

How does the circular economy help to transform the energy system in a resource-efficient way?
Sofia Haas
25.01.2024

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**Research creates knowledge
knowledge creates practice**

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- In cooperation**
 - Joint Research Projects
 - Demonstration, Implementation & Living Labs
 - Accompanying Research
- We offer**
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 - Training & Guidance

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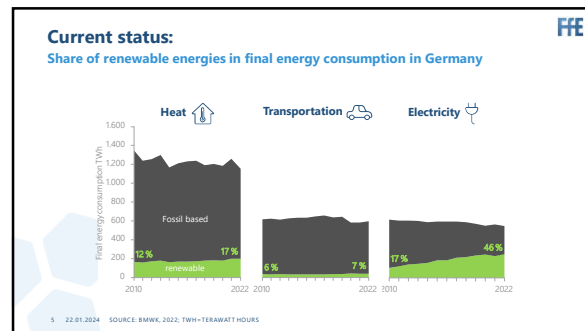
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Competence and versatility in the energy system
Topics of the FFE

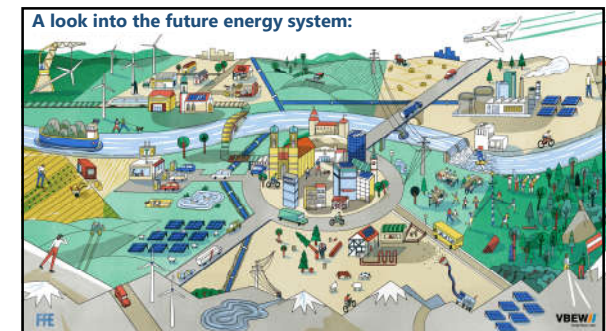
- Heating
- Digitalization
- Industry
- Mobility
- Hydrogen & Synfuels
- Renewable Energies
- Energy Markets
- Resource & Climate Protection
- Grids

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Necessary weekly (!) expansion In Germany from 2022 to 2045

FFE

- PV systems on 345 soccer pitches and ~1,050 buildings
- 17 Onshore- (each 5.5 MW) and 5 Offshore-plants (each 11 MW)
- Replacement of 11,800 fossil fuel heating systems with renewable systems
- Replacement of 36,000 fossil passenger cars with alternative drive systems
- Installation of 9 large-scale battery storage units, 10 MWh each (~36 shipping containers)
- Installation of electrolyzers with a total capacity of approx. 60 MW (~90 shipping containers)

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Materials for the energy transition Both bulk materials and critical raw materials are needed

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- Bulk materials:**
 - Copper, glass, silicon, silver, steel, aluminum, ...
 - Steel, copper, coolant, plastic, ...
 - Lithium, Aluminium, Kupfer, Graphit, Kobalt, Nickel, ...
- Critical raw materials:**
 - Concrete, steel, composites, molybdenum, neodymium, ...
 - Lithium, aluminum, copper, graphite, cobalt, nickel, ...
 - Titanium, aluminum, copper, zirconium, nickel, chrome, ...

8 22.01.2024 SOURCES: DEIRA 2021; CARRARA ET AL. 2020; Ecoinvent

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Growing importance of the Life-Cycle perspective Shift from fossil to renewable energy leads to more environmental impacts in the upstream and downstream chains

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Material production → Manufacturing → Sales and distribution → Use → End-of-life

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And how can these emissions be reduced? The circular economy closes material cycles

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- Circular Design**
- Lifetime Extension**
- Resource Recovery**

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Exemplary Circular Economy approaches Circular design for photovoltaics

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- Reduce**
 - Reduction of bulk materials (glass, aluminum, silicon)
 - Avoidance of production waste
- Refuse:**
 - Avoidance of emission-intensive, toxic materials such as fluorine or lead in the backsheet
- Rethink**
 - Intensification of use, e.g. through product-service-systems/contracting

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Exemplary Circular Economy approaches Lifetime extension of Batteries

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- Repair**
 - different methods to restore the performance of a battery's electrodes
 - E.g. solid-phase sintering to renew the lithium coating of the cathode
- Reuse**
 - Second-Life Application: Reuse of batteries from electric vehicles for stationary applications

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Exemplary Circular Economy approaches

Resource recovery of Wind Turbines

Recycle

- Technically, it is possible to reprocess e.g. Steel, aluminium and copper
- Challenge: Recycling of composite materials

Recover

- Energy recovery of materials

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A holistic approach to create a sustainable future

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