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Evaluation of Energy Saving in Thai Industry by 3-D Decomposition Method

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Abstract: This paper presents the analysis of the energy consumption in Thai industry from 1987 to 2002 by the decomposition method. The energy consumption was analyzed based on energy intensity, economic structure and economic growth factors. It was found that the mining and construction sectors saved energy equivalent to 171.68 thousand tons of oil equivalent (ktoe), while the manufacturing sector, which accounted for 98% of energy consumption in Thai industry, failed to save energy. Despite the fact that many resources and infrastructure, both physical and institutional, were invested for energy saving in industry, Thai industry consumed about 1,401.95 ktoe more than it should otherwise have done.

Keywords: energy model; energy conservation; decomposition method; energy saving, industry.

1. INTRODUCTION

Countries where energy is used efficiently will have sound and sustained economic growth in the restricted international environmental agreement condition. Since energy is essential for economic advancement and competitiveness, there is a pressing need for improving energy efficiency, particularly for countries depending on importation of energy. In 2002 Thailand imported energy, mainly fossil-based fuel, was amounting to 47,413 ktoe [1]. Fossil fuel, which contributes up to 82.9% of total energy consumption, is the main source of energy in Thailand. Energy conservation and the use of indigenous energy sources become an important measure to decrease the dependency of imported energy for the country.

In 2002 the final energy consumption in Thailand was 52,979 ktoe. The major consumers were transportation (37.1%), industry (35.8%), and residential (14.9%). According to energy statistics classifications, industries in Thailand comprise of 3 groups namely, mining, construction and manufacturing. The average energy intensity in industry during 1987-2002 was 335.29 kgoe/1000 US$ (see Table 1), with an increasing trend. In order to be competitive, Thailand deserves energy efficiency management in industry. In 1992 the Parliament approved the Energy Conservation Promotion Act and the Energy Conservation Fund was established thereafter. Many public and private energy saving projects were supported by this Fund. Many evaluation reports were presented and resulted in public perception of the success of energy conservation measures. However, they were mainly project-based evaluations with a lack of concrete evidence to convince energy experts that the country as a whole benefits from the energy conservation plan.

Many researchers have studied energy conservation in Thai industries. The cogeneration process based on the energy utility requirements of a plant is evaluated as a possible option [2]. The DOE-2 simulation program was used to analyze energy in buildings and suggested many cost effective alternatives [3]. The forecast of growth in energy demand and the corresponding emissions from 2003 to 2020 was studied by using a model based on the end-use approach. The results showed that if all options are simultaneously implemented, the energy savings and CO_2 mitigation in 2020 are estimated to be 1,240 thousand toe and 3,622 thousand ton of CO_2 equivalent, respectively [4]. These are samples of fragmented studies which could not give a holistic view of energy conservation of the country.

A convincing explanation should be obtained from the analysis of energy saving by the decomposition method. The decomposition methodology has become a useful and popular tool not only in industry energy demand analysis but also in energy and environmental analysis [5]. It takes into account the relationship between energy consumption and energy-related economy. It is a useful technique to give a broad view of the implementation of energy conservation measures. The forefront study of the application of the decomposition of energy conservation was that presented by Sun [6]. However, most of the studies were limited to two economic dimensions such as energy intensity and GDP.

In this study, the 3 dimension complete decomposition model was formulated to analyze the energy saving in Thai industry. This work modified the 2-D model by adding the effect of the industrial economic structure [7]. The study analyzed data during 1988-2002 to cover the economic crisis period in Thailand (1997-98), when the industry structure was changed significantly. This paper presents results of energy saving in Thai industry based on the complete decomposition method to assess the extent of the acclaimed success in Thailand.

2. METHODOLOGY

2.1 The energy saving model

The complete decomposition method was used to construct the energy saving model for Thai industry. The model starts with *GDP*-related energy intensity,

$$I = \frac{E}{GDP} \quad (1)$$

If the energy intensity is calculated for a particular sector having Q as its gross domestic product, equation (1) becomes,

$$I_i = \frac{E_i}{Q_i} \quad (2)$$

The aggregate *GDP*-related energy consumption can be decomposed as following.

$$E = \frac{E}{Q}\frac{Q}{GDP}GDP \quad (3)$$

Thus, energy consumption for n economic sectors can be obtained from equation (4):

$$E = \sum_{i}^{n} \frac{E_i}{Q_i} \frac{Q_i}{GDP} GDP \tag{4}$$

By defining S_i as the specific gross domestic product in each economic sector, equation (4) can be written as follows

$$E = \sum_{i}^{n} I_i S_i GDP \tag{5}$$

The change of energy consumption over a period of t years is:

$$\Delta E = E^t - E^0 \tag{6}$$

$$= \sum_{i}^{n} I_i^t S_i^t GDP^t - \sum_{i}^{n} I_i^0 S_i^0 GDP^0 \tag{7}$$

This can be rewritten as,

$$\Delta E = I_{effect} + S_{effect} + GDP_{effect} \tag{8}$$

Where, I_{effect}, S_{effect} and GDP_{effect} are the energy intensity effect, the economic structure effect and the effect of economic growth, respectively. Following the decomposition method [8], these three effects can be decomposed as below.

$$I_{effect} = \sum_{i}^{n} \Delta I_i S_i^0 GDP^0 + \frac{1}{2} \sum_{i}^{n} \Delta I_i (\Delta S_i GDP^0 + S_i^0 \Delta GDP) + \frac{1}{3} \sum_{i}^{n} \Delta I_i \Delta S_i \Delta GDP \tag{9}$$

$$S_{effect} = \sum_{i}^{n} I_i^0 \Delta S GDP^0 + \frac{1}{2}\sum_{i}^{n} \Delta S_i (\Delta I_i GDP^0 + I_i^0 \Delta GDP) + \frac{1}{3}\sum_{i}^{n} \Delta I_i \Delta S_i \Delta GDP \quad (10)$$

$$GDP_{effect} = \sum_{i}^{n} I_i^0 S_i^0 \Delta GDP + \frac{1}{2}\sum_{i}^{n} \Delta GDP(\Delta I_i S_i^0 + I_i^0 \Delta S_i) + \frac{1}{3}\sum_{i}^{n} \Delta I_i \Delta S_i \Delta GDP \quad (11)$$

The industry in Thailand is categorized into 3 economic sectors namely, mining, construction and manufacturing. The aggregate change of energy consumption in industry is the summation of the change of the three sectors, which can be calculated from equations (8)-(11).

From equation (6), the "real" energy consumption in the year t can be expressed as.

$$Real = E^t = \Delta E + E^0 \quad (12)$$

The GDP_{effect} is used to predict the "trend" of the energy consumption in year t as in equation (13).

$$Trend = GDP_{effect} + E^0 \quad (13)$$

Energy saving is defined as the difference between Real and Trend. Thus,

$$\psi = Real - Trend$$

$$= \Delta E - GDP_{effect} \quad (14)$$

Energy saving is achieved only if ψ <0, which indicates that the actual increase of energy consumption is less than what should have, otherwise, resulted from the growth of the economy. This condition implies that the energy consumption has been comparatively reduced (saved), which is the indicator of the success of the energy conservation plan. In contrast, if ψ >0, energy saving was not achievable. From equations (8)-(11) and (14), the energy saving model (ψ) can be written as,

$$\psi = I_{effect} + S_{effect}$$

$$\psi = \sum_{i}^{n} \Delta I_i S_i^0 GDP^0 + \frac{1}{2}\sum_{i}^{n} \Delta I_i (\Delta S_i GDP^0 + S_i^0 \Delta GDP) + \sum_{i}^{n} I_i^0 \Delta S_i GDP^0 + \frac{1}{2}\sum_{i}^{n} \Delta S_i (\Delta I_i GDP^0 + I_i^0 \Delta GDP) + \frac{2}{3}\sum_{i}^{n} \Delta I_i \Delta S_i \Delta GDP \quad (15)$$

Energy saving appears mathematically in these models as a negative value of ψ. However, for the ease of perception, positive values are presented as “saving” in the results of ψ. But for I_{effect} and S_{effect} the negative values represent the saving caused by the change of the respective dimensions.

2.2 The mathematical model for sensitivity analysis

In order to understand the degree of parametric contribution in the energy saving, sensitivity analysis is carried out from equation (15), where GDP^t is the summation of gross domestic products (Q^t) of the 3 sectors.

$$GDP^t = Q_1^t + Q_2^t + Q_3^t \quad (16)$$

Thus, for sector i equation (15) is reduced to [9],

$$\psi_i = \frac{1}{3}\frac{E_i^t GDP^0}{(Q_1^t + Q_2^t + Q_3^t)} - \frac{1}{6}\frac{E_i^t Q_i^0 (Q_1^t + Q_2^t + Q_3^t)}{Q_i^t GDP^0} - \frac{1}{3}\frac{E_i^0 (Q_1^t + Q_2^t + Q_3^t)}{GDP^0} + \frac{1}{6}\frac{E_i^t Q_i^0}{Q_i^t} - \frac{1}{6}\frac{E_i^0 Q_i^t}{Q_i^0} + \frac{1}{6}\frac{E_i^0 Q_i^t GDP^0}{Q_i^0 (Q_1^t + Q_2^t + Q_3^t)} + \frac{2}{3}E_i^t - \frac{2}{3}E_i^0 \quad (17)$$

Parameters of the base year, which are represented by the superscript 0, are constants. Alternatively, the energy saving can be written as,

$$\psi_i = f(E_i^t, Q_1^t, Q_2^t, Q_3^t) \quad (18)$$

Total change of energy saving in industry can be written as

$$d\psi = d\psi_1 + d\psi_2 + d\psi_3 \quad (19)$$

$$= dI_{effect1} + dS_{effect1} + dI_{effect2} + dS_{effect2} + dI_{effect3} + dS_{effect3}$$

$$= \sum_{i}^{3} dI_{effect_i} + \sum_{i}^{3} dS_{effect_i} \quad (20)$$

From equations (9) and (10) the differentials of energy intensity effect and economic structure effect in a particular sector are,

$$dI_{effect_i} = \left(\frac{1}{3}\frac{Q_i^0}{Q_i^t} + \frac{1}{6}\frac{GDP^0}{GDP^t} + \frac{1}{6}\frac{Q_i^0 GDP^t}{GDP^0 Q_i^t} + \frac{1}{3} \right) dE_i^t + \left(\begin{array}{l} -\frac{1}{3}\frac{Q_i^0 E_i^t}{(Q_i^t)^2} - \frac{1}{6}\frac{GDP^0 E_i^t}{(GDP^t)^2} - \frac{1}{6}\frac{GDP^0 E_i^0 (GDP^t - Q_i^t)}{Q_i^0 (GDP^t)^2} \\ -\frac{1}{6}\frac{Q_i^0 E_i^t (GDP^t - Q_i^t)}{GDP^0 (Q_i^t)^2} - \frac{1}{6}\frac{E_i^0}{GDP^0} - \frac{1}{3}\frac{E_i^0}{Q_i^0} \end{array} \right) dQ_i^t + \left(-\frac{1}{6}\frac{GDP^0 E_i^t}{(GDP^t)^2} + \frac{1}{6}\frac{GDP^0 Q_i^t E_i^0}{Q_i^0 (GDP^t)^2} + \frac{1}{6}\frac{Q_i^0 E_i^t}{GDP^0 Q_i^t} - \frac{1}{6}\frac{E_i^0}{GDP^0} \right)(dGDP^t - dQ_i^t) \tag{21}$$

$$dS_{effect_i} = \left(\frac{1}{6}\frac{GDP^0}{GDP^t} - \frac{1}{6}\frac{Q_i^0}{Q_i^t} - \frac{1}{3}\frac{Q_i^0 GDP^t}{GDP^0 Q_i^t} + \frac{1}{3} \right) dE_i^t + \left(\begin{array}{l} \frac{1}{3}\frac{GDP^0 E_i^0 (GDP^t - Q_i^t)}{Q_i^0 (GDP^t)^2} - \frac{1}{6}\frac{GDP^0 E_i^t}{(GDP^t)^2} + \frac{1}{6}\frac{E_i^0}{Q_i^0} + \frac{1}{6}\frac{Q_i^0 E_i^t}{(Q_i^t)^2} \\ -\frac{1}{6}\frac{E_i^0}{GDP^0} + \frac{1}{3}\frac{Q_i^0 E_i^t (GDP^t - Q_i^t)}{GDP^0 (Q_i^t)^2} \end{array} \right) dQ_i^t + \left(-\frac{1}{3}\frac{Q_i^t GDP^0 E_i^0}{Q_i^0 (GDP^t)^2} - \frac{1}{6}\frac{GDP^0 E_i^t}{(GDP^t)^2} - \frac{1}{6}\frac{E_i^0}{GDP^0} - \frac{1}{3}\frac{Q_i^0 E_i^t}{GDP^0 Q_i^t} \right)(dGDP^t - dQ_i^t) \tag{22}$$

The overall change of energy saving in the industrial sector can be calculated by substituting equation (21) and (22), for i = 1, 2, 3, into equation (20).

The energy consumption in Thailand [1,10-13] and the sectoral GDP from 1987 to 2002 [14,15] are given in Table 1. They were used to calculate the energy saving in Thai industry. The starting base year is 1987. The gross domestic product data assume the Thai Baht constant at the 1988 price converted to US dollars using the year average 1988 exchange rates [16].

3. RESULTS AND DISCUSSION

3.1 Results and discussion

The results show that, during the period 1988-2002, the total energy saving in Thai industry was -1,401.95 ktoe (negative value means over-consumption instead of saving). This accounted for the saving in the mining, construction and manufacturing sectors of 25.84, 145.84 and -1573.62 ktoe respectively. Since the energy consumed by the mining sector was only 0.67% of the total energy consumption in industry, its role in energy saving is minimal. For the construction sector the energy consumption increased continuously to the peak of 369 ktoe in 1997 (see Table 1), when the economic crisis hit the country and the real estate sector was the first to suffer. As a consequence, the share of the construction sector in the industrial economic structure decreased after 1997 (see Fig. 1). Thus, the change of the industrial economic structure, more or less, has contributed to the success of energy saving. It is interesting to point out that after 1993, the year that Thailand implemented the Energy Conservation Act, the energy saving in the construction sector fluctuated heavily (see Fig. 2). This indicates that Thailand has not yet taken proper action in energy management in the construction sector. However, if the figures of the 2 consecutive years during 1993-1998 are compared, this might suggest the time lagging effect. Even more, the fluctuation and sharp increase in energy consumption implies the instability of the construction sector, which led to the crisis.

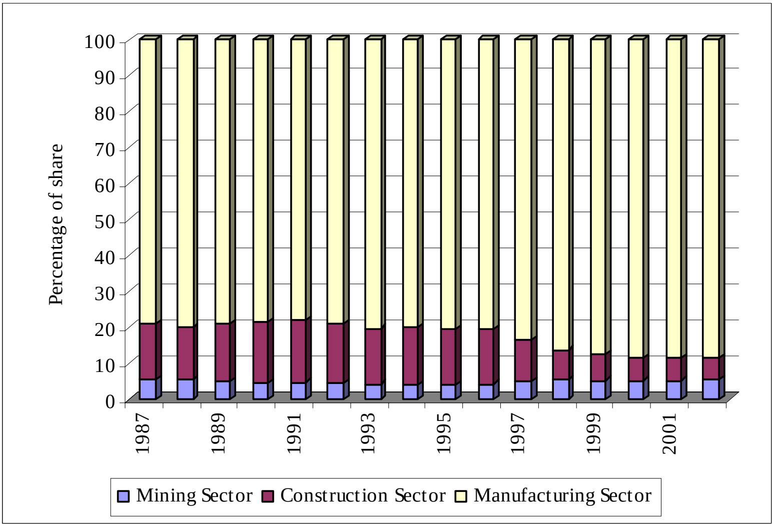

Figure 1. Change of share in Thai industry structure during 1987-2002.

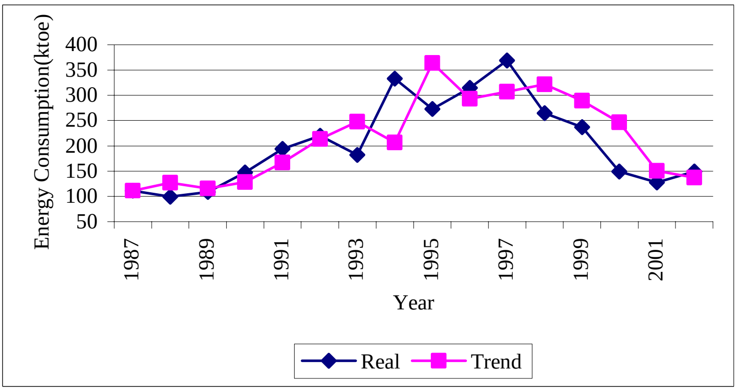

Figure 2. The Trend and Real of energy consumption in Construction sector during 1987-2002.

Table 1. Energy consumption (ktoe), GDP (Q_1, Q_2, Q_3) of sectors (Milions of US dollars at 1988 price levels and exchange rates of 1988) and energy intensity of industries (kgoe per 1000 US$) in Thai industry during 1987-2002.

	Mining		Construction		Manufacturing		Industry		
Years	Energy Consumption	Q_1	Energy Consumption	Q_2	Energy Consumption	Q_3	Energy Consumption	GDP	Energy Intensity
1987	49	953.07	111	2611.69	5599	13511.11	5759	17075.87	337.26
1988	49	1051.6	99	2943.35	6062	15933.98	6210	19928.92	311.61
1989	56	1116	109	3777.73	7712	18487.86	7877	23381.55	336.89
1990	58	1227.7	147	4610.03	8541	21385.78	8746	27223.49	321.27
1991	60	1426.6	194	5238.16	9293	23892.5	9547	30557.29	312.43
1992	84	1500.7	220	5483.51	10847	26592.71	11151	33576.94	332.1
1993	92	1611.8	182	5958.33	11580	30911.09	11854	38481.26	308.05
1994	95	1733.3	333	6801.45	13174	33863.64	13602	42398.36	320.81
1995	104	1769.1	273	7258.64	15664	37889.38	16041	46917.13	341.9
1996	114	2091.1	315	7770.22	17398	40381.87	17827	50243.18	354.81
1997	118	2371	369	5777.58	15986	40964.34	16473	49112.95	335.41
1998	94	2223.6	265	3567.45	13754	36514.67	14113	42305.72	333.6
1999	139	2406.3	237	3323.32	15488	40856.76	15864	46586.38	340.53
2000	85	2539.2	149	3008.66	16208	43329.17	16442	48877.01	336.4
2001	93	2554.5	128	3017.2	16922	43925.32	17143	49497	346.34
2002	106	2834	149	3187.75	18679	46928.05	18934	52949.75	357.58
Total	1396	29410	3280	74335.1	202907	515368.2	207583	619112.8	335.29

As the manufacturing sector consumes a great amount of energy and it contributes to the economic development substantially, energy conservation activities have targeted this sector since the inception of the Energy Conservation Promotion Act in 1993. Energy consumption in this sector during 1987-2002 was 202,907 ktoe (see Table 1). It accounted for 97.75% of the total energy consumption in industry. Hence, energy conservation in this sector is vital. Emphasis will be placed on analyzing energy saving in this particular sector. Table 2 and Fig 3 show that, despite of the implementation of many energy saving measures, energy saving did not actually occur in this sector at all. This indicates that during 1987-2002 the extra energy consumption in manufacturing sector comes from the structural change (S_{effect}) 1,713.61 ktoe while the change in sectoral energy intensity saved 139.99 ktoe of energy. This confirms the role of the change in industrial economic structure, which is a special case occurring during the economic crisis. Consequently, it caused energy inefficiency of this sector, which over consumed of 1,573.62 ktoe. From 1994 to 1996, before the economic crisis started, the Thai manufacturing sector failed to save energy every year.

Table 2. Decomposition of the change in energy consumption and energy saving in Thai manufacturing sector during 1988-2002 (ktoe).

Years	I_{effect}	S_{effect}	GDP_{effect}	Real change	Energy saving
1988	-499.77	60.97	901.80	463.00	438.80
1989	631.72	-76.41	1094.70	1650.00	-555.30
1990	-354.16	-53.06	1236.22	829.00	407.22
1991	-236.08	-41.80	1029.88	752.00	277.88
1992	478.08	129.10	946.81	1554.00	-607.19
1993	-956.29	158.90	1530.39	733.00	797.39
1994	466.68	-70.66	1197.98	1594.00	-396.02
1995	874.62	159.17	1456.21	2490.00	-1033.79
1996	681.89	-79.02	1131.13	1734.00	-602.87
1997	-1651.36	619.22	-379.86	-1412.00	1032.14
1998	-526.19	509.05	-2214.85	-2232.00	17.15
1999	93.20	233.41	1407.39	1734.00	-326.61
2000	-211.02	170.44	760.58	720.00	40.58
2001	487.67	17.56	208.78	714.00	-505.22
2002	581.02	-23.25	1199.23	1757.00	-557.77
1987-2002	-139.99	1713.61	11506.38	13080.00	-1573.62

In the whole industry, the over-consumption of energy in the manufacturing sector out-weighted the other two sectors and resulted in wasteful use of energy by 1,401.95 ktoe (see Table 3 and Fig. 4). During the first year of the economic crisis (1997) it seemed that Thailand could reduce energy consumption in the industry sector. Because the energy consumption in the manufacturing sector decreased (due to the economic downturn), the energy intensity in the manufacturing sector indicated success in energy saving (I_{effect} = -1,651.36 ktoe in Table 2 for 1997) while the structural change indicated over-consumption (S_{effect} = +619.22 ktoe). The positive sign in S_{effect} is partly due to the increasing share of the manufacturing sector (structure change) as appeared in Fig.1. The decrease of the GDP (during the economic crisis) resulted in energy saving with respect to the change of GDP. Therefore, in 1997 it seemed that Thai industry saved energy 963.54 ktoe (see Table 3) and the major contributor was the manufacturing sector (1,032.14 ktoe while the mining and construction sectors over-consumed by 6.65 and 61.95 ktoe, respectively). This might be an illusion because the negative change in energy consumption was due to the slow-down of the large and energy-intensive industries (with negative I_{effect} and GDP_{effect}) not because of good management for energy saving.

In 1997 when Thailand faced the economic crisis, the excessive foreign debt was blamed for the collapse of many industries. But how well the industry performed with respect to energy-related production costs is still a myth to the industrial executives (and also the Energy Conservation Fund). It is interesting to note that seven years before the enforcement of the energy conservation promotion act (1988-1994) Thai industry had an energy saved-consumption of 297.66 ktoe. But, for almost the same duration (eight years), after the full implementation of the law (1995-2002) the energy over-consumption has jumped to 1,699.60 ktoe. Obviously, three years before the crisis (1994-1996) Thailand enjoyed her double-digit economic growth, without realizing that the industry was at the brink of uncompetitive costs (heavily over-consumed energy and fluctuating oil price). During these three years Thai industry consumed 2085.54 ktoe more than it should have consumed (see Table 3). In conclusion, for the last 15 years Thai industry has over consumed energy by 1,401.95 ktoe.

Table 3. Decomposition of the change in energy consumption and energy saving in Thai industry during 1988-2002 (ktoe).

Years	I_{effect}	S_{effect}	GDP_{effect}	Real change	Energy saving
1988	-529.25	54.52	925.73	451.00	474.73
1989	619.58	-72.33	1119.75	1667.00	-547.25
1990	-344.90	-50.32	1264.22	869.00	395.22
1991	-217.61	-37.67	1056.28	801.00	255.28
1992	515.01	115.93	973.06	1604.00	-630.94
1993	-1009.42	142.42	1569.99	703.00	866.99
1994	580.30	-63.93	1231.63	1748.00	-516.37
1995	801.76	140.12	1497.13	2439.00	-941.87
1996	695.67	-68.37	1158.70	1786.00	-627.30
1997	-1504.10	540.56	-390.46	-1354.00	963.54
1998	-495.17	413.09	-2277.91	-2360.00	82.09
1999	118.82	189.37	1442.81	1751.00	-308.19
2000	-340.15	142.92	775.23	578.00	197.23
2001	473.74	15.62	211.64	701.00	-489.36
2002	597.10	-21.36	1215.26	1791.00	-575.74
1987-2002	-38.61	1440.56	11773.05	13175.00	-1401.95

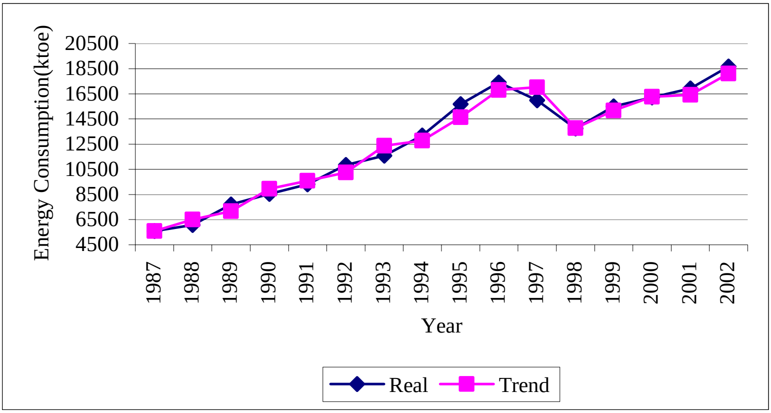

Figure 3. The Trend and Real of energy consumption in manufacturing sector during 1988-2002.

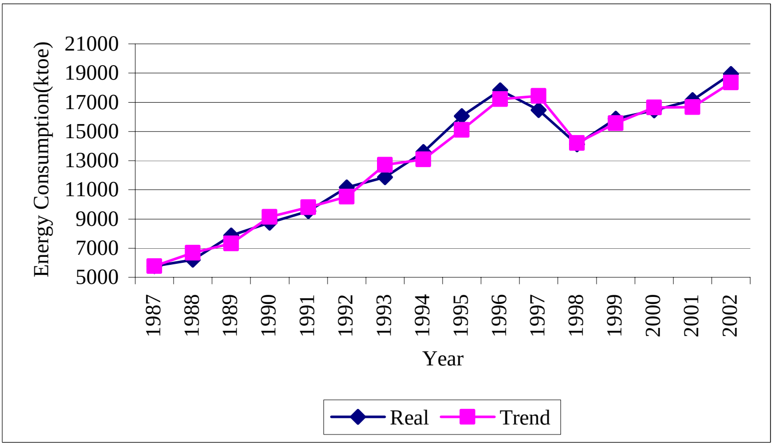

Figure 4. The Trend and Real of energy consumption in the whole industry during 1987-2002.

3.2 Sensitivity of energy saving

The sensitivity analysis of the energy saving model is shown in Table 4. The energy consumption and GDP of 2001 were used as the reference year for the sensitivity analysis of year 2002. The parameters governing energy saving (E_i^t, Q_1^t, Q_2^t and Q_3^t) were varied by 1% to reveal the influence of the parameters.

Equation (20) reveals that the energy saving in industry is a function of the energy saving associated with energy intensity and the economic structure. The total saving of 183.16 ktoe was mainly a contribution from the manufacturing sector (ψ_3 = 180.70 ktoe). It further demonstrates that the influence from energy consumption (E_i^t) overwhelms the influence from the sectoral GDP (Q_i^t).

Table 4 confirms the general trend that energy saving occurs when energy consumption decreases and GDP increases in each economic sector. The increment of 1% of energy consumption in the manufacturing sector results in 180.70 ktoe of energy inefficiency. The change in one sector affects the others. For example, if the GDP of the construction sector (Q_2^t) changes by +1%, a saving in manufacturing of 10.71 ktoe is achieved. However, a change of 1% of all parameters will result in only 2.97 ktoe energy saving difference. The most influential sector is the manufacturing (Q_3^t), as its change will impose substantial change in other sectors. It should be noted that the success of energy conservation in the Thai industry depends wholly on the manufacturing sector.

4. CONCLUSION

This paper presents a detailed study of energy saving in Thai industry. It can be concluded that,

(1) Thai industry had an energy over-consumption of 1401.95 ktoe during 1987-2002. Although having the Energy Conservation Promotion Act and Energy Conservation Fund as the tools, the success of energy saving in Thai industry has not yet been achieved. The energy conservation plan did not function as was expected.

(2) The manufacturing sector is the major player in Thai industry. Emphasis in the energy conservation plan should be placed on this sector. Detailed study of problematic sub-sectors is needed for proper policy recommendation and implementation.

(3) The analysis incorporating economic factors by the decomposition method reveals that the success of energy saving in Thai industry reported previously is an illusion.

Table 4. Sensitivity analysis of 3 dimensional model in Thai industry during 2001-2002.

Parameters	Parameter Variation	Energy saving influenced by I and S (ktoe)											
		Mining			Construction			Manufacturing			Whole industry		
		I_{effect_1}	S_{effect_1}	ψ_1	I_{effect_2}	S_{effect_2}	ψ_2	I_{effect_3}	S_{effect_3}	ψ_3	I_{effect}	S_{effect}	ψ
E_i^t	+1	-1.01	-0.02	-1.03	-1.45	0.01	-1.44	-180.82	0.12	-180.70	-183.27	0.11	-183.16
	-1	1.01	0.02	1.03	1.45	-0.01	1.44	180.82	-0.12	180.70	183.27	-0.11	183.16
Q_1^t	+1	0.99	-0.94	0.05	0.00	0.07	0.07	0.00	9.52	9.52	0.99	8.66	9.65
	-1	-0.99	0.94	-0.05	0.00	-0.07	-0.07	0.00	-9.52	-9.52	-0.99	-8.66	-9.65
Q_2^t	+1	0.00	0.06	0.06	1.38	-1.30	0.08	0.00	10.71	10.71	1.38	9.47	10.85
	-1	0.00	-0.06	-0.06	-1.38	1.30	-0.08	0.00	-10.71	-10.71	-1.38	-9.47	-10.85
Q_3^t	+1	0.00	0.88	0.88	0.00	1.23	1.23	177.82	-20.24	157.59	177.82	-18.13	159.69
	-1	0.00	-0.88	-0.88	0.00	-1.23	-1.23	-177.82	20.24	-157.59	-177.82	18.13	-159.69
Total	+1	-0.01	-0.02	-0.03	-0.07	0.01	-0.06	-3.00	0.12	-2.88	-3.09	0.11	-2.97
	-1	0.01	0.02	0.03	0.07	-0.01	0.06	3.00	-0.12	2.88	3.09	-0.11	2.97

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