

# Resource-Efficient Pathways towards Greenhouse-Gas-Neutrality - RESCUE

## Background

Already today, four out of nine planetary boundaries have been surpassed (climate change, biogeochemical cycles (phosphorus and nitrogen), land-system change, and biosphere integrity). Global greenhouse gas (GHG) emissions continue to rise despite the implementation of various climate protection measures. In 2017, fossil GHG-emissions were with 37 Gigatons (Gt) about 63 % above 1990 levels. Furthermore, global materials extraction has accelerated in the last decades to ca. 90 Gt in 2017 (a fifteen-fold increase compared to 1900). The **RESCUE-study** analyzes possible transformation pathways towards a GHG-neutral and resource-efficient Germany in 2050.

## Integrated view and scenarios

In RESCUE, ambitious climate protection and materials management are being considered together across all economic sectors (Figure 1), to quantify the demand for raw materials (i.e., fossil fuels, metals, non-metallic minerals and biomass) associated with a GHG-neutral Germany until 2050.

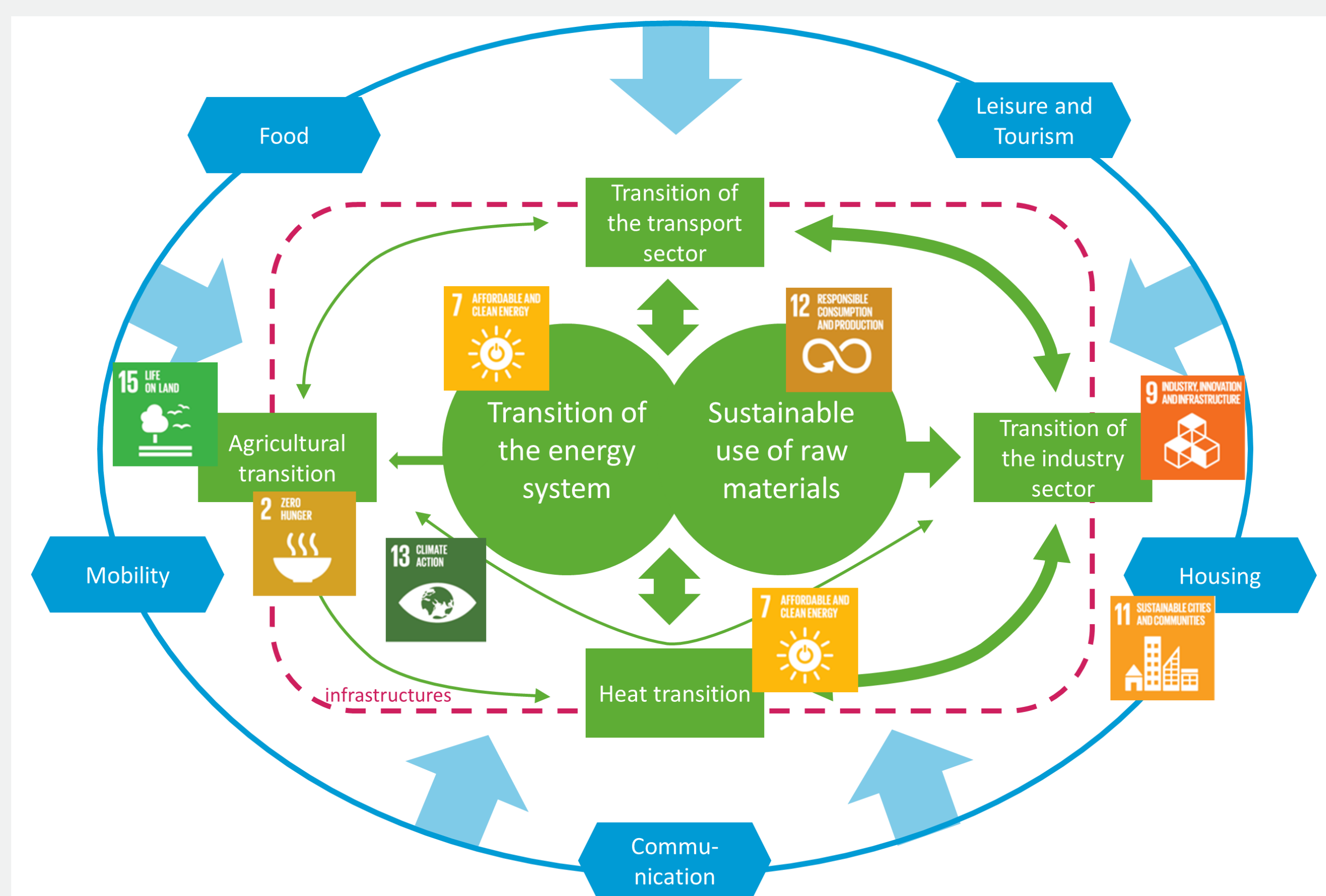


Figure 1. Integrated view across all sectors and UN Sustainable Development Goals addressed.

This is done via **six scenarios** which show possible development paths for Germany **from 2010 until 2050**. These examine the effect of **energy-efficiency** (GreenEe, GreenLate), **materials-efficiency** and product lifetimes (GreenMe), **lifestyle changes** (GreenLife), and **economic growth** (GreenSupreme) on GHG-emissions and materials demands. All scenarios have in common that a transformation towards **100 % renewable energy** (electricity, fuels, and chemical feedstocks) takes place until 2050 without the use of carbon capture and storage (CCS) and nuclear power.

## Results

In all scenarios, the overall GHG-mitigation target for 2030 of the German Climate Action Plan is reached. By 2050, GHG-reductions of 95 % in GreenLate and 97 % in GreenSupreme are achieved which considers the GHG-emissions accounted for in the climate targets of the German Federal Government (Figure 2). Through sustainable agriculture and forestry management (i.e., natural sinks), **GreenLife and GreenSupreme achieve net zero emissions in 2050** and even GreenLate comes close to this goal. **Raw materials consumption**

(RMC) can be reduced by 56 % (GreenLate) to 70% (GreenSupreme) compared to 2010 through a combination of measures targeting energy efficiency, recycling, material substitution, use of innovative materials, and sustainable lifestyles (Figure 3). However, the demand for certain metals (e.g., cobalt and lithium) central for renewable energy and electric vehicles is expected to increase.

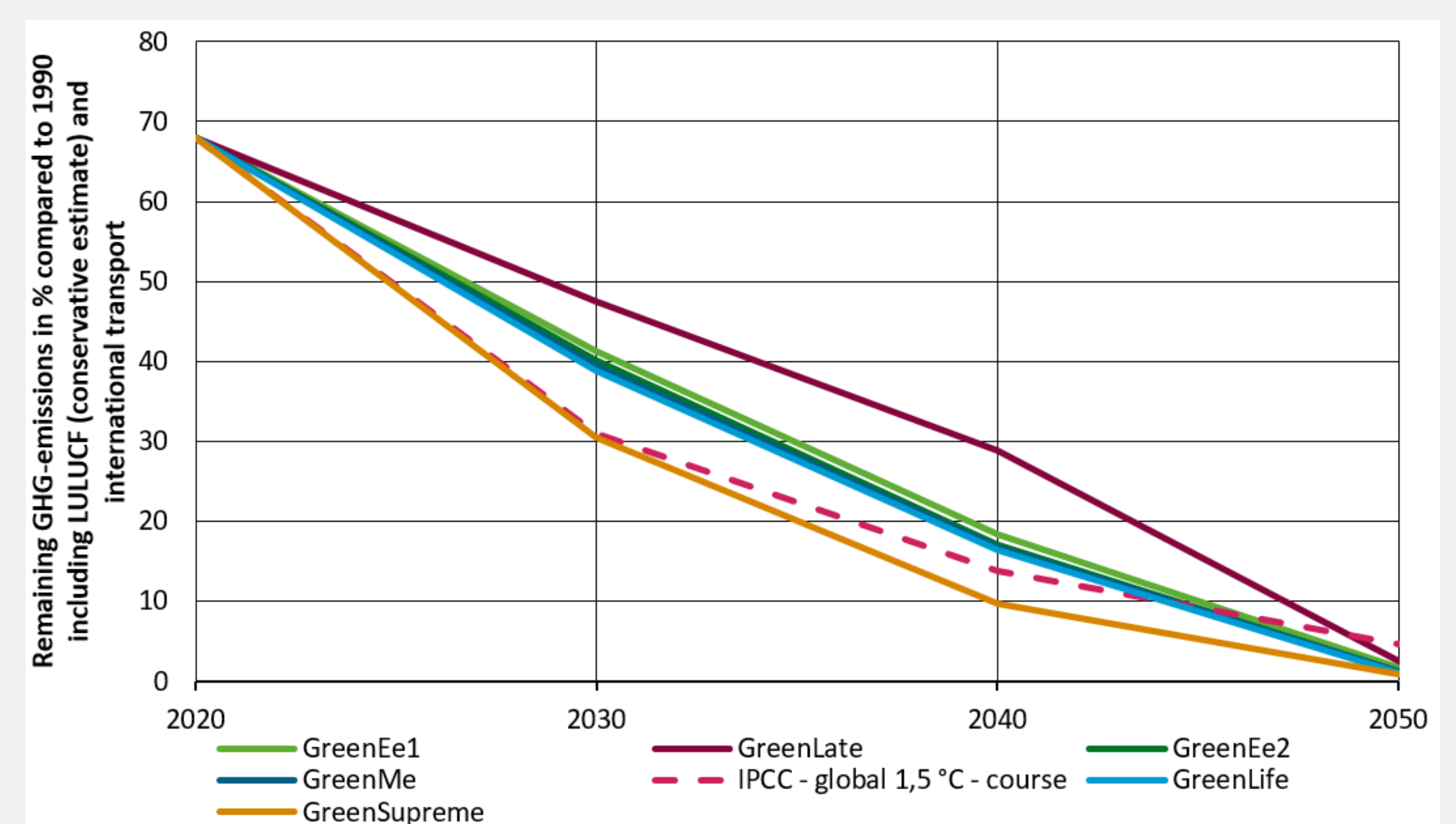


Figure 2. Greenhouse gas (GHG) reductions in RESCUE compared to an IPCC (Intergovernmental Panel on Climate Change) global 1.5°C path.

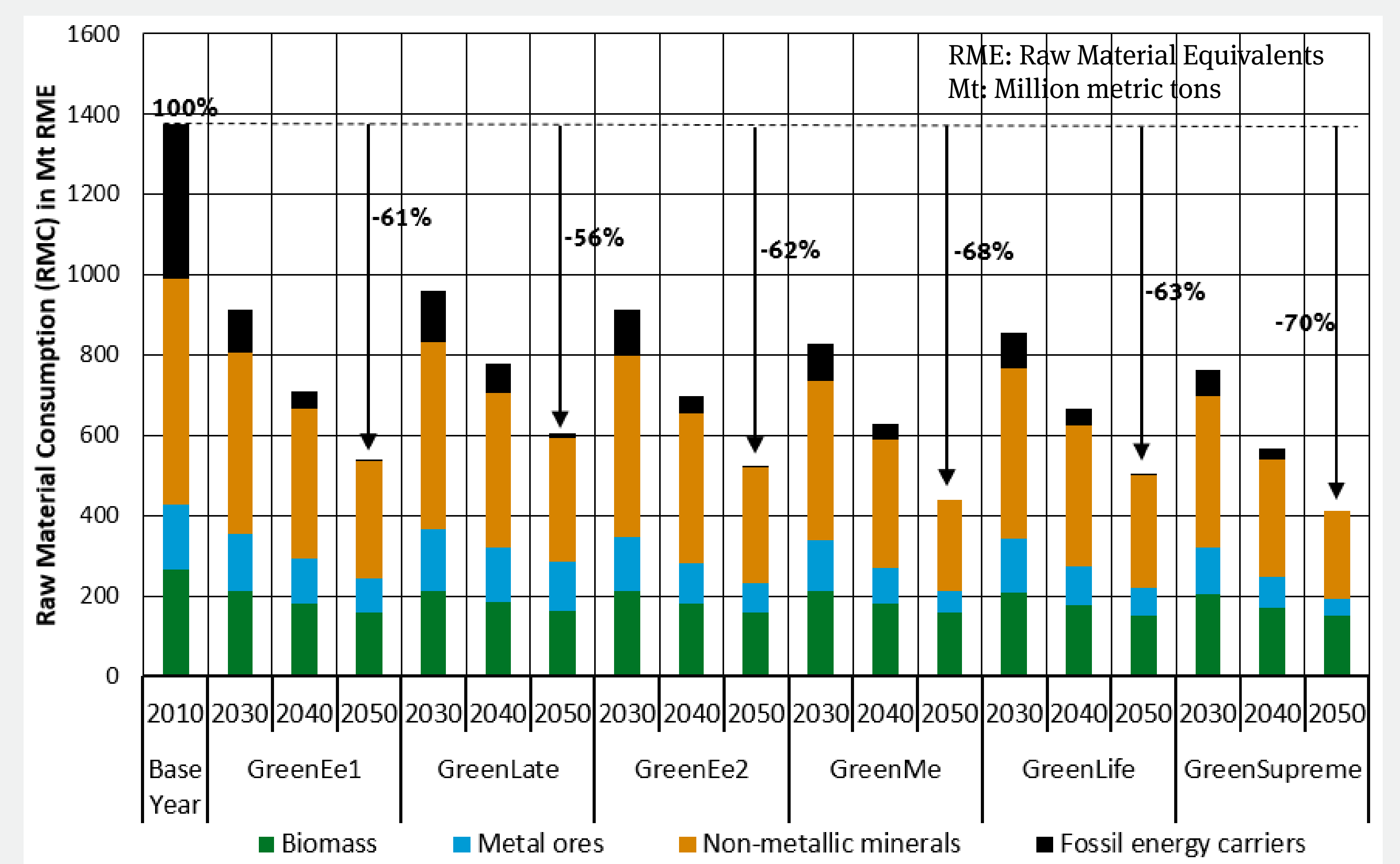


Figure 3. Raw materials consumption (RMC) reductions in RESCUE.

In conclusion, the results of the RESCUE study highlight that **ambitious efforts both at national and international level, as well as enhanced international cooperation similar to the story line of the GreenSupreme scenario, are necessary in order to limit global warming to 1.5 °C above pre-industrial levels, and to achieve a globally more equitable use of raw materials.**

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