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ZENTRUM FÜR EFFIZIENTE
HOCHTEMPERATUR-STOFFWANDLUNG

GAS- UND
WÄRMETECHNISCHE
ANLAGEN

Project MyGlass

Hybrid Heating for Emissions Reduction and Efficiency Increases in Glass Melting

5. Aachener Ofenbau- und Thermoprozess-Kolloquium

Andreas Pestel | 24.09.2025
Ralph Behrend, Sven Eckart, Sindy Fuhrmann, Hartmut Krause
Professorship for Gas and Heat Technology
TU Bergakademie Freiberg

Agenda

1) Motivation of Project MyGlass
2) Construction of the Inclined bed melter
3) Impressions
4) Energy Balance
5) Exhaust gas composition
6) Conclusion

Motivation of MyGlass

Energy consumption in Germany in 2022

- Total: 3 293 TWh
- Industry & production: 2 270 TWh
- Glass, ceramics, stone & earth: 76 TWh

Contribution to the energy transition through

- Decarbonization/electrification
- Use of renewable energy sources
- Energy saving through direct energy coupling in the glass batch
- Targeted atmosphere adjustment for the refining of the molten glass

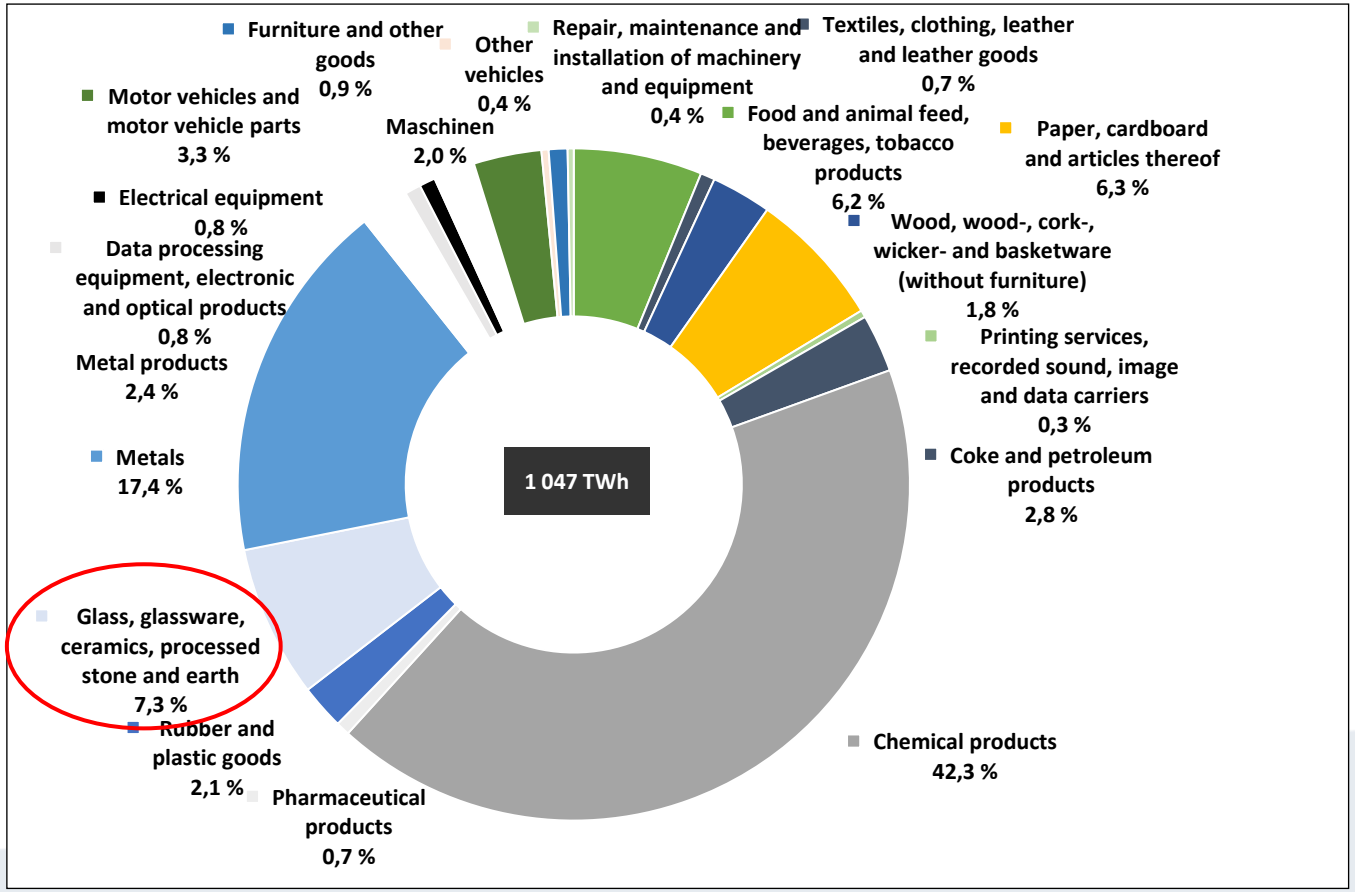


Figure: Energy consumption in the manufacturing industry by sector 2022
Link: https://www.umweltbundesamt.de/daten/umwelt-wirtschaft/industrie/branchenabhaengiger-energieverbrauch-des#der-energiebedarf-deutschlands (23.09.2025)

Construction

Process sequence

1) Feeding the glass batch into the melting area
2) Melting by microwave radiation
3) Glass melt flows from the melting area into the refining area
4) Tempering of the molten glass by the plasma torch
5) Outlet of the “finished molten glass”

6) Optional: Electrical auxiliary heating

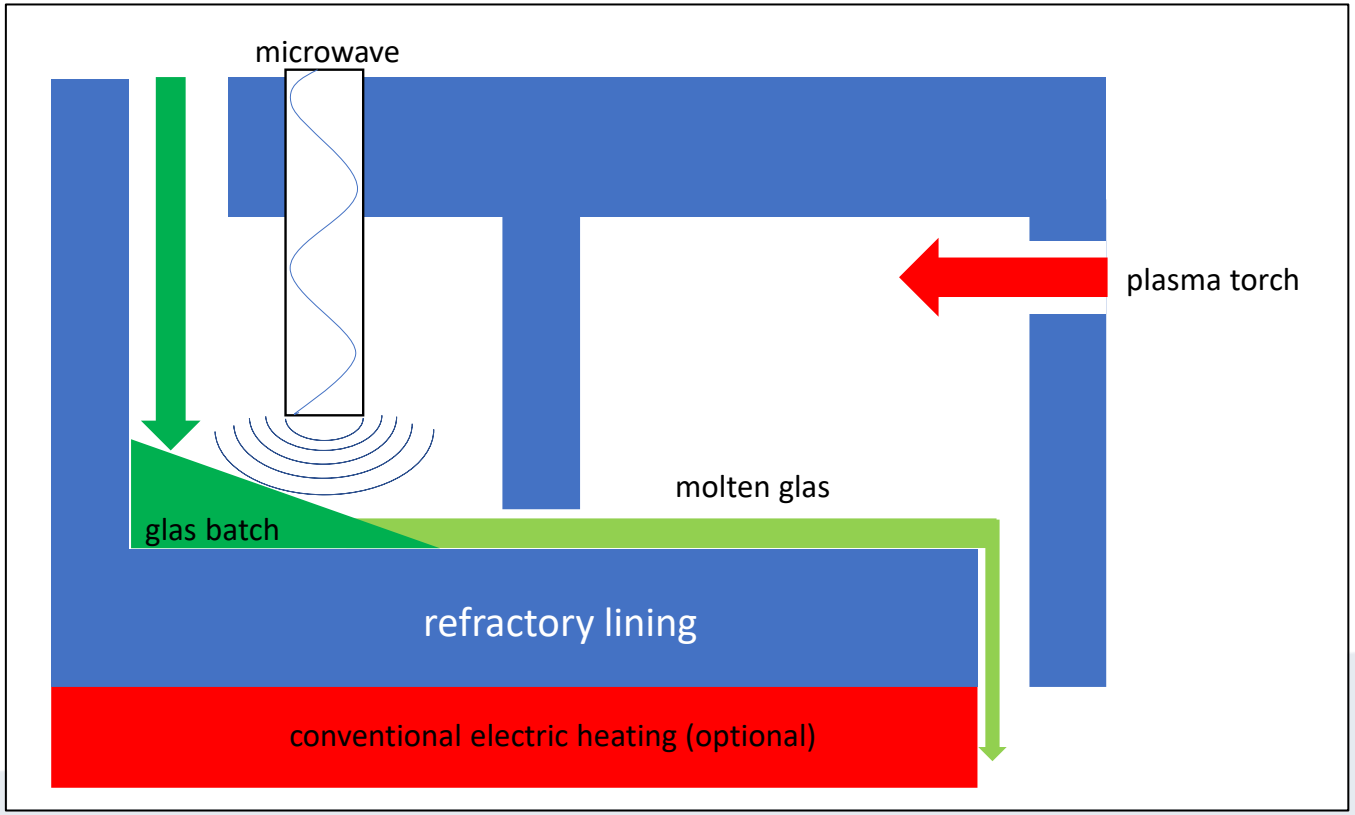


Figure: MyGlass inclined bed melter process diagram

Construction

- Basic design parameters
  - Microwave power 3 kW @2,45 GHz
  - Plasma torch 10 kW @2,45 GHz
  - Conventional heating 2.1 kW in 3 zones
  - Maximum temperature 1 750 °C
  - Microwave heated zone 150 x 150 mm
  - Plasma heated zone 200 x 150 mm
  - Inclination 0 … 5 °

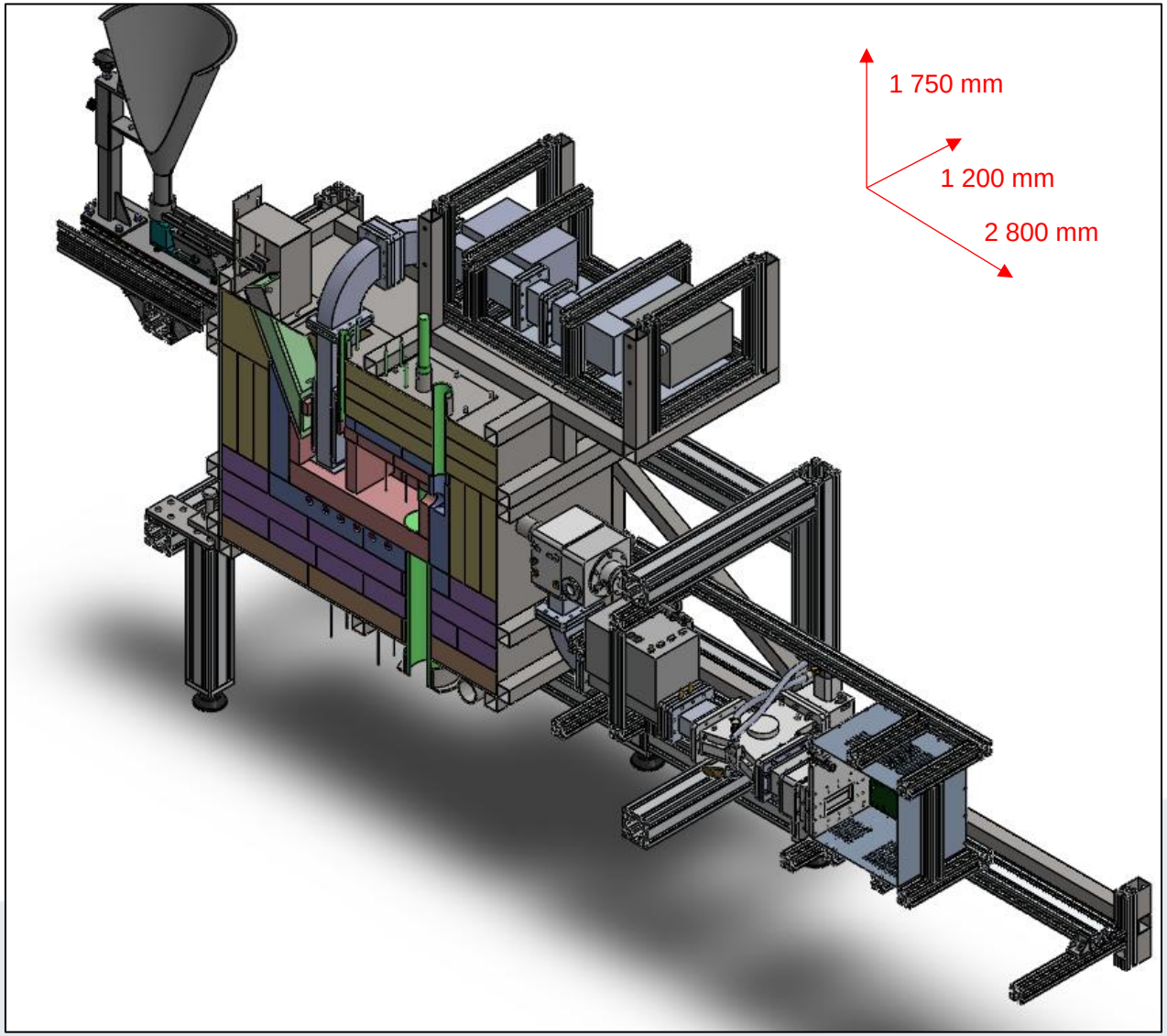
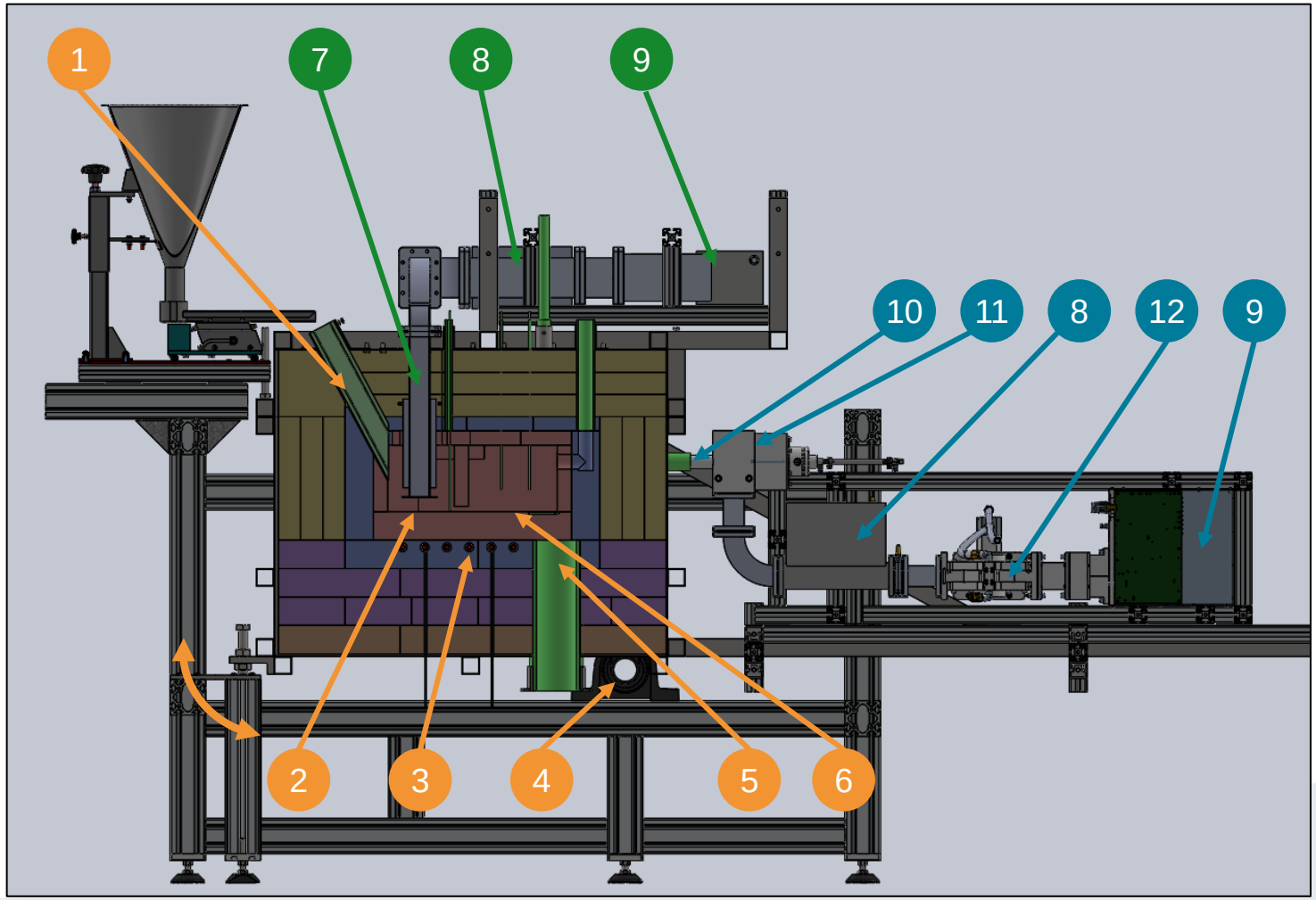


Figure: Sectional view of CAD design from the MyGlass melter

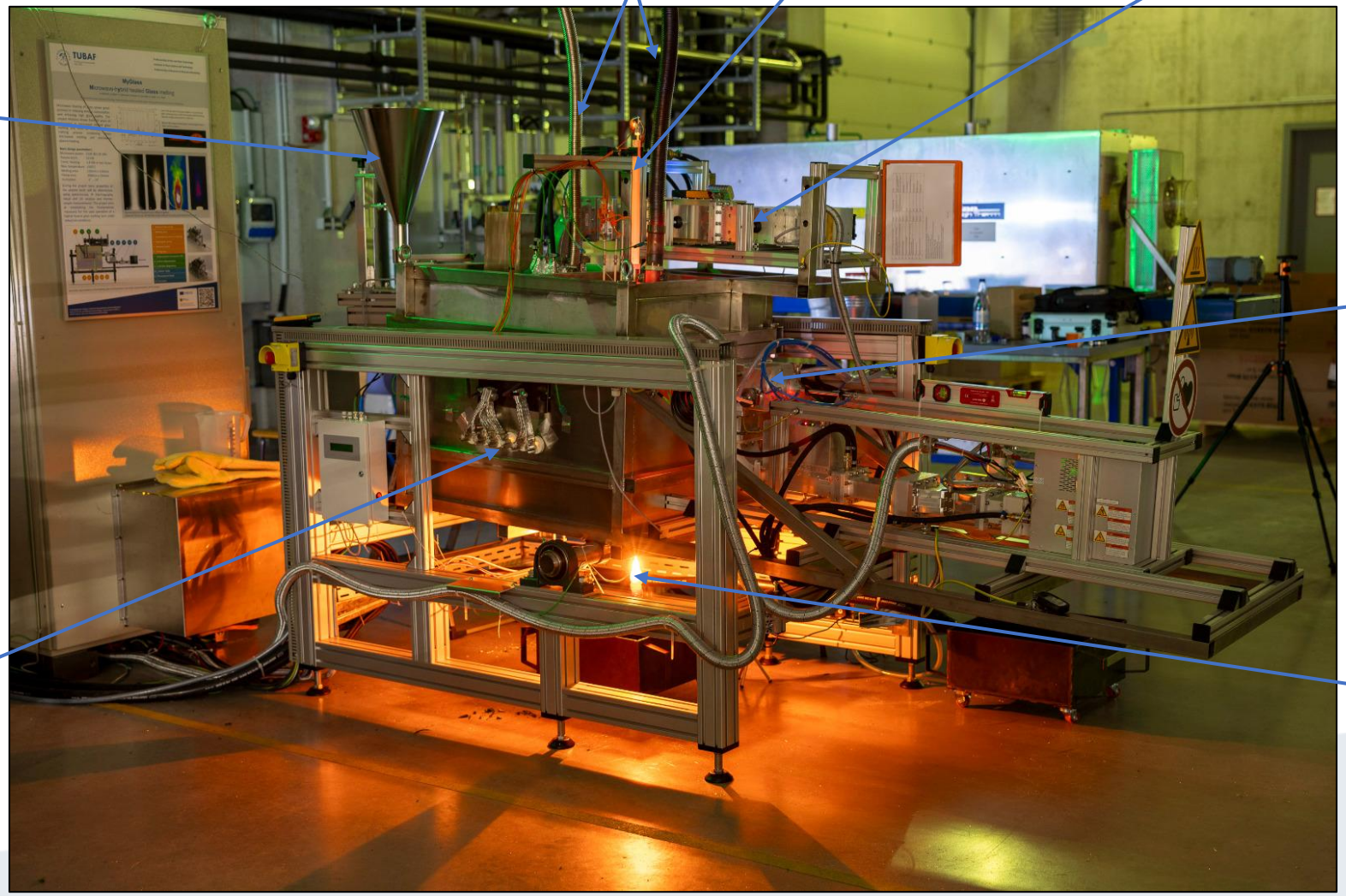
Construction



1	Material inlet chute
2	Melting area
3	Conventional electric heating
4	Bearing for swivel
5	Material outlet
6	Refining area
7	Watercooled microwave inlet
8	6-Port reflectometer
9	2.45 GHz Magnetron
10	„Flame“-tube
11	Plasma torch head
12	Circulator

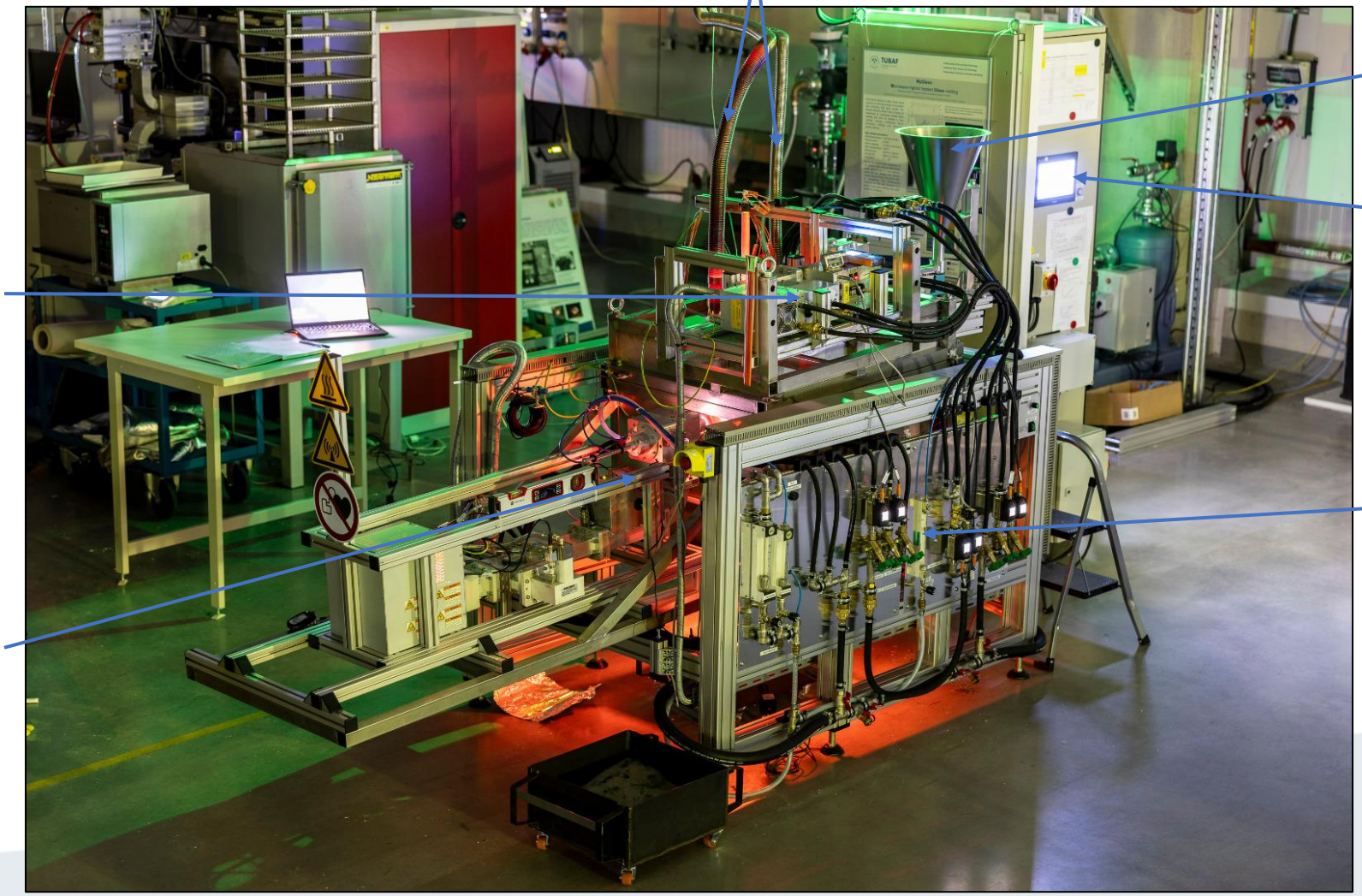
Figure: Sectional view of CAD design for the MyGlass melter

Impressions



Figur: Plant during first melting campaing

Impressions



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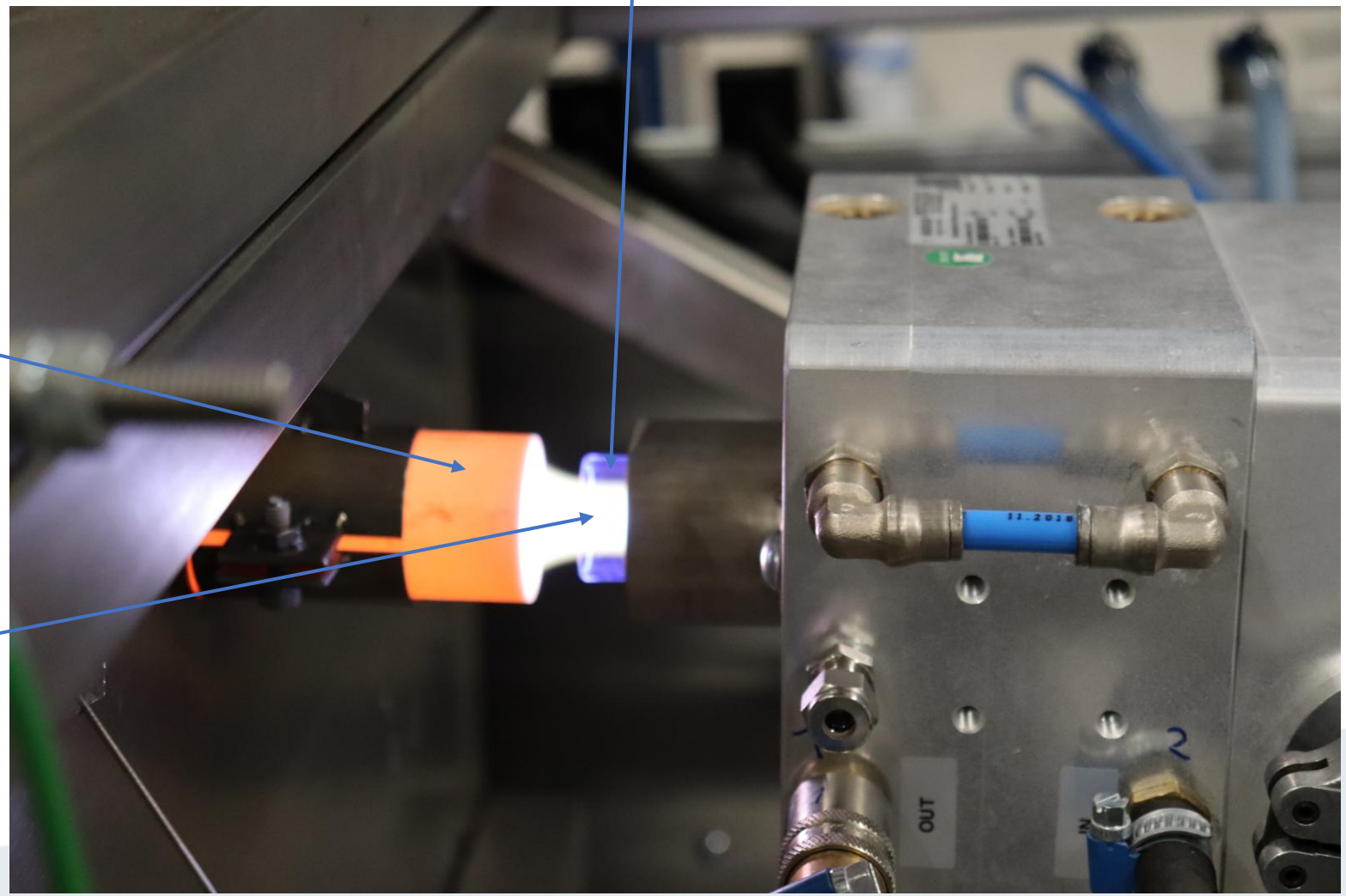


Figur: Plasma torch and inlet tube of melter

Impressions

Material outlet

Exhaust gas outlet

Plasma jet inlet

Figur: Plasma heated zone after melting campaign

Dust deposits

Figur: Waveguide after melting campaign

Impressions

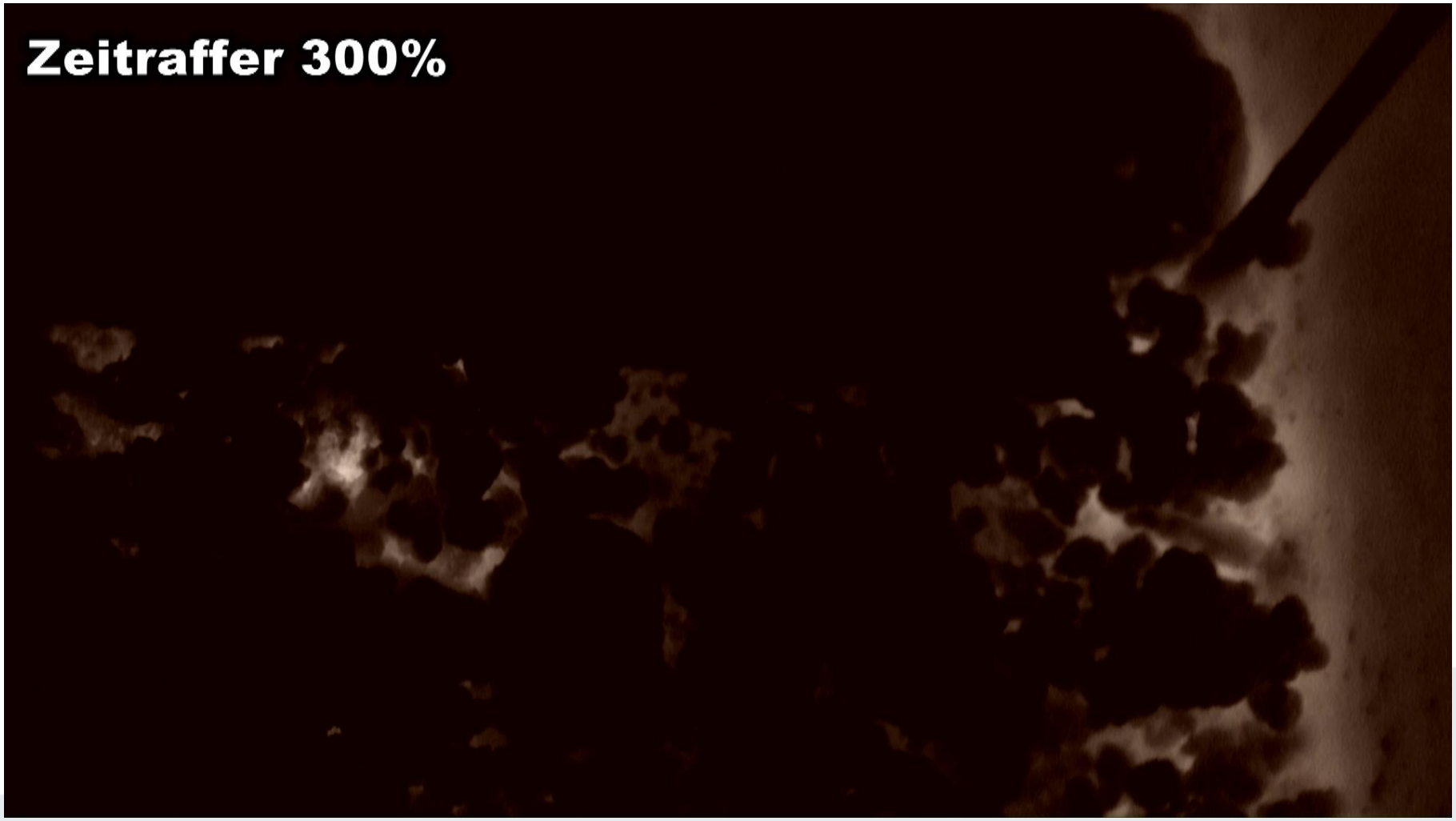


Figure: Melting glass by micro wave inside the inclined bed melter

Energy Balance

Two steps

1) **Consideration of the plasma jet and the plasma heated zone**
2) Consideration of the whole plant

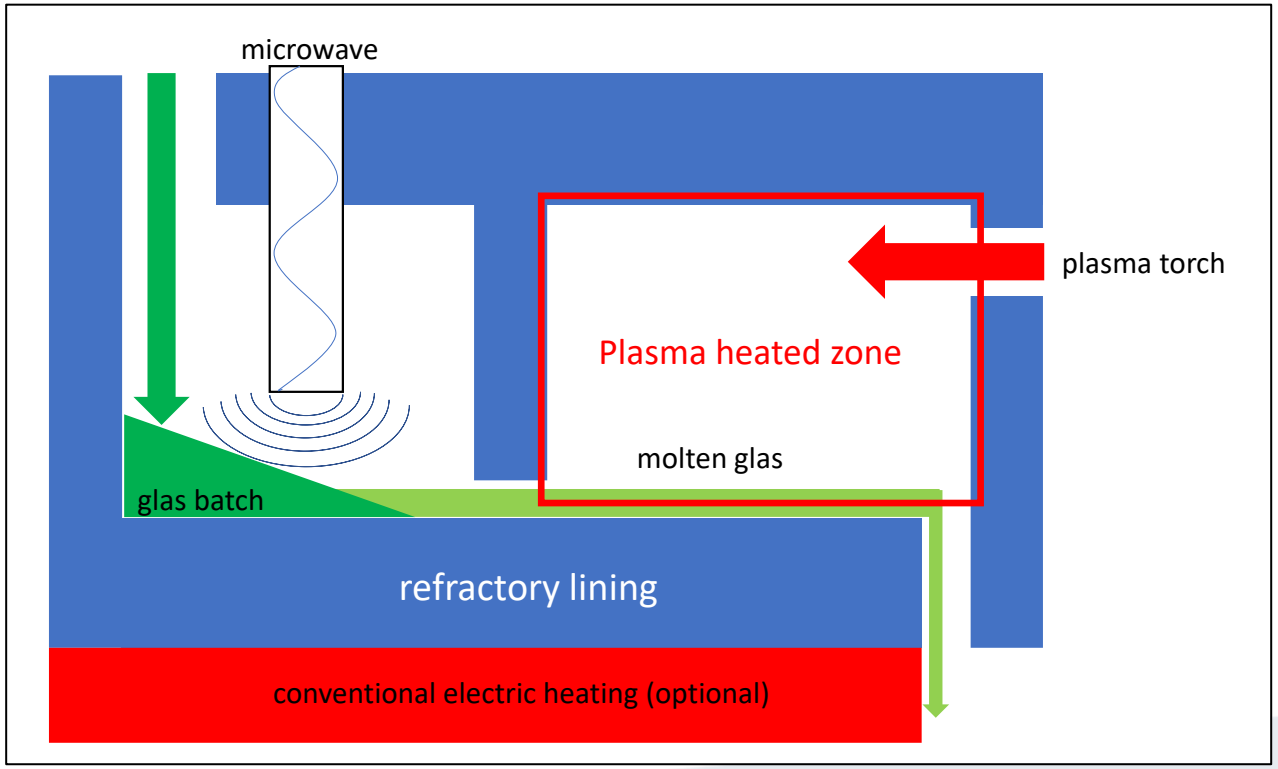
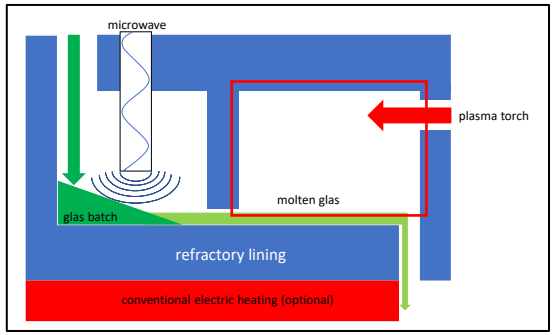


Figure: Limit for the heat flow consideration of the plasma torch

Energy Balance



- Power of the plasma torch controlled according to the temperature at the entrance to the plasma heating zone
- Major influence of volume flow on heat transfer in the inlet and the plasma heated zone
  - ➢ Shorter dwell time in the inlet
  - ➢ Gas flow in plasma heated zone becomes more turbulent
  - ➢ Main heat transfer through convection

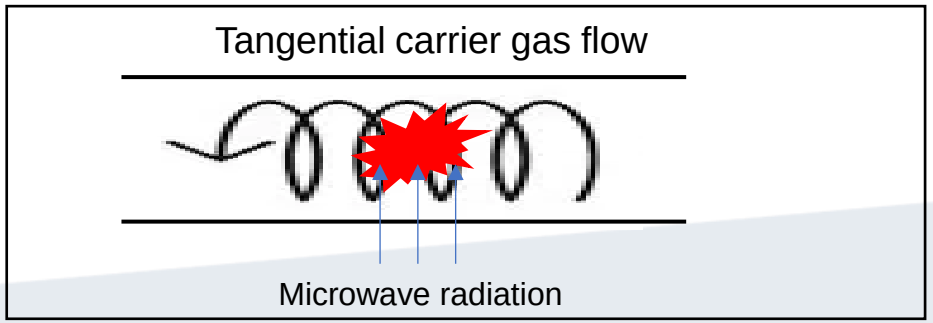


Figure: Schema of plasma generation in the Waveguid

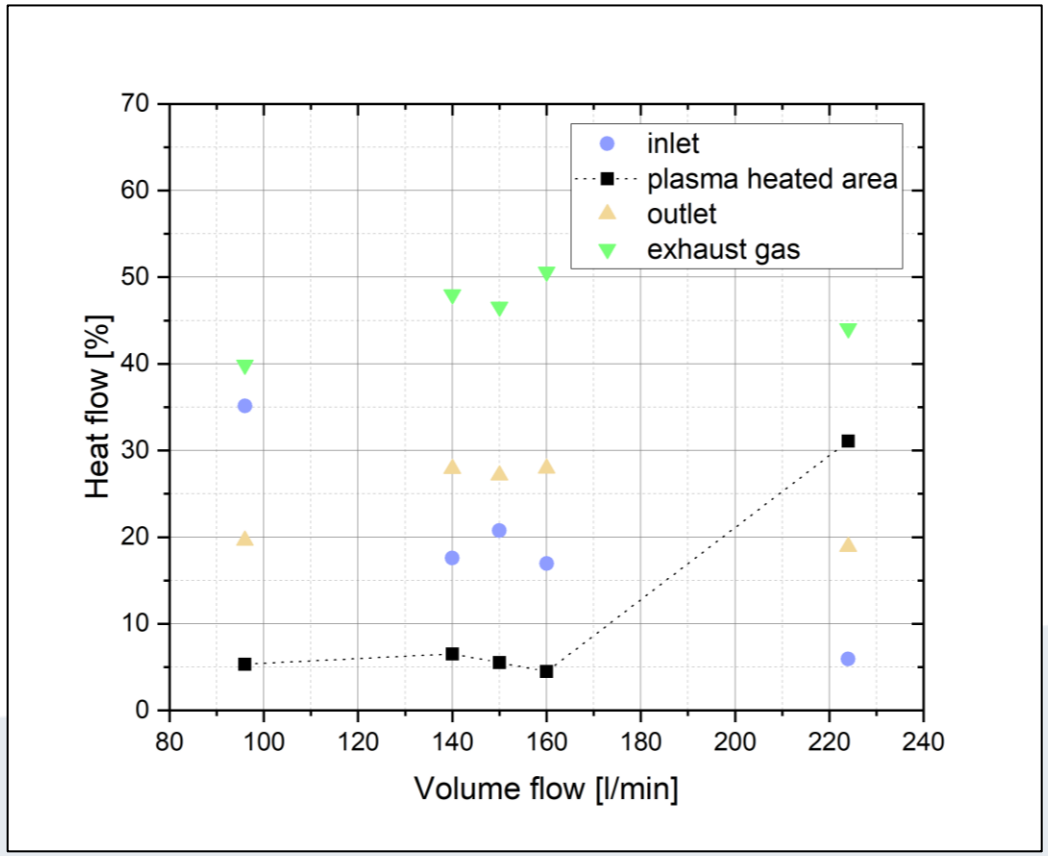
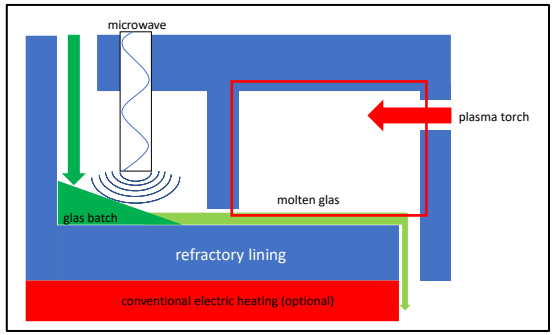


Figure: Heat flow from the plasma to system components depending on the volume flow

Energy Balance



- Major influence of volume flow on heat transfer in the inlet and the plasma heated zone
  - ➢ Shorter dwell time in the inlet
  - ➢ Gas flow in plasma heated zone becomes more turbulent
  - ➢ Main heat transfer through convection

  - ➢ **Significant increase of the heat transfer coefficient when a specified volume flow is exceeded**

Table: Heat flow for the example of 140 l/min volume flow

Area	Heat flow of the plasma jet
Plasma torch	7.0 kW
Entrance plasma heated zone	5.8 kW
Output plasma heated zone	5.3 kW
Exhaust gas	3.4 kW

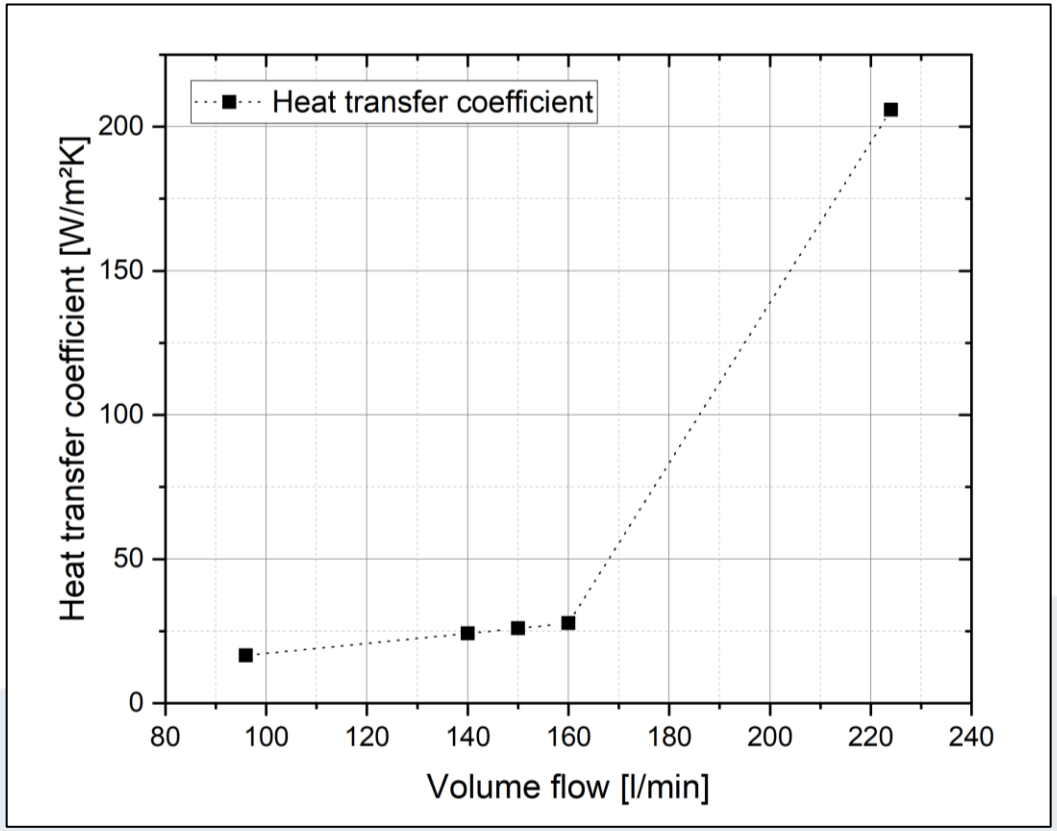


Figure: Heat transfer coefficient in the plasma heated zone depending on the volume flow

Energy Balance

Two steps

1) Consideration of the plasma jet and the plasma heated zone
2) **Consideration of the whole plant**

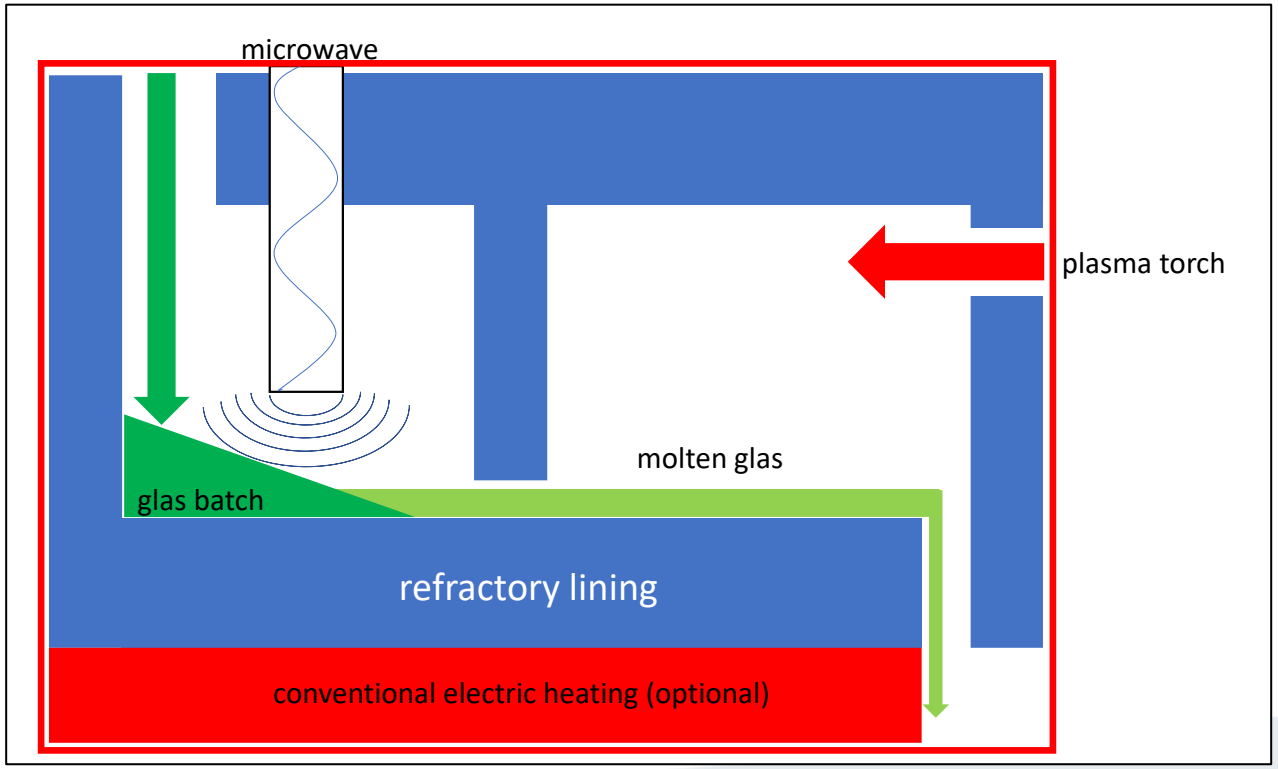
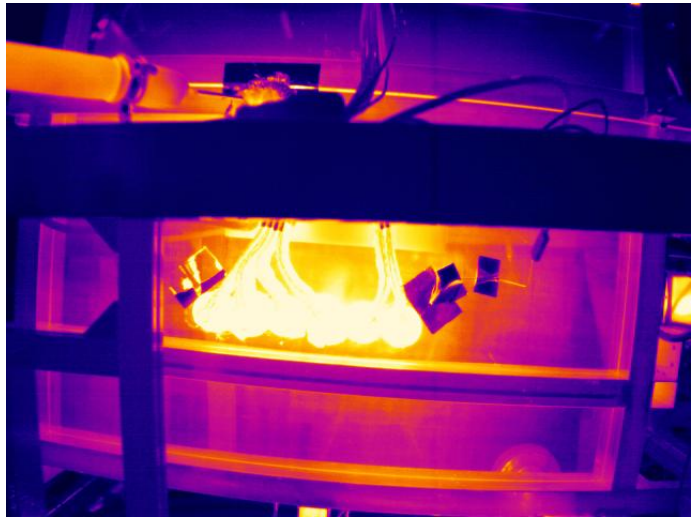


Figure: Limit for the heat flow of the plasma torch

Energy Balance

- Energy losses primarily via surface and exhaust gas
  - ➢ Thermal insulation heavily penetrated by extensive measuring systems
  - ➢ Projects for heat recovery in exhaust gas for a plasma torch in progress



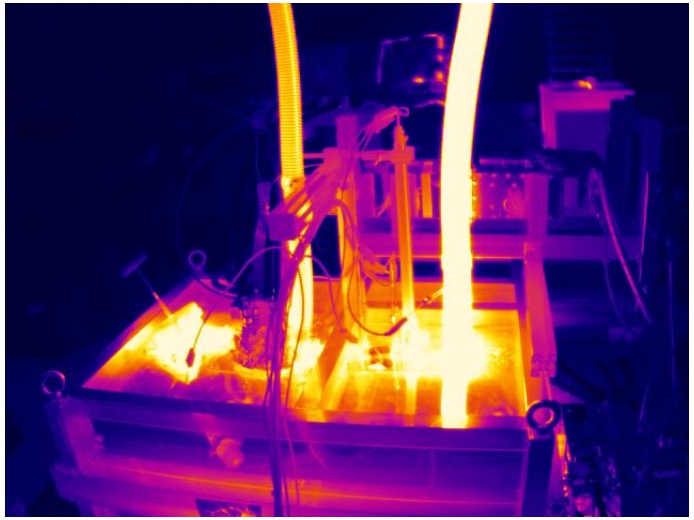


Table: Energy accounting with 140 l/min volume flow

Input		Output	
Plasma torch	7.0 kW	Surface	5.3 kW
Microwave	2.7 kW	Exhaust gas	3.4 kW
Electrical Heating	1.3 kW	Glass (1 kg/h)	0.7 kW
		Watercooling	0.006 kW
Summary	**11 kW**	**Summary**	**9.4 kW**

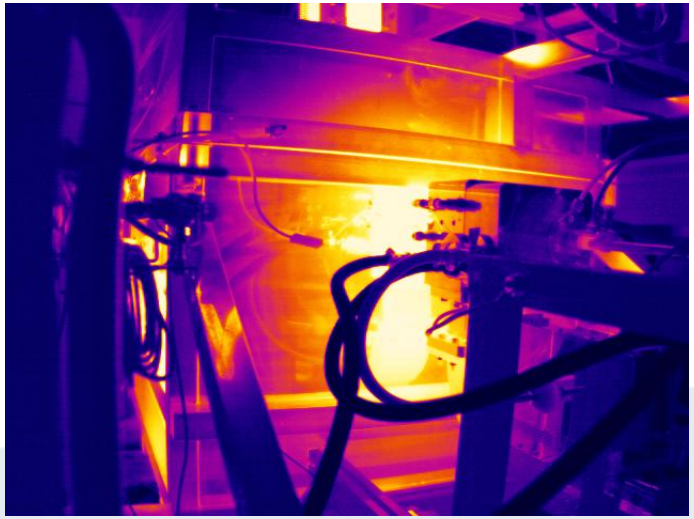


Figure: Images with IR camera of the surface from the MyGlass melter

Exhaust gas composition

- The use of air for the plasma torch generates a high concentration of nitrogen-based pollutants in the process exhaust gas
- The use of nitrogen prevents the formation of these impurities

➢ Other gases will be tested in the future

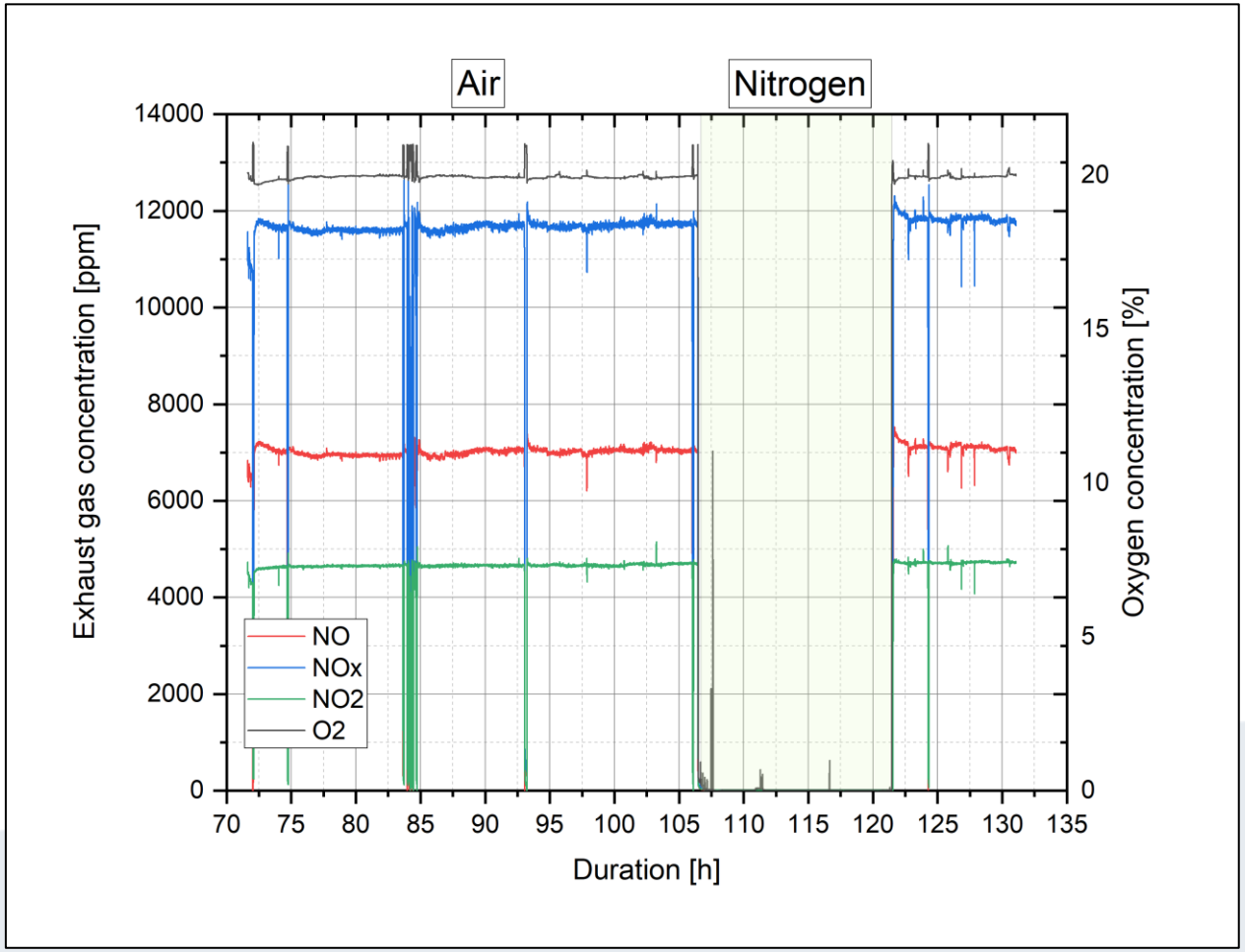


Figure: Exhaust gas concentration of nitrogen-based pollutants

Conclusion

Project MyGlass

- ✓ Development and construction of a technology demonstration platform the size of a pilot plant (TLR 6)
- ✓ Patenting of the technology
- ✓ Proof of function
- ✓ Determination of relevant operating parameters in four melting campaigns
- ✓ Melting of glass fragments, glass batch and CO_2-free glass batch

Future work

- ➢ Optimization of the system
- ➢ Optimization of the operationg parameter
- ➢ Testing various process gases
- ➢ Testing various glass raw materials

Figure:
Melting glass outlet
from the inclined bed melter

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Thank you for your attention!

Kofinanziert von der
Europäischen Union

Freistaat
SACHSEN

Diese Maßnahme wird mitfinanziert durch
Steuermittel auf der Grundlage des vom
Sächsischen Landtag beschlossenen Haushaltes.

Application number: 100688991

Andreas Pestel | 24.09.2025
Ralph Behrend, Sven Eckart, Sindy Fuhrmann, Hartmut Krause
Professorship for Gas and Heat Technology
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