H_2 in Germany

Strategy and outlook

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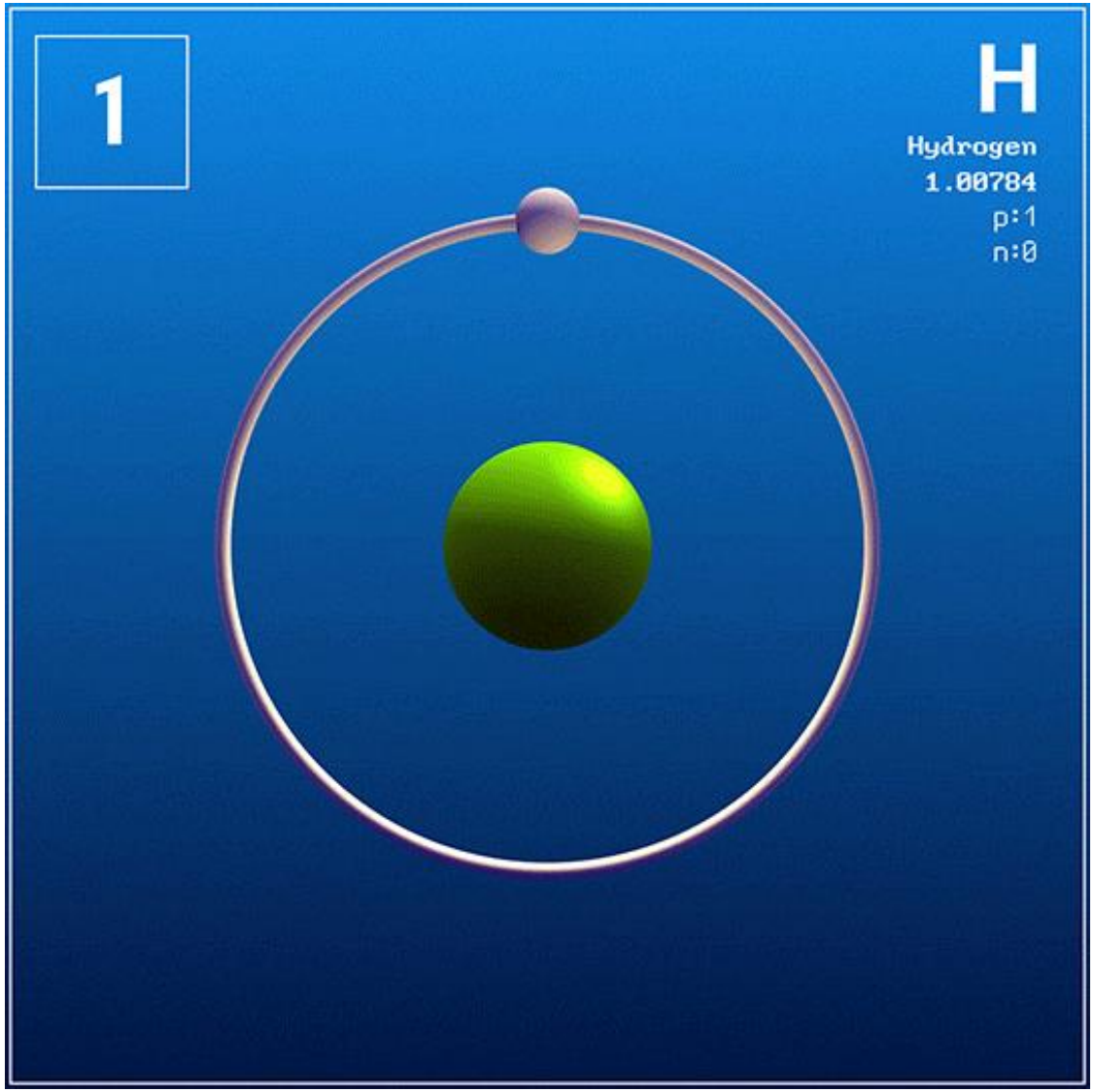
Non-profit think tank

Mission: Work towards and accelerate the global energy transition

Outline of the presentation

I) Green hydrogen:
Updated strategy in Germany

II) Hydrogen and green fuels



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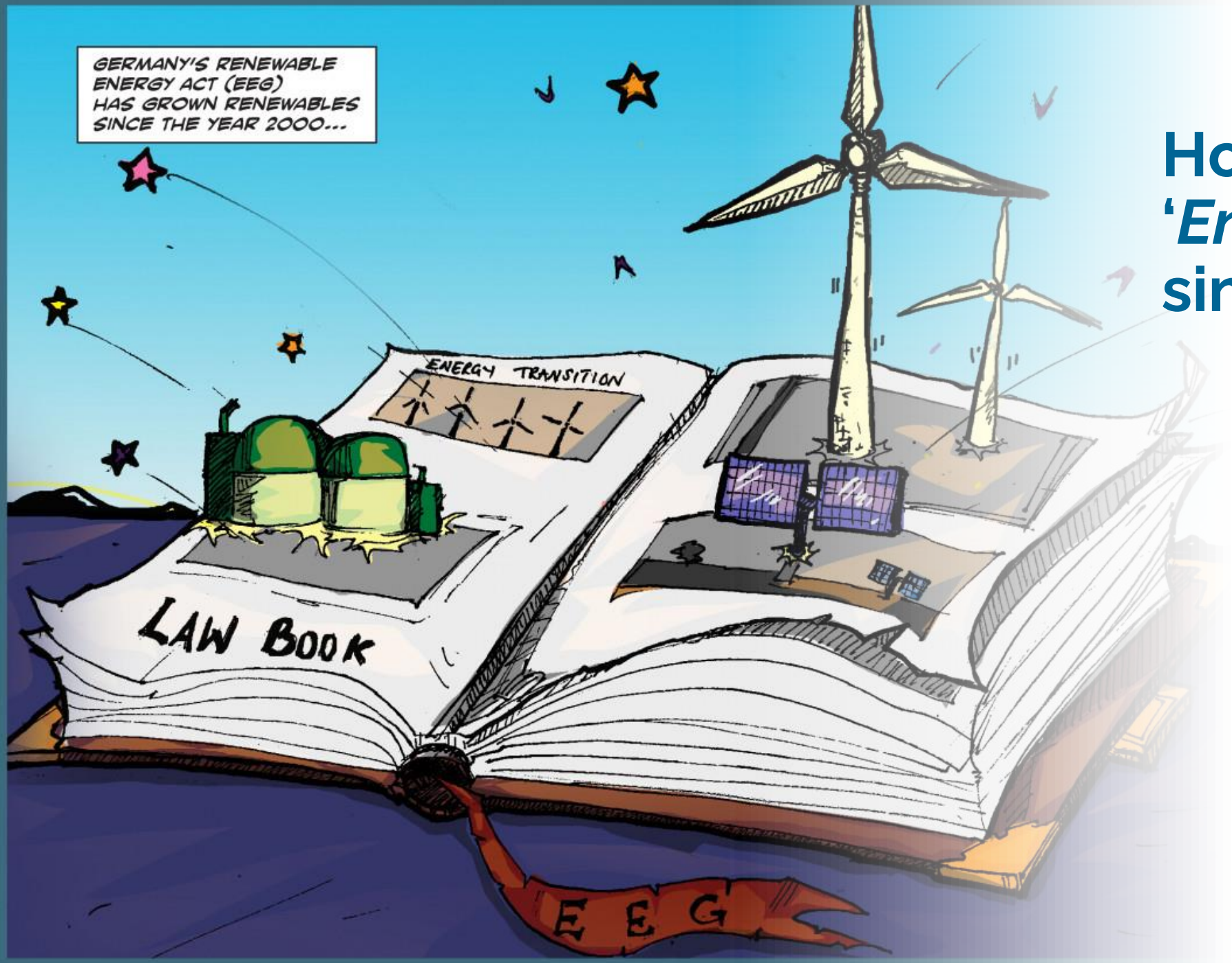
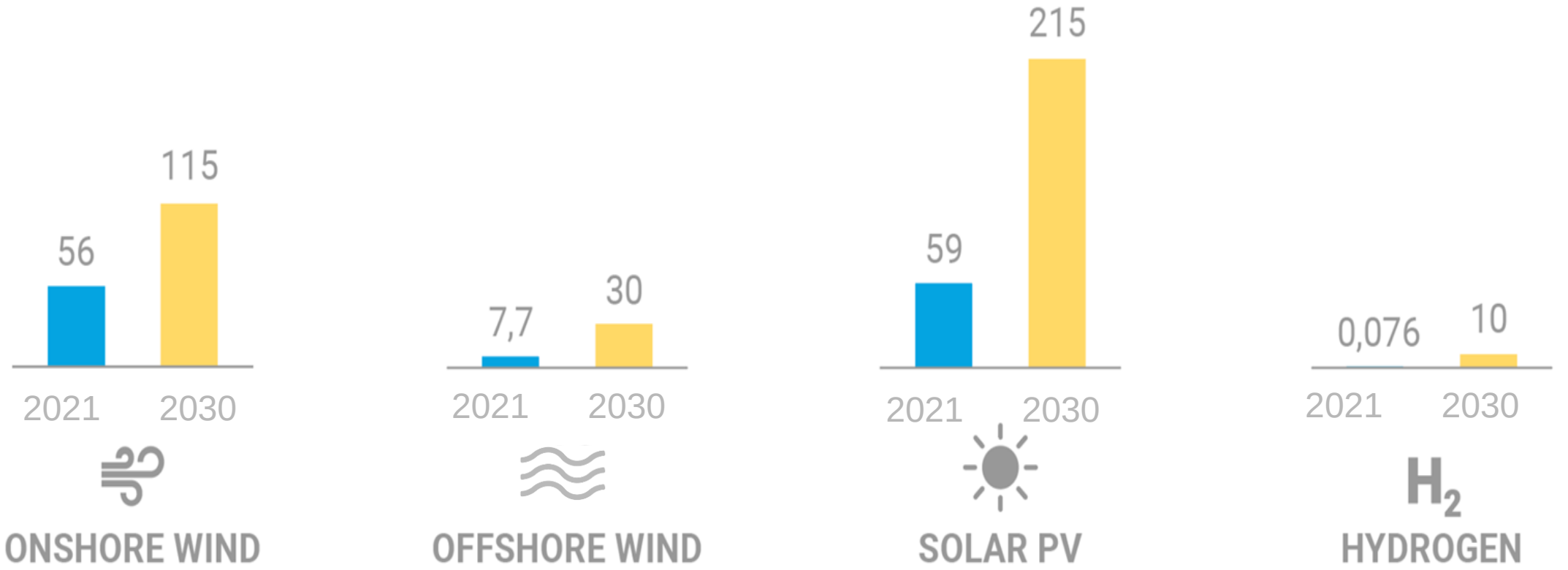


Home of the '*Energiewende*' since 2000

- Feed-in-tariff for all RE
- Grid priority for all RE
- Mainstreamed RE and created economies of scale

New renewable energy 2030 targets

- 80% RE in electricity by 2030
- Climate neutrality by 2045



Growth and employment benefits

Implementation of the goals could yield:

1.4 times
the investment needed

2.7 times
the fiscal support

over
400,000
jobs by 2030

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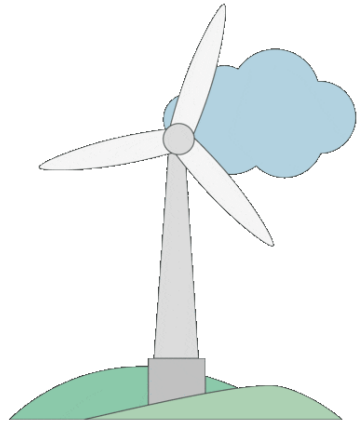
Germany‘s hydrogen strategy 2023

“Investing in hydrogen is an investment in our future – in climate protection, in qualified jobs, and in securing the energy supply.”

Dr Robert Habeck
Federal Minister of Economic Affairs

H2 strategy finetuned in July 2023:

- 10 GW by 2030, but future H2 needs cannot be met domestically:
  - 50-70% of needs met by imports in 2030, set to increase after
  - H2 import strategy being developed
- H2 infrastructure needs: 1800 km of pipeline by 2028
- H2 demand: € 50 billion in contracts of difference for industry to switch to H2
- Current support scheme: Pilot-based, PCI, H2Global (double auction model for federal grants for industrial scale H2)



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Application of green H2

Focus on sectors that are hard to electrify and decarbonise:

- Heavy industry

- Heavy vehicles

- Shipping

- Aviation

Mainstreaming Hydrogen

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Mainstreaming Hydrogen

Basic issue

- Can‘t just repurpose existing infrastructure: must establish new structures, methods, even mindsets
- What is needed is a paradigm shift across entire sectors

Mainstreaming Hydrogen

Pros and cons:

- Hydrogen is very green:
  - High energy content per weight
  - By-product from combustion: water
- But it's also impractical:
  - Very low density (must be cooled down or greatly compressed)
  - Volatile

Hydrogen and other green fuels

Hydrogen-based green fuels

- Biofuels
  - inorganic carbon (usually carbon dioxide) is converted into organic compounds in a relatively short time (fossil fuels: millions of years; synthetic fuels: not a biological process)
- E-fuels/synthetic fuels
  - e-fuels (e-methane, e-kerosene, e-methanol, etc.) produced with electricity as the energy source

Hydrogen and other green fuels

Special case: ammonia

- Pros:
  - no carbon content so doesn't produce carbon when combusted
  - complete ammonia combustion results only in pure nitrogen and water emissions (no pollution)
  - easier to store and transport than hydrogen (but still not easy!)
  - more energy density than hydrogen (but not as much as carbon-based fuels!)
  - infrastructure exists already
  - double use for fertiliser

Hydrogen and other green fuels

Special case: ammonia

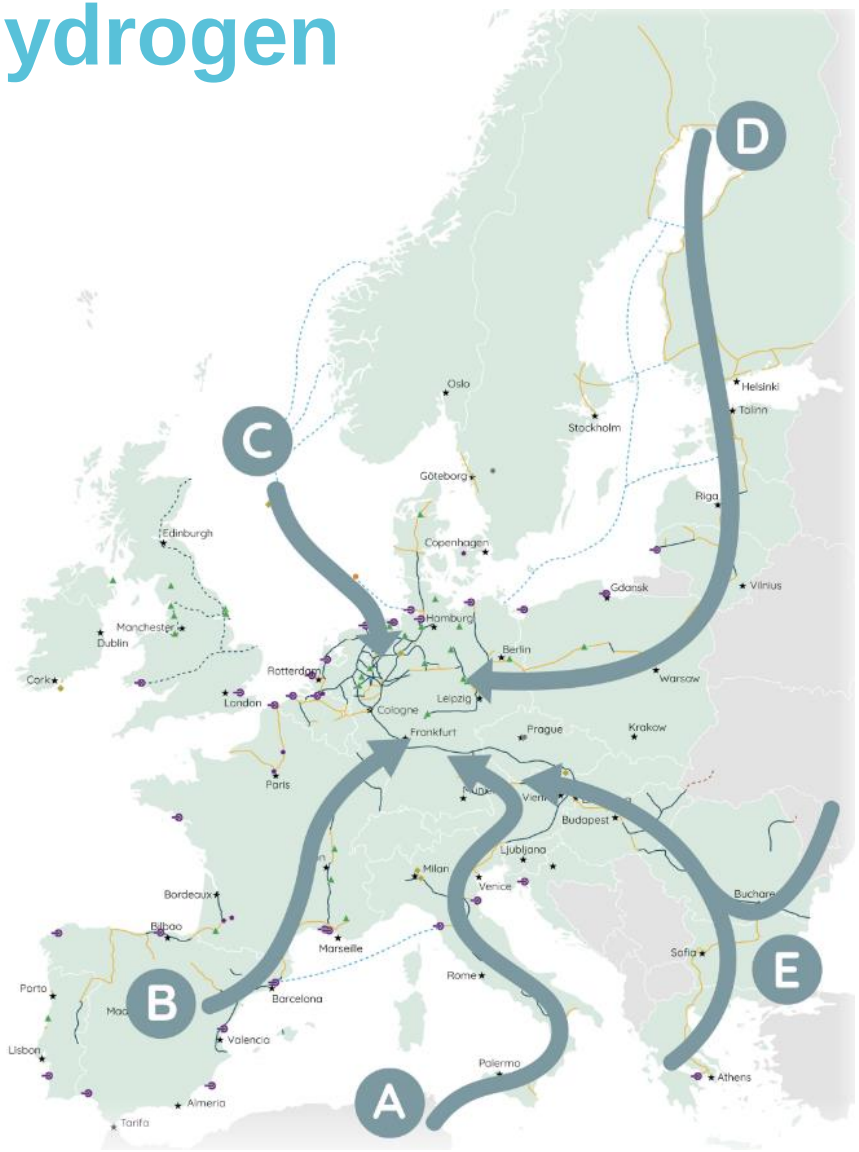
- Cons:
  - made through electrolysis and Haber-Bosch process (highly energy intensive)
  - results in emissions of nitrogen oxides and nitrous oxide (powerful greenhouse gases) in case of incomplete combustion
  - toxic at high concentrations

Mainstreaming Hydrogen

Other transport and storage infrastructure: hydrogen backbones

- Huge amounts of hydrogen need to be imported
- No more dependency on Russia and Saudi Arabia – but where will the hydrogen come from?

Mainstreaming Hydrogen



Mainstreaming Hydrogen

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Mainstreaming Hydrogen

High cost, high reward:

- Domestic industry (or imports from friendly, democratic countries)
- Climate benefits
- High-tech future

Institut für Klimaschutz,
Energie und Mobilität e.V.

Magazinstraße 15 – 16
10179 Berlin

info@ikem.de
www.ikem.de