areNH3a

First Workshop ARENHA project: "Introduction to novel technologies related to ammonia-based energy storage"

Advanced SOC technology at Fraunhofer IKTS

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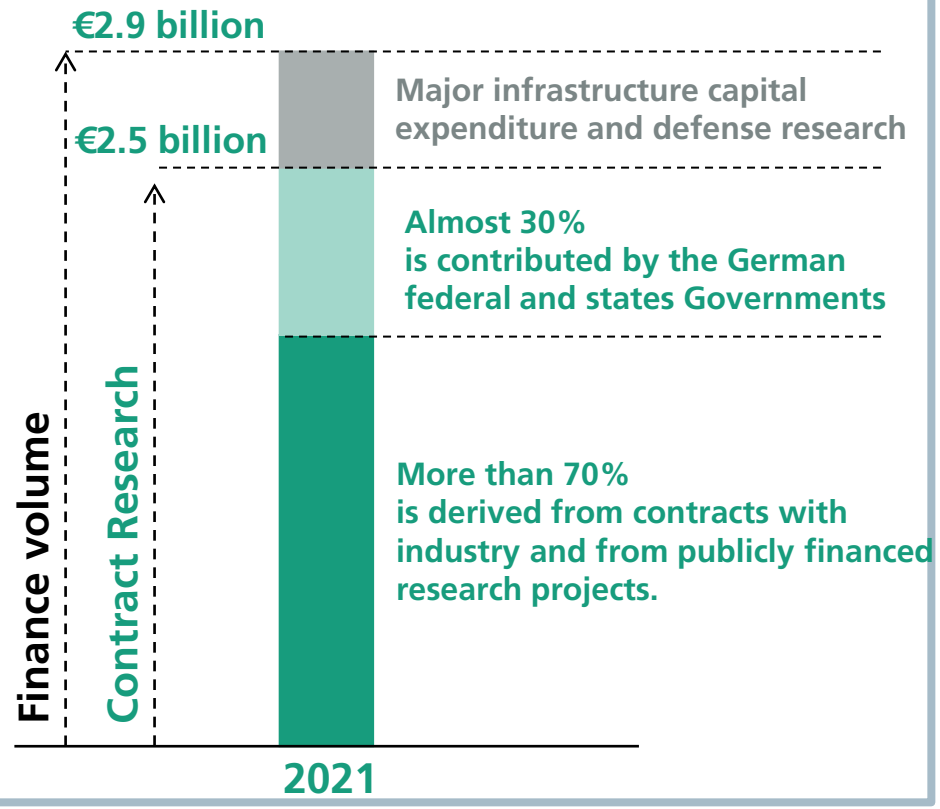
Fraunhofer-Gesellschaft

At a Glance

Applied research organization prioritizing key future-relevant technologies and commercializing its findings in business and industry. A trailblazer and trendsetter in innovative developments and research excellence.

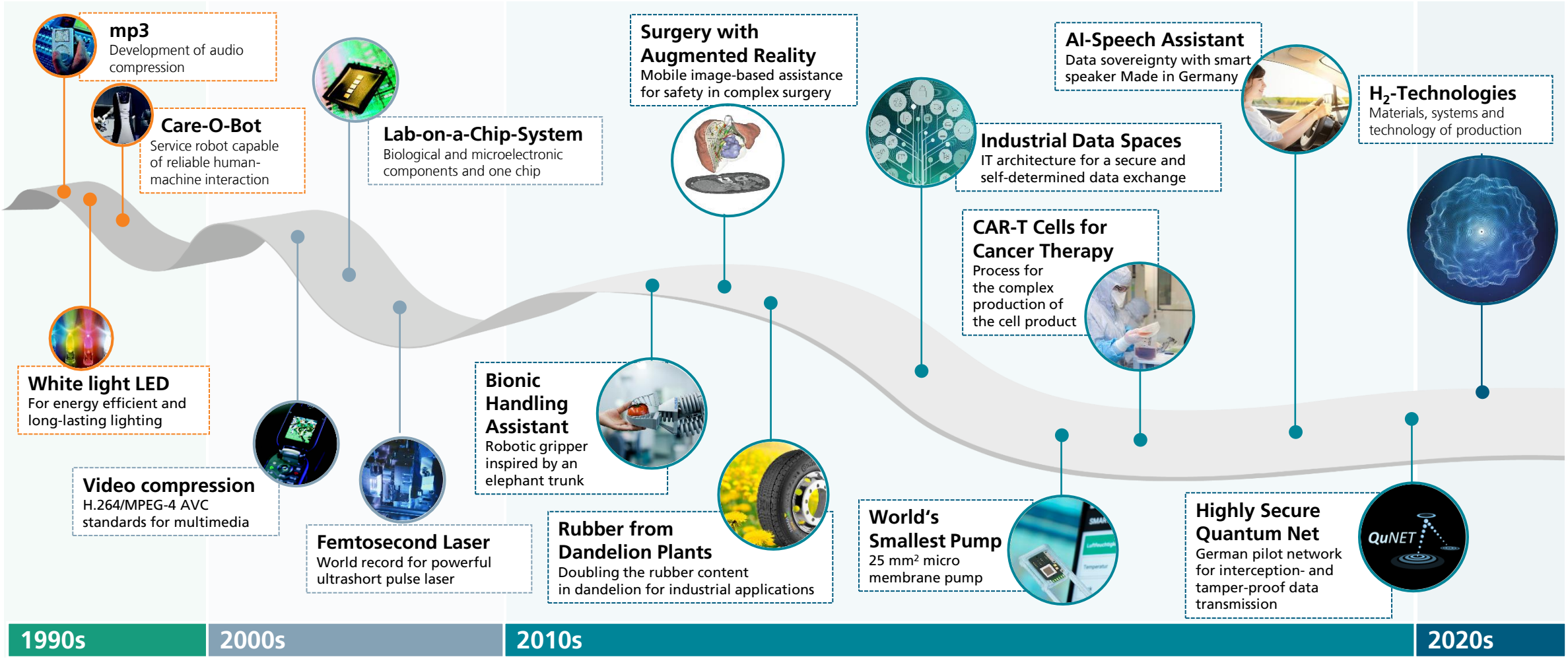
30 000 staff

76 institutes and research units



Fraunhofer

From Fraunhofer R&D
Highlights



Fraunhofer

FRAUNHOFER IKTS IN FIGURES










	Total
Personnel (full-time equivalents)	**658**
Overall budget in million €	**75.8**
Industrial revenues in million €	**20.7**

(December 31, 2020)

Institute Director:
Prof. Dr. Alexander Michaelis

TÜVRheinland CERTIFIED
Management System
ISO 9001:2015
ISO 14001:2015
www.tuv.com
ID 1100005194

Casting slurry.

MATERIALS

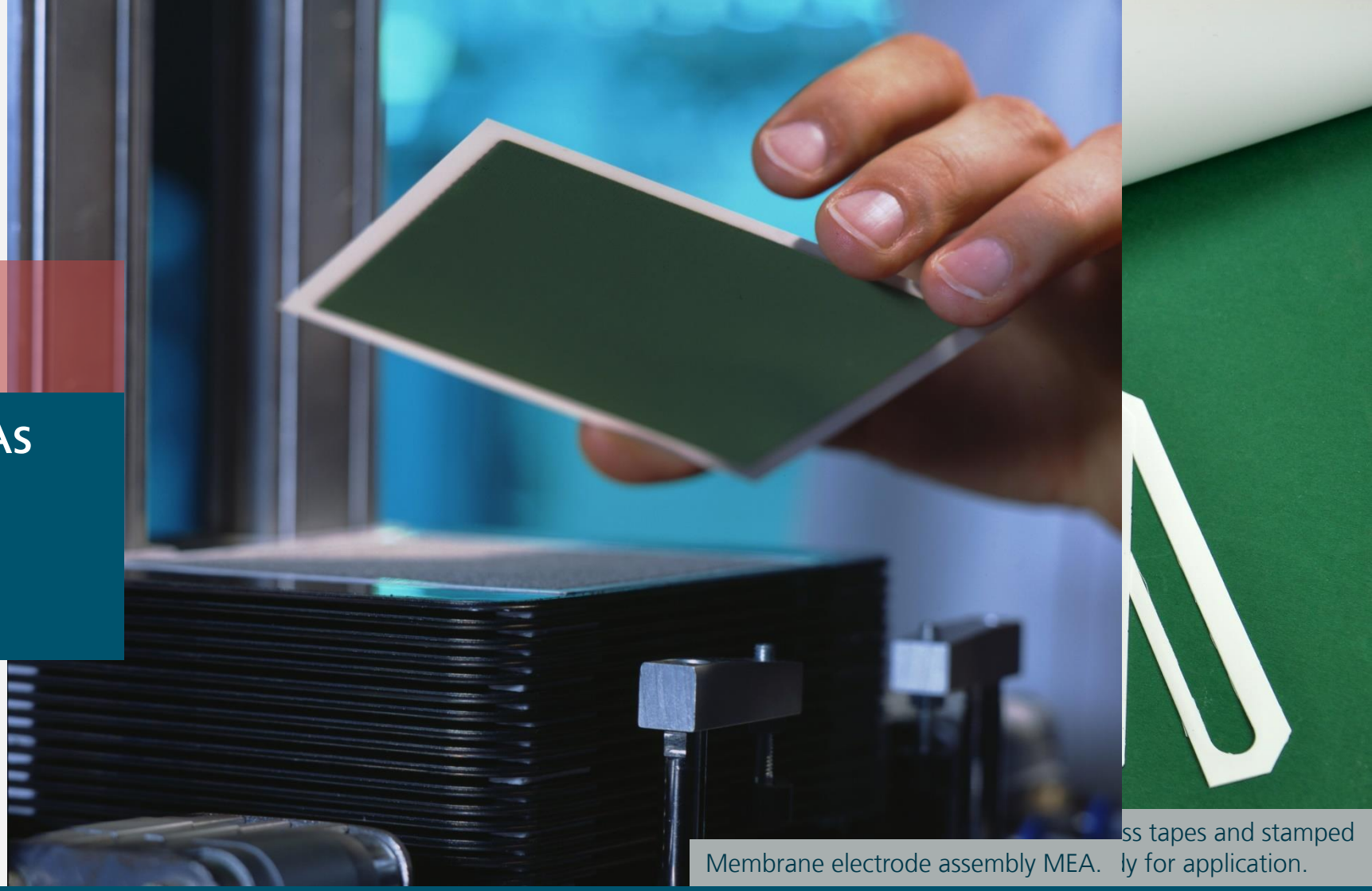
- Powders, pastes, tapes
- Protective coatings
- Characterization

Paste preparation for screen printing on a three roll mill.

SOC TECHNOLOGY @IKTS

CELL AND STACK COMPONENTS

- Electrodes, MEAs
- Contact layers
- Glass sealings



Membrane electrode assembly MEA.

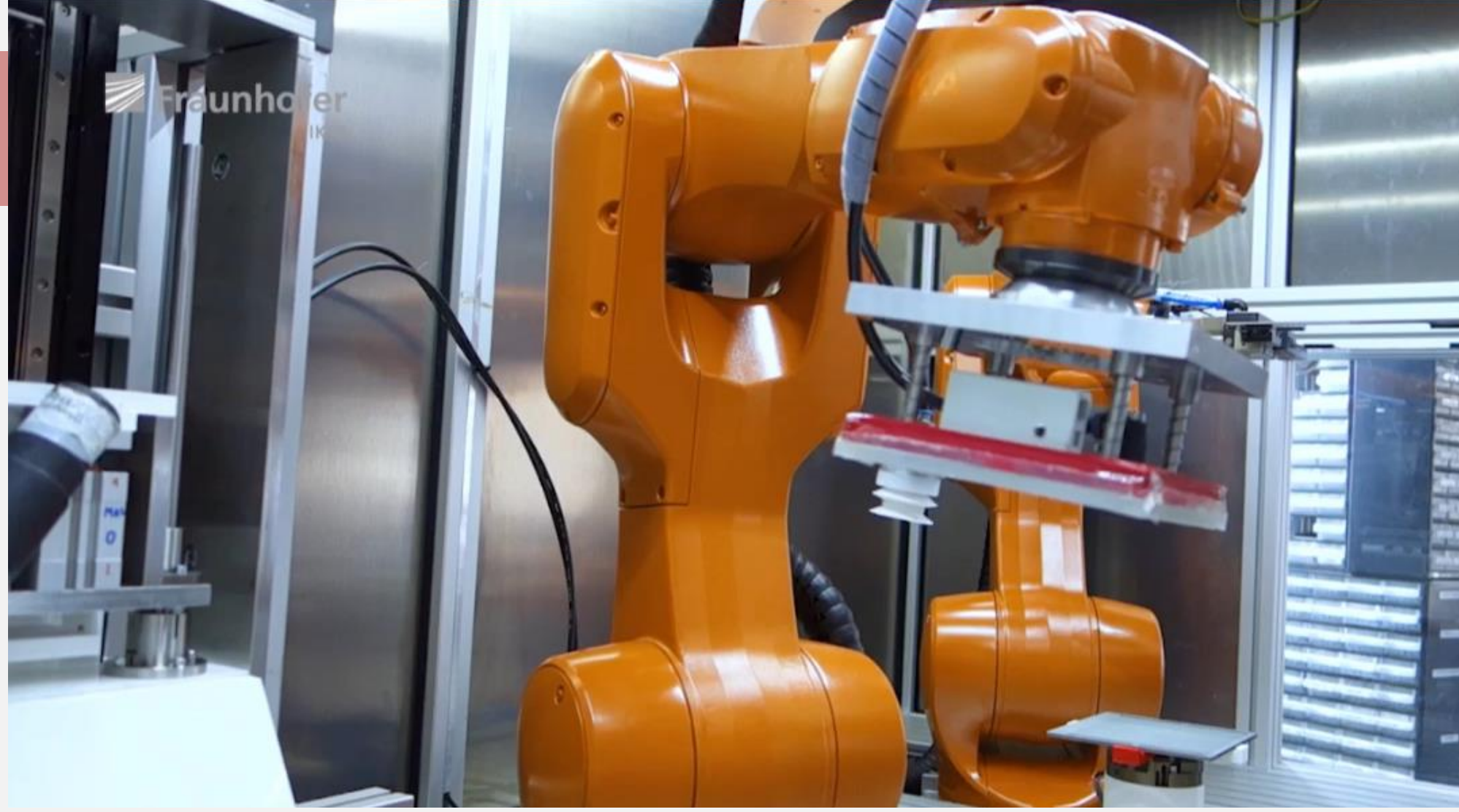
ss tapes and stamped
ly for application.

SOC TECHNOLOGY @IKTS

FULLY AUTOMATED SCREEN PRINTING LINE FOR CELL PRODUCTION

SOC TECHNOLOGY @IKTS

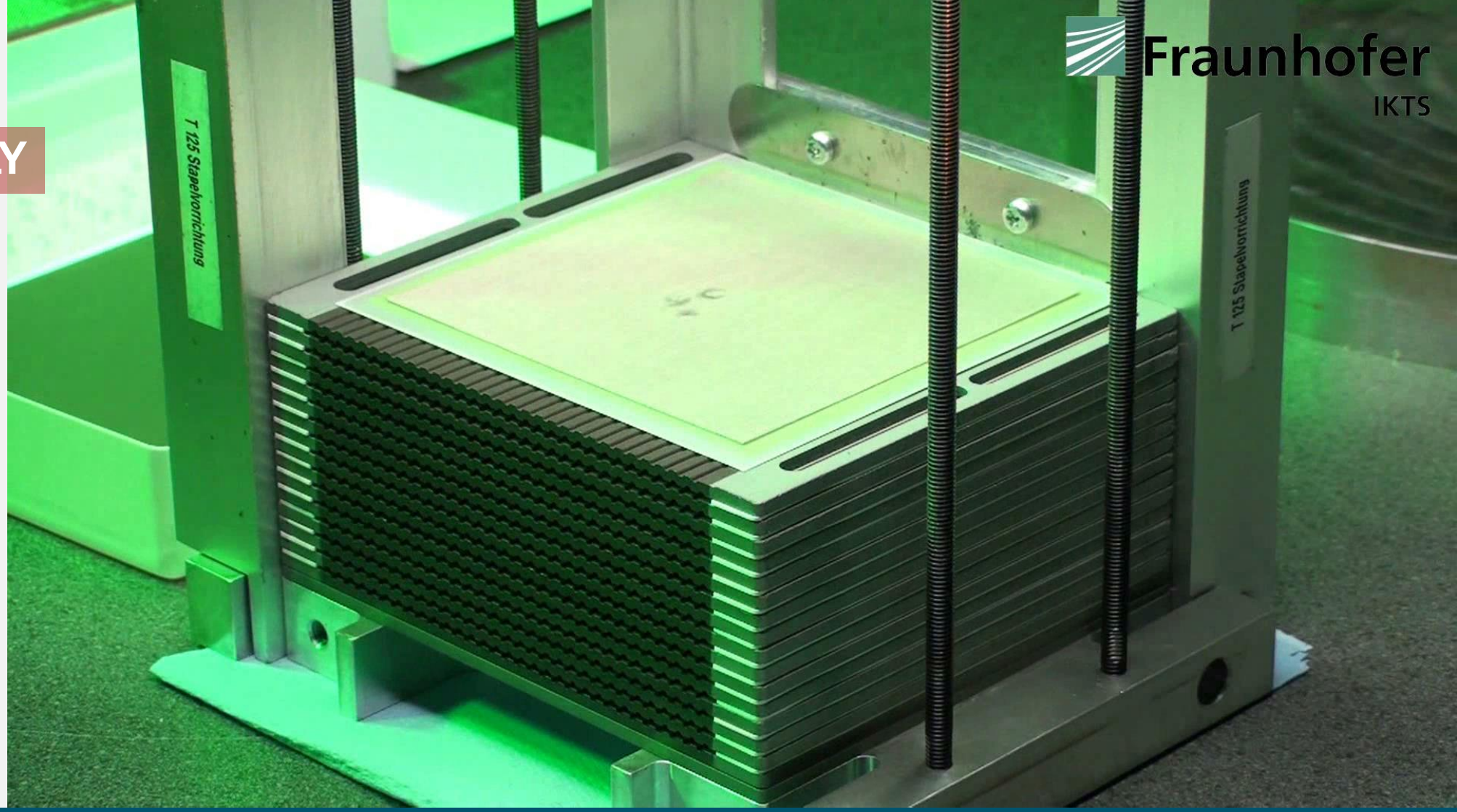
FULLY AUTOMATED STACK ASSEMBLY



Automated stack assembly machine.

SOC TECHNOLOGY @IKTS

STACK ASSEMBLY



Fraunhofer IKTS

MK352 30-cell stack ready for delivery.

SOFC/SOEC STACKS

- MK35x stacks 10-40 cells
- Test and characterization
- Simulation

SOC TECHNOLOGY @IKTS

STACK TESTING

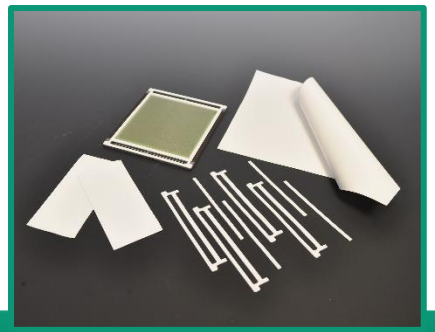
- SOFC/SOEC operation
- Determination of performance and long-term stability

Modern stack test stands are the core of the Fraunhofer IKTS SOFC and SOEC test center.

SOC TECHNOLOGY @IKTS

2. Stack components and manufacturing MK35x

Cell production



Glas production

Roboter assisted stack assembly

Joining and initializing

- Bipolar plate
- Elektrolyte
- Nickel mesh

- Continuous component inspection
- Stacks with 10-40 cells

2. Stack components and manufacturing MK35x

End plate BiP

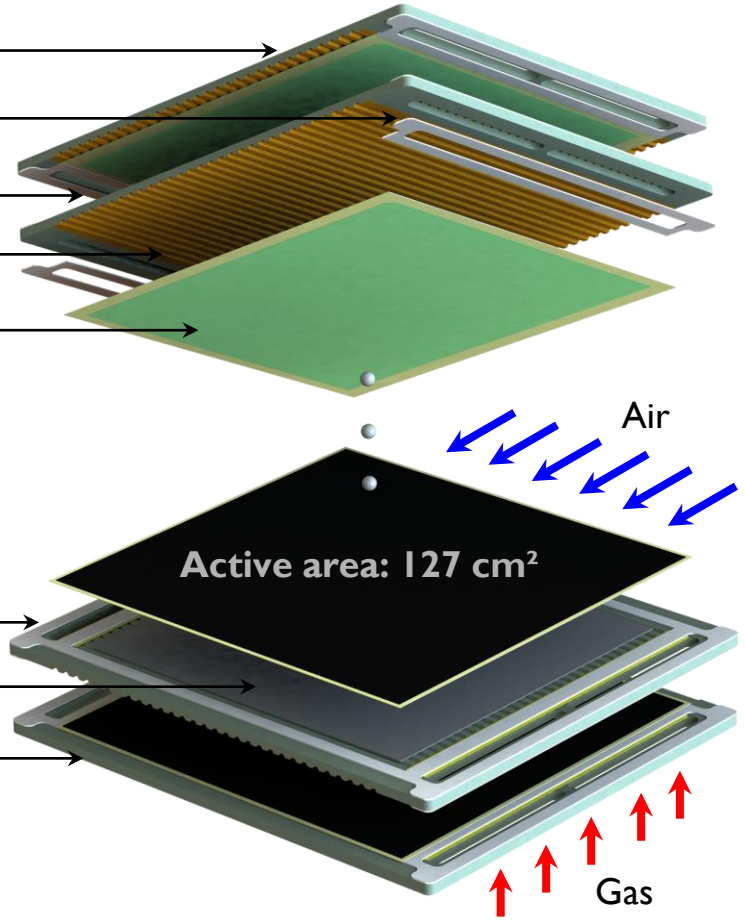
Glass step

Bipolar plate (BiP)

Protection layer

Cell with 10ScSZ Electrolyte

and contact layer on air side



Glas frame

Nickel mesh

Bottom plate BiP

MK354

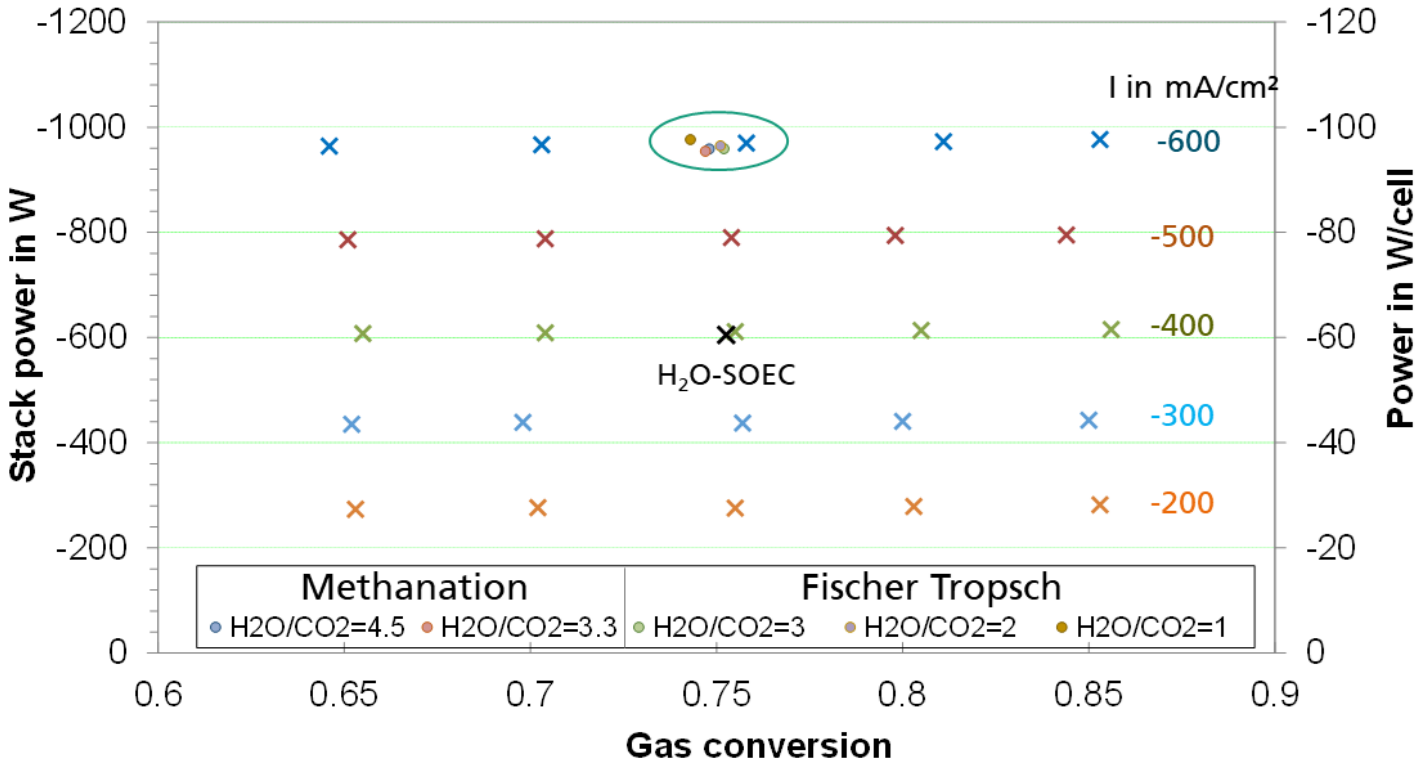
Cross flow design

130x150 mm²

3. Stack results: SOEC performance map

MK352 10-cell stack in a furnace: co electrolysis rated power operation

- @800°C; 61.4% H_2O, 18.6% CO_2, 15.3% H_2 and 4.7% CO (Methanation H_2O/CO_2=3.3)



- High current density possible -76.2 A, -97 W_{el}/cell @ 800°C
- Minimum difference between steam and co electrolysis for FTS or methanation

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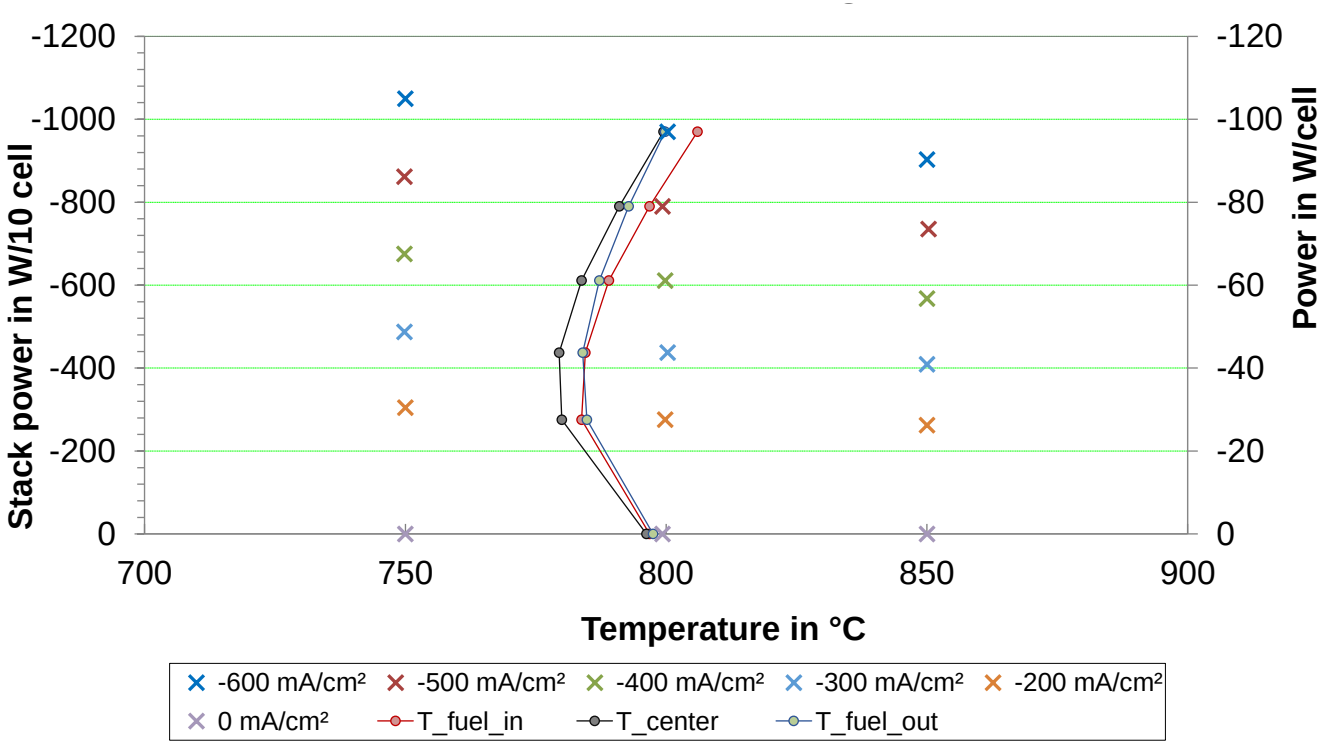

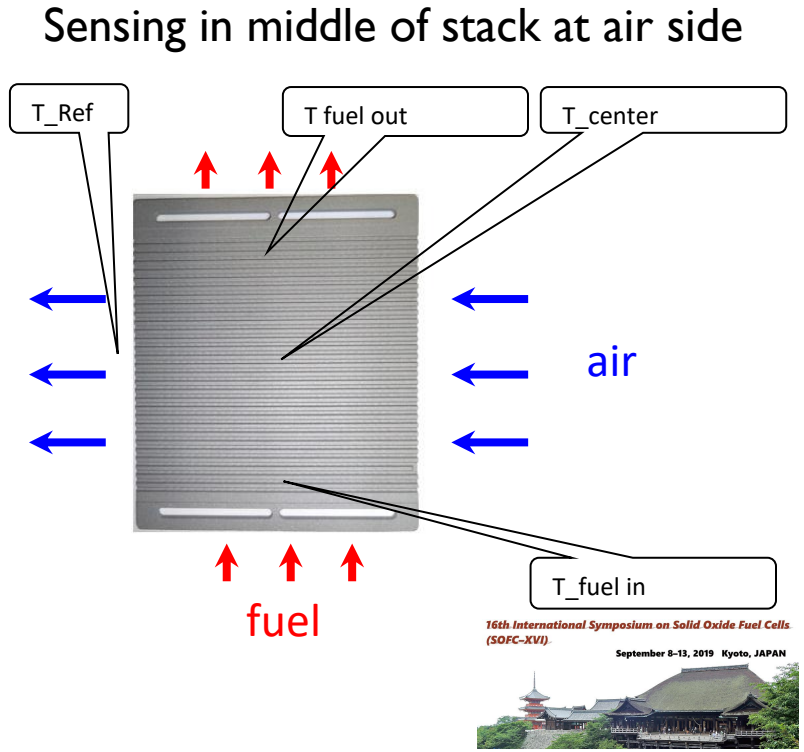

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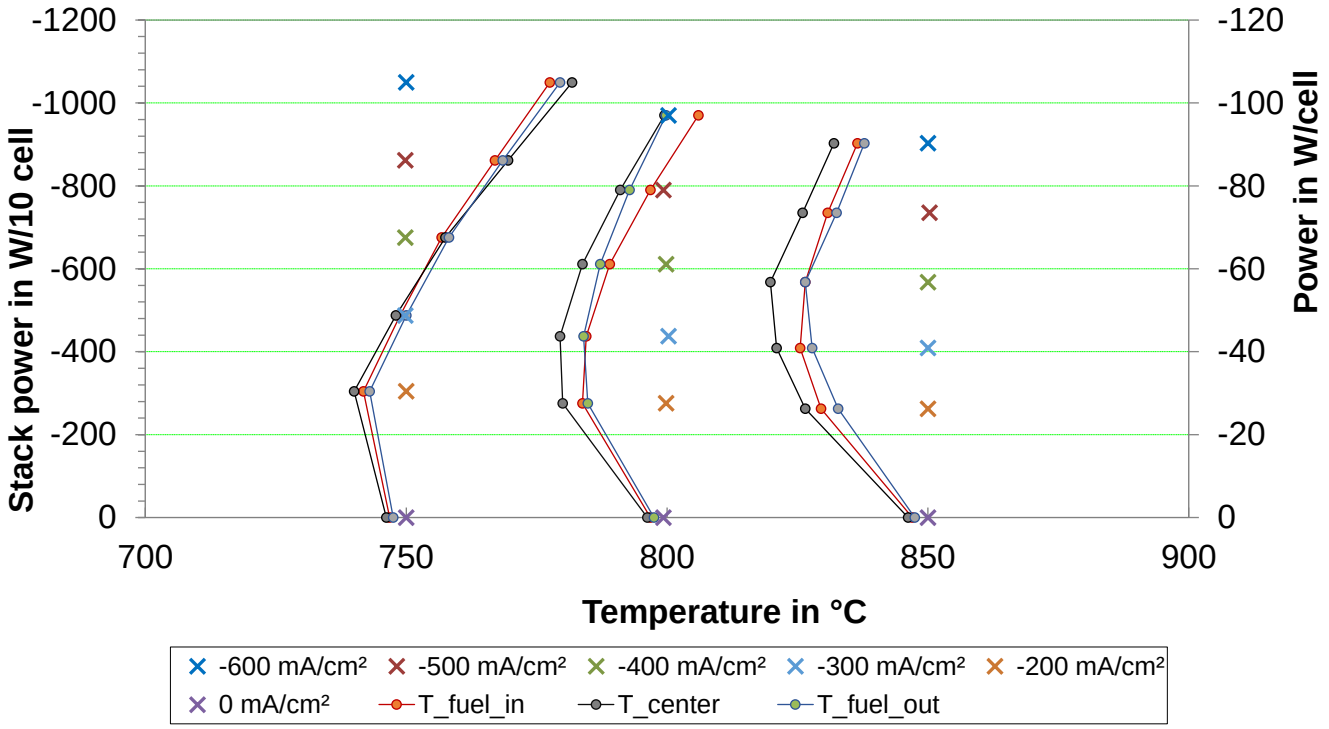
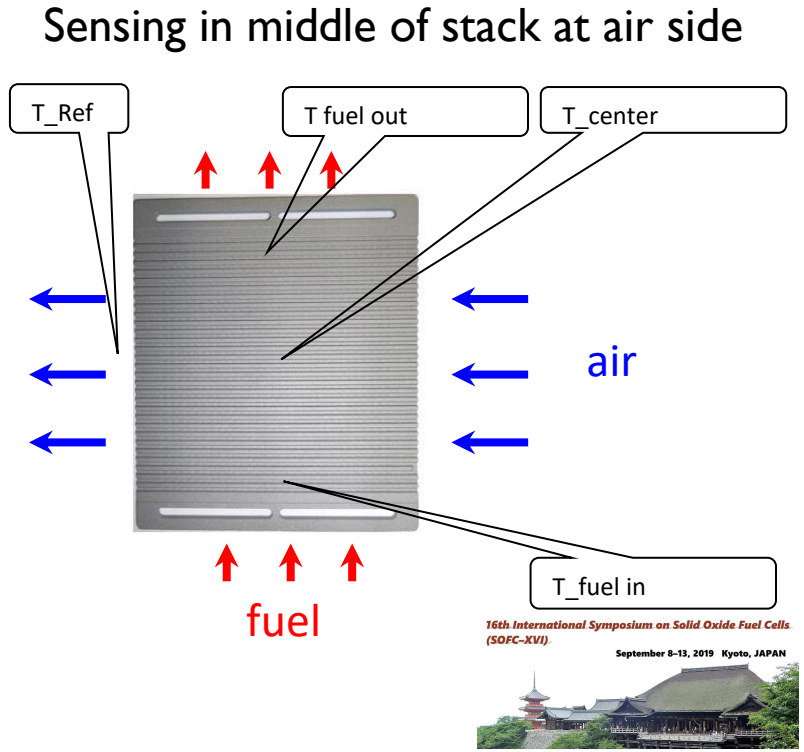
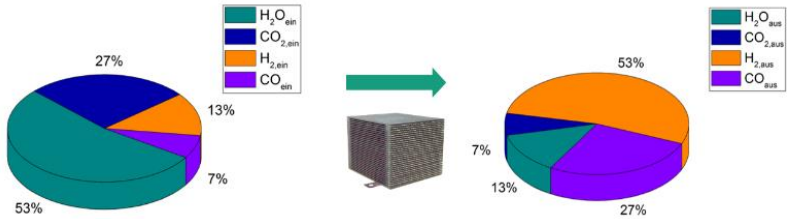


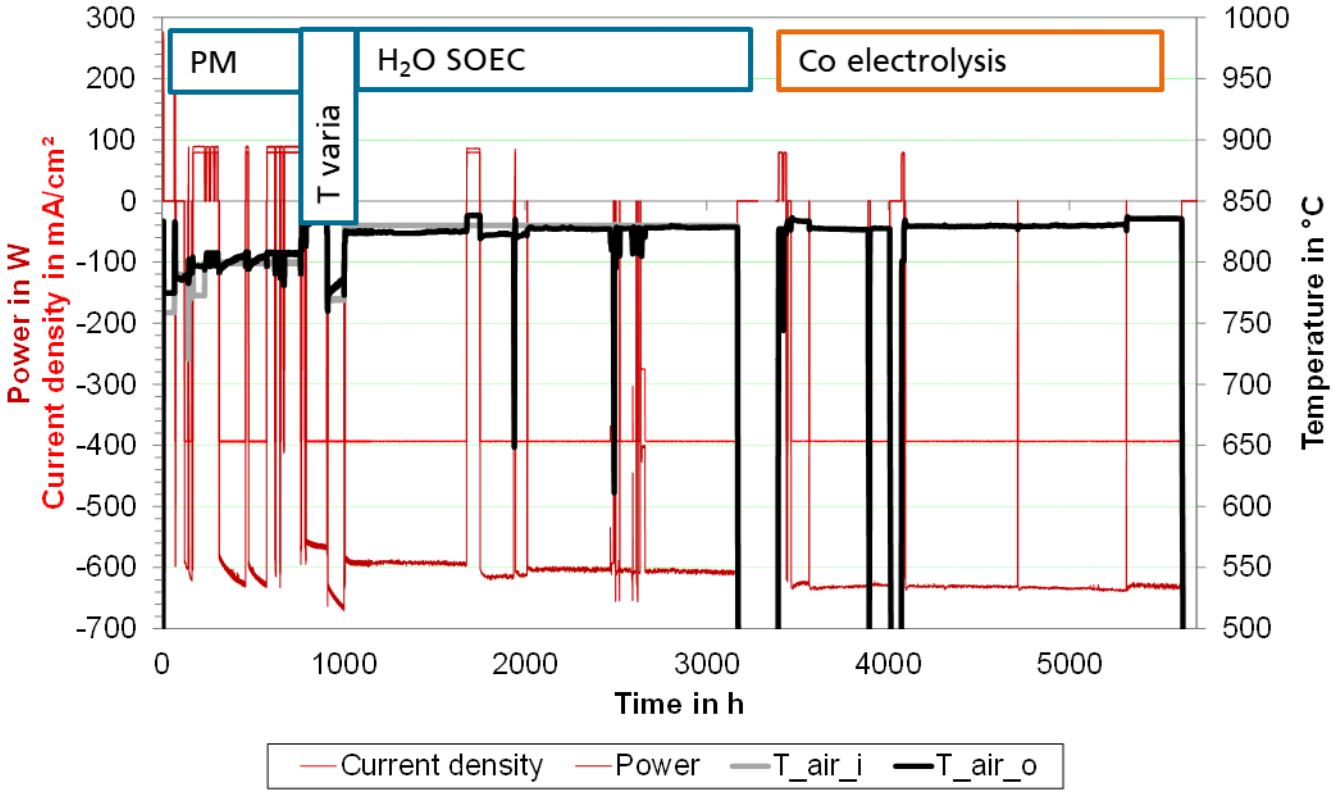


3. Stack results: SOEC long-term stability

MK354 10-cell stack in furnace:

- FU=75%
- Fuel: 20% H_2 in 80% H_2O
- Air: 30 sl/min
- $T_{An,I} = T_{Cat,I} = T_{furnace} = 800°C$





- Degradation in steam and co-electrolysis comparable
- ΔP/P0=-0.5 %/1000 h (> 5,000 h) ΔASR=17 mΩcm²/1000 h

STROM
ALS ROHSTOFF

4. MK35x in ARENHA

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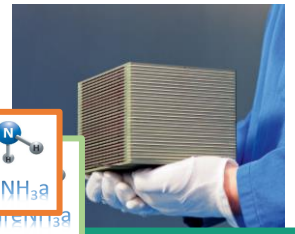
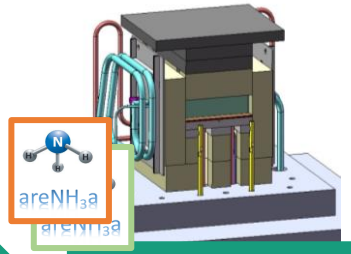
ARENHA SOFC

ARENHA SOEC



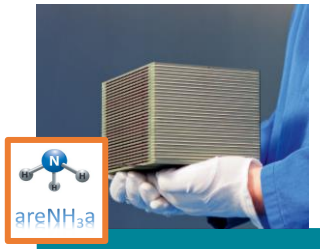
MK35x SOC stack with 10-40 cells



Stack tests in furnace

Cell development at IKTS

Stack from project partner

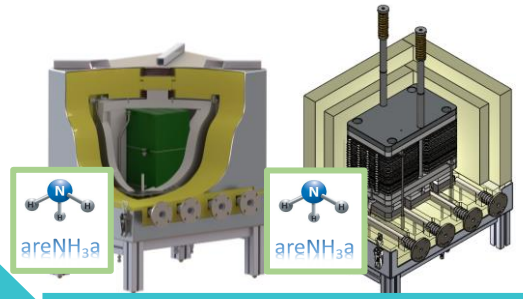


System simulation incl. BoP components

Convion C50

Sunfire Remote 400

Stack integration for systems



Stack module operation in demonstrators

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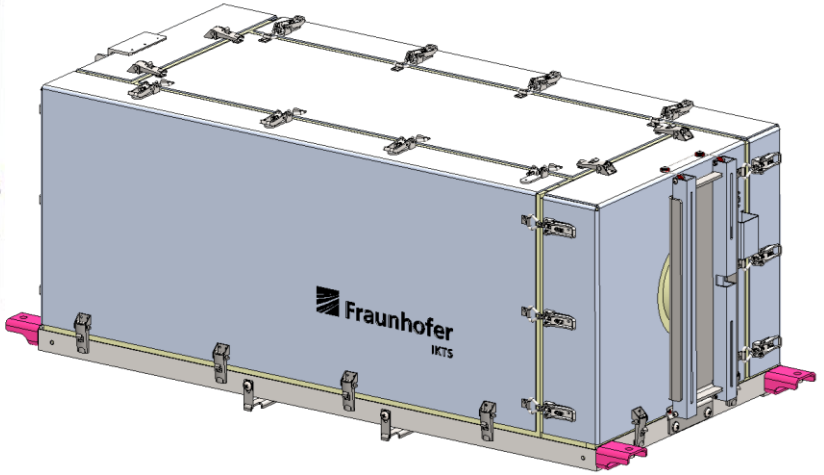
5. Conclusion

- Proofed stack technology MK35x
  - Available robust stacks suitable for SOC operation
  - Wide temperature range 750°C-900°C
  - No compression at room temperature
  - Power SOEC: up to -120 W/cell (-96 W/cell @ 76.2 A & 800°C)
  - SOEC Degradation: $\Delta P/P_{0(800°C)}$=-0.5 %/1000 h (>5.000 h)



- Assembling to modules
- Core element for systems

- References: Integrated in systems in Europe und Asia

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First Workshop ARENHA project, ENGIE Lab CRIGEN, 07-04-2022

Thank you for your attention

Website project: https://arenha.eu/

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