How to roadmap?
Basics and insights from German industry

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Chapter 01

Short introduction into Foresight and Roadmapping
Methods for "looking into the future"

Foresight

- Trend analyses: Where are we coming from?
- Environmental Scanning: Where is something happening?
- SWOT: Where are we at?

- Desirable futures: What inspires?
- Expected futures: What is expected?
- Possible futures: What could happen?
- Scenarios: What are our options?
- Interviews: What are our options?

Roadmaps: How to reach our goals?

Where are we heading?
Foresight is not...

... because an exact prediction is not possible for a complex system and a longer period of time.

...because an accurate prediction is usually wrong.

... an accurate prediction....

...but a step on the way to planning (strategic foresight, corporate foresight).

...but sets the framework for planning.
Basic idea of a roadmap: How do we reach our goals?
Goals of a roadmap

Foresight Methodology

Tool for Communication
Types of Roadmaps

**Technology Roadmaps**
Making a connection between market requirements and a company's technology capabilities.

**Product Roadmaps**
Mapping the conditions and requirements needed to bring a new product to market.

**Project Roadmaps**
Topic-specific roadmap showing required activities
Innovation Policy Roadmaps

**Industry and sector roadmaps**
Contribution of a company in one sector to another sector
A roadmap can be compared to a road map. Both receive information about:

- Places and their interconnection
- Distance from the reference point
- Neighboring and distant places
- Difficulties on the way
- Development/events and their interconnection
- Outlook into the future
- Existing links
- Planning gaps
A classic roadmap is developed in 5 steps...

**Step I**
- **Structuring the roadmap**
  - Definition of target and system:
    - Search fields
    - Timeline/Timeline horizon

**Step II+III**
- **Analysis and forecast**
  - Trends and demands:
    - Trends and influencing factors
    - Market requirements
  - Potentials:
    - Technologies
    - Resources

**Step IV**
- **Generating the roadmap**
  - Step by step production
    - Developments and events
    - Chronological classification
    - Visualization

**Step V**
- **Interpretation and evaluation**
  - Completeness & Consistency:
    - Connections
    - Gaps
    - Fields of action
    - Measures
    - Activities

**Roadmap Implementation**:
- Prioritization of measures and activities
  - Implementation of the results
Chapter 02

Roadmapping for decarbonization of the German steel industry
How can the steel industry be made climate neutral?

Recycling
- High-quality steel with increased scrap usage

Wasserstoff
- H2-based direct reduction (nearly ready to operate)
- H2 plasma smelting reduction (in development)

Electricity
- H2-based direct reduction (in development)
- H2 plasma smelting reduction (in development)

Carbon based
- Optimised BF using „Substitution of fossil energy by biomass, carriers by Carbon oxide conversion, Gas injection into BF,.."
- Iron based smelting reduction; using „Substitution of fossil energy by biomass“, carriers by Carbon oxide conversion
- Recycling of CO2, via thermochemical process, cf. Kildahl et al. 2023
### Study Coverage

<table>
<thead>
<tr>
<th>Study</th>
<th>Coverage</th>
<th>Measures/Technology-mix in 2050</th>
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</thead>
</table>
| Green Steel    | Steel Sector (Europe) | 3 Scenarios: Without other technologies, Other technologies successful, Increased Scrap availability  
⇒ Primary production  
⇒ Optimized BOF 43% and 52% (Biomass, CCUS)  
⇒ H2-DRI btw. 36% and 46%  
⇒ Rest via other Technologies and/or more scrap | ![Green Steel Pathways (2021)](image) |
| IEA, NZE       | Energy system (World) |  
⇒ Primary production  
⇒ CCUS-equipped 54%  
⇒ Hydrogen-based 29%  
⇒ Rest via other Technologies  
⇒ Overall  
⇒ increased share of scrap route, (est. 35-40%) | ![iea (2021)](image) |
| Agora          | Steel Sector (Germany) |  
⇒ Primary production  
⇒ No CCUS  
⇒ Hydrogen-based 100%  
⇒ Overall:  
⇒ Hydrogen-based 54%  
⇒ Scrap route 46% | ![Agora et al. (2021)](image) |
| Langfrist III  | Energy system (Germany) |  
⇒ Primary production  
⇒ No CCUS  
⇒ Hydrogen-based 100%  
⇒ Overall Hydrogen-based 40%,  
⇒ Secondary route 60% | ![Fraunhofer ISI et al. (2021)](image) |
DekarInd: Roadmapping for the cement and steel industry

Approach

- Workshops
- Thesis papers
- Review
- Networking

Commissioned by the German Federal Environment Agency within the framework of the DekarInd project. (FKZ 3719 41 303 0)
Events carried out
and probably there are many more in other project too ...

- IPCEI H2 Expression of Interest
- Steel action concept
- Interviews with steel producers
- Climate protection contracts
- Vision elements
- Funding guidelines for decarbonisation industry
- Basic principles guidelines on CFDs in Germany
- Start realisation IPCEI (selection)
- Amendment to the Climate Protection Act
- Funding
- Lead markets
- Lead market automotive
- Synthesis
- ETS
- Stakeholder Dialogue 1
- Stakeholder Dialogue 2
- EU: Fit for 55

Σ ≈ 90 participants
Stakeholder institutions
By 2050, Germany's steel industry will achieve decarbonization without compromising its global competitiveness and societal image.

➢ Switch in iron ore reduction: moving away from blast furnace towards direct reduction with green hydrogen
➢ Increasing the use of scrap in steel production
➢ Decarbonising electric steel production
Our approach

Workshops

- **Transformation path, i.e. desired development**
  - Construct
  - DRI-plant

- **Barriers: Technical, regulatory, economic and social aspects that are in the way.**
  - Investors are sceptical
  - Lack of capital

- **Drivers: Aspects that help to achieve the desired development.**
  - Demand for "green steel"
  - Climate goals

- **Measures: Measures that help to reduce barriers and strengthen drivers.**
  - Funding
  - Other policies
DekarbInd: Key Points

Initial situation

- So far, there is no national target corridor for the expansion of DRI plants. By 2026, the companies are planning about 5 - 6 million t. Target corridors could be helpful for resource planning.

- Increasing the use of scrap is controversial. Opportunities are seen, but it is unclear how much the use can be increased.

- There is also work to be done in the electric steel process on the road to decarbonisation.
Lead markets are seen as helpful and important. So far, however, there is a lack of concrete implementation plans.

The automotive industry and other sectors are already asking for low-GHG steel, which creates demand.

Lighthouse projects would be a possible approach for public procurement. In some circumstances, the proposals can also come from the steel industry/companies themselves when they see concrete projects.
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References and further reading...

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