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Feasibility of Iron Scrap Recycling with Considering Demand-Supply Balance

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Progress in FY2014

Objective

Estimate CO_2 emission reduction potential from a steel sector in the world in 2050

History

FY2012 : Estimate steel stock in 2005
Develop Material Stock and Flow Model (apply to Japan)

FY2013 Apply MSFM to 35 regions in the world
Estimate steel demand in various cases

FY2014 CO_2 emission reduction from a steel sector in the world (1 region)
Steel production distribution in the world (on going)

Outline of research

Countermeasure for reducing CO_2 emission from steel sector

① Reduce steel production
② Shift from basic oxygen furnace to electric arc furnace ← Target
③ Improve energy efficiency
④ Reduce carbon intensity
⑤ Carbon capture and storage

Contents

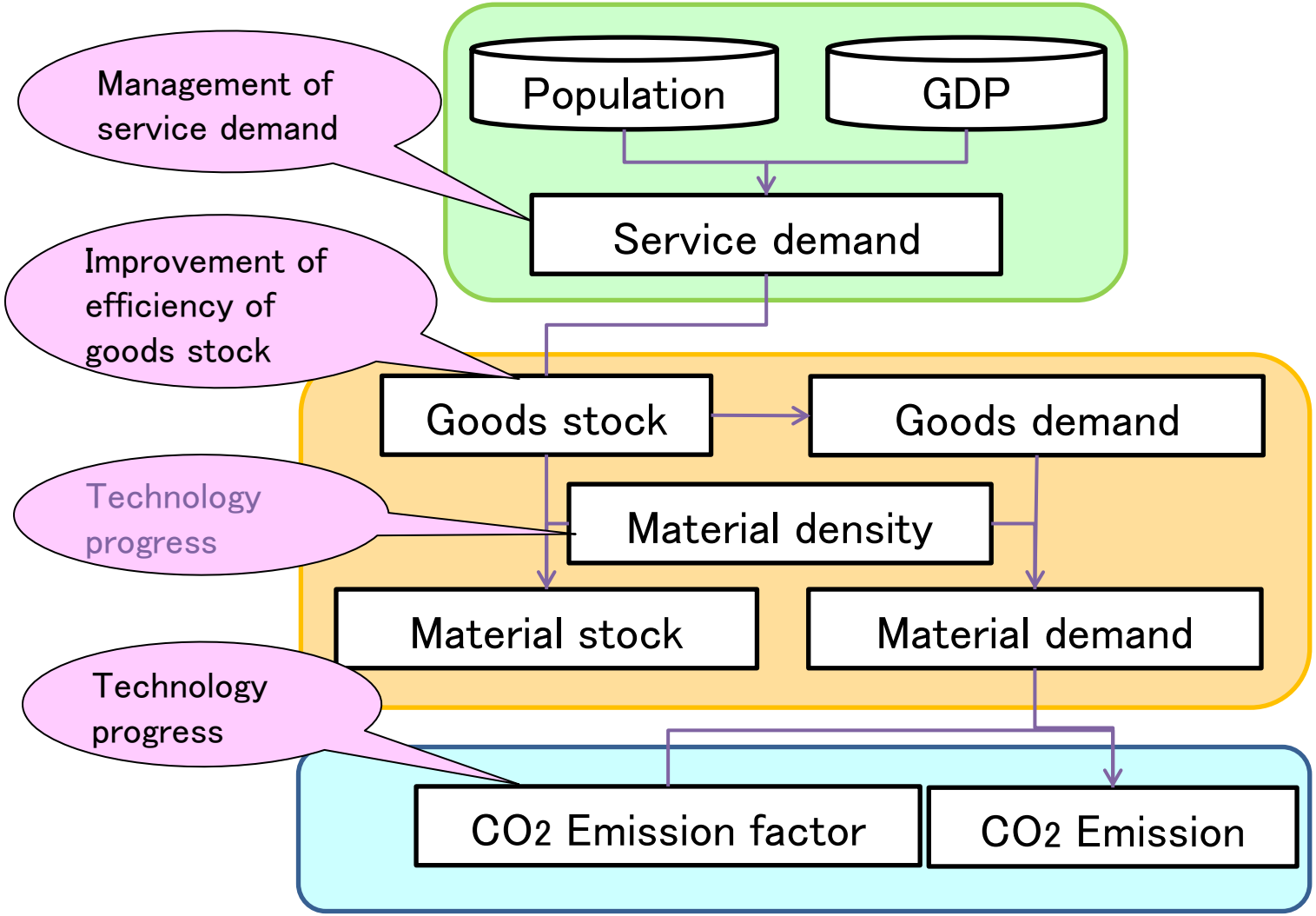
- Estimate steel demand by goods, scrap generation by source in the world
  - Regions : aggregated 35 regions
  - Goods : 29 kinds

  } Material Stock and Flow Model

- Estimate CO_2 emission under the condition with meeting supply-demand balance of steel and scrap based on quality
  - Constraints of scrap recycling
    - from supply-side
    - from demand-side

Methodology: Material Stock&Flow Model

Material Stock&Flow Model (MSFM): 2 modules
Periods: 2005-2050



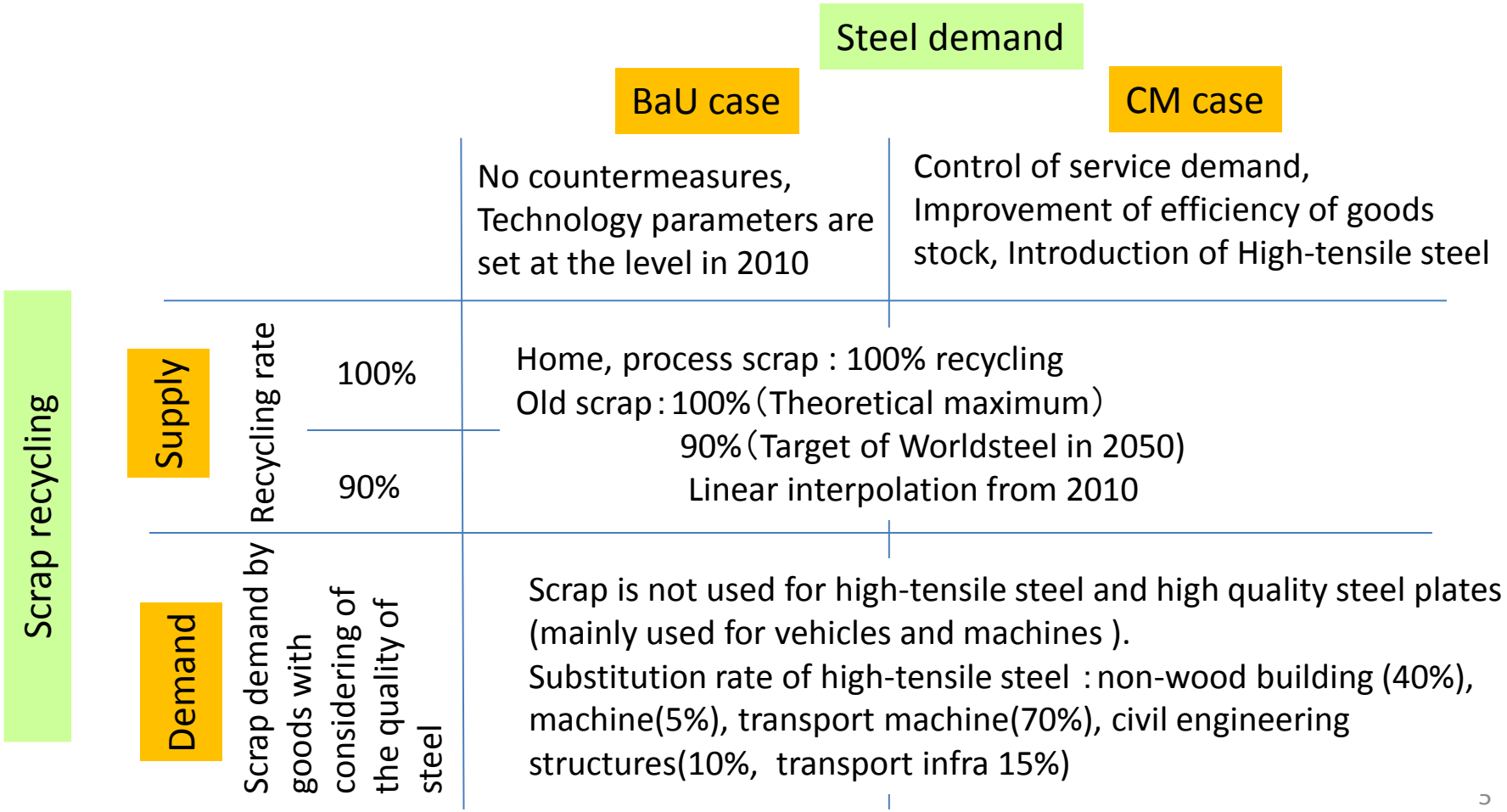
Scenario

＜Exogenous variables＞

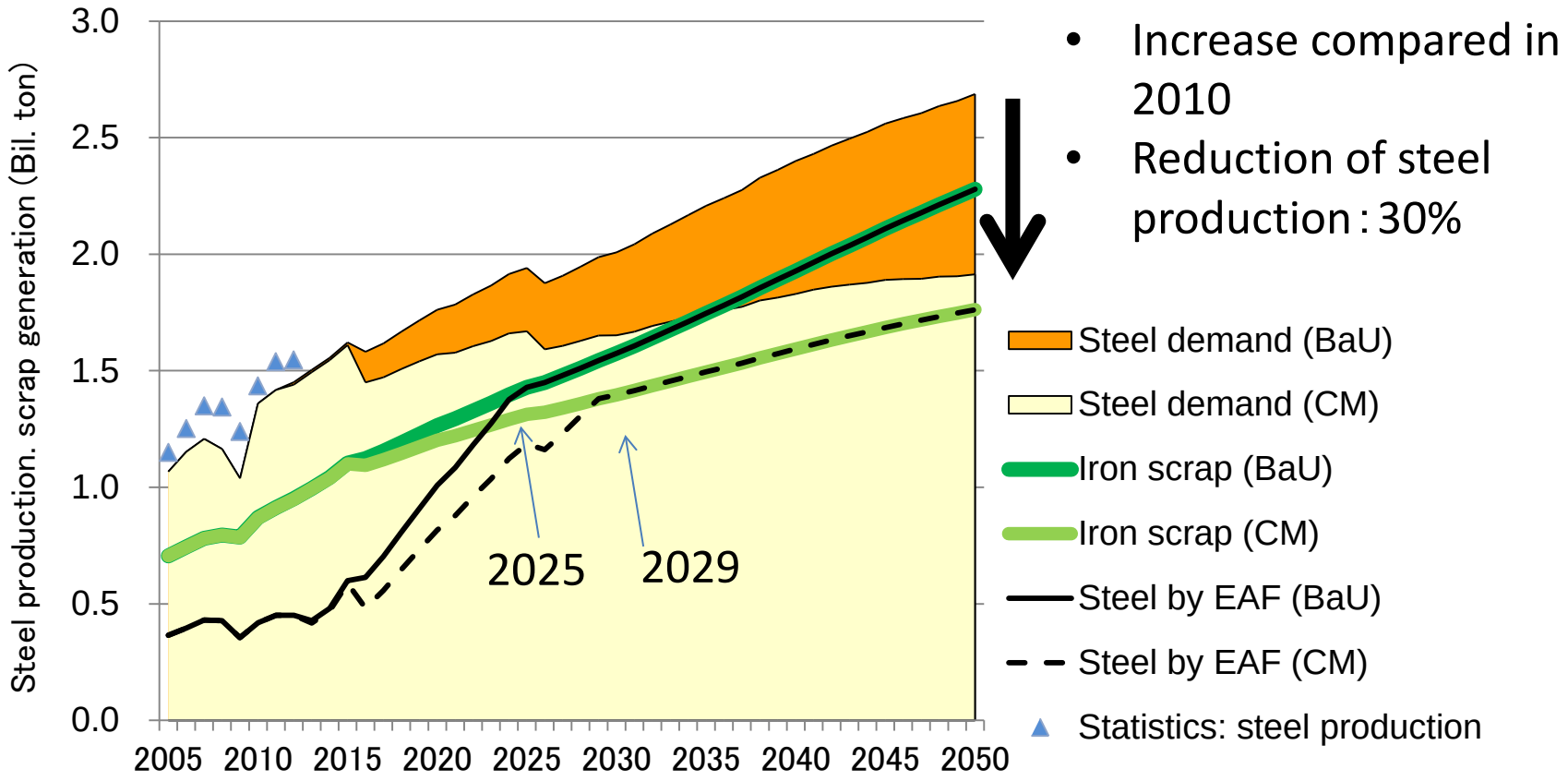
Population, output by sector,

Meeting basic living needs: water, sanitation, house

＜Countermeasures for steel demand and constraints for scrap recycling＞

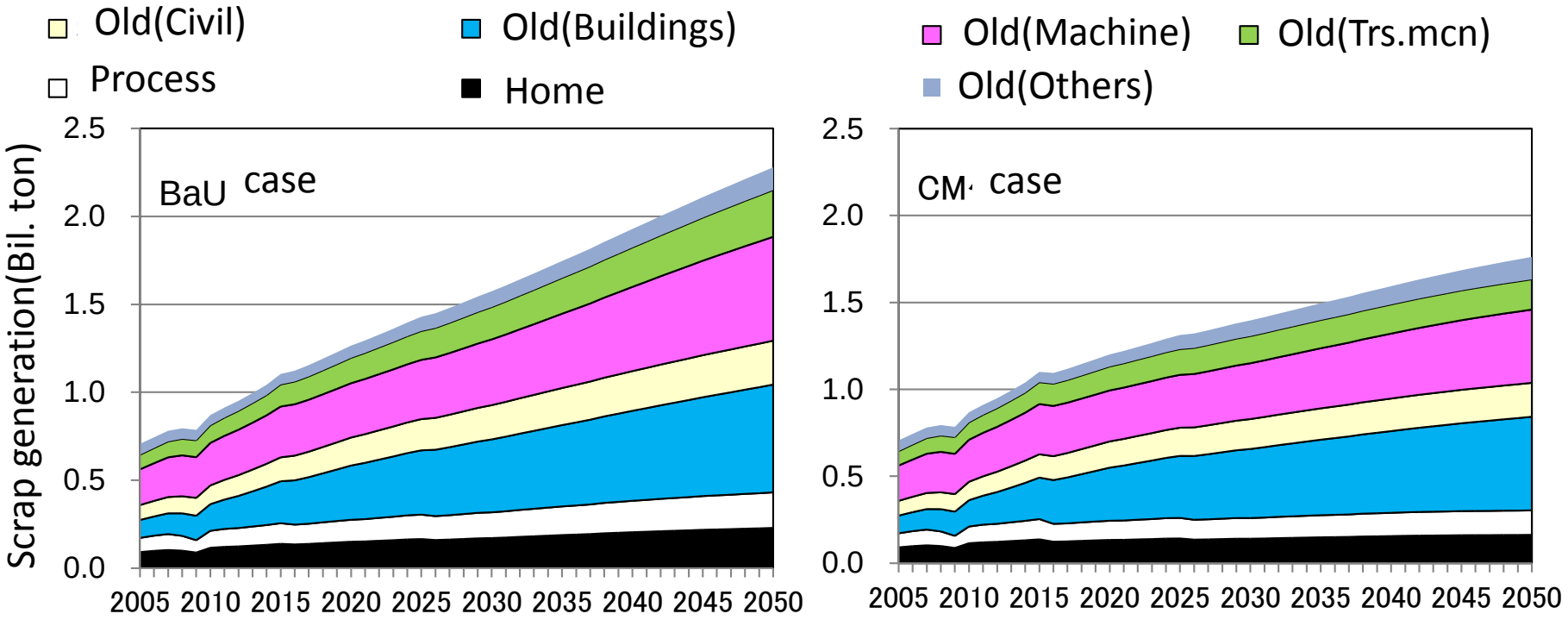


Result1　Steel production and scrap generation (supply-side constraint)



- While iron scrap generations continue to rise in both cases, they remain below steel production throughout the estimation period. It is required to keep 14-38% of the capacity of BOF at a current level.
- If a scrap recycling rate is 90%, a supply –side constraint comes 3-4 years earlier.

Result2　Scrap generation by source

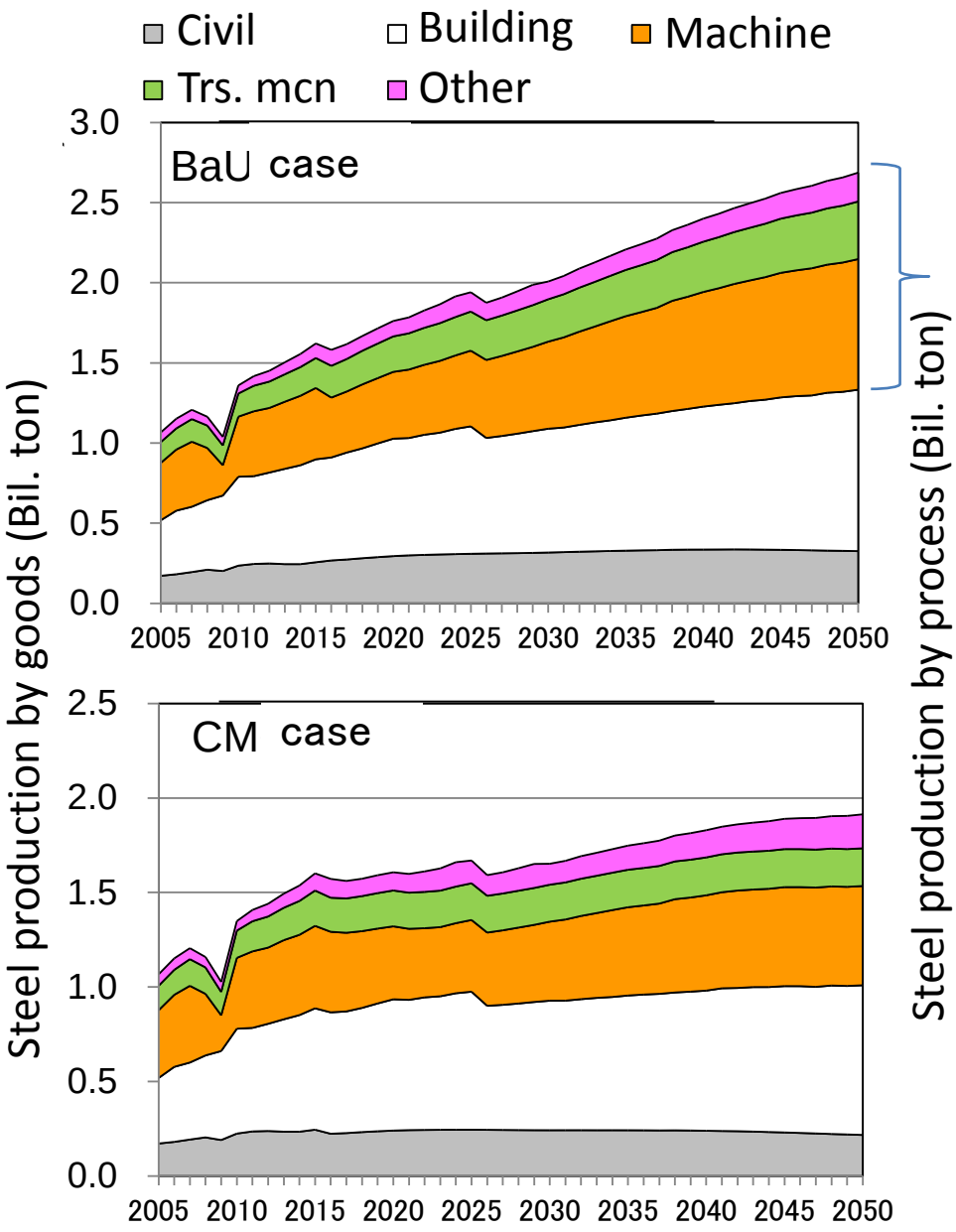


- The share of home and process scrap is 20%.
- Of the old scrap, the share of those from machines and transport machine (easily collected , stable quality) comprises 41-50%.
- The share of scrap relatively easy to collect = 70% (same as a current level)

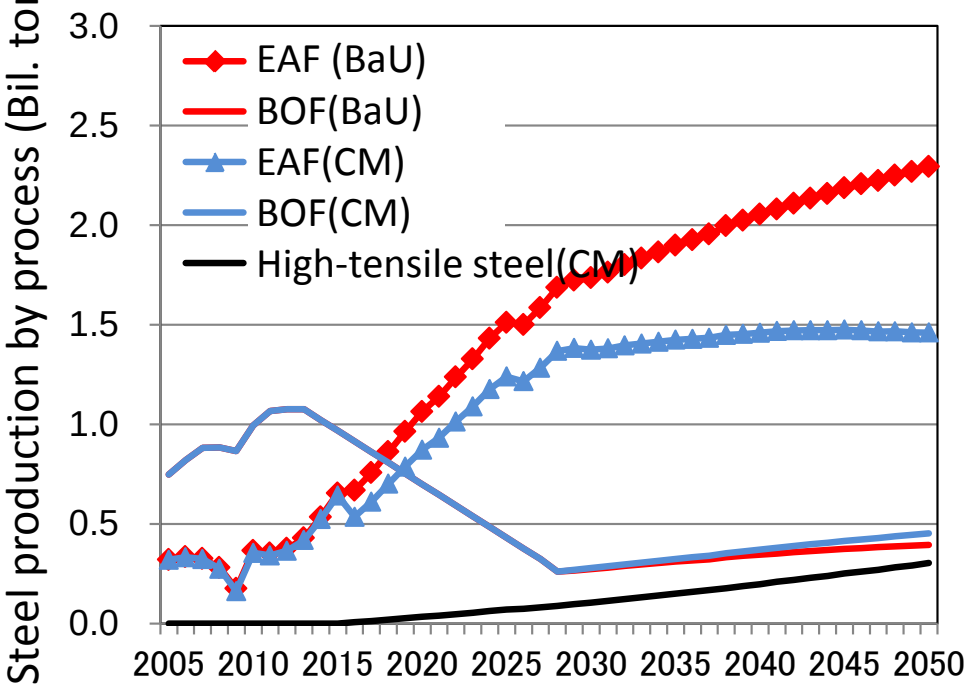
⇨ Increase the recycling rate up to 90% needs large effort.

Result3　Steel production by goods and process

(demand-side constraint)

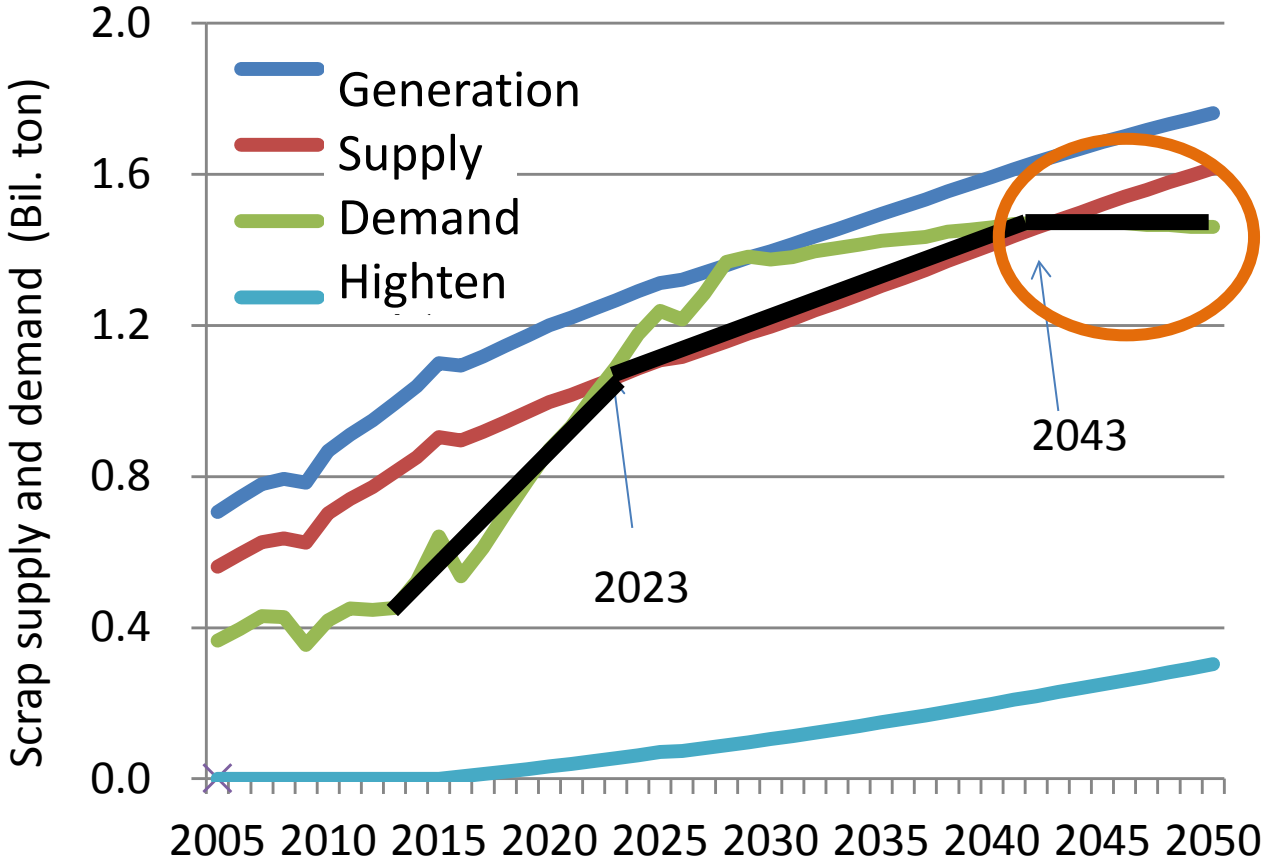


Require relatively large share of high quality steel made by BOF.



In CM case, steel production by BOF is larger than that in BaU case (because of high-tensile steel).

Result4　Demand-supply balance of scrap (CM case)



If technological innovation makes possible to produce high quality steel by EAF, a constraint of demand-side is removed.

Under the condition shifting to EAF at the maximum level,

2023: shortage of scrap (constraint of supply-side)

2043: demand deficiency (constraint of demand-side)

Results5 Summary of CO2 emission

Condition	BaU case		CM case	
	$MtCO_2$	tCO_2/tCS	$MtCO_2$	tCO_2/tCS
2005	2,010	1.75		
2010	2,576	1.80		
	28%	3%		
100%	2,255	0.84	1,366	0.71
Supply side constraints	12%	-52%	-32%	-59%
90%	2,575	0.96	1,644	0.86
	28%	-45%	-18%	-51%
Demand	2,575	0.96	1,888	0.99
constra	28%	-45%	-6%	-44%

rude steel

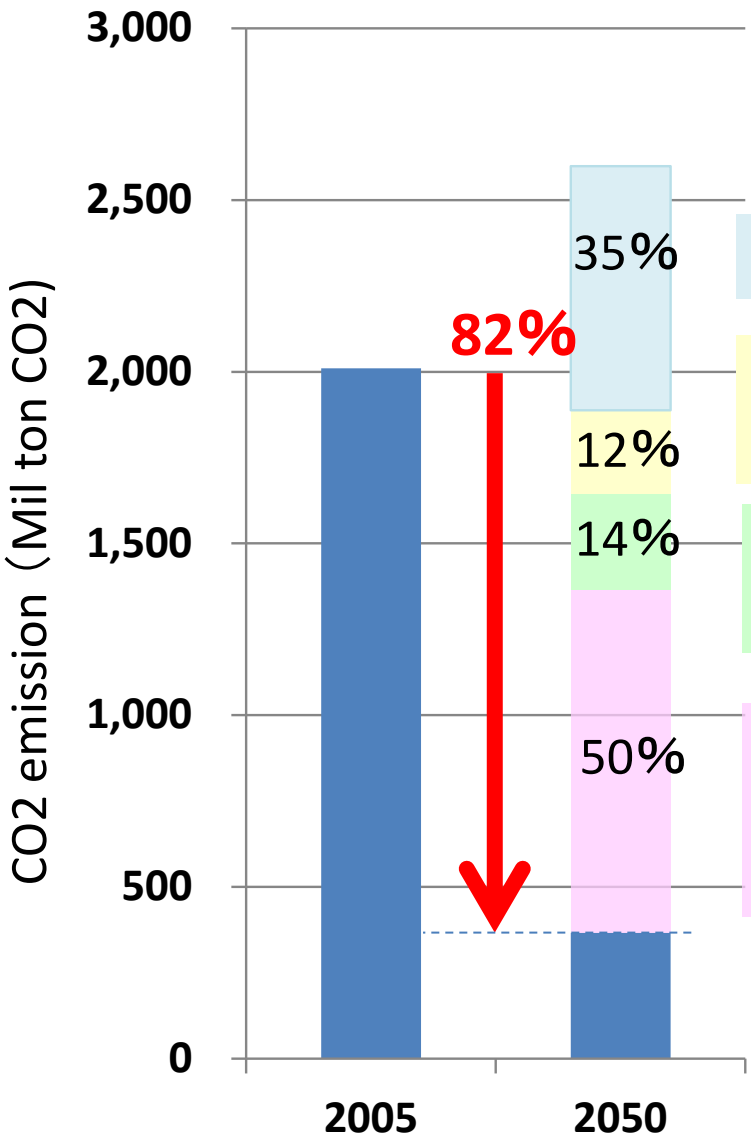
s change rate from 2005

The Maximum CO2 emission reduction is 32%, far from a drastic reduction target.

Steel production increases twice, but growth in CO2 emissions top out at 28%.

In CM case, CO2 emission reduction from BaU case is 15～40%.

CO2 emission reduction potential from steel sector



①reduction of steel demand

②Quality improvement of steel by EAF
(remove of constraint of demand-side)

②increase of recycling rate of scrap
(remove of constraint of supply –side)

③ Improve energy efficiency
④ Reduce carbon intensity
⑤ CCS (ETP by IEA)

Thank you for your attention