

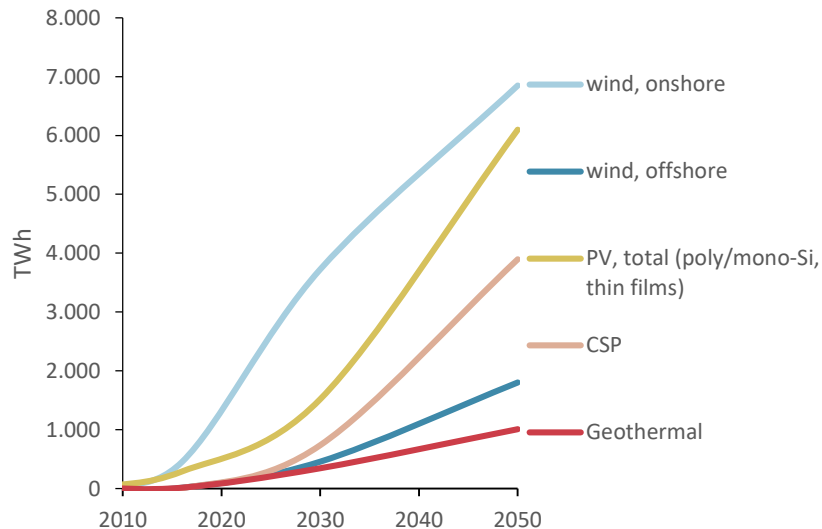
CLIMATE ACTION REQUIRES CIRCULAR ECONOMY STRATEGIES

1. Our global clean energy challenge

Climate action requires significant clean electricity production. To achieve the Paris Agreement, the vast majority of this production capacity needs to be realized in the period up to 2050.

This production capacity requires a **significant amount** of **critical metals** to, amongst others, build wind turbines and PV panels. These metals are also required for batteries and electric transportation.

The **growth** of global metal production since 1998, if continued, will not be enough for supply to meet demand towards 2030 and 2050.

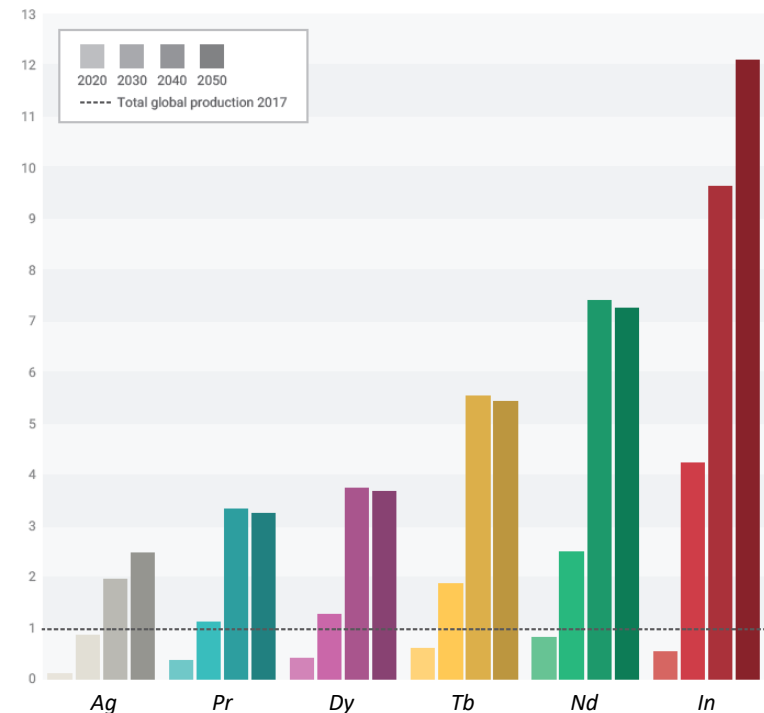


Global renewable electricity production capacity (IEA Beyond 2C scenario)

2. Critical metal demand for energy transition

Critical metals are produced through **complex mining and refining processes**. Opening a new mine (and significantly scaling production) takes on average **10 to 20 years**. Social and environmental impacts of mining can cause resistance and delays.

The **global annual production** of some metals needs to **increase up to twelve times** towards 2050. And that is for renewable electricity stock only. It requires an **unprecedented** growth of mining activity.



Global critical metal demand for renewable electricity production, in factors of present global annual production (2017 = 1).

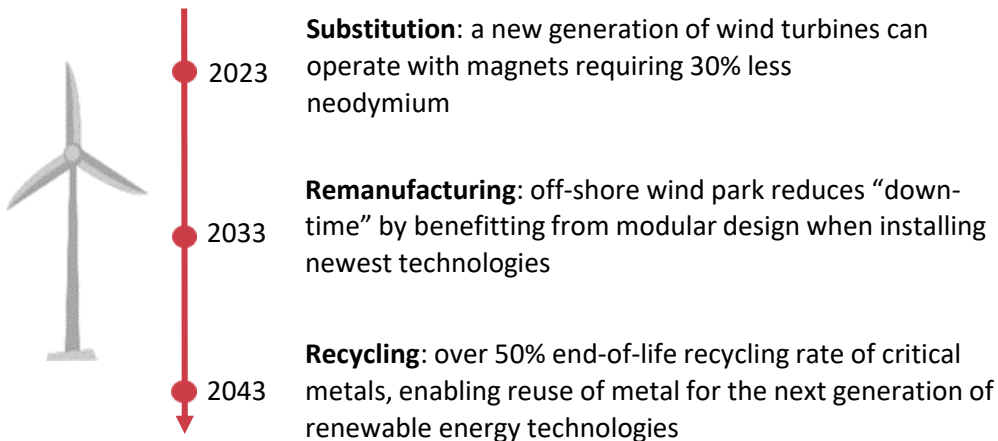
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3. Circular economy strategies

To enable the required growth in renewable electricity production, three strategies are needed:

- **Substitution** of critical metals in renewable electricity stock: critical metal use should be decoupled from capacity growth
- **Circular design strategies** for PV panels and wind turbines: **modular design** to enable future **remanufacturing**
- Clear end-of-life criteria in the building contract enable **higher recycling yields** in the future

Examples of how circular economy strategies can reduce the demand for metals:



4. Follow-up & further reading

Use the **Paris Rulebook**. Authorities should make sure that metal markets can supply renewable energy stock manufacturing, using current free market principles.

Political leaders across the world should **use the leverage** they have. They can demand **circular strategies** when procuring and permitting renewable energy capital stock.

Two studies that have explored the demand for critical metals in the energy transition, are shown in the textboxes below.

Metabolic, Copper8 and Leiden University have specified the critical metal need for the case of the Netherlands.

www.copper8.com



TNO and HCSS have looked at the global need for critical materials, required for the energy transition.

www.tno.nl/en

