# Future projection of greenhouse gas emissions associated with metal production based on shared socio-economic pathways

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## Introduction

- Reduction in global greenhouse gas (GHG) emissions of 78-118% by 2100 compared with 2010 are required (RCP2.6)
- Metal production is one of main contributors for GHG emissions (accounts for 10% of global GHG emissions)
- Decoupling the metal demand and associated GHG emissions from economic growth is essential for sustainable development

✓ Project GHG emissions associated with future global metal production for the five SSPs
✓ Explore influential factors for reducing future GHG emissions in metal cycles

Analysis for six metals (Al, Cu, Fe, Pb, Ni, Zn)

## Methods

### ● Future primary/secondary metal production

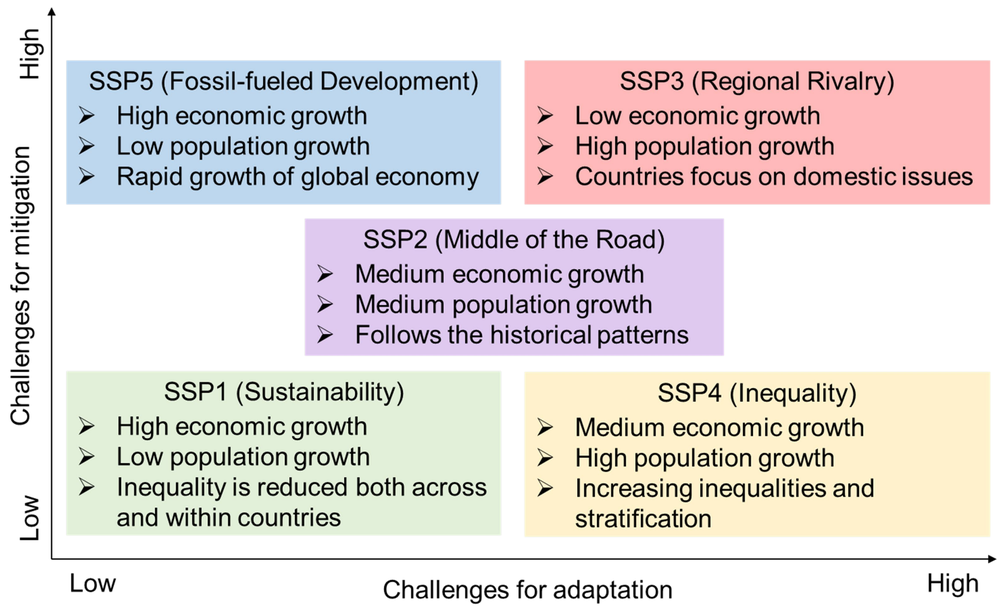
- **Historical in-use metal stocks** are modeled with a logistic curve
- **Future metal demands** are estimated based on future population and economic growth for the SSPs
- **Future primary/secondary metal production** are estimated by using dynamic material flow analysis (MFA)

### ● Future GHG emissions from metal production

- **GHG emission intensities** for primary/secondary metal production are estimated based on previous studies and energy mix for the SSPs
- **GHG emission** is calculated by multiplying future primary/secondary metal production with the GHG emission intensities
- **Explore influential factors** for reducing future GHG emissions by varying parameters associated with metal cycles

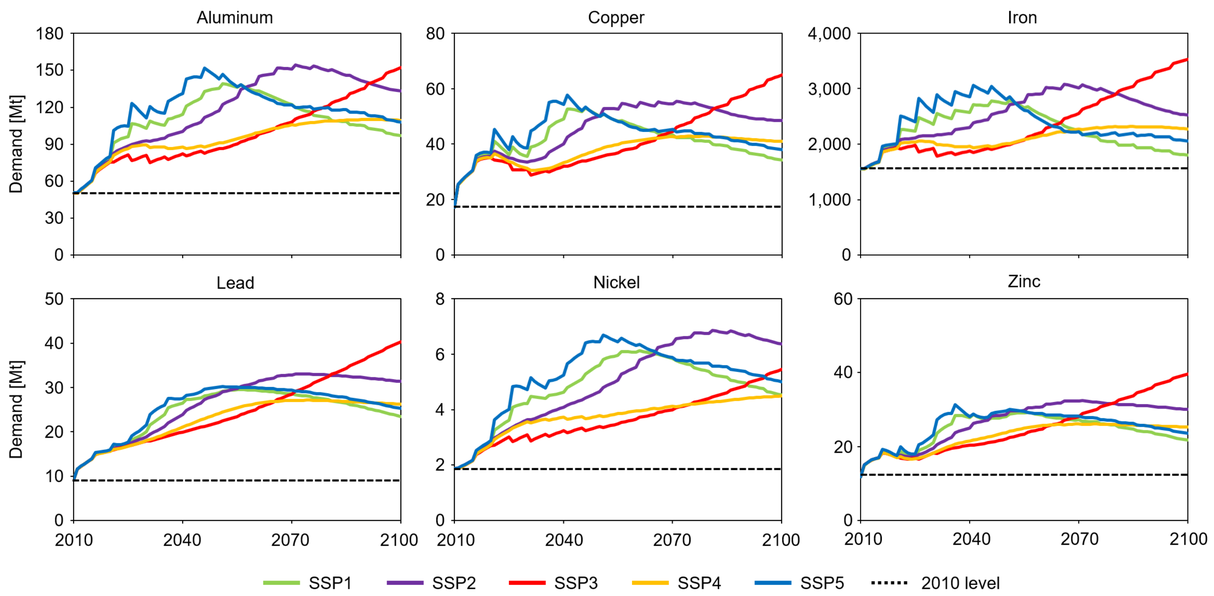
### ● Shared socio-economic pathways (SSPs)

- Future scenarios for socio-economic factors including population and economic growth



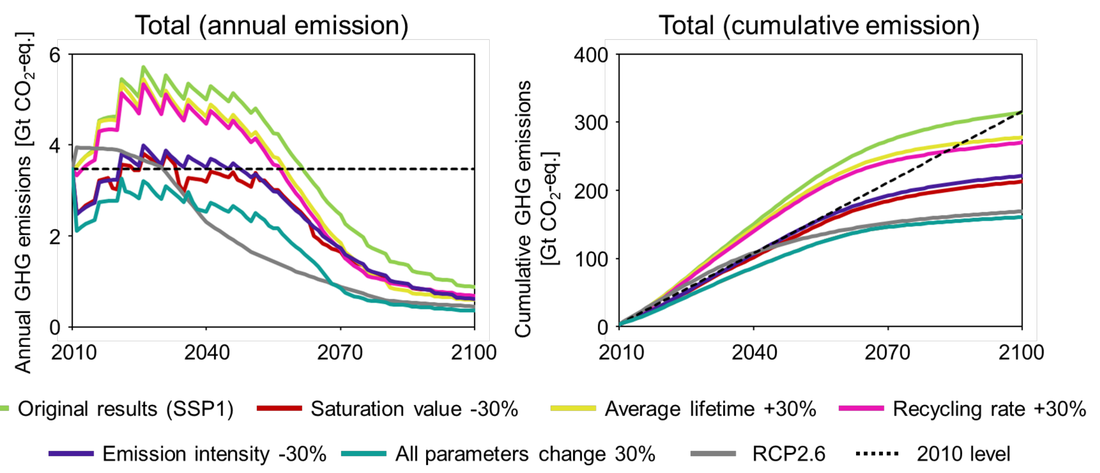

## Results and discussion

### ● Future metal demands for the five SSPs



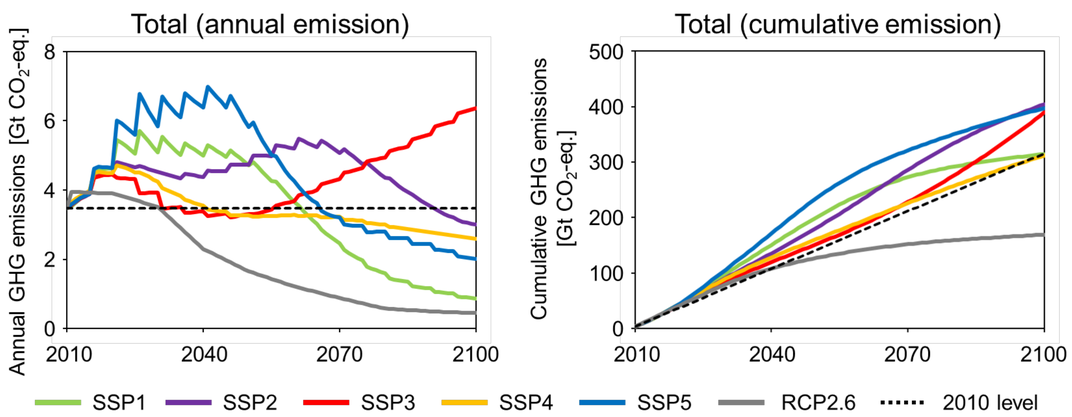

- Future demands of all metals are **larger than the level in 2010**
- Increase in maximum **by 2.3–4.4 times** compared with 2010

### ● Influential parameters for the reduction of GHG




- **Saturation values of in-use metal stocks per capita** and **GHG emission intensities** are influential for both mid-/long-term reduction in cumulative GHG emissions.
- However, improving a single parameter is **insufficient** for achieving the climate goal
- The climate goal can be achieved by **improving all parameters** by 20%

### ● Future GHG emissions from metal production




- Decreases in GHG emissions in the late century are mainly due to **substitution of secondary metal for primary metal**
- SSPs have a great effect on the GHG emissions, but **no SSP can achieve the climate goal** (RCP2.6)
- Further efforts in addition to a sustainable socio-economic pathway are required for the achievement of climate goal

## Conclusions

- For achieving the climate goal in metal production sector, in addition to following the sustainable socio-economic pathway (SSP1), implementing multiple measures immediately with international cooperation is essential.

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