

# Basic Metal and Engineering Industries: Policy Framework and the Firm-level Study

The Basic Metal and Engineering Industries (BMEIs) are identified as one of the eight priority sub-sectors for medium and large industries development in the Growth and Transformation Plan (GTP). In particular the BMEIs are considered as the primary industries to contribute to import substitution-based industrial development, which is newly emphasized in the GTP. In response to the strong request from the Ethiopian Government, The Japan International Cooperation Agency (JICA) conducted the BMEI Firm-level Study, in conjunction with the Metal Products Development Center (MPDC)<sup>1</sup> under the Ministry of Trade and Industry (MOTI)<sup>2</sup> and the German-supported Engineering Capacity Building Programme (ECBP), throughout the first half of 2010. As the BMEIs were a model case of a specific sub-sector in the Industrial Policy Dialogue program, it was featured twice in the series of the High Level Forums (HLFs) as inputs for *A Plan for Accelerated and Sustained Development to End Poverty* (PASDEP) II<sup>3</sup> with following presentations: (1) *BMEIs: International Comparison of Policy Framework and Ethiopia's Approach* (at the fourth HLF in March 2010); and (2) *BMEIs Firm-level Study: Results of parts conducted by JICA/MPDC* (at the fifth HLF in July 2010).

This chapter presents an international comparison of BMEI policy framework and the results of the JICA's part of the Firm-level Study with recommendations, based on the two discussions in the HLFs mentioned above.

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<sup>1</sup> MPDC was reorganized as the Metal Industry Development Institute (MIDI) in June 2010.

<sup>2</sup> In October 2010, MOTI was separated into the Ministry of Trade and the Ministry of Industry, of which latter is currently responsible for BMEIs.

<sup>3</sup> During the preparation process of *GTP*, national five-year development plan for 2010/11-2014/15 which follows *PASDEP* was tentatively called PASDEP II. This chapter uses PASDEP II and GTP interchangeably although the former tends to be used in the context of policy making process.

## 10-1. International comparison of BMEI policy framework

### 10-1-1. Metal/engineering industrial master plans in selected countries

It is hard to find “BMEI” or equivalent sector master plans in other countries. The Ethiopian Government defines the BMEIs to be the industries classified as the Division 27-35 in the United Nation’s International Standard Industrial Classification (ISIC) Rev. 3.1 (Table 10-1). The BMEIs, in particular engineering industries, are rather wide to be singled out as one group of sub-sectors.

Table 10-1. Definition of BMEIs

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

Source: Summarized from UN (2002) and MPDC/MOTI (2008).

Although there is no master plan that singles out BMEI in other countries, there are some comparable master plans as a part of some industrial master plans (for example, Malaysia’s Third Industrial Master Plan 2006-20) and as a master plan at an individual ISIC classification level (for example, Vietnam’s Master Plan of Vietnam Motorcycle Industry for the Period of 2006-2015, with a Vision to 2020). Table 10-2 lists some master plans and other planning documents which are beneficial for plan making on Ethiopia BMEIs.

Table 10-2. List of Master Plans and Other Planning Documents Referred in This Chapter

<p><b>(1) As a part of an industrial master plan</b></p> <ul style="list-style-type: none"> <li>■ <b>Indonesia:</b> National Industrial Development Policy, 2005-2025 (2005) <ul style="list-style-type: none"> <li>◆ 9 out of 32 priority industries can be classified as “BMEI”: steel, machinery and equipment, transport and others</li> </ul> </li> <li>■ <b>Malaysia:</b> Third Industrial Master Plan (IMP3) 2006-2020 <ul style="list-style-type: none"> <li>◆ 5 out of 12 target growth manufacturing industries can be classified as “BMEI”: electrical and electronics, medical devices, machinery and equipment, metals, transport equipment</li> </ul> </li> <li>■ <b>India:</b> National Strategy for Manufacturing 2006-2015 <ul style="list-style-type: none"> <li>◆ 2 out of 7 core sub-sectors can be classified as “BMEI”: auto components, IT hardware - and steel is one of 3 additional core sub-sectors</li> </ul> </li> <li>■ <b>Zambia:</b> Commerce, Trade and Industrial Policy (2009) <ul style="list-style-type: none"> <li>◆ 1 out of 6 priority sectors can be classified as “BMEI”: engineering products</li> </ul> </li> </ul> <p><b>(2) As a sub-sector specific master plan</b></p> <ul style="list-style-type: none"> <li>■ <b>Thailand:</b> Master Plan for Iron Industry <ul style="list-style-type: none"> <li>◆ Iron/steel industry considering linkages with downstream industries (a part of engineering industries)</li> </ul> </li> <li>■ <b>Indonesia:</b> Automotive Industry Roadmap 2025 (2008) <ul style="list-style-type: none"> <li>◆ Based on the automotive chapter of the National Industrial Development Policy</li> </ul> </li> <li>■ <b>Vietnam:</b> Master Plan of Vietnam Motorcycle Industry for the Period of 2006-2015, with a Vision to 2020 (2007) <ul style="list-style-type: none"> <li>◆ Motorcycle industry including its supporting industries</li> </ul> </li> </ul>
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Source: Homma (2010a).

Major findings from these policy documents in other countries are summarized as follows:

- (i) *Duration*—The plans tend to have rather long period, such as 10–20 years, while they are often supplemented by medium-term (ex. five years) master or action plan. A rolling plan is an alternative approach (for example, the Malaysian document is a 15-year rolling plan). The combination of the 20 year long-term master plan (as a vision; rolling plan basis) and five year medium- term action plan (as a practical guidance) is considered to be reasonable as they can complement each other.
- (ii) *Volume*— (a) *As a part of an industrial master plan*: the volume varies – ex. Malaysia (15–35 pages for each sub-sector out of total 750 pages); Indonesia (six formatted pages for each sub-sector out of total 250 pages). (b) *As a sub-sector specific master plan*: it also varies from several pages

to 100 pages. A brief and concise one would work; a formatted sub-sector master plan would be useful and easy for comparison.

- (iii) *Industry classification and prioritization*—Most of the master plans identify priority industries (or sub-sectors). Some BMEI-related sub-sectors are identified as priority industries and occupy a significant part in the industrial master plans. However, it is not as an overarching “BMEI” sector but as more focused sub-sectors within the engineering industries (such as agriculture machinery, automotive and electric components).
- (iv) *Performance review*—It is indispensable to begin the policy document with critical performance review of preceding plans. Major performance items and indicators reviewed in the surveyed plans include structural change, number of companies, new investments, productivity improvement, export/import trend, technological development and major products. They identify various challenges such as low capacity utilization, dependency on external resources (imported inputs, funding and others), low technological/technical capability, limited political/financial support and inadequate infrastructure. The review often compares domestic situations with performances of neighboring countries, regional performances and international trends. The primary purpose of performance review is provision of relevant information for benchmarking for which critical analysis and accurate data are required.
- (v) *Numerical target setting in basic metal industries*—Setting numerical targets in the basic metal industries is common. Some master plans set numerical targets on directly related indicators (ex. Indonesia) and some others set indirect numerical targets (ex. Malaysia and Thailand). The former case covers indicators on steel consumption per capita, production capacity of crude steel, iron making capacity and capacities of products such as flat, long, hot rolled and cold rolled products. In the latter case, for example in Malaysia, the government sets macro-economic targets, overall manufacturing sector targets and investment targets by the priority sector.

- (vi) *Numerical target setting in engineering industries*—As the engineering industries are quite diversified, numerical targets vary according to countries and sub-sectors. They include production volume, installed capacity utilization, investment and export value (when they are considered as export-oriented industries), supply-side capacity of component industries against demand (when they are considered as supporting industries) and employment creation (when they are considered as labor-intensive industries).
- (vii) *Target markets*—Regarding the basic metal industries, the compared plans explore downstream market creation other than construction materials, for example electric appliances, automotive, furniture and canning as is designated by Thailand. On the other hand, markets for the engineering industries vary from final machinery users to assembly industries. Contribution to machinery development and prototyping is often suggested. Market destinations of the BMEIs also vary from domestic consumption to export, depending on type and level of products.
- (viii) *Institutional framework*—Identification of key stakeholders with their roles and functions is described in all plans, which include various ministries (industry, trade, finance, technology, higher education, energy, mineral resources etc.), regional governments, R&D and training institutes (ministerial, governmental, university, educational, vocational and private), and business associations (by sub-sector, by elemental technology, by region and by size). In order to avoid unnecessary duplication and build up an effective institutional framework, coordination among these organizations with appropriate division of labor is quite important.
- (ix) *Identification of appropriate technology and process*—Basic metal industries, in particular the steel industry, tend to have process-oriented identification, while engineering industries have elemental technology-oriented identification. Depending on market needs and technological availabilities, the former includes the full ranged process with blast furnace iron making, electric arc furnace steel making process, direct reduced iron (DRI) process as well as steel product making (such as hot rolling, cold rolling, long

products and flat products) without steel making process. On the other hand, the latter includes elemental technologies such as casting, forging, welding, machining, metal stamping and pressing, heat treatment and surface treatment and mold and die.

- (x) *Technology development and technical capability improvement*— The comparable master plans discuss various aspects of technology development and technical capability improvement such as: adoption of new and appropriate technology that matches available resources; improvement of current technology quality; improvement of quality and productivity management; research and development; prototyping and product development; facility improvement and development; certification and standardization system; partnership and strategic alliance among industry, academics and government; partnership between upstream and downstream industries; and adoption of foreign technology through partnership, investment and technology transfer.

### **10-1-2. Ethiopia's BMEI policy framework**

As the BMEI has been considered as one of the priority industries for import substitution, a series of documents were prepared for building up the policy framework of BMEI in the course of PASDEP II formulation. This includes: (i) *Basic Metal and Engineering Industry Development Strategy and Action Plan (BMEI Strategy)* drafted by MPDC/MOTI in 2008; (ii) *Metal and Engineering Industries Sub-sector 5-Year Development Plan 2003-2007 EFY (BMEI 5-Year Plan)* prepared by MPDC/MOTI in May 2010; and (iii) *Basic Metal and Engineering Industries Firm-level Study* (see section 10-2 for further details) conducted in the first half of 2010.

The BMEI Strategy is well structured and has a smooth flow from general and technical background to performance review, circumstance (infrastructure, human resource and policy), gap analysis and development strategy. On the other hand, strategic issues, strategic objectives and goals and action plans presented in the BMEI Strategy need to be more logically consistent. The document is informative

with some detailed data and 100 pages of contents but additional industrial information and data are required to capture the whole picture of the BMEIs. This is why the Firm-level Study was required to complement it.

The BMEI 5-Year Plan was prepared as an input for PASDEP II, focusing on BMEI's possible role in import substitution. It was prepared in Amharic and only a summary was available in English. It was treated as a given framework for conducting the Firm-level Study.

The BMEI 5-Year Plan notes that 85% of demand for BMEI products is currently fulfilled by imports. It sets various targets including: (i) gross production value in 2014/15 to be ETB101 billion,<sup>4</sup> which equivalent five times the value in 2010/11; (ii) steel demand to grow 28% per annum and per capita steel consumption to grow from 12.1kg (EFY2002) to 34.72kg (EFY2007); (iii) forecasted demand for BMEI products by major industrial sectors in the next five years; (iv) domestic design and manufacturing capacity targets in percent of forecasted demand for each industrial sector and each year (for example, 90% for the leather industry; 35% for the textile industry; 85% for the sugar industry; 85% for the cement industry; 95% for construction steel; 85% of small and medium transport vehicles at the end of the five-year period).

Compared with plans in other countries, the BMEI 5-Year Plan is clearer in terms of quantitative targets. The target figures are quite challenging and sometimes not certain whether they are targets or projection, but the figures and the plan itself are consistent with PASDEP II / GTP. Approaches to achieve these ambitious targets need to be further elaborated and visualized including material flow, geographical strategies and vertical and horizontal industrial linkages.

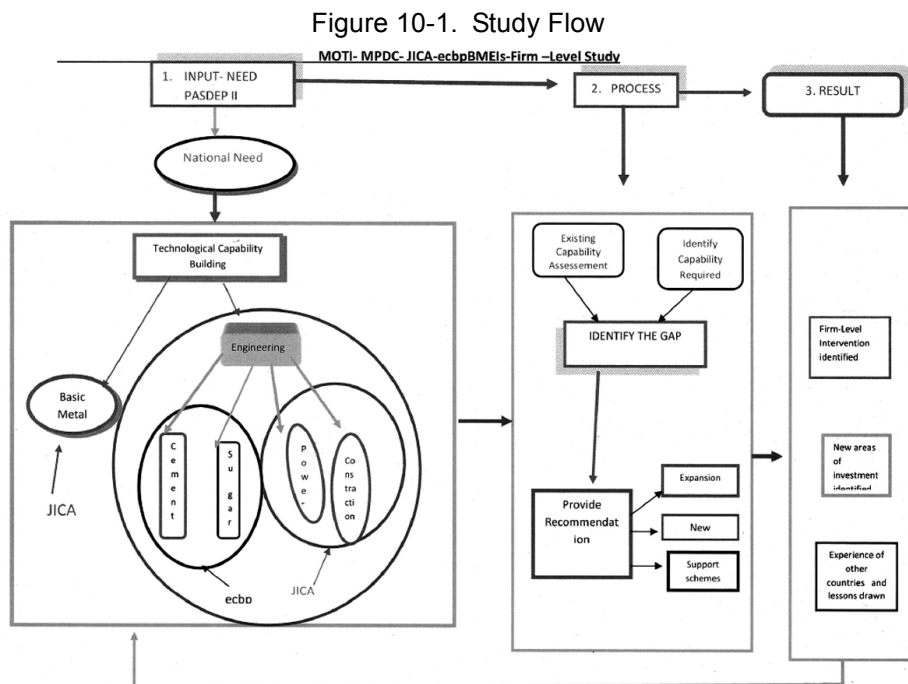
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<sup>4</sup> ETB is the Ethiopian currency (Ethiopian Birr). USD1 = approximately ETB17.1 as of August 2011.

## 10-2. Results of the BMEI Firm-level Study

### 10-2-1. Outline of the BMEI Firm-level Study

The BMEI Firm-level Study was requested to JICA in cooperation with MPDC and ECBP, in the course of a series of the Ethiopia-Japan Industrial Policy Dialogue. It was conducted intensively from April to June 2010. Initial outline consisted of Phase 1 by MPDC and ECBP to conduct a field survey for collecting data with basic data processing and Phase 2 by MPDC (a team including external consultants) supported by experts from ECBP (demand side – user industries) and JICA (supply side – BMEI industries) for analysis based on the collected data. The outline was, however, changed by the Ethiopian side after the dispatch of experts. Finally JICA was requested to contribute to technical survey on basic metal industries and a part of engineering industries (for the power sector and the construction machinery sector), while ECBP contributed to technical survey on another part of engineering industries (for the sugar and cement industries) under overall responsibility of MPDC (Figure 10-1).



Source: Ministry of Trade and Industry.



A summary of major findings on both basic metal industries and engineering industries entrusted to JICA respectively are presented in the following sections. The basic approach in respective industries was to analyze the current situation, grasp the supplying capacity and the market demand, identify the supply-demand gap both quantitatively and qualitatively and finally to present technical recommendations to fill the gap.

## **10-2-2. Major findings on basic metal industries**

### **10-2-2-1. Iron ore exploration and possible utilization**

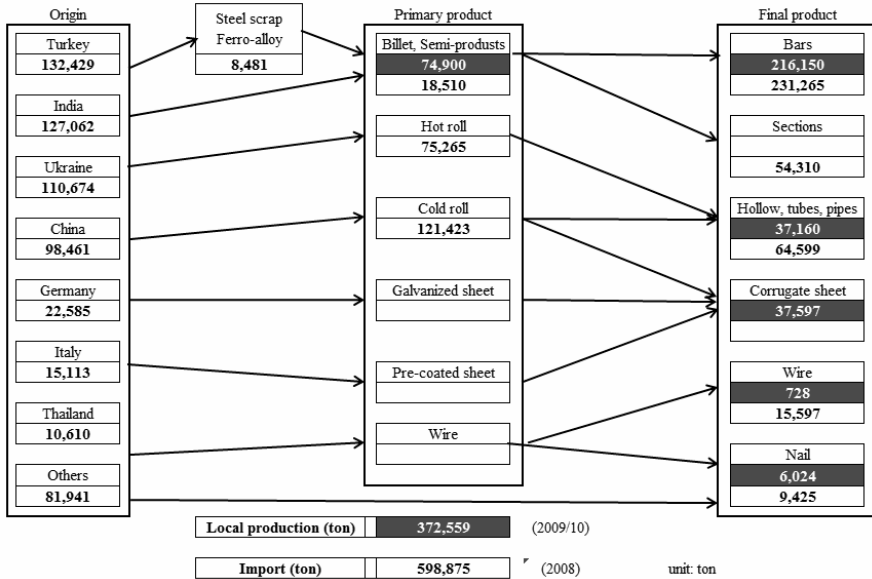
Bikilal Iron Ore Deposit located in Western Ethiopia is a promising site with an estimated 22 million tons of iron ore. According to the two previous studies by (i) the Ethio-Korean team in 1988; and (ii) Swedish Boliden Contech in 1995, it has relatively low Fe content (41%) but high  $TiO_2$  (15-18%) and  $V_2O_5$  (0.18%) contents, which increases the ore value. At the time of the two studies, it was not proved to be strictly economically feasible. But its estimated production cost was ETB 2.5/kg (if converted in current price), which compares to the current steel scrap cost of ETB 3-5/kg. This implies that it is worthwhile re-investigating its feasibility under the current and prospective high mineral price situation, with a view to introducing the DRI process which can fully utilize the potential of Bikilal iron ore (see also sub-section 10-2-2-6 on the availability of DRI).

### **10-2-2-2. Material flow: iron and steel in Ethiopia**

It is quite significant for the basic metal industries, in particular the steel industry, to analyze the material flow to find out the linkages among raw materials, primary products, semi-products and final products. There are many missing data to complete it but a tentative material flow chart was prepared in the Firm-level Study as in Figure 10-2. It clearly shows that the Ethiopian steel industry heavily depends on raw material import from multiple countries such as Turkey, India, Ukraine and China, rather than domestic iron making process. The products are mainly final products for basic construction materials such as bars, hollows, tubes, pipes and corrugate sheets. It is recommended that a data collection system should be

established to clarify the material flow further so that appropriate intervention can be made.

Figure 10-2. Material Flow of Steel Industry in Ethiopia



Source: JICA (2010).

### 10-2-2-3. Existing capability assessment

Aggregate production capacity of the 14 major basic metal companies surveyed, which cover almost all national production, exceeds 1 million tons per annum (Table 10-3). It is interesting to note that half of this capacity has been recently installed (Table 10-4). The two tables also show that the products produced in Ethiopia are concentrated in rather basic construction materials such as reinforced bars, hollow sections and corrugate sheets as well as billets which are intermediate products. It is also found that iron and steel manufacturing processes that exist in Ethiopia are still limited (Figure 10-3) and need to be expanded toward upstream processes.

Table 10-3. Production Capacity and Actual Production in 2009/10 (Unit: ton)

No.	Finn- code	Billet		Reinforce bar		Hollow section		Corrugate sheet		Wire		Naif		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							22,000	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

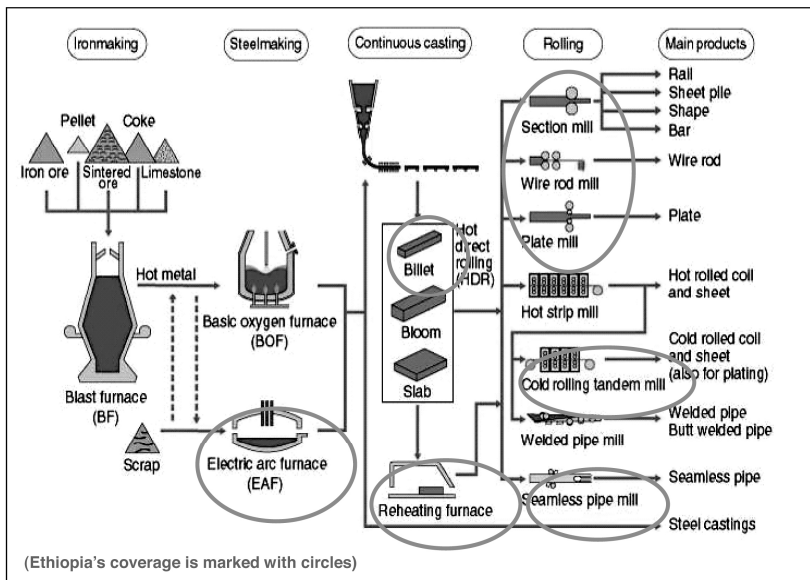
Source: Questionnaire and hearing by the JICA study team (2010).

Table 10-4. New Facilities Installed in the Last Five Years (Unit: ton)

Company No.	Product	Capacity (ton/year)
1	Hollow section, corrugate sheet, reinforced bar	43,500
2	Reinforced bar	60,000
3	Hollow section	20,000
4	Reinforced bar	280,000
5	Reinforced bar, section	108,000
Total		511,500

Source: Questionnaire and hearing by the JICA study team (2010).

Figure 10-3. Iron and Steel Manufacturing Process



Sources: JFE 21st Century Foundation (2003) and JICA (2010).

### 10-2-2-4. Identification of capability required

According to the five-year projection shown in the Metal and Engineering Industries Sub-sector 5-Year Development Plan 2003-2007 EFY (BMEI 5-Year Plan), steel consumption grows 28% per annum and in 2014/15 demand will reach 3 million tons (Table 10-5), which is over the minimum efficient scale to introduce domestic iron making such as the DRI process (see 10-2-2-6 for further details). This projection is based on the assumption that per capita steel consumption will increase from current 12kg to 34kg, which is equivalent to the current African average,<sup>5</sup> in five years.

Table 10-5. Steel Consumption Projection (Unit: ton)

		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

Sources: MPDC/MOTI (2010) and JICA (2010).

According to the projection shown in the BMEI 5-Year Plan, domestic production must grow at more than 30% per annum, in order to achieve the target set in PASDEP II / GTP (Table 10-6).

Table 10-6. Projection of Gross Production (Unit: ton)

	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

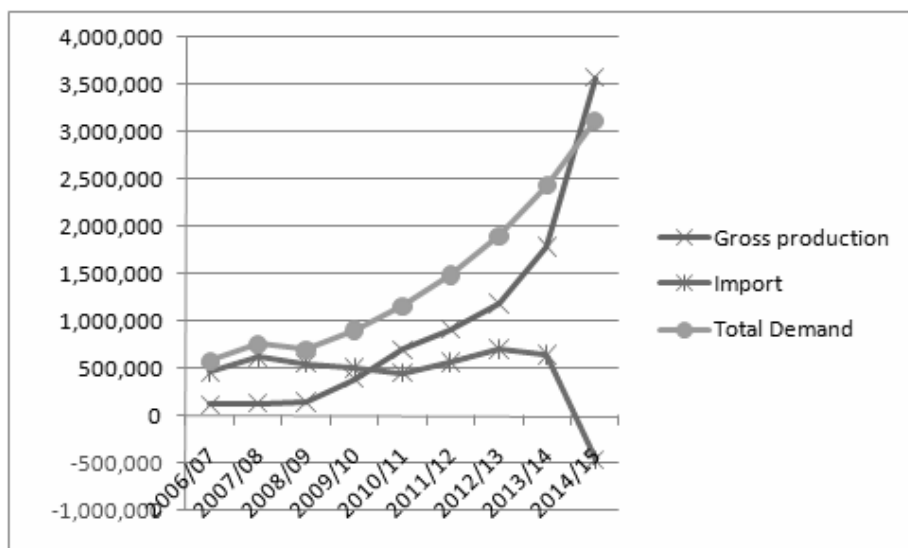
%	20.1	58.0	10.0	10.1	0.2	1.6	100.0
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Source: MPDC/MOTI (2010) and JICA (2010).

<sup>5</sup> The current world average of per capita steel consumption is approximately 200kg (World Steel Association).

These projections of steel consumption and gross production imply that a capacity gap will exist until 2013/14 while gross production will surpass total demand in 2014/15 (Figure 10-4). However, the data presented here is based on a number of assumptions and requires further explanation to be considered as reliable projections.

Figure 10-4. Estimation of Basic Metal Production (Unit: ton)



Source: MPDC/MOTI (2010) and JICA (2010).

### 10-2-2-5. Technical recommendations

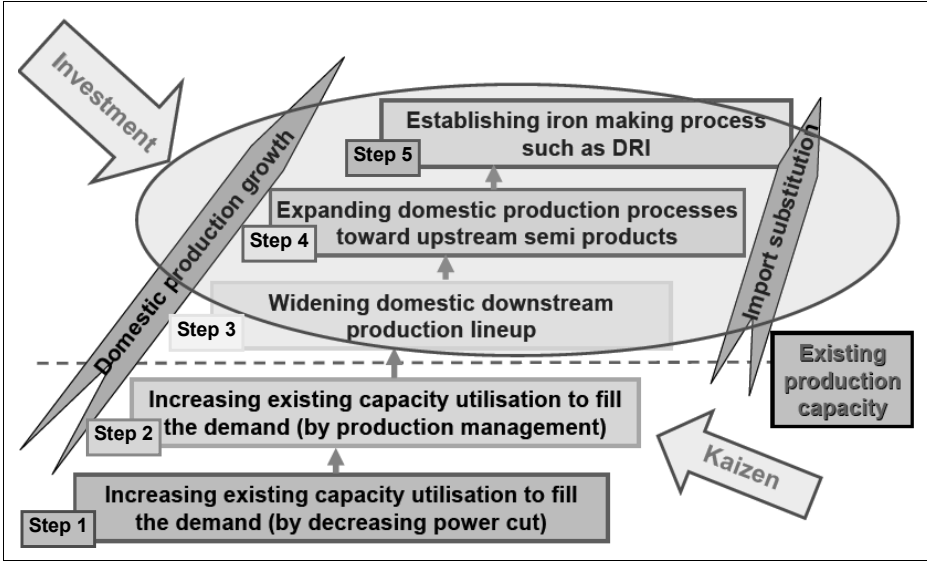
Considering the current situation analyzed in the previous sections and targets set in the BMEI 5-Year Plan, five steps are proposed to achieve domestic production and import substitution as described in Figure 10-5. The first two steps are based on the existing production capacity, while steps 3-5 require investment to expand capacity.

- (i) Step 1—*Increasing existing capacity utilization to fill the demand by decreasing power outage*—Currently the existing capacity is underutilized despite high demand, mainly due to frequent power cuts. Ethiopia's power industry is rapidly expanding its capacity along with the GTP and

reduction of power disruption is promising. It will increase existing capacity utilization.

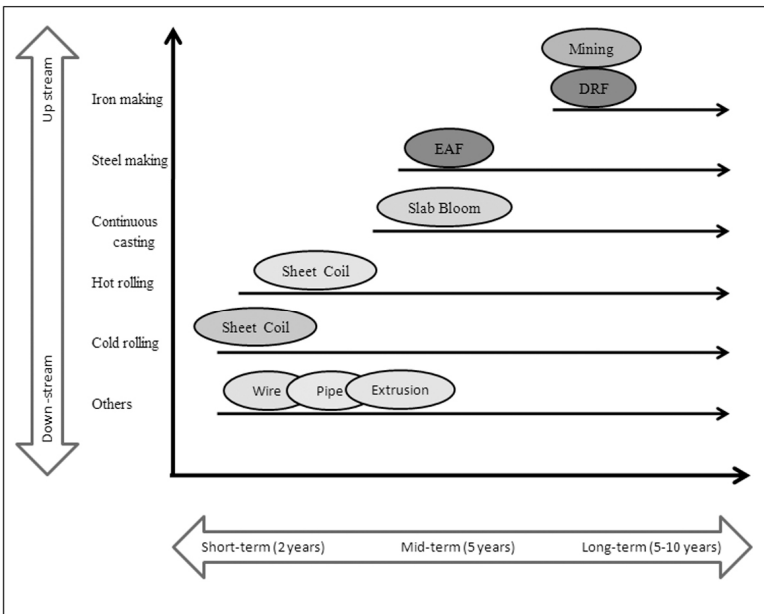
- (ii) Step 2—*Increasing existing capacity utilization to fill the demand by production management*—Compared with Step 1 which relies on external conditions, Step 2 encourages internal efforts to increase the existing capacity utilization by production management, in particular quality and productivity improvement such as *kaizen*.
- (iii) Step 3—*Widening domestic downstream production line-up*— From this step onward, investment is required. The current structure of Ethiopian basic metal industries is concentrated in limited conventional downstream products such as basic construction materials. It is necessary to broaden the downstream production line-up gradually. The standard sequence of development of downstream products is as follows: (a) cold rolled coil & sheet; (b) heat treatment, galvanizing & coating; (c) pipe and tube; (d) hot rolled sheet and coil.
- (iv) Step 4—*Expanding domestic production processes toward upstream semi products*—The other direction of expanding the currently limited production is to climb up the ladder from downstream products to upper-stream semi products as described in Figure 10-6. It is the critical step in particular for import substitution of basic metal industries.
- (v) Step 5—*Establishing iron making process such as DRI*—The final step is localization of iron making, which is at the upper end of the production process as seen in Figure 10-6. The DRI process is considered to be most reasonable for Ethiopia (sub-section 10-2-2-6).

Figure 10-5. Proposed Scenario for Achieving Domestic Production and Import Substitution



Source: Homma (2010b).

Figure 10-6. Basic Metal Products: Technological Development Scenario



Source: JICA (2010).

### 10-2-2-6. International experience: initial investment and direct reduced iron (DRI)

As the steel industry heavily depends on large-scale facility which needs large investment, minimum efficient scale and initial investment cost for major processes must be considered in selecting appropriate processes. Sato (2008) summarizes them from the experiences of many countries (Table 10-7). Regarding the upstream process which is the most facility-intensive part, it suggests that, while the conventional blast furnace based process requires minimum three million ton per annum which is triple of current Ethiopia's whole steel production amount, electric furnace based process needs only 1 million ton as the minimum efficient scale and furthermore DRI process requires only 0.5-1.0 million ton to become economically viable to absorb initial investment cost easily.

Table 10-7. Minimum Efficient Scale and Initial Investment Cost for Major Processes

◆ Conventional process
● Simple rolling of steel bars and shapes: 100,000 tons/year (t/y) (USD20 million)
● Steel rolling companies which uses electric furnace: 300,000 t/y (USD100 million)
● Simple rolling and hot strip milling of steel sheets: 2 million t/y (USD400 million)
● Blast furnace - integrated steel mill: 3 million t/y (USD4 billion)
◆ Alternative process
● Hot coil production based on electric furnace and thin slab continuous casting: 1 million t/y (USD300 million)
● Direct reduction method: 0.5-1.0 million t/y (USD100 million)

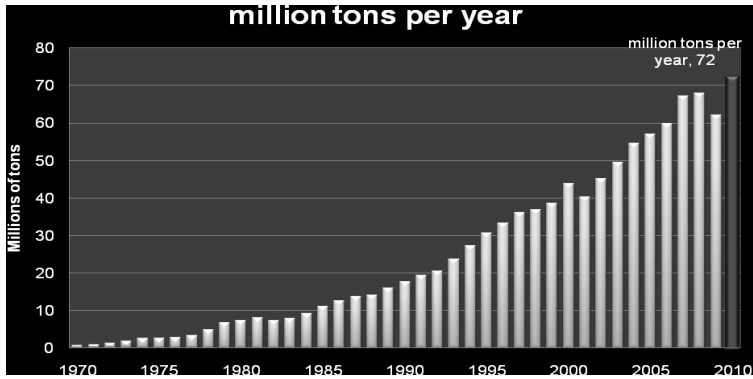
Source: H. Sato (2008).

This points to the possibility of using the Bikilal iron ore in Ethiopia by introducing the DRI process. DRI production continues to increase in developing countries as an alternative to the blast furnace-based integrated iron making (Figure 10-7). The basic flow of the DRI process is as described in Figure 10-8. Gas-based reduction is currently dominant occupying 74% of total DRI production, while 26% adopts coal-based reduction.<sup>6</sup> As there are several kinds of DRI processes available, it is important to choose the most suitable type of DRI for the current situation in Ethiopia by conducting detailed feasibility study.

<sup>6</sup> Source:Midrex technologies, Inc (2010).

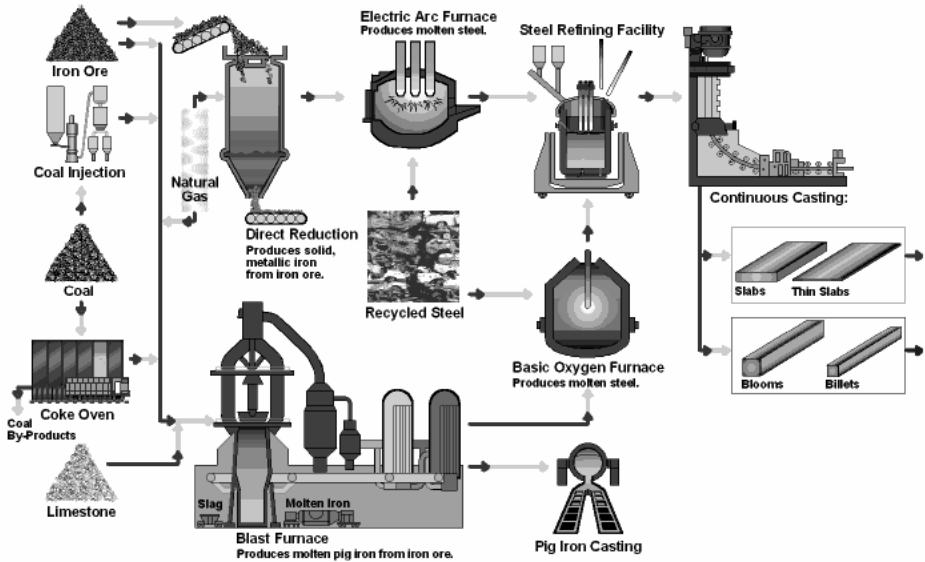


Figure 10-7. World Direct Reduced Iron Production



Source: Ravenscroft (2010).

Figure 10-8. Direct Reduced Iron versus Blast Furnace



Source: American Iron and Steel Institute.

Southeast Asian countries have diverse experiences reflecting their different historical situations. They are useful inputs for drafting Ethiopia’s basic metal industry development plan.

The first case is *Indonesia* (Y. Sato, 2008). It is interesting to note that Indonesia is

one of the few countries which realized DRI integrated production (natural gas-based) and was to some extent successful in introducing conventional level steel production. Indonesia's steel industry, however, is a state-owned integrated production system, which now faces problems of high cost structure and weak competitiveness. Indonesia's steel industry is expected to grow fast as it has a vast market potential with the world fourth largest population and strong economic growth. Its currently small per capita steel consumption (29kg, compared to 228kg in Thailand and 65kg in Vietnam) provides large room to grow.

The second case is *Vietnam* (JICA and Nippon Steel, 1998). The government of Vietnam requested the government of Japan to provide assistance for master plan making in order to develop the domestic steel industry. Key recommendations of the master plan included: preferential tax system; maintaining competitiveness of the integrated steel mill; infrastructure development; advanced technologies; quality improvement; state-owned enterprise reform; and environmental conservation.

### **10-2-3. Major findings on engineering industries (power sector and construction machinery industries)**

#### **10-2-3-1. Gap analysis and technical recommendations for engineering industries for the power sector**

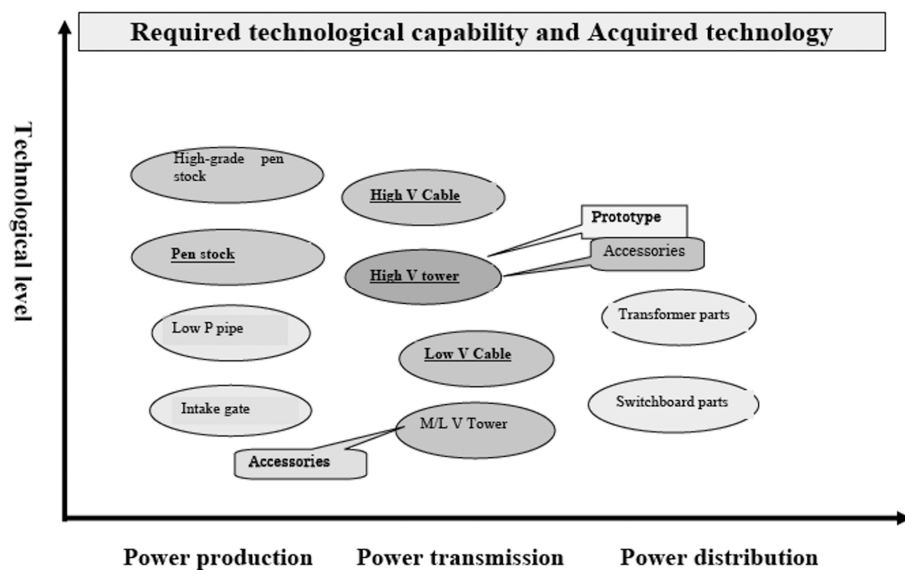
- (i) *Overview of the power sector*—Ethiopia's current power capacity is 1,600 Megawatt (MW), which consists of hydro (86%), diesel (13%) and geothermal (1%). This is not enough to meet national power demand and as a result power failure is frequent, which is considered as the most serious obstacle for industries. The GTP addresses this issue in depth and the Ethiopian Electric Power Corporation (EEPCO) plans to develop the capacity of 11,600MW consisting of hydro (10,710MW), wind (540MW) and geothermal (350MW) within the 5-year period (according to the Firm-level Study analysis based on EEPCO's data). This if realized will be enough to cover the future national demand and additionally to export to the neighboring countries. Ethiopia's potential power resource is estimated to be 60,000MW in total, consisting of hydro (45,000MW), wind

(10,000MW) and geothermal (5,000MW).

- (ii) *Existing technical capability*—Ethiopia’s power facility and equipment heavily depends on import or foreign companies’ engineering services on a “full turn key basis”. This has resulted in limited opportunities to enhance technical capabilities of domestic companies and human resources. On the other hand, in the past, EEPCO with domestic companies had some experiences in producing (a) medium-level products such as penstock, (b) lower-level consumable products such as accessories for middle voltage transmission, and (c) prototypes such as high voltage transmission tower. It also plans to produce new products such as wind power facilities.
- (iii) *Identification of technical capability required*—The BMEI 5-Year Plan estimates the five-Year demand in the power sector for BMEI products to be ETB860,112 million equivalent in gross value of which 50% (ETB430,056 million equivalent) should be domestically produced. This will account for 75% of whole demand for BMEI products in all major industries. According to the Firm-level Study with EEPCO, demand for steel fabrication in power plants and transmission towers is estimated at 650,000 tons per annum in the next five years. Extension of transmission lines over 2,440km is planned and emerging demand for wind power farms is identified. EEPCO encourages domestic production of BMEI products and prepared new strategies on increasing domestic procurement, such as “Detailed Technical Requirement for Transmission Line Materials” and “Detailed Technical Requirement for Power Transformers and Steel Structures”. To facilitate import substitution, EEPCO also summarizes concrete demand for BMEI products in long and short lists, such as “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” and “List of machinery/equipment/metals/instruments for procurement at the EEPCO mechanical workshop for five years after 2010.”

- (iv) *Technical recommendation on how to fill the gap*—*First*, strengthening of design capacity is critical in localizing the manufacturing process of BMEI products for the power sector. Approaches for this include: capacity building of design engineers, disseminating CAD/CAE and standardizing of specification of power products. Wind power facilities have a large potential to be designed domestically. *Second*, developing engineering products to be newly produced domestically should be prioritized. Considering potential demand and technological capability of domestic industries, concrete products that can be developed include penstock, water gate, valve for dam, transformer, induction motor, direct current synchronized motor, high voltage transmission products, various parts for wind power generation system and others, according to the BMEI Firm-level Study. Figure 10-9 maps out these products based on technological level and power sub-sector. For developing these products, feasibility studies are needed to utilize existing capacity fully and organize joint product development where applicable. *Third*, management capability is another area that requires policy intervention. Effectiveness of quality and productivity improvement through *kaizen* is demonstrated by the experience of the JICA Kaizen Project implemented in Ethiopia in recent years. Other approaches are establishing the quality assurance/quality control (QA/QC) system, inspection ability and preventive maintenance, utilizing the Metal Industry Development Institute (MIDI) as an incubator, and developing human resources in basic elemental technology on metal and engineering. *Fourth*, increasing the power and voices of domestic engineering companies should be further considered by strengthening the Ethiopian Association of Basic Metals and Engineering Industry (EABMEI) and organizing events such as reverse exhibitions.

Figure 10-9. Required Technological Capability and Acquired Technology of BMEIs for the Power Sector: A Possible Scenario



Source: JICA (2010).

### 10-2-3-2. Gap analysis and technical recommendations for engineering industries for the construction machinery industry

- (i) *Overview of the construction machinery industry*—Compared with the power sector, there are less potential engineering products to be targeted for future import substitution. They can be classified into two groups, Type A and B. Type A machinery is of simple design; for housing/building construction; portable; and produced by many domestic manufacturers even now. For example, portable concrete mixer, hollow block making machine (HBM) and jaw crusher belong to the Type A category. Meanwhile, Type B products are of heavy duty; for road construction and large concrete structure; with wheels; and almost all are imported at present. Typical machinery of Type B is concrete mixer lorry, motor grader and road roller.
- (ii) *Existing technical capability*—Regarding Type A, almost all processes are

available domestically including steel welding, machining, gear making by casting and gear cutting. No bottlenecks are observed including parts supply, skilled labor and number of makers for local demand. On the other hand, Type B machinery and equipment are produced by only handful countries. It is quite difficult to enter this market as it needs comprehensive technological capability, except for concrete mixer lorry, which could be locally fabricated.

- (iii) *Identification of technical capability required*—There is continuous demand for Type A machinery. With regard to Type B, some demand for concrete mixer lorry is observed. The import of this product was 894 tons (112 lorries equivalent if the average lorry size is assumed as 8 tons) in 2008. Although there is no significant visible demand for high level Type B machinery, demand for their spare parts is relatively high.

### **10-2-3-3. International experience in engineering industries**

There are a large number of international experiences in Total Quality Management (TQM) and *kaizen* available for study and adoption by engineering companies, such as the Indian case mentioned in the BMEI Firm-level Study. As elemental technology is important for engineering industries, as mentioned earlier, the Firm-level Study discusses other countries' experiences in developing casting technology as an example, featuring JICA projects in Brazil, Indonesia and Ghana. It also advances some recommendations on approaches to develop casting industry in Ethiopia for engineering industries in general. It suggests first that the cost factor is important and second that several casting products, such as agricultural equipment (irrigation and pump), cement ball, axle shaft drum, hub, balance weight for tractor, incinerator and other machined components, should be considered for import substitution.

### **10-3. Conclusions**

The international comparison of BMEI policy frameworks and the BMEI Firm-level

Study revealed that Ethiopia's basic metal and engineering industries have the potential to contribute to import substitution. The following recommendations are given as the summary and conclusions of this chapter.

*First*, the proposed development scenario for the basic metal industries has five steps, among which the first two steps do not require new investment in BMEI while the remaining three will require investment to achieve targeted domestic production and import substitution: (i) increasing existing capacity utilization to fill the demand by decreasing power outage; (ii) increasing existing capacity utilization to fill the demand by production management methods such as *kaizen*; (iii) increasing the variety of downstream products ; (iv) expanding into upstream processes that should strengthen the steel industry; (v) iron making using the DRI method with Bikilal ore as input should be considered.

*Second*, regarding the engineering industries, a large part of the demand for BMEI products by the power sector, which is the largest consumer (75%) of engineering products in the next five years, is currently fulfilled by imports but there are various products which can be domestically produced in the future. Enhancement of designing capacity is required to exit from "full turn key" dependency which deters industrial development.

*Third*, technical capability and human resource development, particularly in basic elemental technology and managerial methodology including quality and productivity improvement using *kaizen*, are fundamental to the creation of sound industrial base and thus should be further stressed.

*Fourth*, it is revealed in the course of the Firm-level Study that many projections are based on weak assumptions rather than detailed analyses and facts. Lack of reliable data and a data collection system are also observed. Addressing these issues will take time and require certain amount of financial and human resources but the problem should at least be recognized and shared among stakeholders. Establishing a monitoring and evaluation system is also necessary to improve planning and implementation based on feedback.

*Fifth*, experiences in Asian and other countries can provide useful and practical lessons. While international comparison of policy framework is the very objective of the Industrial Policy Dialogue, comparison of approaches at the operational level should also add value. Ethiopia's strong and sustained interest in learning Asian experiences is a positive factor that contributes to such policy learning.