Investment Opportunity in Iron and Steel, Petrochemical and Food Processing Industry

“Experience with the energy efficiency in the Iron and Steel industry”

www.efficiency-from-germany.info
Contents

- Thailand’s Steel Industry
- The Current Status of the Energy Consumption in Thailand’s Steel Industry
- Potential & Opportunity for Steel Industry
Contents

- Thailand’s Steel Industry

- The Current Status of the Energy Consumption in Thailand’s Steel Industry

- Potential & Opportunity for Steel Industry
Iron and steelmaking process

Mainly produced by EAF Route. No upstream process.
Thailand steel industry structure

Ironmaking
- Scrap recycle
- 16 Mills
  - TATA
  - G Steel
  - GJS
  - SYS
  - TRIUMPH
  - Etc.
  Production: 4.2 m T
  Import: 3.7 m T
  Export: 0.2 m T
  Demand: 7.7 m T

Steelmaking
- ~ 50 Mills
  - TATA
  - Sahaviriya
  - Tycoon
  - Etc.
  Production: 3.7 m T
  Import: 1.7 m T
  Export: 0.8 m T
  Demand: 4.7 m T
- ~ 100 Mills

Finishing & Coating
- Long Product
  - Cold-Drawing
    - ~ 100 Mills
- Flat Products
  - Hot-Rolling
    - 5 Mills
      - G Steel
      - GJS
      - Sahaviriya
      - LPN
      Production: 3.9 m T
      Import: 3 m T
      Export: 0.3 m T
      Demand: 4.2 m T
    - Import
      - Japan, S. Korea, Australia, China
    - Export
      - Vietnam, Malaysia, Laos
  - Cold-Rolling
    - 3 Mills
      - SUS
      - TCRSS
      - Bluescope
    - Production: 1.7 m T
      Import: 0.7 m T
      Export: 0.1 m T
      Demand: 1.6 m T
    - Import
      - Japan, S. Korea, Taiwan, China
    - Export
      - Vietnam, Laos, Malaysia, Indonesia
- Coating
  - ~ 15 Mills
    - Bluescope
    - Thai Tin Plate
    - Production: 0.8 m T
      Import: 0.2 m T
      Export: 0.1 m T
      Demand: 0.9 m T
    - Import
      - Japan, S. Korea, Taiwan, China
    - Export
      - Vietnam, Laos, Myanmar, Hong Kong

Forming
- >1,000 Mills
  - Machining
  - Bending
  - Cutting
  - Welding
  - Forging
  - Heat Treatment
  - Etc.

End Users
- Construction 54%
- Automobiles and parts 16%
- Machinery and Industrial Products 13%
- Electrical Appliances 12%
- Packaging 5%

Source: Iron and Steel Institute of Thailand
Thailand steel industry development started from re-rolling business.

- Traders / Stockists
  - 1950s: Rebar – old mill
  - 1960s: Long – mini mills
  - 1960s: Cold-formed section & pipe
  - 1992: Flat – rolling mills
  - 1995: Flat – mini mills
  - 1996: Flat – mini mills

Capacity:
- Semi – Long: 5.8 million tpy
- Semi – Flat: 3.0 million tpy
- Rolled products: Long: 8.5 million tpy
- Rolled products: Flat: 12.9 million tpy

Source: Iron and Steel Institute of Thailand
... that limit local production to serve overall demand

Apparent steel demand compares to crude steel production (‘000 Tonnes)

- Thailand imported all raw material, semis and finished products at 14.96 million tonnes in 2011
- High grade steel products are imported from Japan, South Korea, Taiwan, EU and US at 6.59 million tonnes in 2011 (45% of overall steel demand)
- Intensive competition from Chinese steel products as import rose from 0.65 million tonnes in 2009 to 1.9 million tonnes in 2011
- Thailand exported steel products at 0.73 million tonnes, 53% of total export go to ASEAN

Source: Iron and Steel Institute of Thailand
Overall steel market has increased on average 7.3% per year during last 11 years

Thailand apparent steel use (‘000 Tonnes)

<table>
<thead>
<tr>
<th>Year</th>
<th>Production</th>
<th>Import</th>
<th>Export</th>
<th>Apparent steel use</th>
</tr>
</thead>
<tbody>
<tr>
<td>1997</td>
<td>8,031</td>
<td>3,837</td>
<td>1,388</td>
<td>8,031</td>
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<tr>
<td>1998</td>
<td>3,670</td>
<td>1,559</td>
<td>1,388</td>
<td>6,607</td>
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<tr>
<td>1999</td>
<td>5,960</td>
<td>1,388</td>
<td>1,388</td>
<td>7,607</td>
</tr>
<tr>
<td>2000</td>
<td>7,607</td>
<td>1,388</td>
<td>1,388</td>
<td>10,049</td>
</tr>
<tr>
<td>2001</td>
<td>10,967</td>
<td>1,388</td>
<td>1,388</td>
<td>12,661</td>
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<tr>
<td>2002</td>
<td>12,154</td>
<td>1,388</td>
<td>1,388</td>
<td>13,876</td>
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<tr>
<td>2003</td>
<td>12,716</td>
<td>1,388</td>
<td>1,388</td>
<td>13,581</td>
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<tr>
<td>2004</td>
<td>10,758</td>
<td>1,388</td>
<td>1,388</td>
<td>14,012</td>
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<tr>
<td>2005</td>
<td>8,087</td>
<td>1,388</td>
<td>1,388</td>
<td>14,104</td>
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<tr>
<td>2006</td>
<td>7,463</td>
<td>1,388</td>
<td>1,388</td>
<td>8,967</td>
</tr>
</tbody>
</table>

CAGR 11/00 (%)

- 7.3%
- 4.3%
- 7.9%
- -1.1%

Source: Iron and Steel Institute of Thailand
Construction is major steel consuming sector

- Demand per capita = 217 Kg.
- Ratio Long product : Flat product = 33 : 67
- Demand breakdown
  - Construction 54%
  - Automotive 16%
  - Machinery & Industrial 13%
  - Appliance 12%
  - Packaging 5%

Source: Iron and Steel Institute of Thailand
Total steel demand breakdown by product in 2011

100% = 14.65 million tonnes

- Bar & Section: 18.6%
- Wire rod: 11.1%
- Seamless pipe: 1.8%
- HRC: 30.9%
- HRP: 3.8%
- CRC: 11.3%
- Galvanized: 11.5%
- TP & TF: 4.2%
- Other coated: 5.5%
- Other products: 1.3%

Source: Iron and Steel Institute of Thailand
Finished steel import breakdown by product in 2011

**Long product import in 2011**

- Bar: 29.6%
- Wire rod: 15.6%
- Section: 5.6%
- Seamless pipe: 41.0%
- Others: 8.2%

100% = 1.89 million tonnes

**Flat product import in 2011**

- Bar: 33.3%
- Wire rod: 3.5%
- Section: 15.1%
- Seamless pipe: 44.9%
- Others: 3.1%
- HRC: 0.1%

100% = 7.09 million tonnes

*Source: Iron and Steel Institute of Thailand*
Finished steel import breakdown by country in 2011

Long product import in 2011
100% = 1.89 million tonnes

- China: 40.5%
- Japan: 6.5%
- Korea: 2.8%
- Taiwan: 6.1%
- Malaysia: 1.7%
- India: 6.6%
- Others: 35.6%

Flat product import in 2011
100% = 7.09 million tonnes

- Japan: 52.2%
- Korea: 18.1%
- China: 13.5%
- Taiwan: 5.5%
- Australia: 3.9%
- Vietnam: 1.8%
- Others: 5.1%

Source: Iron and Steel Institute of Thailand
Steel demand in 2012 is expected to expand by 6.1% to 15.55 million tonnes

Thailand apparent steel use projection in 2012 (‘000 Tonnes)

<table>
<thead>
<tr>
<th>Year</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012E</th>
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<tr>
<td></td>
<td>10,758</td>
<td>14,012</td>
<td>14,653</td>
<td>15,887</td>
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<td>15,547</td>
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<td></td>
<td></td>
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<td>15,207</td>
</tr>
</tbody>
</table>

Assumption

Construction sector expands by 1%-3%
Automotive sector expands by 20%-39%
Appliance sector expands by 5%-7%
Machinery sector expands by 3%-5%
Canned food sector expands by 2%-4%

Source: Iron and Steel Institute of Thailand
Contents

- Thailand’s Steel Industry
  - The Current Status of the Energy Consumption in Thailand’s Steel Industry
- Potential & Opportunity for Steel Industry
Current Status of the Energy Consumption in Thailand

Specific Energy Consumption (MJ/Tonne)

- Semi-finished products
- HR, Long products
- HR, flat products
- Galv.pipe

Specific Energy Consumption (MJ/Tonne)

- Galv.sheet (HDG+EG)
- Tin plate / Tin free
- Pipe
- Cold Formed

![Energy Consumption Graphs](image-url)
# Total Energy Consumption in Thailand’s Steel Industry

<table>
<thead>
<tr>
<th>Material Type</th>
<th>Specific Energy Consumption (MJ/ton)</th>
<th>Production (1,000 ton)</th>
<th>Energy Consumption (ktoe)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Semi-HR, Long</td>
<td>3.374</td>
<td>4.7</td>
<td>381</td>
</tr>
<tr>
<td>HR, flat</td>
<td>1.967</td>
<td>4.1</td>
<td>193</td>
</tr>
<tr>
<td>CR, flat</td>
<td>2.367</td>
<td>4.7</td>
<td>215</td>
</tr>
<tr>
<td>Galv.sheet</td>
<td>1.963</td>
<td>3.8</td>
<td>78</td>
</tr>
<tr>
<td>Tin plate /..</td>
<td>1.245</td>
<td>1.6</td>
<td>15</td>
</tr>
<tr>
<td>Galv.pipe</td>
<td>2.178</td>
<td>81</td>
<td>3</td>
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<tr>
<td>Pipe</td>
<td>693</td>
<td>517</td>
<td>0.4</td>
</tr>
<tr>
<td>Cold Formed</td>
<td>32</td>
<td>550</td>
<td>0.4</td>
</tr>
</tbody>
</table>
Total Energy Consumption classified by Products

Energy Consumption (ktoe)

The Pressure & Driving Force for Energy Conservation

Heat waves will be more frequent and more intense.

The Arctic Ocean could be ice-free in summer by 2050.

The sudden death of fish was caused by a lack of oxygen.

Smoggy city
Cost Structure of Thai Steel Industries

Energy shares 5 - 14% of total production cost
Contents

▪ Thailand’s Steel Industry

▪ The Current Status of the Energy Consumption in Thailand’s Steel Industry

▪ Potential & Opportunity for Steel Industry
Opportunity for Energy Conservation in Thai STEEL industry

10 – 33% Gap between Thai & World Best Practice

Ref: BATs from Department of Energy (DOE), USA, Worrell et al 2007
Opportunity for Energy Conservation in Thai STEEL industry

26 – 28% Gap between Thai & World Best Practice

Ref: BATs from Department of Energy (DOE), USA, Worrell et al 2007
20 Years Energy Conservation Master Plan

• Survey & Evaluate the current status of the Energy Consumption
  – Questionnaires (80% of Production Capacity)
  – In-dept Interview & On-site Monitoring (10 - 20% of Production Capacity)

• Map out the Strategies & Action Plans to conserve the Energy in Steel Industry
  – **Short Term**: Improve the operation practices & Apply the Best Available Techniques
  – **Medium Term**: Enhance the Supporting Facilities & Equipments Modification
  – **Long Term**: Invest the New Technology
<table>
<thead>
<tr>
<th>Item</th>
<th>Steelmaking _ EAF Option</th>
<th>Fuel Saving (GJ/To n)</th>
<th>Electric Saving (GJ/To n)</th>
<th>Annual Operation Cost ($/Ton)</th>
<th>Retrofit Capital Cost ($)</th>
<th>Payback Period (years)</th>
<th>Categories</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Bottom stirring/stirring gas injection</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>1*</td>
<td>New or Emerging Technology</td>
</tr>
<tr>
<td></td>
<td>Improved process control (neural network)</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Energy Management</td>
</tr>
<tr>
<td></td>
<td>Oxy-fuel burners</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>New or Emerging Technology</td>
</tr>
<tr>
<td></td>
<td>Scrap preheating, post-combustion—SIEMENS VAI SHAFT</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>New or Emerging Technology</td>
</tr>
<tr>
<td></td>
<td>Scrap preheating—Consteel</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>New or Emerging Technology</td>
</tr>
<tr>
<td></td>
<td>Scrap preheating - ECO ARC</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>New or Emerging Technology</td>
</tr>
<tr>
<td></td>
<td>Scrap preheater - Twin-shell DC</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>New or Emerging Technology</td>
</tr>
<tr>
<td></td>
<td>Adjustable speed drives (ASDs)</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Energy Management</td>
</tr>
<tr>
<td></td>
<td>Foamy slag practice</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>New or Emerging Technology</td>
</tr>
<tr>
<td></td>
<td>Flue gas monitoring and control</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Energy Management</td>
</tr>
<tr>
<td></td>
<td>Eccentric bottom tapping on existing furnaces</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>New or Emerging Technology</td>
</tr>
</tbody>
</table>

Estimate EAF capacity 70 ton, Production 525,000 ton/year

### The Technologies that support the Energy Conservation in Continuous casting machine & Hot rolling

<table>
<thead>
<tr>
<th>Item</th>
<th>CCM &amp; Hot-rolling</th>
<th>Fuel Saving (GJ/Ton)</th>
<th>Electricity Saving (GJ/Ton)</th>
<th>Annual Operation Cost ($/Tont)</th>
<th>Retrofit Capital Cost ($)</th>
<th>Payback Period (years)</th>
<th>Categories</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preventive maintenance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Energy Management</td>
</tr>
<tr>
<td>Controlling oxygen levels and VSDs on combustion air fans</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Energy Management</td>
</tr>
<tr>
<td>Energy monitoring and management systems</td>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td>Energy Management</td>
</tr>
<tr>
<td>Process control in hot strip mill</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>Energy Management</td>
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<tr>
<td>Efficient caster ladle/tundish heating</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>New or Emerging Technology</td>
</tr>
<tr>
<td>Recuperative burners</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>New or Emerging Technology</td>
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<tr>
<td>Energy efficient drives in the rolling mill</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>Energy Management</td>
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<tr>
<td>Near net shape casting - thin slab</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>New or Emerging Technology</td>
</tr>
<tr>
<td>Hot charging</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>New or Emerging Technology</td>
</tr>
<tr>
<td>Insulation of furnaces</td>
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<td></td>
<td></td>
<td></td>
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<td></td>
<td>Energy Management</td>
</tr>
<tr>
<td>Waste heat recovery (cooling water)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Energy Management</td>
</tr>
</tbody>
</table>

*Estimate Production Capacity 300,000 ton/year*

# The Technologies that support the Energy Conservation in Cold rolling

<table>
<thead>
<tr>
<th>Item</th>
<th>Cold-rolling</th>
<th>Fuel Saving (GJ/Ton)</th>
<th>Electricity Saving (GJ/Ton)</th>
<th>Annual Operation Cost ($/Ton)</th>
<th>Retrofit Capital Cost ($)</th>
<th>Payback Period (years)</th>
<th>Categories</th>
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<tbody>
<tr>
<td>Energy monitoring and management system</td>
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<td>Energy Management</td>
</tr>
<tr>
<td>Automated monitoring and targeting system</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>Energy Management</td>
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<tr>
<td>Heat recovery on the annealing line</td>
<td></td>
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<td></td>
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<td>New or Emerging Technology</td>
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<tr>
<td>Combined heat and power/cogeneration</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>New or Emerging Technology</td>
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<tr>
<td>Reduced steam use (pickling line)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Energy Management</td>
</tr>
<tr>
<td>VSD—flue gas control, pumps, and fans</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Energy Management</td>
</tr>
<tr>
<td>Preventive maintenance</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Energy Management</td>
</tr>
</tbody>
</table>

Estimate Production Capacity 1 Million-ton/year

Policies and programs to improve energy efficiency worldwide can be classified as follows:

1. **Regulations/Standards (R&S)**
   - typically applied to particular pieces of equipment such as motors or boilers
   - can also be used for equipment specific to an industry, such as EAF or rotary kilns
   - can require that industrial facilities conduct energy audits, employ an energy manager, or adopt an energy management system

2. **Fiscal Policies (FP)**
   - imposition of taxes, tax rebates, investment tax credits
   - establishing investment bank lending criteria for promotion of energy efficiency
   - public-private partnerships (PPPs) with 3 main mechanisms

3. **Agreements/Targets (AT)**
   - agreements to meet specific energy use or energy efficiency targets
   - typically but not always voluntary
   - 2 common bases; (1) specified energy efficiency improvement targets
     (2) specific energy use or carbon emissions reduction commitments

4. **Reporting/Benchmarking (RB)**
   - raising management awareness of internal energy consumption trends
   - provides a means to compare the energy use of one company or plant to that of others producing the same products
5. Audits/Assessments (AA)
   - provide information regarding current energy use patterns as well as opportunities to reduce energy use through implementation of energy efficiency measures
   - promote establishment/operation of ESCOs who typically assume the technical, financial, and operational risks associated with implementation of the identified energy efficiency measures and are paid through the realized energy savings

6. Information Dissemination and Demonstration (IDD)
   - provide industries with information on energy efficiency technologies and practices that may be difficult, costly, or time-consuming for individual enterprises to gather

7. Research and Development (RD)
   - increase the stock of knowledge, including knowledge of people, culture and society, and the use of this knowledge to devise new applications
Thailand’s Existing Policy & Measures to support the Energy Efficiency Improvement

Only focused on the Financial Support & Voluntary Program
China’s Compulsory Measures on Energy Conservation

• China will impose a tax on energy usage of eight industrial sectors which have the highest energy usage in the country it recently announced. The eight sectors include iron & steel, aluminum and cement. The Chinese agencies have divided the industrial units into two categories, seemingly according to their energy usage and efficiency.

• The units which lag others in energy efficiency and has very high energy usage will be taxed ¥20 per kWh of the electricity consumed. While the second category of relatively more efficient units will face a surcharge ¥5 per kWh of electricity consumed.

• The energy tax is the latest in a series of efforts launched by the Chinese agencies. China had announced that it aims to reduce its carbon intensity (carbon emissions per unit GDP) by 20 percent by 2020 from 2005 levels. As an intermediate goal, China aims to reduce carbon intensity by 17 percent between 2011 and 2015.
Thanks for your kind Attention

Mr. Wikrom Vajragupta
President
Iron and Steel Institute of Thailand (ISIT)
Tel +66 (0) 2713-6290 ext 102
E-mail: wikrom@isit.or.th