International Journal of Energy Economics and Policy
Vol. 2, No. 3, 2012, pp.103-107
ISSN: 2146-4553
www.econjournals.com

Effect of the Energy Price Rate on Insulation Applications

Mehmet Sait Söylemez
Department of Mechanical Engineering, Gaziantep University,
Gaziantep, Turkey. Email: sait@gantep.edu.tr

ABSTRACT: Energy price rate is a significant economical factor in the optimization searches. The energy price rate seems to be continuously available as the energy reserves of the world decreases. The possible increases in energy price rate will be unavoidable due to the reduction in the energy reserves. This is natural with respect to the main law of economics. Previous studies on the energy price rate are searched and discussed in the present work.

Keywords: Energy price rate; economics; optimization
JEL Classifications: Q430; Q510

Nomenclature

d	Market discount rate in fraction,
i	Energy price rate in fraction,
M_s	Ratio of annual maintenance cost to first original cost,
N	Technical life of system, (yr)
P_1	Ratio of total life cycle net energy cost of system to first year's cost,
P_2	Ratio of the life cycle expenditures incurred because of the additional capital investment to the initial investment,
R_v	Ratio of resale value into first original cost.

1. Introduction

Energy recovery projects will possibly be more and more economical in the next years as the energy prices increase further. Energy price rate is directly related to the economical view of the design of the thermal systems. Since the energy cost is a continuous type of expenditure throughout the life of the system it generally yields to get a more amount of value than the initial cost value. The most recent studies take the rate of energy price into account. Most researchers did not consider its value in the past. In the older studies neither energy price nor market discount rate had been considered. This is exactly correct that the energy price rate has a dominant effect on the optimum size of elements or systems. It is obvious that the energy crisis in 1970 affected the world's economy seriously. Energy prices began to escalate after this crisis. Market discount rate is strongly related to the population rate and as the population affects the energy consumption, it can be concluded that the energy price rate would possibly be greater than the market discount rate in the future. For that reason, energy price rate must certainly be used in energy cost calculations. Results of economical output values in optimization studies change as the energy price rate is taken into consideration. The rate of energy price affects these results more or less due to the group of countries in the world of developed, developing and undeveloped types. The price of the energy is also related to its type, which are electricity, petroleum, natural gas, and coal mainly. The price and the rate of energy are both dependent on the natural abundance of the source of it.

There exist several studies on energy price rate in the current literature. Results from a study with Austrian consumers on their possible responses to an increase in the price of energy are reported in Stix et al. (1999). Effect of energy price increases on energy usage and environmental protection is examined by Schurmann (1998). Effect of different price values of energy on the economic sectors is searched by Templet (2001). Variation of energy prices with the fiscal reforms in some countries was presented in Pangestu (2001). The possibility of extreme price movements increased the risk of trading in electricity market (Veron, 2000). Impact of energy price on the U. S. Economy is examined in detail by DOE (2001). It was shown by DOE that the economy was no longer able to absorb the energy price risk and higher energy prices began to affect prices of other goods and services. World oil price projections up to year 2020 were presented in EIA (2000). Energy price escalation rate estimation for various energy sources is available in Fuller and Rushing (2002). The effect of energy prices on the feasibility of energy saving renovation measures in urban buildings and the acceptable payback criterion was searched by Papadopoulos et al. (2002). They used 12 % as an average electricity retail price rate in their study. The energy price rate was considered in the thermoeconomic calculations by Sekhar and Toon (1998). They used the energy price escalation values offered by DOE-2 (1994). Toffolo and Lazzaretto (2002) suggested how to perform a multiobjective optimization including the changes in energy market prices or in energy politics. Effects of large increases in the prices during the early to mid 1970's on the amount of R&D performed by U. S. Manufacturing firms was investigated by Lichtenberg (1986). Amano and Norden (1998) suggested that oil prices might have been the dominant source of persistent real exchange rate of shocks. Inflation control by the energy prices is searched by Thoresen (1993) whereas the impact of higher energy prices on wage rates, return to capital, energy intensity and productivity is examined by Mountain (1986). Walls (1998) studied the dispersion of U. S. Energy prices for a specific period using a variety of metrics. The role played by imperfect competition in the response of markups to energy price and monetary changes was investigated by Ghosal (2000). Foster (2001) reported energy rate increase for California. Uri (1995) examined the effect of energy scarcity on economic growth. Higby (2002) analyzed the Iraq and the energy price crisis. Söylemez (1999) considered the energy price rate in his study using a well-known P_1-P_2 method (Duffie and Beckman, 1980).

2. Mathematical Formulation Concerning the Energy Price Rate, i

The effect of the energy price rate on the overall cost throughout the life cycle period of a system can be estimated by the P_1-P_2 method. The values of P_1 and P_2 are as follows. If i = d economic parameter P_1 can be evaluated as: (Duffie and Beckman, 1980)

$$P_1 = \frac{N}{1+i} \tag{1}$$

Or whether i # d then the value of the P_1 is calculated by the following formula: (Duffie and Beckman, 1980)

$$P_1 = \frac{1}{(d-i)}.\left\{1-\left[\frac{1+i}{1+d}\right]^N\right\} \tag{2}$$

P_2 is defined by the following equation: (Duffie and Beckman, 1980)

$$P_2 = 1 + P_1.M_S - R_V.(1+d)^{-N} \tag{3}$$

3. Results and Discussions

The value of energy price rate, i, is a very important parameter in determining the value of P_1 which depends upon the values of N and d together with i. Variation of P_1 as a function of i and d are depicted in Figure 1 and 2. These figures explain the importance of energy price rate. The values are also available in Table 1. It is seen from this table that the value of P_1 increases from 8.51 to 52.28, which is about six times as compared for the maximum and the minimum energy price rates.

Table 1. Variation of P_1 with i and d for N=20.

i and d	d = 0.0	d = 0.02	d = 0.04	d = 0.06	d = 0.08	d = 0.10
i = 0.0	20.00	16.35	13.59	11.47	9.82	8.51
i = 0.02	24.28	19.61	16.09	13.42	11.35	9.74
i = 0.04	29.78	23.73	19.23	15.84	13.25	11.24
i = 0.06	36.79	28.96	23.18	18.87	15.60	13.08
i = 0.08	45.76	35.61	28.18	22.67	18.52	15.36
i = 0.10	52.28	44.09	34.51	27.44	22.17	18.18

On the other hand for a sample optimization problem available in Söylemez (1999), optimum insulation thickness values are determined and presented for these various P_1 values in Figs. 3 and 4. Optimum insulation thickness values are listed in Table 2 also. Value of optimum insulation thickness increases from 44.2 mm to 120.1 mm, which is approximately three times from minimum to maximum energy price rate values.

Table 2.Variation of Optimum Insulation Thickness in mm with i and d for N=20.

i and d	d = 0.0	d = 0.02	d = 0.04	D = 0.06	d = 0.08	d = 0.10
i = 0.0	71.5	64	57.7	52.4	48	44.2
i = 0.02	79.6	70.8	63.4	57.3	52.1	47.8
i = 0.04	88.9	78.6	70	62.9	56.9	51.8
i = 0.06	99.6	87.6	76.6	69.3	62.3	56.5
i = 0.08	111.9	97.9	86.3	76.6	68.6	61.8
i = 0.10	120.1	109.7	96.2	85	75.7	67.9

4. Conclusion

Following conclusions were drawn from the present review that the rate of energy price is a significant factor for the energy cost estimation. It must be used to obtain more realistic results. The energy price rate will possibly be greater in the next years depending upon the reduction in the energy reserves. Either energy saving projects or application of alternative energy systems might be much more desirable economically as the energy price rate is considered. Utilization of alternative energy source may be enhanced as soon as the energy price rate increases further. Energy price rate must not be greater than the rate of the reduction of the energy reserves naturally. Energy saving projects may prevent the rate of reduction of available energy reserves and so the rate of energy price also.

References

Amano, R.A., Norden, S.V. (1998), Oil Prices and the Rise and Fall of the US Exchange Rate, *Energy and Buildings*, 28, 307-316.

DOE. (2001), Energy Price Impacts on the U. S. Economy.

DOE-2, (1994), Supplement, Version 2.1E, Building Energy Simulation Group, Lawrence Berkeley Laboratory.

Duffie, J.A., Beckman W.A. (1980), Solar Engineering of Thermal Processes, *J. Wiley*, New York.

EIA, *World Oil Markets, International Energy Outlook 2002*, (2000), 23-42.

Fuller, S.K., Rushing, A.S. (2002), Energy Price Indices and Discount Factors for Life-Cycle Cost Analysis, *Annual Supplement to Nist Handbook 135 and NBS Special Publication*, 709, 26-40.

Foster, J. (2001), Energy Rate Increase OK's for California, *World Net Daily, March,* 28.

Ghosal, V. (2000), Product Market Competition and the Industry Price-Cost Markup Fluctuations: Role of Energy Price and Monetary Changes, *International Journal of Industrial Organization,* 18, 415-444.

Higby, N.P. (2002), Iraq and Energy Price Crisis, *Oil & Gas Journal*, 10, 10.

Lichtenberg, F.R. (1986), Energy Prices and Induced Innovation, *Research Policy*, 15, 67-75.

Mountain, D.C. (1986), Impact of Higher Energy Prices on Wage Rates, Return to Capital, Energy Intensity and Productivity, *Energy Economics*, 8, 171-176.

Pangestu, M., Goeltom, M.S. (2001), Survey of Recent Developments, *Bulletin of Indonesian Economic Studies*, 37, 141-171.

Papadopoulos, A.M., Thedosiou, T.G., Karatzas, K.D. (2002), Feasibility of Energy Saving Renovation Measures in Urban Buildings The Impact of Energy Prices and the Acceptable Payback Time Criterion, *Energy and Buildings*, 34, 455-466.

Schurmann, K. J., (1998), Overall Energy Price Increase, *Energy and Buildings*, 28, 257-268.

Sekhar, S.C., Toon, K.L.C. (1998), On the Study of Energy Performance and Life Cycle Cost of Smart Window, *Energy and Buildings*, 28, 307-316.

Söylemez, M.S. (1999), Optimum Insulation Thickness for Refrigeration Applications, *Energy Conversion and Management,* 40, 13-21.

Stix, U., Koll, O., Muhlbacher, H., and Woodside, A.G. (1999), Consumers' Self-Forecasts of Behavioral Changes Following Energy Price Increases, *Advances in Consumer Research*, 26, 58-62.

Templet, P.H. (2001), Energy Price Disparity and Public Welfare, *Ecological Economics*, 36, 443-460.

Thoresen, P.E. (1983), Inflation Controlled by Energy Prices, *Energy Economics*, 5, 202-206.

Toffolo, A., Lazzaretto, A. (2002), Evolutionary Algorithms for Multi-Objective Energetic and Economic Optimization in Thermal System Design, *Energy*, 27, 549-567.

Uri, N.D. (1995), A Reconsideration of Effect of Energy Scarcity on Economic-Growth, *Energy*, 20, 202-206.

Walls, W.D. (1998), Energy Policy and Energy Price Dispersion: Methods and Application to US Data, *Energy Exploration & Exploitation,* 16, 443-451.

Weron, R. (2000), Energy Price Risk Management, *Physica A*, 285, 127-134.

Appendix:

Figure 1. Variation of P_1 with i and d for N=20.

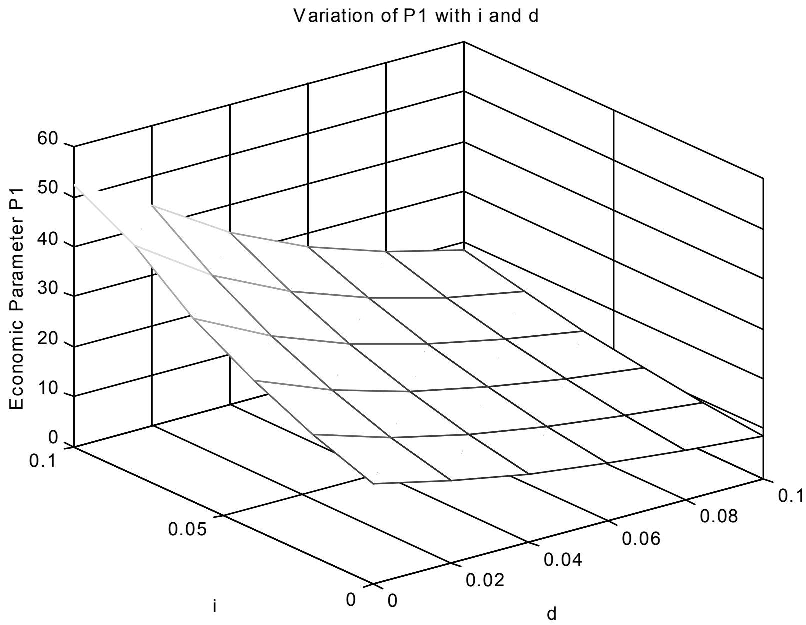

Figure 2. Variation of P_1 with i and d for N=20.

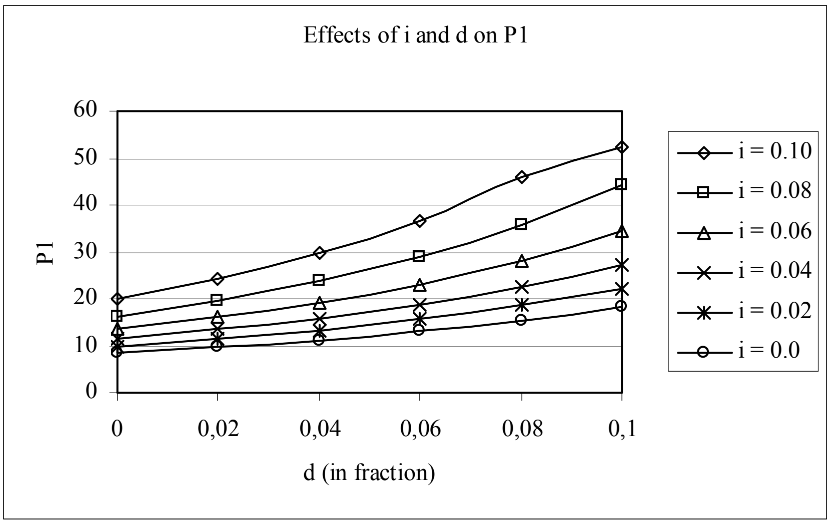

Figure 3. Variation of Optimum Insulation Thickness with i and d for N=20.

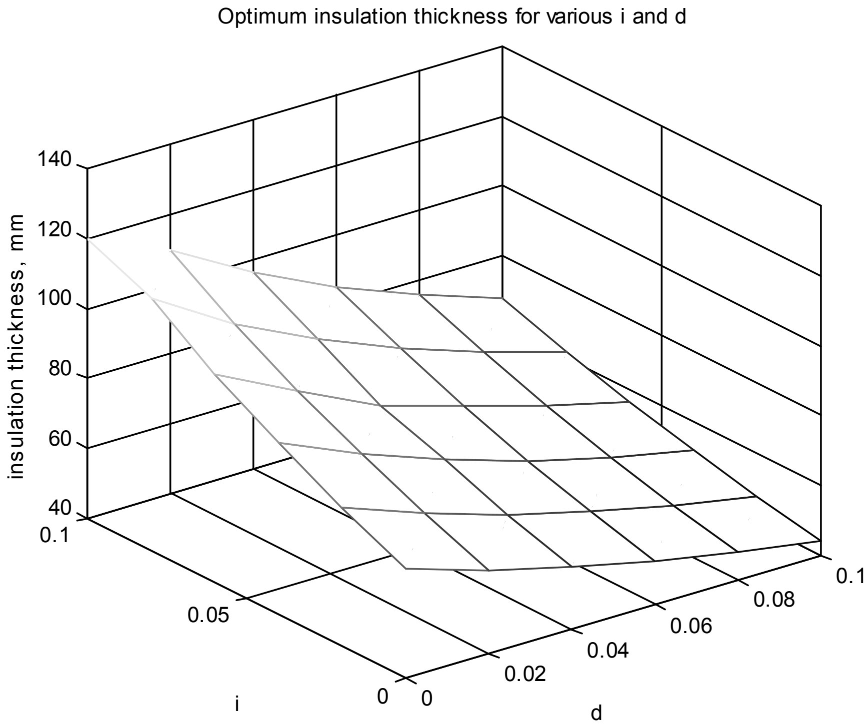

Figure 4. Variation of Optimum Insulation Thickness with i and d for N=20.