FEVE
The European Container Glass Federation

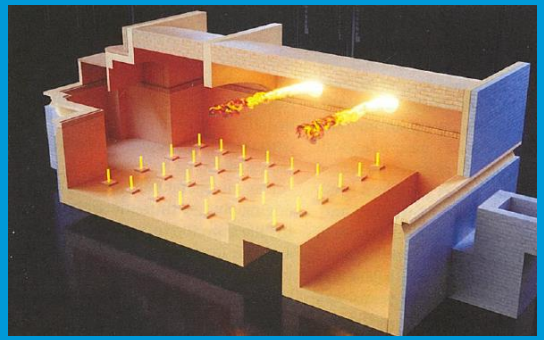
ArdaghGroup

Ways to climate neutral glass production – Furnace for the Future

Wege zur klimaneutralen Glasproduktion – die Schmelzwanne der Zukunft

Praxisworkshop Glasindustrie

22-04-2021



Sven-Roger Kahl, Manager Furnace Operations Group Ardagh Glass Europe

Overview

- Furnace for the Future – a sectoral approach
- F4F - Timeline and financing
- F4F - What is the basic concept
- F4F - What are the expected results
- F4F - What is possible for other sectors?
- F4F - Where are we actually and what holds the future?

Furnace for the Future (F4F)

A fundamental Milestone towards Climate-Neutrality

The F4F project has several unique features:

1. **Will be developed by and benefit the whole European container glass sector**: 19 companies (>90% EU production) collaborate. Co-financing vs knowledge sharing.
2. Will **significantly reduce CO_2 emissions** (replace 80% natural gas by renewable electricity)
3. Be the world's **first large scale hybrid furnace** for **reduced glass** using **recycled glass** (will be built by Ardagh in Obernkirchen, Germany, Lower Saxony)
4. Directly produce glass containers for the **commercial markets** (2023)

F4F Founding Members

Allied Glass

Ardagh Group

BA Glass

Beatson Clark

FEVE - The European Container Glass Federation

Gerresheimer Group

Gürallar

O-I Europe

Pochet Group

Saverglass Group

SGD Pharma

Steklarna Hrastnik d.o.o

Stölzle Glass Group

Verallia Group

Verescence

Vetreria Cooperativa Piegarese

Vetreria Etrusca

Vetropack Group

Vidrala Group

Wiegand-Glashüttenwerke GmbH

Time Line

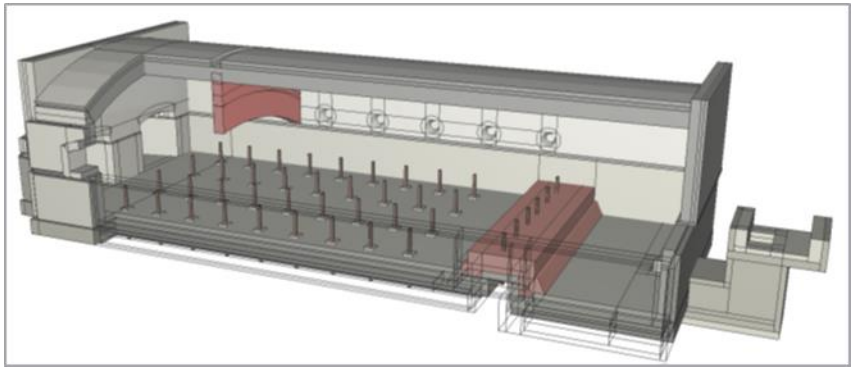
- July 2020: Project call published
- March 2021: F4F is invited to 2nd phase application (70 out of 311 proposals)
- Cooperation Agreement covers 19 glass producers and FEVE = > 90% of European container glass manufacturing capacity

Project Financing

- Grant: finance from Innovation Fund (ETS phase 4) covers up to 60% of eligible CAPEX and OPEX
- 40% is shared by the participating FEVE members
- Ardagh receives financial contributions from FEVE members, in exchange all relevant operational data will be shared. Operators will be trained on site for all participating FEVE members
- SORG is the chosen partner for the Grant application

F4F - What is the basic concept?

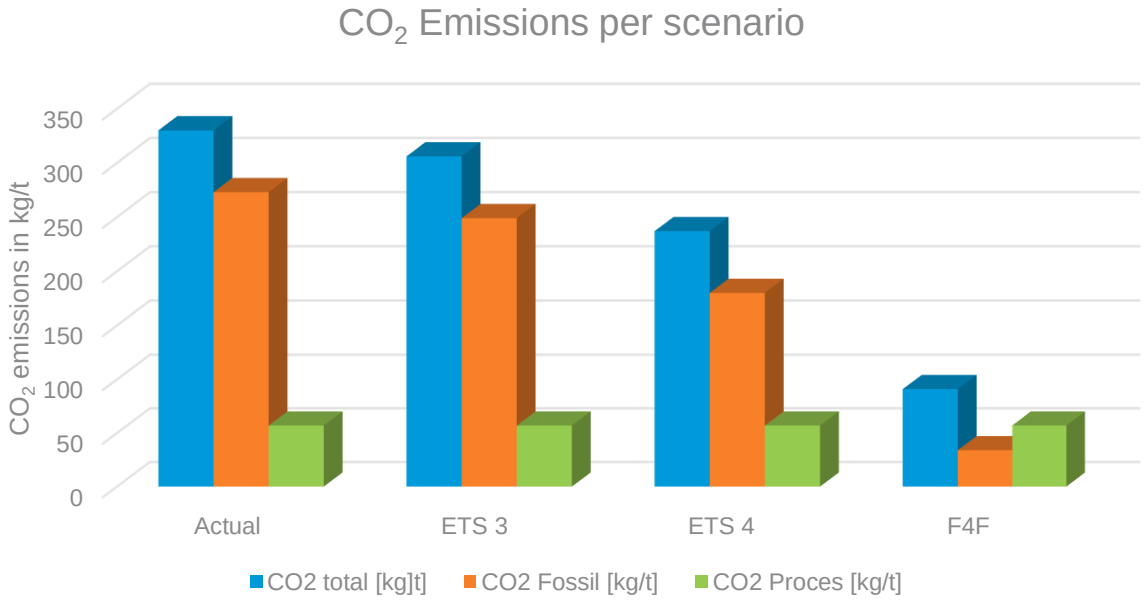
- Classic container glass furnaces use ± 90% fossil fuel and ± 10% electrical boosting
- F4F will turn the ratio to the opposite, 80% electricity, 20% fossil fuel with the possibility to return to standard oxy-fuel
- This combines sustainability with operational flexibility



- Bottom electrodes
- Segmented crown to keep energy in place
- Deep Refiner design for quality and residence time

Picture used with permission by SORG

Expected results



- 180 / 116 kt CO_2 over 10 years equals 56% / 45% versus ETS benchmark phase 3 and phase 4

Possibilities in other sectors

- A combination of horizontal melting with some top energy to keep the batch blanked flexible is applicable in most sectors where all electric melting is not possible
  - High pull rates > 200 t/d
  - High cullet rates above 50%
  - Melting of reduced glasses
- F4F at 350 t/d is a step change in melter capacity

Actual status, outlook

- All involved parties work hard on the 2nd phase application to be filed in June 2021
- Grant decision in quarter IV/2021

- After 2023: practical proof of hybrid concept at full commercial scale
- Possible introduction of hydrogen once available
- Top heat can come from various sources, also electricity

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