



# Towards circular and sustainable materials in 2050

4TU.HTM 20-1-2022 – René Kleijn (LDE Centre for Sustainability) & Benjamin Sprecher (TU-Delft)

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## Increased attention for the material basis of society



### The Role of Critical Minerals in Clean Energy Transitions



### EUROPEAN ALLIANCE FOR A MORE RESILIENT AND GREENER EUROPE



International Round Table on Materials Criticality in Business Practice

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# Three Key Issues: 1) Security of Supply / Resilient Supply Chains

## Executive Order on Addressing the Threat to the Domestic Supply Chain from Reliance on Critical Minerals from Foreign Adversaries

ECONOMY & JOBS | Issued on: September 30, 2020



I therefore determine that our Nation's undue reliance on critical minerals, in processed or unprocessed form, from foreign adversaries constitutes an unusual and extraordinary threat, which has its source in substantial part outside the United States, to the national security, foreign policy, and economy of the United States. I hereby declare a national emergency to deal with that threat.

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# Three Key Issues: 1) Security of Supply / Resilient Supply Chains

REUTERS® World Business Legal Markets Breakingviews Technology Investigations

NOS NIEUWS • ECONOMIE • MA 7 JUNI, 10:39 • AANGEPAST MA 7 JUNI, 10:49

## Bijna een op vijf fabrieken Nederland heeft toeleveringsproblemen



October 19, 2021 11:06 PM CEST Last Updated 9 days ago

## Business U.S. needs more mines to boost rare earths supply chain, Pentagon says

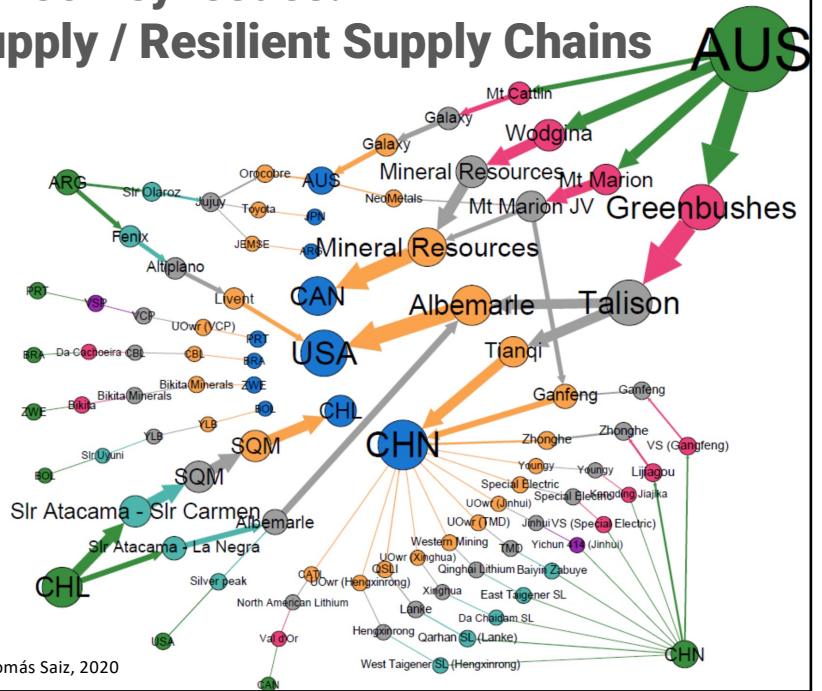
## NOS NIEUWS • NUTTENLAND • GISTERDAG, 22:18 Poetin geeft opdracht gasvoorraden Europa aan te vullen



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### Three Key Issues: 1) Security of Supply / Resilient Supply Chains

Lithium: mines, operators, shareholders



Source: Tomás Saiz, 2020

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### Three Key Issues: 2) Responsible Sourcing

- Conflict minerals 3TG (Tin, Tungsten, Tantalum Gold)
- Child Labour and other social issues
- Artisanal & small scale mining (>40 million people)
- Certification of raw materials



Picture: Esther van der Camp

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### Three Key Issues:

### 3) Environmental impacts: mining, production & waste



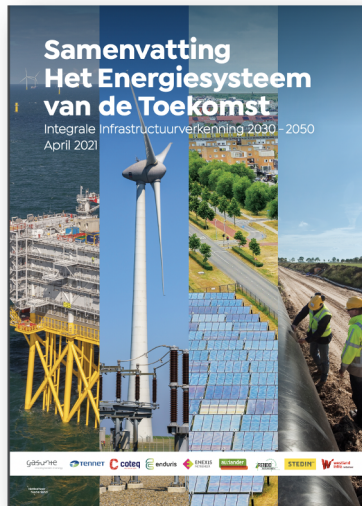
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### For the energy system of the future we need critical metals



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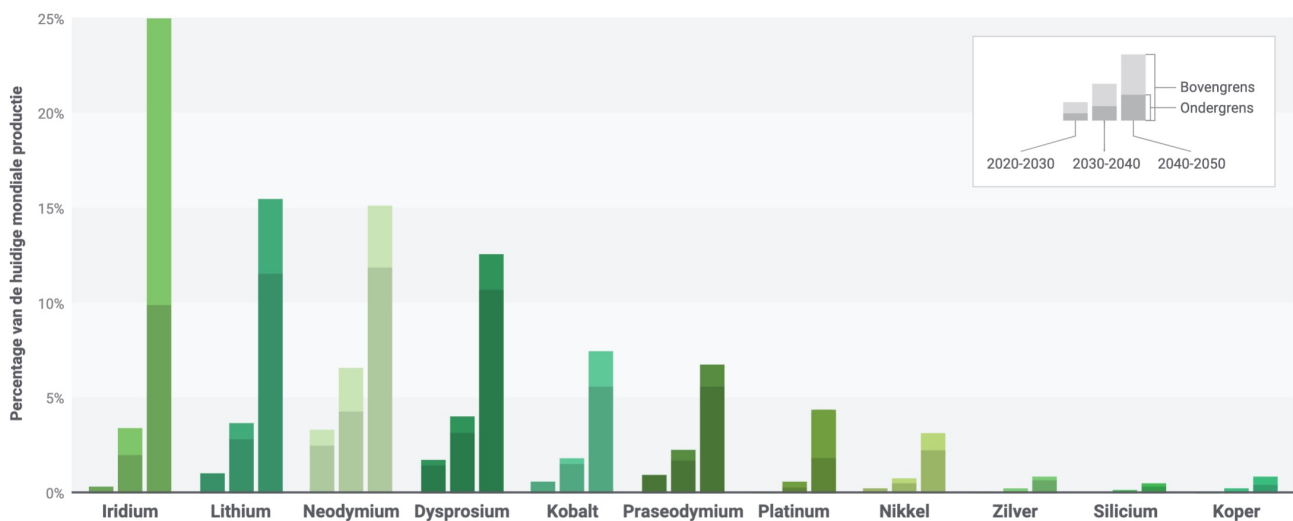
We explored the Dutch energy system of 2050 in four scenarios



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The Netherlands will require a significant share of global production

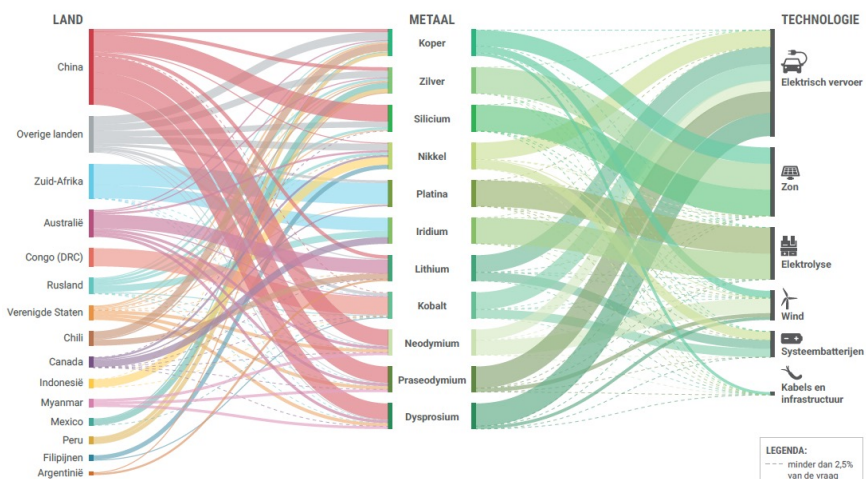
Average annual demand for 10 critical metals



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## Critical raw materials are sourced from a diverse set of countries

*But China is very important in most of these supply chains*



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## Conclusions

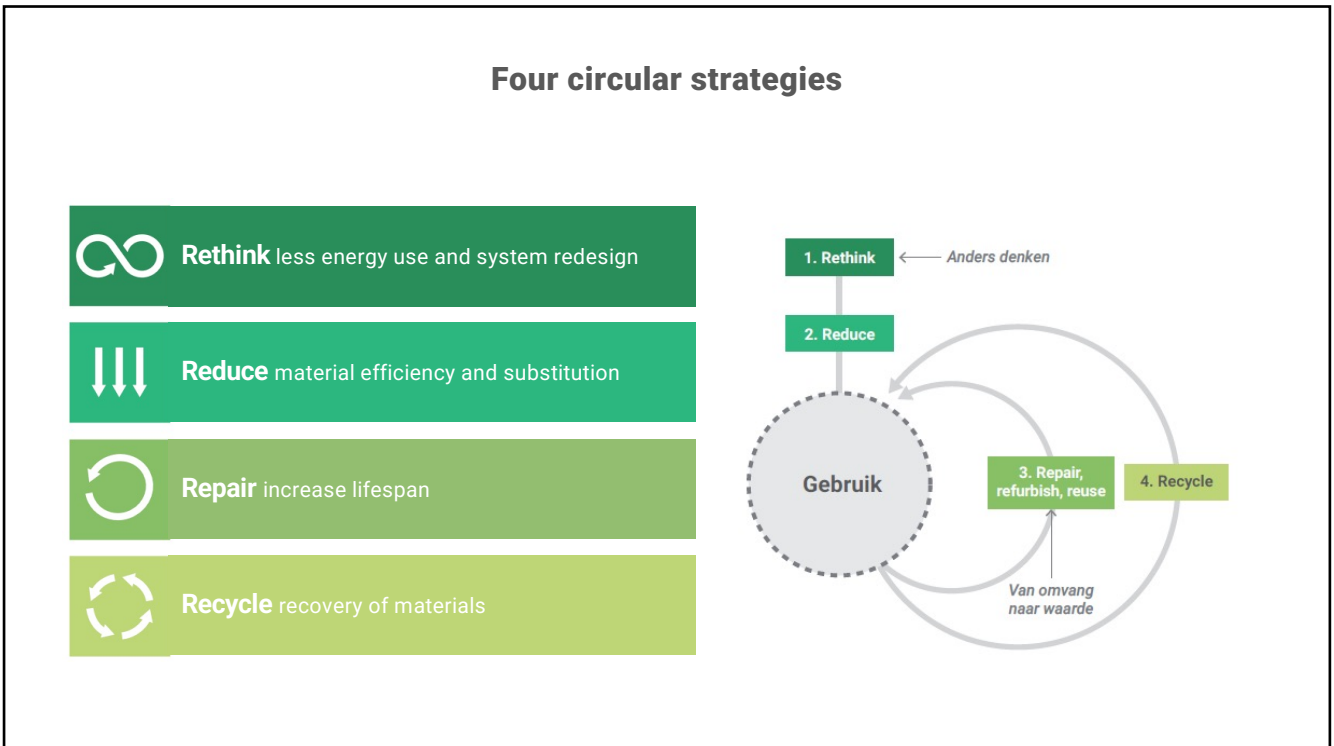
*The limited availability of critical metals is a risk to the energy transition*



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## Four circular strategies

Potential impact of circular strategies for the period 2040-2050



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Deze verkenning is uitgevoerd in opdracht van onderstaande partijen.



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