

ElringKlinger

# Components for Electric Energy Storage and Fuel Cell Systems from ElringKlinger

**A3PS-Conference**  
Eco-Mobility 2025<sup>plus</sup>  
November, 10<sup>th</sup> 2015, Wien

Dr. Uwe Maier  
Head of Fuel Cell Department

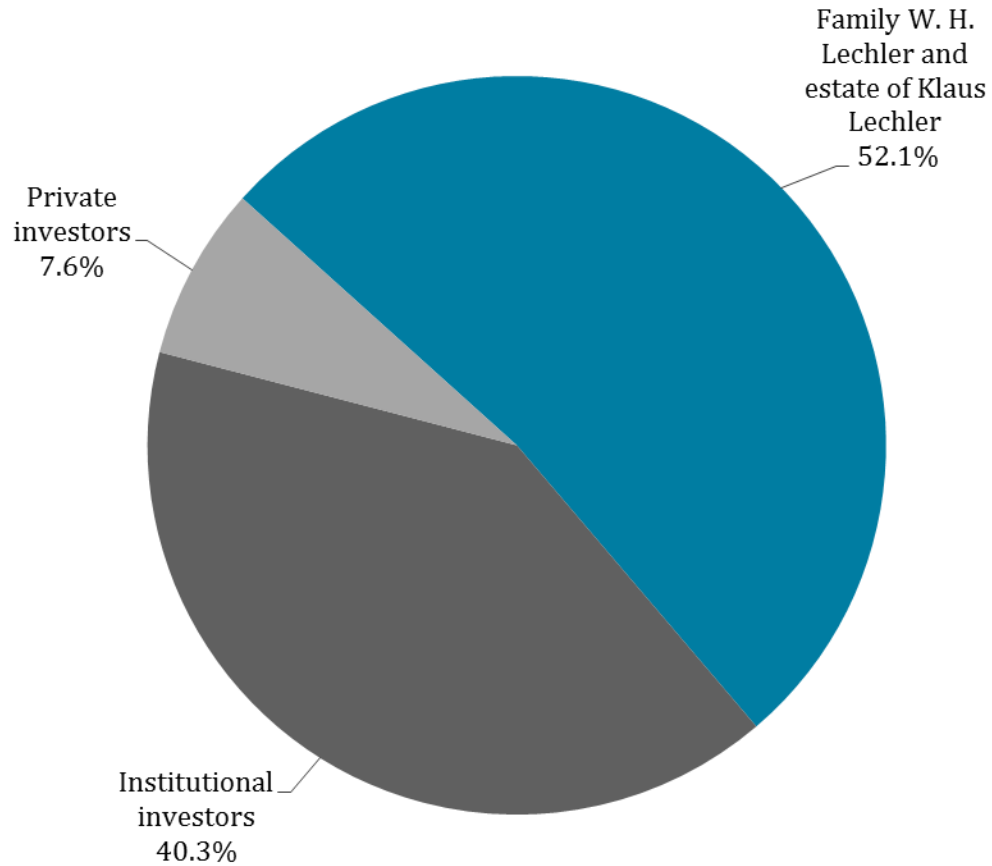


# Company History

- 1879 Foundation of Paul Lechler in Stuttgart, Germany (later: Elring GmbH)
- 1885 Foundation of Richard Klinger in Vienna, Austria
- 1994 Merger of Elring GmbH and Richard Klinger Automotive to Elring Klinger GmbH
- 2000 Merger of Elring Klinger GmbH and ZWL Grundbesitz- und Beteiligungs-AG (former Holding Company of Elring Klinger GmbH), renaming as ElringKlinger AG
- 2008 Acquisition of Sevex AG based in Sevelen, Switzerland
- 2009 Acquisition of the Turkish automotive supplier Ompaş A.Ş., Bursa
- 2011 Acquisition of the Static Flat Gaskets business of the Freudenberg Group (Germany, France, Italy)
- 2011 Takeover of a 66.7% interest in the Swiss Hug Group based in Elsau, Switzerland (since 2013: 93.67%)
- 2014 Acquisition of 75.0% of the shares in the New Enerday GmbH, Neubrandenburg
- 2015 Acquisition of the U.S. automotive supplier M&W Manufacturing Co., Michigan



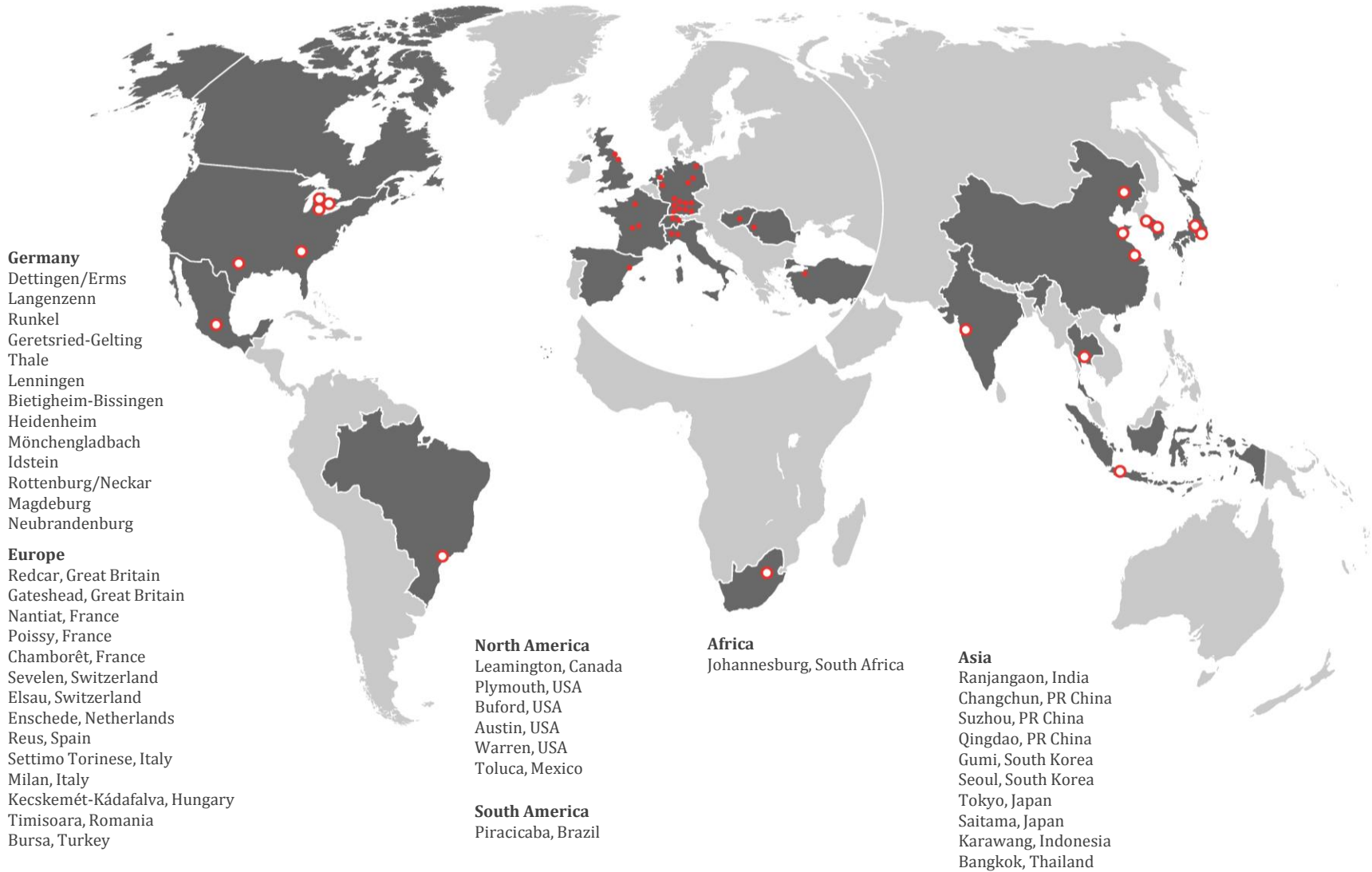
# Shareholder structure\*



\* Based on information available to the company as of December 31, 2014

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# Worldwide

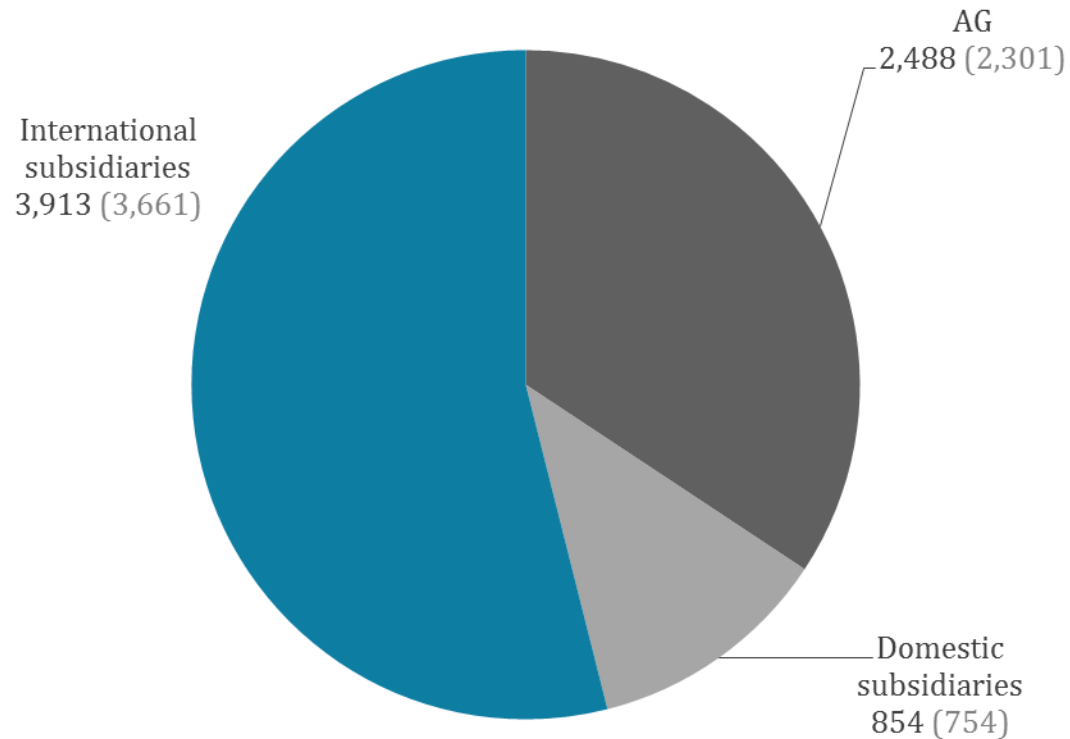


# Employees ElringKlinger Group worldwide

as of December 31, 2014 (py)

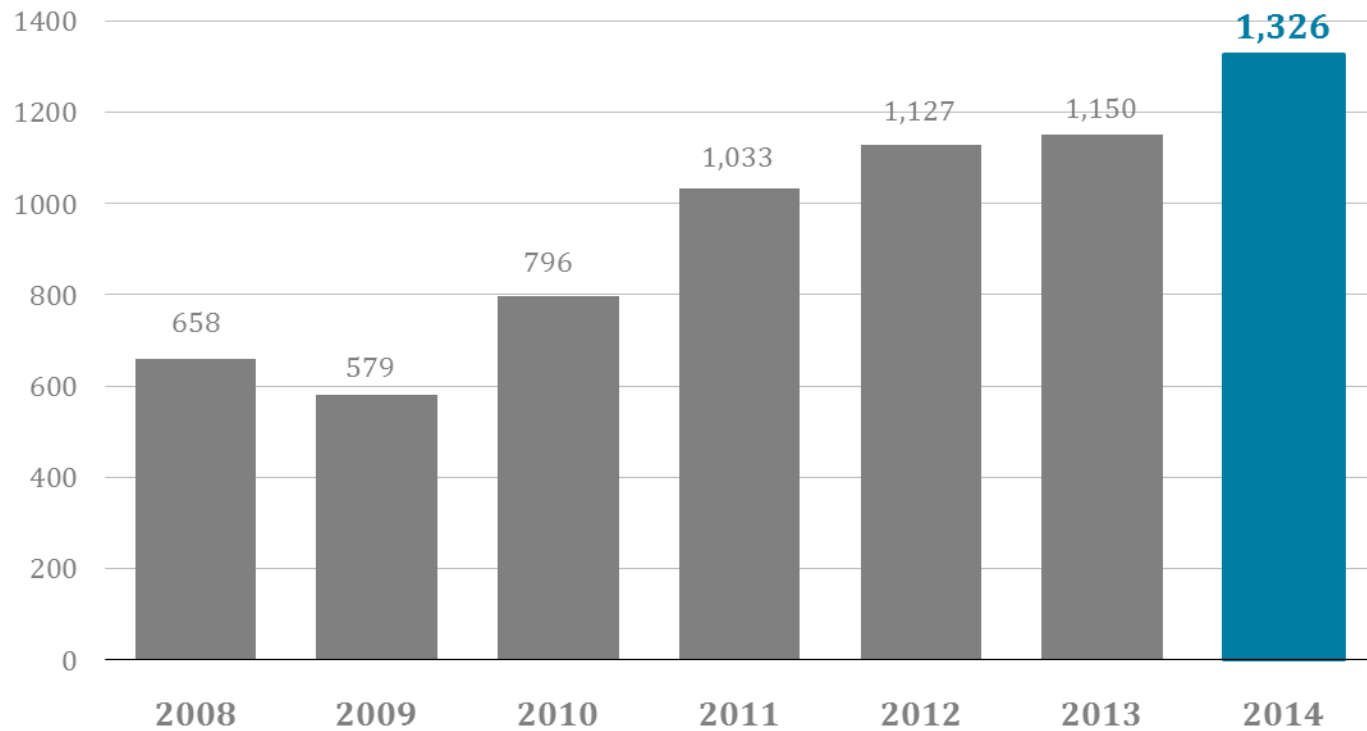
**Group**  
7,255 (6,716)  
+ 8.02%

**Germany**  
3,342 (3,055)



# Group Sales

EUR million



# Divisions



Cylinder-head gaskets



Specialty gaskets



Plastic modules



Lightweight plastic components



Shielding systems



Aftermarket



E-Mobility



Fuel cells



Exhaust gas purification



Engineered plastics



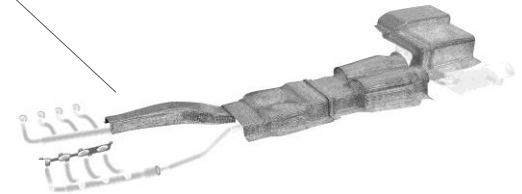
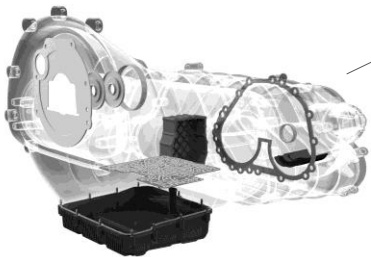
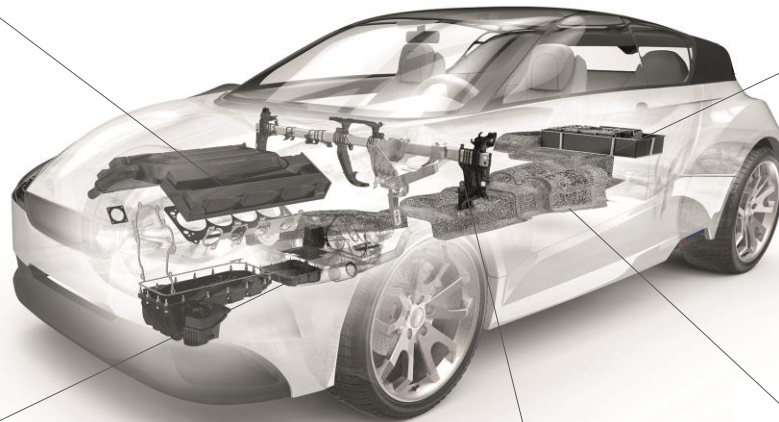
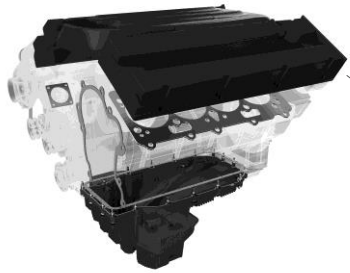
Engine testing services



Tooling technology

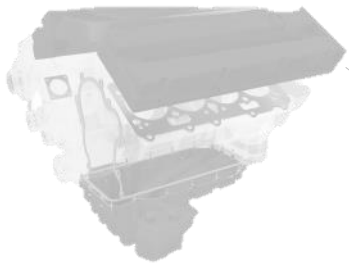
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# Expertise at a glance



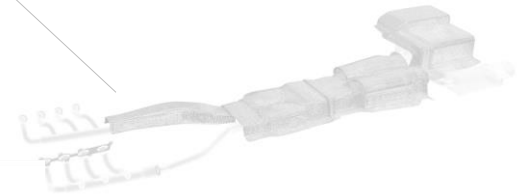
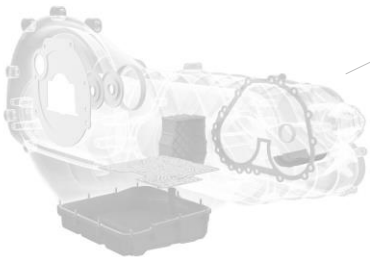


## Role of ElringKlinger in these business areas



As a global development partner and original equipment manufacturer we supply a large section of the international automotive industry .

In the field of alternative drive technology, we develop innovative components to start-of-production level.



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# At the heart of the key issues of the automotive industry



Lowering  
emissions



Weight  
reduction



Optimizing the  
combustion engine  
“Downsizing“



Alternative  
drivetrain technologies

# Fuel cell and battery related production processes



Sheet metal forming

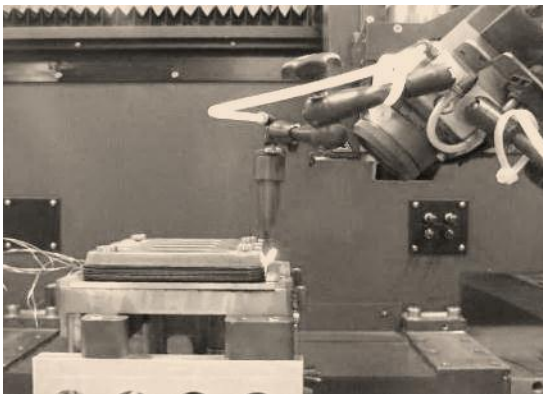


Injection molding

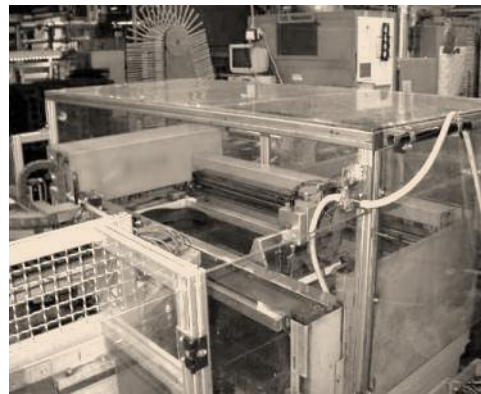


In house tooling

Joining technologies



Coating technologies



Sheet metal stacking



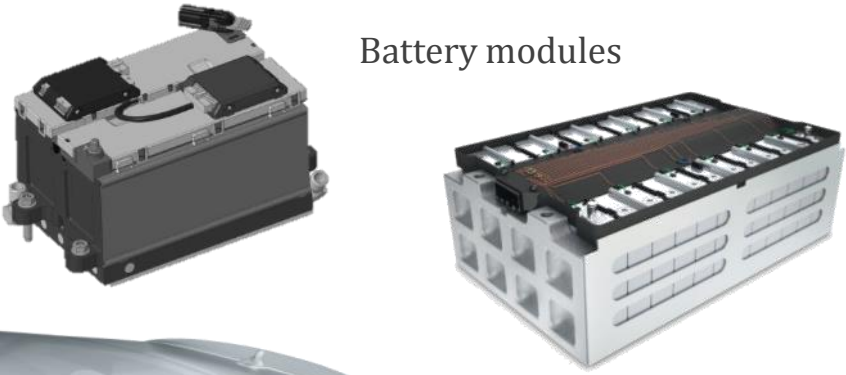
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# Components for Electric Energy Storage



# Li-Ion battery product and technology range

Battery modules



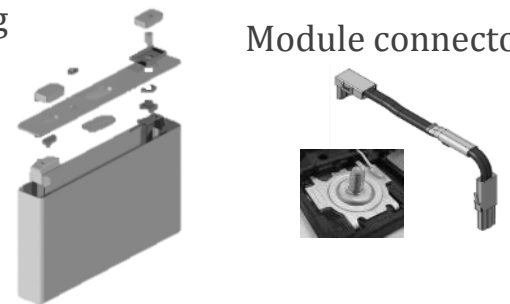
Cell contacting system



Pressure equalizing element



Module connectors



Cell housing



Automotive

BEV

HEV

PHEV

Truck application

Non-Automotive

Fork lifts

eScooters

Marine applications

Cleaning machines

etc.

Battery housing



# Cell contacting system

## ■ Requirements

- Simple module assembly
- Integration of cell connectors
- Integration of signal carrier
- Integration of sensors for the module control
- Interface to battery management
- Directed degassing out of the battery housing

## ■ Solution

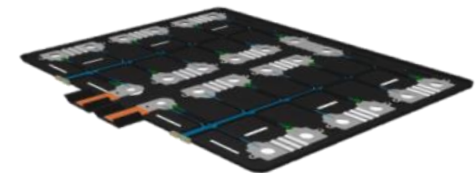
- Cell connecting system in plastic frame with integrated voltage and temperature sensors
- Non-conductive elastomer gasket assembled to the cell contacting system



Lead frame



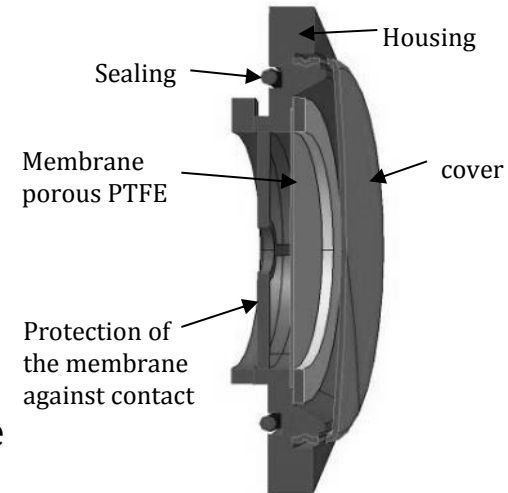
Circuit board



Wire harness

# Pressure equalizing element

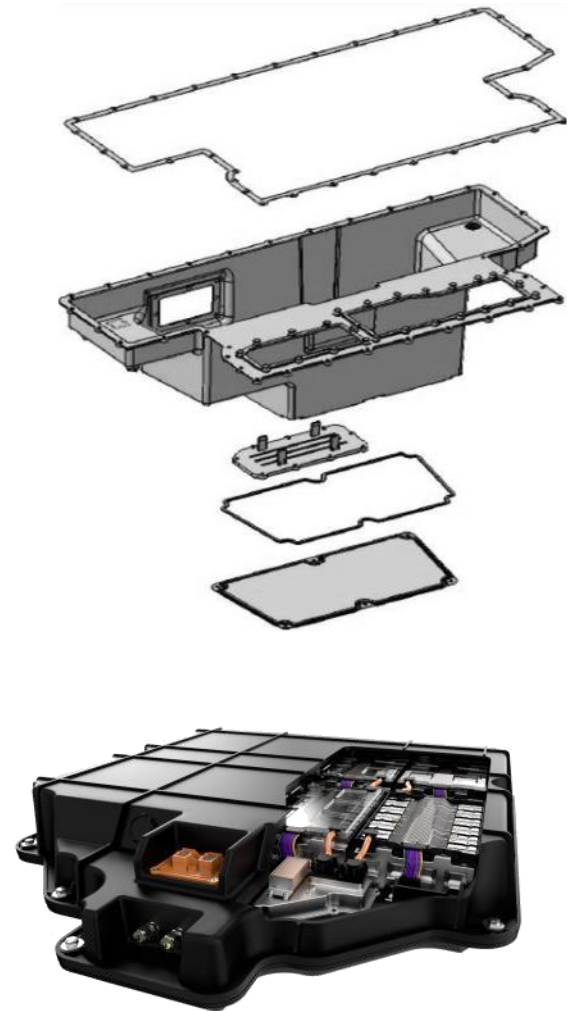
- Requirements
  - Controlled pressure equalization at atmosphere changes
  - Integrated burst function for degassing
- Solution
  - Adjustment of air conductance by the porosity of the PTFE-membrane (developed and produced at an ElringKlinger subsidiary)
  - Precise adjustment of the burst pressure





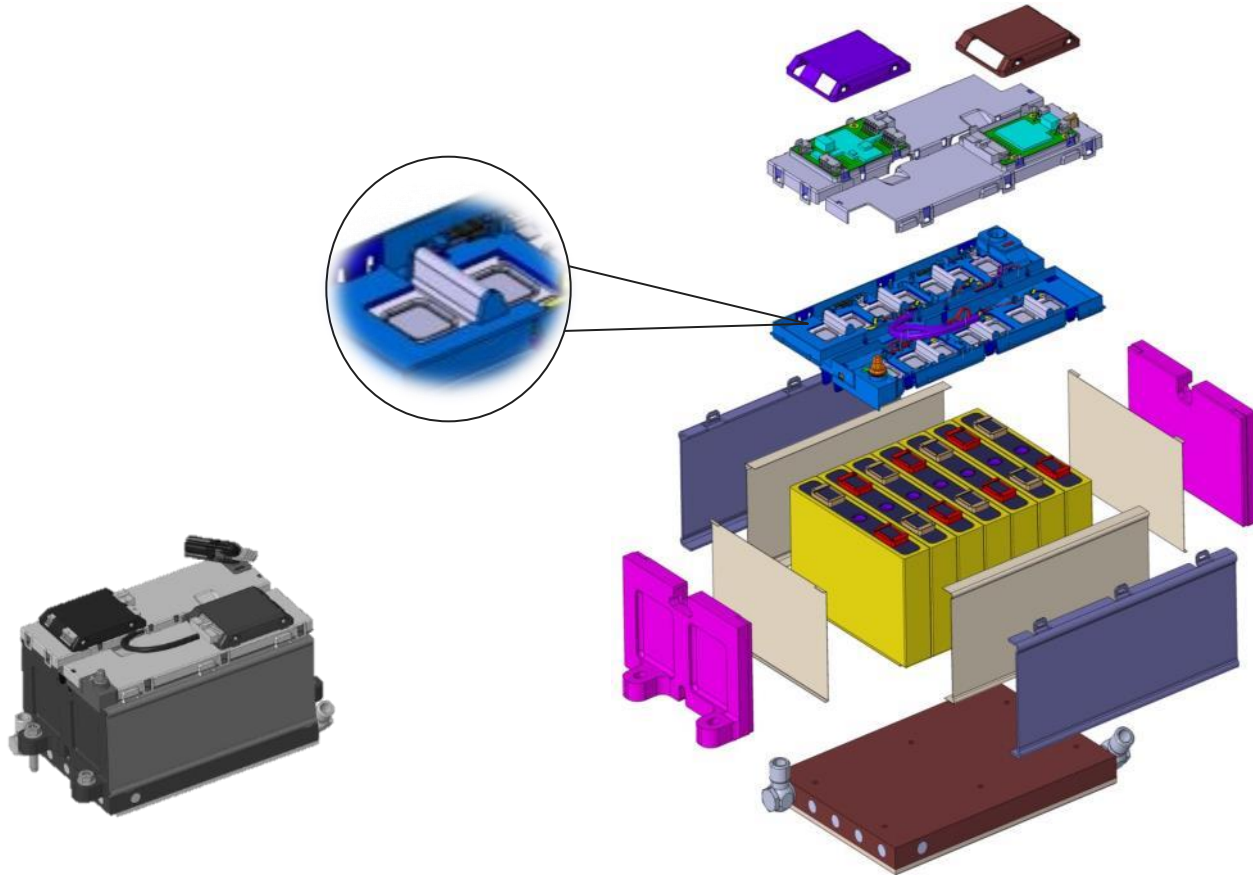
# Battery housing

- Requirements
  - Crash resistance
  - EMC shielding
  - Low weight
  - Integration of functionality
  - Simple assembly
- Solution
  - Utilization of application-specific plastic materials
  - Improvement of weight and stability by forming, by ribs, by numeric optimization of the structure etc.
  - Integration of gaskets, connections, wire guidance etc.





# Li-Ion Battery Module



- One module design for a variety of applications
- Optimization of cost, space and weight
- Certification (UN Test/62133) or according to Customer Requirements

# Production facilities

- Prototype shop
  - Flexible production of cell contacting samples
  - Production of busbars and cell connectors
  - Production of prototype pressure equalizing element
  
- Flexible assembly line
  - Manual assembly of cell connectors to the frame
  - Automated ultrasonic welding and sealing
  - EoL-Test-Facilities
  
- Fully automated production line
  - Automatic stamping-bending machine
  - Automated assembly
  - Joining processes (welding, soldering)
  - EoL test facilities



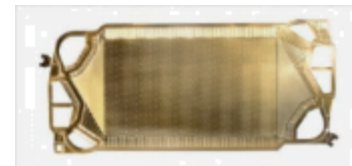
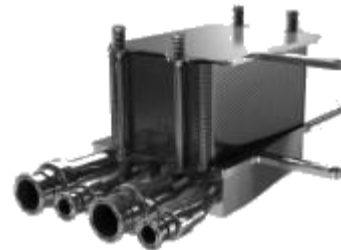
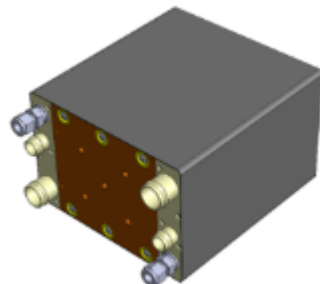
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# Fuel Cell Systems and Components for Fuel Cell Systems



# Fuel cell product and technology range

- Stack components: Sheet metal bipolar plates, stack end modules, housing/thermal shielding for PEMFC and SOFC
- 1-50kW PEMFC stacks for forklifts, range extenders and other industrial applications
- 0,2-5kW SOFC stacks for power generators and CHP
- 0,2-0,8kW SOFC power generators



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# PEMFC module suitable for mass production

**Power output scalable from 1 to 50kW**

**One footprint for a variety of applications**

**Focus on manufacturability and cost**

**Integrated functions:**

## **Sensors**

- Pressure and temperature, anode and cathode

## **Actuators**

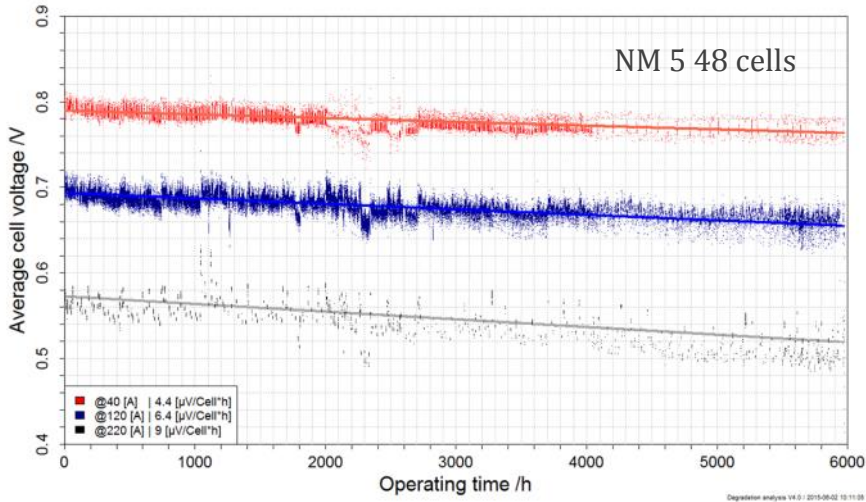
- Pressure regulation, anode inlet
- Purge-valve, anode outlet
- Drainage-valve and valves for cathode and anode

## **Passive components**

- Droplet separator



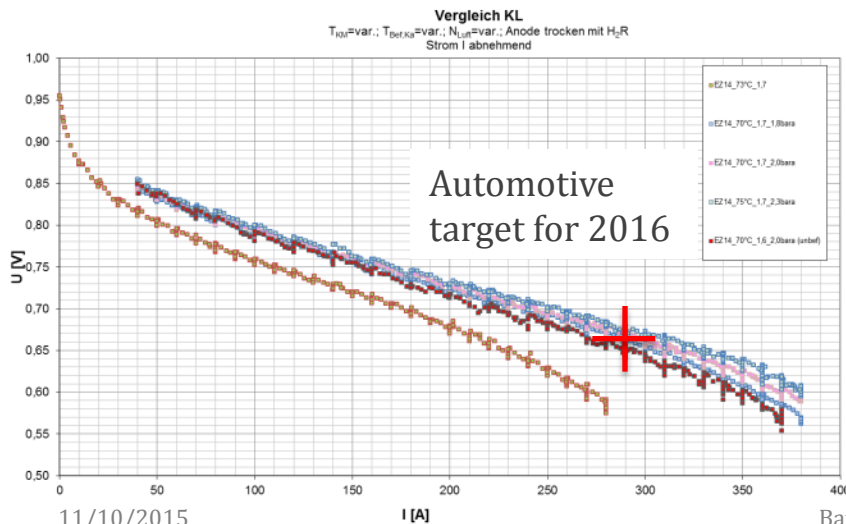
# Outstanding performance data



Lifetime test ongoing, currently more than 6500 hrs

Power density(2,5 bar<sub>a</sub>, 380 A @ U<sub>C</sub>=0,6 V):

- 7,3 kW/l (CCM area → low cost)
- 4,6 kW/l (cell block)
- 3,6 kW/l (stack module)
- Dry operation 1,5 A/cm<sup>2</sup> @ 0,66V



e.g. stack NM 5- 48 cells

12 kW @ 2,5 bar<sub>a</sub>

7,5 kW @ 1,2 bar<sub>a</sub>

L /W/H (mm): 243/161/73



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# The ElringKlinger stacks – Certified and awarded

Focus on mass production and early scales

Use of commercially available components

Stacks are commercially available

ZERTIFIKAT

Nr.: Z-IS-DDG-MUC-13-01-10007625-001-001

Zertifikatsinhaber: ElringKlinger AG  
Max-Eyth-Str. 2  
D-72581 Dettingen/Elm

Zertifizierungszeichen: 

Produkt: PEM NG3 (Brennstoffzellenstack)  
Das Produkt wurde auf Basis der Norm DIN EN 62282-2, VDE 0130-2:2013-01 sicherheitstechnisch begutachtet und auf die Einhaltung der grundlegenden Anforderungen geprüft. Die Anforderungen wurden erfüllt, daher kann das Produkt mit dem oben abgebildeten Prüfzeichen gekennzeichnet werden.

Bericht Nr.: P-IS-DDG-MUC-13-01-10007625-001-001, vom 28.01.2013

Typen: PEM NG3

Kennzahlen: 2,0 kW / 4,0 kW / 6,0 kW Nettolastleistung

Prüfspezifikation: DIN EN 62282-2 (VDE 0130-2):2013-01 (REC 62282-2:2012)

Fertigungsstätte: wie Zertifikatsinhaber

Gültig ab: 06.03.2013

Gültig bis: 05.03.2014



TUV SUD Industrie Service GmbH • Leistung: Qualität • Kompetenz: Know-How • Verantwortung: Sicherheit • 50 • 5000 München • Deutschland  
Tel. +49 (0) 89 0791 3071 • Fax. +49 (0) 89 0791 3202 • www.tuv-sud.de



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# SOFC module suitable for mass production

Power output scalable from 0,2 to 5kW

One footprint for a variety of applications

Focus on mass production requirements

Integrated functions:

Sensors

- Temperature

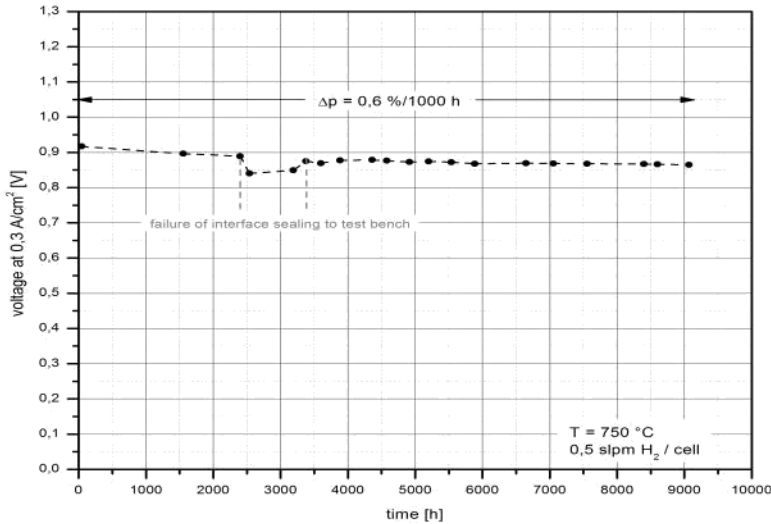
Passive components

- Sul<sup>-</sup>
- Rec





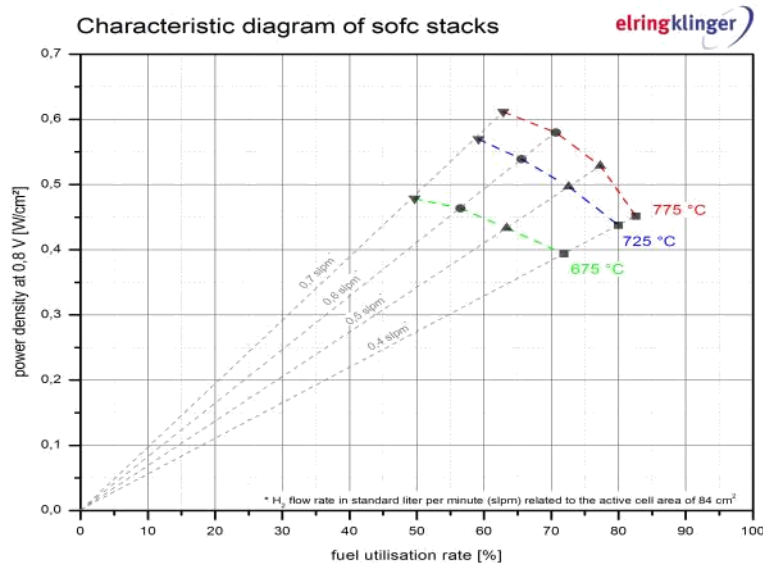
# Outstanding performance data



Lifetime test over more than 9000 hrs @ 0,3A/cm<sup>2</sup> constant.

Power loss less than 0,6% per 1000h

OCV loss less than 3% after 150 full thermal cycles



Power output @ 775 °C; 0,8 V

- 0,5 W/cm<sup>2</sup> @ 80%FU
- 0,6 W/cm<sup>2</sup> @ 65%FU

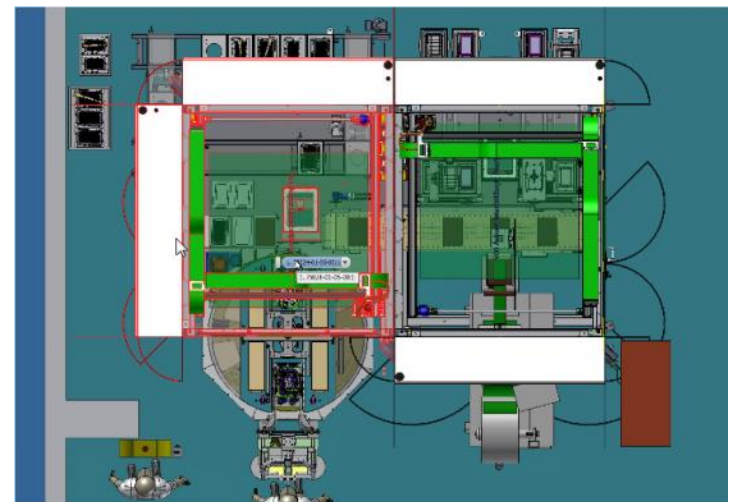
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## Production facilities

SOFC-stack assembly pilot line. In operation since 2007, recently updated



PEMFC-stack assembly line. Going to be in operation in April 2016



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# Application examples PEMFC and SOFC



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# Summary and perspective



## Technical maturity – Summary

- All battery and fuel cell products are designed for use in a variety of applications and therefore for early scale effects
- All battery-, PEFC- and SOFC- components and products are technically ready for mass production
- Business models work out in some niches
- Lack of scale effects and minor technical issues prevent marketable cost and therefore mass market

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## Summary – It's all about CO<sub>2</sub>-reduction



**... but why don't we see zero emission technology already today at least in niches?**

## Summary

### What is still needed for a successful market introduction?

- Supportive legislation (Emission regulations,...)
  - Bonus and/or penalties for zero emission/non zero emission technology
- Industry and politics will have to move in the same direction for a successful market entry of zero emission technology
- Joint strategy and clear roadmap for implementation of zero emission technology needed



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Experience mobility – Drive the future.

**Thank you for your  
attention.**