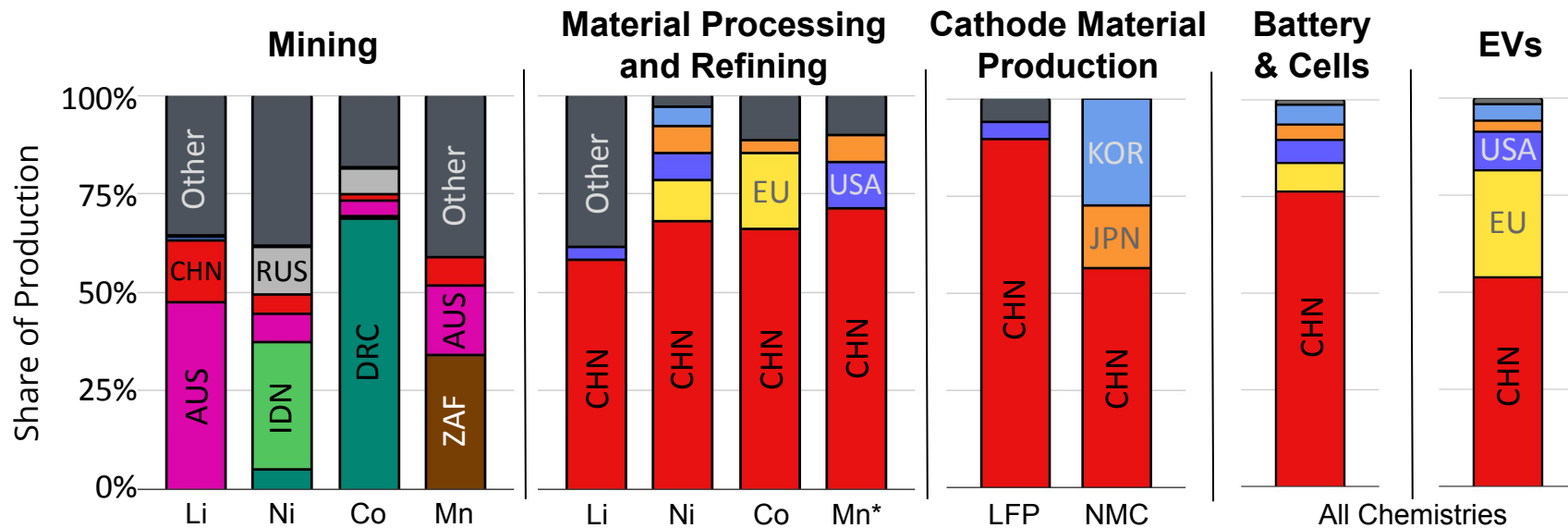


The battery mineral supply chain is geographically concentrated

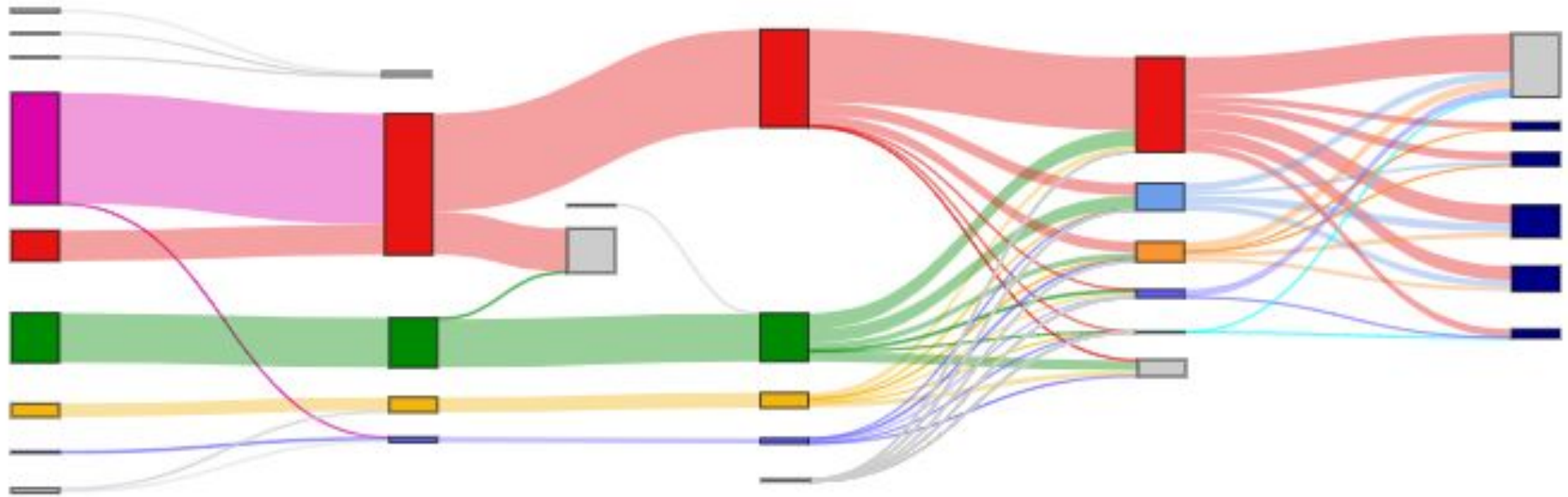


Li: Lithium; Ni: Nickel; Co: Cobalt; Mn: Manganese*. Adapted from IEA 2022, USGS 2022, and Sun et al. 2021

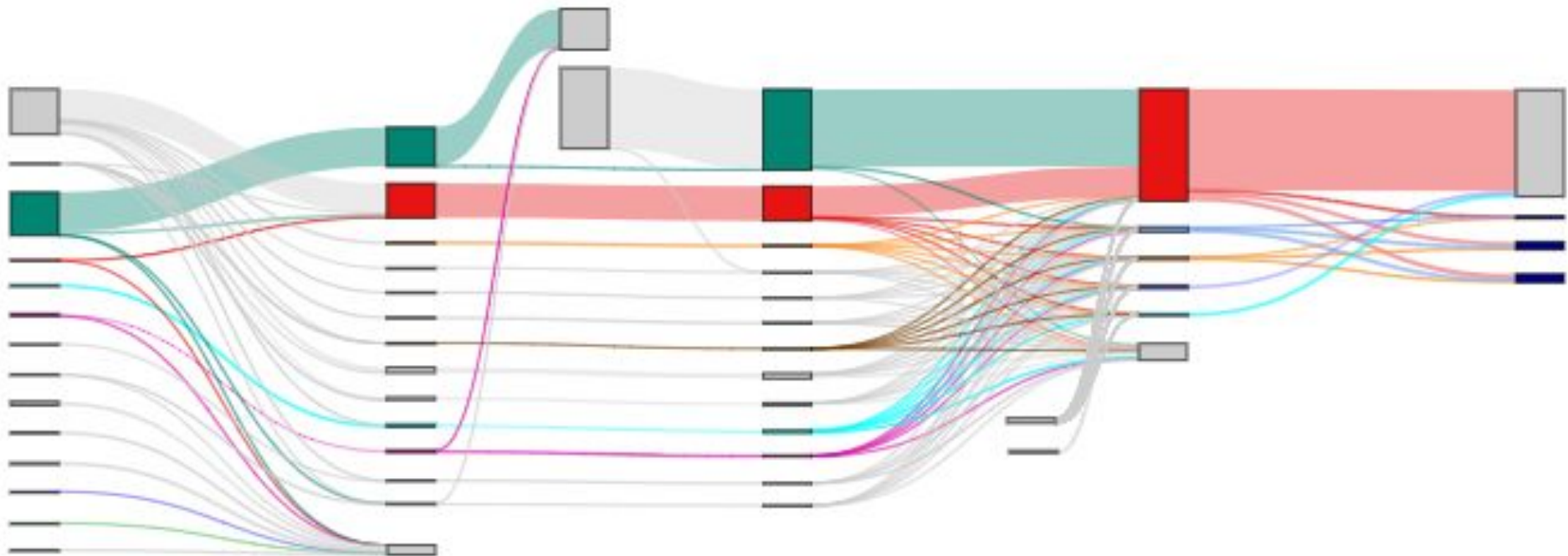
Abbreviations: CHN: China, AUS: Australia, IDN: Indonesia, RUS: Russia, DRC: Democratic Republic of the Congo, KOR: Republic of Korea (South Korea), JPN: Japan, USA: United States; EU: European Union; Other: any other country not named here

*Electrolytic Manganese Dioxide only

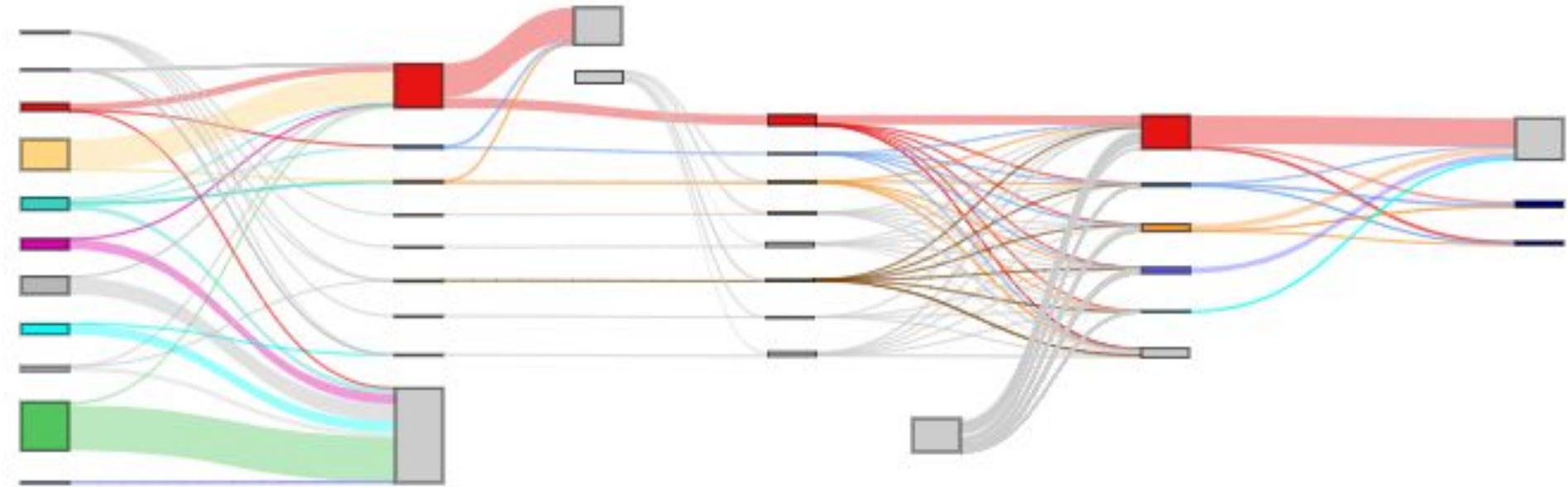
Lithium (unsharpened/unlabeled)



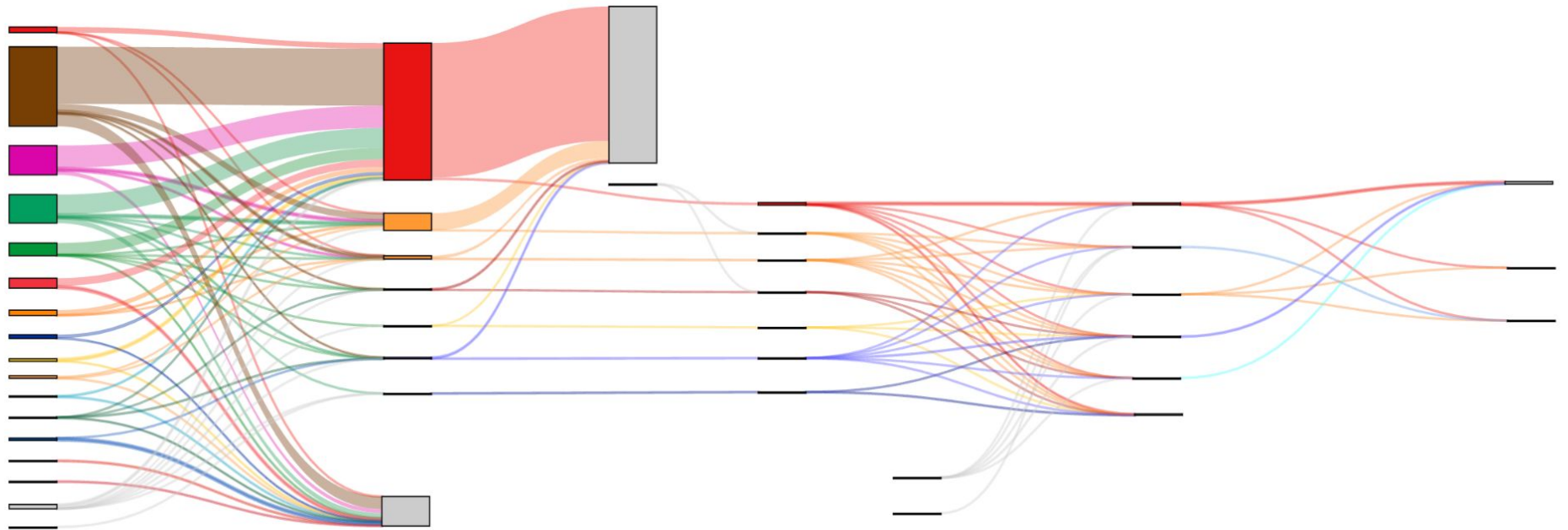
Cobalt (unsharpened/unlabeled)



Nickel (unsharpened/unlabeled)



Manganese (unlabeled)



Lithium

Raw Material

Mining & Extraction

Post-Trade

Refined Material

Refining & Processing

Post-Trade

Cathode Production

Manufacturing

— Brazil
— Portugal
— Zimbabwe

Australia

China

Chile

Argentina

USA

Missing extracted material used in refining step

Trade to countries with no battery-related refining, or raw materials not accounted for in trade

China

Unaccounted-for additional refining production

Raw materials not accounted for in battery-related refining production

Chile

Argentina

USA

Trade from countries with no refining

China

China

South Korea

Japan

USA

Canada

China

South Korea

Japan

USA

Canada

Trade to non-cathode producing countries, or refined materials not accounted for in trade

Non-Cathode Products

LMO

LCO

NCA

NMC

LFP

EV Cathodes

Lithium

Scale

≈ 9 thousand metric tons contained Lithium

Trade

Processing

Trade

Processing

Raw Material

Mining & Extraction

Post-Trade

Refined Material

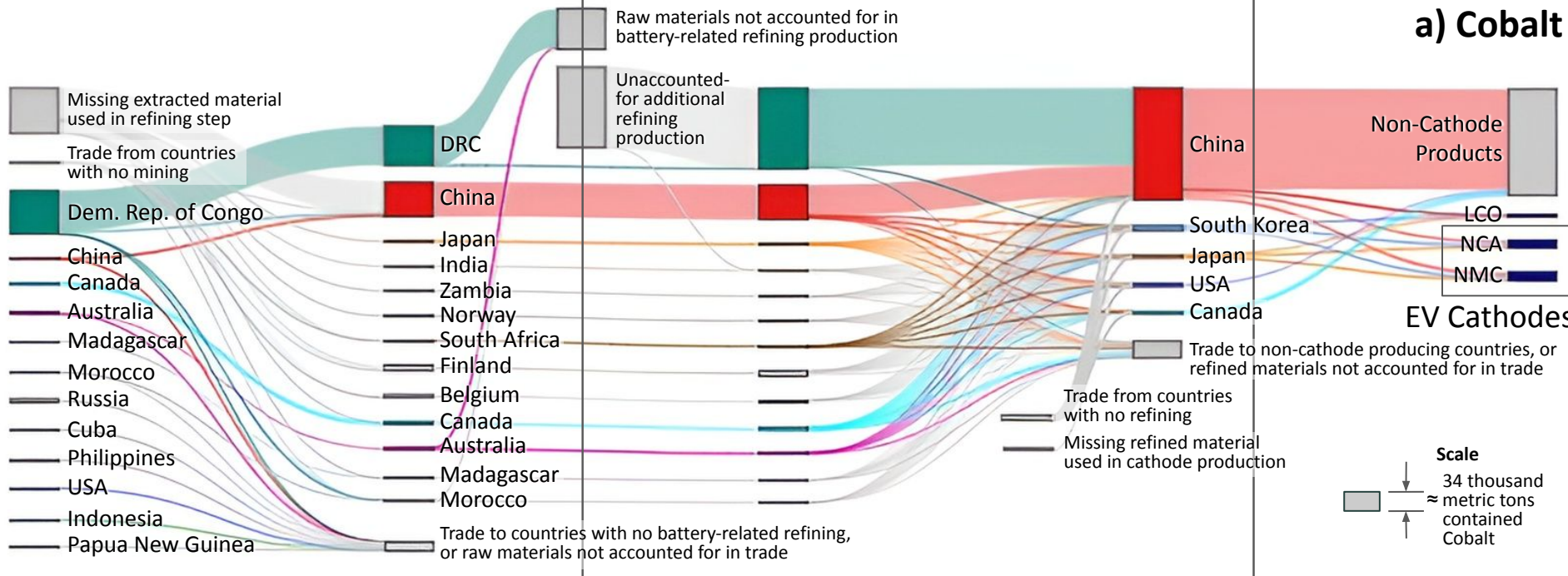
Refining & Processing

Post-Trade

Cathode Production

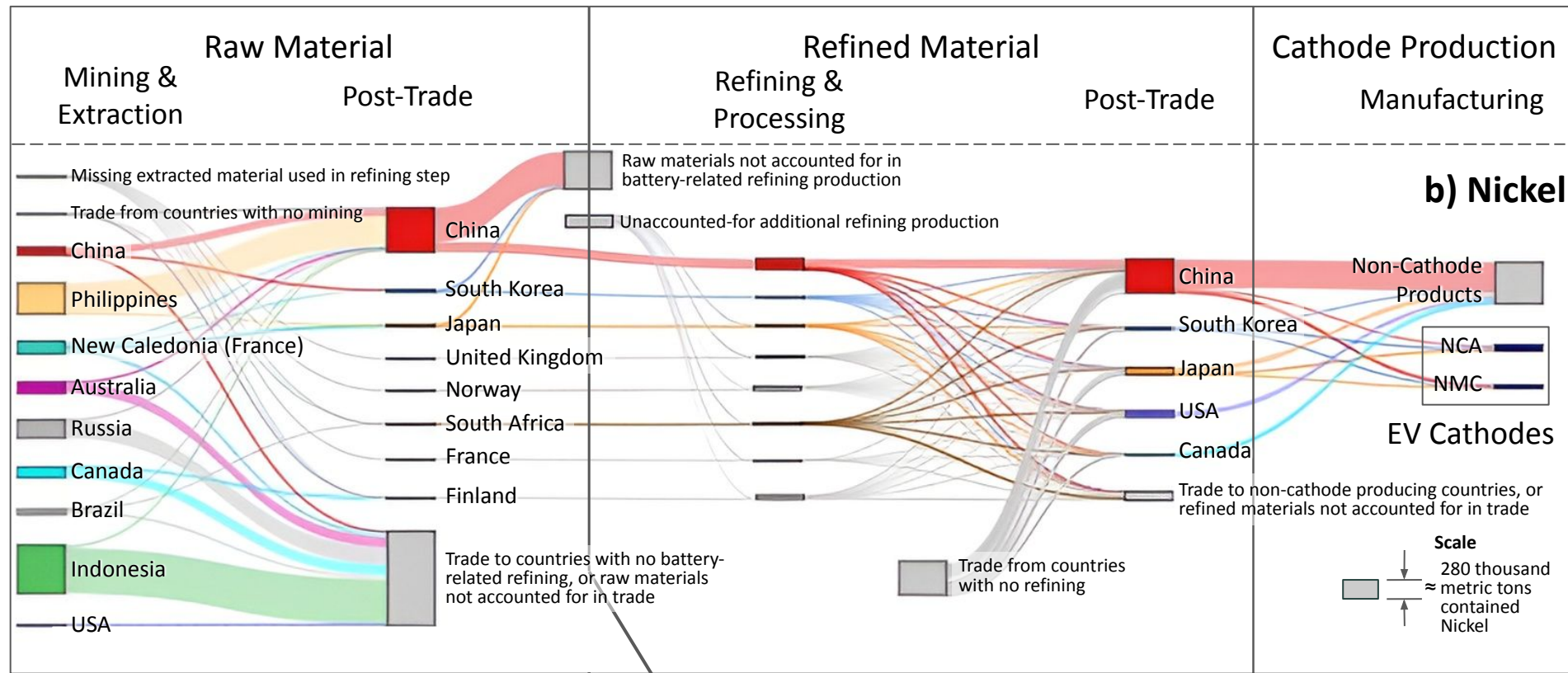
Manufacturing

a) Cobalt

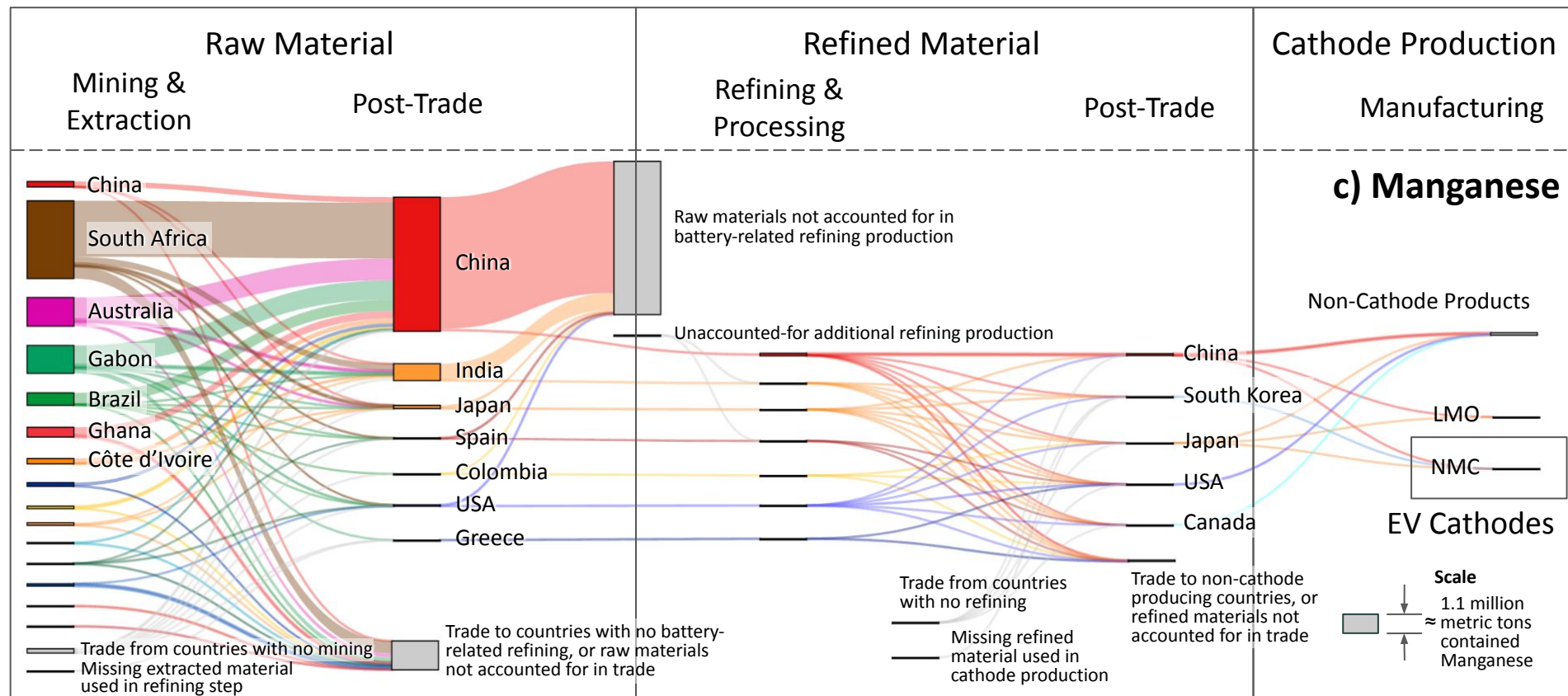


Trade → Processing → Trade → Processing

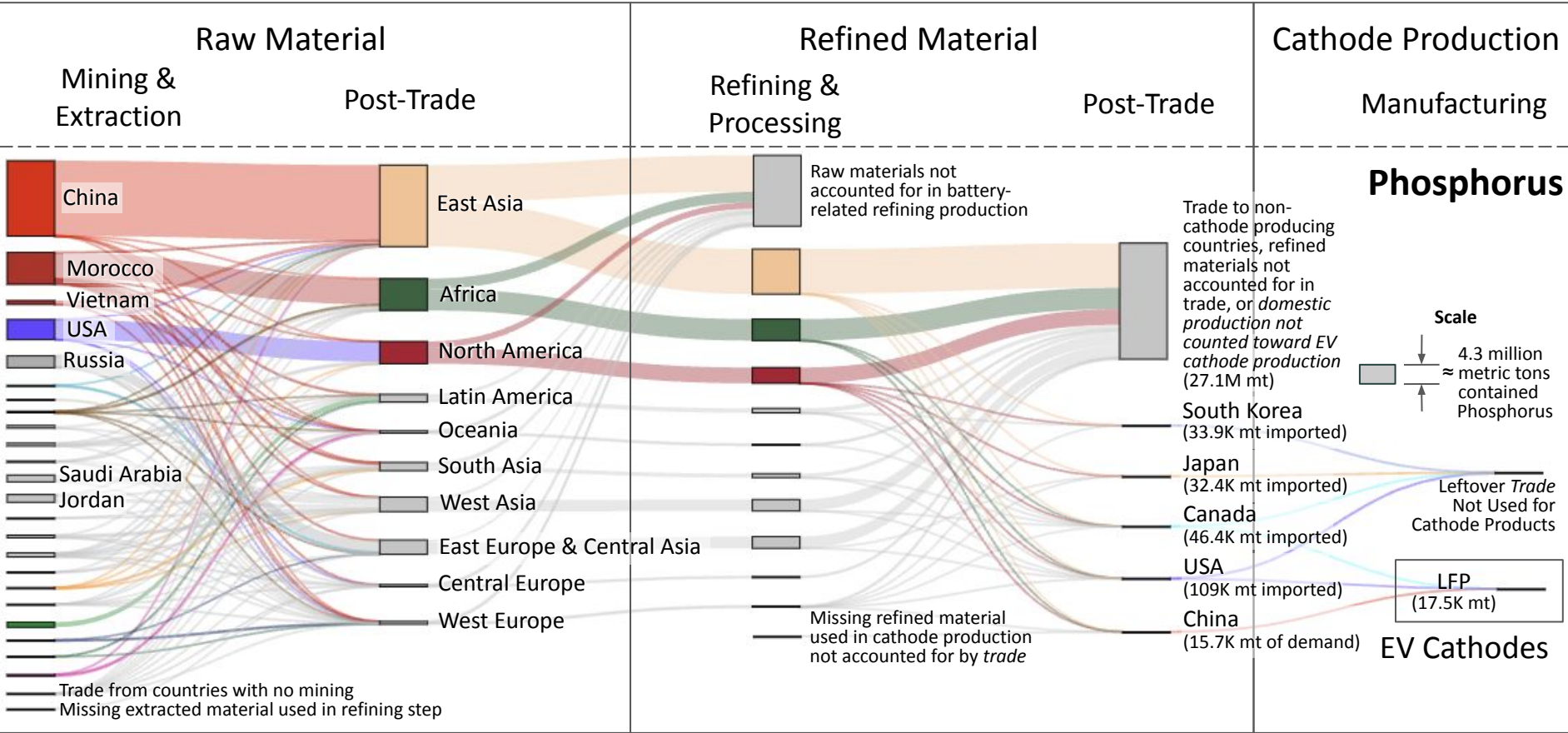
Nickel



Manganese

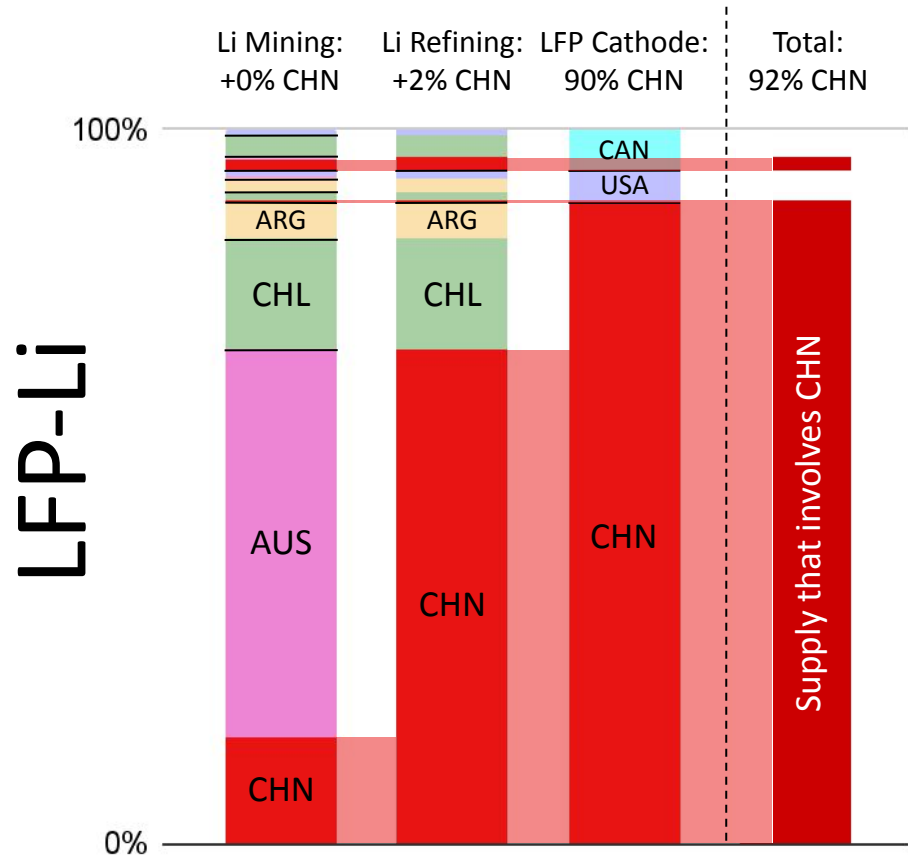


Trade → Processing → Trade → Processing

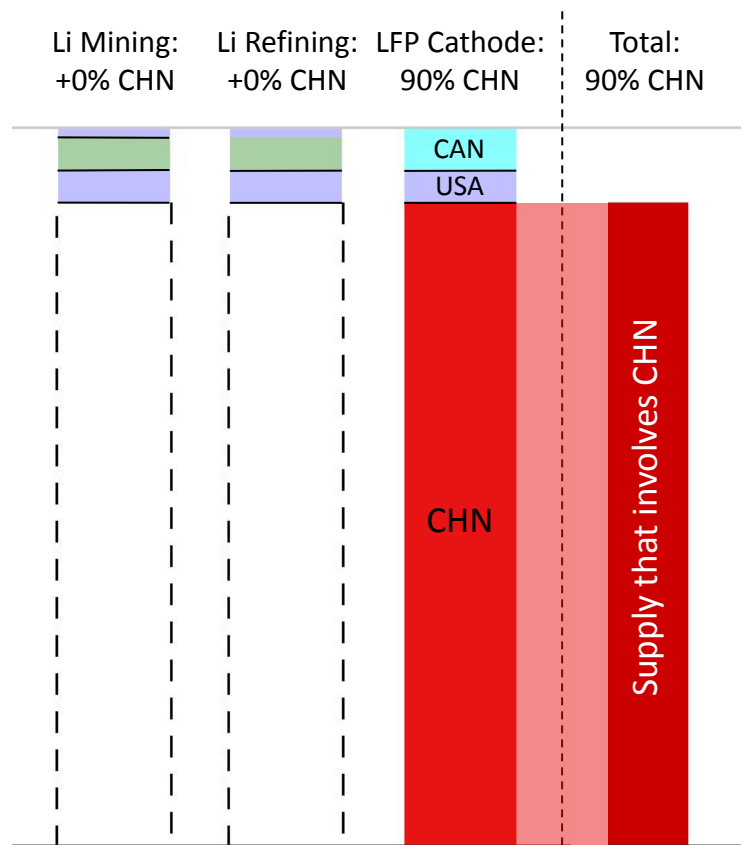


Trade → Processing → Trade → Processing

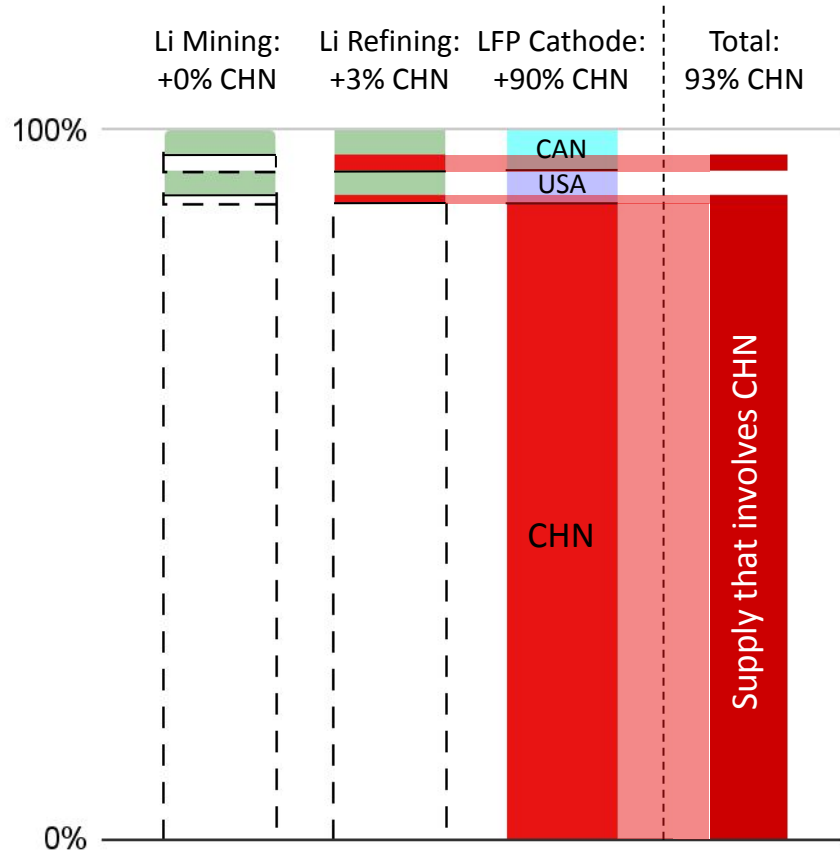
a) Base (Proportional) Case - LFP



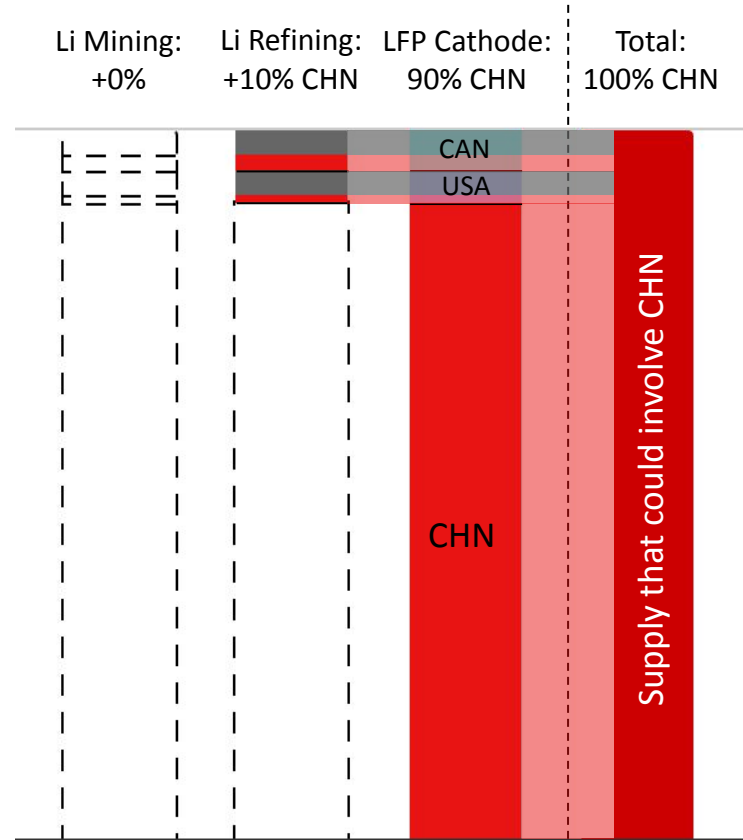
b) Optimistic (Minimum) Case - LFP



c) Pessimistic (Maximum) Case A - LFP*



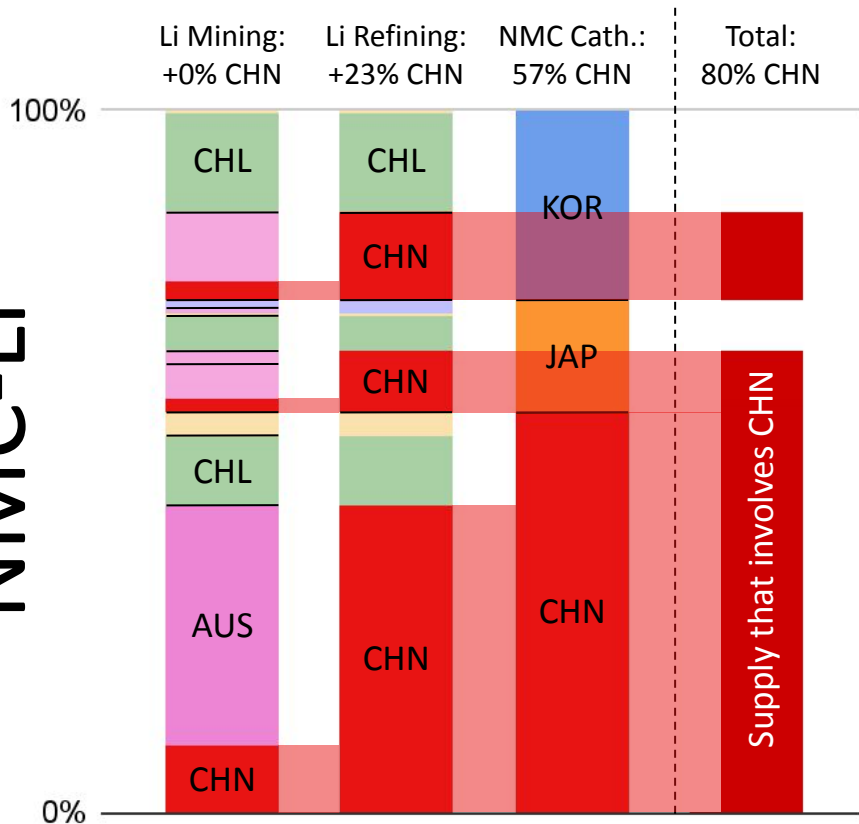
d) Pessimistic (Maximum) Case B - LFP**



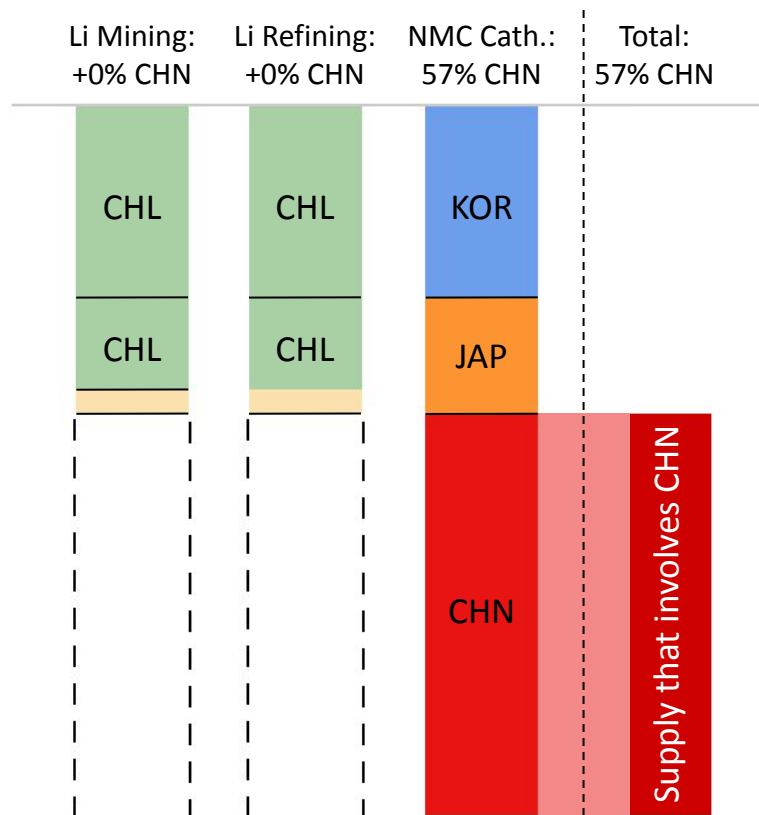
-  China
-  USA
-  Canada
-  Chile
-  Argentina
-  Australia
-  Unobserved and Indirect Trade
-  Production irrelevant to total level of CHN involvement

e) Base (Proportional) Case - NMC

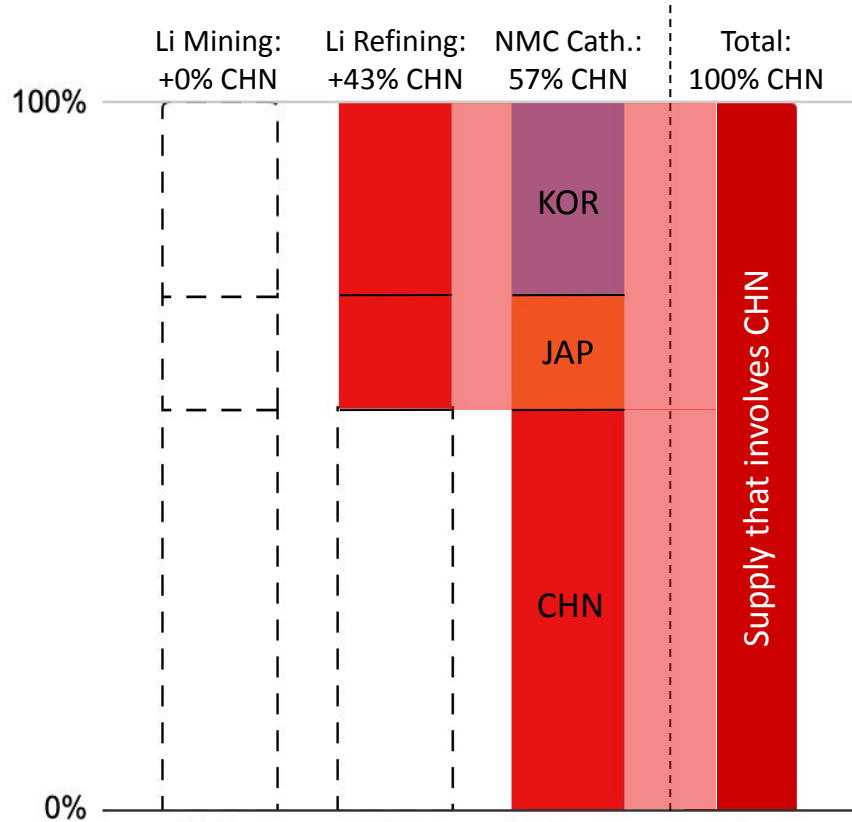
NMC-Li



f) Optimistic (Minimum) Case - NMC



g) Pessimistic (Maximum) Cases - NMC[†]



- Total
- China (CHN)
- Canada (CAN)
- USA
- South Korea (KOR)
- Unobserved and Indirect Trade
- Production irrelevant to total level of CHN involvement
- Japan (JAP)
- Chile (CHL)
- Argentina (ARG)
- Australia (AUS)

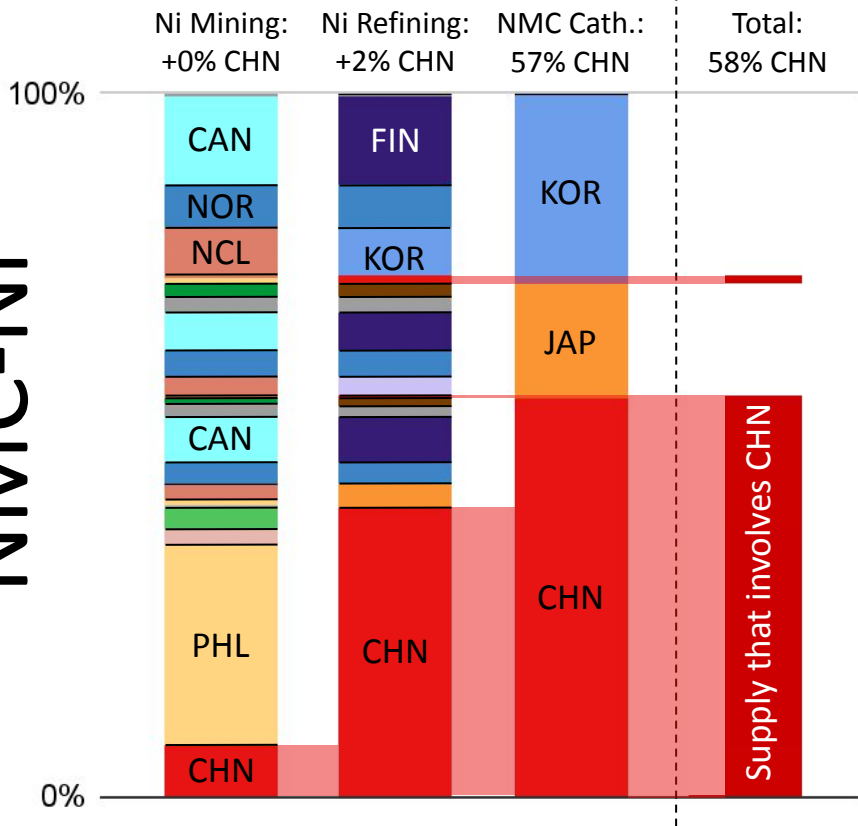
- * Observed direct trade only
- ** All Observed and non-observed trade
- † Both NMC maximum cases have the same numerical index value, though the underlying distribution could vary

- China
- USA
- Canada
- Chile
- Argentina
- Australia
- Unobserved and Indirect Trade
- Upstream production and trade hidden by downstream vulnerability

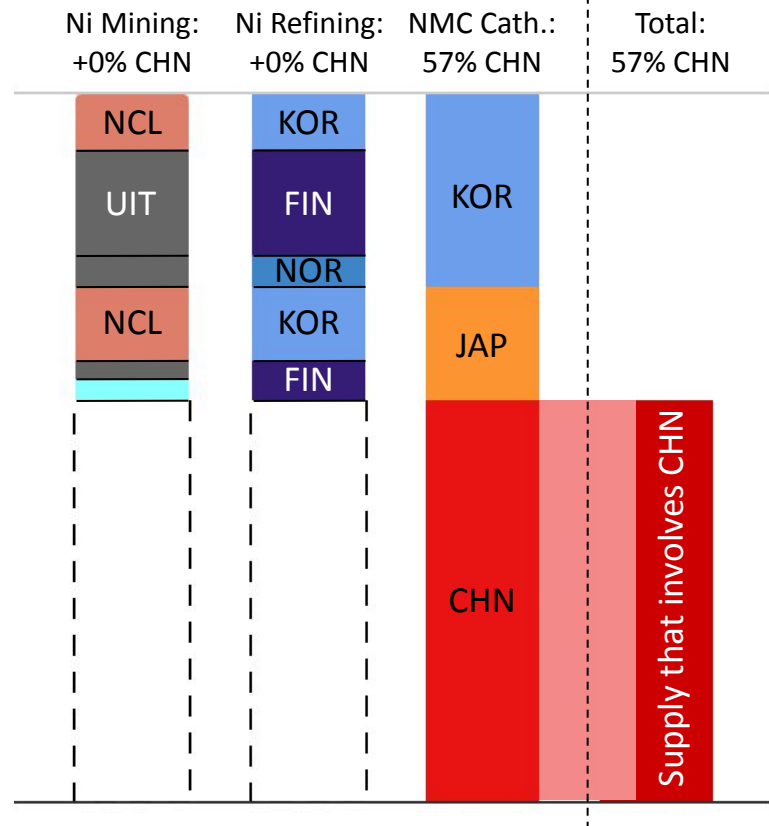
- China
- Japan
- South Korea
- USA
- Canada
- Chile
- Argentina
- Australia
- Unobserved and Indirect Trade
- Upstream production and trade hidden by downstream vulnerability

NMC-Ni

Base (Proportional) Case - NMC-Ni

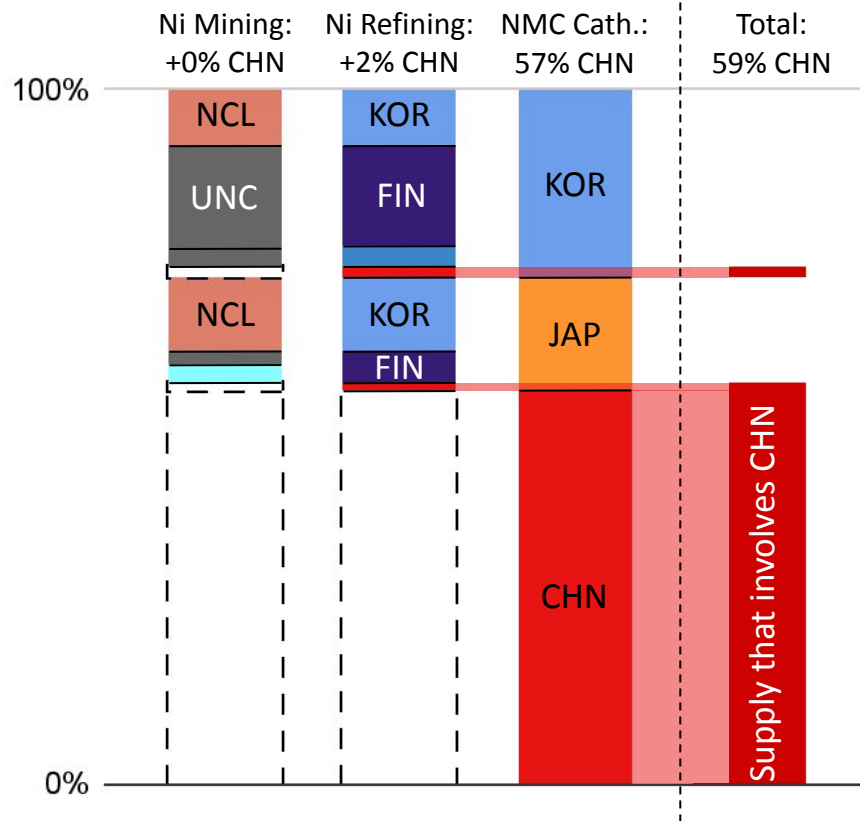


Optimistic (Minimum) Case - NMC-Ni



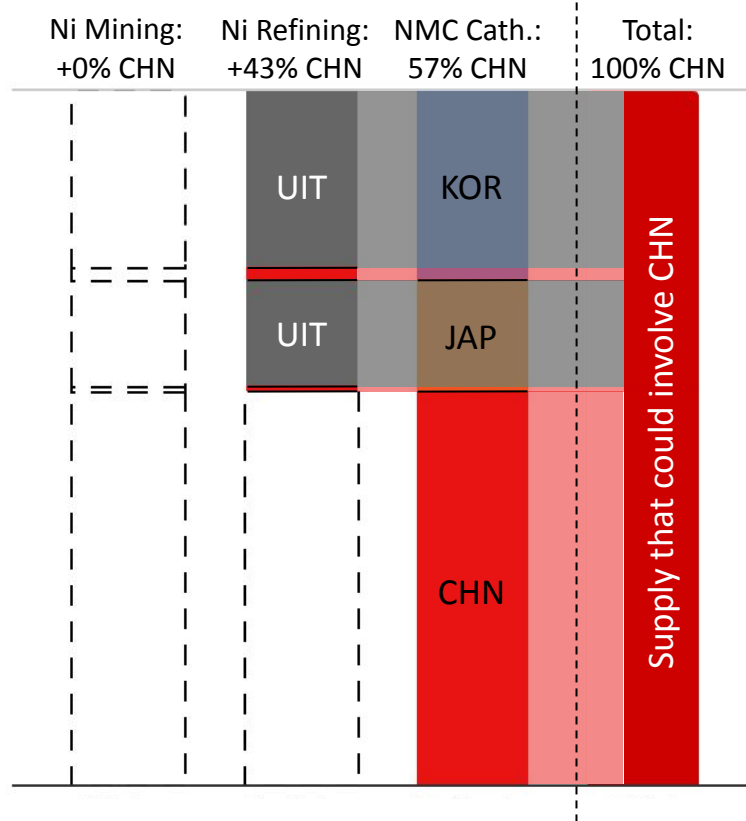
Pessimistic (Maximum) Case A - NMC-Ni

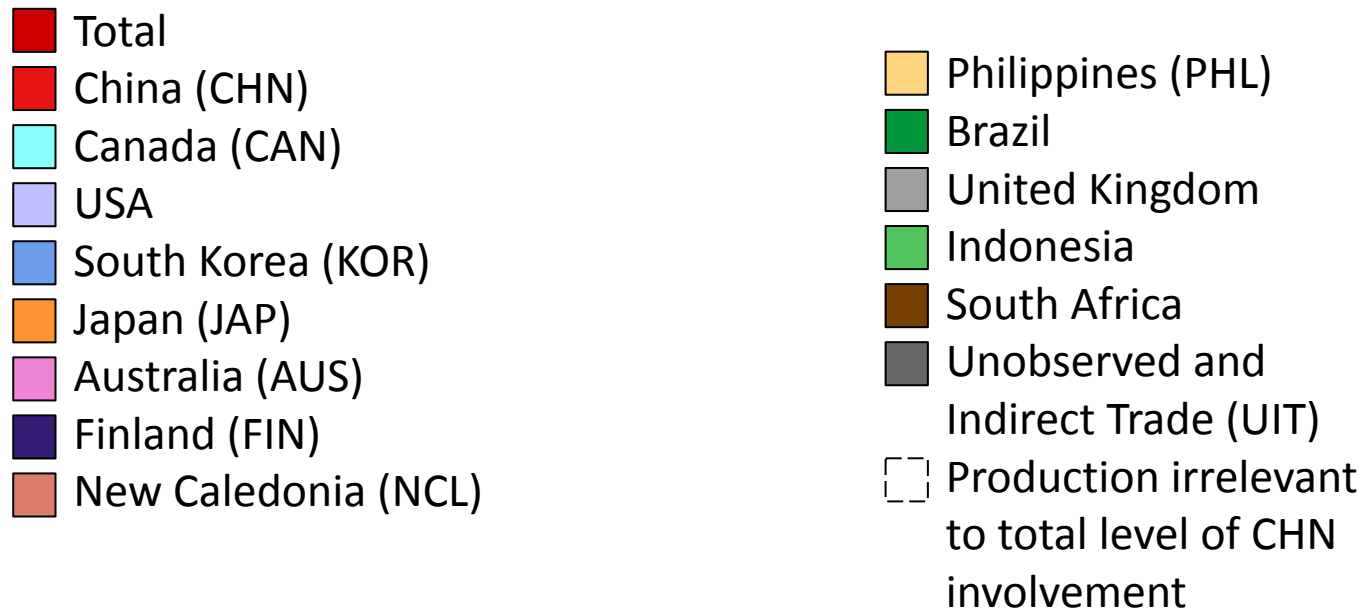
Observed direct trade only



Pessimistic (Maximum) Case B - NMC-Ni

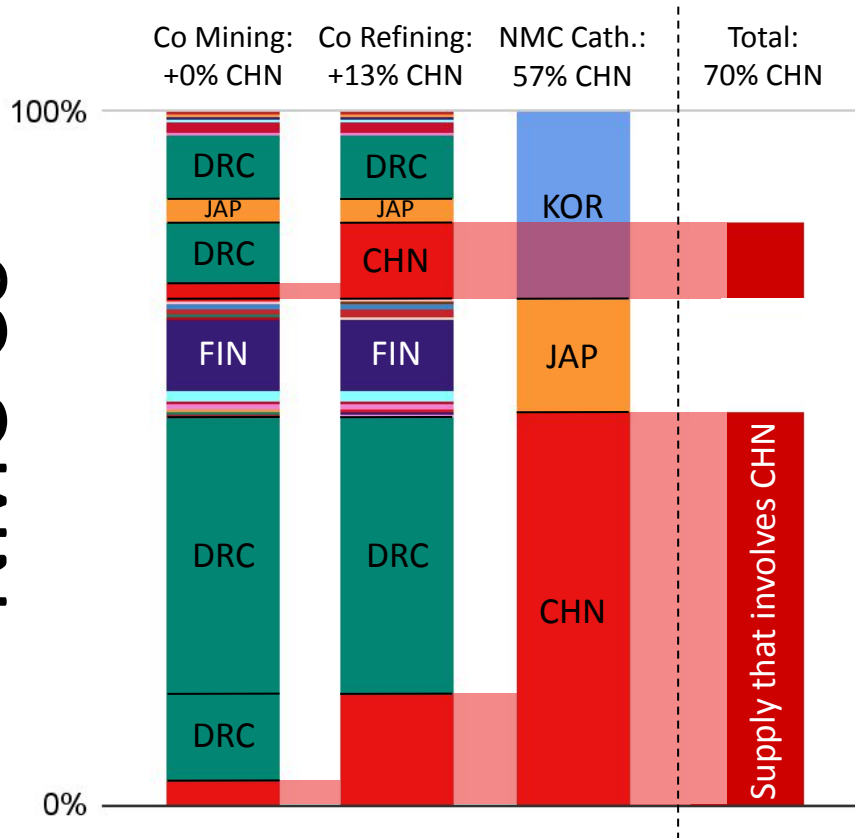
All observed and non-observed trade



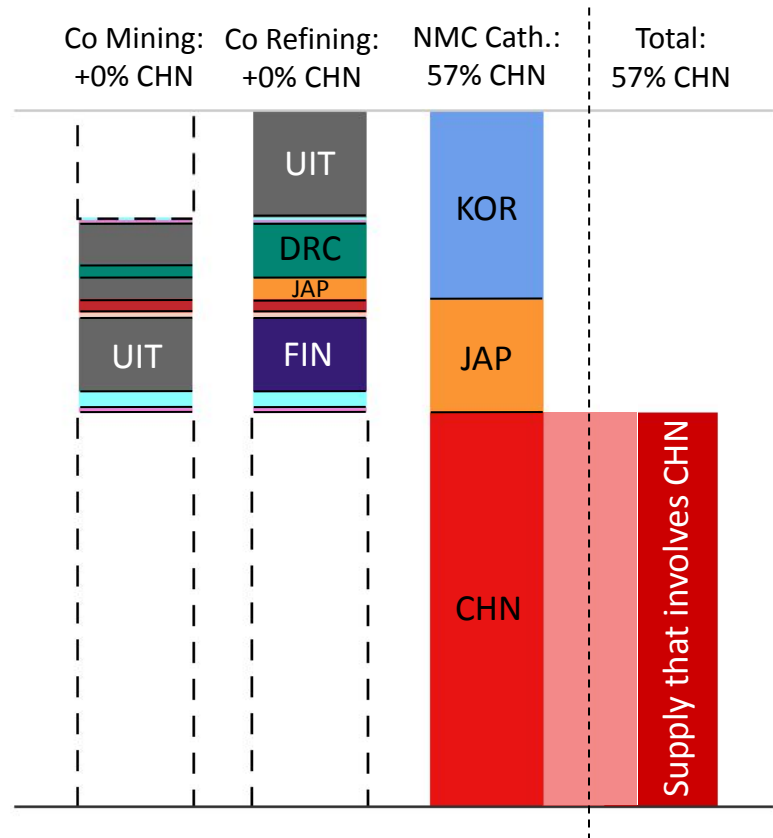


NMC-Co

Base (Proportional) Case - NMC-Co

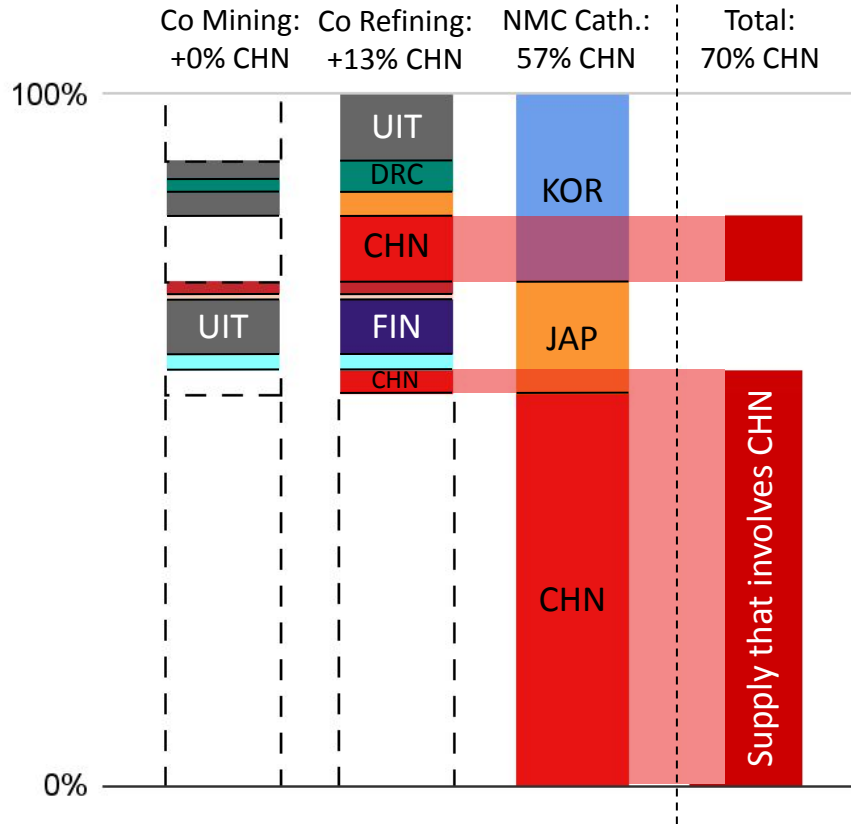


Optimistic (Minimum) Case - NMC-Co



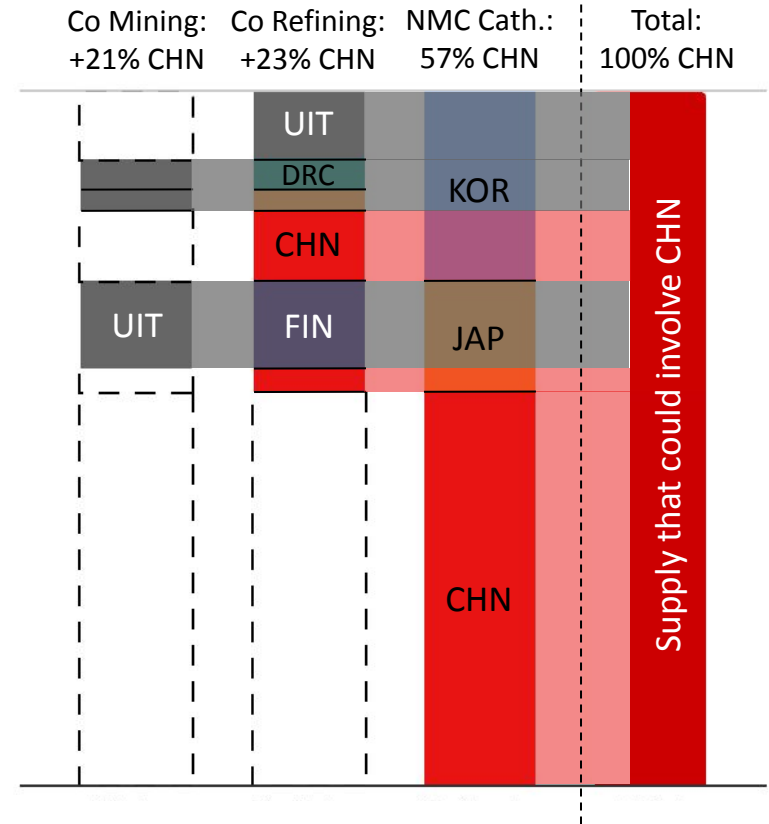
Pessimistic (Maximum) Case A - NMC-Co

Observed direct trade only



Pessimistic (Maximum) Case B - NMC-Co

All observed and non-observed trade

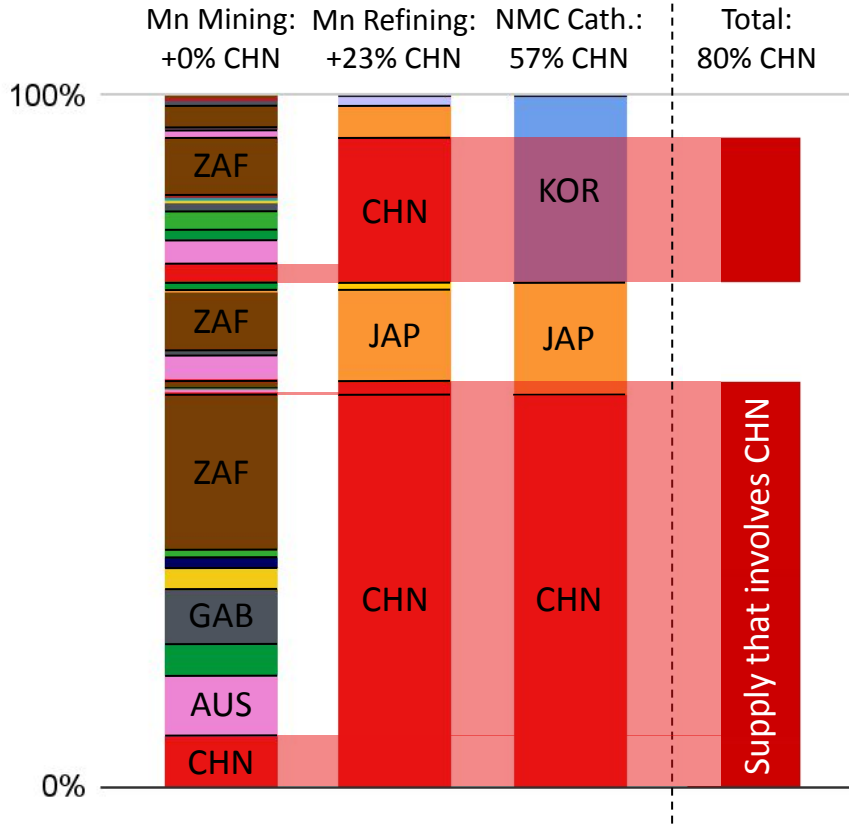


- Total
- China (CHN)
- Canada (CAN)
- South Korea (KOR)
- Japan (JAP)
- India
- Finland (FIN)
- Belgium
- Australia
- Democratic Republic of the Congo (DRC)

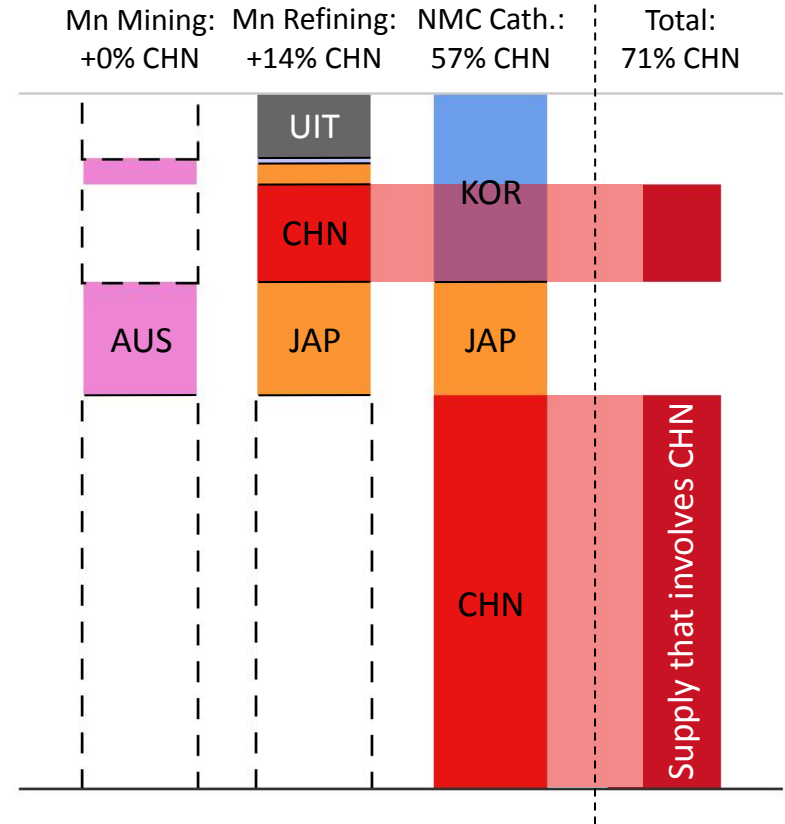
- Zambia
- Norway
- Morocco
- Madagascar
- Unobserved and Indirect Trade (UIT)
- Production irrelevant to total level of CHN involvement

NMC-Mn

Base (Proportional) Case - NMC-Mn

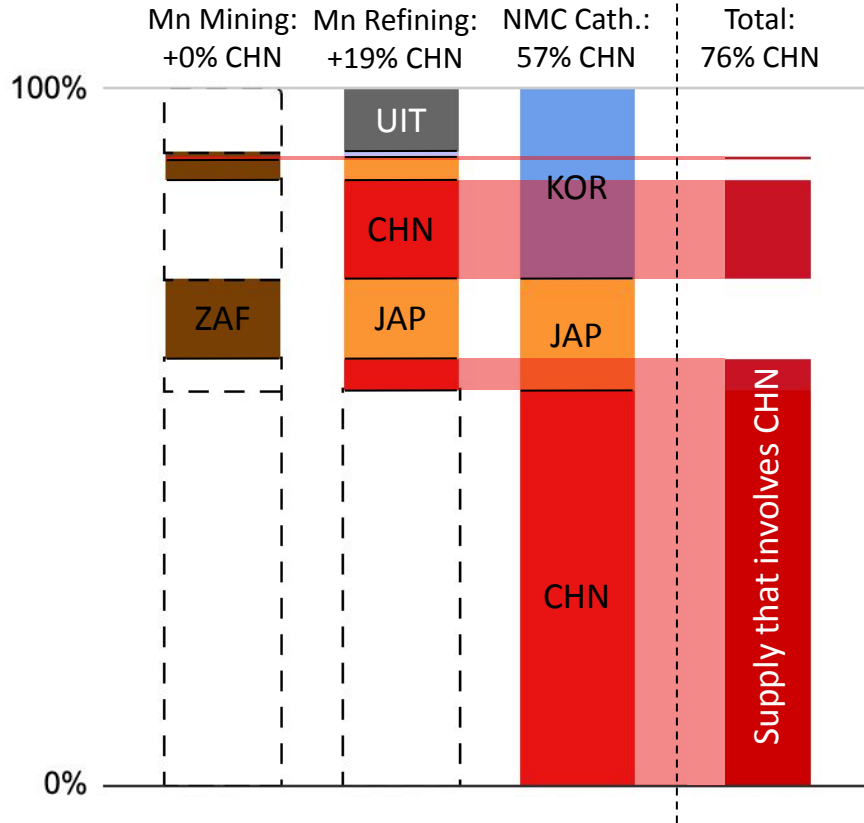


Optimistic (Minimum) Case - NMC-Mn



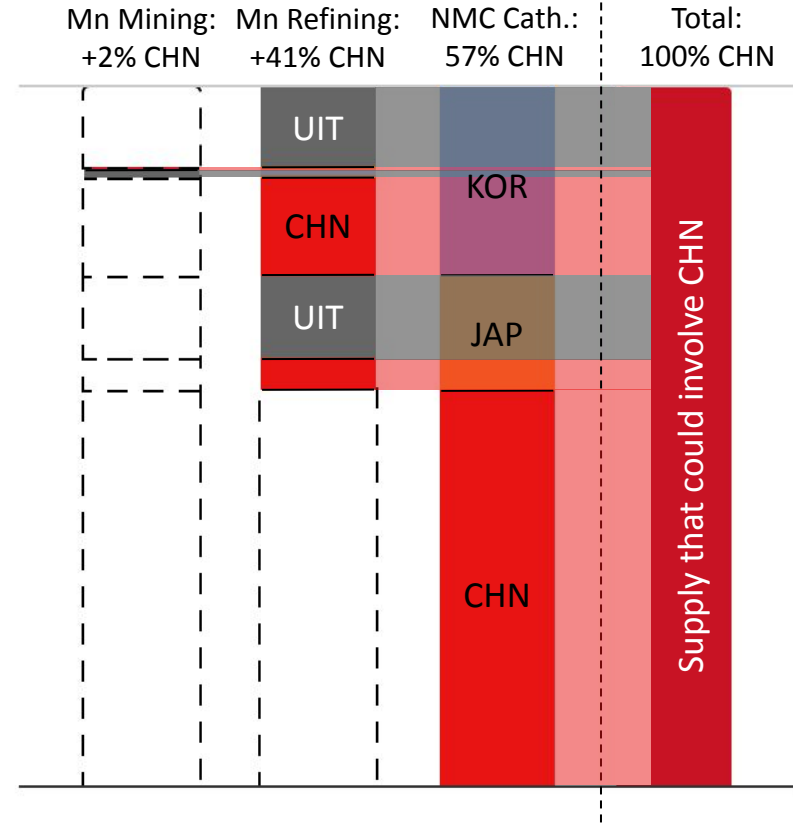
Pessimistic (Maximum) Case A - NMC-Mn

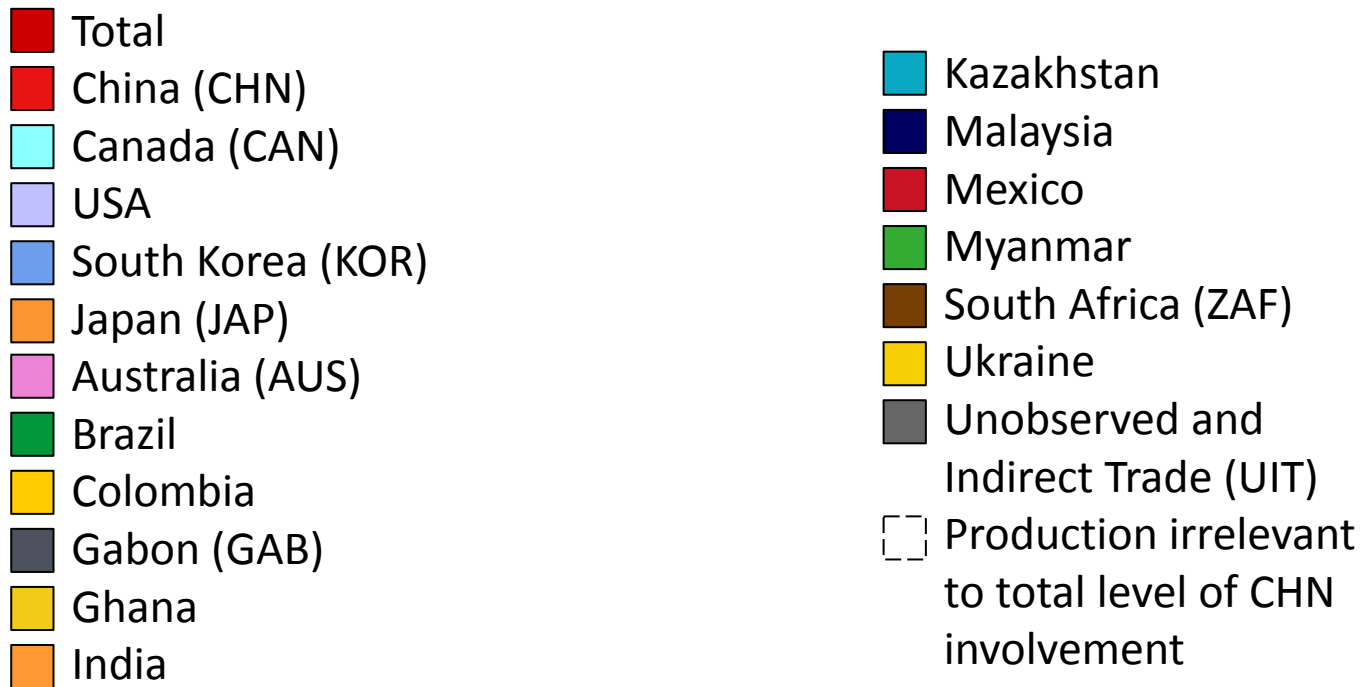
Observed direct trade only

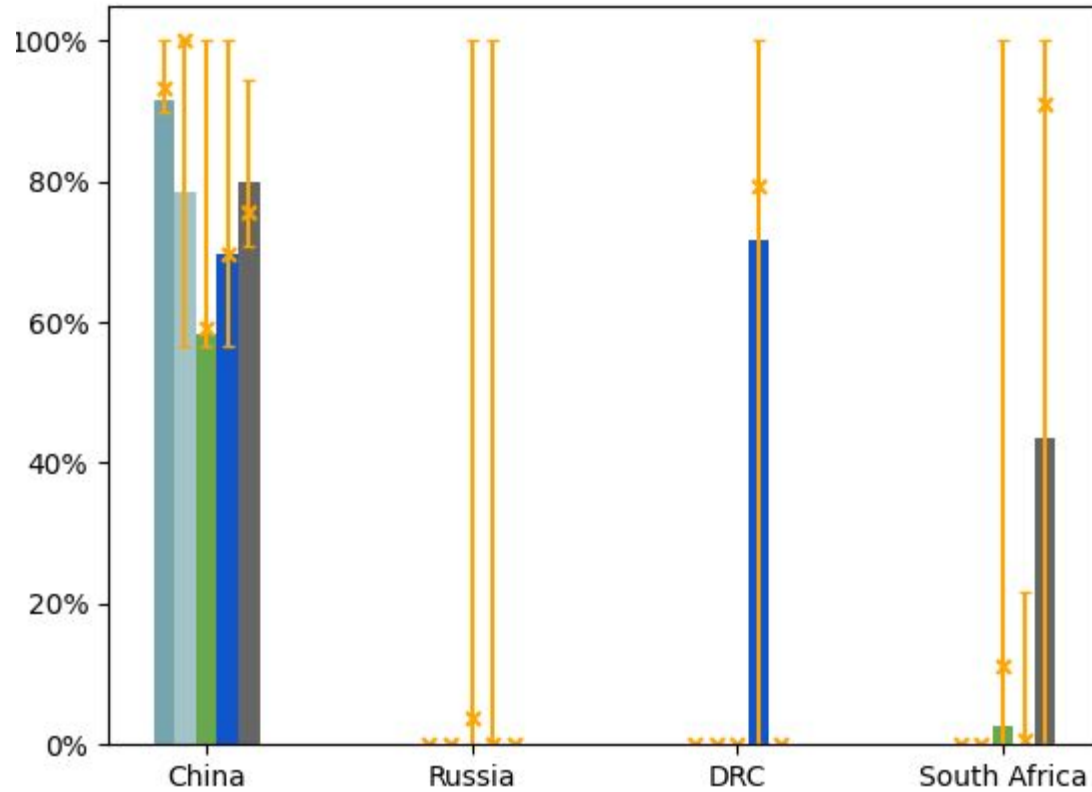


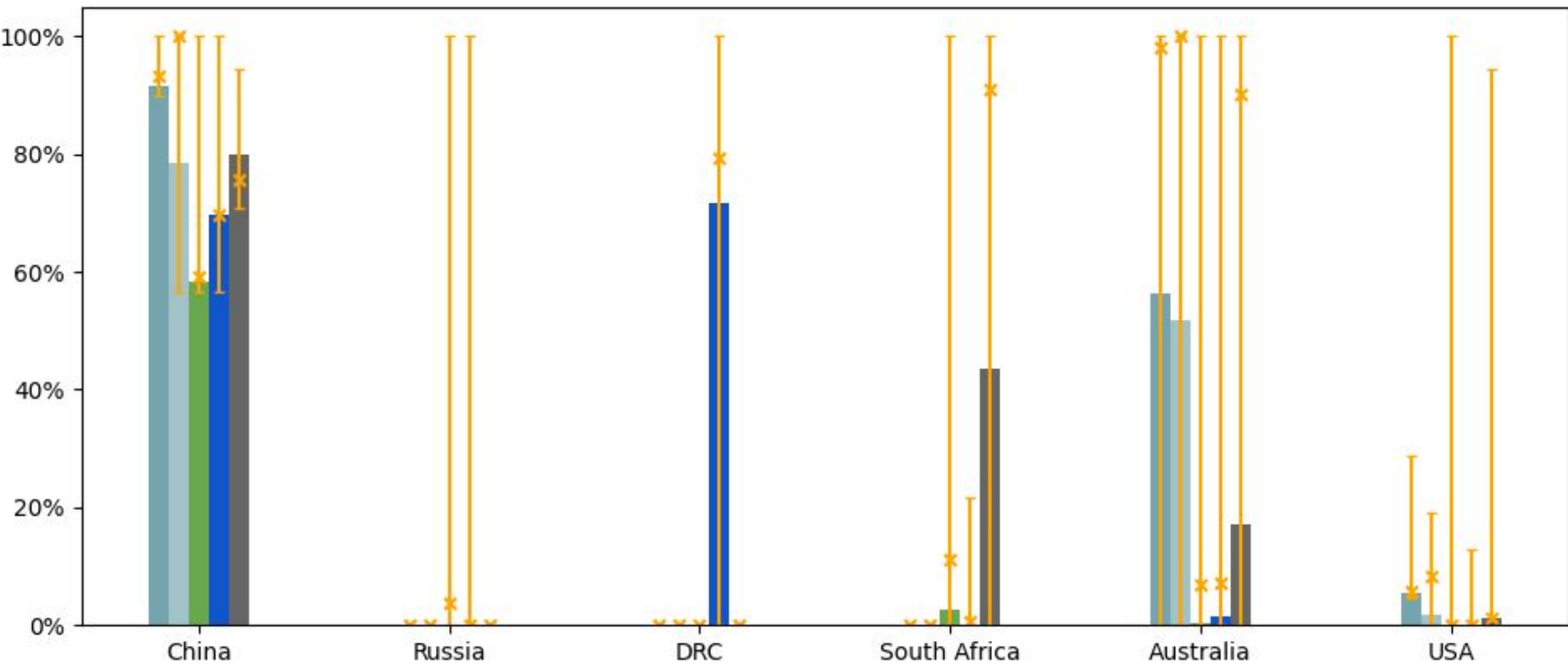
Pessimistic (Maximum) Case B - NMC-Mn

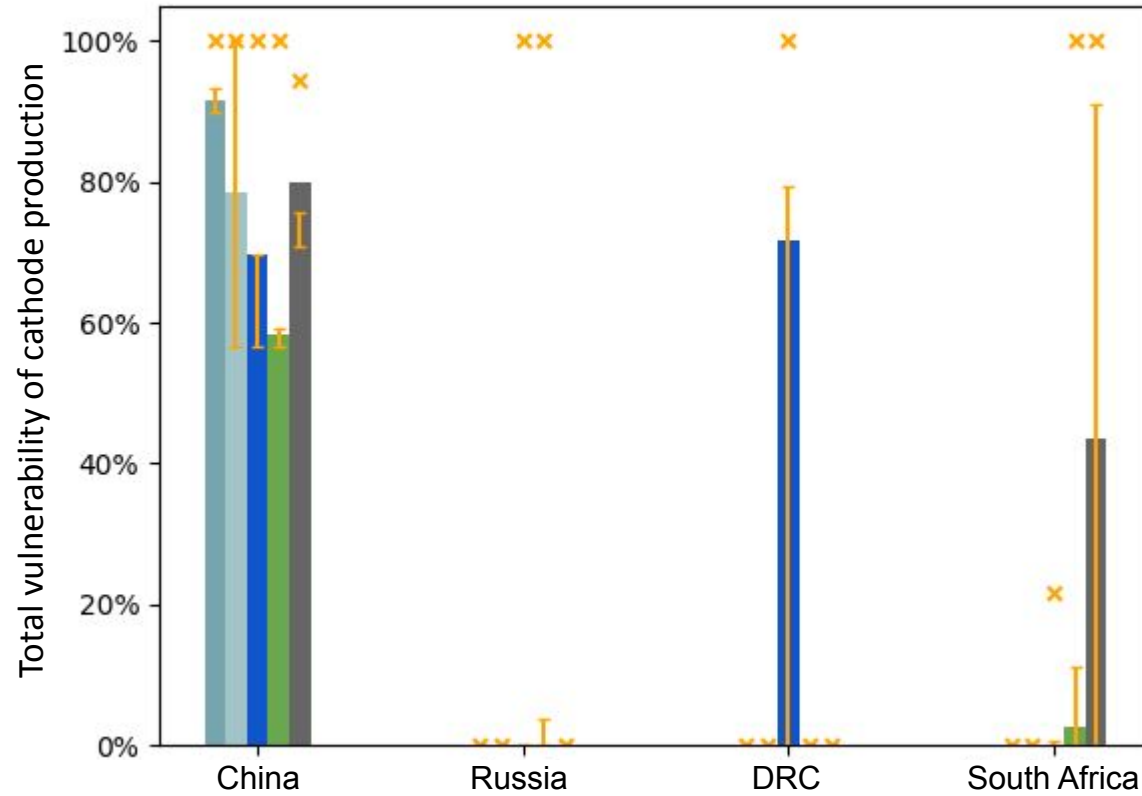
All observed and non-observed trade

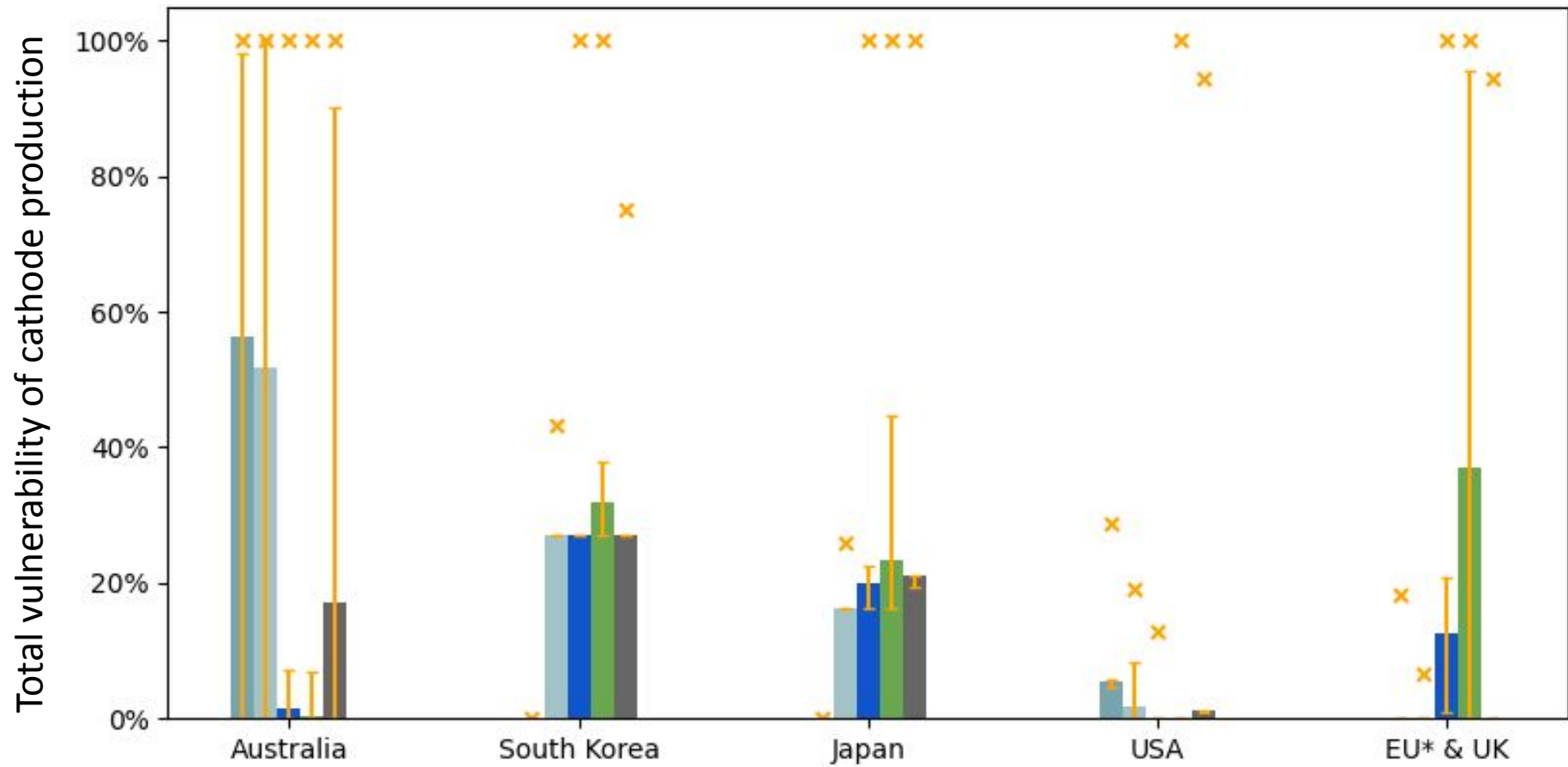




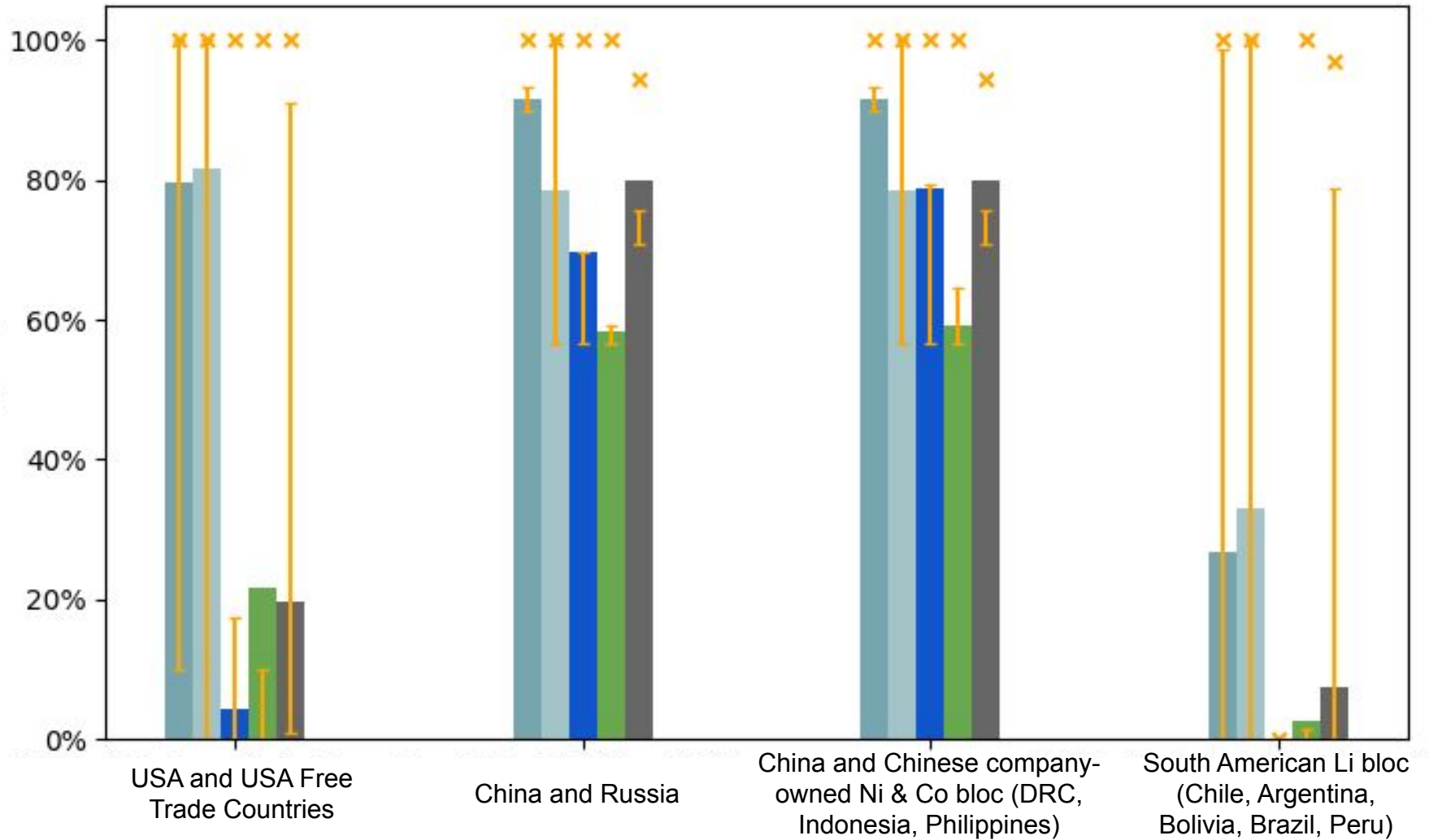








Total vulnerability of cathode production





LFP-Li



NMC-Li



NMC-Ni



NMC-Co



NMC-Mn



LFP-Li



NMC-Li



NMC-Co



NMC-Ni



NMC-Mn

