

CIRCULAR ECONOMY AND RESOURCE- EFFICIENCY

ARA CONFERENCE
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Outline

- FEVE and the EU container glass industry
- Why is glass a permanent material?
- The benefits of glass recycling
- The EU context around circular economy and what it means for glass
- Conclusions



FEVE and the EU container glass industry

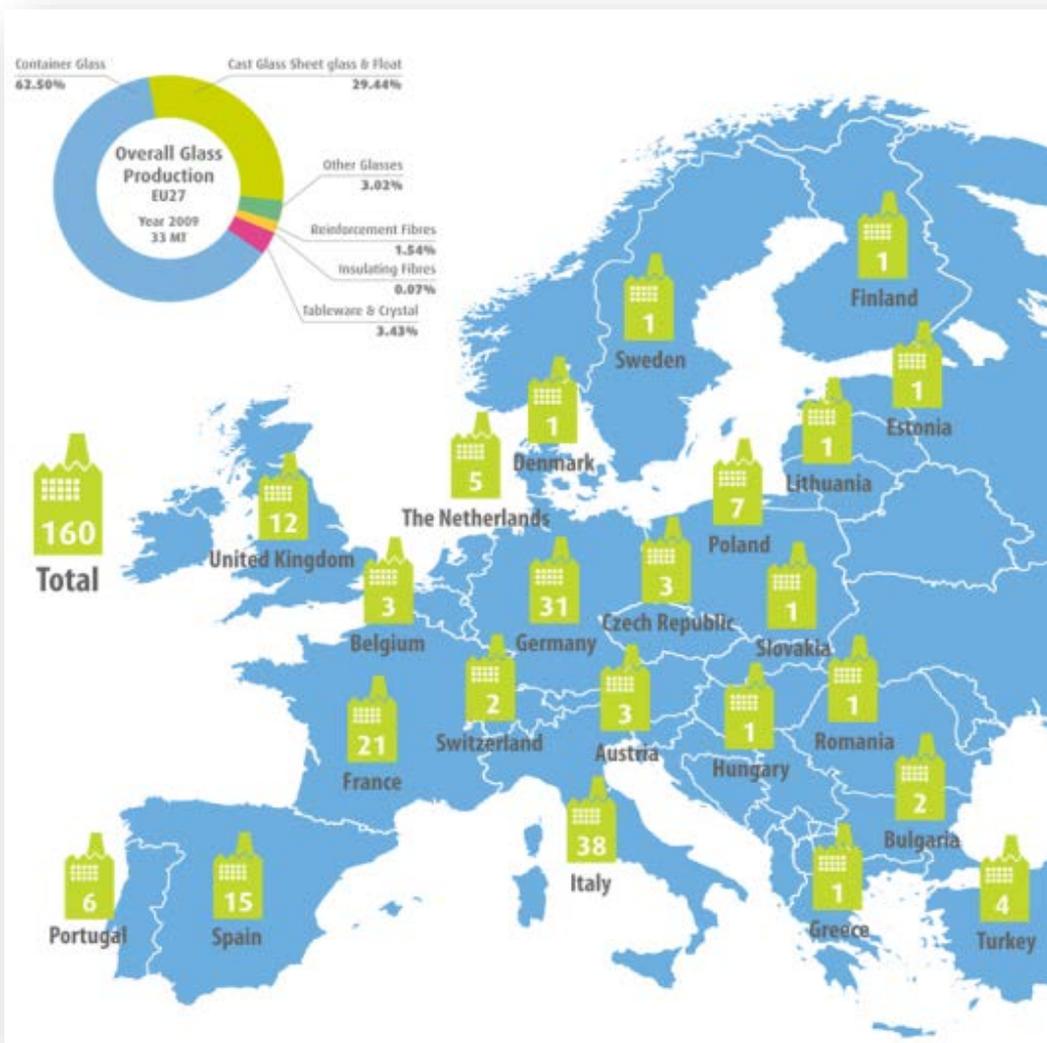
What is FEVE?

- FEVE is the association of European manufacturers of glass packaging containers
- Founded in 1977
- The federation **defends and represents the container glass industry** at the international, and especially European level and serves as a forum for examining common questions.
- FEVE represents 60 member companies (20 groups), producing glass in 22 countries (EU, Switzerland & Turkey)
- FEVE **maintains a dialogue with the European institutions** and agencies on environmental, trade and other important issues.
- **The federation promotes glass packaging and glass recycling**

FEVE Members

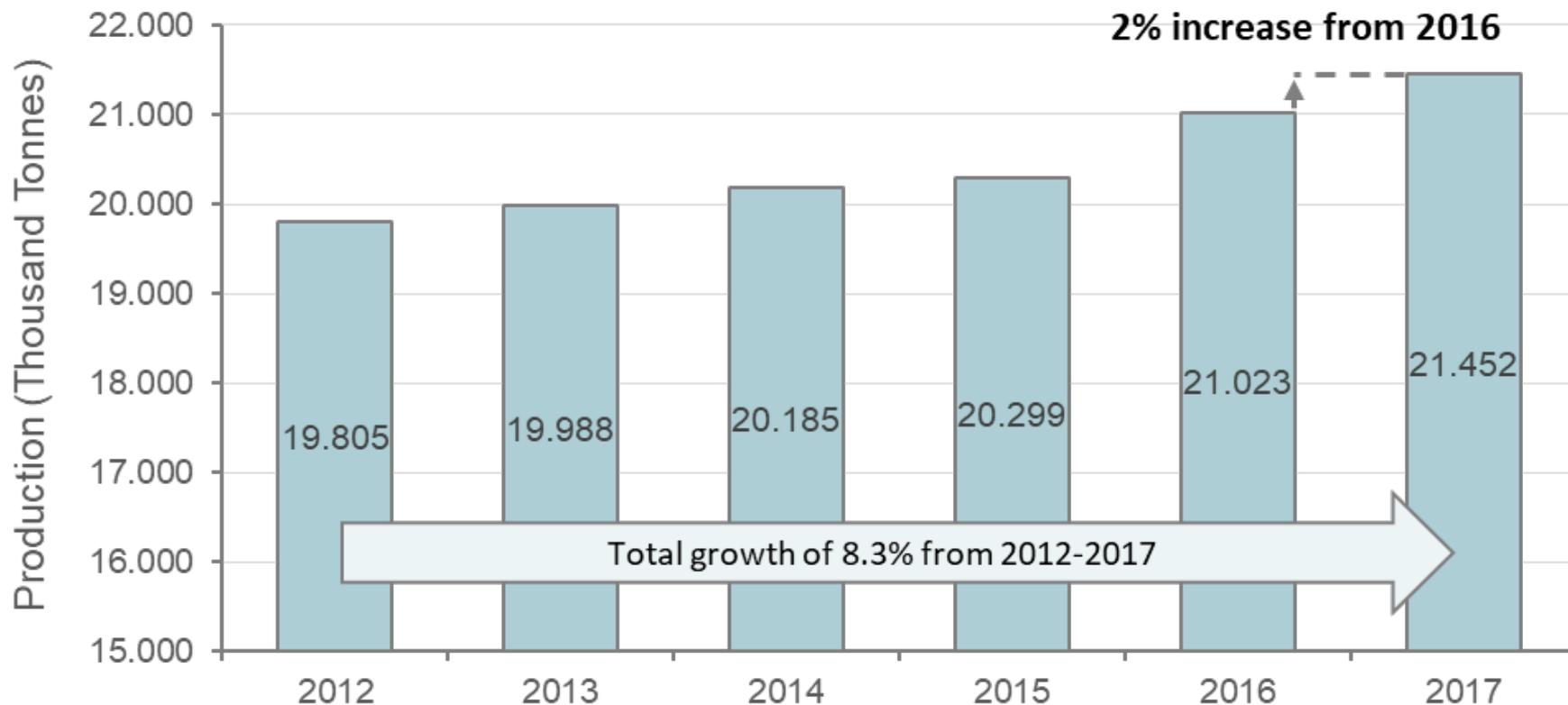


The European glass packaging plants



- 40,000 direct jobs (125.000 direct and indirect)
- 160 plants in 20 countries
- ~21 million tonnes glass per year
- 66% of the total EU glass production
- 74% collected for recycling
- > €600 million investment in the EU every year

Container glass production





Why is glass a
permanent material?



What is the concept of a permanent material?

- There is a BSI Guidance document BS 8905:2011 “*Framework for the assessment of the sustainable use of materials – Guidance* » defining permanent materials as:
 - ‘...materials for which efforts are made to retain for use in society the energy and raw materials invested in their production at the end of the product life, either through reuse or recycling, with no loss of quality no matter how many times the material is recycled’
- The term permanent material was also formally recognised by the European Parliament in May 2012 as part of a resolution on a Resource Efficient Europe. The report that was put forward to the European Parliament contained the following reference to permanent materials:
- ‘whereas a future holistic resource policy should no longer merely distinguish between ‘renewable’ and ‘non-renewable’ resources, but should also extend to permanent materials.’

Stazione Sperimentale del Vetro on Permanent materials - Commissioned by FEVE in 2016

Simone Tiozzo, Nicola Favaro

Permanent Materials in the framework
of the *Circular Economy* concept: review
of existing literature and definitions, and
classification of glass as a Permanent
Material

What is glass?

The definition of glass most accepted is the formulation according ASTM-C162 (1983):

“Glass - an inorganic product of fusion that has cooled to a rigid condition without crystallization”

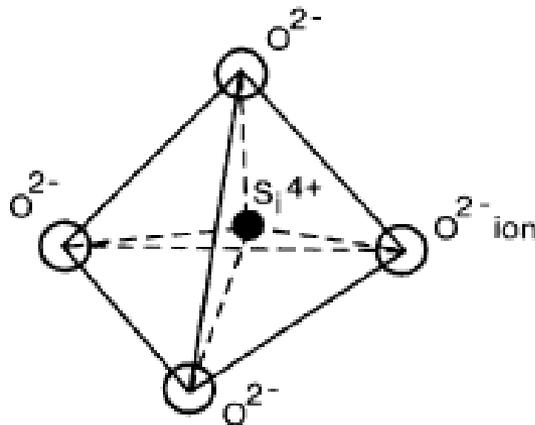


Figure 2 Schematic SiO₄²⁻-polyhedron

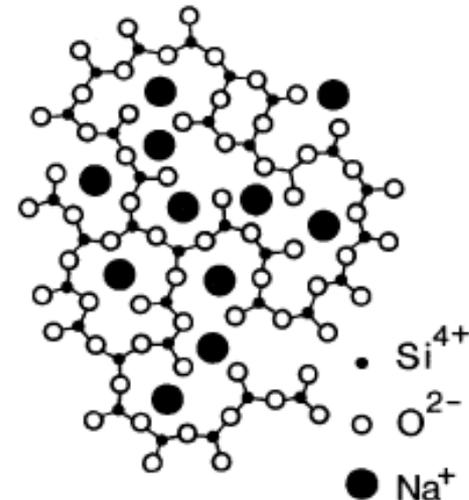


Figure 3c. Floating oxygen positions caused by Na-addition

Glass is a permanent material – physical & chemical properties

- Soda-lime glass is constituted by a **disordered tridimensional highly interconnected silicate network**, whose basic unit is the SiO_4^{4-} tetrahedron.
- The strength of the Si–O bonds, renders soda-lime glass an highly inert material, that **does not undergo any appreciable degradation during normal service life**.
- **In its molten state**, glass is still made up of SiO_4^{4-} tetrahedra connected to each other, even though, compared to its solidified state, the network is fragmented into smaller, more linear and less interconnected domains,
- **Upon cooling down, the silicate chains spontaneously bond again** to each other, rebuilding the interconnected tridimensional network of solid glass without any need of external intervention, addition or catalysis.
- The capability of the network to be partially fragmented during the melting phase (or re-melting in case of glass cullet), and then to spontaneously reform again in a completely reversible way is one of the features that **render glass a *Permanent Material***, allowing **endless recycling without any loss of intrinsic properties or quality**.

Glass is a permanent material – Material stewardship

- Separate collection of waste has been intensively promoted by Media, in Schools, by Municipal Solid Waste management companies, etc, therefore at present used **glass containers are easily available for recycling** all over Europe.
- **The existing technologies for wastes sorting and subsequent elimination of impurities** like ferrous and non-ferrous metals, organic matter, ceramics, lead crystal glass, glass-ceramics, etc are quite **mature**, and capable of producing “furnace-ready” glass cullet of good quality with good efficiency.
- Recycling of glass cullet produces **great benefits for the environment**, since it reduces the exploitation of non-renewable mineral resources, the emissions of CO₂ into the atmosphere by carbonated primary raw materials, the energy consumption for the melting process (and thus CO₂ emissions by fuel burning and electrical energy production), the use of landfills, etc.



The benefits of glass recycling

Glass recycling: a long history since Roman times

- Poet Martial, who wrote epigrams which were collected in 14 books between 85 and 102AD. Martial referred to glass recycling in an epigram in his first book (1.41.1-5):

Urbanus tibi, Caecili, videris.

Non es, crede mihi. Quid ergo? Verna es,

hoc quod Transtiberinus ambulator

qui pallentia sulphurata fractis

permutat vitreis.

Caecilius, you consider yourself urbane.

Believe me, you are not. What then? A

home-born slave,

just like a hawker from Trastevere,

who barter pale sulfur

for broken glass.

- This reference shows that from Flavian times onwards, glass recycling has become common by the late 1st c. AD.



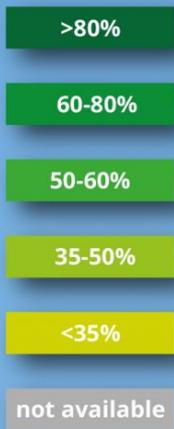
Glass chunks stored in a pottery vessel in the 6th-7th c. AD workshop of Beth Shean, Israel

CONTAINER GLASS RECYCLING IN EUROPE

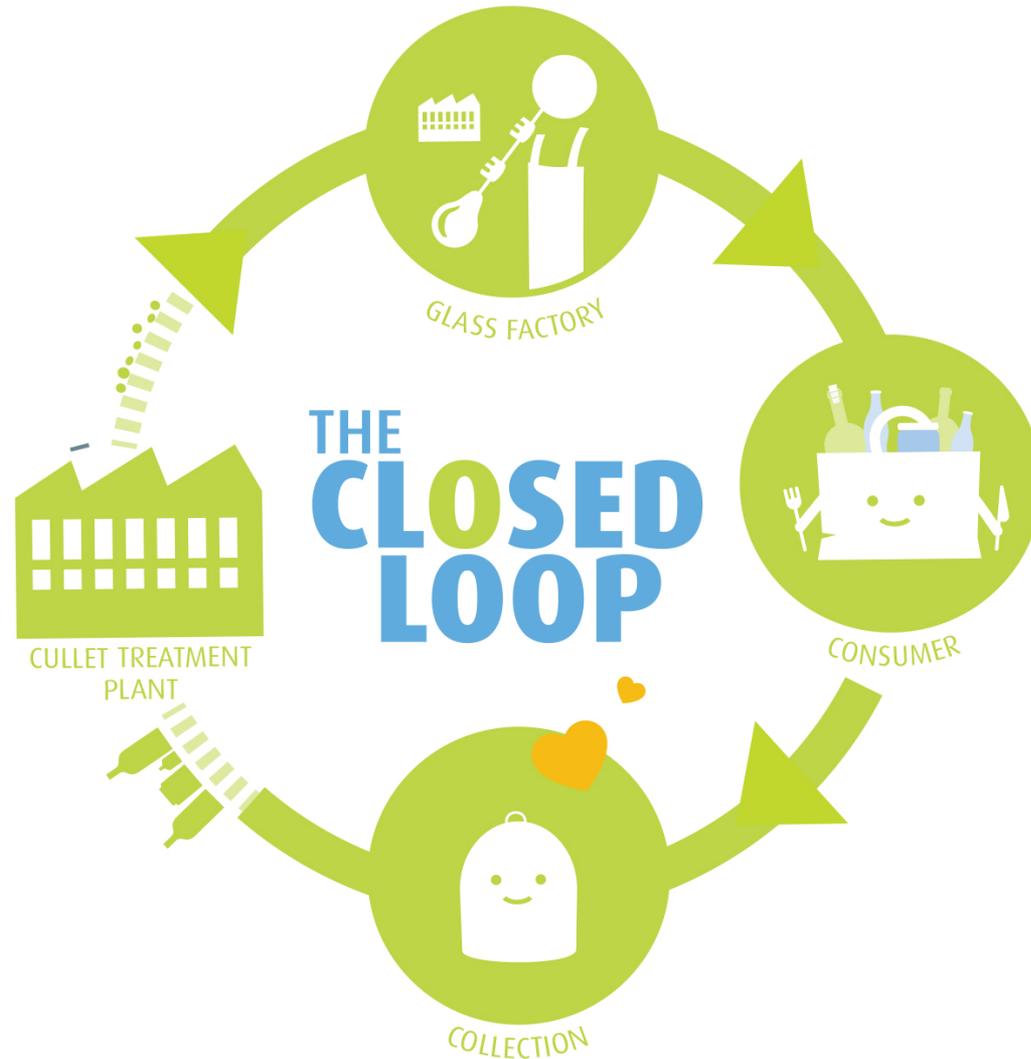


IN THE EU28, ON AVERAGE **74%** OF GLASS BOTTLES AND JARS ARE COLLECTED AND RECYCLED INTO **FOOD GRADE MATERIAL**

THE **90%** OF IT GOES BACK TO THE **BOTTLE-TO-BOTTLE PRODUCTION**



The glass recycling chain is relatively simple





FEVE

The European Container
Glass Federation

FEVE/ACR+ study on best practises around glass recycling (2011)

- Several case studies around the EU
- Though glass waste was one the first waste flows to be selectively collected already in the 80's, there have been major improvements and innovation in order to improve the quantity and quality of the glass waste collected.
- In Belgium and Austria the underground bottle banks located in parks, near shopping centres, by residential establishments have shown to increase the quantity and quality of glass waste collected.



**“Good Practices in collection and closed-loop glass recycling
in Europe”**

Report prepared by the Association of Cities and Regions for Recycling and
sustainable Resource management (ACR+) in partnership with
the European Container Glass Federation (FEVE)



FEVE/ACR+ study on best practises around glass recycling

Approximately 80,600 glass bottle banks are available for the collection of glass waste.

They have a total volume of around 80,000 m³ and come in different modules and sizes. Glass bottles are collected through bottle banks (1 chamber: see photo) that have a dual system:

- Clear glass
- Coloured glass (green/ brown)



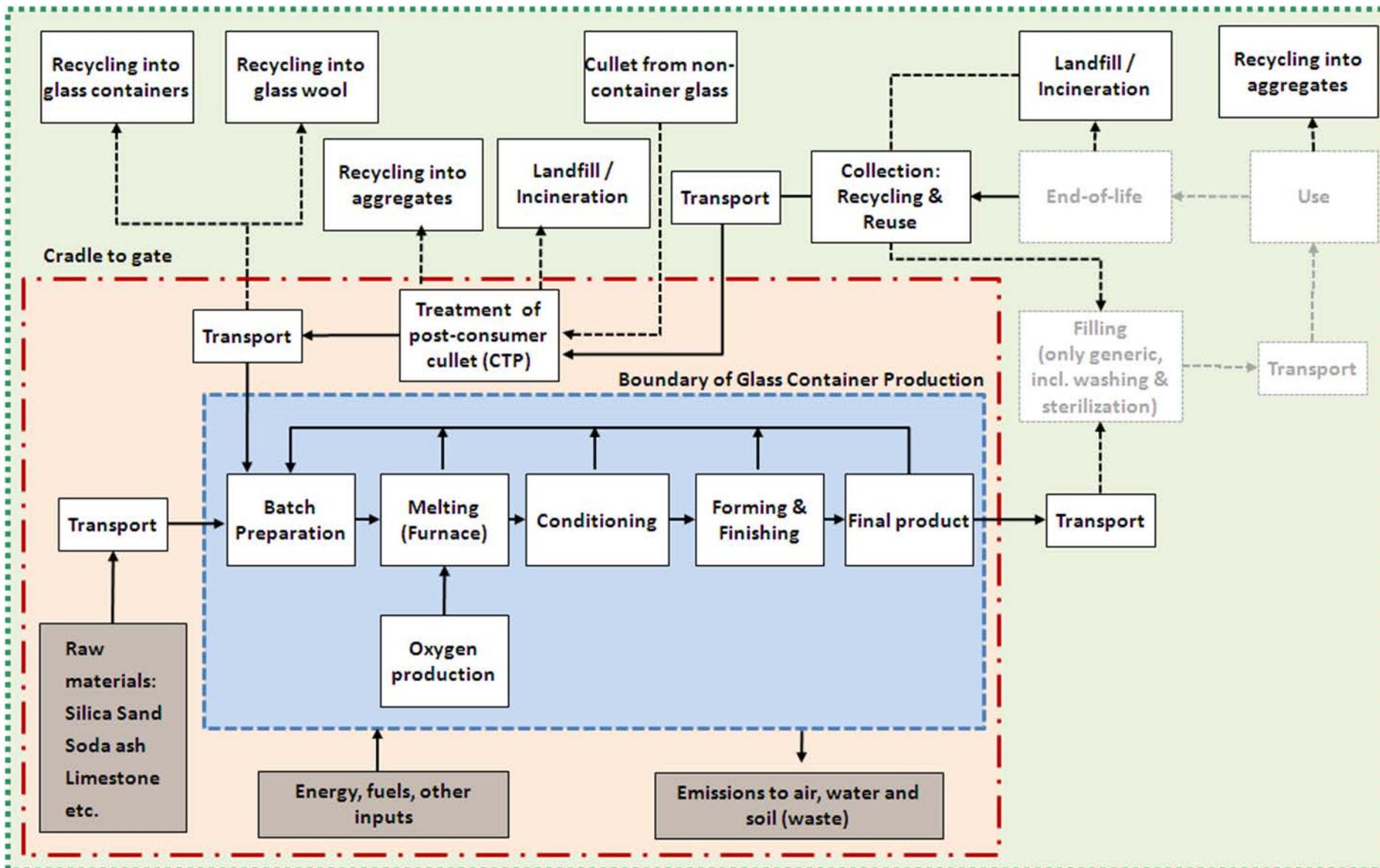
Facts about glass recycling

- Glass can be **infinitely** recycled without loss of properties: it is a **permanent material**
- Glass **is always safe for food and beverages** even when recycled
- **Recycling ≠ downcycling**. Glass forms a real closed loop
- Glass is recycled **locally** in Europe
- **Cullet** (=recycled glass) **quality** is very important
 - Limit external contamination by non-glass products
 - Separate by colors (brown/green/white) at source or in cullet treatment plants
 - Some glass products can contain very high amount of cullet (green beer bottle up to 85%), while others cannot due to cullet quality and product properties (perfumes bottles)

Facts about glass recycling

- Recycling glass saves energy, reduces CO₂ emissions, reduce waste generation and preserves natural resources
- 1 tonne of cullet
 - saves 1.2 tonne of raw materials
 - Avoid the disposal of 1 tonne of waste
- Every 10% cullet increase in the batch saves ~ 2.5 to 3% of energy and ~ 4 to 5% CO₂ in the furnace (*Glass BREF*)
- 1 ton of cullet will save 322 kWh of energy combustion and avoid 246 kg of CO₂ emissions (*“Study of the balance between furnace operating parameters and recycled glass in glass melting furnaces” edited by Glass Technologies Services in September 2004*)
- savings even bigger when looking at the whole life cycle...

Life Cycle approach of glass making



Life Cycle savings related to glass recycling

- Recycling one tonne of glass saves about 580 kg CO₂ on a cradle-to-grave basis (*FEVE LCA 2012*)



The EU context around circular economy

The EU Circular Economy Package

4 Legislative proposals on waste

1. Waste Framework Directive
2. Packaging Waste
3. Landfill
4. WEEE

Action Plan - Key action areas

1. Production
2. Consumption
3. Innovation
4. Waste
5. Secondary materials

Priority sectors

1. Plastics
2. Food waste
3. Critical raw materials
4. Construction
5. Bio-based

Potential impacts of the EU Circular Economy Package on glass

- 75% packaging glass recycling per country by 2030 (70% by 2025)
- Moving from « collected for recycling » to « genuinely recycled »
 - new measurement point
 - loss rates to be defined for recycling plants
- 5% reuse can be accounted for
- EPR schemes become the cornerstone of EU waste management policy, made mandatory for packaging
- Glass has long history of EPR, setting up bottle bank infrastructure in municipalities over 40 years ago – success story

Potential impacts of the EU Circular Economy Package on glass

- Eco-modulated EPR fees (to come)
- Review of the essential requirements of the Packaging & Packaging Waste Directive (to come)
- Difficult to assess how the **Single-use plastic regulation** (superseding the PPWD) will affect other materials
 - Recycled content is not an appropriate indicator for glass as the market is collection-driven (**shortage of cullet on the market**)
 - The 90% collection rate for plastic bottle makes a **Deposit Return Scheme (DRS)** quasi inevitable, while the glass industry has developed since 40 years an **efficient system based on bottle banks**

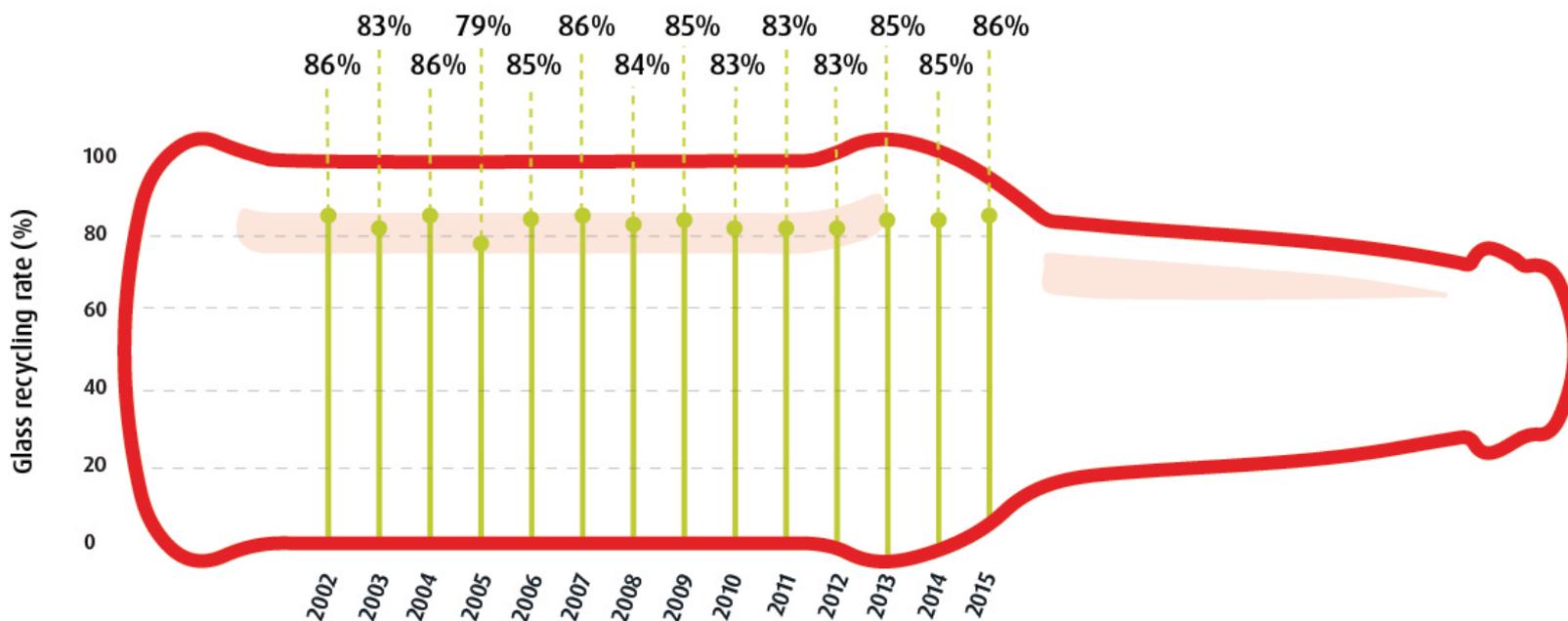
DRS are not the best option for glass recycling

EU-28 GLASS PACKAGING RECYCLING RATES (2015)



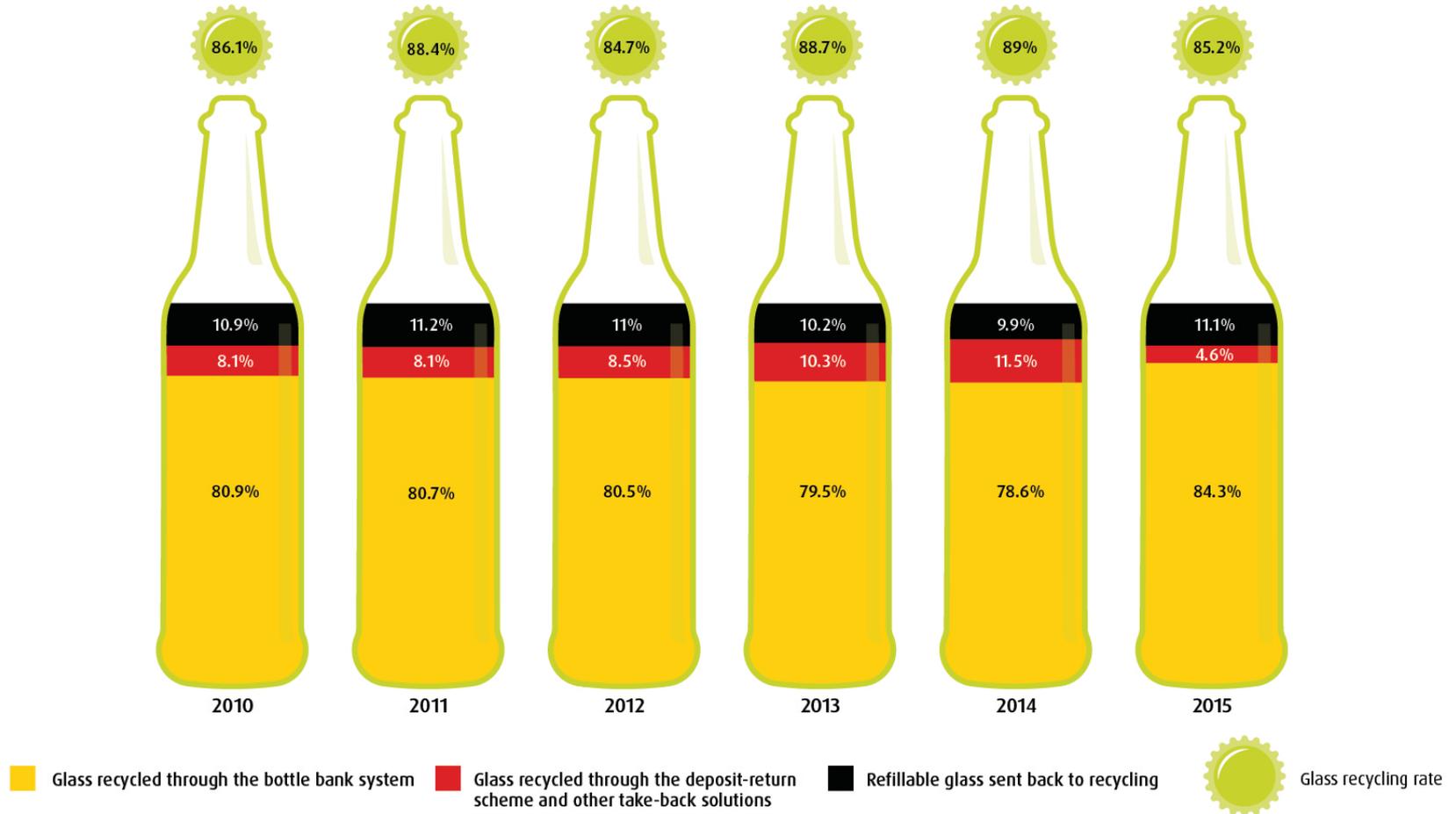
EVOLUTION OF THE GLASS RECYCLING RATES IN AUSTRIA BETWEEN 2002-2015

VERY HIGH PERFORMANCE ON GLASS RECYCLING
WITHOUT A DEPOSIT-RETURN SCHEME



PERCENTAGE OF GLASS BEING RECYCLED THROUGH THE DIFFERENT COLLECTION SYSTEMS IN GERMANY, FROM 2010-2015

THE HIGH RECYCLING RATES IN GERMANY ARE ACHIEVED THROUGH THE BOTTLE BANK SYSTEM

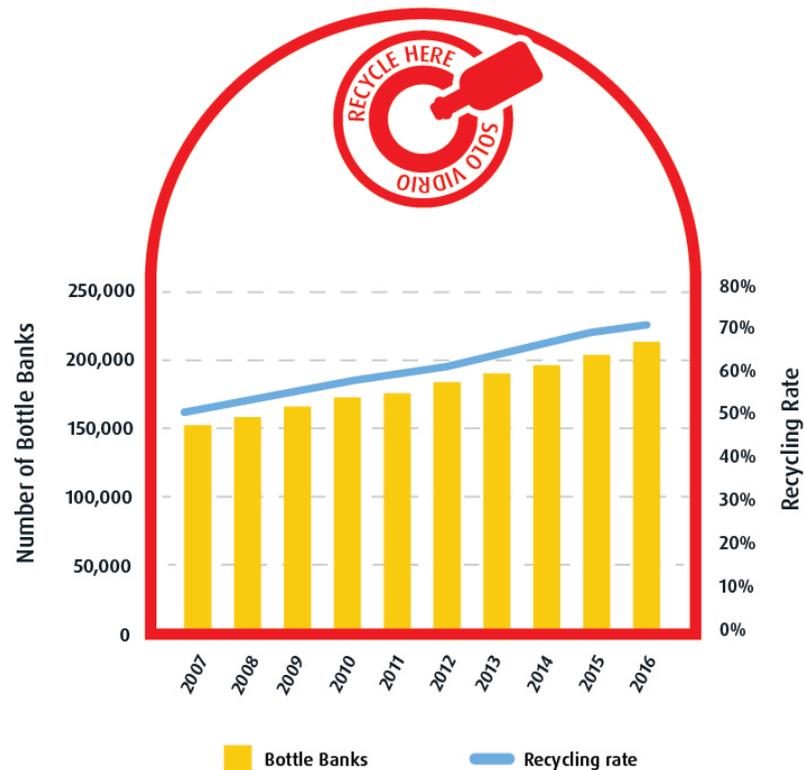


Source: Oakdene Hollins study "Raise the Glass"

Bottle banks need to be promoted

EVOLUTION OF THE NUMBER OF BOTTLE BANKS AND THE GLASS RECYCLING RATE IN SPAIN BETWEEN 2007-2016

THE MORE BOTTLE BANKS AVAILABLE,
THE MORE GLASS IS RECYCLED





Conclusions

Conclusions

- Glass packaging is a **stable**, and even growing, industry
- Glass is a **permanent** material and is **well positioned** in the context of the **Circular Economy**
- Glass recycling brings many **environmental benefits**
- The **bottle bank system** is working extremely well and **should not be destroyed by introducing Deposit Return Schemes** targeting other materials

THANK YOU
FOR
YOUR
ATTENTION