Basic Metal and Engineering Industries Firm-Level Study:

Results of parts conducted by JICA/MPDC

5th High Level Forum on Industrial Development in Ethiopia

Toru Homma

Senior Advisor on Private Sector Development

Japan International Cooperation Agency (JICA)

Homma.Toru@jica.go.jp

Addis Ababa, 6 July 2010

With JICA experts in charge:

- Mr Kyoji Uzuka (Basic Metal)
- Mr Eizo Maeda (Eng. Industries)

Contents of today's presentation

- Outline of the Basic Metal and Engineering Industries Firm-Level Study
- Major findings from the JICA's part: basic metal industries
- Major findings from the JICA's part: engineering industries (part 2: power sector and construction machinery industries)
- Recommendations derived from the findings and conclusions

1. Outline of the Basic Metal and Engineering Industries Firm-Level Study

BMEI Firm-level Study
Initial outline

- Period: February – June 2010
  (JICA 2 Experts: from 12 April to 18 June)
- Organisations: Metal Products Development Center (MPDC), Engineering Capacity Building Programme (ecbp) and JICA
- Implementation:
  - The MPDC team headed by the MPDC Head
  - Phase 1(field survey – collecting data and basic data processing): by MPDC and ecbp
  - Phase 2 (analysis): The MPDC team supported by experts from ecbp (demand side – user industries) and JICA (supply side – BMEI industries) and MPDC local consultants
- Field survey: 10 basic metal companies, 30 engineering companies, 10 user companies
- It was requested to JICA in relation to the Ethiopia-Japan Industrial Policy Dialogue

Study flow

(provided at the Kick-off Meeting in MOTI in April)

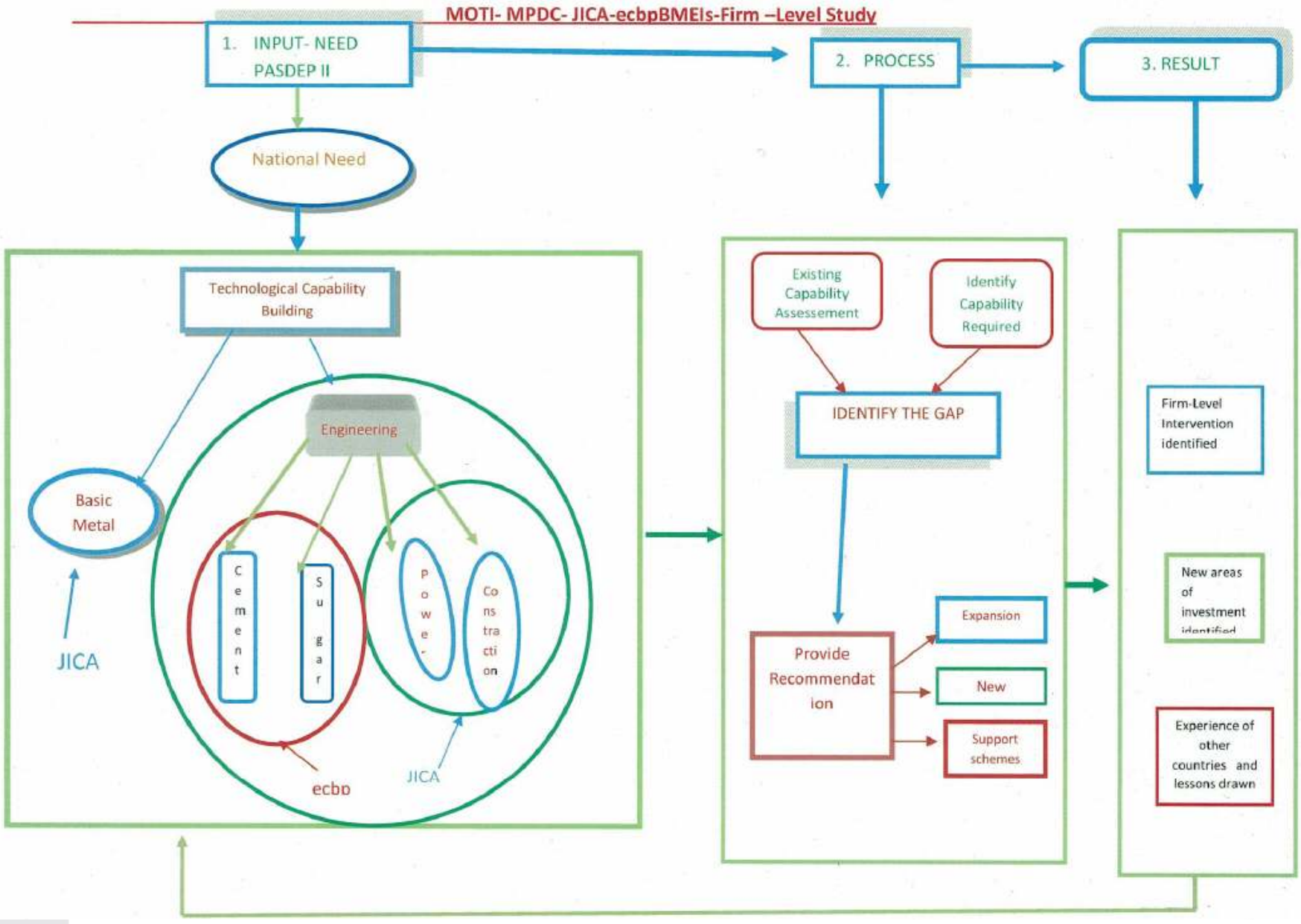


Table of contents of the study report

- I. Background: MPDC
- II. Basic metal industries: JICA with MPDC
- III. Engineering industries (Part 1: Sugar and cement industries): ecbp
- IV. Engineering industries (Part 2: Power and construction machinery industries): JICA with MPDC
- V. Experience of other countries: ecbp and JICA
- VI. Summary of lessons, recommendations and conclusions: ecbp and JICA
- VII. Executive summary: MPDC and ecbp
- VIII. Annex. Processed data: ecbp and JICA

Table of contents (JICA's part) (1)

Table of contents (JICA's part) (2)

Definition of Basic Metal and Engineering Industries

- Basic Metal Industries (ISIC Rev.3.1 Div. 27):
  production of metal from ore, scrap and conversion of billet, slab etc. into primary metal products
- Engineering Industries (ISIC Rev.3.1 Div. 28-35):
  28. *Manufacture of fabricated metal products, except machinery and equipment*
  29. *Manufacture of machinery and equipment n.e.c.*
  30. *Manufacture of office, accounting and computing machinery*
  31. *Manufacture of electrical machinery and apparatus n.e.c.*
  32. *Manufacture of radio, television and communication equipment and apparatus*
  33. *Manufacture of medical, precision and optical instruments, watches and clocks*
  34. *Manufacture of motor vehicles, trailers and semi-trailers*
  35. *Manufacture of other transport equipment*

Metal and Engineering Industries Sub-sector 5-Year Development Plan 2003-2007 EFY (BMEI 5-Year Plan)

- Prepared by Ministry of Trade and Industry (MOTI) / Metal Products Development Center (MPDC) in May 2010
- English version of the summary of the report prepared as an input for the PASDEP II, which is likely to put focus on BMEI as a prioritised industry for import substitution
- It identifies that 85% of the demand for BMEI products are currently fulfilled by imports.
- It sets various targets including: (i) Gross production value in 2014/15 to be 5 times of that in 2010/11; (ii) Steel demand to grow 28% p.a.; per capita steel consumption to grow from 12.1kg (EFY2002) to 34.72kg (EFY2007); (iii) future 5-year demand for BMEI products by major industrial sectors; (iv) domestic capacity targets (%) for each industrial sector and each year.

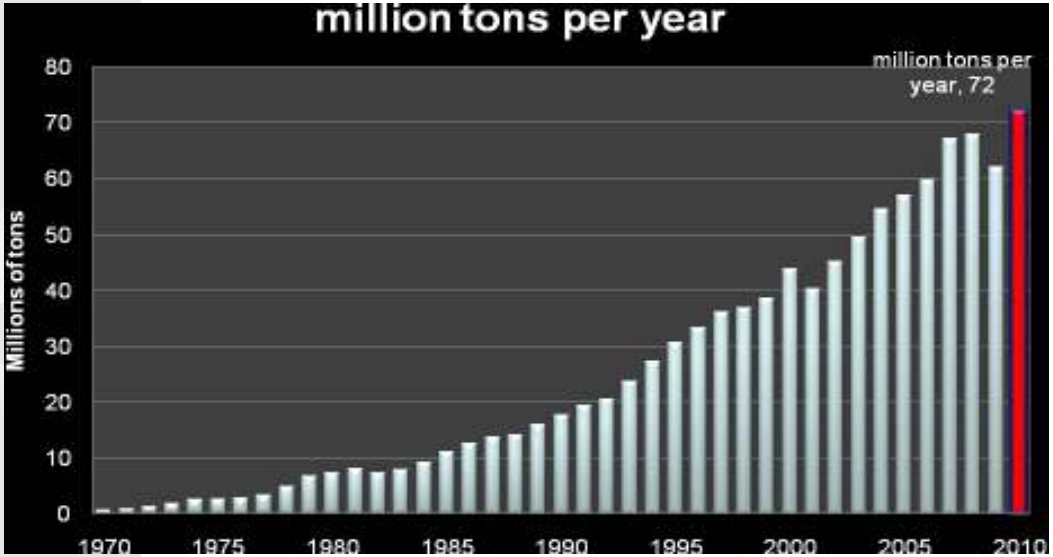
2. Major findings from the JICA's part (Chapter II): Basic metal industries

II-1. Iron ore exploration and possible utilization

- Promising site: Bikilal Iron Ore Deposit (West Ethiopia) – estimated quantity 22 mil tons
- Two previous studies: (i) Ethio-Korean, 1988, (ii) Swedish Boliden Contech, 1995
- Relatively low Fe content (41%) but high TiO_2 (15-18%) and V_2O_5 (0.18%) contents, which increase the ore value
- Was not proved to be strictly economically feasible at that time but…
- Production cost is Birr2.5/kg (if converted in current price) which compares to steel scrap cost Birr3-5/kg

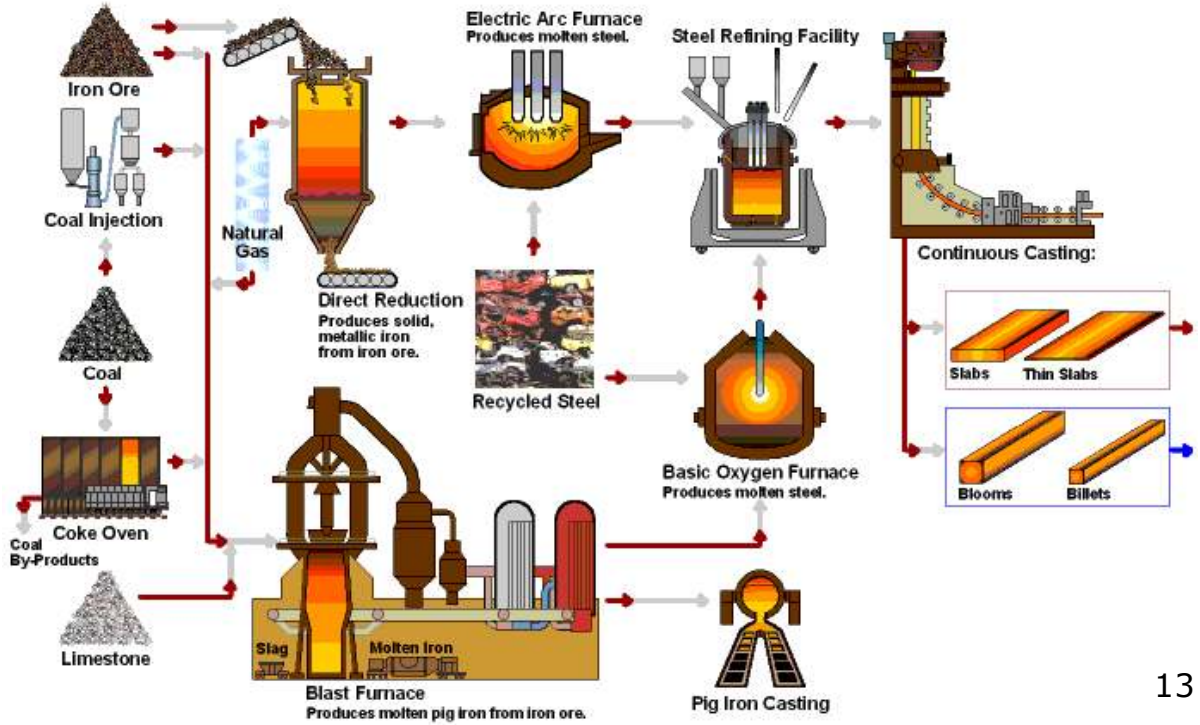
Recommendation: It is worth while re-investigating its feasibility under the current high mineral price situation.

Direct Reduced Iron (DRI) (1)



(Source) Ravenscroft, C., Midrex Technologies Inc., presented at 2010 SEAISI Conference

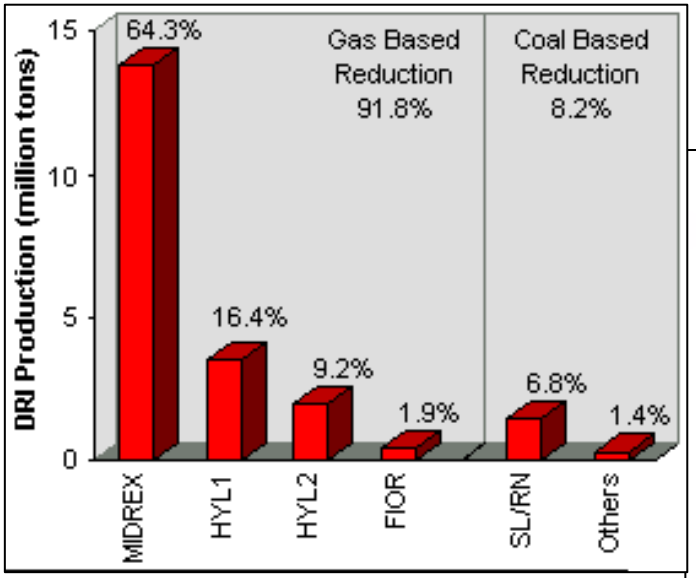
- World DRI production continues to increase as an alternative to the blast furnace-based integrated iron making in developing countries.



(Source) American Iron and Steel Institute

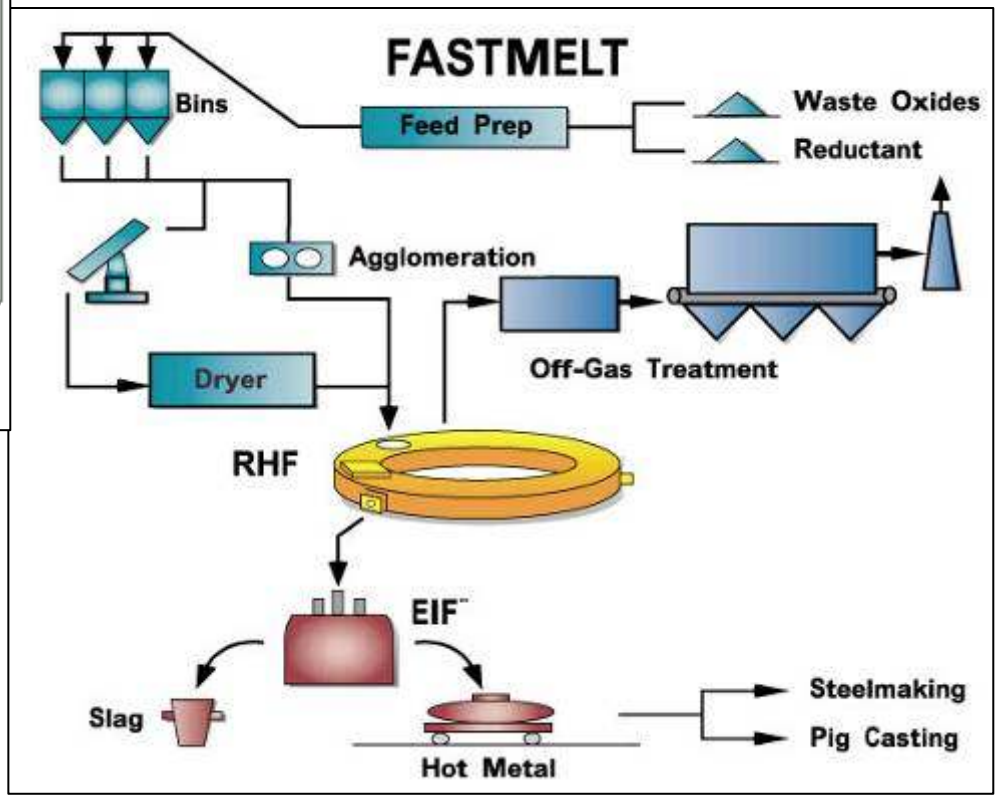
Direct Reduced Iron (DRI) (2)

- Among various kinds of DRI production process have been developed, MIDREX has been the most major one while FASTMELT is updated energy-efficient process.



Recommendation:

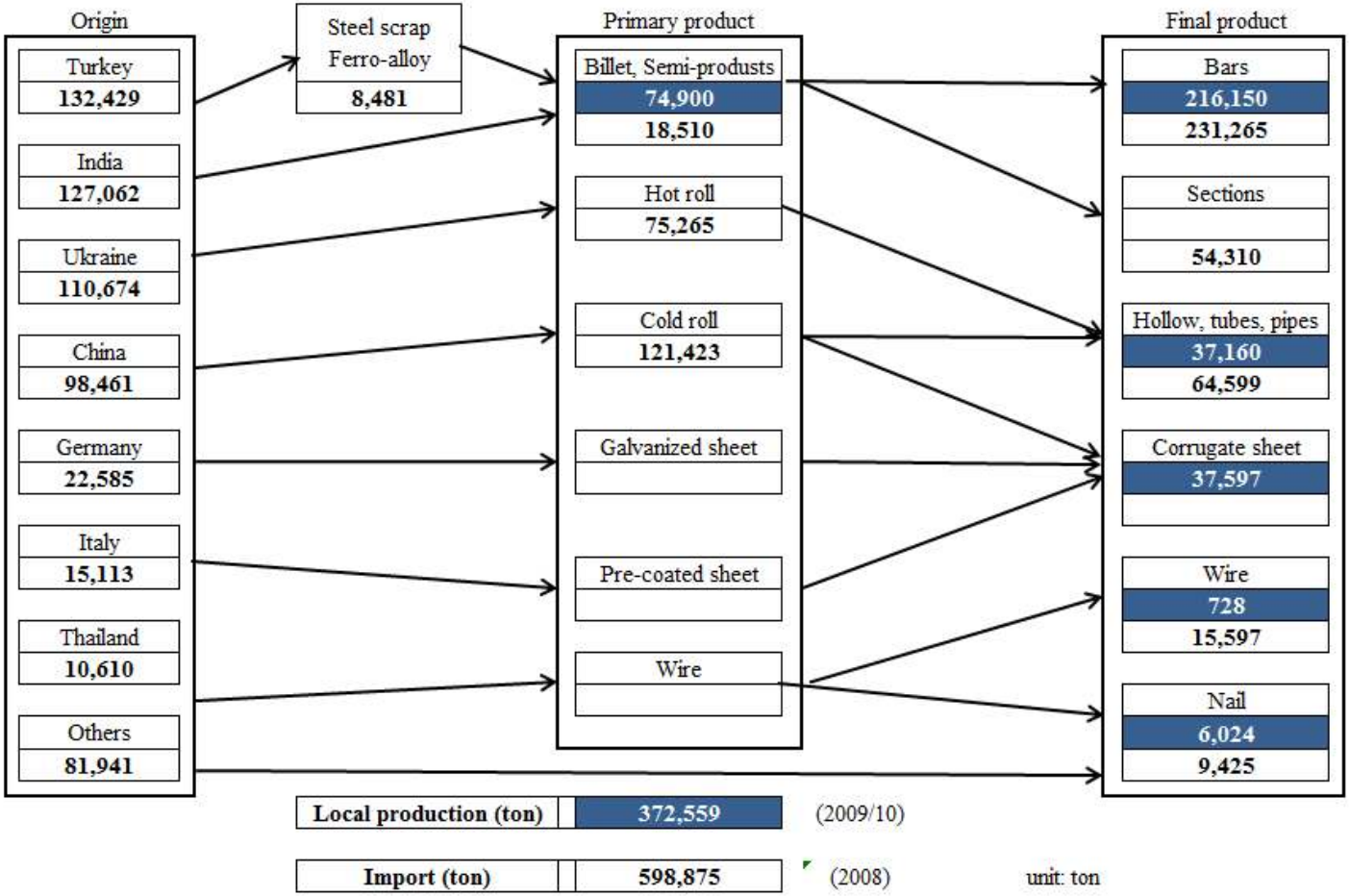
Examine if any type of DRI is suitable for the current situation in Ethiopia through F/S.



(Source) Brochure of Midrex technologies, Inc

II-2. Material flow: Iron and steel in Ethiopia

- The steel industry heavily depends on raw material import.
- It tends to concentrate in the downstream sub-sectors.
- There are many missing data.



Recommendation: establish data collection system and clarify the material flow further so that appropriate intervention can be made

II-3. Existing capability assessment (1)

- Production capacity of the major 14 BM companies exceeds 1 million tons. Half of them have been recently installed.

Production capacity and actial production in 2009/10 (Unit: ton)

No.	Firm-code	Billet		Reinforce bar		Hollow section		Corrugate sheet		Wire		Nail		Total	
		Attainable	Attained	Attainable	Attained	Attainable	Attained	Attainable	Attained	Attainable	Attained	Attainable	Attained	Attainable	Attained
1	2					2,300	460	1,000	200					3,300	660
2	3	13,000	3,900	13,500	9,600	30,000	18,000	25,000	7,500					81,500	39,000
3	4							22000	9,000					22,000	9,000
4	5			100,000	36,000									100,000	36,000
5	7	35,000	10,500	156,200	52,900									191,200	63,400
6	9	9,600	2,900	6,823	6,650					1,700	520	6,246	3,440	24,369	13,510
7	10	72,000	21,600	108,000	27,000									180,000	48,600
8	E-12									600	70	4,000	2,000	4,600	2,070
9	MA					48,000	12,000							48,000	12,000
10	S-1							35,000	16,000					35,000	16,000
11	S-4							12,000	3,000	904	138	480	4	13,384	3,142
12	S-5					7,200	6,700	2,430	1,897					9,630	8,597
13	S-7											800	580	800	580
14	ST	120,000	36,000	280,000	84,000									400,000	120,000
Total		249,600	74,900	664,523	216,150	87,500	37,160	97,430	37,597	3,204	728	11,526	6,024	1,113,783	372,559

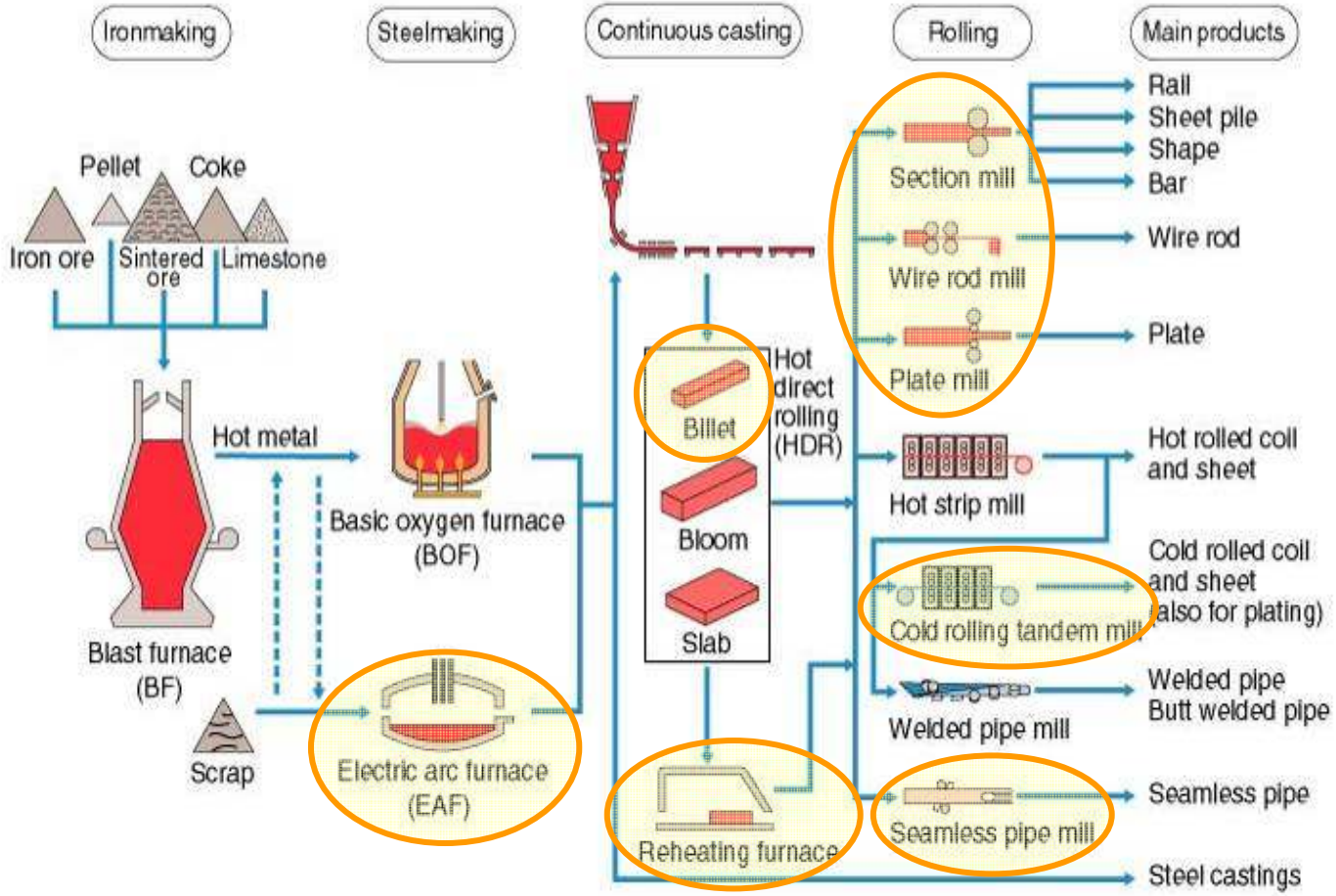
New facilities installed in the last five years (Unit: ton)

No.	Firm_Code	Product	Capability (ton/year)
1	3	Hollow section, corrugate sheet, reinforced bar	43,500
2	5	Reinforced bar	60,000
3	N/A	Hollow section	20,000
4	ST	Reinforced bar	280,000
5	10	Reinforced bar, sections	108,000
Total			511,500

(Source) questionnaire and hearing by the Study team

II-3. Existing capability assessment (2)

- Iron and steel manufacturing processes which are covered by Ethiopia are still limited and need to be explored toward upstream processes.



Iron and steel manufacturing process
(Ethiopia's coverage is marked with circles

(Source) JFE 21st Century Foundation (2003)

Basic metal companies surveyed

- Basic metal industries (14 companies):
  - Billet (5 companies)
  - Reinforced bar (6 companies)
  - Hollow section (4 companies)
  - Corrugate sheet (6 companies)
  - Wire (3 companies)
  - Nail (4 companies)

II-4. Identification of capability required

- According to the 5-year projection, steel consumption grows 28% p.a. and 2014/15 demand will reach 3 million ton.

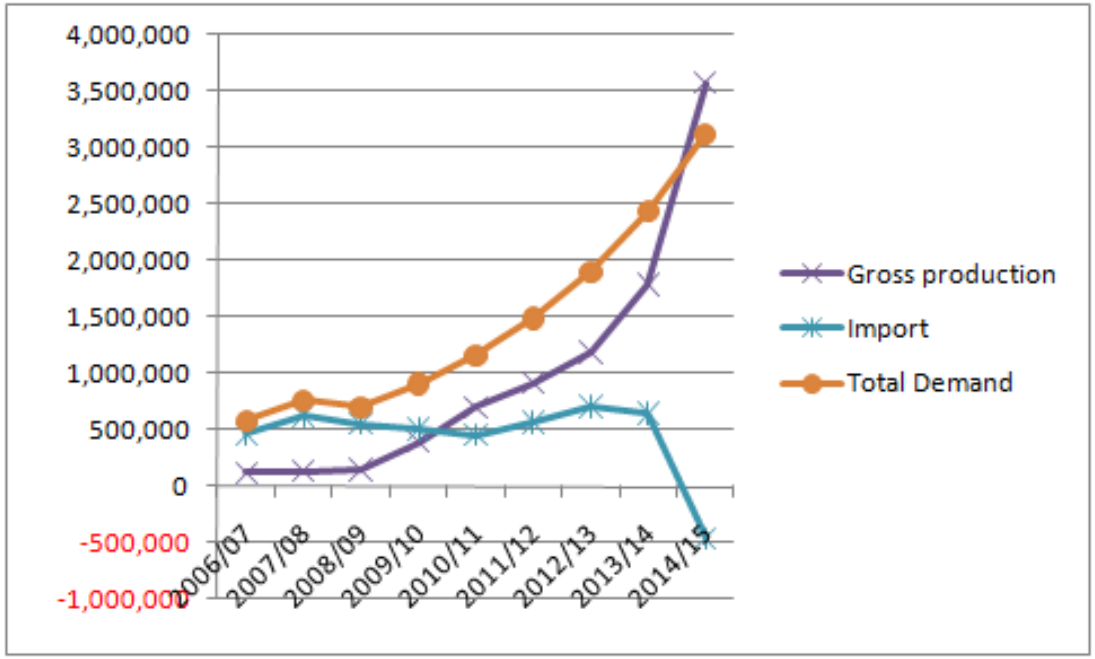
Steel consumption projection

		Present 2009/10	2010/11	2011/12	2012/13	2013/14	2014/15
Population	(million)	-	81.7	83.7	85.7	87.8	89.9
	growth (%)	-	-	2.4	2.4	2.5	2.4
Average crude steel consumption	(kg)	12.1	14.23	17.78	22.23	27.75	34.72
	growth (%)	-	17.6	24.9	25.0	24.8	25.1
Demand for steel	(ton)	908,385	1,162,733	1,488,298	1,905,021	2,437,427	3,121,187
	growth (%)	-	28.0	28.0	28.0	27.9	28.1

(Source) MOTI/MPDC (2010) Metal and engineering industries 5-year plan etc.

II-5. Identification of the gap

- According to the 5-year projection, domestic production will grow faster than the steel consumption grow. This will result surpassing the total demand in 2014/15.



Estimation of basic metal production (ton)

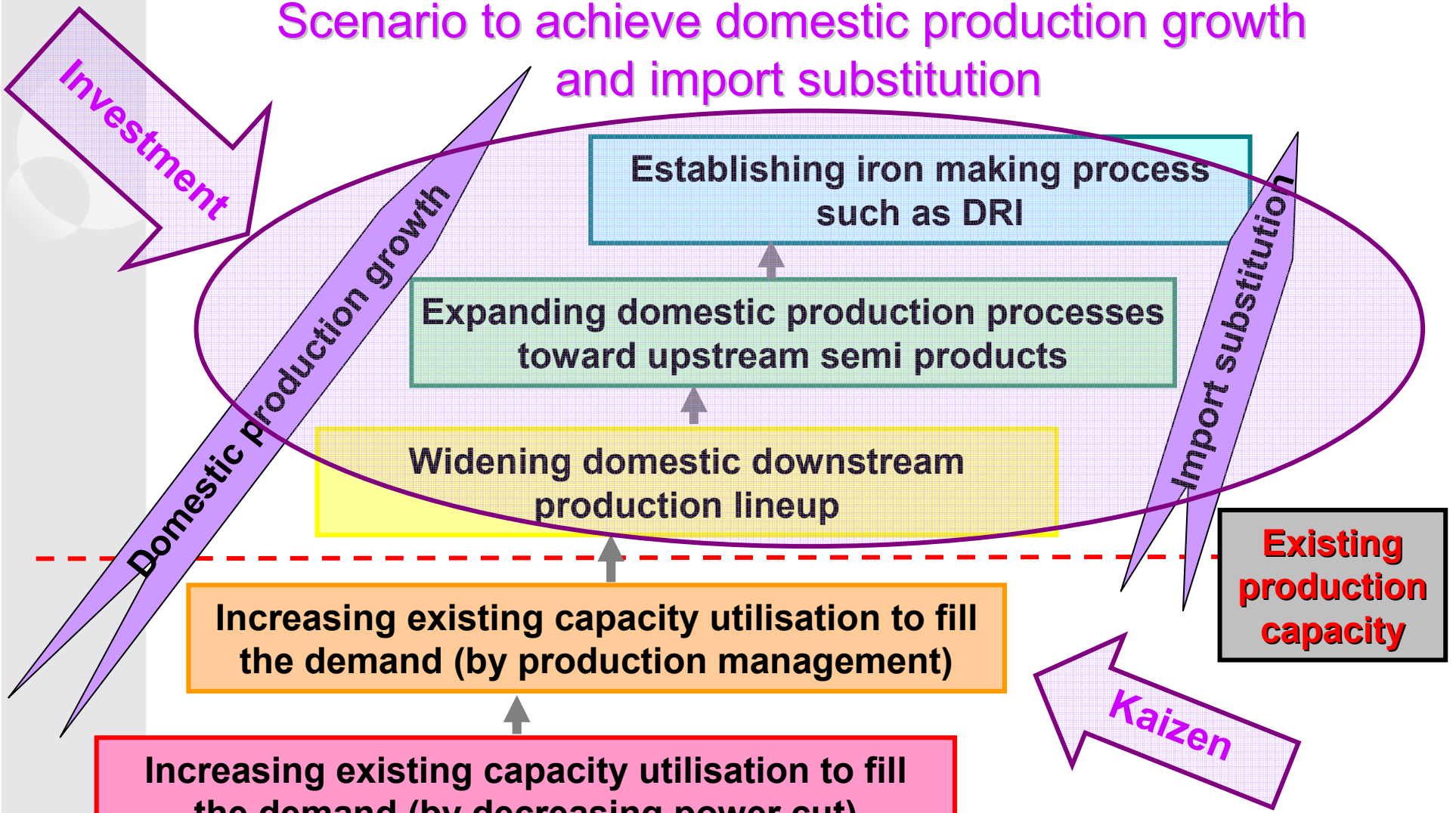
(Source) MOTI/MPDC (2010) Metal and engineering industries 5-year plan etc.

	Billet	Bar	Hollow	Corrugate	Wire	Nail	Total
2009/10	74,900	216,150	37,160	37,597	728	6,024	372,559
2010/11	140,438	405,281	69,675	70,494	1,365	11,295	698,548
2011/12	182,569	526,866	90,578	91,643	1,775	14,684	908,113
2012/13	237,339	684,925	117,751	119,135	2,307	19,089	1,180,546
2013/14	356,009	1,027,388	176,626	178,703	3,460	28,633	1,770,819
2014/15	712,018	2,054,776	353,252	357,406	6,921	57,266	3,541,639
%	20.1	58.0	10.0	10.1	0.2	1.6	100.0

Estimate capability requirement (ton)

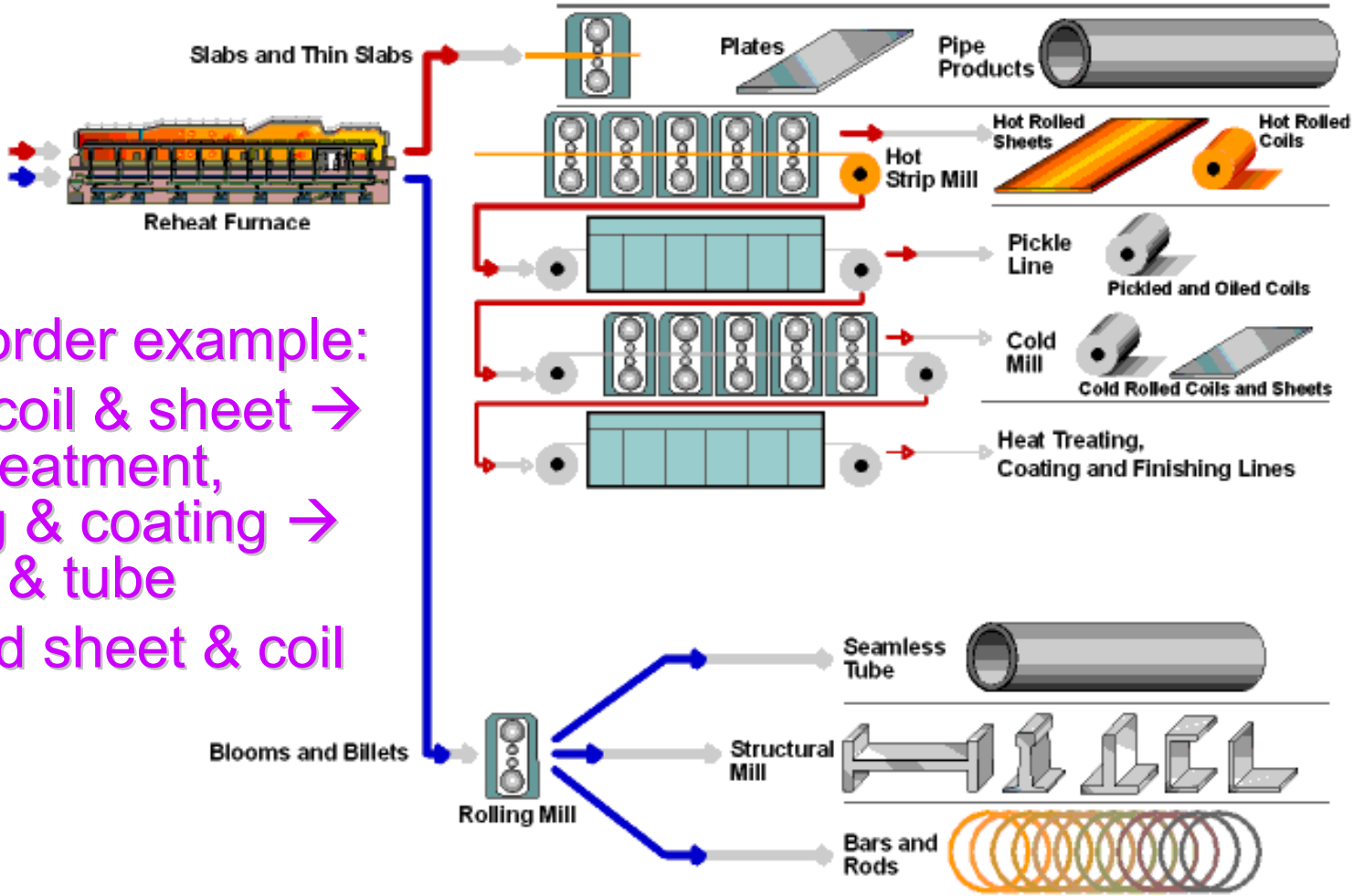
II-6. Technical recommendation how to fill the gap (1)

Scenario to achieve domestic production growth and import substitution



II-6. Technical recommendation how to fill the gap (2)

- Widening domestic downstream production lineup

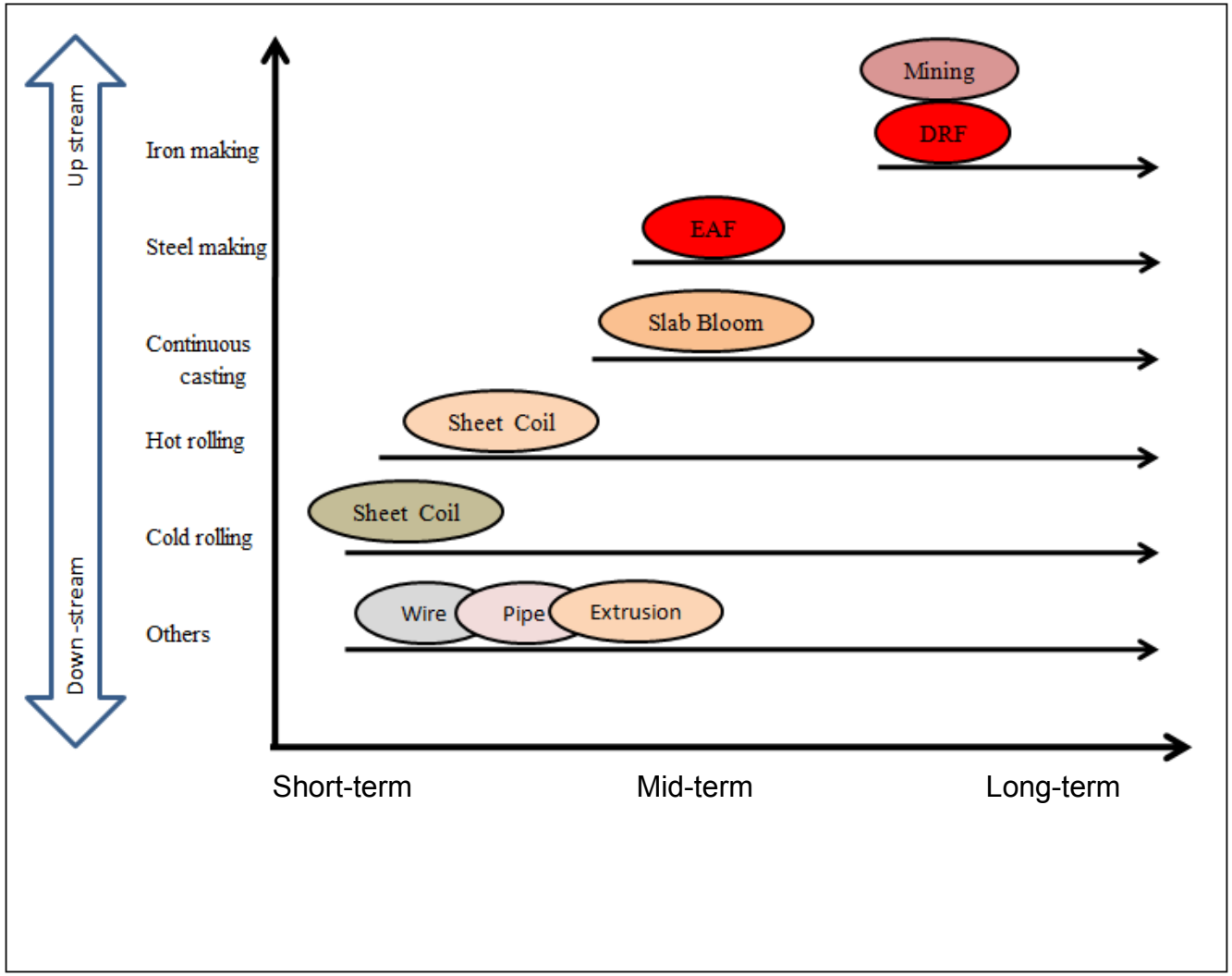


Sequential order example:
Cold rolled coil & sheet → heat treatment, galvanising & coating → pipe & tube
→ hot rolled sheet & coil

(Source) American Iron and Steel Institute

II-6. Technical recommendation how to fill the gap (3)

Basic metal products technological development scenario



II-7. Examples of other countries (1)

- Minimum efficient scale and initial investment cost for major process according to other countries' experience
  - Conventional
    - Simple rolling of steel bars and shapes: 100,000 t/y (US$20 million)
    - Steel rolling companies which uses electric furnace: 300,000 t/y (US$100 million)
    - Simple rolling and hot strip milling of steel sheets: 2 million t/y (US$400 million)
    - Blast furnace - integrated steel mill: 3 million t/y (US$4 billion)
  - Alternative
    - Hot coil production based on electric furnace and thin slab continuous casting: 1 million t/y (US$300 million)
    - Direct reduction method: 0.5-1.0 million t/y (US$100 million)

(Source) Sato, Hajime (2008) Steel Industry in Asia: Development and Restructuring, IED-JETRO.

II-7. Examples of other countries (2)

- Southeast Asian countries have different experiences according to their historical situations
  - Example 1. Indonesia
    - State enterprise-led integrated production system at a turning point
    - One of a few countries which realised direct reduced iron integrated production (natural gas based)
    - Large market potential with 230 million population and less per capita steel consumption (29kg, compared to Thailand 228kg, Vietnam 65kg)
    - Struggling with high cost structure and weak competitiveness
  - Example 2. Vietnam
    - Government of Vietnam requested Government of Japan to provide assistance for master plan making in order to develop domestic steel industry
    - Key recommendations: preferential tax system; maintaining of integrated steel mill competitiveness; infrastructure development; advanced technologies; quality improvement; state-owned companies reform; environmental conservation

(Source) Sato, Yuri (2008) Iron and Steel Industry in Indonesia. (ed.) Sato, Hajime. (2008) Steel Industry in Asia: Development and Restructuring, IED-JETRO.
(Source) JICA / Nippon Steel (1998) Master Plan Study on the Development of Steel Industry in the Socialist Republic of Viet Nam

3. Major findings from the JICA's part (Chapter IV): Engineering industries (part 2) – Power sector and construction machinery industries –

IV-1-1. Overview of the power sector

- Current capacity: 1,600MW
- Hydro (86%), Diesel (13%), Geothermal (1%)
- Frequent power cut is a major obstacle for industries
- Ethiopian Electric Power Corporation (EEPCO)'s plan: 11,600MW to be newly developed = Hydro (10,710MW) + Wind (540MW) + Geothermal (350MW)

  (according to the Study analysis based on EEPCO data)
- Estimated potential 60,000MW in total: Hydro (45,000MW), Wind (10,000MW), Geothermal (5,000MW)

IV-1-2. Existing technical capability

- Major part of power facility/equipment depends on import or foreign companies' engineering services as "full turn key basis"
- Domestic companies focused
- Examples of domestic production experience
  - Penstock
  - Accessories for middle voltage transmission
  - High voltage transmission tower (prototype)
  - Wind power facilities (approaching)

IV-1-3. Identification of technical capability required (1)

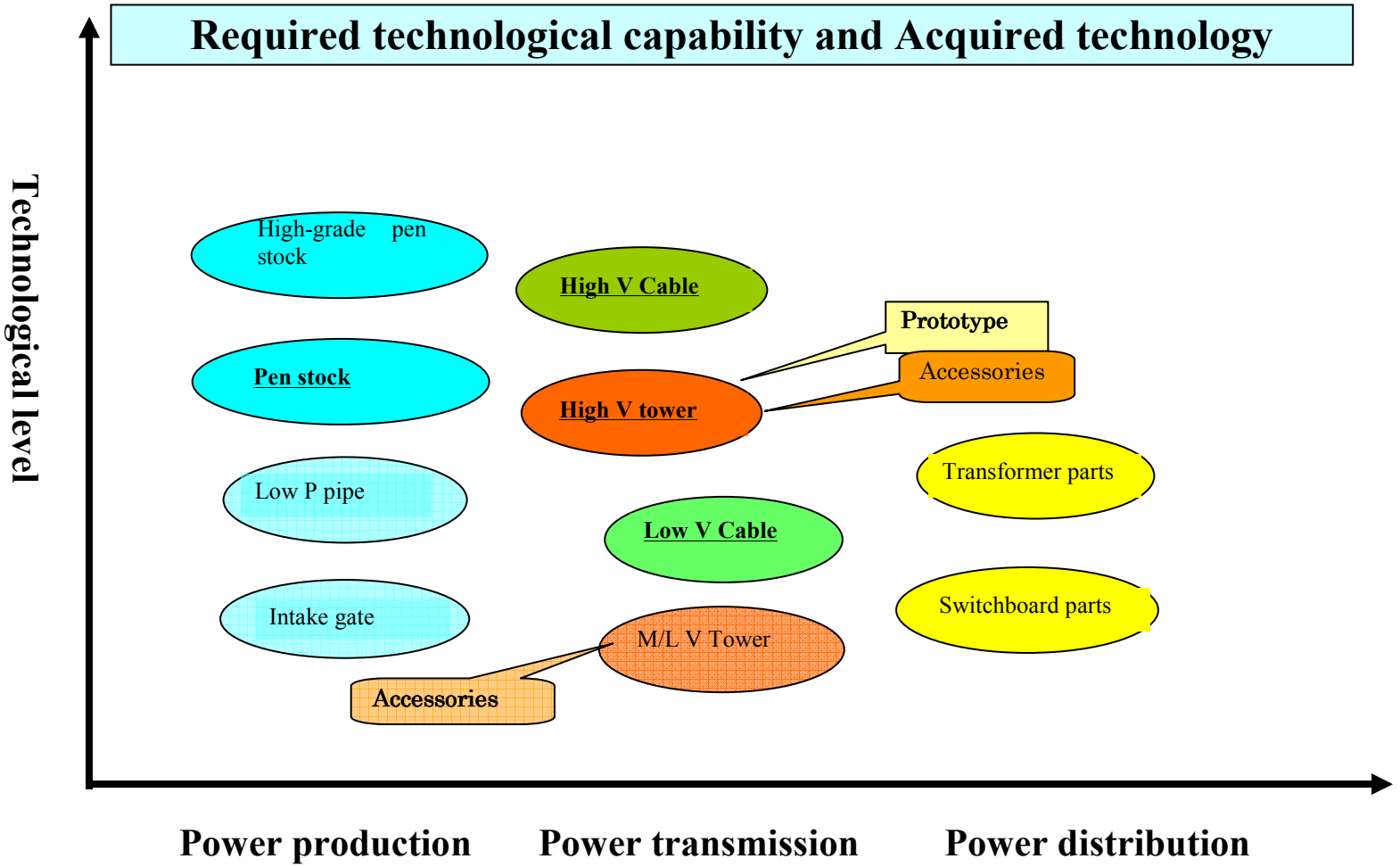
- BMEI 5-Year Plan
  - 5-Year demand for BMEI products – 860,112 mil. Birr
  - 5-Year gross value of domestic production – 430,056 mil. Birr (Domestic capacity target 50%) = Power sector provides 75% of whole demand from all major industries
- EEPCO's new strategies on increasing domestic procurement
  - "Detailed Technical Requirement for Transmission Line Materials"
  - "Detailed Technical Requirement for Power Transformers and Steel Structures"
- Demand for steel fabrication in power plant and transmission tower
  - Study analysis shows 650,000t demand in next 5 years
  - Plan for extension of 2,440km transmission line
  - Emerging demand for wind power farms – transportation advantage for domestic companies

IV-1-3. Identification of technical capability required (2)

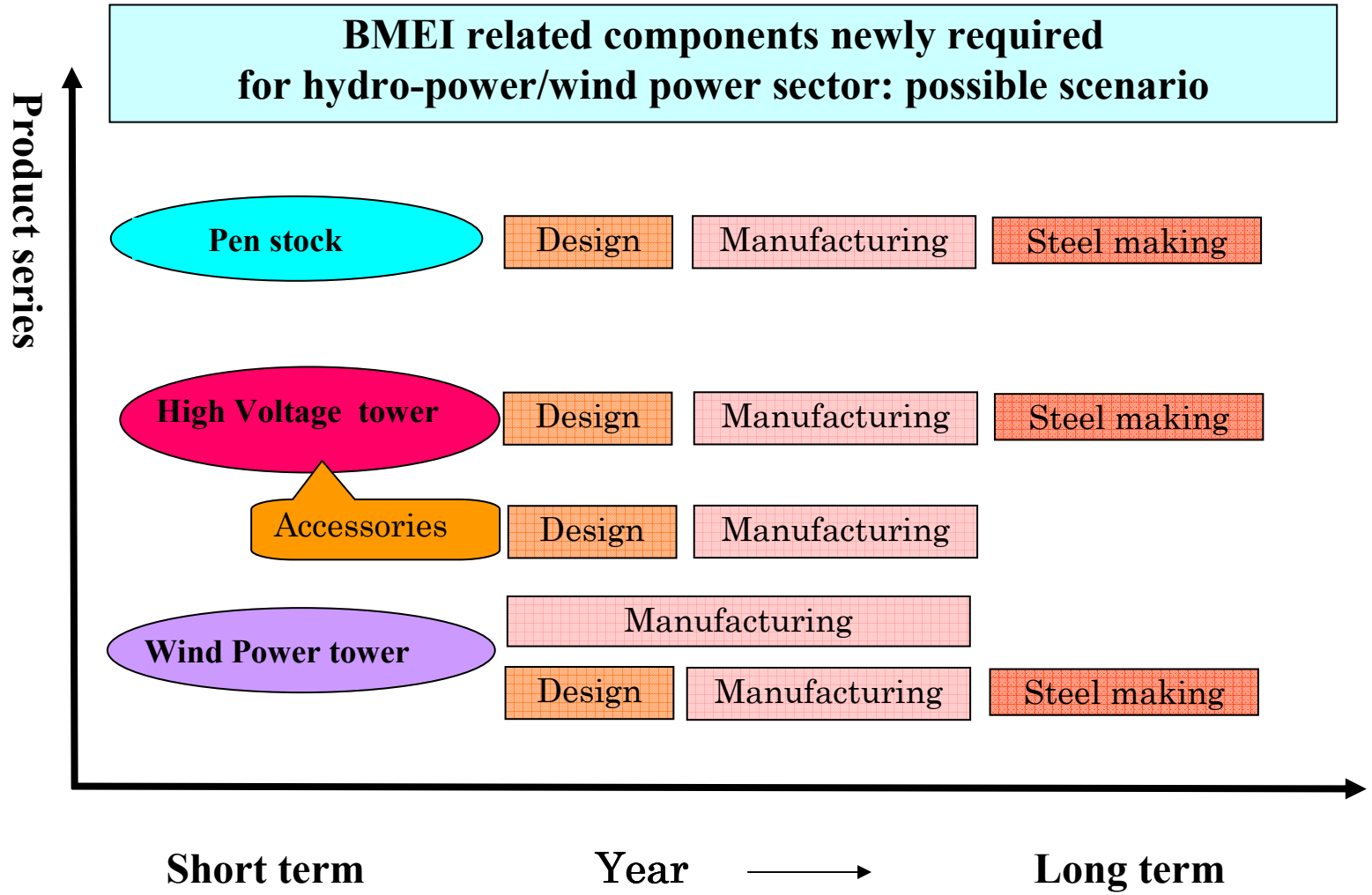
- Concrete demand for metal and engineering products by EEPCO – various kinds of long and short lists
  - List of machinery/equipment and metal products for a typical hydropower plant (258MW)
  - List of parts and materials for Finchaa-Amerti-Neshe multi purpose project
  - List of BMEI parts and components necessary for rural electrification and distribution
  - List of machinery/equipment/metals/instruments for procurement at the EEPCO mechanical workshop for 5 years after 2010

An example of accessories- Spacer

IV-1-4. Technical recommendation on how to fill the gap (1)



IV-1-4. Technical recommendation on how to fill the gap (2)



Capacity, gap and recommendations on major power equipment

	Capability	Gap analysis	Recommendation
Hydro Power plant			
Penstock	2 companies have actual result	Correspondence for advanced technology	Upgrading in technology and equipment
	(other company)	Huge gap	Technical cooperation / Equipments
Intake liners etc	Irrigation gate (1 company)	Not so large	Upgrading in technology and equipment Design is important.
Wind power plant			
Tower /Column	3 companies approach.	Current status unknown	-
Transmission/ Distribution tower and accessories			
High V Tower	A prototype (1 company)	New guide line of EEPCO	Adjustment for the guide line. Standardization.
Middle V Tower	(other company)	New guide line of EEPCO	Design/equipment according to the guide line. Standardization.
High V Accessories	(other company)	Huge	Design/equipment according to the guide line.
Middle V Accessories	Actual result (1 company)	New guide line.	Zinc dip equipment. Upgrading by coupling of insulator.
Transformer	(other company)	Huge	Technical cooperation / Equipments.
General equipments/ machine			
Spare parts	Actual result (1 company)	Small gap. But not for any kind of spare parts.	How to break the limit. (Rapid modeling etc)

IV-1-4. Technical recommendation on how to fill the gap (3)

General technical recommendations (i)

- Strengthening of design capacity
  - Training / capacity building of design engineer
  - Disseminating CAD/CAE
  - Wind power facility as a large potential for designing
  - Standardisation of specification, etc.
- Development of new products
  - Concrete products to be developed: for example, penstock, water gate and valve for dam, transformer, induction motor / direct current synchronised motor etc.
  - Feasibility study on domestic production of motors
  - High voltage transmission products
  - Various parts for wind power generation system
  - Existing capacity utilisation and joint product development, etc.

IV-1-4. Technical recommendation on how to fill the gap (4)

General technical recommendations (ii)

- Management
  - QA/QC system, inspection ability, preventive maintenance
  - Kaizen
  - Utilisation of MPDC as an incubator
  - Human resource development on basic elemental technology
- Others
  - More opportunities for domestic engineering companies to be engaged in public investment projects as required
  - Electricity stabilisation
  - Cooperation with Ethiopian Association of Basic Metals and Engineering Industry
  - Reverse exhibition

IV-1-4. Technical recommendation on how to fill the gap (5)

Technical recommendations for some identified companies
(Example of Company A)

- Capacity analysis
  - Huge capacity in terms of quantity of machinery, available production process etc.
  - 65% of total sales – middle/low voltage transmission accessories, etc.
- Expected products to be developed/produced
  - Water gate and its valve, gear box for gate
  - Core part of transformer such as conductor wire
  - Distribution panel/board, transformer container, motor, etc.
- Recommendations
  - Designing technology upgrade
  - Technical collaboration with other companies
  - Galvanising by the hot dip process of zinc to be required.
  - Casting technology improvement, etc.

[Recommendations for some other companies
are also available in the report]

IV-2-1. Overview of the construction machinery industry

- Can be classified into two groups
- Type A: simple design; for housing/building construction; portable; many domestic manufacturers existing
- Type A typical machinery: portable concrete mixer; hollow block making machine (HBM); jaw crusher
- Type B: heavy duty; for road construction and large concrete structure; with wheels; almost all imported
- Type B typical machinery: Concrete mixer lorry, motor grader, road roller etc.

(Above) portable concrete mixer.

(left) HBM.

(below) concrete mixer lorry

IV-2-2. Existing technical capability

- Type A: almost all the process are available domestically including steel welding, machining, gear making by casting and gear cutting. No bottlenecks are observed including parts supply and man power/skill. Enough number of makers for local demands.

- Type B: produced by only a handful countries. Very difficult to enter this market. Except for concrete mixer lorry, which could be locally fabricated if there are some demands

(Source) Brochure of Midrex technologies, Inc

IV-2-3. Identification of technical capability required

- Continuous demand for Type A machinery.
- Some demand for concrete mixer lorry: imported amount in 2008 is 894 tons (if the average lorry size is 8 tons, 112 lorries.
- No significant visible demand for high level Type B products. However, spare parts demand for these are high.

(Source) Brochure of Midrex technologies, Inc

IV-Annex. Experience of other countries

- Technology development in local firms
  - Some examples including an Indian company adopted Toyota production system including TQM and Kaizen
- JICA projects on casting technology
  - Examples of the projects in Brazil, Indonesia, Ghana

- Approach to casting industry in Ethiopia: Recommendations

How to get good cost cycle: Cost down → Increasing order → Increasing production → Cost decrease
New products development
➢Civil engineering: Offering new design.
➢Cement ball :World wide goods. Quality/cost.
➢Development of agricultural equipment: Irrigation. Pump.
➢Cooperation with machine maker: Axle shaft drum, hub (Imported), Balance weight for tractor (Imported), Incinerator (Big volume of grates)
➢Export of machined parts. (engine parts)
➢Export of machined and assembled parts.

Recommendations and Conclusions

- Ethiopia's basic metal and engineering industries have promising potential to contribute as an import substitution industry.
- Development scenario with investment for the basic metal industries are various: (i) iron making using Bikilal ore with direct reduced iron method should be re-examined; (ii) widening downstream domestic production line up should be pursued; (iii) expanding toward upstream process should strengthen the steel industry.
- Major part of the huge demand for the BMEI products for the power sector, the top consumer of the engineering products in the next 5-years, are currently fulfilled by import but there are various products which could be domestically produced in future.
- Asian and other countries' experience could provide useful lessons.
- Technical capability and human resource development, particularly on basic elemental technology such as casting, are fundamental to create sound industrial base. Quality/productivity improvement such as Kaizen should complement from managerial aspect.
- Designing capacity enhancement is also required to exit from "full turn key" dependent situation which disturbs industrial development.

Thank you

JICA's VISION

"Inclusive and Dynamic Development"