

The 19th AIM International Workshop

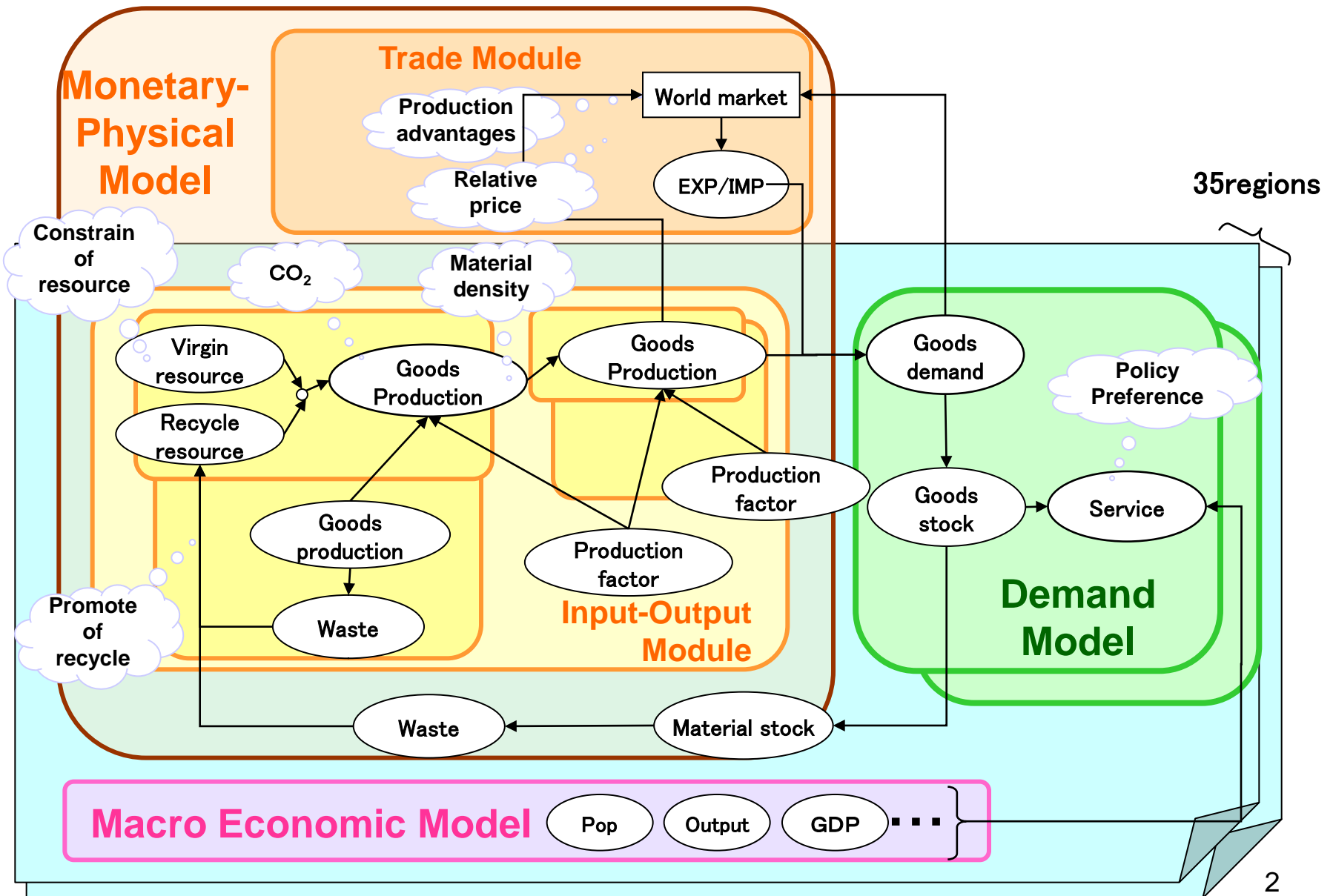
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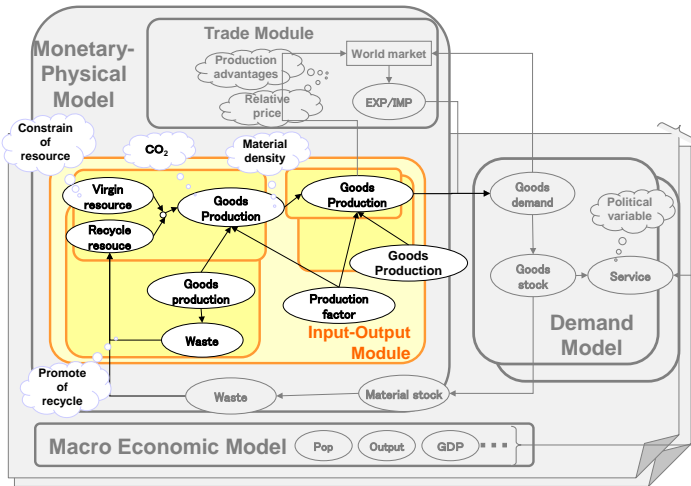
Application of Material Stock and Flow Model_demand/country to Japan

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Research topics in FY 2013



Progress in FY 2013 (1)



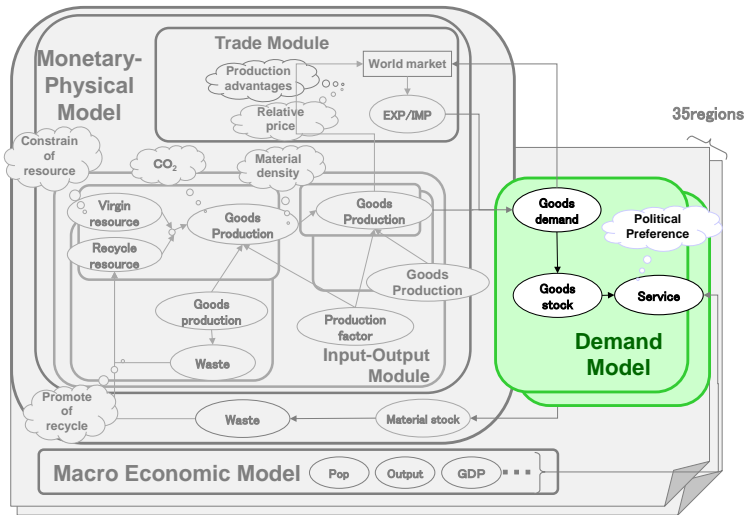
Develop material account matrix

- steel, cement
- 1971–2005
- 35 regions

	Production Sector	Goods	Value Add and Other	Capital Stock	Final Demand Sector	Environment	Final Stock	TOT
Production Sector								
Goods								
Value Add and Other								
Stock goods								
Capital Stock								
Final Ddemand Sector								
Initial Stock								
TOT								

- Express flow and stock in one matrix
- Unit: monetary term, physical term, unique term for goods
- Physical information past few decades is essential to analyze material flow in the future.

Progress in FY 2013 (2)



MSFM_demand/country

- Analyze country by country
- Introduce country-specific countermeasures
- User-friendly tool

MSFM_demand : Material Stock and Flow Model_demand

MSFM_demand/country was separated from MSFM_demand/global.

To make possible to introduce more various countermeasures, the formulation was modified, especially in the service demand part.

The input data was controlled by Excel file. User can easily change values of many coefficients and variables in the future and analyze material demand and stocks with various scenarios.

Material Stock and Flow Model_demand/country

➤ Target : Domestic (not incl. trade)

➤ Region : Japan

➤ Material : Steel

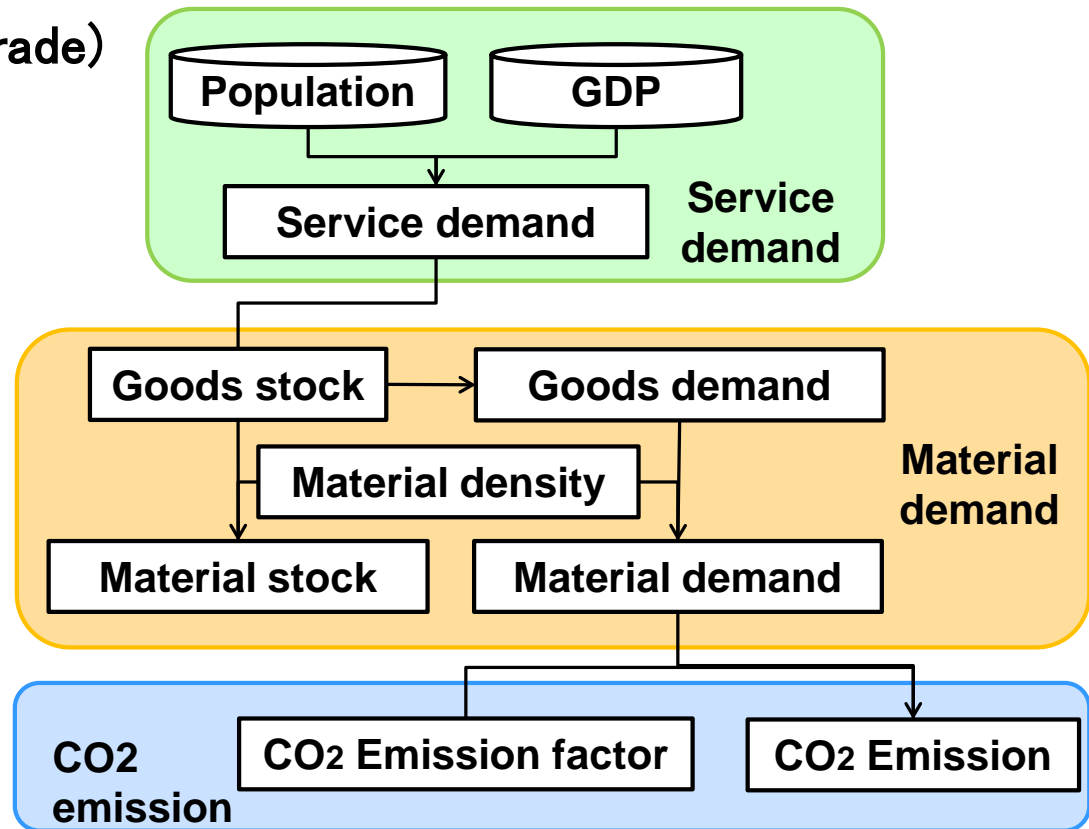
➤ Periods : 2005–2050

➤ Description :

- Service demand
12 classifications
- Goods stocks
24 classifications

➤ Scenario:

- FIX scenario
 - Fix parameters at the value in 2005
- CM scenario
 - Control of service demand, Change of preference
 - Improvement of efficiency of goods stock
 - Technology progress



Estimation of Service Demand

Basic equation

Service demand = Service scale index * Service level index



Ex: Dwelling

Dwelling floor area = Household * Floor area per dwelling

Floor area per dwelling = Household size * Floor area per capita

Ex: Passenger transport

Ps. Trs. volume(d) = population * Trs. volume per capita(d)

Trs. volume per capita (d)=

365.25 * Trip generation unit * distance share(d)
* average distance(d)

Estimation of Service Demand (2)

Ex : Other household service

Other household service index

= Standard of other household service * service supply rate

Ex : Domestic water

Domestic water demand

= population * (household water use/capita + municipal water use/capita)

Household water use/capita

= \sum (Water supply per facility * Share * Rate of access to improved water)
+ Water supply per facility * (1 - Rate of access to improved water)

Ex : Other infrastructure service

Other infrastructure service index

= Standard of other infrastructure service * service supply rate

Standard is
Japan's value
(2005)

Scenario and countermeasure

Scenario : FIX scenario, CM scenario

Common setting

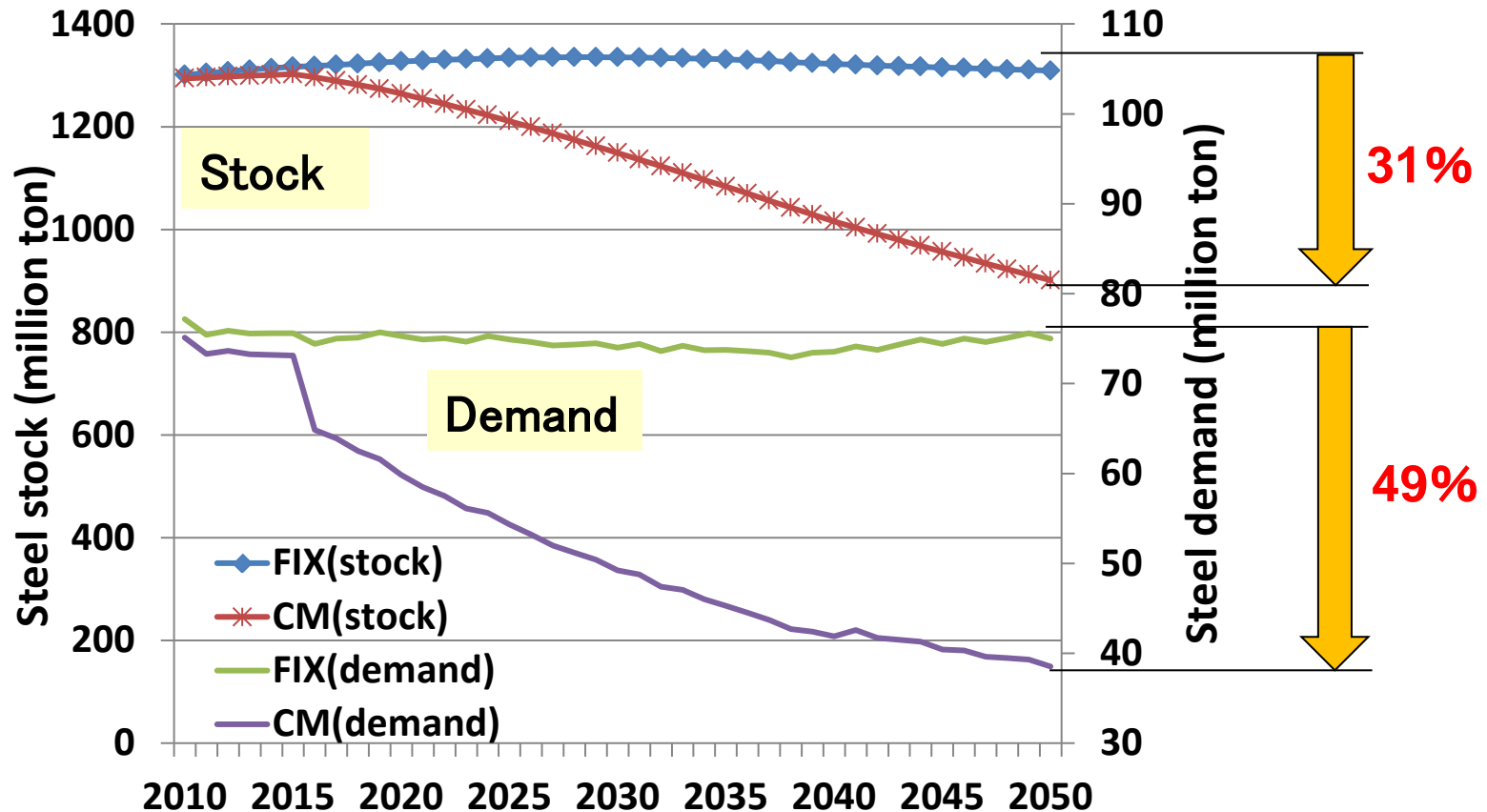
Variables	2005	2050	2050/2005
Population (Million)	126	109	0.87
Household (Million)	49.1	50.0	1.02
Labor force in 2&3 sector (Million)	59	41	0.69
GDP (Bil. USD 2005price)	4,181	5,264	1.26
Power generation (Bil. kWh)	683	1,042	1.53

CM scenario :

- Control of service demand
 - modal-shift of transportation
 - share of material of building
- Improvement of efficiency of goods stock
 - improvement of coefficient of service output
 - improvement of operation rate
- Technology progress
 - introduction of high-performance material
(ex. Increase of share of high-tension steel for steel input)
 - increase in share of electric furnace

Gap between LCS scenario and actual trend

Steel stock and steel demand



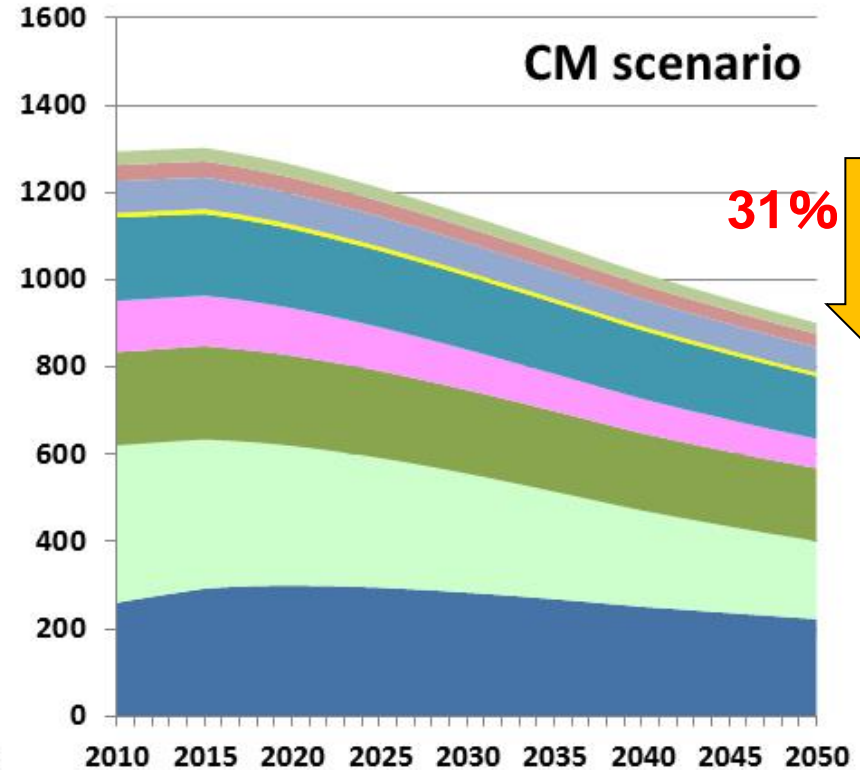
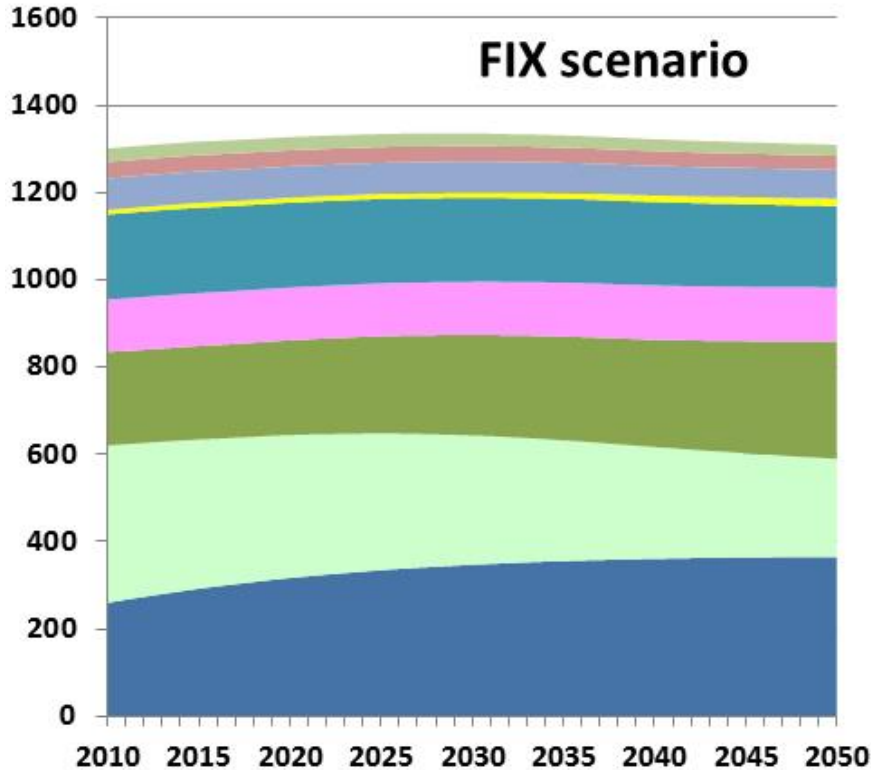
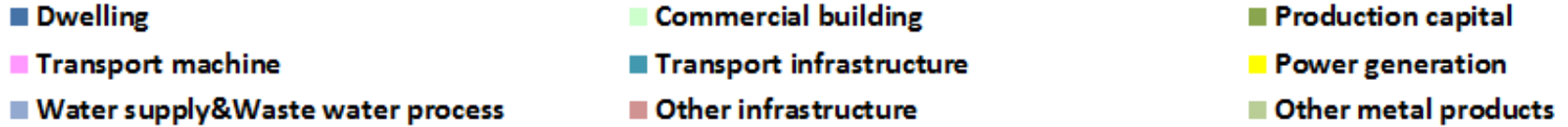
- By introduction of various countermeasures, steel stock is reduced by 31% in CM scenario compared to FIX scenario.
- Steel demand can achieve the 49 % reduction.

Goods stock in 2050

Goods	Unit	2005	2050 (2050/2005)	
			FIX scenario	GM scenario
Dwelling	Mil. m2	5,259	4,982 (0.95)	4,223 (0.80)
Com. building	Mil. m2	1,989	1,357 (0.68)	1,149 (0.58)
Prd. capital	Billion USD	2,005	2,050 (1.02)	2,050 (1.02)
Pow. gen(THR)	Mil. kW	177	289 (1.64)	227 (1.29)
Pow. gen(HYD)	Mil. kW	47	79 (1.66)	26 (0.55)
Ps-car	1000 number	58,722	50,431 (0.86)	30,864 (0.53)
Bus	1000 number	226	194 (0.86)	193 (0.85)
Ps-train	1000 number	53	46 (0.86)	56 (1.05)
Bike	1000 number	13,175	11,315 (0.86)	13,215 (1.00)
Bycycle	1000 number	86,550	74,331 (0.86)	42,165 (0.49)
Airplain	1000 number	0	0 (1.00)	0 (0.75)
Truck	1000 number	18,357	20,528 (1.12)	21,549 (1.17)
Fr-train	1000 number	16	18 (1.14)	36 (2.27)
Ship	1000 GTR	13,564	15,670 (1.16)	14,964 (1.10)
Road	1000km	1,192	1,097 (0.92)	773 (0.65)
Rail	1000km	20	19 (0.92)	26 (1.27)
Harbor	Mil. ton	686	779 (1.14)	699 (1.02)
Airport	Mil. Ps	116	99 (0.86)	87 (0.75)
Irrigation	1000KM	25,560	25,560 (1.00)	25,560 (1.00)
Ind. Water.fac.	Mil. m3	15,750	12,185 (0.77)	10,466 (0.66)
Water sup. fac.	Mil. m3	24,500	21,041 (0.86)	18,373 (0.75)
Waste W. pr	Mil. m3	24,500	21,041 (0.86)	18,333 (0.75)
Oth. infra.	MkW	1	1 (1.00)	1 (1.00)
Oth. metal pr.	Mm3	1	1 (1.00)	1 (1.00)

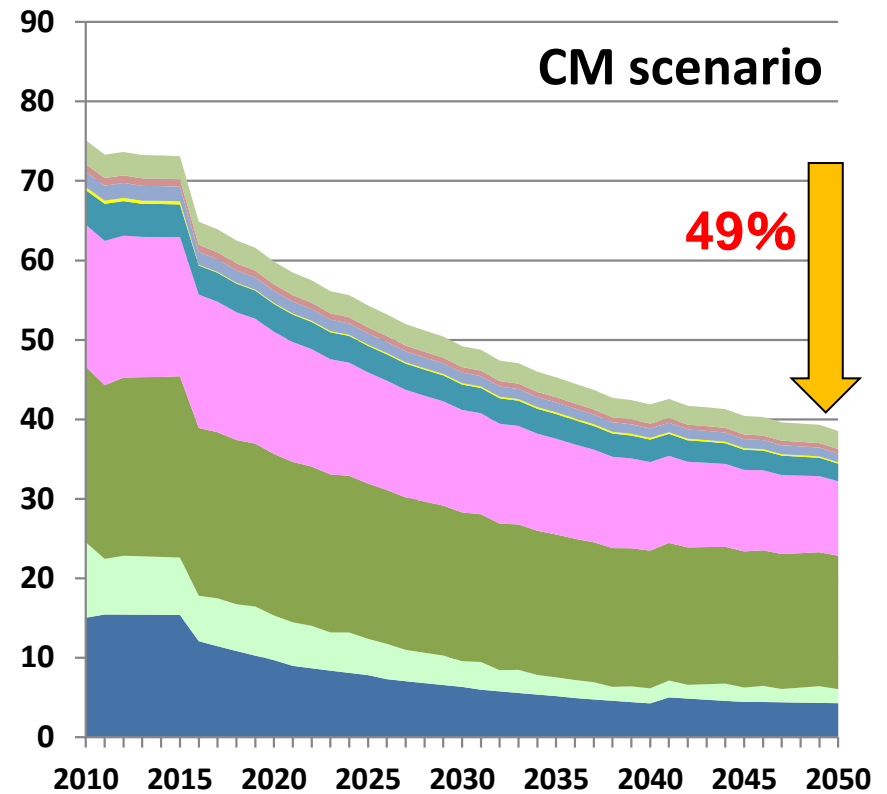
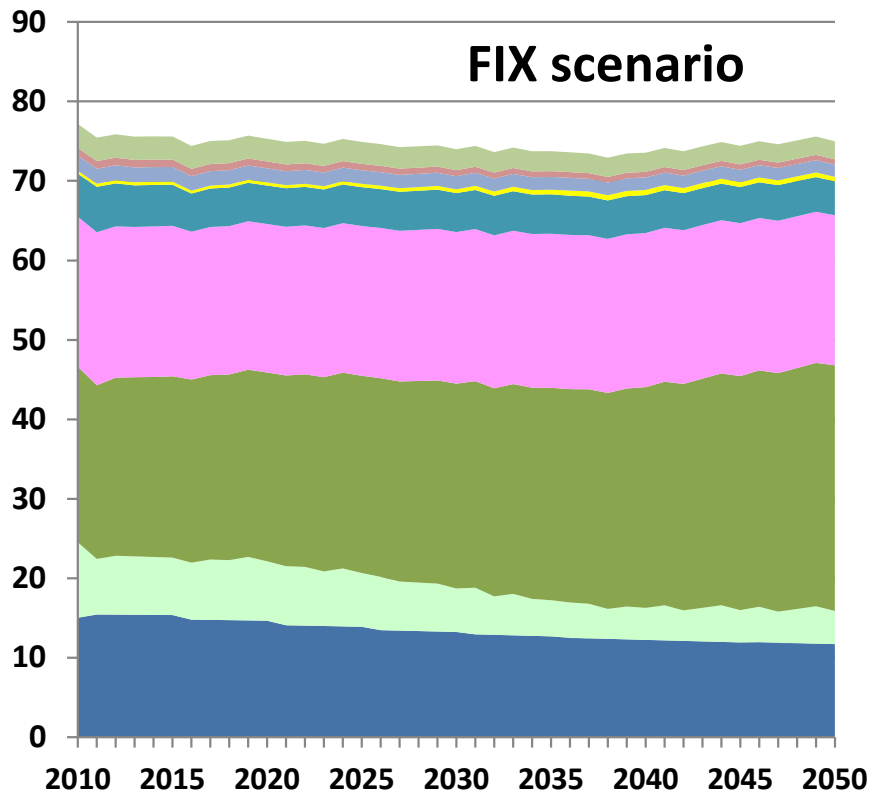
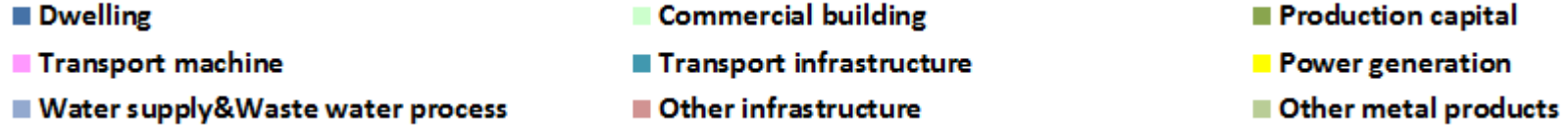
Share: 5% -> 10 %

Breakdown of material stock



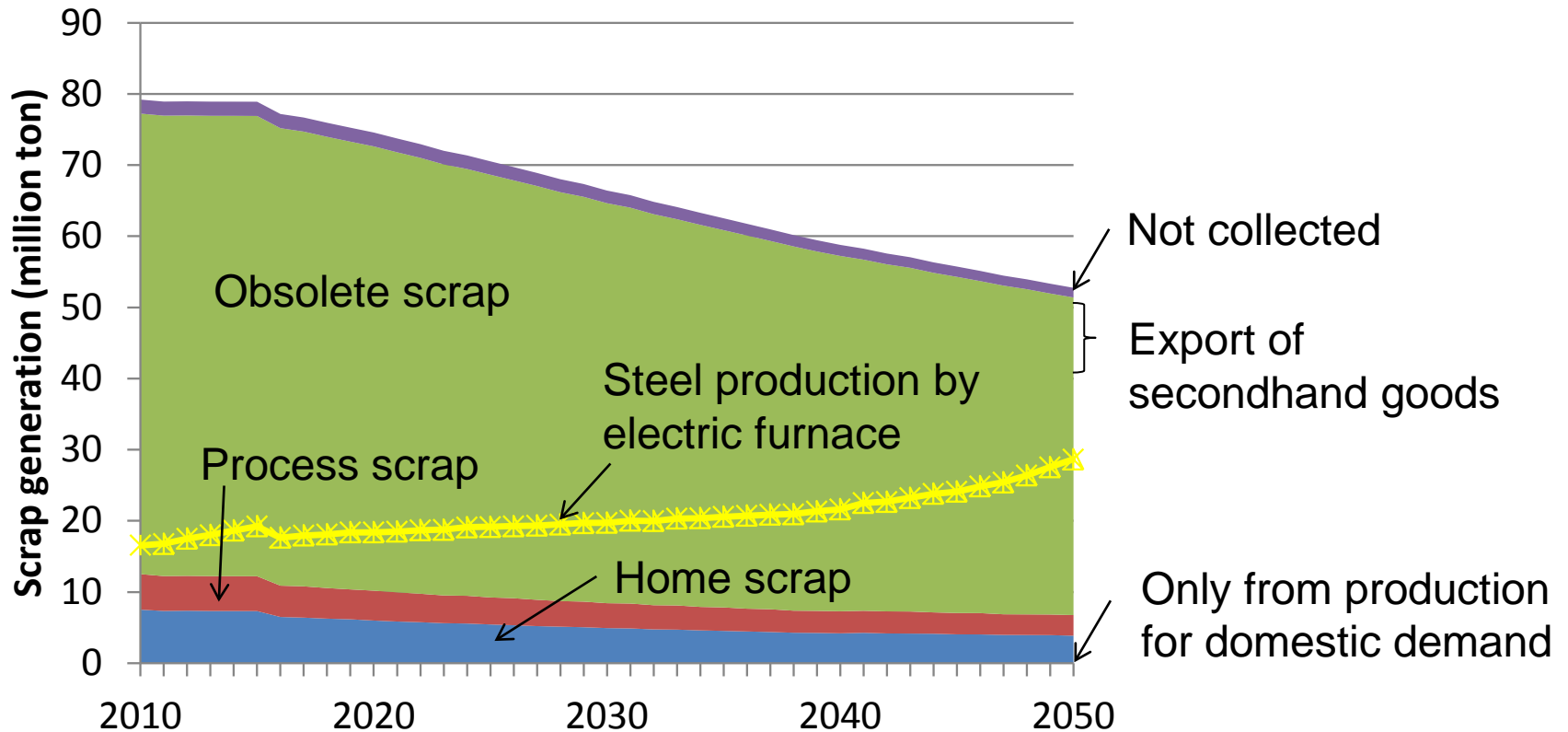
- Main contributor: building, production capital
- Effective countermeasure: improvement of efficiency of goods stock
introduction of high-performance material

Breakdown of material demand



- Effective countermeasure: introduction of high-performance material
 - Building (50%), Production capital (40%), Transport machine (70%)
 - Transport infrastructure (50%), Others (less than 30%)

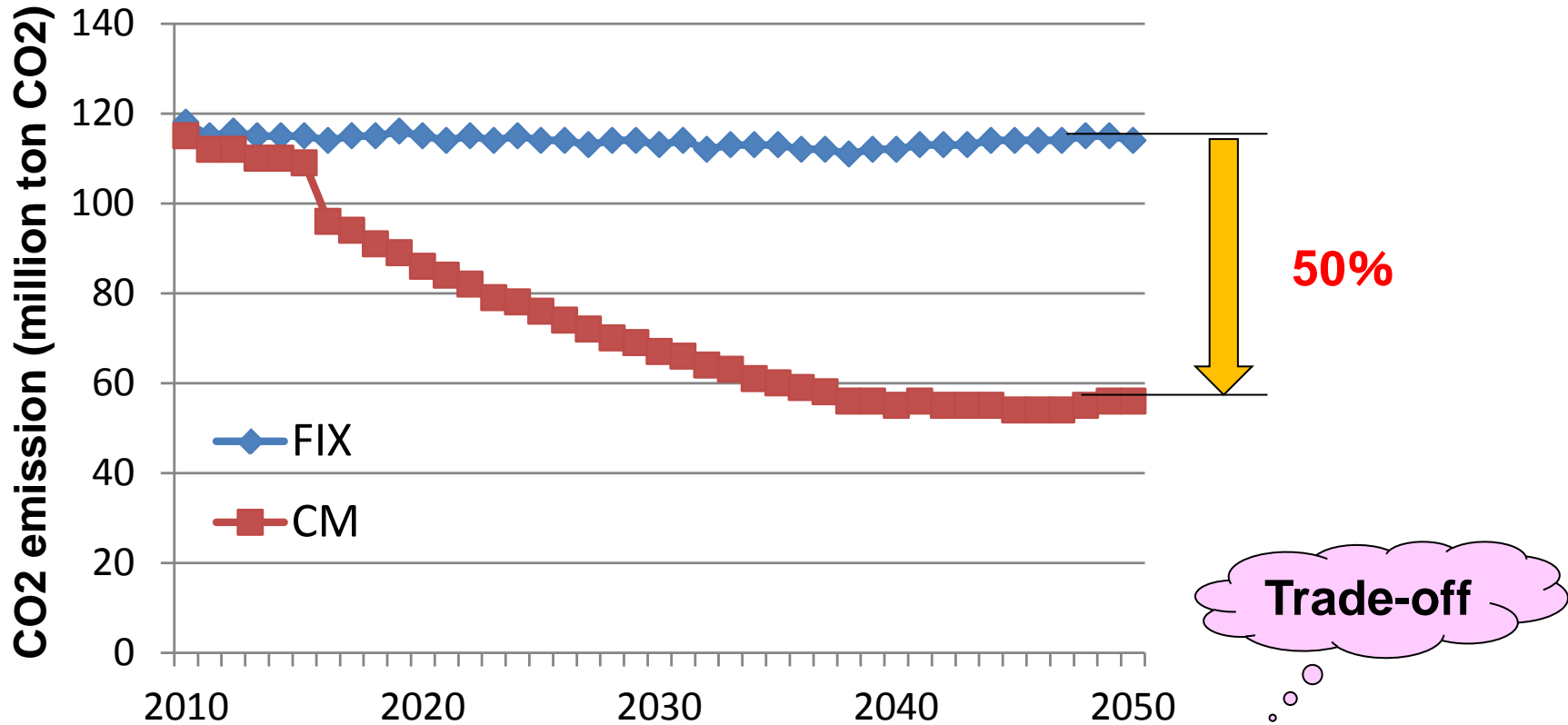
Scrap supply-demand balance



Scrap generation is around 5% of steel stock.

Even though the share of electric furnace reaches 55% in 2050 (22% in 2010), Japan can be self-sufficient.

Gap between LCS scenario and actual trend CO2 emission



High-tension steel is produced by blast furnace. So introduction of electric furnace has an upper limit.

How to bridge gap toward LCS: Production of high-tension steel by EAF

Increase in share of high-tension steel input 14

Task in FY 2014

- Apply MSFM_demand/country to 35 regions
- Develop Monetary–Physical Model and estimate material flow under the framework of material account matrix.
- Integrate all the modules and models

Thank you