



Waste Management

*Santé et  
Environnement, 2<sup>ème</sup>  
année*

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# Introduction

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- Glass is a product of the supercooling of a melted liquid mixture consisting primarily of sand (silicon dioxide) and soda ash (sodium carbonate) to a rigid condition, in which the supercooled material does not crystallize and retains the organization and internal structure of the melted liquid.



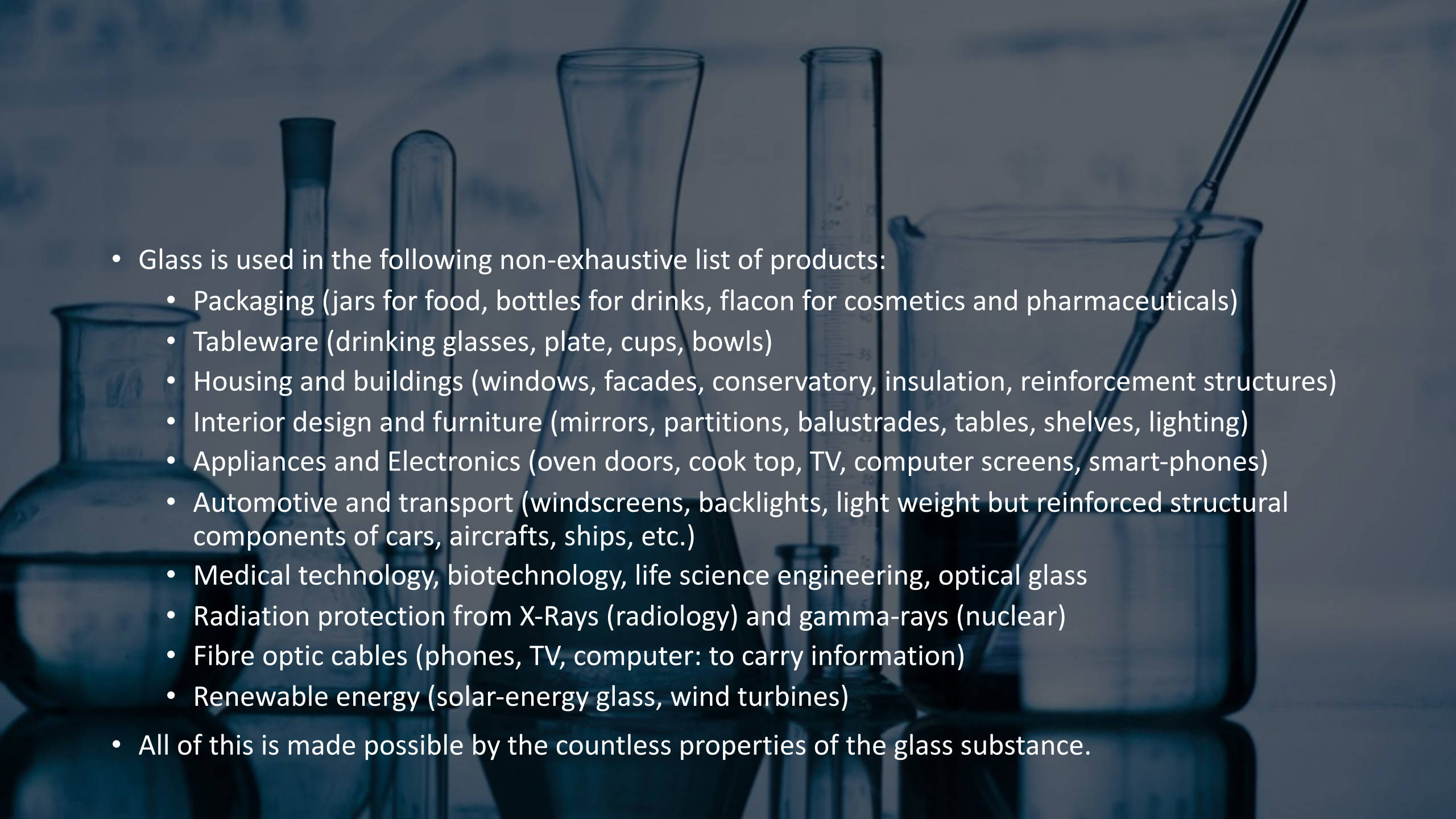
# Different uses of glass

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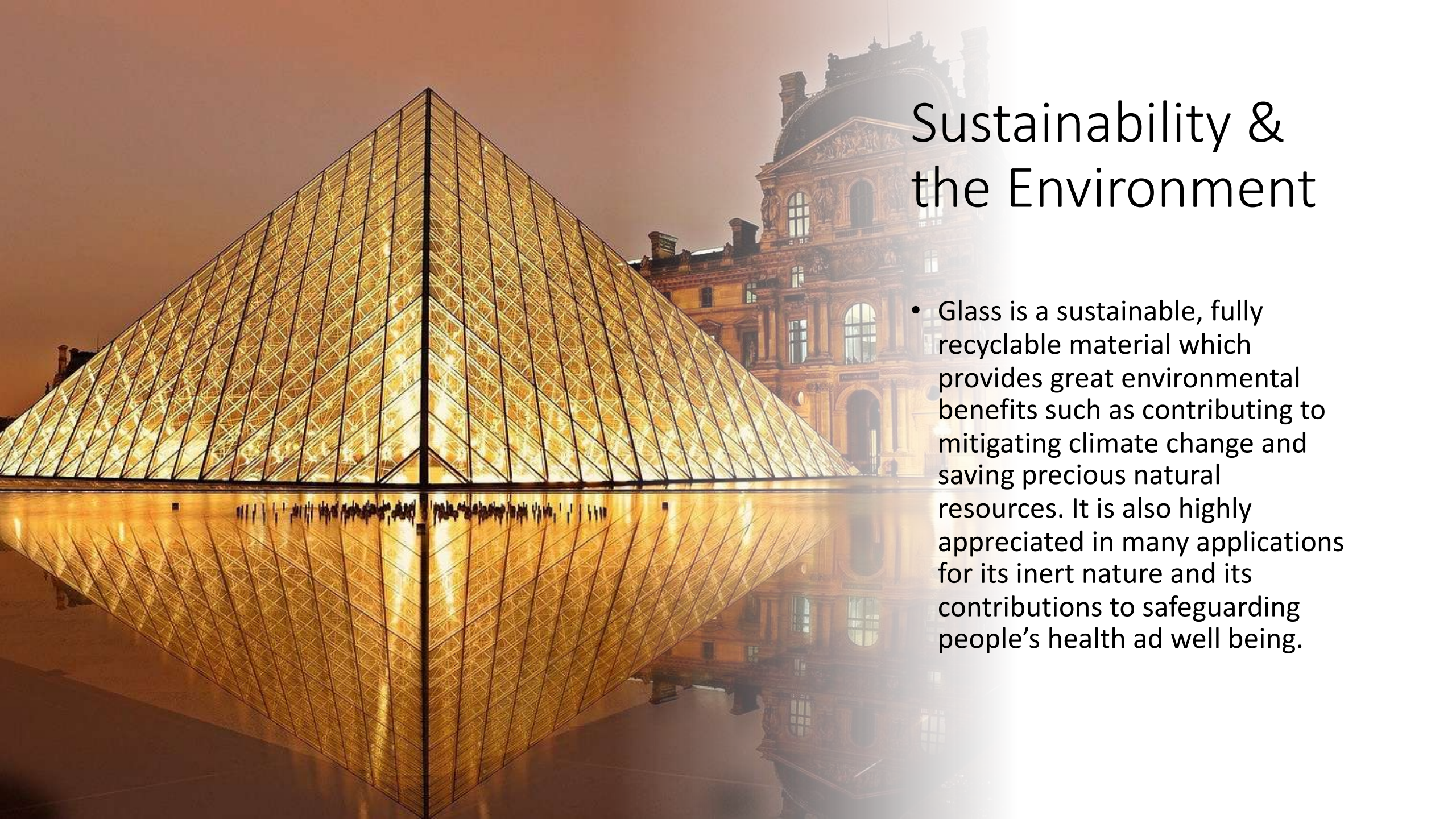
- Glass is an unlimited and innovative material that has plenty of applications. It is an essential component of numerous products that we use every day, most often without noticing it.
- It is clear that **modern life would not be possible without glass!**





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- Glass is used in the following non-exhaustive list of products:
    - Packaging (jars for food, bottles for drinks, flacon for cosmetics and pharmaceuticals)
    - Tableware (drinking glasses, plate, cups, bowls)
    - Housing and buildings (windows, facades, conservatory, insulation, reinforcement structures)
    - Interior design and furniture (mirrors, partitions, balustrades, tables, shelves, lighting)
    - Appliances and Electronics (oven doors, cook top, TV, computer screens, smart-phones)
    - Automotive and transport (windscreens, backlights, light weight but reinforced structural components of cars, aircrafts, ships, etc.)
    - Medical technology, biotechnology, life science engineering, optical glass
    - Radiation protection from X-Rays (radiology) and gamma-rays (nuclear)
    - Fibre optic cables (phones, TV, computer: to carry information)
    - Renewable energy (solar-energy glass, wind turbines)
  - All of this is made possible by the countless properties of the glass substance.






# Sustainability & the Environment

- Glass is a sustainable, fully recyclable material which provides great environmental benefits such as contributing to mitigating climate change and saving precious natural resources. It is also highly appreciated in many applications for its inert nature and its contributions to safeguarding people's health and well being.





# Some benefits of glass usage

- **Mitigate climate change**
- **Save natural resources**
- **Safeguard people's health and well-being**
- **Can be made in different sizes and objects**
- **Can be coloured or colourless**
- **Does not rust**
- **Waterproof**

# Disadvantages of using Glass



An expensive material



Breaks, and easily-Melts in  
high temperatures



When broken, the pieces may  
be sharp

# Warning

- Broken glass and other sharps are physical hazards.
- Broken glass also has the potential to be a health hazard if it is contaminated with toxic chemicals, blood, or infectious substances which may enter the body through a cut or puncture.





A photograph of a modern glass skyscraper at night. The building's facade is composed of a grid of glass panels, many of which are illuminated from within, creating a warm, glowing effect. The interior lights vary in color, with some appearing as bright white, others as soft pink, and a few as cool blue. The building's structure is visible through the glass, showing multiple floors and internal spaces. The overall scene conveys a sense of modernity and technological advancement.

# Glass and the future

- **Glass is everywhere and meets societal needs**
- Almost no other man-made material provides so many possibilities across so many industries and disciplines
- Preferred for food and beverages
- Important role in transportation
- Key element in architecture & buildings
- Part of renewable energy strategy
- Crucial in modern communications
- Many pharmaceutical, health and science applications.
- Glass is an unlimited material whose number of applications is constantly evolving, and which is more and more used in combination with other material for high-tech applications. It is unavoidable for health and comfort, to preserve the European heritage (glass techniques, crystal, culture), and as a key actor in local communities (use of local raw materials for local customers).





- **The future of glass could translate in unlimited opportunities**

The outcome of research in all different fields could open up tremendous opportunities for the development of future glass products and the way we currently use glass in various applications. Just imagine:

- **Smart glass bottles and containers** whose colour changes depending on the liquid temperature (medicines, wines, perishable products, etc.)
- **Interactive drinking glass**
- **Photovoltaic sunroof** to provide electricity to hybrid and electric vehicles
- **LED light sources in jewellery**
- **Mirrors assessing the health condition** of the person standing in front of it
- **Jewellery** assessing the cardiac rhythm and body temperature
- More **complex glass shapes and further improved insulation** properties to free architects from constraints
- Smaller and best performing **photovoltaic and wind energy electricity generation equipment** whose integration would become easier to fulfil most of Europe's energy needs.



# Knowing that glass is recyclable

- Knowing that glass is eco-friendly, we can apply on it the following concept:
  - Reduce
  - Reuse
  - Recycle





# Glass Recycling

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- Recycling glass is one of the many ways we can help reduce pollution and waste. Everyday we throw away tones of rubbish and glass is a significant part of it. Instead of letting landfills pile up with glass objects that are a threat to safety and the environment, we can use it again.
- Glass can be melted down and made into many different forms from drinking glasses to glass fibre. When the glass is taken to a manufacturing or recycling plant, it is broken up into smaller pieces called cullet.





## Example(s)

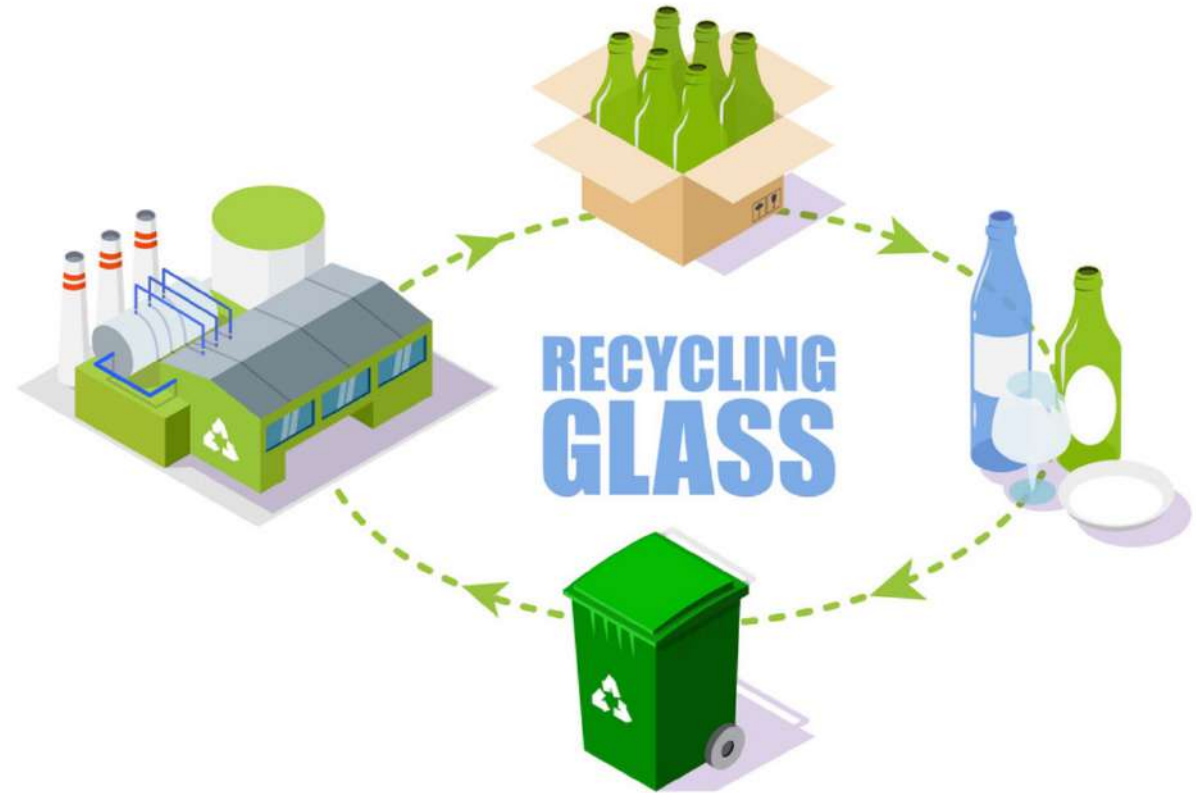
- In countries like USA, there are kerbside recycling schemes, which have specially demarcated boxes to collect glass that can be recycled. Some supermarkets, car parks and other public areas have glass bottle banks, where you can take your recyclable jars and bottles.





# Advantages of Glass Recycling

- The cost savings of recycling is in the use of energy. Compared to making glass from raw materials for the first time, cullet melts at a lower temperature. So, we can save on energy needed to melt the glass.
- Glass produced from recycled glass reduces related air pollution by 20% and related water pollution by 50%.
- Recycling glass reduces the space in landfills that would otherwise be taken up by used bottles and jars.
- Using glass for recycling means there are less glass objects lying around in the landfill or bin.



# Disadvantages of Glass Recycling

A very simplified version of how new glass is produced is this: sand is heated until it melts, and then cooled rapidly so it keeps some of its liquid properties, such as transparency.

It's a little more complicated than that, but the main ingredients are all natural, such as limestone and soda ash. However, heating sand to its very high melting point of 1,700 Celsius takes a lot of energy, and the manufacturing process of virgin glass uses a lot of water too.

There's some air pollution, too. Sulphur oxides are released during the melting process, and nitrogen oxides are generated if the glass is heated by burning gas. So, although we tend to think of glass as a 'clean' product, it has its drawbacks.



# How to manage Glass Waste in an efficient way?

Here is an idea that involves doing your own research, collecting data and building a recycle mode for display.

- Tracking glass waste.
- In your neighbourhood or in the school, you can track the different kinds of glasses that are disposed. Green, amber, clear. Track them over a week to get a better picture of what kind of glass objects we throw into the bin.
- Collect the end product of different stages
- To display your project, make a chart showing the recycling process and show the end product after each stage. Get old bottles that can be recycled to produce new bottles. It would be better if the bottles are from the neighbourhood bins.
- Collect bottles of different shapes and colours. Clean them with soap and water and remove paper labels. Take their metal strips and caps off. Arrange the bottles in a line. Sort them by colour- green, amber and clear. This is the first stage of recycling.
- After the glass bottles are washed, they are cut into small pieces called cullets. With adult supervision, and using gloves, you can break the glasses or collect the cullets from the local recycling plant.
- For the melting of the mixture of raw materials and cullets, you should not attempt to make a furnace because such high temperatures can be achieved only at a recycling plant. Never try this at home.





# Tracking Glass Waste

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- Glass is to be separated from other recyclable waste and kept in recycling containers. Glass collection points, known as Bottle Banks are very common in the developed countries where most collection points have separate bins for clear, green and amber glass as re-processors require glass separated by colours.





# Processing of external cullet

- To be able to use external cullet in production, any contaminants should be removed as much as possible. Typical contaminations are:
- Organics: Paper, plastics, caps, rings, PVB foils for flat glass
- Inorganics: Stones, ceramics, porcelains
- Metals: Ferrous and non-ferrous metals
- Heat resistant and lead glass
- Manpower or machinery can be used in different stages of purification. Since they melt at higher temperatures than glass, separation of inorganics, the removal of heat resistant glass and lead glass is critical. In the modern recycling facilities, dryer systems and optical sorting machines are used. The input material should be sized and cleaned for the highest efficiency in automatic sorting. More than one free fall or conveyor belt sorter can be used, depending on the requirements of the process. Different colours can be sorted by optical sorting machines.

# Recycling into glass containers

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A variant of the "Tidyman" symbol, intended to encourage people to recycle glass

Glass bottles and jars are infinitely recyclable. The use of recycled glass in manufacturing conserves raw materials and reduces energy consumption. Because the chemical energy required to melt the raw materials has already been expended, the use of cullet can significantly reduce energy consumption compared with manufacturing new glass from silica ( $\text{SiO}_2$ ), soda ash ( $\text{Na}_2\text{CO}_3$ ), and lime ( $\text{CaCO}_3$ ). Soda lime glass from virgin raw materials theoretically requires approximately 2.671 GJ/tonne compared to 1.886 GJ/tonne to melt 100% glass cullet. As a general rule, every 10% increase in cullet usage results in an energy savings of 2–3% in the melting process, with a theoretical maximum potential of 30% energy saving. Every metric ton (1,000 kg) of waste glass recycled into new items saves 315 kilograms (694 lb) of carbon dioxide from being released into the atmosphere during the manufacture of new glass.





# Recycling into other products

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- The use of the recycled glass as aggregate in concrete has become popular, with large-scale research on that application being carried out at Columbia University in New York. Recycled glass greatly enhances the aesthetic appeal of the concrete. Recent research has shown that concrete made with recycled glass aggregates have better long-term strength and better thermal insulation, due to the thermal properties of the glass aggregates. Glass which is not recycled, but crushed, reduces the volume of waste sent to landfill. Waste glass may also be kept out of landfill by using it for roadbed aggregate or landfill cover





Not tracking glass waste could lead to the following consequences.

- Glass left untreated in the environment can cause fires, which are often very hard to control like the Fisher 231 fire, which started July 31 and burned roughly 80 acres near Reardan, Washington, and it was apparently caused by shards of broken **glass**.
- When (light) hits a curved surface, that can cause the light rays to become concentrated, and that can cause a fire. That's how a magnifying glass works.



# How can glass left in the nature harm the poor animals

- Broken glass can cut the feet of wild animals, and unbroken bottles can be a death trap. Hungry animals in search of food remains at the bottom of a jar or can often get their heads stuck, causing fatal suffocation. Even the tiniest of creatures can be lured by something like a beer or soda can. The sharp edges of a discarded can can be a threat to such delicate creatures seeking shelter or a taste of what remains inside.



# Glass coming from the testing labs can be very harmful

- Broken glass and other sharps are physical hazards.
- Broken glass also has the potential to be a health hazard if it is contaminated with toxic chemicals, blood, or infectious substances which may enter the body through a cut or puncture.
- Contaminated broken glass thrown in the trash without being cleaned can cause injuries to those handling the waste containers which would transfer viruses to them.





# How to prevent this?

## Injury and Illness Prevention:

- Inspect glassware for defects or cracks before use.
- Do not handle broken glass with bare hands. Use appropriate cut-resistant gloves to handle broken glass.
- Use forceps, tongs, scoops, or other mechanical devices for removing or retrieving broken glass from the work area or a fume hood.
- A dustpan and brush should be used to clean up shards/small pieces of broken glass, Pasteur pipettes, or shards of glass.
- Do not remove any items from a sharp's container.
- Substitute glassware with plastic ware, including desiccators, wherever possible.





A clear glass incandescent lightbulb with a black metal base is positioned vertically on a dense carpet of green clover leaves. The background is a soft-focus field of the same green foliage, creating a natural and eco-friendly aesthetic.

## So, what now?

- Glass is a good and recommended material because of its recycling and "reuse" properties if its waste is managed properly.



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Thank You for reading, hope it  
was impressive!

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