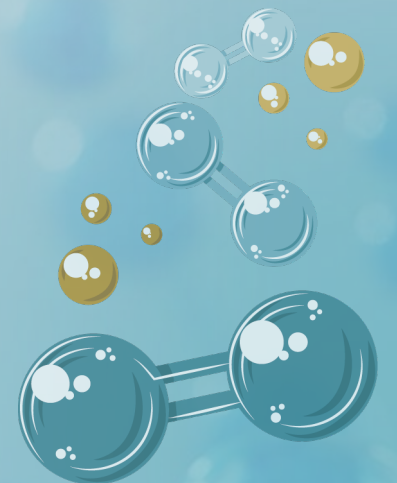




Strategies for the Decarbonization of the Steel Industry

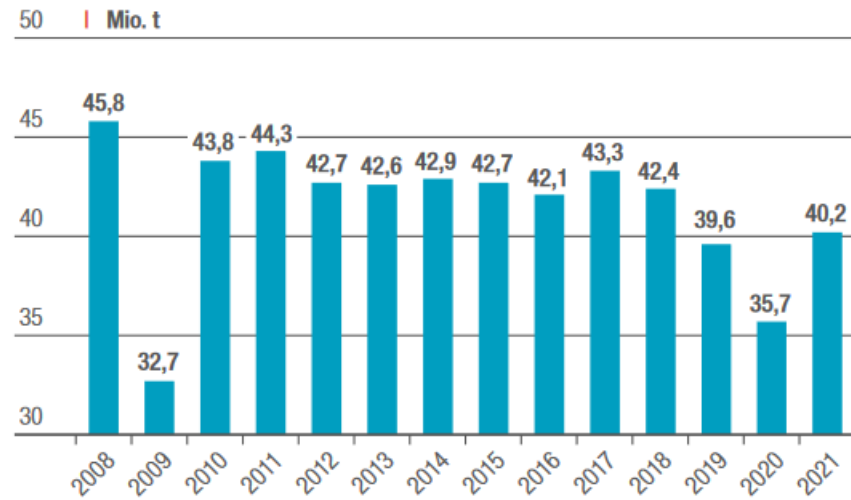
Sahara Renaissance Project Conference

10.10.23 Dr. Bettina Hübschen, Saarländische Wasserstoff-Agentur

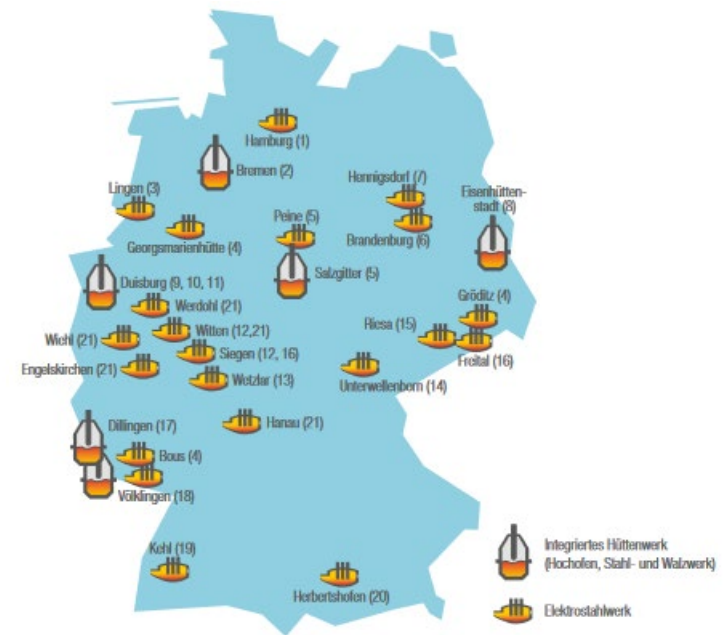


The Steel Industry in Germany

Annual production of ca 40 Million tonnes



Steel is produced throughout Germany



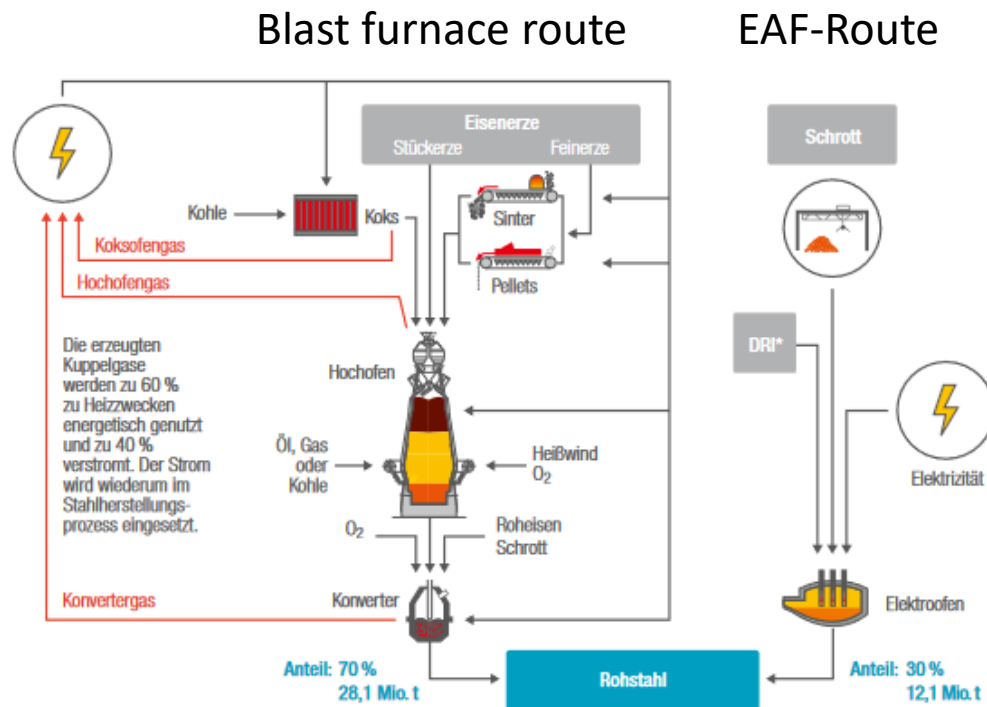
- (1) ArcelorMittal Hamburg
- (2) ArcelorMittal Bremen
- (3) Sander
- (4) Goossmarienhütte Holding
- (5) Salzgitter
- (6) Brandenburgische Eisen- und Stahlwerke
- (7) Hennigsdorfer Elektrostahlwerk
- (8) ArcelorMittal Eisenhüttenstadt
- (9) ThyssenKrupp Steel Europe
- (10) HBM
- (11) ArcelorMittal Duisburg
- (12) Deutsche Edelstahlwerke
- (13) Budenau Edelstahl
- (14) Stahlwerk Thüringen
- (15) SSF Ober-Steinwerke Ferrel
- (16) BSH Edelstahl
- (17) Dillinger Hüttenwerke
- (18) Saarstahl
- (19) Badische Stahlwerke
- (20) Lech Stahlwerke
- (21) Übrige Stahlstandorte

Stand: Januar 2021
Quelle: VWS Stahl

Source: Wirtschaftsvereinigung Stahl, Fakten zur Stahlindustrie in Deutschland 2022

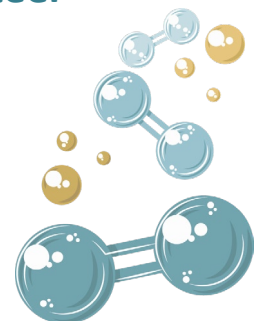


Two process routes to produce steel

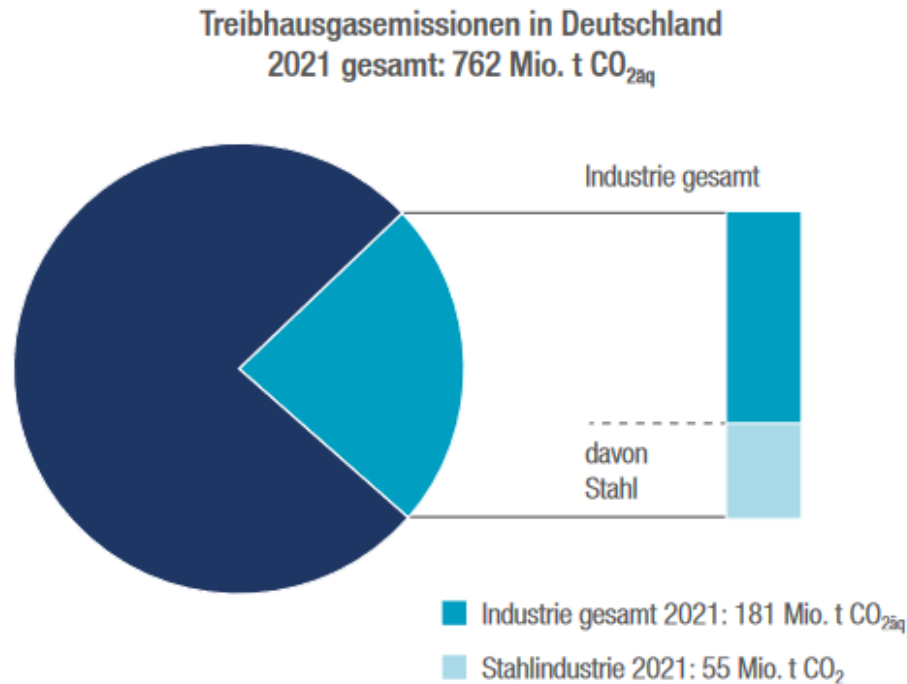


- **EAF-Route** (ca. 30% of production):
 - Remelting of steel scrap
 - Electric energy main energy source
- **Blast furnace route** (ca. 70% of production):
 - Production of hot metal from iron ore
 - Coal/coke as energy and reducing agent
- **CO₂ created in process and emitted to atmosphere**
- **Circa 2t CO₂ emitted per 1 ton of steel produced**

Source: Wirtschaftsvereinigung Stahl, Fakten zur Stahlindustrie in Deutschland 2022



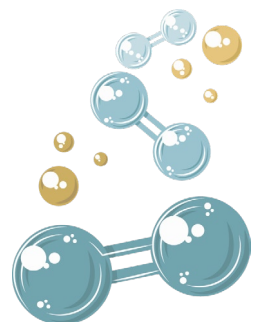
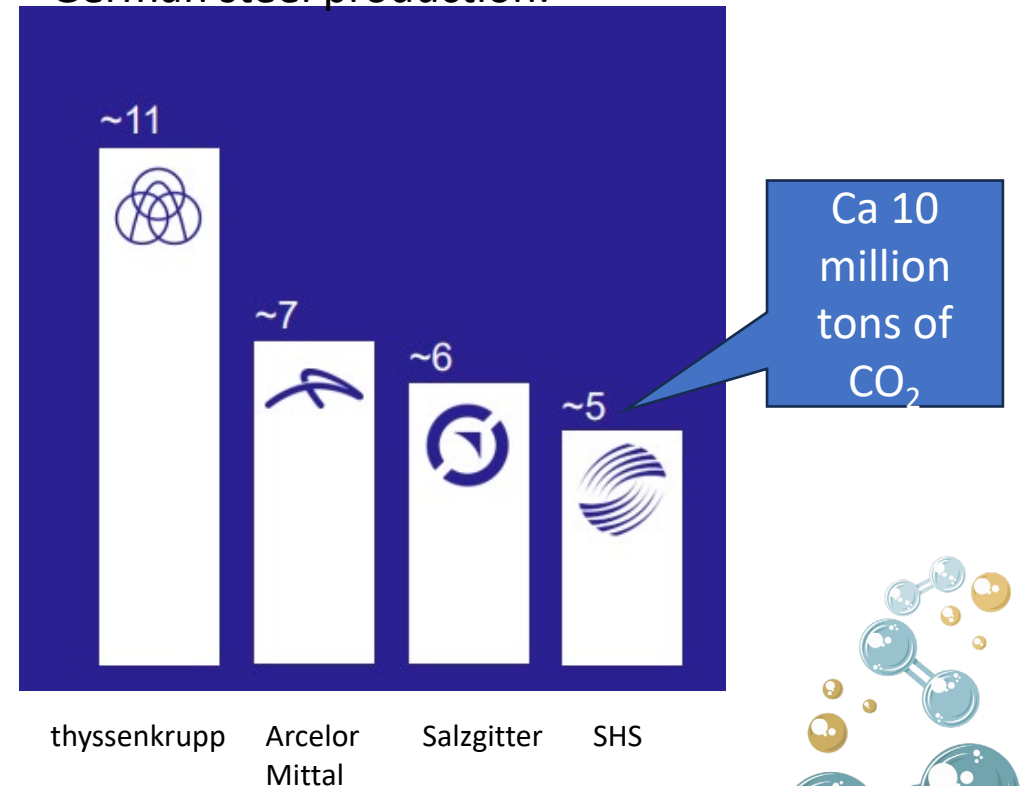
The German steel industry is responsible for 55 million tons of CO₂ emissions



Quelle: Bundesklimaschutzgesetz, UBA, DEHSt, WV Stahl

Quelle: Wirtschaftsvereinigung Stahl, Fakten zur Stahlindustrie in Deutschland 2022

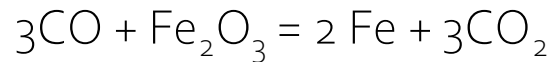
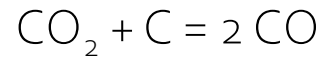
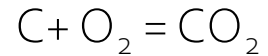
German steel production:



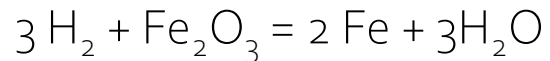
Hydrogen can be used to replace carbon

Simplified reactions

Carbon as reducing agent

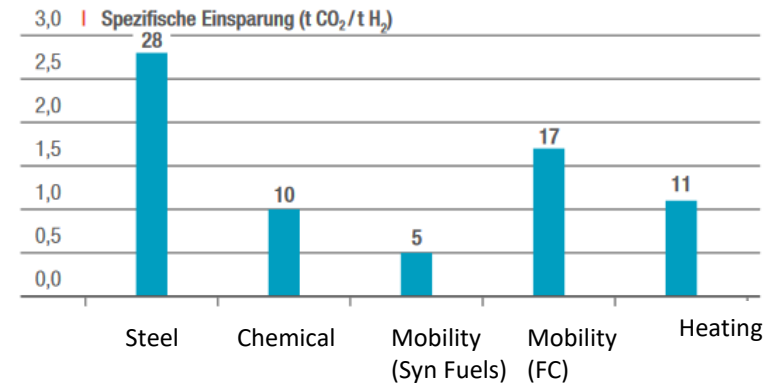


Hydrogen as reducing agent



Hydrogen usage:

Reduction potential of CO₂ for different industries



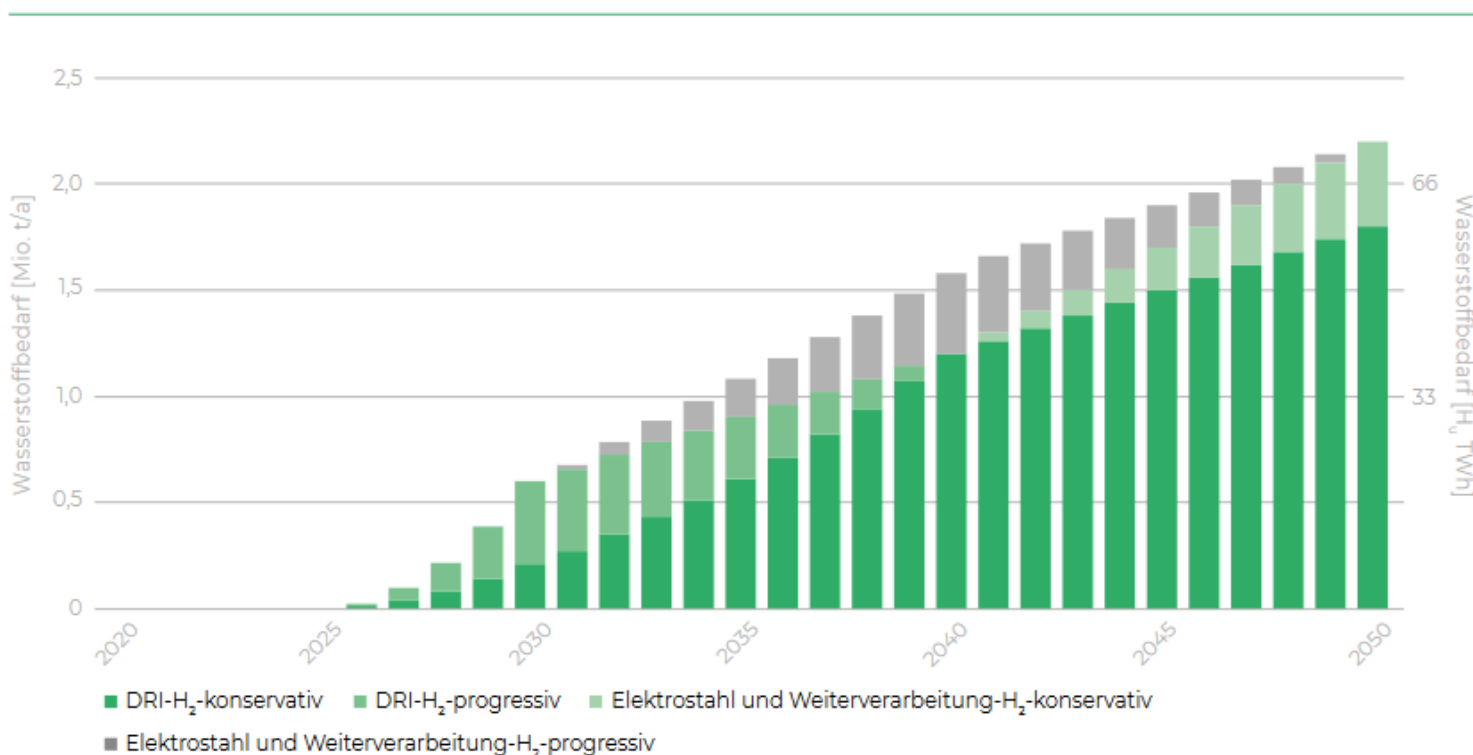
*Mittelwert Potenziale heute und 2050

Quelle: Nationaler Wasserstoffrat, Berechnungen der WV Stahl, unter Einholung einer Stellungnahme des Fraunhofer-Instituts für Umwelt-, Sicherheits- und Energietechnik UMSICHT

Source: Wirtschaftsvereinigung Stahl, Fakten zur Stahlindustrie in Deutschland 2022



Hydrogen demand of German steel industry



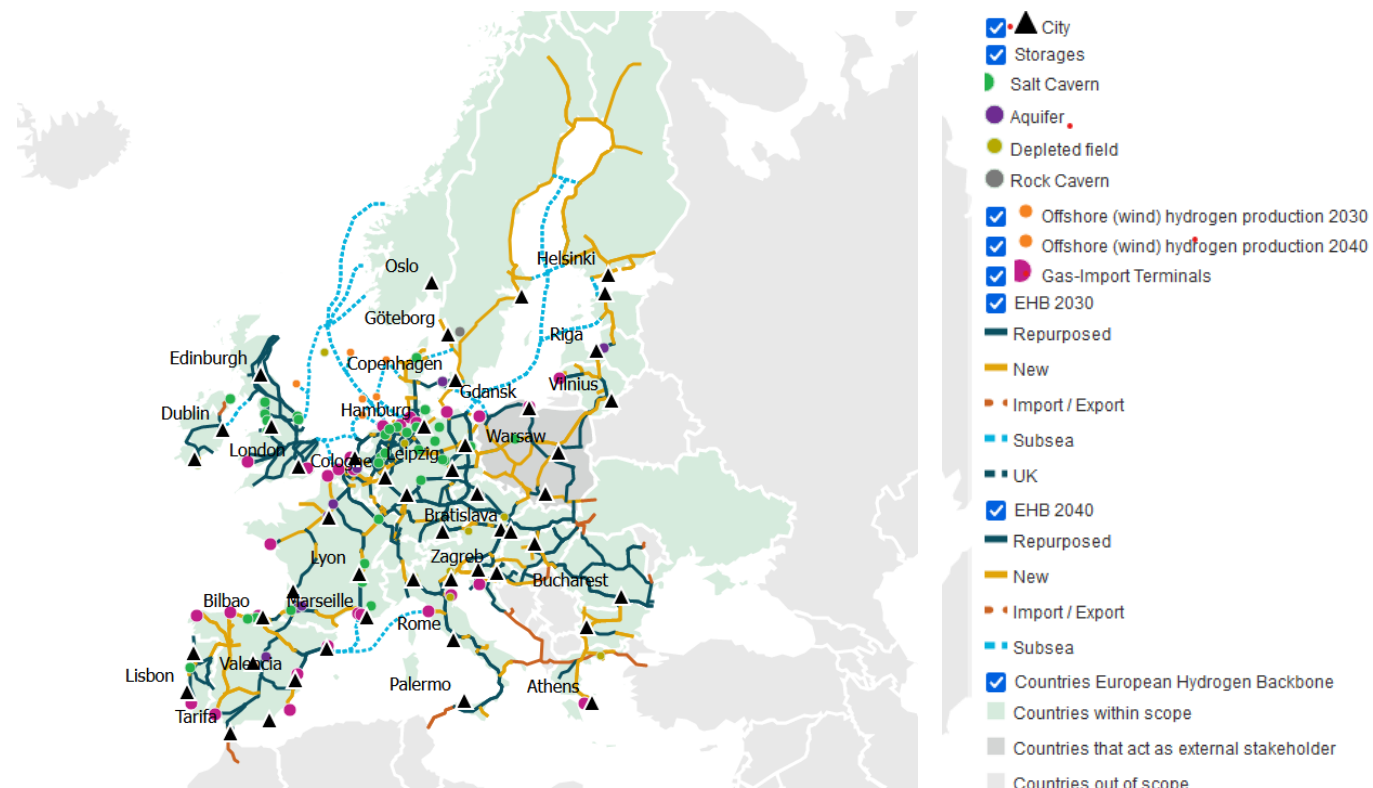
Assumptions:

- Substitution of all blast furnaces by direct reduction units
- Additional demand from downstream operations
- Demand can reach 500 kt in 2030 and ramp up to 2 million tons by 2050

Source: Nationaler Wasserstoffrat, Grundlagenpapier „Treibhausgaseinsparungen und der damit verbundene Wasserstoffbedarf in Deutschland“, Februar 2023



Therefore hydrogen will have to be imported



Source: European Hydrogen Backbone

- Setting up the European pipeline network is essential
- Intermediate solutions to be examined



Role of the Saarland Hydrogen Agency

- We act as first contact for hydrogen related questions
- We connect players along the value chain
- We analyze the markets and keep track on changes and new development
- We support in developing strategies to kick-start the hydrogen economy
- We help you find funding schemes
- We consult companies, citizens and other interested parties in hydrogen applications, safety and technology questions

