

# 73rd LCA Discussion Forum

21 November 2019

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Institute of Science, Technology & Policy

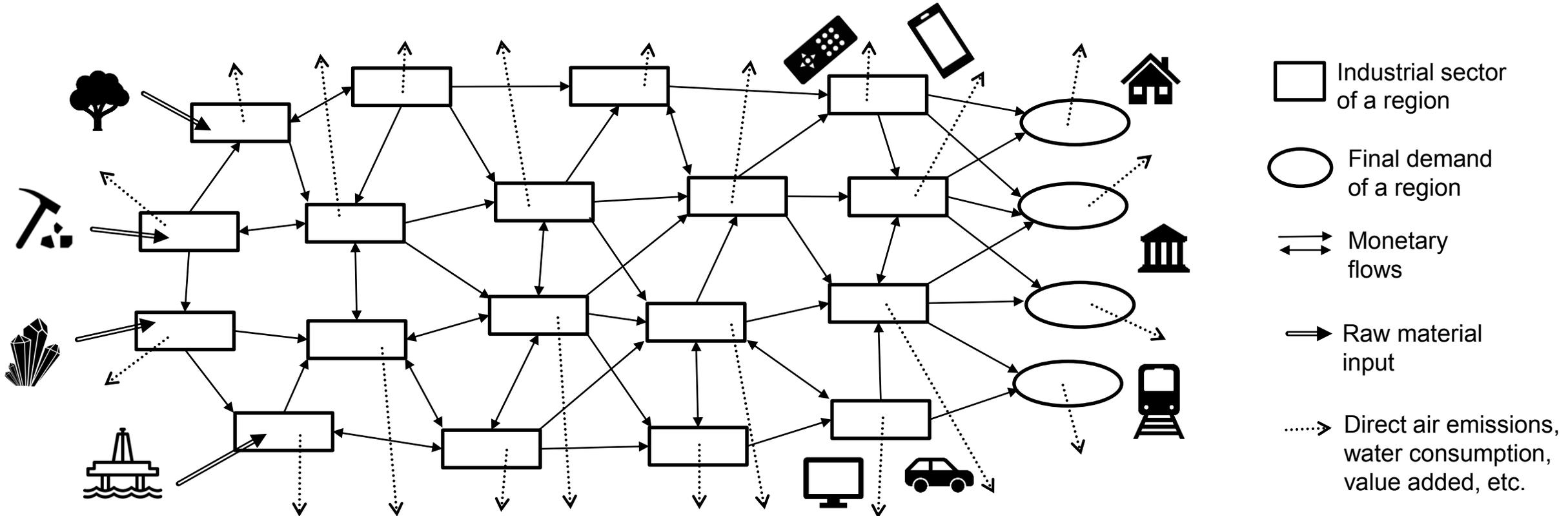


## Global supply chain analysis of material-related impacts in ICT (MRIO approach)

## Questions:

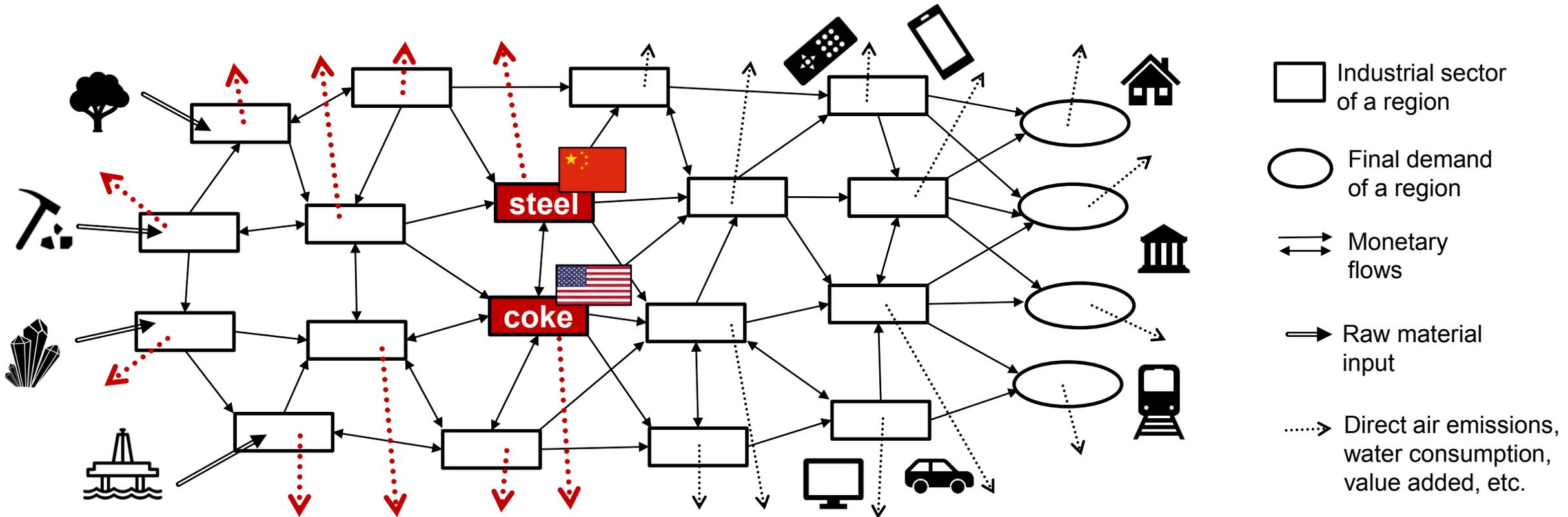
- Why are materials important in ICT?
- What are key materials?
- Where on globe are the material-related impacts caused?
- Which regions consume ICT?
- What is the role of trade?
- Has trade changed over time?
- How does Switzerland compare to the global average?
- How to reduce material-related impacts in Swiss ICT?

# How does my method work?



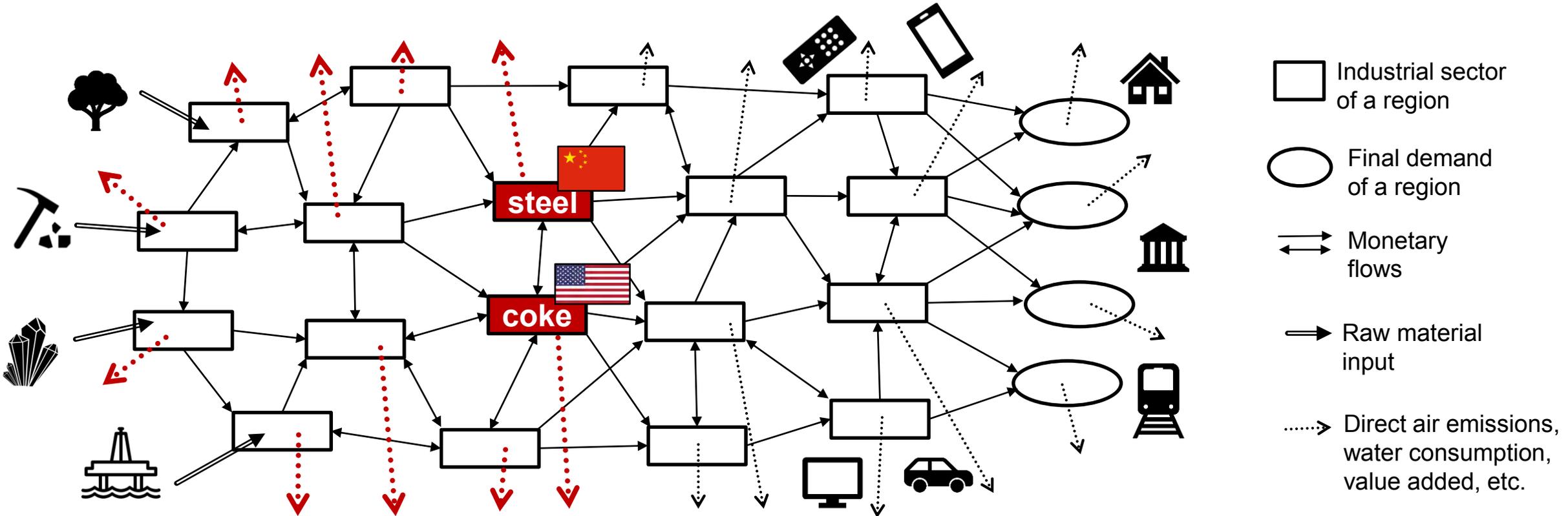
MULTI-REGIONAL INPUT-OUTPUT ANALYSIS (MRIO):  
simplified example

# 1. Assess the cumulated upstream impacts of target-sector-regions without double counting

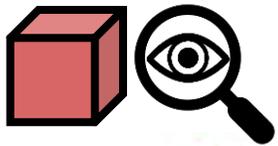


MULTI-REGIONAL INPUT-OUTPUT ANALYSIS (MRIO):  
simplified example

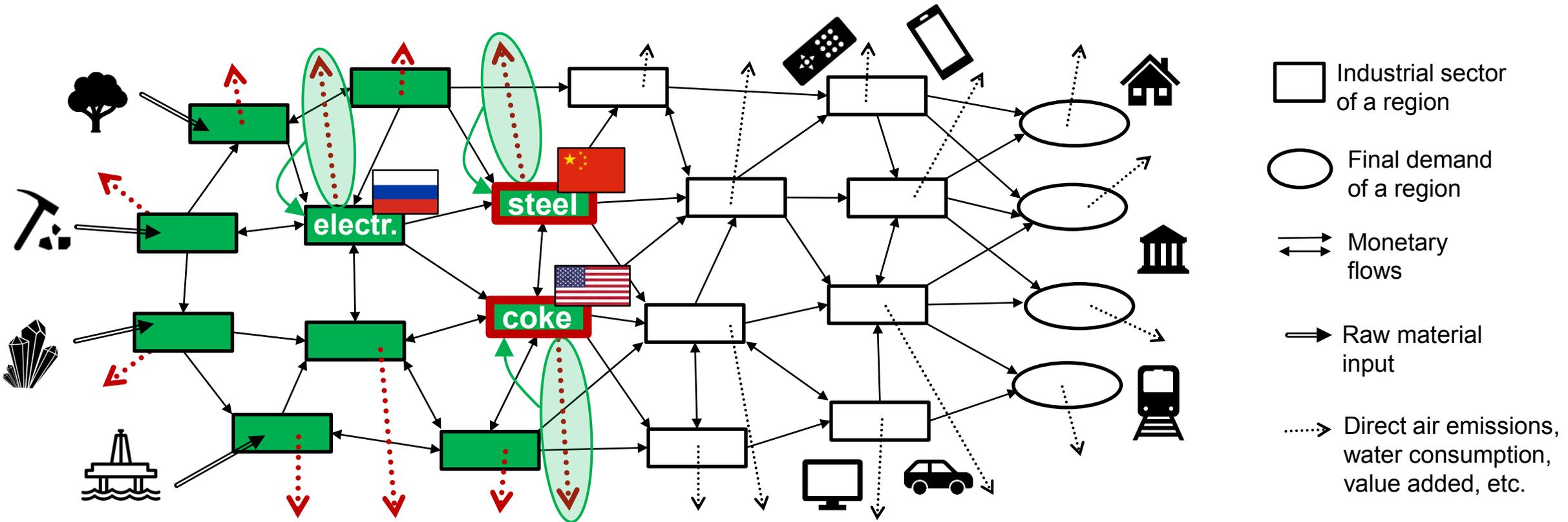
## 2. Track the **cumulated upstream impacts of target-sector-regions without double counting** along several steps of the global value chain



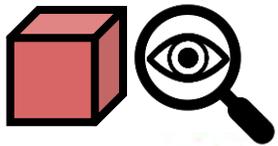
### PERSPECTIVES:



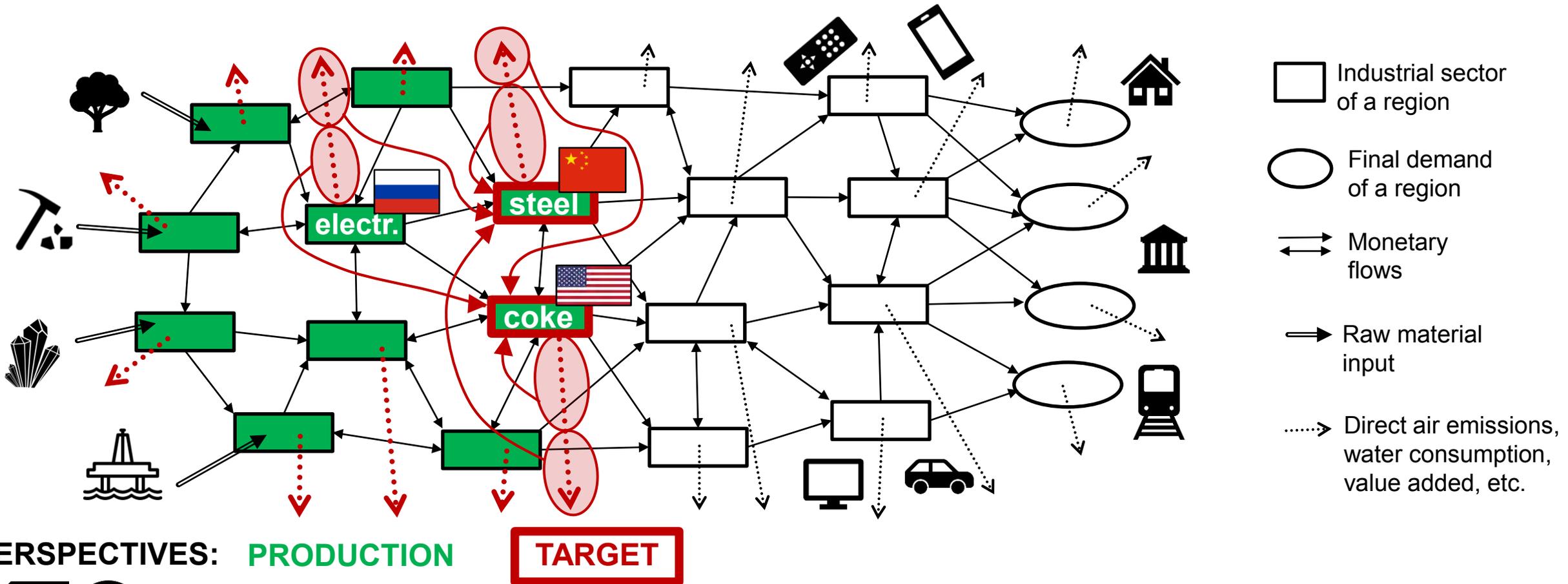
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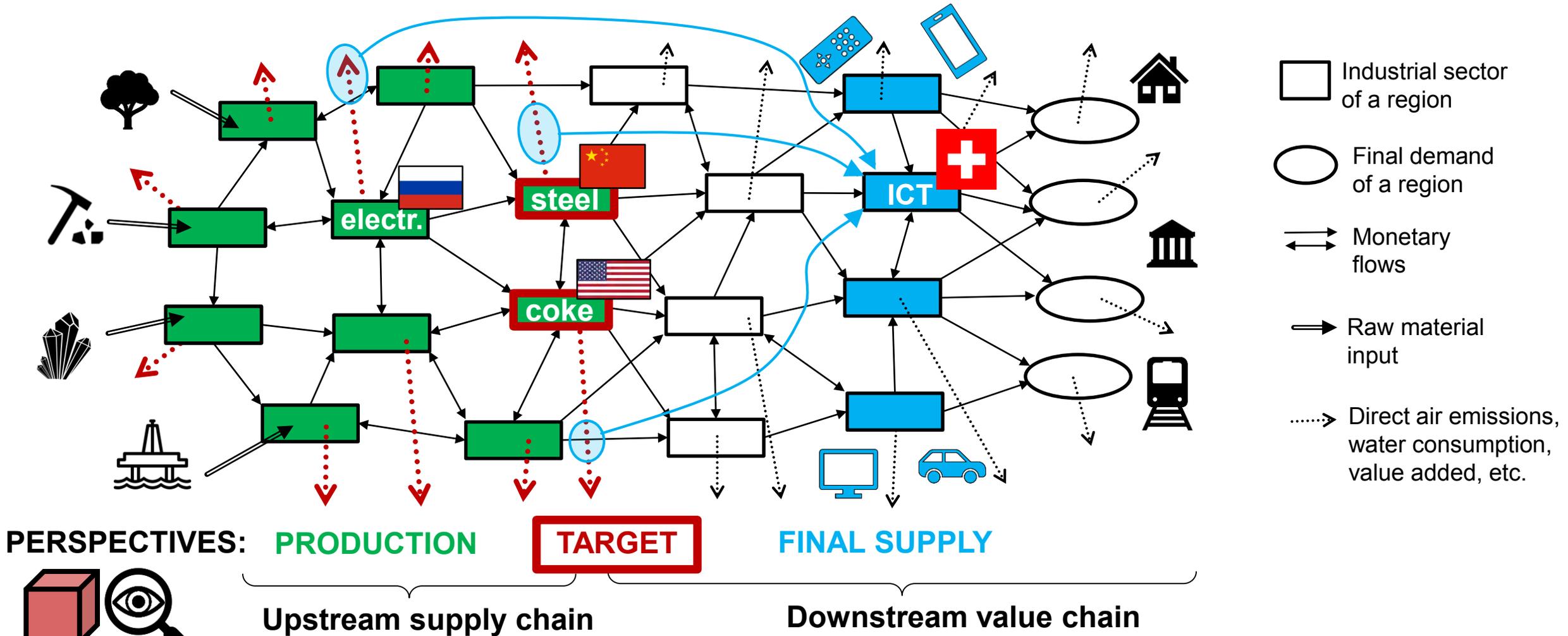
PERSPECTIVES: **PRODUCTION**



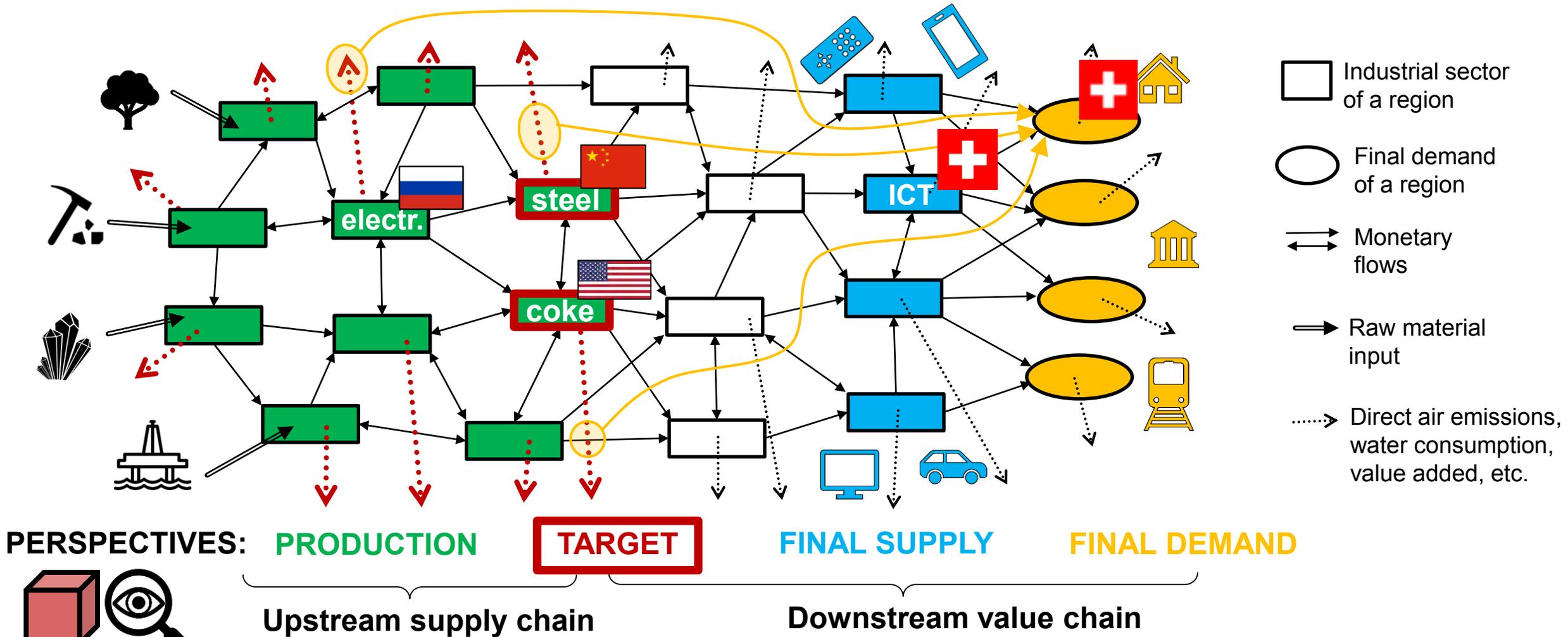
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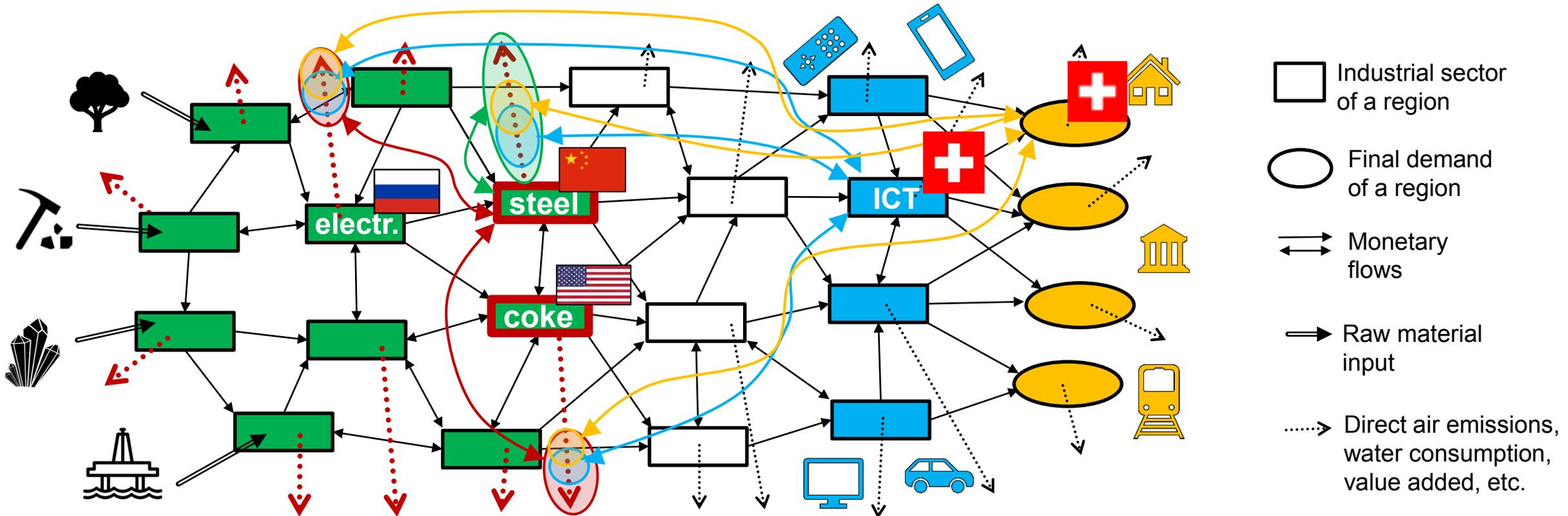
## 2. Track the **cumulated upstream impacts of target-sector-regions without double counting** along several steps of the global value chain



## 2. Track the **cumulated upstream impacts of target-sector-regions without double counting** along several steps of the global value chain



### 3. Evaluate the linkages in the global supply chain to identify the leverages

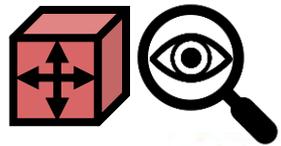


-  Industrial sector of a region
-  Final demand of a region
-  Monetary flows
-  Raw material input
-  Direct air emissions, water consumption, value added, etc.

LINKAGES: **PRODUCTION** ↔ **TARGET** ↔ **FINAL SUPPLY** ↔ **FINAL DEMAND**

Upstream supply chain

Downstream value chain



# Application to EXIOBASE3



Science of The Total Environment  
Available online 5 May 2019  
In Press, Accepted Manuscript



A new method for analyzing sustainability performance of global supply chains and its application to material resources ☆

Livia Cabernard, Stephan Pfister, Stefanie Hellweg

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<https://doi.org/10.1016/j.scitotenv.2019.04.434>  
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- EXIOBASE3: 163 industrial sectors x 49 regions
- Set of (regionalized) environmental and socio-economic indicators
  - Climate change impacts
  - PM health impacts
  - Water stress
  - Land-use rel. Biodiversity loss
  - ...
  - Compensation of Employment
  - Taxes
  - Workforce
  - ....
- Method provided as a tool:  
→ Open access: <http://dx.doi.org/10.17632/nddmgkm3cc.2>

Mendeley Reference Management | Research Network | **Datasets** | Careers | Funding

Find Research Data | My Datasets | New Dataset | FAQ

**A new method for analyzing sustainability performance of global supply chains and its application to material resources**

Published: 11 May 2019 | Version 1 | DOI: 10.17632/nddmgkm3cc.1  
Contributor(s): Livia Cabernard, Stephan Pfister, Stefanie Hellweg

Description of this data

OVERALL DESCRIPTION:  
We share here the data compiled to calculate the results presented in the study «A new method for analyzing sustainability performance of global supply chains and its application to material resources». In order to allow for the compilation of all results of interest, we provide a matlab tool. The tool is based on the multi-regional-input output

Latest version

**Version 1** | 2019-05-11  
Published: 2019-05-11  
DOI: 10.17632/nddmgkm3cc.1

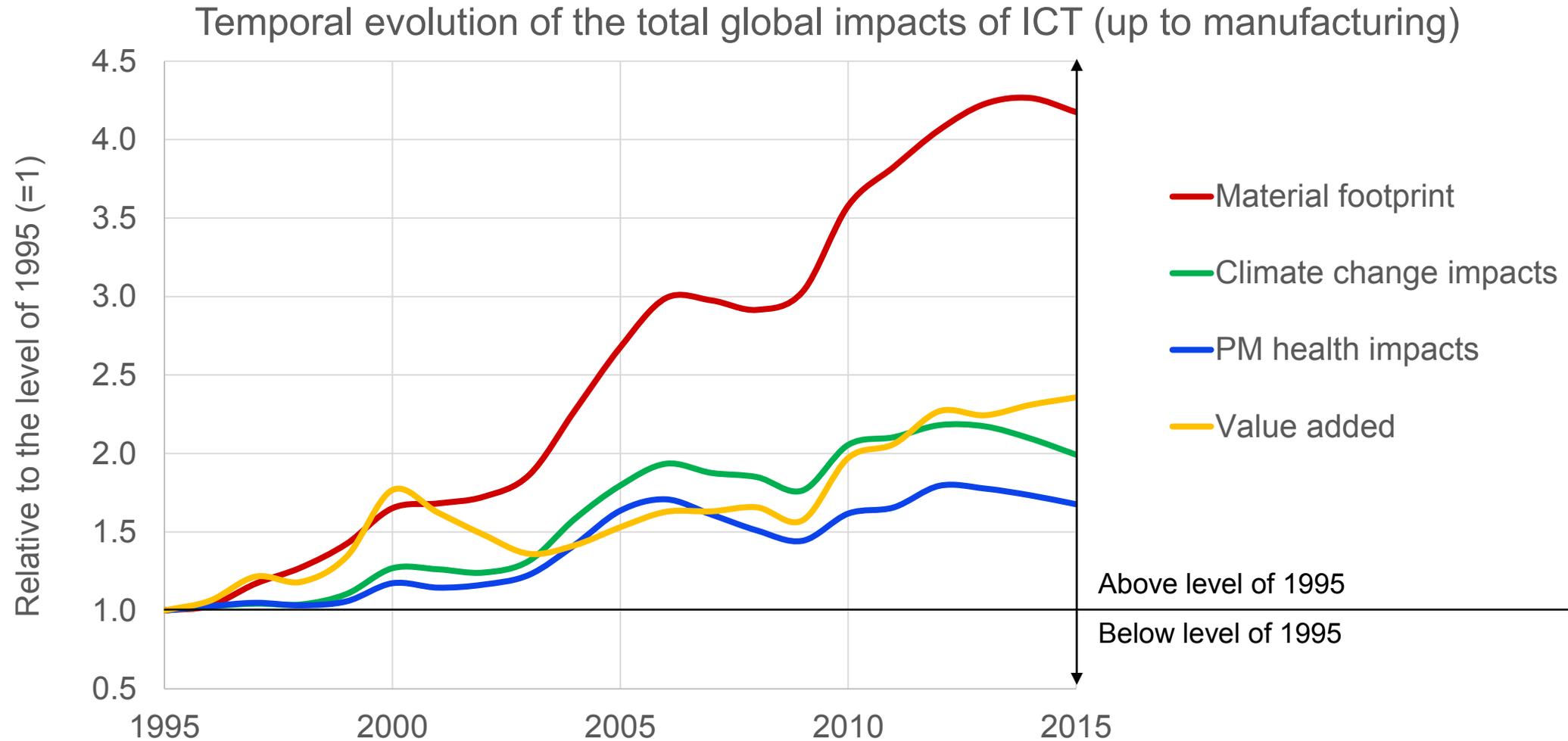


## NATURAL RESOURCE USE IN THE GROUP OF 20

Status, trends, and solutions

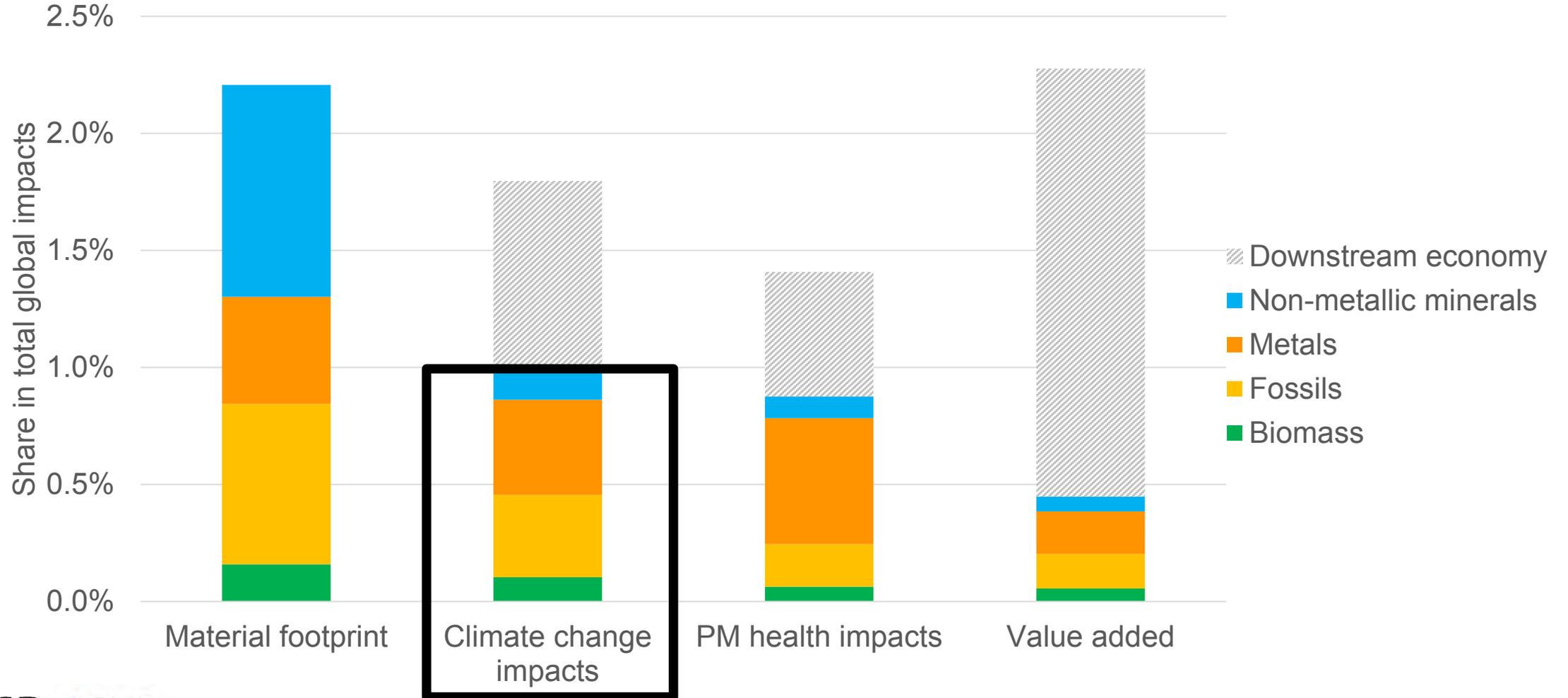


# Why are materials important in ICT?

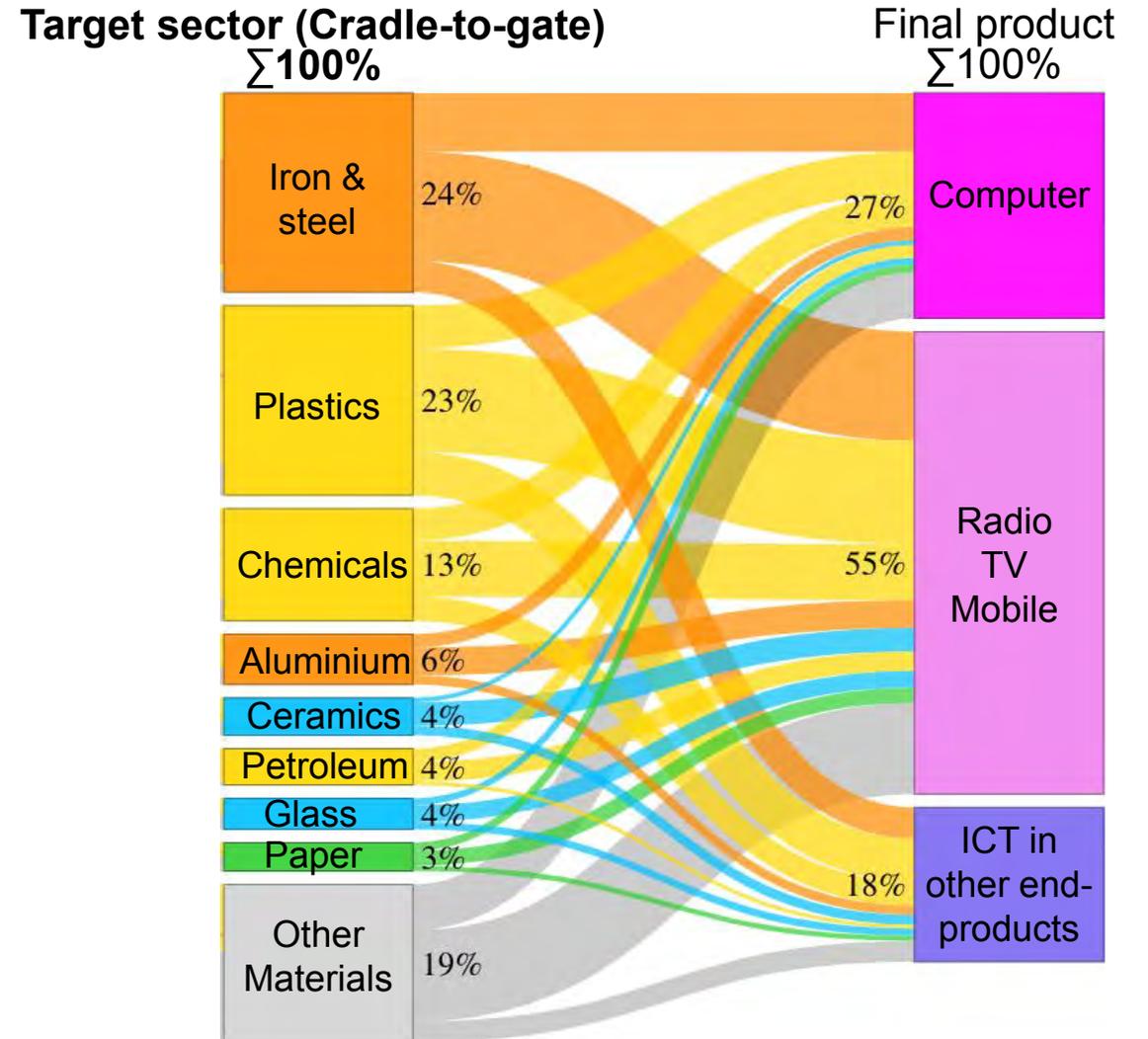


# Why are materials important in ICT?

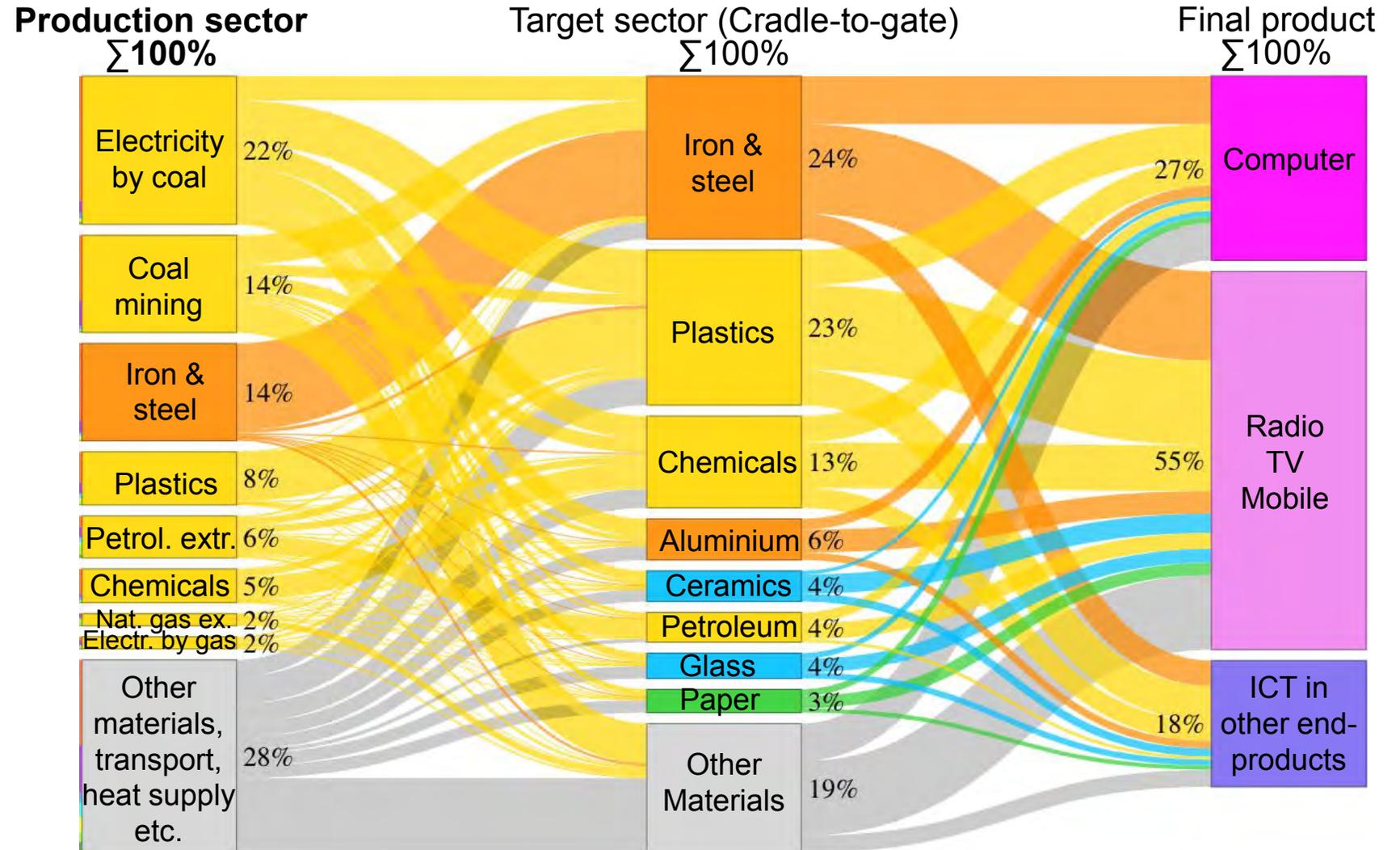
Global share of ICT and the contribution of material production (Year 2015)



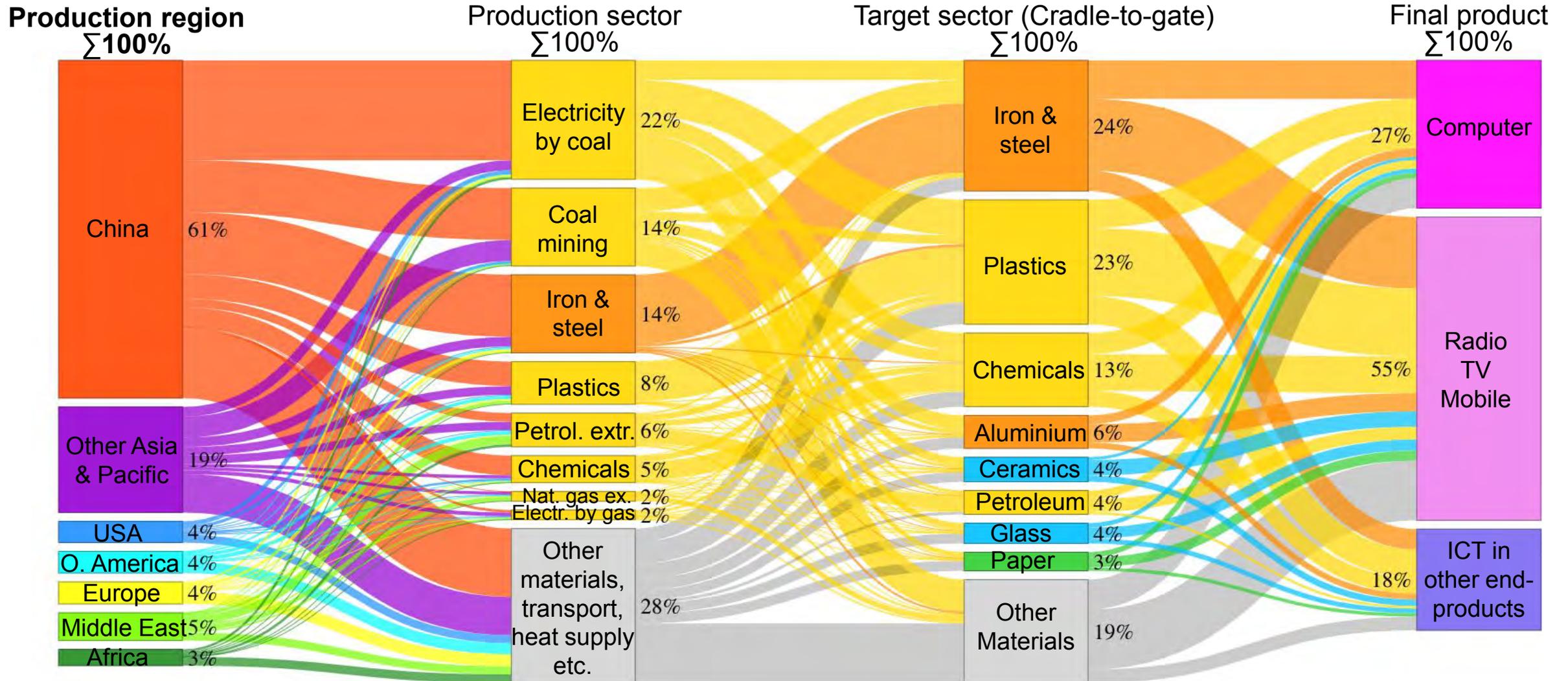
# What are the key materials in ICT causing climate change impacts? (Year 2015)



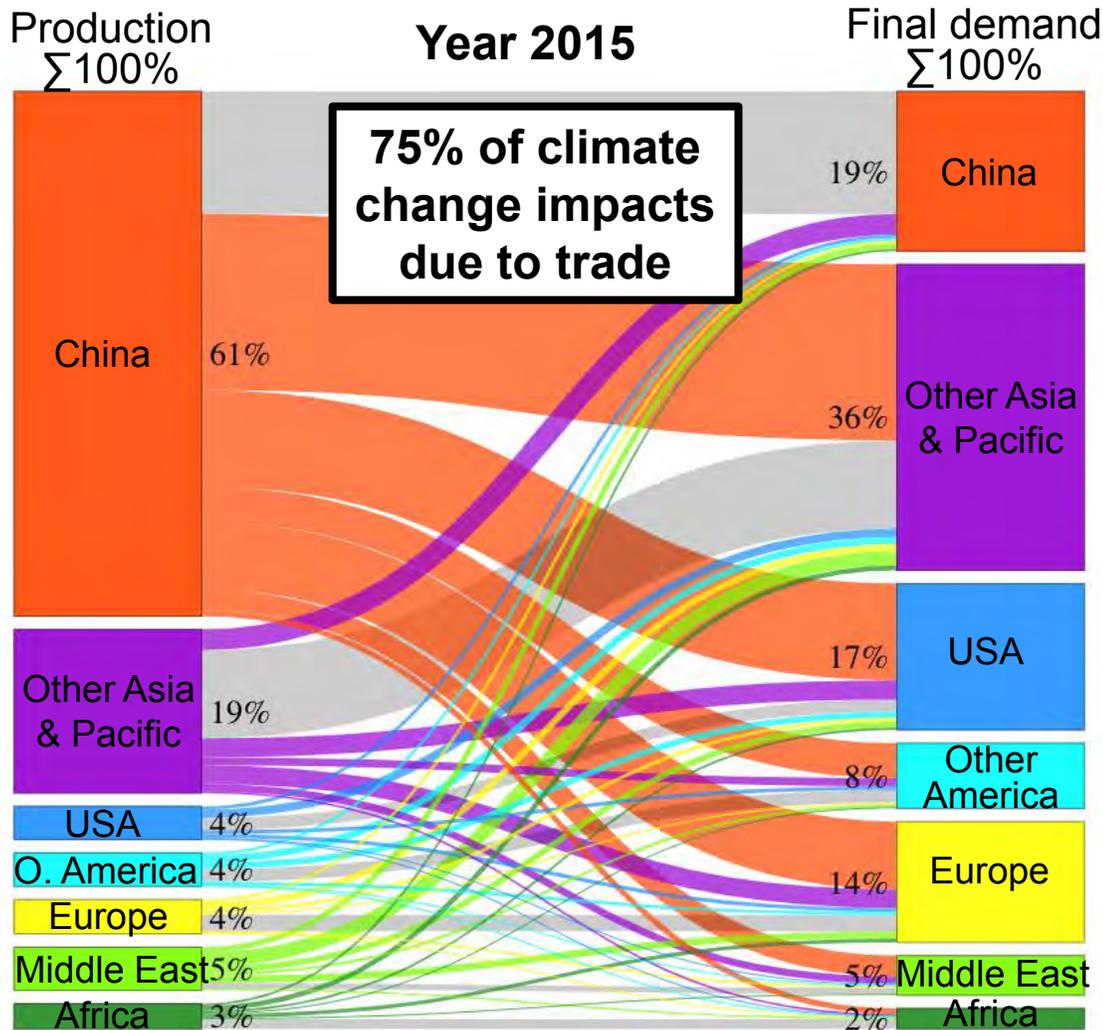
# Which industrial sectors emit the GHGs directly? (Year 2015)



# In which regions are the climate change impacts caused? (Year 2015)

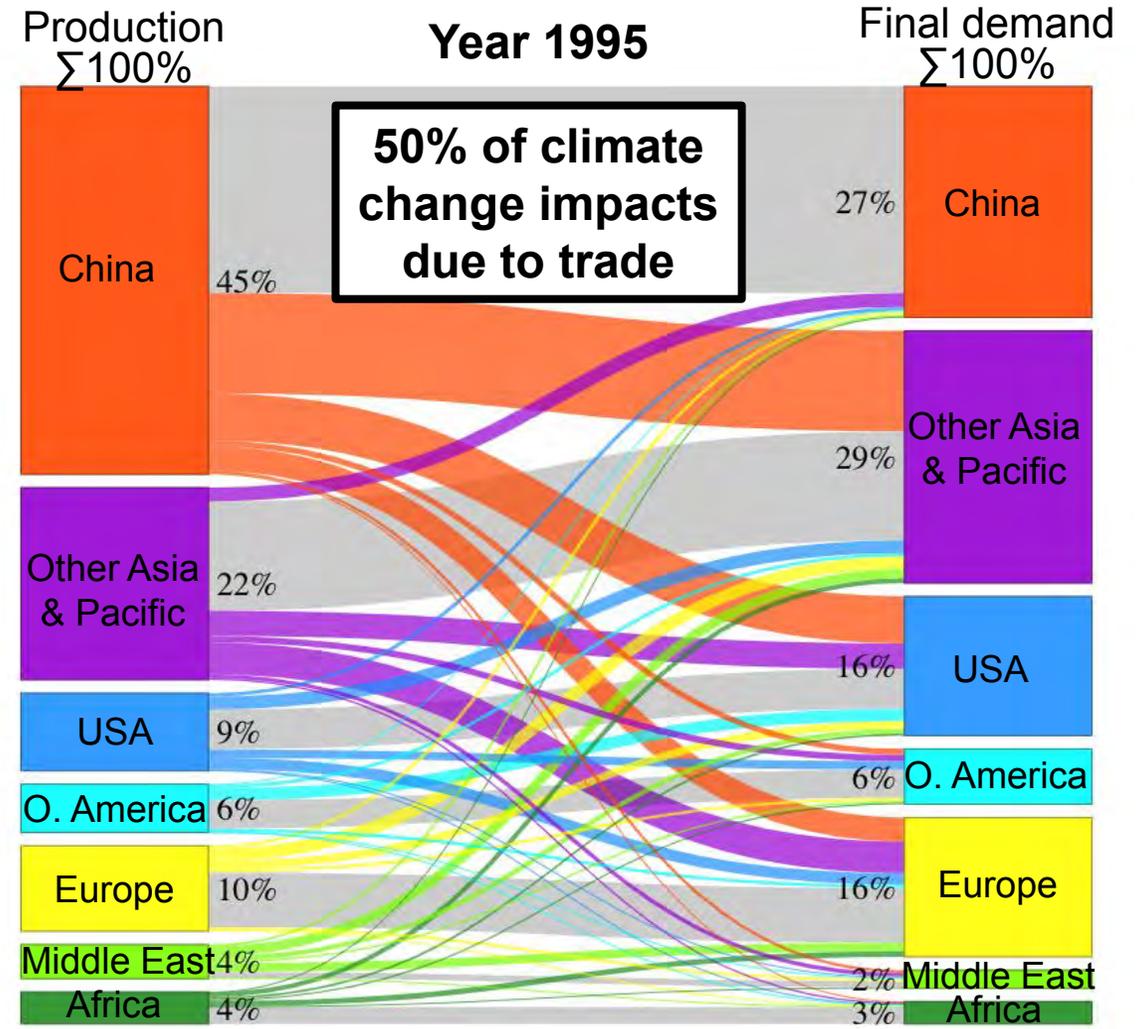
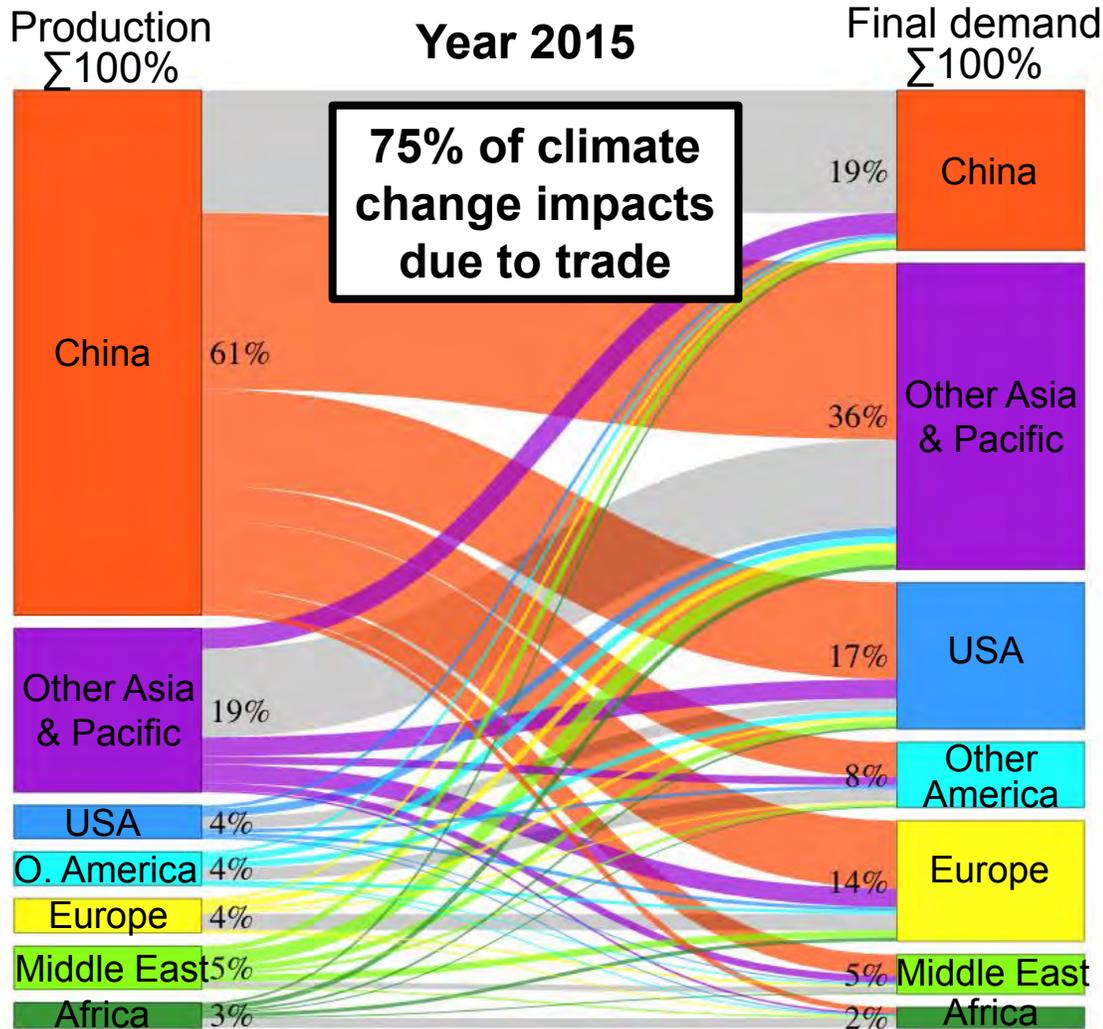


# What is the role of trade for material-rel. climate change impacts in ICT?

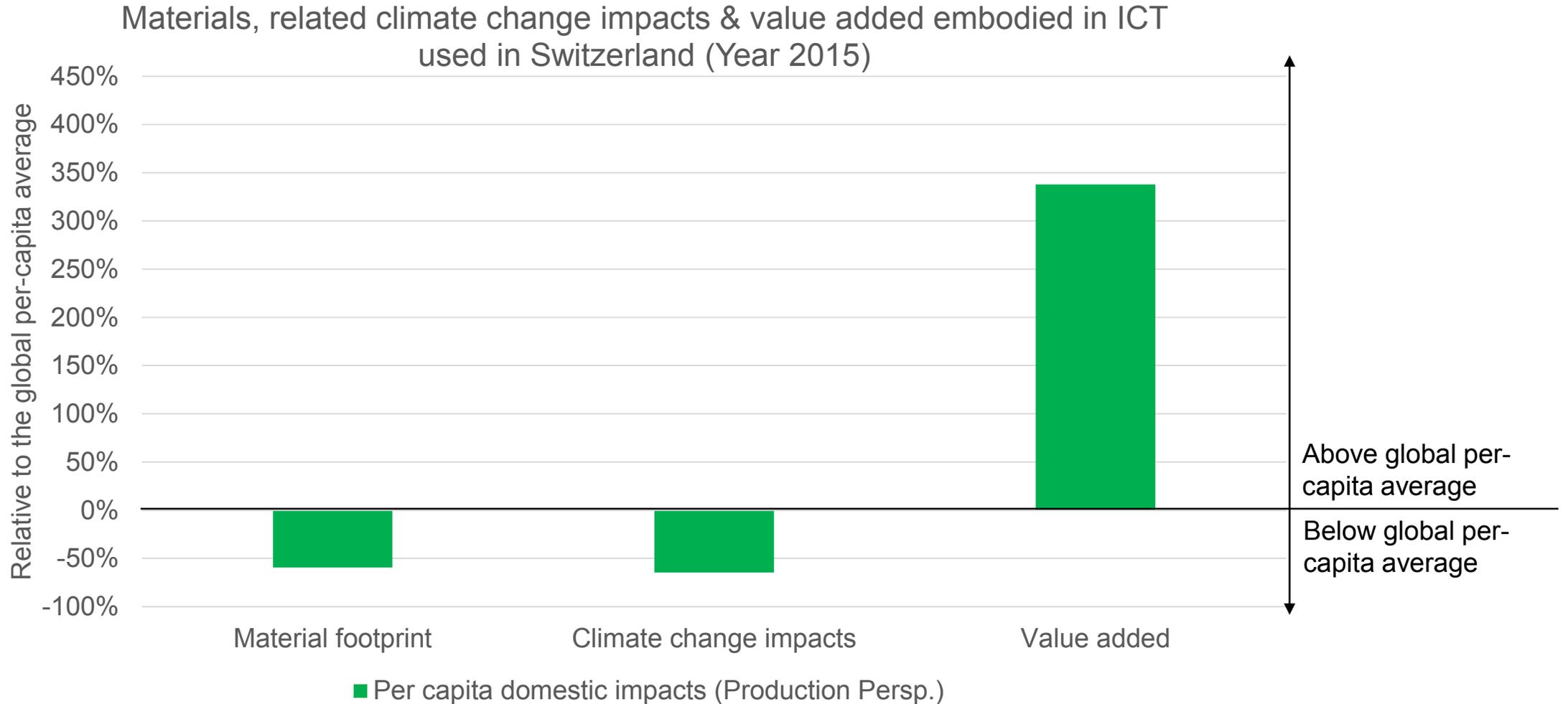


Grey flows: domestic  
Colored flows: trade

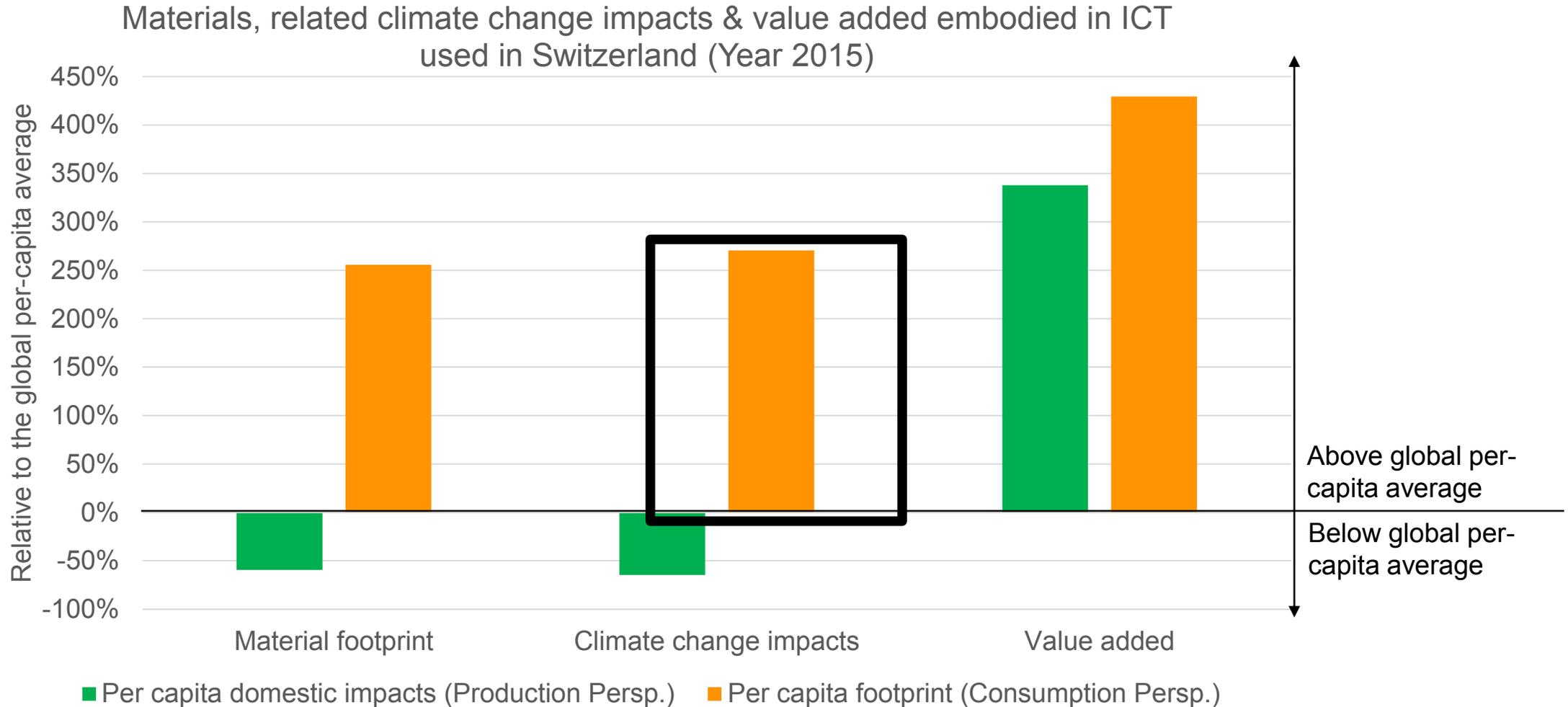
# Have trade pattern changed over the past 20 years?



# How does Switzerland compare to the global average?

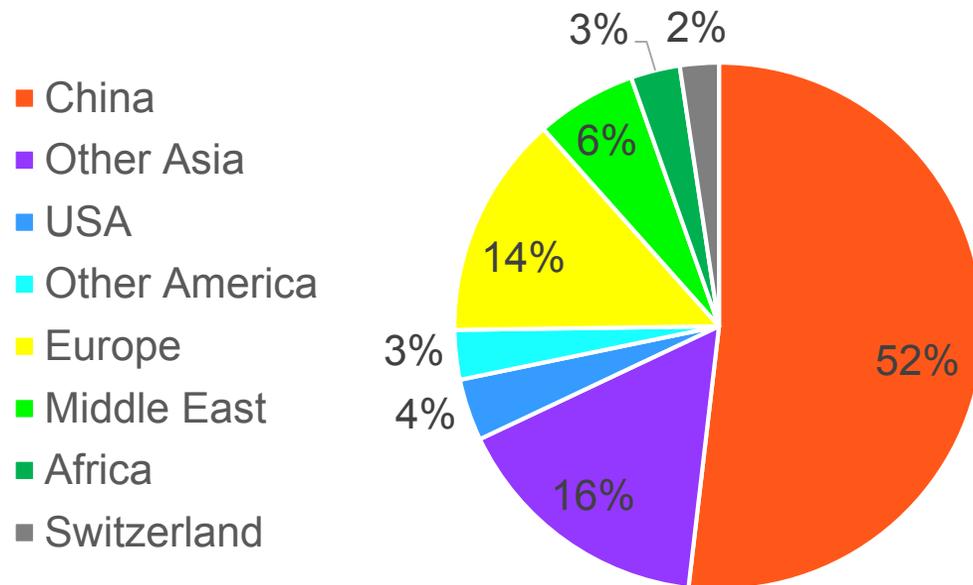


# How does Switzerland compare to the global average?

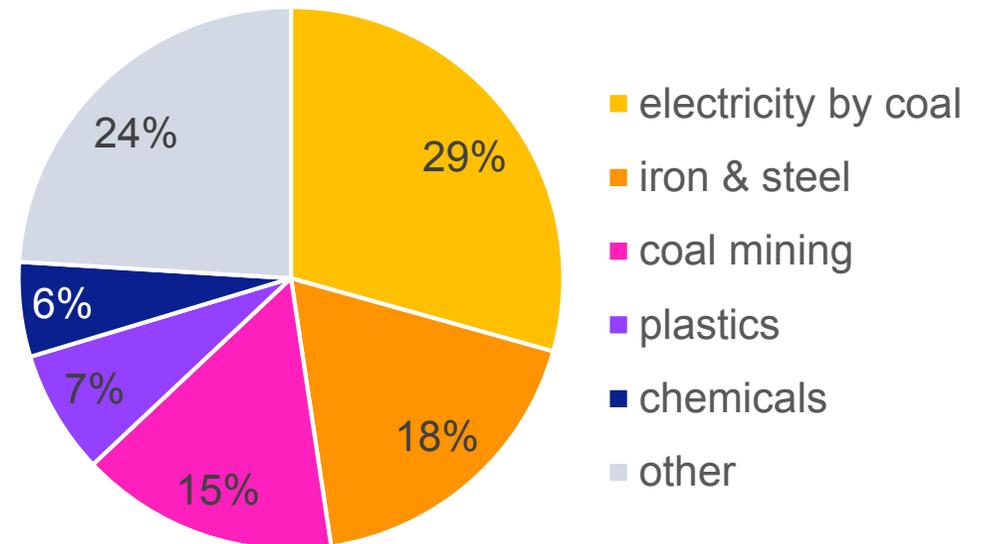


# How to reduce material-related climate change impacts in Swiss ICT?

In which region are the impacts caused?



In which sector in China are the impacts caused?



# Conclusions & Outlook

- ICT relevant on a global scale (increasing trend, almost 2% of global climate change impacts)
- Materials in ICT are important (increasing trend , 60% of climate change impacts of ICT)
- Key materials: Iron & steel, plastics & chemicals
- In the upstream chain: coal mining & electricity in China
- Increasing role of trade and outsourcing to China
- Improved supply chain management essential
- Tool for in depth-analysis:
- <http://dx.doi.org/10.17632/nddmgkm3cc.2>
- Limitations:
  - Limited resolution in sectors (163) and regions (49)
  - Impacts of use of ICT unknown

The screenshot shows the Mendeley interface for a dataset. The title is "A new method for analyzing sustainability performance of global supply chains and its application to material resources". It was published on 11 May 2019, Version 1, with a DOI of 10.17632/nddmgkm3cc.1. The contributors are Livia Cabernard, Stephan Pfister, and Stefanie Hellweg. The page includes a description of the data and a table of versions.

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OVERALL DESCRIPTION: We share here the data compiled to calculate the results presented in the study «A new method for analyzing sustainability performance of global supply chains and its application to material resources». In order to allow for the compilation of all results of interest, we provide a matlab tool. The tool is based on the multi-regional-input output		<b>Version 1</b> 2019-05-11 Published: 2019-05-11 DOI: 10.17632/nddmgkm3cc.1

**Many thanks for the attention!**

Tool: <http://dx.doi.org/10.17632/nddmgkm3cc.2>

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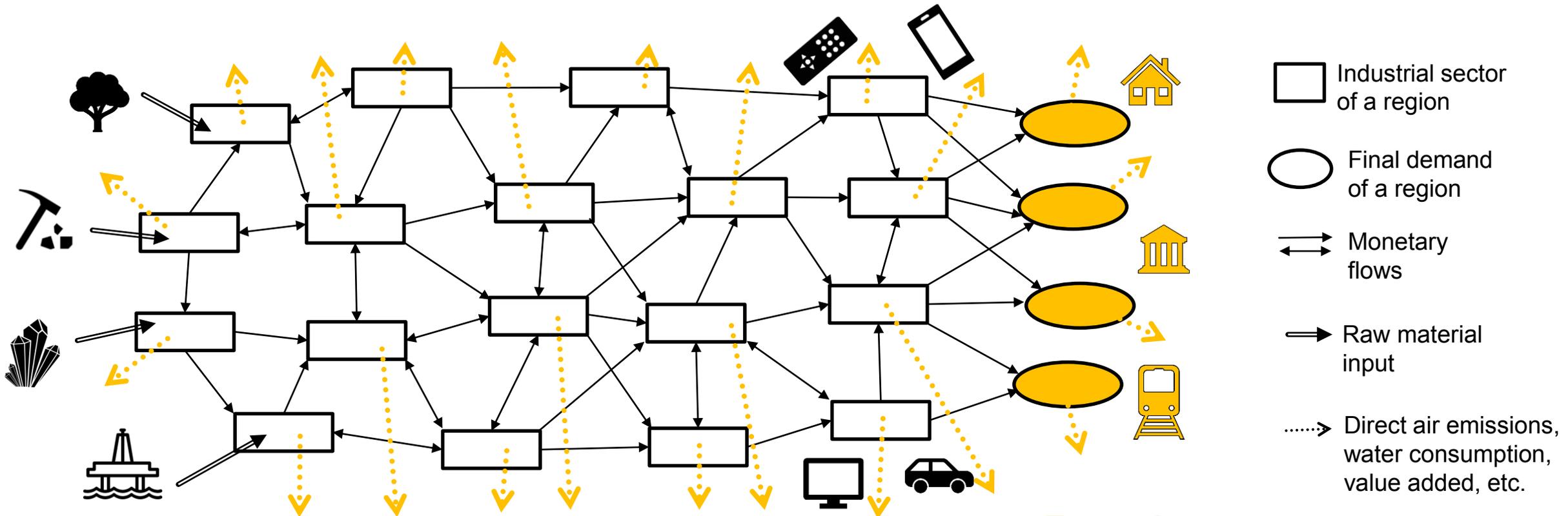
Global Resource Outlook:

<http://www.resourcepanel.org/reports/global-resources-outlook>

G20 factsheets: <https://www.resourcepanel.org/reports/natural-resource-use-group-20>

Contact: [livia.cabernard@istp.ethz.ch](mailto:livia.cabernard@istp.ethz.ch)

# Previous studies

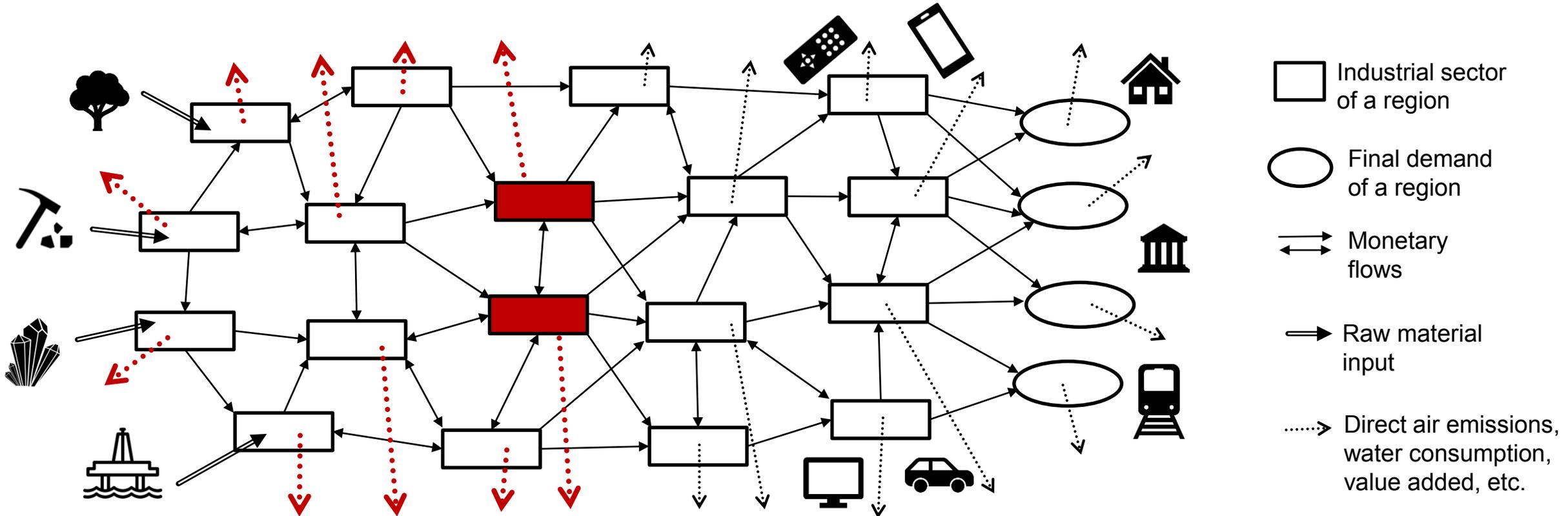


-  Industrial sector of a region
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**Footprints of regions**

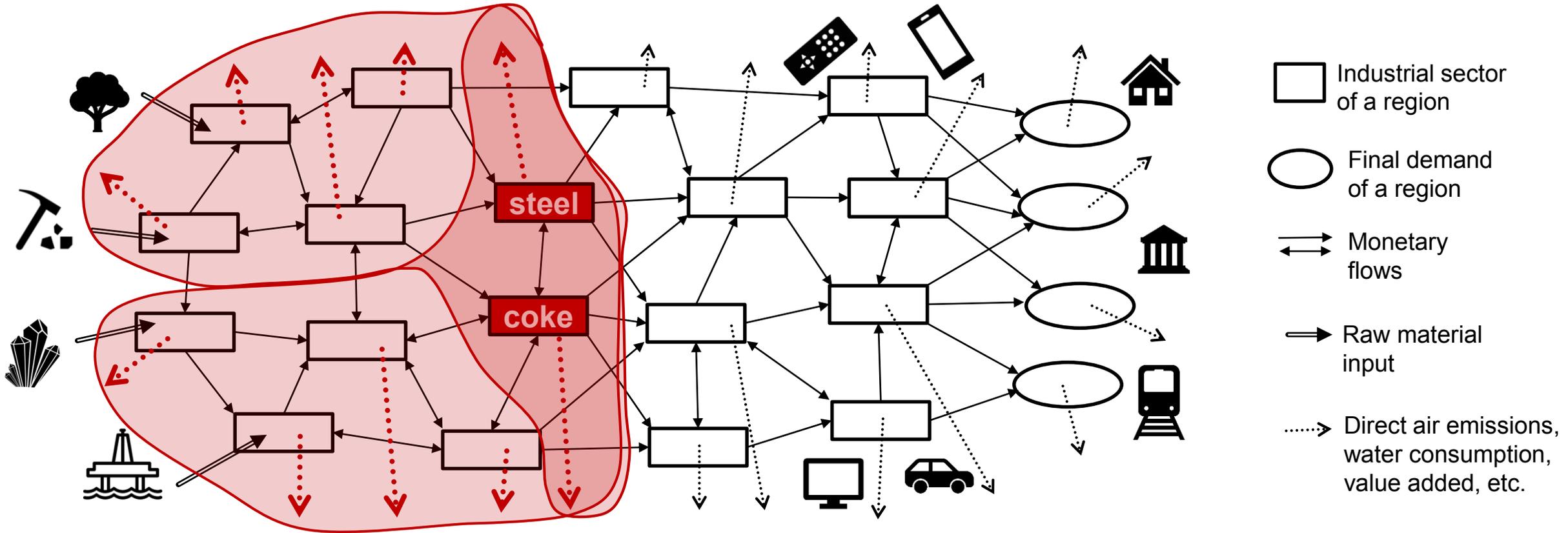
MULTI-REGIONAL INPUT-OUTPUT ANALYSIS (MRIO):  
simplified example

# Previous limitations



**Cumulated upstream impacts of intermediate sectors → Issue of double counting**

# Previous limitations



**Cumulated upstream impacts of intermediate sectors → Issue of double counting**

# INTERFACE

## Matlab Tool to Analyze Sustainability Performance along the Global Value Chain

### 1) Make your Settings (press command to select several items)

#### Target-Sectors

Biomass extraction: Cultivation of paddy rice  
Biomass extraction: Cultivation of wheat  
Biomass extraction: Cultivation of cereal grains nec  
Biomass extraction: Cultivation of vegetables & fruit and nuts  
Biomass extraction: Cultivation of oil seeds  
Biomass extraction: Cultivation of sugar cane and sugar beet  
Biomass extraction: Cultivation of plant-based fibers  
Biomass extraction: Cultivation of crops nec  
Biomass extraction: Cattle farming

#### Target-Regions

Africa: South Africa  
Africa: RoW Africa  
Australia: Australia  
China: China  
China: Taiwan  
Europe: Austria  
Europe: Belgium  
Europe: Bulgaria  
Europe: Czech Republic

#### Environmental (E) & Socioeconomic (S) Indicators

E: Material footprint (kt)\*  
E: Unused material footprint (kt)  
E: Climate change impacts: total (kg CO2-eq)\*  
E: CO2-related climate change impacts (kg CO2-eq)  
E: CH4-related climate change impacts (kg CO2-eq)  
E: N2O-related climate change impacts (kg CO2-eq)  
E: HFC-related climate change impacts (kg CO2-eq)  
E: PFC-related climate change impacts (kg CO2-eq)  
E: Particulate-matter rel. health impacts: total (DALYs)\*

#### Years

1995  
1996  
1997  
1998  
1999  
2000  
2001  
2002  
2003

#### Which results do you want to display?

Single Perspectives (one table for each year and indicator): Production (Sectors & Regions)  
Single Perspectives (one table for each year and indicator): Target (Sectors & Regions)  
Single Perspectives (one table for each year and indicator): Final Supply (Sectors & Regions)  
Single Perspectives (one table for each year and indicator): Final Demand (Categories & Regions)  
Linkages (one table for each year and indicator): All linkages between Production and Target\*\*  
Linkages (one table for each year and indicator): All linkages between Target and Final Supply\*\*  
Linkages (one table for each year and indicator): All linkages between Target and Final Demand\*\*  
Linkages (one table for each year and indicator): All linkages between Production and Final Demand\*\*  
Linkages (one table for each year and indicator): Sectoral linkages between Production and Target

#### How to display your results?

In the unit of the resp. indicator  
As shares in total global impacts

2) Insert the name of your folder where the results will be stored

3) Start Calculation (Press Button)

Progress:

# INTERFACE

→ Application to global material production

## Target-Sectors

Biomass extraction: Cultivation of paddy rice  
Biomass extraction: Cultivation of wheat  
Biomass extraction: Cultivation of vegetables & fruit and nuts  
Biomass extraction: Cultivation of oil seeds  
Biomass extraction: Cultivation of crops nec  
Biomass extraction: Cattle farming

Chose between 163 industrial sectors  
→ 75 material sectors

## Target-Regions

Africa: South Africa  
Africa: RoW Africa  
Australia: Australia  
China: China  
China: Taiwan  
Europe: Austria  
Europe: Bulgaria  
Europe: Hungary  
Europe: Czech Republic

Choose between 49 regions  
→ All regions

## Environmental (E) & Socioeconomic (S) Indicators

- Climate Change Impacts
- PM Health Impacts
- Water Stress
- Land-use related Biodiversity Loss
- ...

## Years

1995  
1996  
1997  
1998  
1999  
2000  
2001  
2002  
2003

Time-frame:  
1995 – 2011

## Which results do you want to display?

- Production, Target, Final Supply, Final Demand Perspective
- Linkages
- Multiple indicators
- Timelines

## How to display your results?

Unit &/ Global Shares

2) Insert the name of your folder where the results will be stored

3) Start Calculation (Press Button)

Progress: