

Energy saving potential in non-metallic industry in Thailand

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Abstract:

In 2012, the industrial sector in Thailand consumed 36.7% of the total final energy, which increased 8.26% from the previous year. The major energy consumed in this sector was electricity, sharing 26.0% of its energy consumption, followed by coal & lignite, renewable energy, petroleum products, natural gas and traditional renewable energy respectively. Non-metallic industry is one of the large energy consumers in Thailand and is likely to increase its energy consumption due to the continuing expansion of the economy. Therefore it is necessary to promote energy conservation and energy efficiency in the industry. Factories in the non-metallic industry can be divided into 3 main groups; cement production, ceramic production, and glass production. Specific energy consumptions (SEC) for factories in the non-metallic industry are calculated and plotted from the best to the worst against their productions. Those factories with higher SECs than the world best have the potentials to improve their energy efficiency. Cumulative energy saving potential for the factories constitutes the country energy saving potential for the non-metallic industry. SECs for glass and ceramic industries in the country are larger than the world best, which indicate possibility in energy efficiency improvement and energy saving potential. SEC for cement industry in the country is smaller than the world best, which implies that Thai cement industry is among the world leaders in energy efficiency.

Keywords: Energy saving potential; Non-metallic industry; Specific energy consumption

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1. Introduction

Energy is a fundamental factor in the economy of the country, which is used as an infrastructure for the manufacturing industry. Currently the industry has continued growing and resulting in an increase in energy demand for production which requires close control and monitor through an effective policy management and optimal energy management. In 2012, final energy consumption increased by 3.9% from the previous year and the industrial sector consumed 36.7% of the total final energy and shared an increase of 8.26% from the previous year. The major energy consumed in this sector was electricity, sharing 26.0% of its energy consumption. The industrial sector is consisted of various sub-sectors, including food & beverages, textiles, wood & furniture, paper, chemical, non-metallic, basic metal, fabricated metal and other sub-sectors. Non-metallic sub-sector is the largest energy consumer which accounts for 25% of the total energy consumption in industrial sector in Thailand, as showed in Fig. 1.

In most countries, cement and lime production are by far the largest energy users in the sector, accounting for more than 80% of the sector's energy use according to international energy statistics. In the 20-year energy efficiency development plan (2011-2030) an energy saving potential of non-metallic industry of 2,500 ktoe is estimated by setting the best SEC as the target for energy sufficiency improvement in the next 20 years (EPPO, 2011). This research presents an approach to promote energy efficiency for all three (3) groups in the non-metallic industry.

1.1 Non-metallic industry in Thailand

Non-metallic industry is one of high energy consumption industry in Thailand and is likely to increase its energy consumption by continuing the expansion of the economy. Therefore it is necessary to find ways to encourage the industry to conserve and use energy more efficiently. The non-metallic mineral sector includes the production of cement, lime, bricks, glass and ceramics. It can be distinguished into 3 main groups; cement production, ceramic production, and glass production.

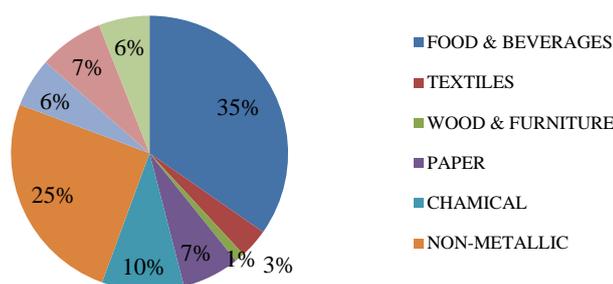


Fig. 1 Energy Consumption in Industrial Sector in Thailand, 2012 (DEDE, 2012).

2. Methodology

Among many indicators for energy efficiency measurement, the specific energy consumption per unit of production (Specific Energy Consumption: SEC), which is a performance index to measure an average amount of energy required for the production of a unit of output, is used for energy performance comparison in this research. The indicator is quite popular because they can be used as a basis for comparison of performance between different factories in the same industry. The SEC can be calculated from equation (1).

$$SEC = \frac{(3.6 \times \text{Electricity, kWh}) + (\text{Heat, MJ})}{\text{Production}} \quad (1)$$

When there are variations in production output, the amount of energy used varies as well. The energy variation can be explained by the energy-production relationship. The energy-production relationship can help to determine optimal energy needs for various production output levels. Energy consumption is determined and then serves as a target for the production process.

A plant or process with a lower SEC value corresponds to a similar plant or similar process that is more energy efficient. By comparing SECs, the developed information can be used to assess the energy-efficiency improvement potential of a plant. The SEC can also be used for evaluating and tracking a plant's progress in energy-efficiency improvements by eliminating the effects of a change in product mix.

2.1 Comparison of SECs for Thai Non-metallic Industry with Global SECs

Glass and cement are the most energy consuming groups in the non-metallic mineral industry compared with ceramic. The world best SECs for glass and cement industries are 3,850 MJ/tonne and 3,100 MJ/tonne respectively (UNIDO, 2010), while SEC for ceramic industry is 1,700 MJ/tonne, as shown in Table 1.

Table 1 Global Specific Energy Consumption in Non-metallic Minerals Industry in 2009 (UNIDO, 2010)

Non-metallic minerals industry	The World Best SEC (MJ/tonne)
Cement	3,100
Ceramics	1,700
Glass	3,850

Table 2 shows energy consumptions and productions of Thai non-metallic sub-sectors, cement, ceramic, and glass (DEDE, 2010), which are used to calculate SECs for the sub-sectors. The calculated SECs for the cement, ceramic, and glass sub-sectors are 1,004 MJ/tonne, 2,568 MJ/tonne, and 6,261 MJ/tonne respectively.

Table 2 Thai Specific Energy Consumption, Production, and Energy Consumption (DEDE, 2010)

Non-metallic	Summative Production (tonnes)	Summative Energy Consumption (TJ)	Specific Energy Consumption (MJ/tonne)
Cement	28,292,548	28,405	1,004
Ceramics	1,754,078	4,505	2,568
Glass	2,006,938	12,566	6,261

2.2 SECs and total energy consumption in Thai non-metallic industry

The SECs of Thai non-metallic industries are compared with the world best SECs for glass, cement, and ceramic. Cumulative production is plotted against SEC of each factory, from the smallest to the largest SEC. Then the world best SEC is plotted as a straight line for reference for energy efficiency improvement. Those with higher SECs than the world best reference can be improved their energy consumption and their SECs, by which energy saving potential can be determined by the area above the world best reference.

3. Results and discussions

Specific energy consumptions (SEC) for factories in the non-metallic industry are plotted from the best to the worst against their production. Those factories with higher SECs than the world best have the potentials to improve their energy efficiency. Cumulative energy savings potential for the factories constitutes the country energy savings potential for the non-metallic industry.

SECs for the ceramic industries in the country are larger than the world best reference, which implies possibility in energy efficiency improvement and energy saving potential.

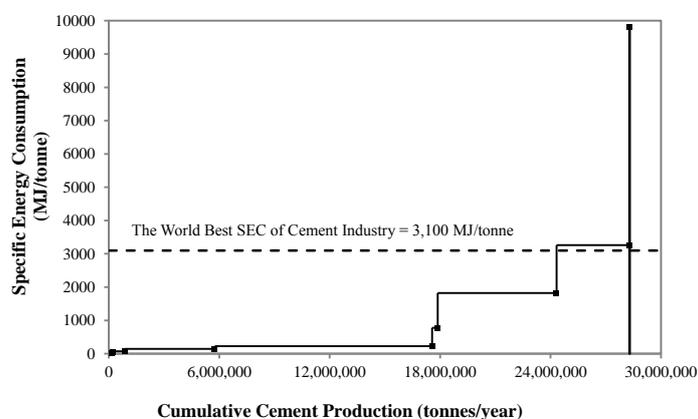


Fig. 2 SEC Curve for Cement Production.

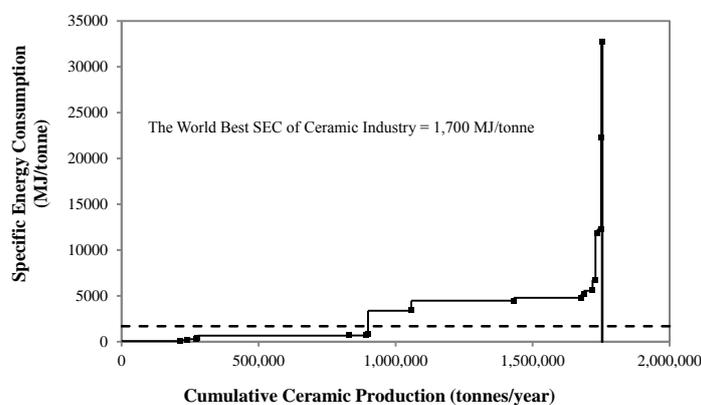


Fig. 3 SEC Curve for Ceramic Production.

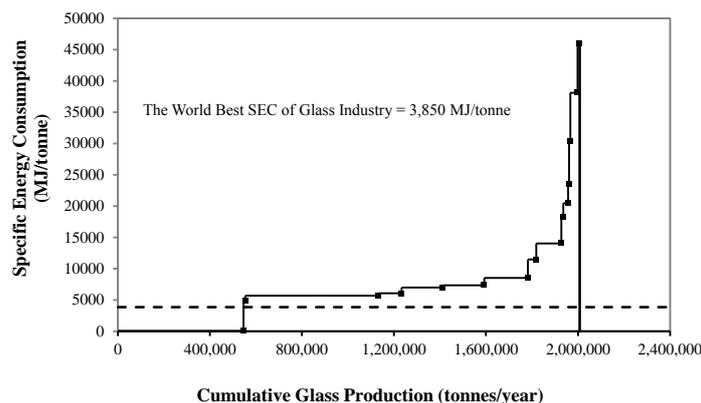


Fig. 4 SEC Curve for Glass Production.

3.1 Cement Sub-sector

The energy saving potential in Thai cement industry was assessed based on several factories that together accounted for about 75% of the cement production in 2010, the results of this study can give a perspective of energy saving potential in the overall Thai cement industry. Fig. 2 shows the cumulative sum of production that is plotted against a SEC of cement factories, and the dotted line represents the world best SEC for cement industry. The SEC curve shows the energy saving potential in Thai cement industry accounted for 709 terajoules (TJ). SEC for Thai cement industries in the country is smaller than the world best SEC, which implies that Thai cement industry is among the world leaders in energy efficiency. A highest SEC in the curve is because a factory has low production.

3.2 Ceramic Sub-sector

The energy saving potential in Thai ceramic industry was assessed based on several factories that together accounted for about 60% of the ceramic production in 2010, the results of this study can give a perspective of energy saving potentials in the overall Thai ceramic industry. Fig. 3 shows the cumulative sum of production that is plotted against a SEC of ceramic factories, while the dotted line represents the world best SEC for ceramic industry. The SEC curve shows the energy saving potential in Thai ceramic industry accounted for 2,604 TJ.

3.3 Glass Sub-sector

Fig. 4 shows the cumulative sum of production that is plotted against a SEC of glass factories and the dotted line is the world best SEC for glass industry. The SEC curve shows that the energy saving potential in Thai glass industry is estimated as 6,911 TJ. SECs for Thai glass industries in the country are larger than the world best SEC. Energy efficiency improvement and energy saving potential are possible. Table 3 summarizes the energy saving potentials for all sub-sectors of the non-metallic industry in the country. The total energy saving of 10,224 TJ is estimated.

The electricity efficiency for the non-metallic industry can be improved by several measures, such as;

- a) provision of information of energy consumption to factories so that they are aware of their inefficiencies and find remedies for themselves,
- b) technology support by utility to factories in the industry and perhaps a subsidy program to encourage the improvement,
- c) special offers for subsidies by the government for the factories to replace their existing equipment with more energy efficient facilities.

Table 3 Energy Saving Potential in Non-metallic industry in Thailand

Sub-sector	Energy Saving Potential (TJ)
Cement	709
Glass	2,604
Ceramics	6,911
Non-metallic	10,224

4. Conclusion

The non-metallic sector consisting of cement, glass, and ceramic is one of the largest energy consuming sector which accounts for 25% of the total energy consumption in industrial sector in Thailand. Specific energy consumptions of the factories in each sub-sector were calculated and compared with the world best SEC to determine energy saving potentials. As shown in Table 3, cumulative energy saving potential for the non-metallic industry in the country is 10,224 TJ.

5. Acknowledgement

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