

The logo for Ramboll, featuring the word "RAMBOLL" in a bold, white, sans-serif font. The letter "O" is stylized with a blue checkmark-like shape inside it. The logo is set against a white rectangular background.

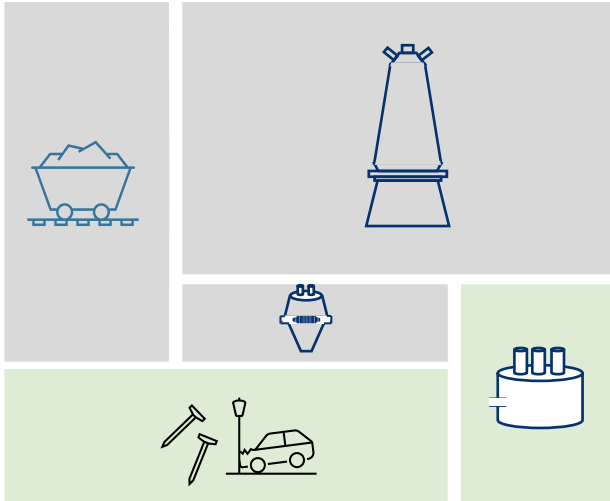
Bright ideas.
Sustainable change.

Powering the green steel development

Essen, Green steel world 2024-06-26

Production routes and decarbonization alternatives

Current production



Decarbonization options

- CCS
- Replacing coke with bio char
- Replacing natural gas with hydrogen
- Replacing natural gas with bio syngas
- Renewable electricity

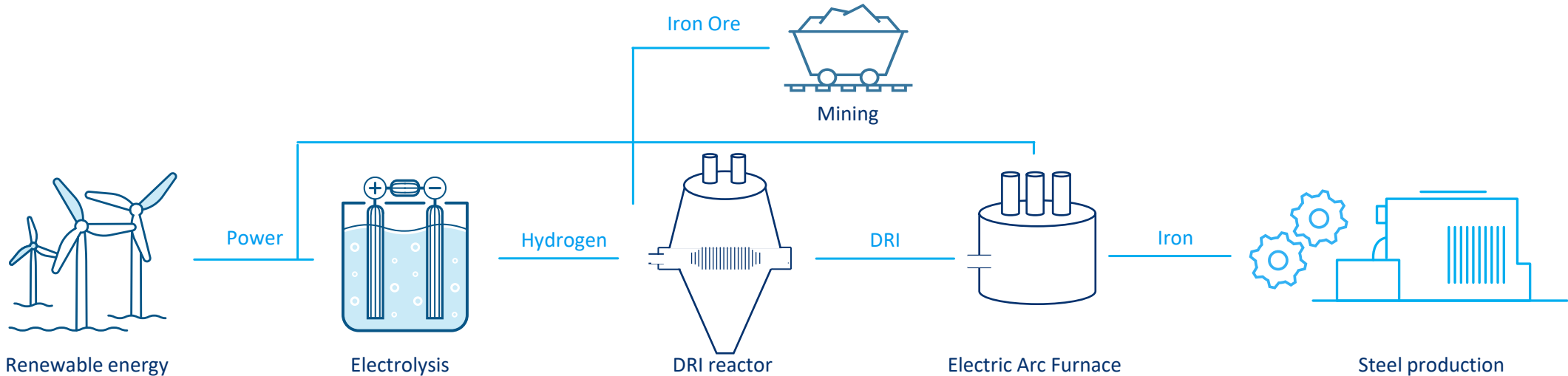
New technologies
(direct electrolysis etc)

Conclusions:

There are several options to decarbonize also today
The decarbonization will increase electricity demand
DRI capacity will increase significantly



The energy demand for the hydrogen DRI + EAF, change the energy balance on regional level



2 GW
(2,5 Mtpa)



50%

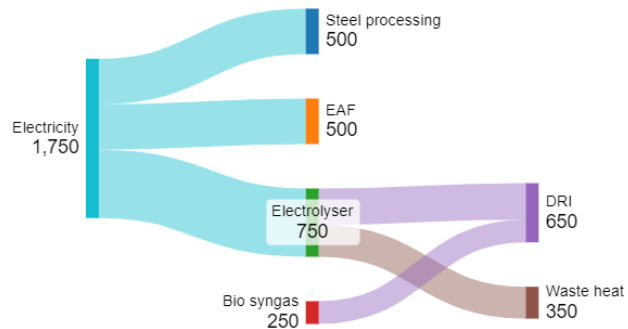
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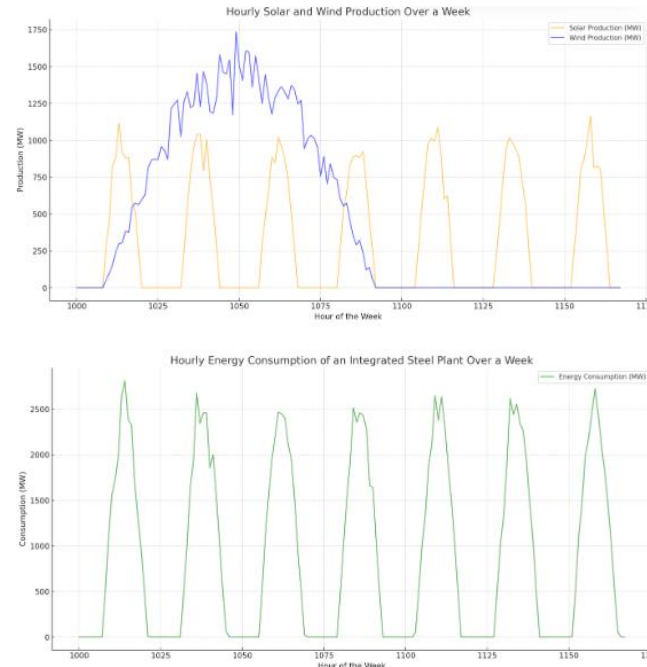
Securing a low LCOE and LCOH will be crucial for future competitiveness

A number of things will affect LCOE/LCOH. Apart from commercial success; the risk profile and environmental requirements will determine the end result. The options can be viewed according to:

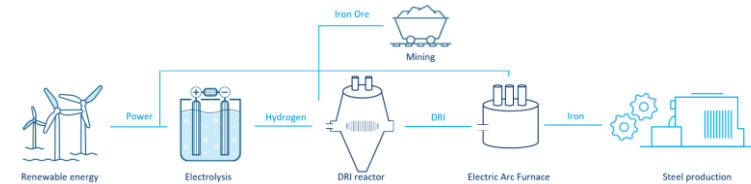
Options to impact the amount of energy used from which energy carrier



Options to impact the source of energy used through storage



Options to secure cost, through value chain positioning



Example: scale of the energy challenge in Germany

Example Germany (by 2030)

- Increase in DRI+EAF capacity: 11 Mtpa
- Increase in electricity demand: 12 GW
- Increase in production: 20 GW
- Increase in green H2 production: 6 GW

Added wind production in the last 5 years	app. 10 GW
Added electrolyser capacity in the last 5 years	app. 1 GW
Planned hydrogen backbone	2030



Modelling to understand options, risk and env – what LCOE and LCOH can you expect?

Assess your options

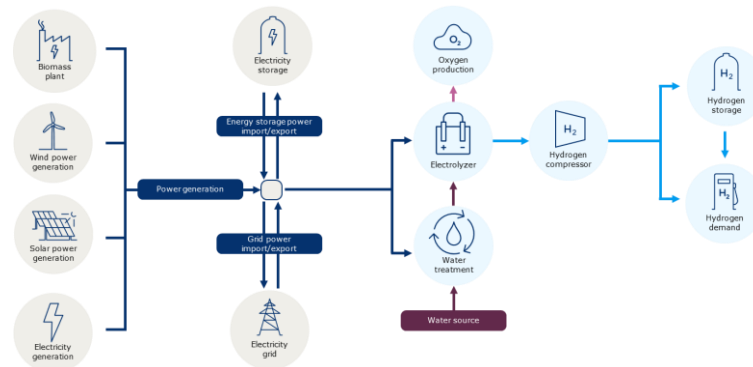
Options:

- Electricity
 - Offshore wind
 - Onshore wind
 - PV
- Hydrogen
 - Green
 - Blue
- Biomass
 - Bio char
 - Bio syngas

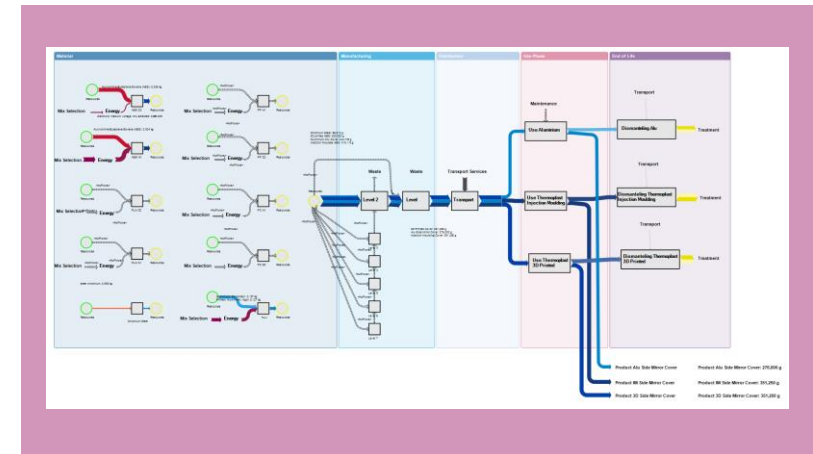
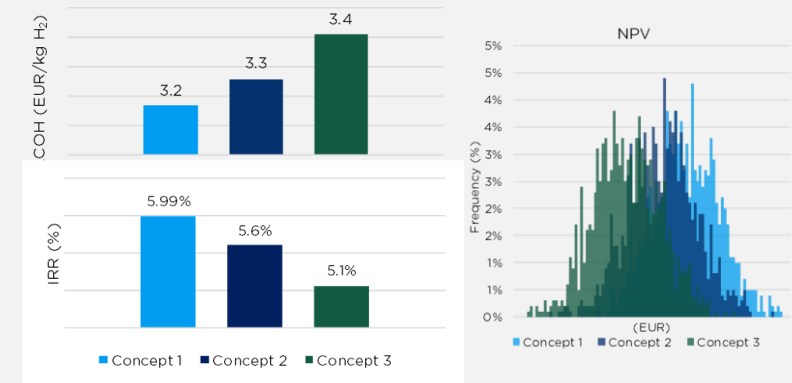
Risk assessment

- ✓ Regulatory
- ✓ Technical development
- ✓ Dependency on 3rd party
- ✓ ...

Build your concepts



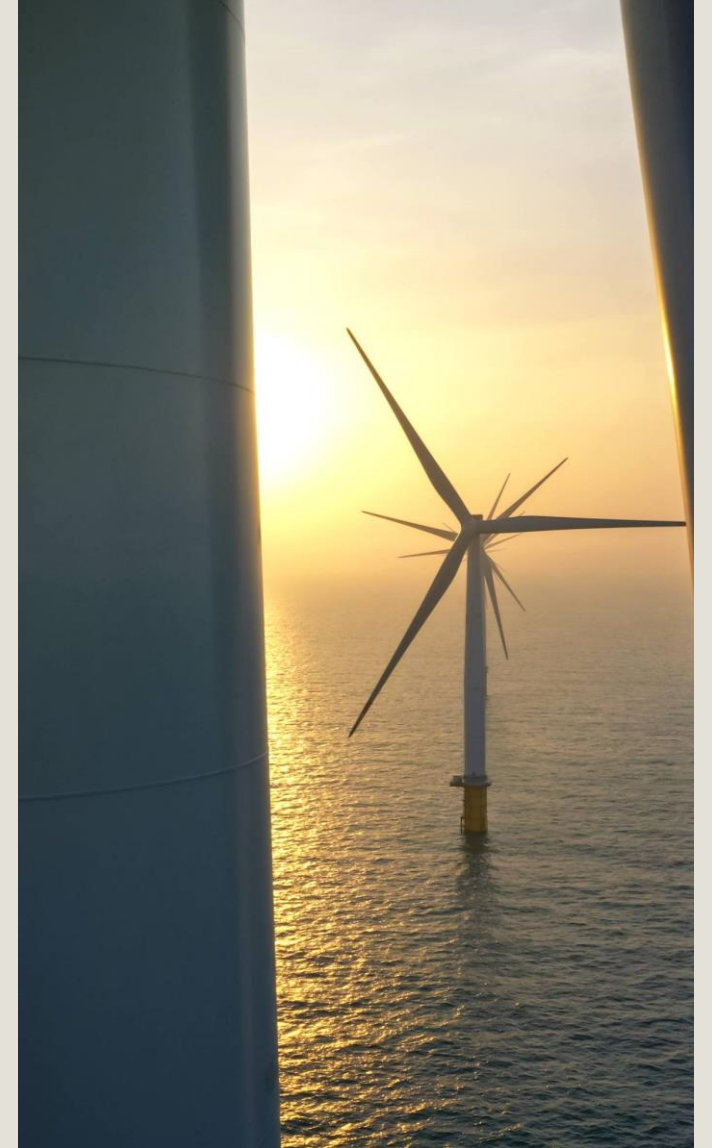
Model your outcome



Take aways

1. Understand your options and compare them on equal terms
2. You will depend on collaboration partners, start discussions with them early and don't forget the grids!
3. Make a risk assessment based on a sober understanding of the market. There are many "truths" out there.

 If you want to know more about risks and options for construction of electrolyser plants listen in on Carlos Bernuy Lopez speech "Beyond electrolysers" tomorrow at 09.30.



Thank you!



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