What will glass production look like in 2045?

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Agenda

What will glass production look like in 2045?

- Association presentation
- Key data glass industry
- Motivation/Introduction
- Decarbonisation
  - Technologies
  - Transformation pathways
- Impact of a GHG-neutral glass production in 2045 on
  - Energy consumption
  - CO2 emissions
  - Costs
- Policy instruments
- Conclusion

The Association

- The Bundesverband Glasindustrie e.V. (BV Glas), based in Düsseldorf and Berlin, represents around 85 % of glass production in Germany from the following sectors
  - Flat glass
  - Container glass
  - Utility and special glass
  - Glass fibres
  - Table ware and domestic glass
  - Water glass
  - Processing and finishing
- Represents **economic, environmental, energy and climate policy interests**
- informs users and decision-makers from industry, trade and commerce, opinion leaders from science, research, politics, the media and consumers about the German glass industry and the material glass.

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Key data

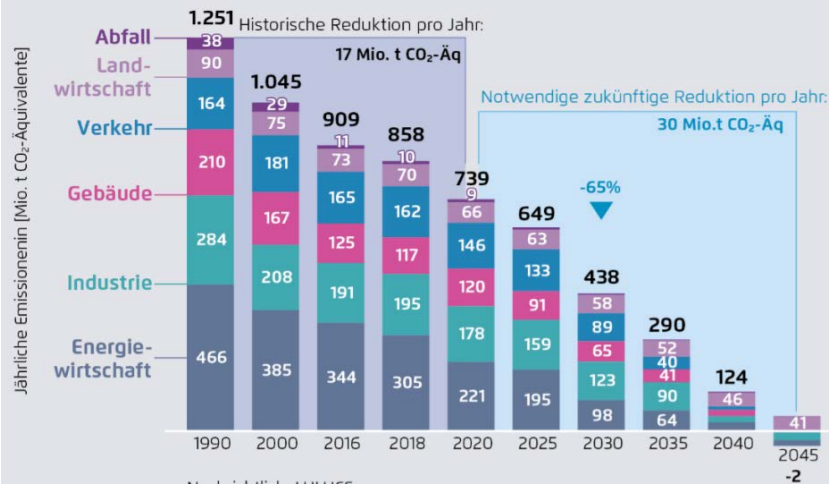
The glass industry in Germany is the largest in Europe

	2020 resp. 2018	Change 2019/2020
Turnover*	EUR 9.3 bn	-4,6 %
Production**	7.4 million tonnes	-1,4 %
Operations*	388	-1,5 %
Employees*	53.690	-4,2 %
Total final energy consumption (2018)***	19.1 TWh (68.7 PJ)	+1,6 %
Fuel consumption (2018)***	15.1 TWh (54.3 PJ)	+1,9 %
Electricity consumption (2018)***	4.0 TWh (14.4 PJ)	-1,0 %
Direct CO_2 emissions (2017)****	5.4 million tonnes	
thereof process-related (2017)	1.0 million tons	
Direct CO_2 emissions ETS plants	3.9 million tonnes	

Motivation/Introduction

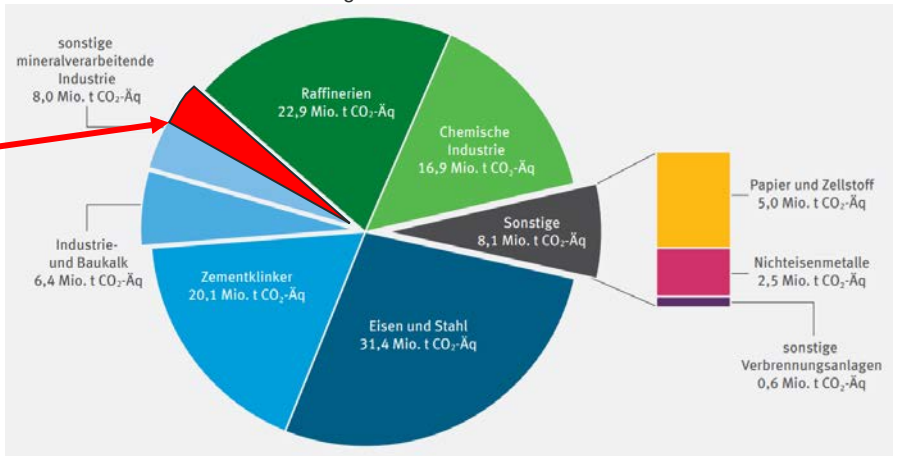
- Agreed goal of the Federal Government
  Cross-sectoral **climate neutrality by 2045**
- Far-reaching consequences for
  Germany as an industrial location

Source: 2021 Agora Energiewende - Climate Neutral Germany 2045



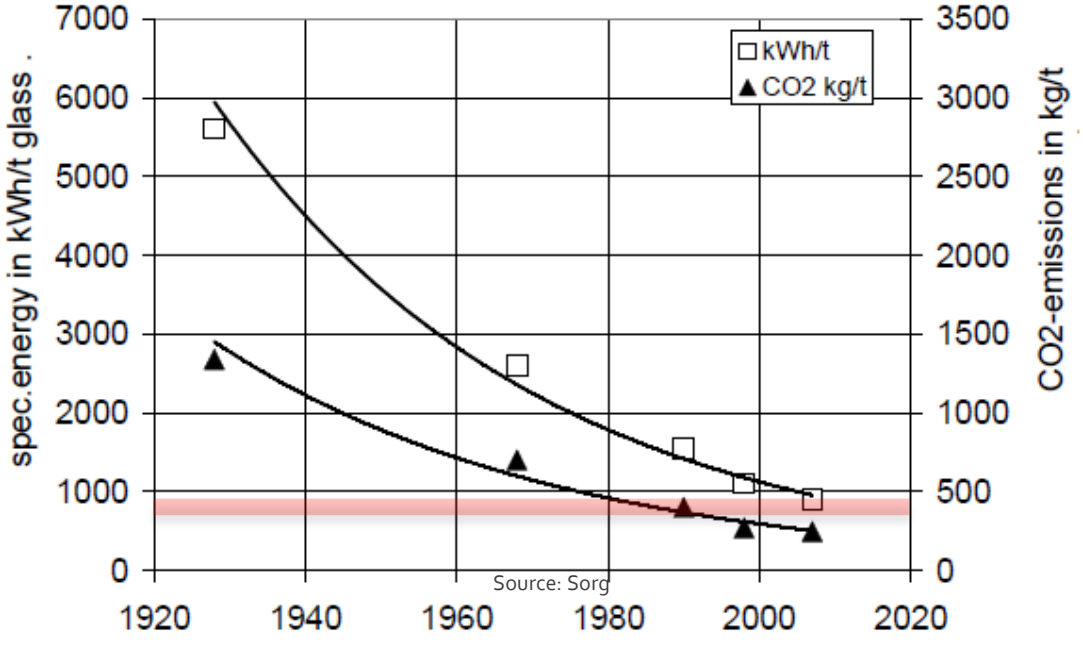
Source: 2020 DEHSt- Greenhouse gas emissions 2020

- Direct CO_2 emissions (2020)
  - Energy-intensive industries: 114 million t CO_2
  - Glass industry: 3.9 million t CO_2



Energy efficiency: physical-technical minimum almost reached

Specific energy consumption and CO_2 emissions from the start of industrial production



BV Glas: Current studies and projects

BV Glas represents the glass industry in several governmental and non-governmental energy and climate studies and projects

Study by the **Federal Ministry of Economics and Technology (BMWi)** "Energiewende in der Industrie" (Energy transition in industry)

dena - German Energy Agency has nominated 3 BV Glas member companies for lighthouse projects on CO_2reduction

BV Glas is one of the founding members of the **Energy Efficiency Networks initiative of the** German government and industry.

IN4Climate.NRW: Initiative of the Ministry of Economics of the State of North Rhine-Westphalia. The aim is to help shape the transition to a climate-neutral industrial sector.

KEI - Competence Centre for Energy-Intensive Industries in Cottbus, Member of the Advisory Board

HyGlass project with GWI, funded by the state of North Rhine-Westphalia

Study by the Federal Ministry of Economics and Technology (BMWi) "Energiewende in der Industrie" (Energy transition in industry)*

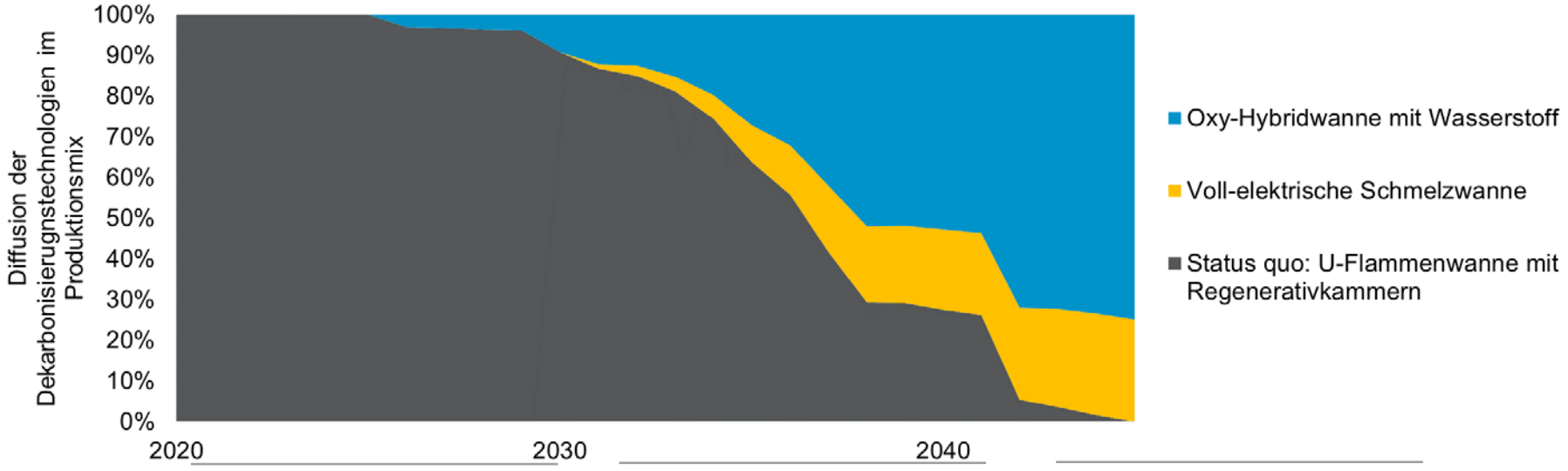
Decarbonisation - Technologies

Decarbonisation measure	Brief description
Fully electric melting tank	Melting of the batch by direct electrical energy input via electrodes. The process heat is transferred to the melting material by resistance heating.
Oxy-hybrid tank with hydrogen	Hybrid melting tank in which 80% of the required melting energy is supplied electrically via electrodes and 20% by pure oxygen combustion of hydrogen in the melting tank.
Use of $_2$low-carbon/free raw materials	Substitution of CO_2 -rich raw materials with alternative fluxes and stabilisers. When using silicates or dissociated carbonates, no process-related CO2 emissions would be produced in the melting process. The early dissociation of carbonates could take place centrally and with the use of CCS/U.
Oxy-fuel melting tank (+CCS)	Provision of the melting energy in the furnace by oxidation of the energy source (natural gas) with pure oxygen. The waste gas of an oxy-fuel furnace consists mainly of water vapour and CO $_2$, so that the waste gas stream after condensation consists of highly concentrated CO . $_2$This lends itself to the additional use of CCS technology to completely decarbonise the glass manufacturing process (energy and process-related emissions).

Source: Preliminary project results from the BMWi-funded project "Energiewende in der Industrie"
https://www.bmwi.de/Redaktion/DE/Artikel/Energie/energiewende-in-der-industrie.html

Decarbonisation - transformation path

Container glass



- From 2025 first conversion to oxy-hybrid furnaces

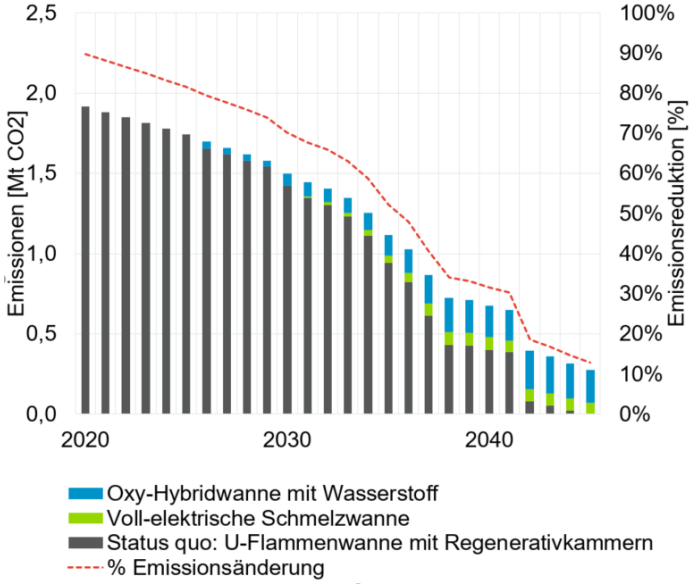
- From 2030, increased conversion to oxy-hybrid furnaces with hydrogen use
- From 2030 first fully electric melting furnaces

- Complete replacement of conventional natural gas-fired furnaces with all-electric and oxy-hybrid furnaces by 2045

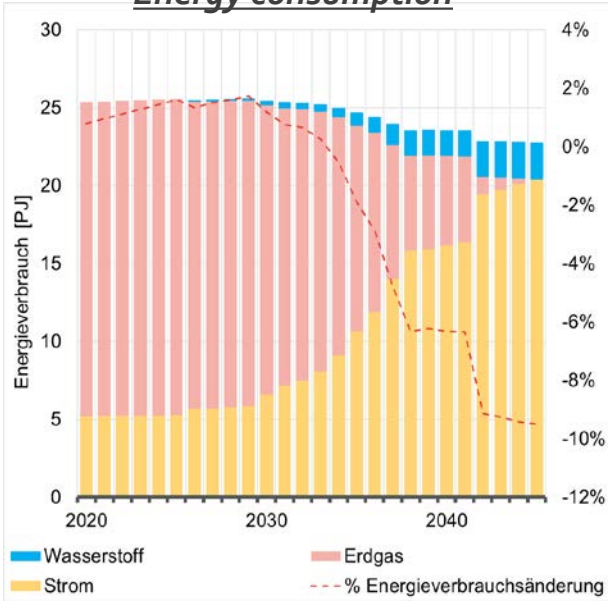
Impact of GHG-neutral glass production 2045

Container glass

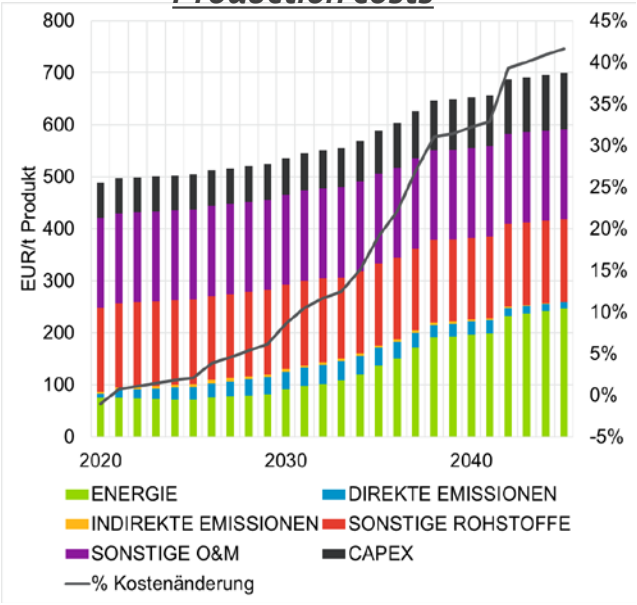
CO2 emissions



Energy consumption



Production costs



Impact

- CO_2 reduction: 85 %
- Remaining 15% are process-related CO_2emissions

Impact

- Slight decrease in energy consumption
- Electricity use: 20 PJ + 300%
- H_2 use: 3 PJ

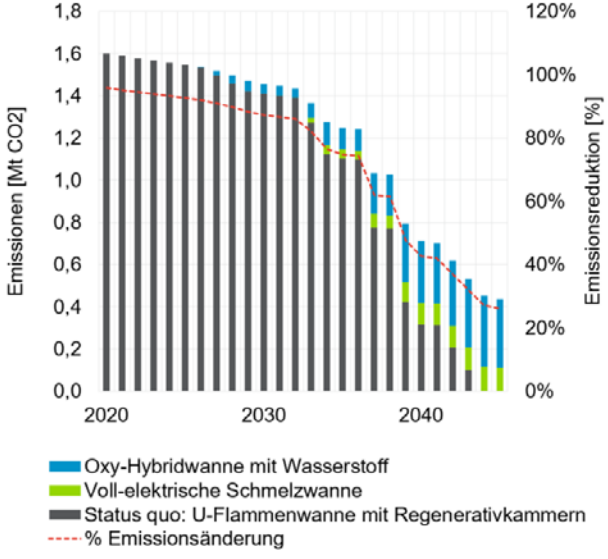
Impact

- Increase in production costs by almost 50%
- Energy costs factor 3 to 2020

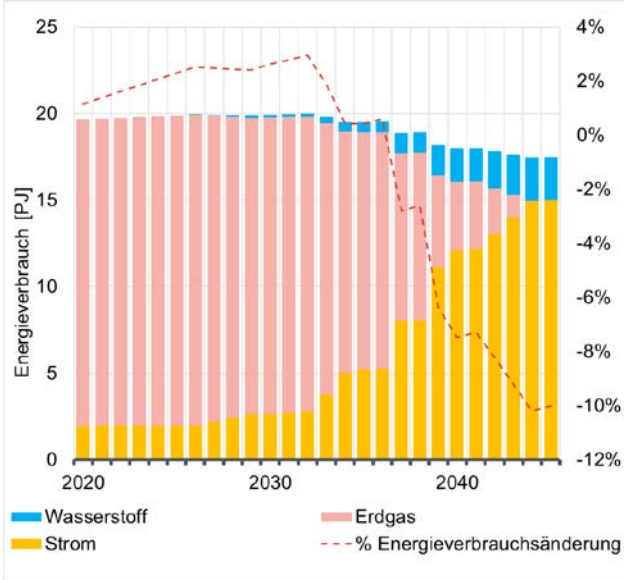
Impact of GHG-neutral glass production 2045

Flat glass

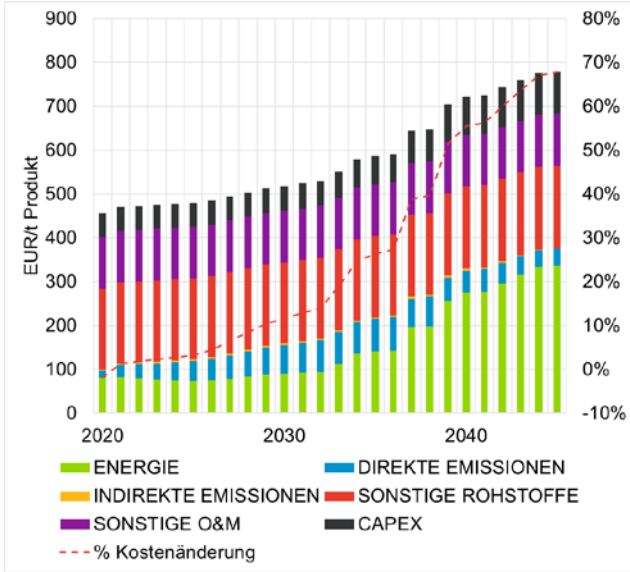
CO2 emissions



Energy consumption



Production costs



Impact

- CO $_2$reduction: 75 %
- Remaining 25% are process-related CO_2emissions

Impact

- Slight decrease in energy consumption
- Electricity use: 15 PJ + 500%
- H_2 use: 2.5 PJ

Impact

- Increase in production costs by almost 70%
- Energy costs factor 4 to 2020

Policy instruments

Main challenges

- **Use of electricity + hydrogen**
- **Production costs**
- **Process-related CO_2 emissions**

Development of political Recommendations for action and instruments

Energy system

Reliable and affordable provision of "green" energy

Infrastructure

Sufficient and secure electricity and gas grids. Flexibility in demand and energy sources

Balancing mechanisms

Subsidies to offset the additional costs of decarbonisation

Circular economy

Increasing the recycling rate and material efficiency

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Summary and conclusion

- The glass industry in Europe must produce in a climate-neutral way by 2050. In Germany by 2045. To achieve this, greenhouse gas emissions from glass production must be reduced to zero.
- The glass industry is therefore facing enormous challenges, because energy savings in the glass melting process are hardly possible - energy consumption today is close to the theoretical energy demand.
- Climate neutrality can therefore only be achieved by substituting conventional energy sources (natural gas, conventional electricity) with renewable energy sources (green electricity, hydrogen, synthetic and biogenic fuels).
- The remaining process-related emissions must be reduced via CCS, CCU or by using GHG-neutral raw materials.
- Decarbonisation technologies include the all-electric melting furnace, the oxy-hybrid melting furnace with hydrogen or other greenhouse gas-neutral fuels.
- These technologies are currently not yet available in the required installation size or are still being developed or tested.

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Summary and conclusion

- The presentation here presents the results of the study "Energy transition in industry" by the Federal Ministry of Economics and Technology for the container glass and flat glass industry in Germany (calculation of climate paths, measures and costs)
- Assuming that the technologies mentioned are available, the study concludes that climate neutrality is achievable for the container and flat glass industry in 2045, but would lead to a huge increase in production costs.
- Production costs in the container glass industry would increase by almost 50 % and in the flat glass industry by almost 70 % by 2045. This does not yet take into account the decarbonisation of process-related emissions.
- Since these enormous increases in production costs would lead to a loss of competitiveness, the study recommends the following policy instruments:
- Funding the additional costs of decarbonisation e.g. through carbon contracts for difference
- Reliable and affordable provision of "green" energy
- Sufficient and secure electricity and gas grids (Hydrogen). Flexibility in demand and energy sources