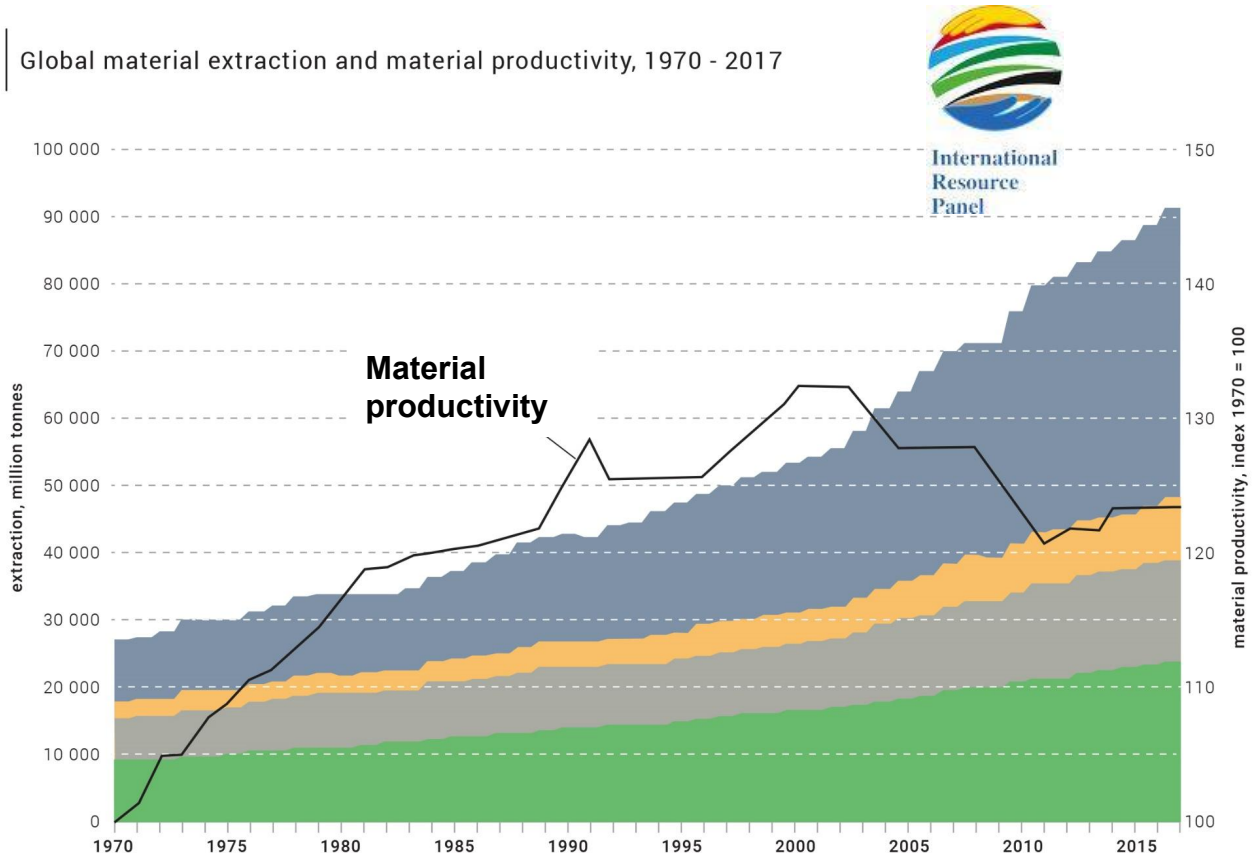
Dr. Harry Lehmann – Climate Talk, Residence of the German Ambassador, Tokyo, 20th February 2025

The Role of Resilient Supply Chains for Raw Materials for the Energy Transition

Insights and Opportunities for German-Japanese Cooperation

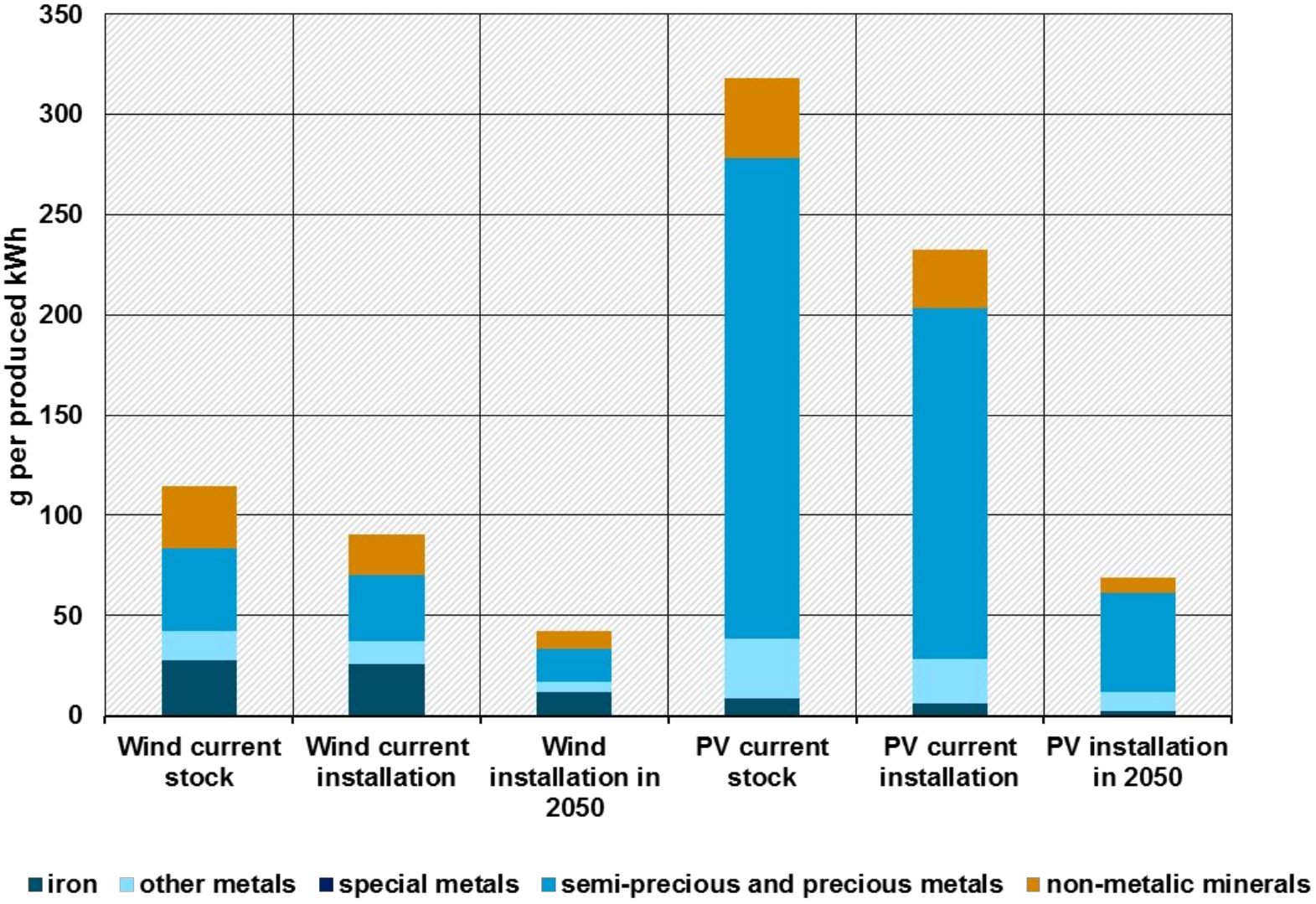
Resource use and its upward trend



- Global resource use: more than tripled since 1970
- Global material demand per capita: 7.4 tonnes in 1970; 12.2 tonnes in 2017
- Material productivity: started to decline around 2000 and stagnated in recent years

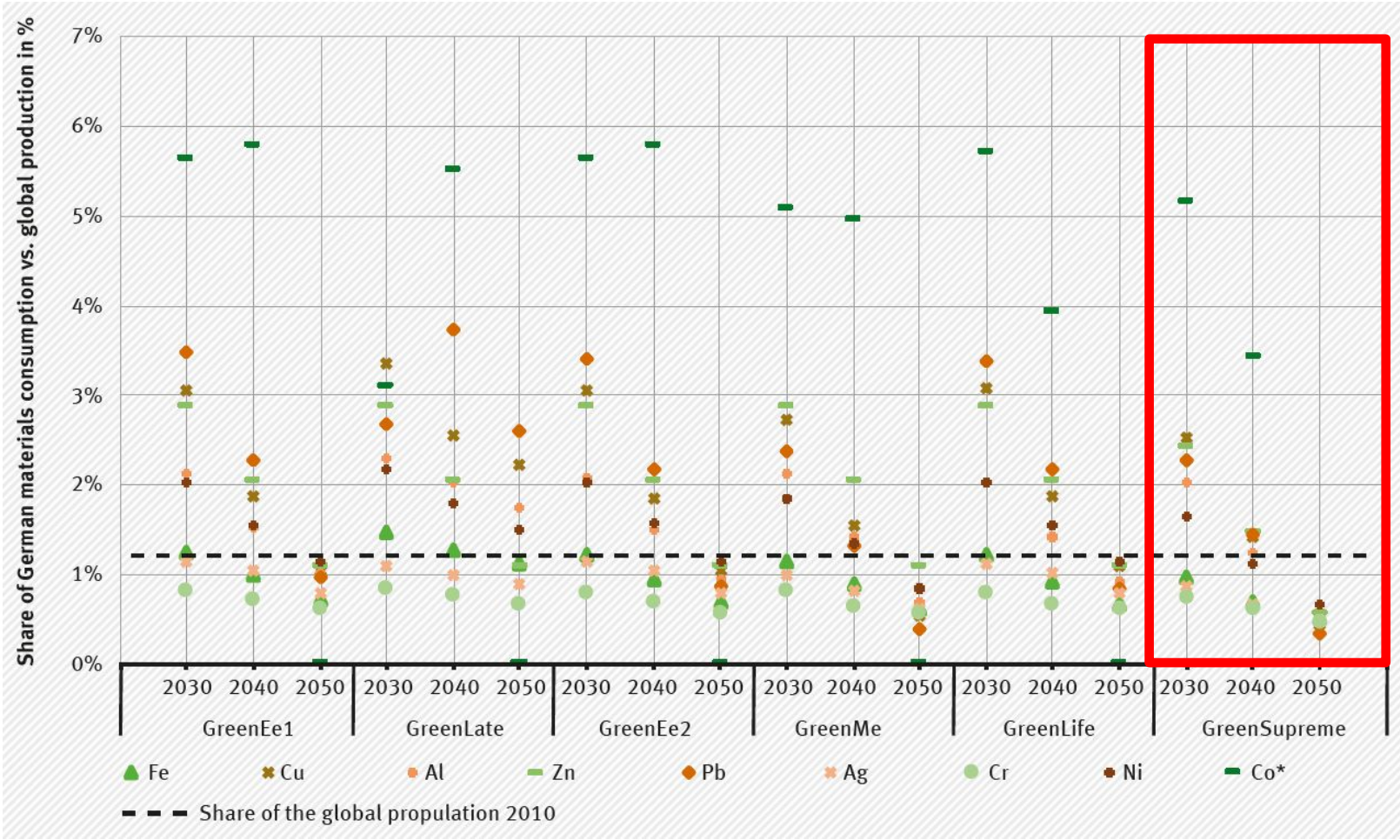
Non-metallic minerals
Metals
Fossil fuels
Biomass

All Technologies need Ressources



Source: Wiesen et al (2017). Analyse des Rohstoffaufwands der Energieinfrastruktur in Deutschland. Sachverständigengutachten für das Umweltbundesamt

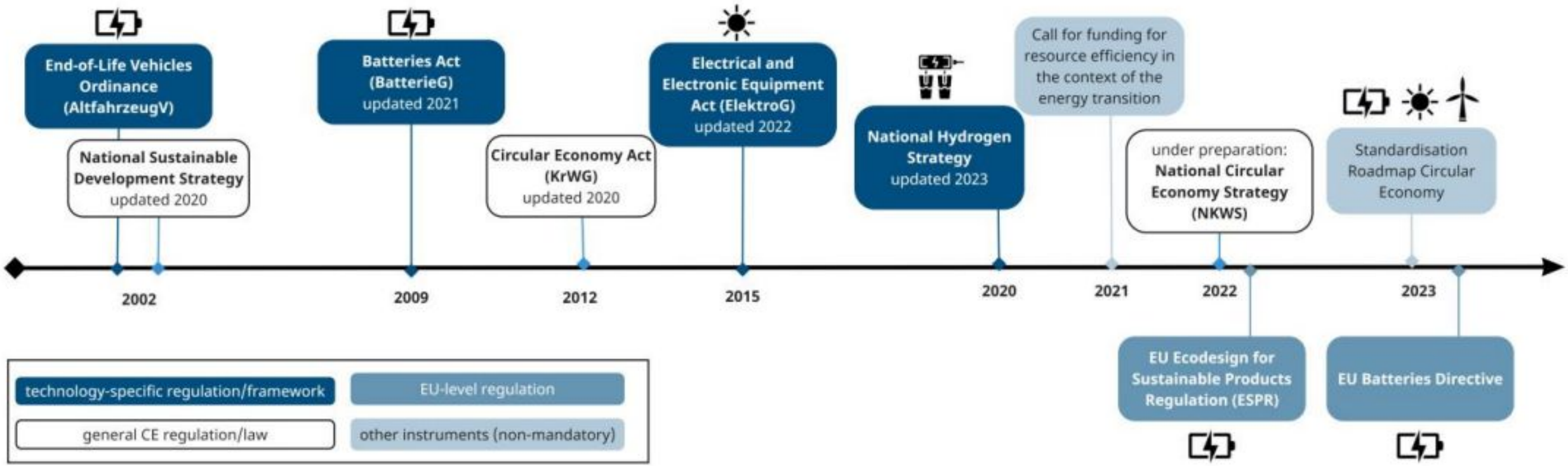
Final demand of selected raw materials as a share of global prim. Production in 2015/16



* Estimate only for batteries used in transportation.
** Germany's population in 2010 was 81.75 million people and the global population equaled 6.96 billion people (81.75 million people / 6.96 billion people = 1.17 %).

Note: Global production estimates were taken from USGS for the latest year available. For chromium, the production data from chromite was used and a metal content of 30 % assumed.

Figure 4: Overview of policy frameworks in Germany

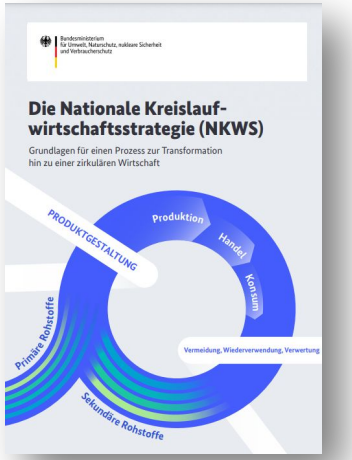


Source: https://energypartnership-japan.org/fileadmin/japan/media_elements/2024_critrawmat_energy-trans_ger_jpn.pdf

The National Circular Economy Strategy

The National Circular Economy Strategy

- The NCES aims to make Germany climate-neutral, more competitive and economically resilient by 2045, and to achieve the goals of the German Sustainable Development Strategy.



- **Guiding principle:** Reducing primary raw material consumption using RMC
  - 6-8- tonnes per capita proposed by the UNEP for the SDGs
  - Reviewed every 5 years together with industry
  - Includes changes in raw material demand, costs and availability

- **Strategic goals and indicators:**
  - Close material cycles (Indicator: Circular Material Use Rate – CMUS)
  - Increase the security of raw material supply and sovereignty (implementation of the CRMA)
  - Prevent Waste – reduce municipal waste by 10 % (2030) and 20 % (2045) vs. 2020 level)

The Critical Raw Material Act (CRMA)

Under the Green Deal industrial Plan

- In force since May 2024
- List of 34 critical raw Materials and 17 strategic critical raw materials
- based on **supply risk** and **Economic Importance**

Aluminium/Bauxite	Copper*	Lithium	Scandium
Antimony	Feldspar	Magnesium	Silicon metal
Arsenic	Fluorspar	Manganese	Strontium
Baryte	Gallium	Natural Graphite	Tantalum
Beryllium	Germanium	Nickel*	Titanium metal
Bismuth	Hafnium	Niobium	Tungsten
Boron/Borate	Helium	Platin group metals	Vanadium
Cobalt	Heavy rare earth elements	Phosphate rock	
Coking coal	**Light rare earth elements**	Phosphorus	

Benchmarks:

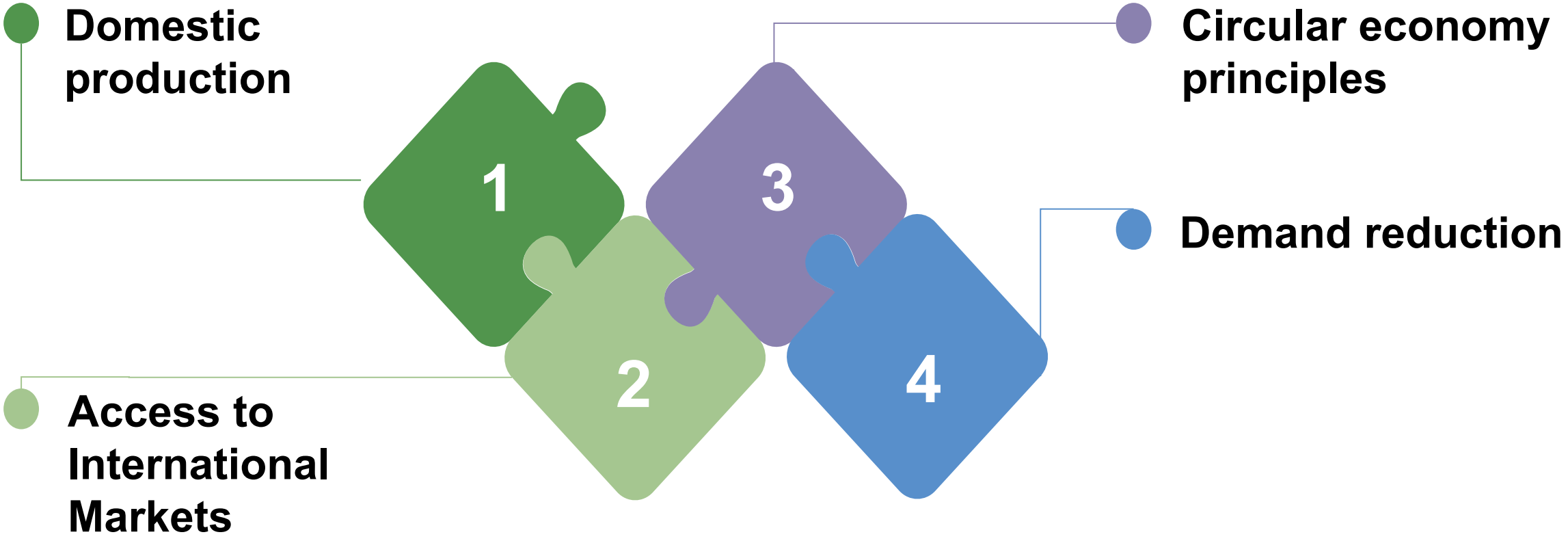
- 10% < of the EU's annual consumption for extraction
- 40% < of the EU's annual consumption for processing
- 25% < of the EU's annual consumption for recycling
- 65% < of the EU's annual consumption from a single third country

Goals:

- Creating secure and resilient supply chains
- Supply risk preparedness and mitigation
- Improving sustainability and circularity of CRM on the EU market
- Diversifying the Union´s import of raw materials

All MS need to adopt national programs to achieve common benchmark within two years of adoption (2026)

Sufficiency – Efficiency – Substitution – Redesign – Reuse – Circularity



Changes to our **consumer behavior**

are necessary in reducing the overall consumption of primary raw materials


thank you
danke
謝謝
ngiyabonga
teşekkür ederim
gracias
merci
obrigado
dziękuje
bedankt
спасибо
Баярлалаа
рахмат
mersi
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welalin
tack
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mahalo
tapadh leat
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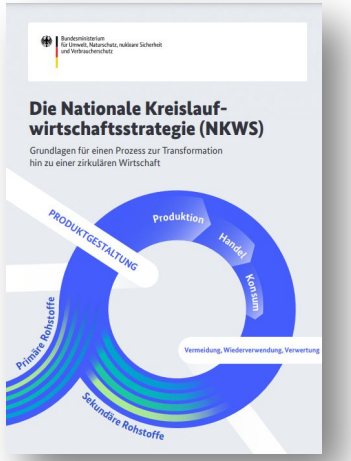
Zusätzliche Folien

Raw material policies in Germany

1) The National Circular Economy Strategy



- The NCES aims to make Germany climate-neutral, more competitive and economically resilient by 2045, and to achieve the goals of the German Sustainable Development Strategy.
  - **1 Guiding principle:** Reducing primary raw material consumption using RMC
    - 6-8- tonnes per capita proposed by the UNEP for the SDGs
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    - Includes changes in raw material demand, costs and availability
  - **3 Strategic goals and indicators:**
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2) The National Raw material Strategy (2010)

- Based on EC Raw Material initiative (2008)
- New RM Strategy 2020. <u>Key areas:</u>
  - strengthening the domestic extraction of raw materials
  - supporting the import
  - recovering raw materials through increased recycling activities
- 2022 Eckpunktepapier: Complement and refocus the 2020 Strategy

Conclusions

- **Sufficiency – Efficiency – Substitution – Redesign – Reuse – Circularity**

► ***Substitution***: Replacing greenhouse gas- and resource-intensive technologies and products with greenhouse gas-neutral or greenhouse gas- and resource-poor alternatives.
► ***Avoidance***: Reduced consumption of products and activities through efficiency , sufficiency and consistency, leading to low greenhouse gas emissions, low primary raw material consumption and resource consumption.
► ***Carbon sinks***: The removal of CO2 already emitted from the atmosphere by carbon sinks (CDRs) to reduce greenhouse gases.

Next to material efficiency approaches, changes to our consumer behavior are important in reducing the overall consumption of primary raw materials

The earlier we act, the more leeway we have.

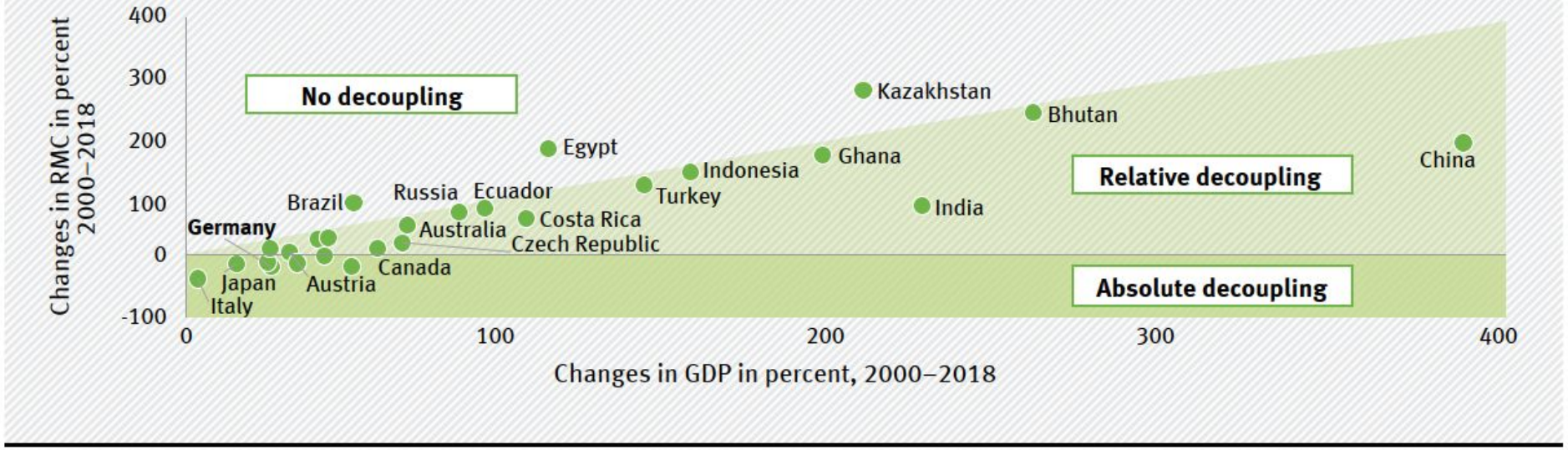
The importance of Raw Material Productivity (RMP)

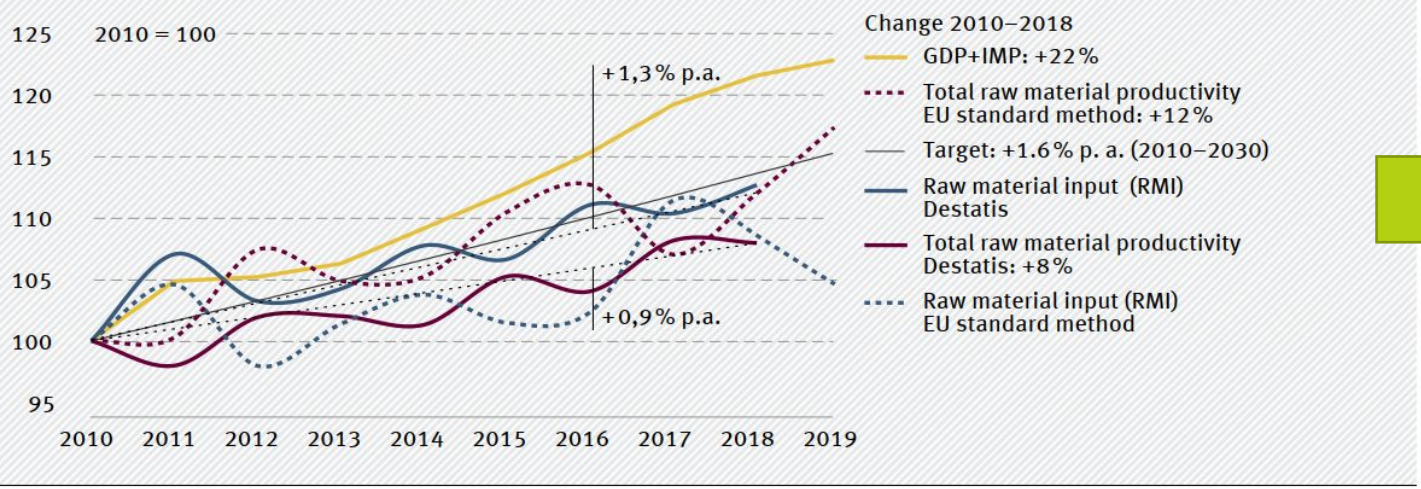
owth from raw

rect material flows

2020) and the National

Decoupling trends of raw material consumption (RMC) from gross domestic product (GDP), 2000–2018





Due to conceptual differences, calculations based on Destatis and the EU Standard Method respectively yield different results (see p. 9–11).

Destatis: Actual annual growth in total raw material productivity from 2010 to 2018 (0.9%) does no meet the 2030 goal:
-> **need to increase further 22%**

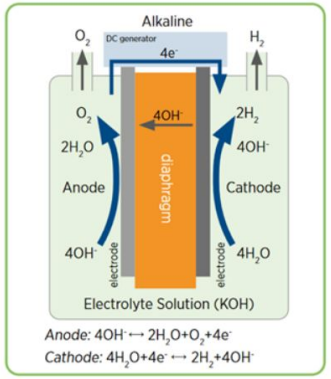
EU calculation (only primary raw materials): increase by 1.2%

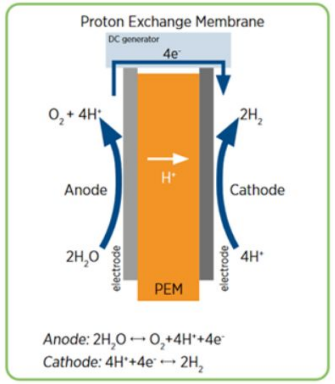
Green Hydrogen and Raw material

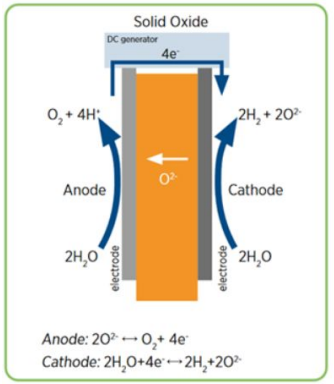
- **Polymer electrolyte membrane electrolysis (PEM)**
  - **Contains precious critical metals such as platinum and iridium**
  - Lighter and compacter
  - High energy efficiency
  - Quick reaction to electricity fluctuations (fast rump-up und -down) – ideal for RE

- **Alkaline electrolysis (AEL)**
  - Mosts mature technology
  - Low currenty density -> Long-term stability (>20y)
  - Low investment costs
  - No critical raw materials needed

- **Solix oxide electrolysis cell (SOEC)**
  - High-temperature (600-800 °C)
  - Technology still at TRL 6-7 (Sunfire recenty commissioned a 250 kW SOEC)
  - High rump-up time (over 14h) but lowest energy consumption
  - Low costs but high material degradation
  - **Contains low amounts of critical materials (Boron, Barium, Manganese, Nickel)**

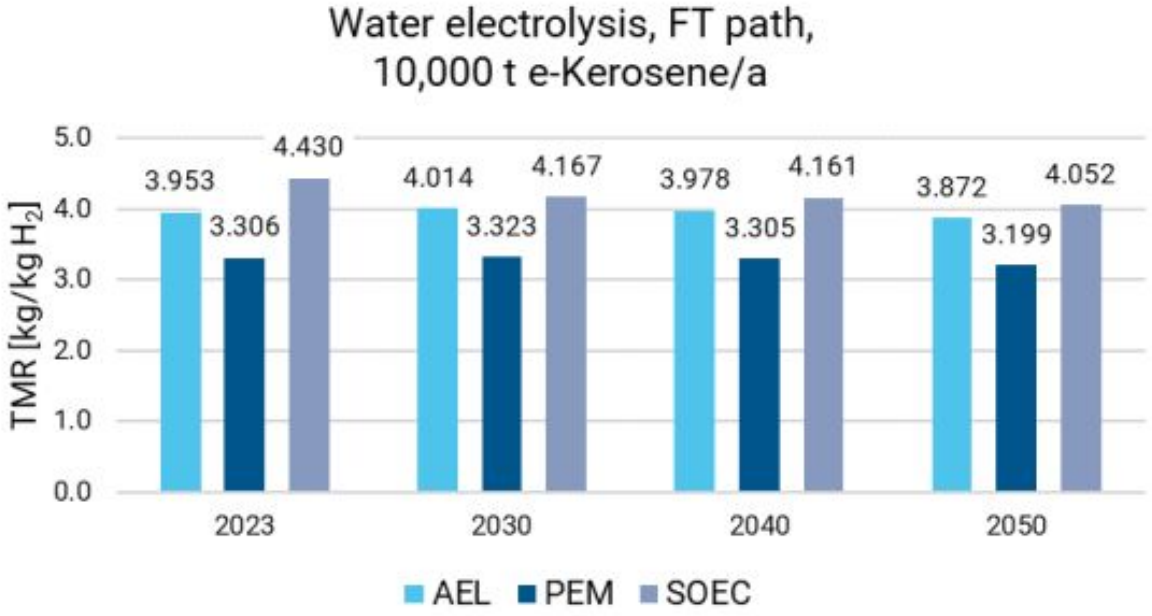


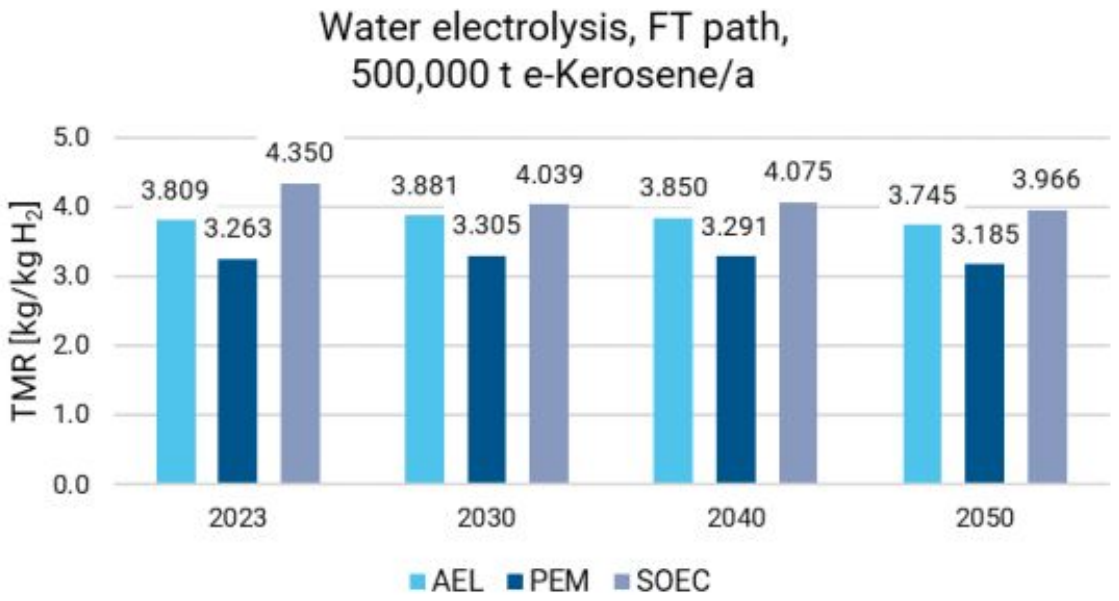




Source: https://www.finh2.fi/electrolyser-technologies/

Resource study, TMR and CRM for electrolysers



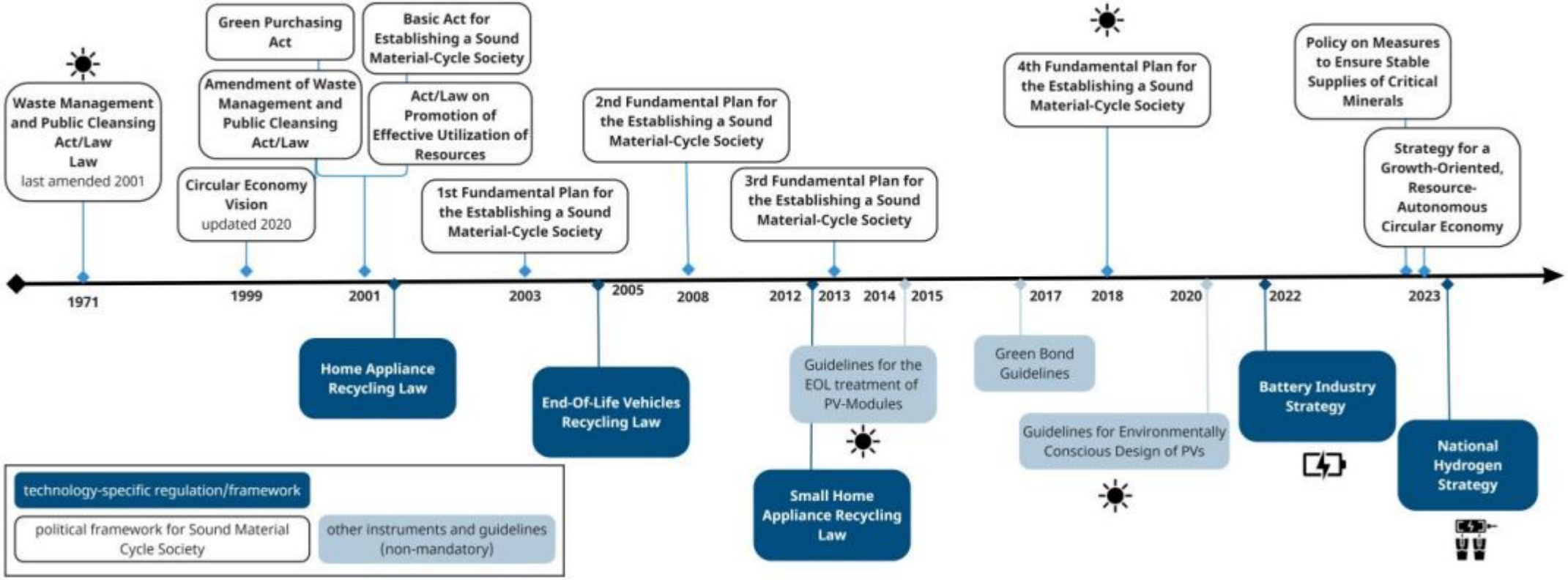


- No TMR differences between small vs. large e-kerosene plants
- AEL requires until 24kt of Nickel until 2050 (8% of current EU annual demand) – **future high competition!**
- Nickel requirement for PEM is extremely low
- Iridium in PEM: 80Kg in 2050 (9& of current EU annual demand)
- Cobalt: More than double needed for AEL (262t) vs. PEM – due to background processes (Ni und Co extraction)
- **Conclusion: At the current state SOEC and PEM (with reduced need of CRM) must be further developed to avoid high CRM dependency**

Übergeordnete Policy

- Strengthen cooperation with like-minded countries, multilateral forums and initiatives
- Strengthen (leadership) positions (e.g. technological, R&D)
- Encourage joint public-industry efforts (in GER not traditional policy)
- Cohesive connection of security and environmental goals

Figure 5: Overview of policy frameworks in Japan



Source: Own illustration.

Source: https://energypartnership-japan.org/fileadmin/japan/media_elements/2024_critrawmat_energy-trans_ger_jpn.pdf

Background: Overview most important existing Japanese raw material policies

- Green Growth Strategy Through Achieving Carbon Neutrality (2021): carbon neutrality by 2050 and 2030 HGH reduction of 46 % from 2013 levels
- Strategic Energy Plan, guided by the Basic Act on Energy Policy (entered into force in 2002): target of 36-38 % renewable energy by 2030
- METI's Battery Industry Strategy (2022) aims for 24 GWh of storage batteries by 2030 and to increase Japan's battery production capacity to 150 GWh, increase domestic battery production to reach 150 GWh by 2030
- National Hydrogen Strategy (2023): hydrogen use to 3 million tons by 2030 and 20 million tons by 2050, with an interim goal of 12 million tons, including ammonia, by 2040, aiming for hydrogen and ammonia to supply 1% of its energy by 2030 overall increase in demand for CRMs needed in electrolysis, such as REEs, nickel and platinum
- **Japan relies heavily on import of CRMs 58 % of CRMs from China**, followed by Vietnam at 14 %, France at 11 %, Malaysia at 10 %, and the remaining 8 % from various other countries
- Basic Guidelines for Securing Stable Supplies of Specified Critical Minerals (2022)
- Japan's international resource strategy (2020): securing a stable supply of essential minerals, incl**. stockpiling system** for 34 types of rare metals
- Policy on Measures to Ensure Stable Supplies of Critical Mineral: mitigate the challenges of high dependency on imports and potential monopolization by certain countries, especially in the context of critical minerals like REEs
- **Economic Security Promotion Act (2022)**: prioritizes economic security over market efficiency and prioritizes reducing Japan’s reliance on China as primary supplier of CRMs.
- **US and Japan: Critical Minerals Agreement (2023):** primary goal of enhancing and diversifying CRM supply chains