Zentrum für Sonnenenergie- und Wasserstoff-
Forschung Baden-Württemberg

Electrolysis made in Baden-Württemberg – supporting the local industry in the market ramp-up

Maike Schmidt, Marc-Simon Löffler

SPÄIN * The LÄND „Science meets Industry – Hydrogen”

10.12.2024, ZSW Ulm

Hydrogen, a key element for greenhouse gas neutrality - at global, European, national and local level

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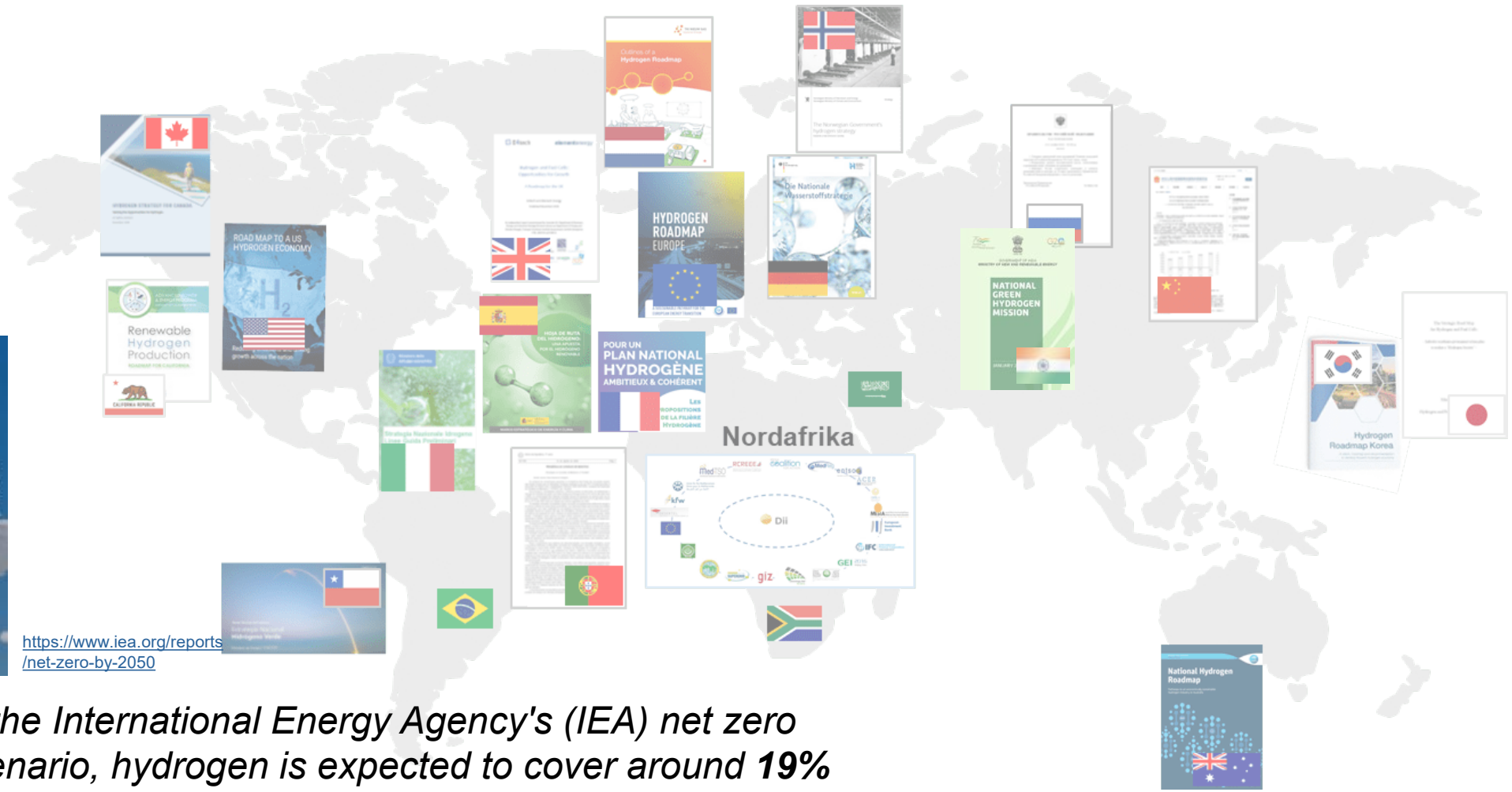
https://www.iea.org/reports/net-zero-by-2050



*According to the International Energy Agency's (IEA) net zero emissions scenario, hydrogen is expected to cover around **19%** of **global final energy consumption** in **2050**.*

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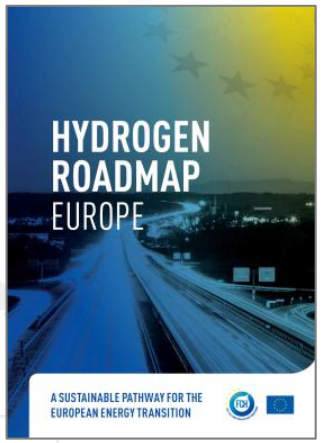


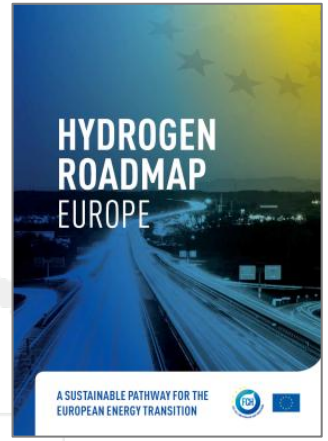
*According to the Hydrogen Roadmap Europe, hydrogen is expected to cover around **24%** of the **EU's final energy consumption** in **2050**.*

Hydrogen, a key element for greenhouse gas neutrality - at global, European, national and local level

https://bdi.eu/

*According to the Climate Pathways 2.0 scenario of the Federation of German Industries, hydrogen and its synthetic downstream products are expected to cover around **34%** of **Germany's final energy consumption** in **2045**.*

https://www.iea.org/reports/net-zero-by-2050



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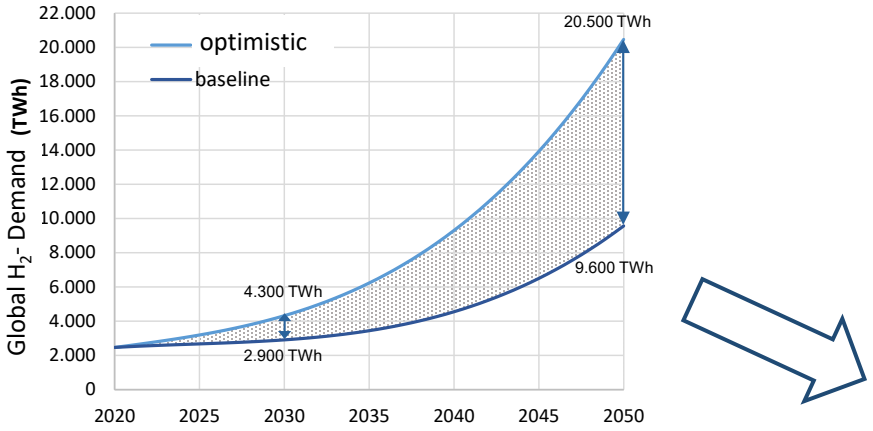
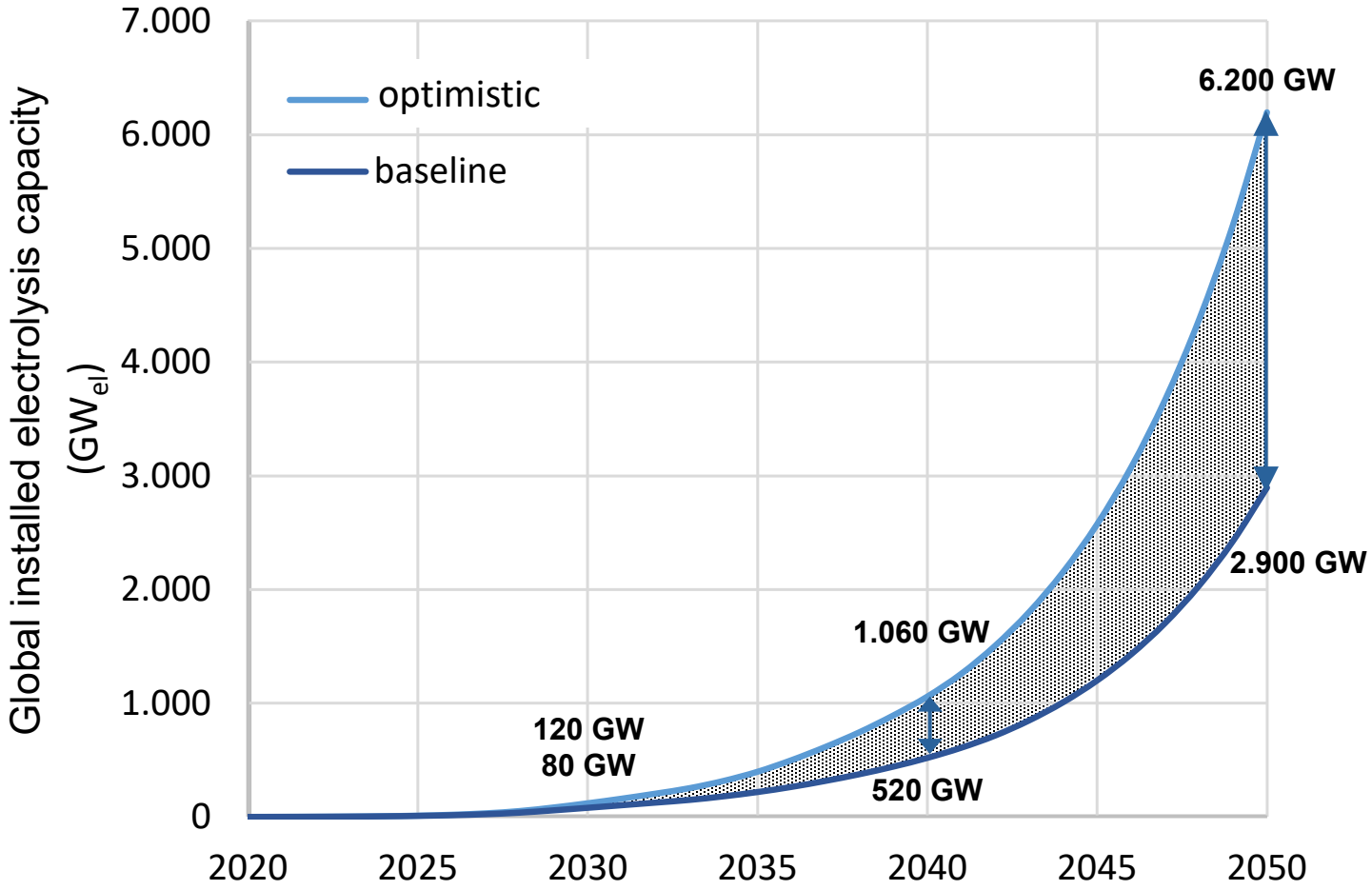
Electrolysis market expected to grow exponentially

Expansion targets and market potential in Germany, the EU and worldwide



Derivation of plant output based on the following assumptions:

- Increasing shares of green hydrogen up to 100% 2050
- Full load hours 5.000 h/a
- Development of Efficiency (2020 – 2050)
  - AEL, PEM: 60% - 65,9%
  - SOEC: 68,7% – 76,3%



"To achieve net zero emissions by 2050, global cumulative investments [on hydrogen] must increase to USD 1.2 trillion by 2030 and USD 10 trillion by 2050." *(International Energy Agency; Global Hydrogen Review 2021).*

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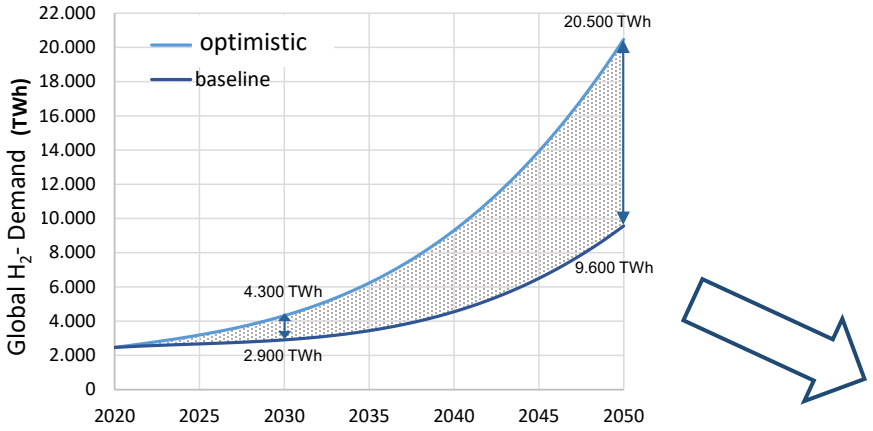

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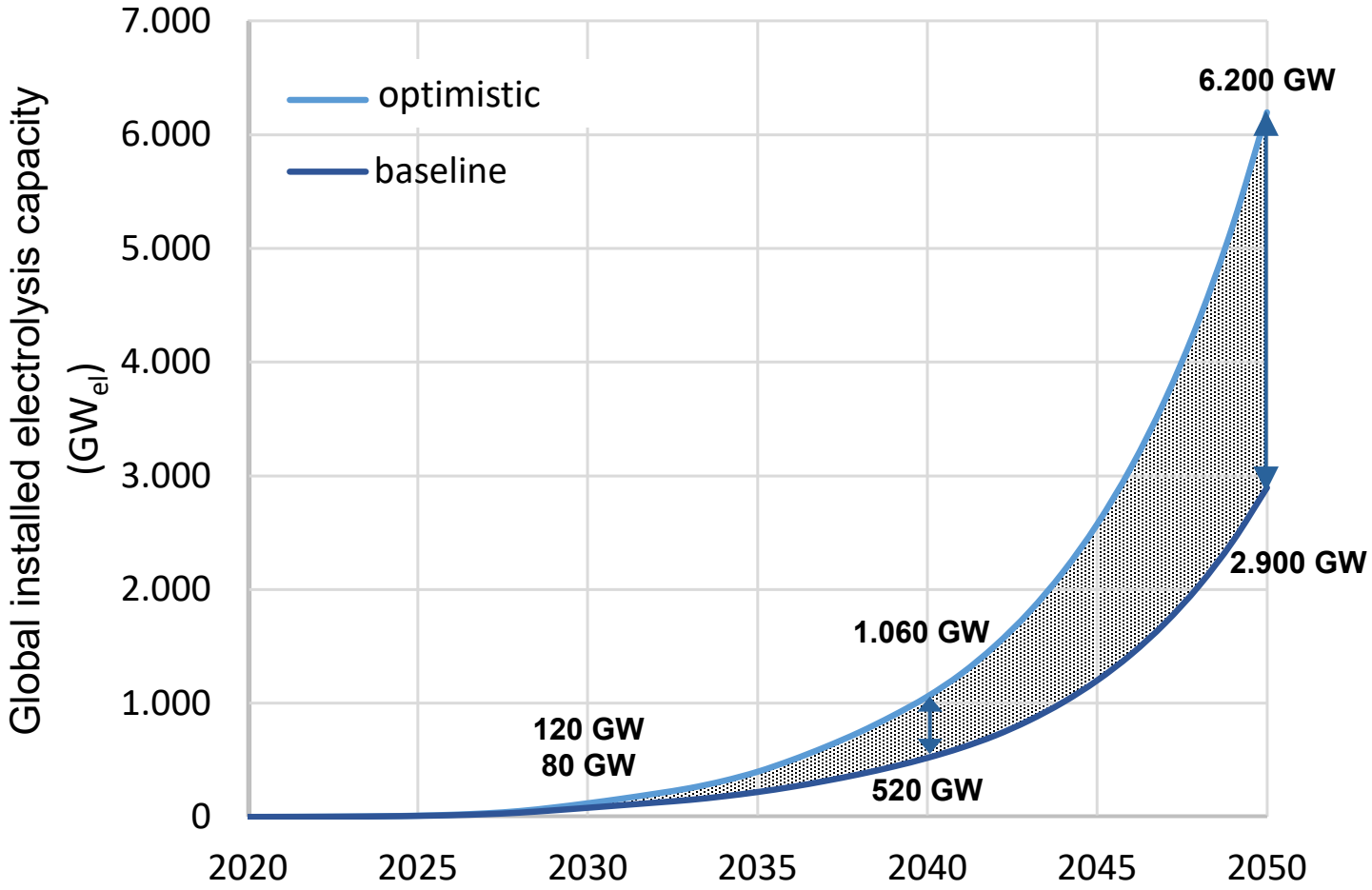
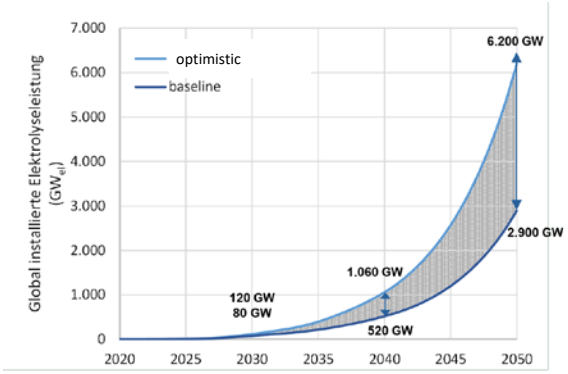


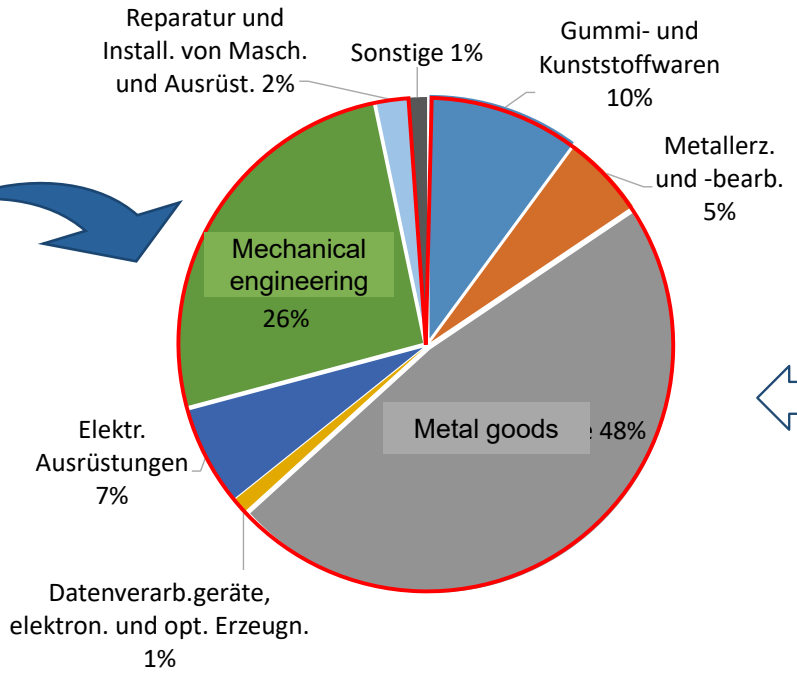
As with other climate-neutral technologies, this is not just an innovation competition, but an innovation race. The “time to market” is very important for companies.

Does Electrolysis fit Baden-Württemberg's Industry???

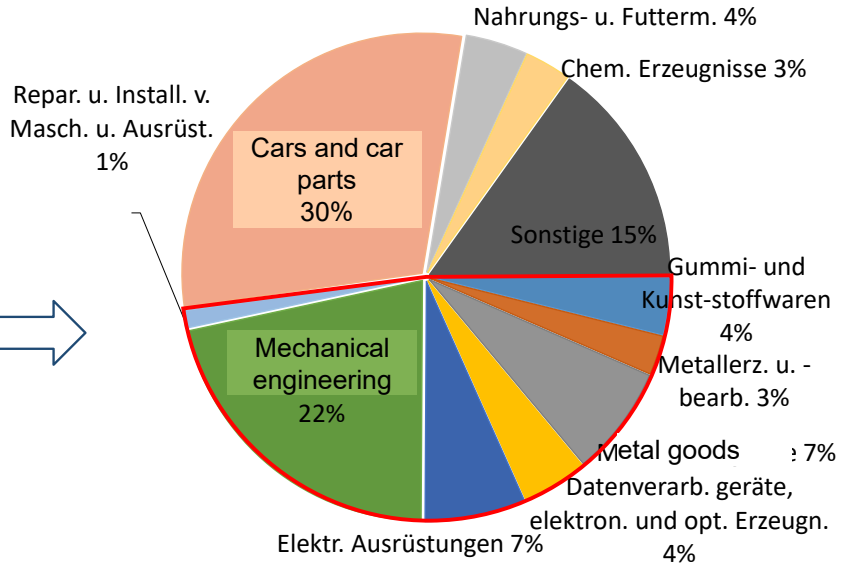
Sales/employment potential through the manufacture and export of components and systems



Breakdown of the investment costs of an electrolysis plant by economic sector



Turnover shares of the economic sectors in the manufacturing industry in B.-Württemberg 2019

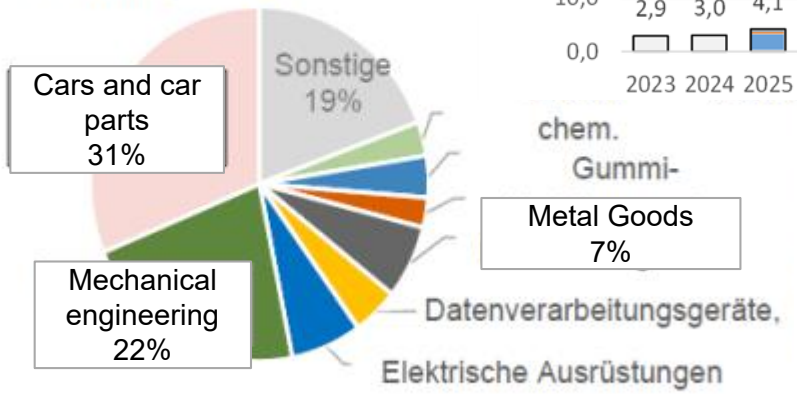


- >95% of investment costs are incurred in economic sectors that are represented on a significant scale.
- Sales potential of up to around €8 billion per year and at least 37,000 new jobs can be derived by 2050.
- **Baden-Württemberg and the production of electrolyzers: a perfect match!**

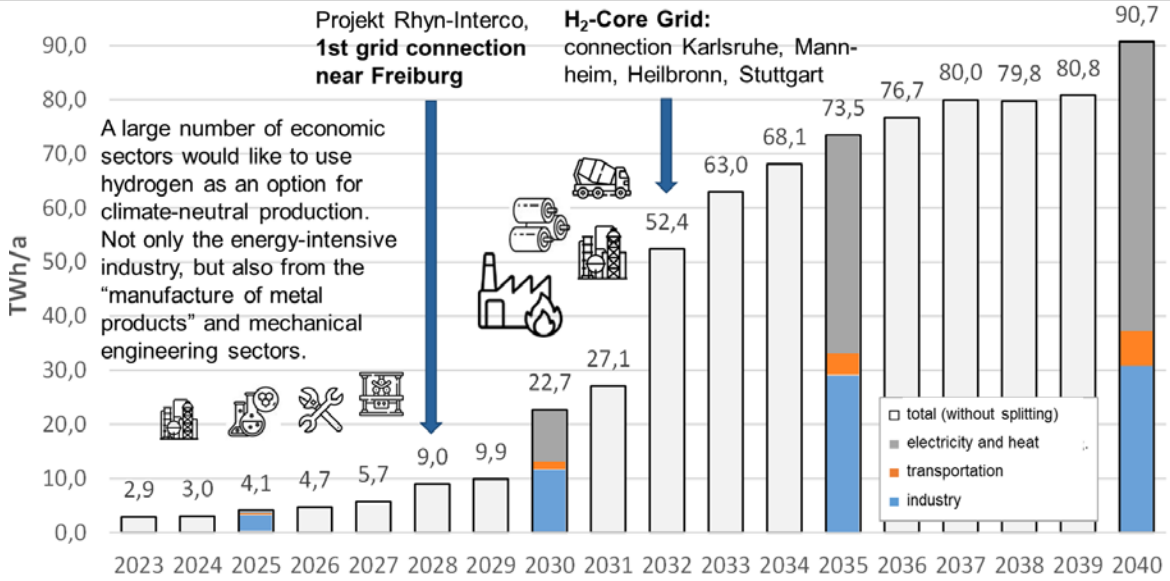
Opportunities of an international hydrogen economy for Baden-Württemberg

Import
Hydrogen and PtX-Products

Export
Generation and use technologies



Hydrogen Demand in Baden-Württemberg

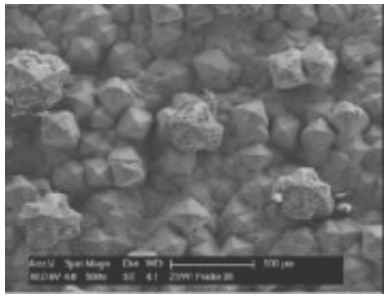


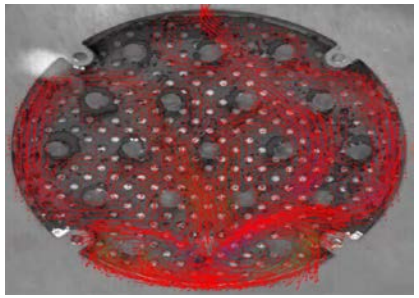
Turnover shares of the economic sectors in the manufacturing industry in Baden-Württemberg 2019
Foreign turnover: € 200 billion
Export share: 55%

"Green hydrogen is a key factor in meeting climate protection targets [...] Our aim is not to make our country a major production location, but to make our companies a global supplier of hydrogen technologies and to support them in doing so." (S. 37)

ZSW – Electrolysis research

Development of alkaline electrolysis technology since 2012



materials

- catalysts & coatings
- material screening
- accelerated stress testing

components

- electrode development
- electrode packages
- cell frames

stacks & manufacturing

- stack designs up to MW scale
- from 100 cm² up to 10.000 cm² electrode area

systems & test field

- system designs up to MW scale
- ElyLab test field

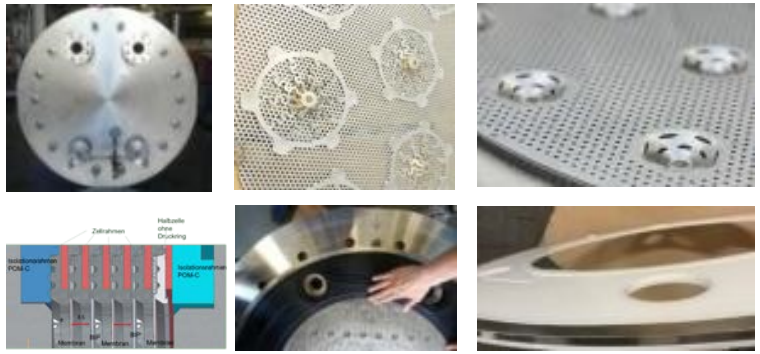
digitalization & AI

- stack-integrated sensors
- data monitoring
- data analysis applying AI
- digital twins

Supporting the industry in the market ramp-up

Own electrolysis technology on a megawatt scale

- Alkaline pressure electrolysis technology (1 MW_{el}, double stack system 2 x 0,5 MW_{el}, 30 $bar_{ü}$).
- ZSW's own system technology with patented stack design (0,5 MW_{el}, 3,000 cm² active cell area, to be scale up >10.000 cm² by 2025).
- Complete system documentation and CE certification.



Toolbox of components designs

Electrolysis system (1 MW_{el})

Electrolysis stack

Stack design

Baden-Württemberg
MINISTERIUM FÜR WIRTSCHAFT, ARBEIT UND TOURISMUS
Bundesministerium für Wirtschaft und Energie
ZSW

The initiative „Electrolysis made in Baden-Württemberg“

- Baden-Württemberg as a possible **export state** for electrolysis technologies.
- In 2019 approx. **10 suppliers of electrolysis systems worldwide** with references in the MW range.
- **No commercial supplier of electrolysis technology in Baden-Württemberg…**
- **…but considerable potentials** in mechanical and plant engineering industry and supply industry.

“The electrolysis word 2019”
Electrolysis suppliers worldwide (all technologies and performance classes).

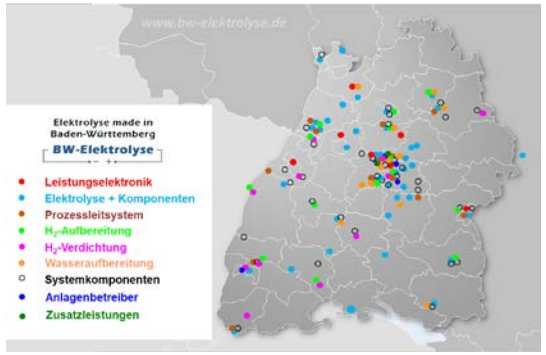
„Electrolysis made in Baden-Württemberg“ *www.bw-elektrolyse.de*

Baden-Württemberg
MINISTERIUM FÜR WIRTSCHAFT, ARBEIT UND TOURISMUS

Initiation of a regional electrolysis & components production in Baden-Württemberg

Industry dialogue

- cross-technology electrolysis network established.
- more than 80 companies are actively involved so far.



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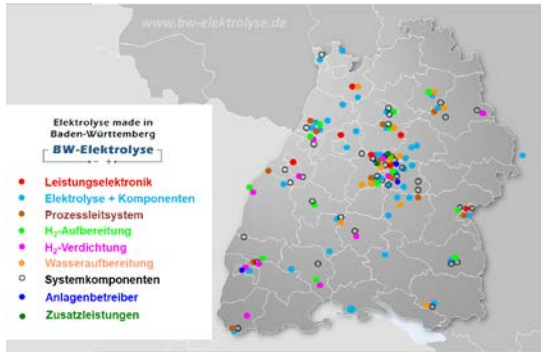

Electrolyser „made in BaWü“

- Electrolysers can be manufactured “made in BaWü”.
- More than 40 companies from BaWü contributed components and technologies.

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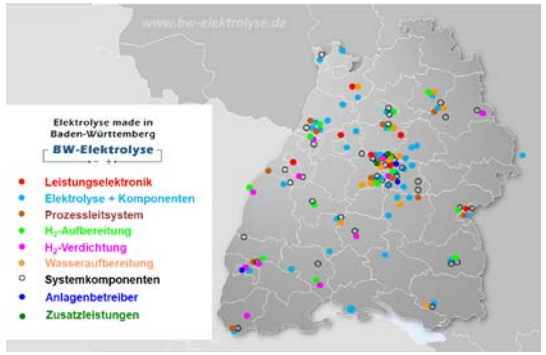

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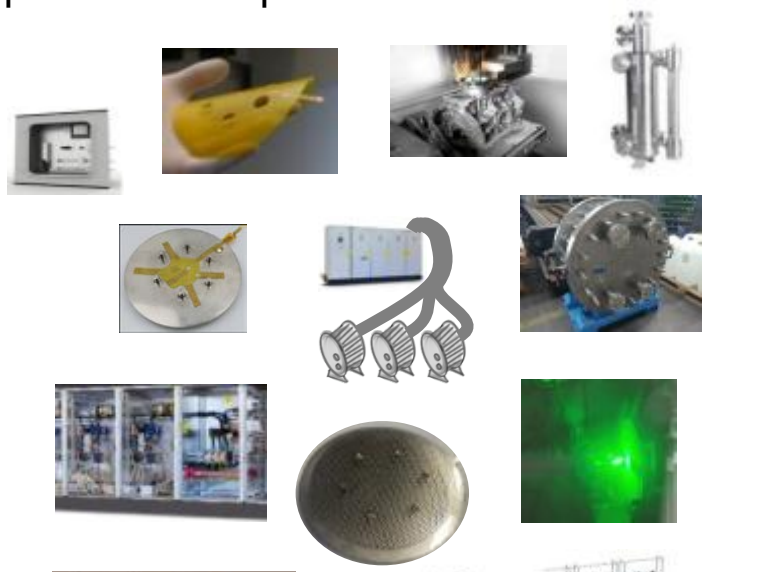
Industry transfer

- some product developments have already been initiated.
- first companies are starting to build up production capacities.



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„Electrolysis made in Baden-Württemberg“

Examples for a successful industry transfer

Baden-Württemberg
MINISTERIUM FÜR WIRTSCHAFT, ARBEIT UND TOURISMUS

Electrolysis system

ECOCLEAN
technology that inspires

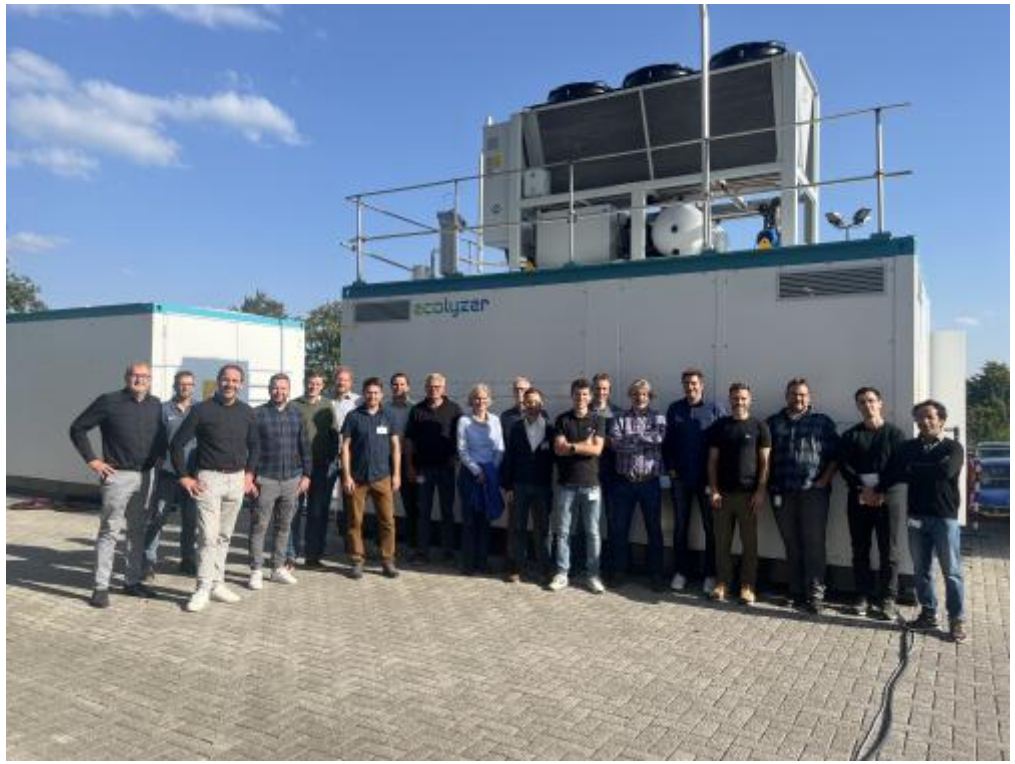
Filderstadt, ca. 900 employees

- Production started in 2023.
- Series production line planned for up to approx. 200 MW_{el}/a

ZSW

Product development „EcoLyzer“

Supporting Ecoclean (Filderstadt) getting into the H_2 market



- First series product (1 MW, 30 bar) put into operation in summer 2024.
- <3 years from the start of know-how transfer to the commissioning of the first EcoLyzer system.
- ~30 suppliers from Baden-Württemberg.

„Electrolysis Made in Baden-Württemberg“

Examples for a successful industry transfer

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Electrolysis stack

Ravensburg, ca. 1700 employees

– Production of first series stacks is planned from 2025.
– Layout of a production line for up to approx. 5 GW_{el}/a.

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„Electrolysis Made in Baden-Württemberg“

Examples for a successful industry transfer

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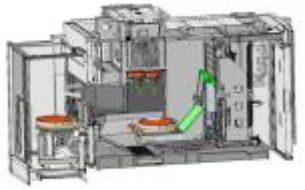
Electrode coatings

HELLER

Nürtingen, ca. 2600 employees



– Transfer coating process from the automotive industry to electrolysis.
– Coating machines for customers available since 2023.

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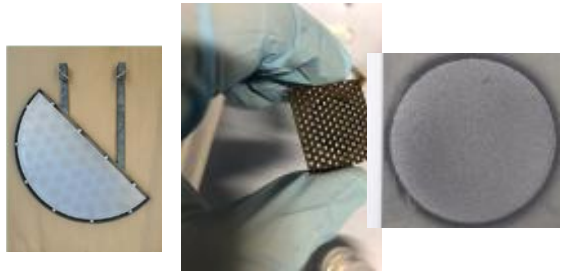
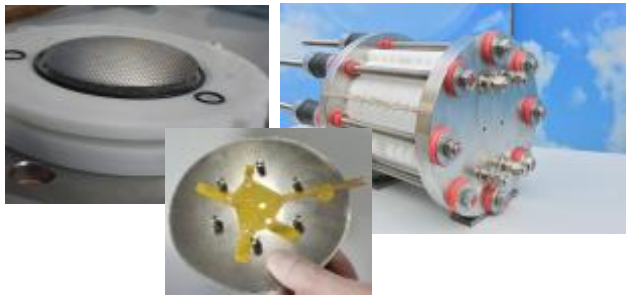
Electrolysis test field at ZSW (ElyLab)

Test and consulting services from material analysis up to megawatt stack testing

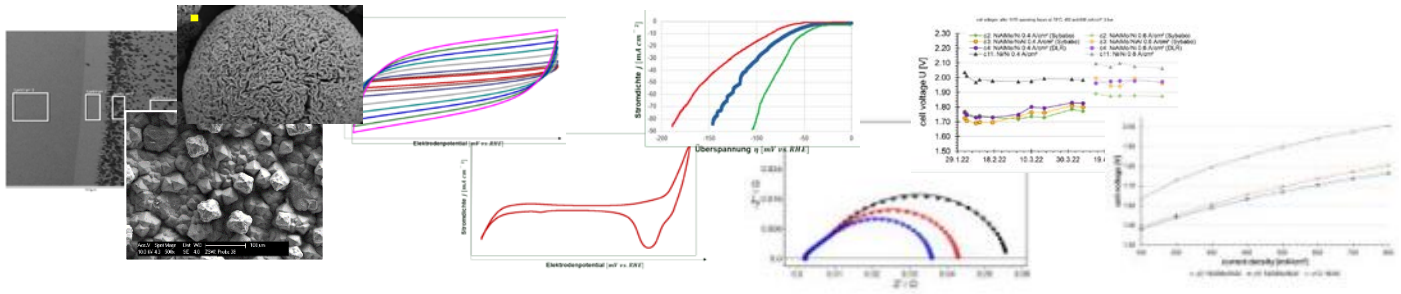




Electrode characterisation and material analysis

Prevalidation of cell components (up to 30 bar, 100 cm², up to 10 kW)

Short and full stack testing (up to 30 bar, up to 40.000 cm², up to 0,5 MW)



THANK YOU FOR YOUR ATTENTION!

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