workshops that excite and inform the public of this rich history, and highlight links between glass, art and culture.
- Holding: an inaugural *Conference* in Geneva, Switzerland; a July *International Glass Congress* in Berlin, Germany; a *Glass Technology event* in China; a Congress in Egypt; and a *World Congress and Exhibition* on glass art and history.
- Stimulating glass research in educational organizations, industry, and the public domain, including museums, to address the great challenges the world faces such as sustainable, equitable growth and an improved quality of life for all.
- Building worldwide alliances focusing on science and engineering for young people,



Bioglass structures

addressing gender balance and tackling the needs of emerging economies.

UN developmental Goals and Glass

The UN has set a series of development goals with a completion date of 2030. In the following we demonstrate how glass is helping to address these targets.

GOAL 3: Good health and well-being

Biocompatible and bioactive glasses have been universally life changing for patients. Specialty glasses can bond broken bones without rejection. Deep, persistent wounds, especially in diabetic patients, are hard to treat but new glasses show a remarkable restorative capacity.

Porous hollow glass microspheres (HGMs) can encapsulate fragile drugs but reject undesired biological agents. Radioactive Yttrium-90 delivered in HGMs has treated liver cancer.

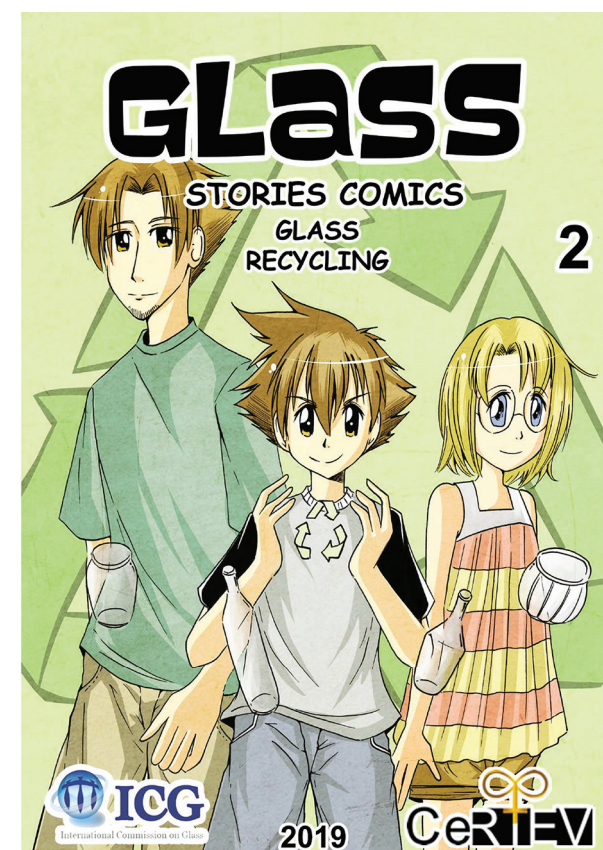
Chemically inert glass vials, cartridges, syringes and ampoules prevent interaction with their contents, particularly active formulations. The EpiPen® auto-injector cartridge treats severe allergic reactions - at its heart is chemically strengthened glass; millions have been made. Glass has multiple roles in orthodontics and even toothpaste.

GOAL 4: Quality education

A quality education underpins sustainable development. An inclusive education

delivers the tools to create innovative solutions for the world's pressing problems. A well-rounded education offers insights into how society copes with change.

Education is at the heart of the International Commission on Glass (ICG); it links experts in science, technology, art, history and education and in the last decade has organized 20 schools in Europe, China, India, North America and South America. The book *Teaching Glass Better* celebrates these Schools, capturing their development and summarizing content.





ICG Summer School class

Sharing staff across schools propagates best practice. An ICG Youth Outreach team arranges events and mentors to attract and retain future talent.

Beyond ICG University Glass Art programs are transforming craftspeople into sculptors. Brazil and India already run educational glass programs for younger students and technicians. ICG actors represent many international teaching organizations - our IYoG goals are to share aspirations, stimulate fresh ideas and seed new courses.

GOAL 5: Gender equality

Gender equality is a fundamental human right, a foundation for a peaceful, prosperous and sustainable world. A must for the IYoG, it will be achieved by recruiting top glass-women for plenary and invited talks, as well as CEO and Management

Board positions. The IYoG board will propose and support committees chaired by women and, whether organising a congress or a smaller event, a balanced constituency. Educating industry and institutions to manage diversity, making it an engine for innovation and creativity, is the best path to a brighter future. Gender matters. Women are half of the world; they must become half the glass world.



Goal: a 50:50 admin split

GOAL 6: Clean water and sanitation

In the last century billions have experienced an unprecedented rise in living standards, but many still live in poverty with little access to clean water. Sufficient fresh water exists but damaging economics or poor infrastructure cause millions to die annually from diseases linked to inadequate supplies, sanitation and hygiene. Similar issues impact adversely on food security, life choices and educational opportunities.

Industrial discharges, excess agrochemicals and domestic waste landfill

contaminate surface and groundwater. Glass can mimic current water treatment processes. Porous foam glass or phase separated glass filters can aid sanitization (and purify air, another global issue). Sunlight on coated glass immersed in solutions of organic pollutants can oxidize many into non-toxic products and likewise restore drinking water. Most cost-effective is a combination of porous glass filters with titania-coated glass.

GOAL 7: Affordable and clean energy

Energy epitomises the opportunities and challenges the world faces. Universal access to energy is crucial to build more sustainable and inclusive communities and in turn entails more efficient generation, renewable energy sources and ways to store it. Sunlight is the main carbon-neutral source and brings more energy hourly to the earth than society consumes annually, But renewable energy is just 17% (2018) of global consumption.

Solar energy harvesting uses: photovoltaic cells, solar thermal energy generation and photobioreactors. Photovoltaics need glass protective covers which are highly transparent and have antireflection coatings. Solar thermal devices have glass mirrors to reflect the sun's rays and heat a fluid inside a glass tube, which powers a generator. In photobioreactors, microorganisms such as green algae grow in glass tubes, converting



Architectural glass, the Louvre, Paris

solar into chemical energy.

Turbine blades made from fiberglass-reinforced composites convert wind energy to electricity. Improved glass design has created stronger composites and given us larger, more efficient and reliable windmills.

Nuclear power is another low carbon energy source but generates radioactive waste that decays over geological time. New glasses will dissolve and immobilise this waste.

New glasses are also improving solid-state batteries and hollow glass microspheres may have a role in hydrogen storage for transport.

GOAL 9: Industry, innovation, infrastructure

Investing in infrastructure such as communication technologies is imperative for sustainable development and increases social cohesion. Low-loss glass optical

fibers were the precursor to the Internet and catalysed a paradigm shift in global communications. They are indispensable in our knowledge-based society.



Glass fibre optics play a vital role in communications

Product development is being driven by the demand to send more data further; on the horizon are photonic crystal fibers (made from glass) and communication via quantumly entangled photons.

But photonics is more than fibers: optical communications industries manage information streams with circuitry fabricated wholly or partly in glass such as spherical lenses, prisms and beam splitters.

Recent advances concern signals such as 5G carried over fiber-optic cables. Fiber lasers exploit rare earth doped glass and are now standard for many applications. Their use in surgery and therapy is expanding and they are furthering studies in nonlinear optics.

LEDs based on light emission from crystalline semiconductors, require a phosphor, often a doped glass, to produce white light. One-dimensional photonic structures, which can manipulate light, are made by depositing glass layers with different refractive indices. 2D and 3D photonic crystals require self-assembling glass nanoparticles and are attracting interest as sensors.

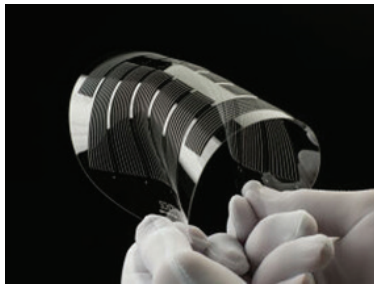
Television began with glass cathode ray tubes before moving to glass flat panel displays. As resolution improves and pixel size shrinks, thin film deposition display electronics need panels with exceptionally stable dimensions. Ultra-thin glasses for bendable, even foldable displays are being developed. Integrated optical circuits in films on ultra-thin glasses may soon lead to a breakthrough like that in flexible electronics. Glasses to visualize information through augmented and virtual reality devices offer another revolution.



3D printed glass artefact

Glasses have transformed data storage. Rewritable storage is realized by toggling regions between glassy and crystalline states. Magnetic memory disks are high-strength, high-stiffness glasses for faster reading and higher densities. Glass holographic memories promise exceptional capacity.

Sol-gel has been a developing process technology for 50 years. Low temperature and low cost, it works well for coatings and membranes and offers: mechanical and corrosion protection; anti-reflectivity; hydrophobicity; photocatalytic self-cleaning; with optical and optoelectronic functions such as filters, switches, waveguides and integrated optical circuits for solar cells, solid-state lighting and communications.



Thin and flexible glass for future applications

GOAL 11: Sustainable cities & communities

Cities are hubs for ideas, commerce, culture, science, production, social development and more. At their best, cities have enabled social and economic advances. But by 2030 cities will house

5 billion people and require efficient management. Issues include: congestion, underfunded services, a lack of adequate housing, solid waste management, ageing infrastructure and air pollution.

In transport, glazing allows unimpaired vision and contributes to safety and security, as well as style. So, airplane cockpit windshields are chemically strengthened. Innovative designs offer thermal comfort; improve fuel efficiency by light-weighting; and integrate display features which expand entertainment and connectivity options.

Contemporary architectural designs use larger windows with more energy-efficient coated panes and new double/triple glazing formats. Buildings may soon be energy-neutral or even contribute to the energy grid.

A TNO study showed that new glazing could reduce energy consumption across the EU by 30% in 2030, saving CO₂ emissions of 94 million tons. Savings are potentially greater using glazing-integrated photovoltaics, switchable/electrochromic glazing and other novel technologies. The EU aims by 2050 to have the first climate neutral economy.

Glass containers lessen solid urban waste (SUW). The “*Reduce, Reuse, Recycle*” philosophy is vital to a sustainable lifestyle and waste management. 60% of SUW is packaging, mostly single use, often non-renewable or scarce materials. ‘*Reduce*’

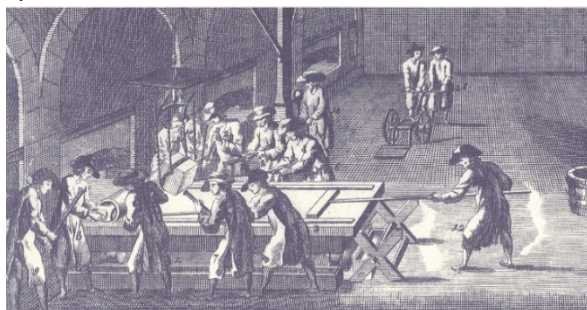
means using durable goods such as glass kitchenware. Some hotels and restaurants use returnable glass bottles for ‘*Reuse*’ and glass jars are often *reused* for storage. Supermarkets though prefer single-use containers leading to the third R, ‘*recycling*’, the transformation of an object into a raw material and back. Glass is the only truly recyclable container: one glass bottle produces another, a perfect “circular economy” expressed as “from cradle to cradle”. Glass containers are the only ones with the GRASS and Food Safety stamp in Europe and US.



Glass bottles: easily recycled or reused

Culture is essential to city life, enhancing the well-being of its inhabitants. Museums have a strategic role, preserving the heritage of humanity for scholarship and enjoyment. In museums with glass collections art, science, archaeology, history and social sciences meet. Glass objects spanning history, works of art and glass for everyday use, are displayed with specialized glassware for industry

and science. They describe raw materials and production, telling the stories of those who made and used them. Glass museums, particularly ones with hot and cold workshops, promote lifelong learning through programs for young and old (Goal 4).



Early production of large glass sheets

GOAL 12: Responsible consumption & production

Sustainability means “doing more and better with less”. It concerns efficiency throughout the life cycle; infrastructure, supply chains and basic services; green and decent jobs; and a better quality of life for all.

Glass firms are addressing these environmental challenges and ICG organizes international bench-marking exercises to stimulate improvement. Glass is innately environmentally friendly. Most glasses are made from safe, readily available raw materials. Recycling rates are high and industry actively seeks more energy efficient melting technologies and alternative glass compositions to reduce

its carbon footprint. It has a rich history of responding to challenge, a valuable example for the future.



The glass industry has a long history of energy conservation. Electric melting and hydrogen based fuels offer sustainability

Educating consumers on sustainable lifestyles depends on distributing information through standards, labels and advertising. The concept of a “circular economy” needs to be understood so all can commit to the challenges of global change; ways to maintain lifestyle without damaging the planet need explaining. Many organizations already do this and an IYoG can help to disseminate best practice.

GOAL 13: Climate Action

Climate change is affecting every country on every continent, disrupting national economies and individual lives, costing people, communities and even countries.

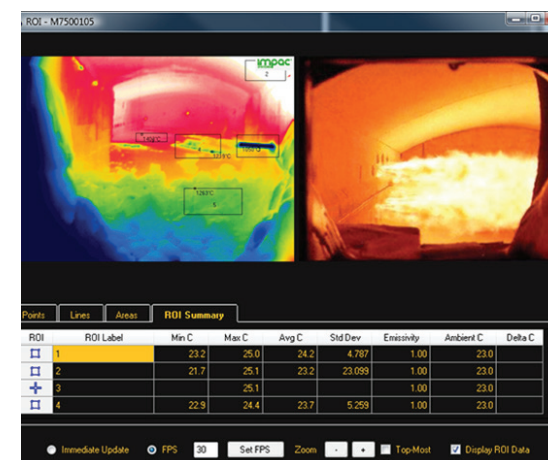
Glass recycling and product lightweighting have increased the energy

efficiency of glass melting substantially; affordable pathways to decarbonization are under development. Glass windows let light into homes and offices while protecting from harsh weather. Double-glazed units increasingly have vacuum insulated glazing, a more effective new technology. Laminated glasses improve acoustic damping to reduce “noise pollution”. Architects are using more glass for its functionalities and appealing aesthetics.

Energy saving glass products compensate during their service life several times over for the energy used to make them. So, replacing single with double-glazed windows can give a 5 month energy payback.

GOAL 14: Life below water

The world’s oceans and rivers – their temperature, chemistry, currents and life



Furnace modelling to improve efficiency

– drive global systems that make Earth habitable. Careful management is vital for a sustainable future but plastic waste is polluting them. Marine animals ingest it causing health issues for humans consuming seafood: immune disorders, birth defects, some cancers. Glass packaging is infinitely recyclable and a safe, clean alternative made of natural, plentiful materials.

GOAL 17: Partnerships to achieve goals

A successful sustainable development agenda requires partnerships between governments, the private sector and civil society built on principles and values, a shared vision and goals with people and the planet at the center; partnerships are needed at global, regional, national and local levels. An IYoG will underline the varied roles of glass and stimulate, mobilize and redirect such partnerships to unlock their resources and deliver sustainable development.



Summary

With its unparalleled versatility and technical capabilities, glass has fostered numerous cultural and scientific advancements. Its history is shared with the evolution of humankind. Its future will contribute to the challenges of a sustainable and fairer society. For an IYoG we (the International Commission on Glass; the Glass Art Society, the Community of Glass Associations and the International Museums Organisation) will:

- Weave together the multicolored threads of technology, social history and art through educational programs and museum exhibitions.
- Plan national and international events for varied audiences centered on glass history, key anniversaries, technologies, applications, and building a future.
- Promote networking among glass associations; R&D centers; universities, colleges, schools; producers, processors and suppliers; museums; and civil society.
- Mobilize governments, industry, academia and cultural centers to collaborate in the initiative and promote a multitude of activities, building on the imaginative programs already proposed.
- Activate support for a UN IYoG by showing that glass is worth celebrating. Let's drink a glass to that!

