韓國環境科學會誌 第3卷(第2號), 165~175, 1994
J. of the Korean Environmental Sciences Society

Emergy Analysis Overview of Korea

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(Manuscript received 5 May 1994)

Abstract

An emergy analysis of the main energy flows driving the economy of humans and life support systems was made including environmental energies, fuels, and imports, all expressed as solar emjoules. The total emergy use (4,373 E20 sej/yr) is 90 per cent from imported sources, fuels and goods and services. The emergy flows from the environment are modest, because the share of global inputs such as rain and geological uplift flux is modest. Consequently, the ratio of outside investment to attracting natural resources is already large, like other industrialized countries. The population level is already in excess of carrying capacity. The emergy use per person in Korea indicates a moderate emergy standard of living, even though the indigenous resource is very poor. If the present economy were running entirely on stored reserves of fuels, soils, woods, etc., it would last about 2 years. Its carrying capacity for steady state on its renewable sources is only 3.3 million people, compared to 43.3 million in 1991. Continued availability of foreign oil at a favorable balance of emergy trade, currently about 7 to 1 net emergy, is the basis for present economic activity and must decrease as the net emergy of foreign oil purchased goes down. Close economic integration with Middle East may determine how long this is possible in the future.

Key Words : Emergy, Ecological economics, Emergy-dollar ratio, Carrying capacity, Standard of living, Future trends, Public policy.

1. Introduction

During 1962~91, the Korean economy expanded at an average annual rate of nearly 9 per cent. Commodity exports rose from $54.8 million in 1962 to $71.9 billion in 1991, making Korea one of the world's major trading partners. The rapid growth seen in the Korean economy over the last three decades has brought with it important changes in the country's energy sector. Not only has the amount of energy consumed by Korea increased significantly, but there have also been important structural changes in the way that energy is consumed. Total consumption of energy in Korea has increased by over the last three decades. Total Primary Energy Supply (TPES) has gone from 10,346 thousand toe in 1962 to 103,622 thousand toe in 1991.

Korea has very little in the way of indigenous energy resources. Its only significant sources of energy are hydropower and anthracite. Firewood was in the past a major indigenous source of energy but its use has fallen very sharply, in parallel with the increasing urbanization of the Korean population, and it now provides less than 1 per cent of Korea's primary energy consumption. It is expected that this share will fall further as consumers continue to switch to alternatives such as electricity and gas.

The move from an agrarian economy to an industrialized one has beem based almost entirely on imported energy. Korea's energy import dependence rose steadily from around 10 per cent in 1964 to around 88 per cent by 1990. Korea's energy import dependence climbed to 91.3 per cent in 1991 (OECD/IEA, 1991).

Environmental considerations have until recently taken a back seat to the government's desire to promote rapid economic development. However, rapid economic growth, coupled with industrialization, urbanization and population increased has given rise to an increasing number of environmental problems.

Future of Korea depends on the connection of energy, economics and environment into one system of interdependent actions. The need for better understanding the linkages among them is paticularly urgent in developing country as Korea.

One way of visualizing many parts in order to make complexity simple is called the systems approach. In this approach, diagrams are used to visualize systems, and from the diagrams calculations are made about flows and storages. Environmental systems science seeks to develop a package of basic principles that govern the working of both natural and human systems.

Since 1962 energy circuit language has been used for synthesis, analysis and simulation of ecological systems (Odum, 1967a, 1967b, 1972, 1983, 1988), new measures of energy hierarchy, transformity, and emergy (spelled with an "m") are used to evaluate environmental contributions to the economy and public policy alternatives (Odum, 1988). Emergy is a scientific-based measure of wealth, which puts raw materials, commodities, goods, and services on a common basis, the energy of one type required to generate that item. Emergy measures the real basis for economic vitality in the long run. The energy systems procedure was applied to a lot of nations, evaluating their energetics and basis for economic vitality (Odum et al, 1982; Odum and Odum, 1983; Pillet and Odum, 1984; Odum and Odum, 1985; Odum and Arding, 1991; Huang and Odum, 1991; Ulgiati et al, 1992). New perspective results on growth, foreign trade, defense, environmental management, standard of living, carrying capacity and future trends.

This paper presents the methodology of emergy analysis which emphasizes the use of energy as evaluating criteria for threading together national system and human economy into a common framework. In addition the emergy indices were also calculated to understand present and further Korea's international status.

2. Symbolic Language and Emergy Concepts

2.1. Symbolic language

The symbols given in Fig. 1 are simple graphic representation of system components – the words of our system language. The symbols each have rigorous energetic and mathematical meanings that are given elsewhere (Odum, 1983). A familiarity with the symbols and their use can help us a great deal when thinking about how systems operate.

2.2. Solar emergy

It takes a lot of low quality energy (i.e.,solar) to make higher quality energy (fossil fuels). Therefore, to compare different forms of energy, a circulation must be made. This is usually done by using joules of solar energy as your starting point to determine how many joules of solar energy it takes to make another energy source.

We use the word emergy to express this idea

– the amount of solar energy used to make a product. It is expressed in emjoules.

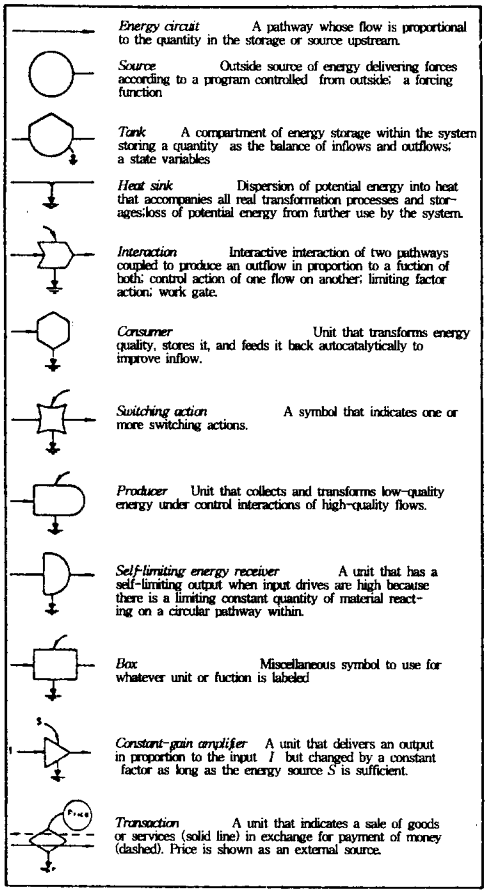

Fig. 1. Symbols of the energy circuit language; for further explanations and mathematical discussions see Odum, 1983.

2.3. Solar transformity, a measure of quality of energy

The solar energy required to make one joule of some type of energy is the solar transformity of that type of energy. The units are solar emjoules per joule (abbreviated sej/j).

Solar transformity of energy type A

$$= \frac{\text{Solar joules required}}{\text{1 joule of energy of type A}}$$

3. Method

In this study the emergy analysis of national system in Korea was studied with following stages.

3.1. Energy systems diagram

First a detailed energy systems diagram was drawn as a way to gain an initial network overview, combine information of participants, and organize data-collecting from various sources of geographical or economic information and statistics of the study area.

3.2. Emergy anaslysis table

An emergy analysis table was set up to facilitate calculations of main resources and contributions of the system. Raw data on flows and storage reserves were evaluated in emergy units to facilitate comparisons and public policy inferences.

3.3. Aggregated diagram

With the help of the energy system diagram and the emergy analysis table, an aggregated diagram was generated from the detailed one by grouping components into those believed important to system trends and those of particular interest to current public policy questions.

3.4. Emergy indices

From the aggregated categories of emergy, various indices such as emergy/dollar ratio, per capita emergy use, fraction of indigenous emergy used, emergy import-export ratio and emergy investment ratio were calculated to compare system, predict trends, to suggest which alternatives will deliver more emergy, which will be more efficient, and which will be successful.

4. Results

4.1. Energy flow of national system

The system of causal interaction for Korea is given in Fig. 2. Energy sources and symbols are arranged from left to right in order of their transformities from sunlight.

The Republic of Korea (ROK) lies on the southern end of Korean peninsula. It has a land area of approximately 99,300 square kilometers (The Korean statistical association, 1992). The area of continental shelf is 244,600 square kilometers (The World Resources Institute, 1990), over two times of land area. The terrain is mostly rugged and mountainous with only 21% of the land being arable. The climate is temperate with hot and humid summers and relatively long , dry, cold winters. The average annual rainfall is 1,280 mm/yr (Korea meteorological Administration, 1992). Typhoons occur almost every year, especially in the summer.

In 1991, Korea had a population of 43.3 million people with a growth rate of about 0.8 per cent. About 70 per cent of the population live in cities and this population is forecast to increase to about 77 per cent by the year 2,000. Currently, one in four Koreans live in the capital, Seoul. The major mineral resources on the Korean peninsula are found in the North, although tungsten, copper, lead, molybdenum and amorphorous graphite are found in the South. Generally speaking, the ROK is an energy resource poor country. There are no significant oil or gas resources and only limited anthracite coal deposits are found in the ROK.

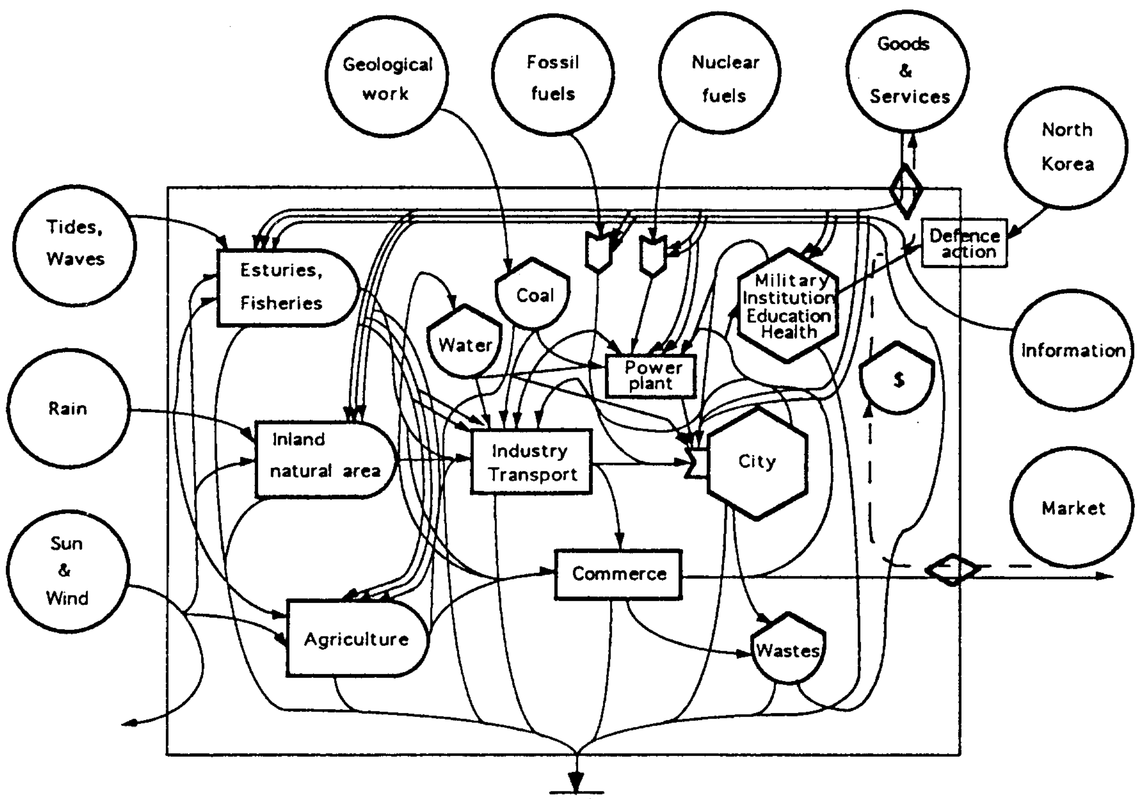

Fig. 2. Energy diagram of Korea

Airborne radiometric surveys have identified a number of uranium deposits, however no development of these has taken place. Consequently, energy security is prime concern of the ROK government. Nuclear power development has been made a top priority in Korea and has received considerable funding over the last two decades since the first oil shock. Korea's nuclear share of electricity generation in 1991 was the fourth highest in the world at 47.5 per cent, just behind France, Belgium, and Sweden (OECD/IEA, 1992).

Nominal per capita GNP during the period grew from $87 in 1962 to $6,498 in 1991, with real per capita GNP increasing nearly eightfold. At the same time, the proportion of GDP originating from the mining and manufacturing sector increased from 16.4 per cent in 1962 to 27.9 per cent in 1991. In the initial stages of industrialization, labor-intensive light industry, especially textiles, was the growth leader. More recently, the heavy and chemical industries have come to account for over half the country's manufacturing output. Economic development requires continuous structural change and for developing economies, the essence of structure change is industrialization. In 1960 industry's share of GDP was 20.1 per cent. By 1970 it was 29.2 per cent, and by 1980 it reached 43.1 per cent. After 1980, however, the industrialization process slowed, reaching 43 per cent in 1987. This is a natural development, as it seems that the manufacturing sector's share of a nation's GDP grows to a certain level - that is, 30 to 40 per cent - and then slowly declines. This is evident in the pattern of industrialization in certain advanced and developing nations. A declining industrial share of GDP in recent years, or deindustrialization, is recorded in virtually all of today's developed nations. It remains to be seen how soon Korea will start to experience it.

Korea's total trading volume in 1962 was only $477 million, but it reached $153.4 billion by 1991 to make Korea the 11th largest trading nation in the world. Korean exports and imports grew at an annual average rate of about 30.3 per cent and 22.1 per cent, respectively, between 1962 and 1990. In fact Korean exports grew much faster than world export growth, and consequently, the share of Korean exports in the world gradually increased over the period, from a meager 0.04 per cent in 1962 to 2.23 per cent 1990 (SaKong, 1993). Korea's dramatic economic growth has slowed somewhat in recent times. Over the last few years the Korean economy has experienced rapid wages growth, high inflation, rising imports and falling exports, which is reflected in the deterioration in the country's balance of payments. While they are by no means the sole reason for the difficulties in the Korean economy, the cost of Korea's rapidly rising energy imports has played a role in the deterioration in the current account.

4.2 Emergy analysis

Based on the preliminary understanding of the ecological-economic system of Korea (Fig. 2), energy flows such as renewable, nonrenewable indigenous and imported sources were listed for the study of Korea's status in terms of its ecological-economic interface.

Table 1. Energy flows in Korea

Sources	Actual energy J/yr	Transformity sej/J	Solar emergy E20 sej/yr
Direct sunlight	9.47 E20	1	9.47
Winds absorbed	1.63 E17	663	1.08
Ocean waves	2.03 E17	30,600	62.12
Tides	2.54 E17	16,800	42.67
Rain, chemical	2.18 E18	15,400	335.72
Rain, mechanical	6.40 E16	10,400	6.66
Earth cycle	9.93 E16	34,000	33.76
Indigenous coal	3.08 E17	40,000	123.20
Imported coal	8.87 E17	40,000	354.80
Imported oil	3.20 E18	66,000	2,112.00
Imported gas	1.63 E17	48,000	78.24
Nuclear electricity	2.03 E17	200,000	406.00
Imported good & services	6.88 E10 ($/yr)	1.40 E12 (sej/$)	963.20

As shown in Table 1, 2 each items of annual flows and storages that are important for studying the ecological-economic interface of Korea was evaluated, using data for 1991. The solar emergies of each of the flows and storages were obtained from the product of raw data and solar tranformities. Evaluation of principal emergy flow can provide quantitative measures of the ecological-economic system. Based on the examination of the aggregated emergy flows of Korea (see Table 3 and Fig. 3), it becomes apparently that imported fuel and goods and services are the principal sources for the national economy in Korea. Specially, Korea operated its economy on 8 per cent renewable resources, 3 per cent local non-renewable resources, 67 per cent imported fuels (especially 48 per cent imported oil) and 22 per cent imported goods and services. As shown by Fig. 3 emergy flow of imported fuels is the major driving forces of economic growth.

Table 2. Emergy Storages in Korea

Item	Actual energy J	Transformity sej/J	Solar emergy E23 sej
Soil	1.986 E19	1.30 E4	2.582
Wood	1.151 E17	3.50 E4	0.040
Ground water	4.905 E18	4.10 E4	2.011
Coal	1.394 E19	4.00 E4	5.567
Iron ore	2.587 E12	6.00 E7	0.002
Limestone	1.768 E15	1.62 E6	0.029
Sand	7.486 E13	2.00 E7	0.015
Total			10.246

The ratio of emergy flow to dollar circulation within the country is 1.56 E12 sej/$. Human service is the final sector toward which most

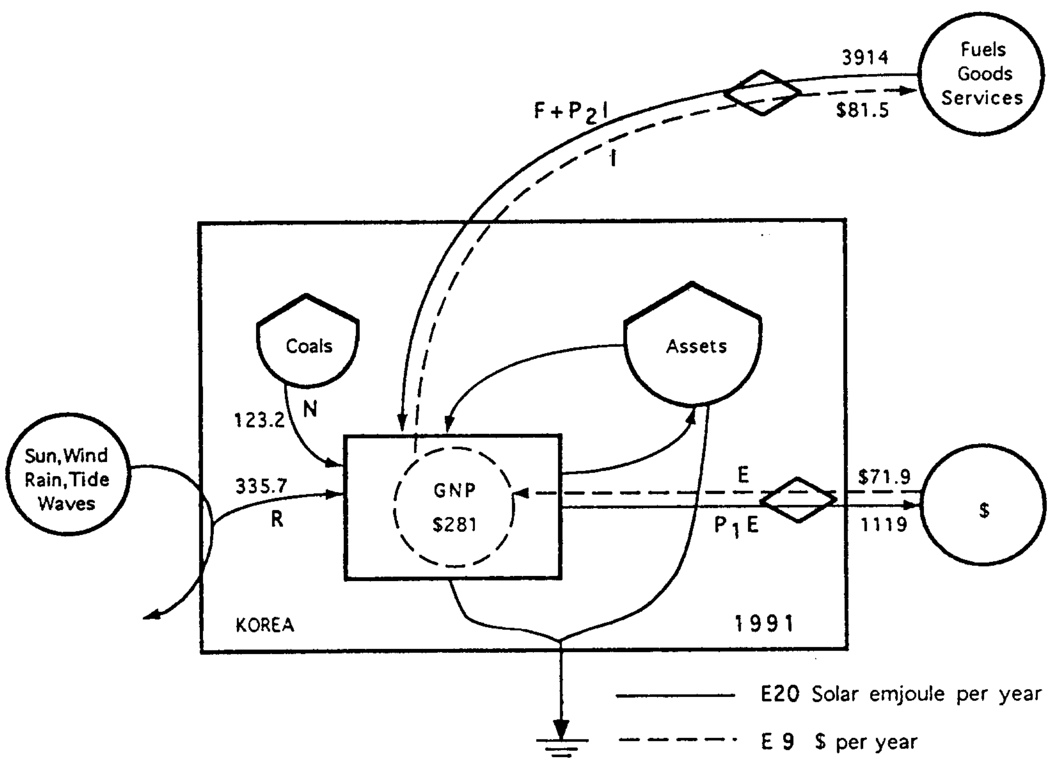

Fig. 3. Overview of the Korea system

other environmental, industrial, and commercial sectors converge their work in hierarchical organizations of humanity and nature. The total emergy of the nation's economy used within the country was taken as the basis for the nation's human services for which monies were circulated from human to human. The ratio between the total emergy used and gross national product indicates the real work equivalent of a unit of currency spent for human service.

As the diagram in Fig. 3 shows all money goes to human service only. Even when one buys fuels or goods, the money is for the human service in processing the fuels or goods, only indirect for externalities of energy and materials from the environment. The environment never receives money for its work. Since undeveloped countries have large ratios of emergy supporting a small monied economy, the emergy to dollar ratios are larger than in developed countries. This means that the money buys more of nature's work in the developed country, although it may not be recognized that nature's work is following to people, much of it indirectly in providing cheap wood, soils, clean air, clean water, cheap waste disposal, cheap food, etc. When a purchase is made from another country, it is that country's emergy to dollar ratio that determines how much real services one can purchase. The emergy dollar ratios of countries change with inflation, and the ratio may be one of the best measures of inflation.

4.3. Emergy indices

Various flows calculated in Table 3 are combined in various ways in Table 4 to provide perspectives on national overview to compare countries, and to suggest public policies. Relative roles of renewable, non-renewable, imports, concentrated, and rural emergy are examined. Self-sufficiency, emergy concentration per area, and emergy per person as an index of living standard are calculated. Carrying capacity is the number of people that can be supported at a stated standard of living. This is estimated for current sources and for development in which outside resources are attracted in a ratio of 7 to 1 typical of the developed countries. Also included is the carrying capacity on renewable resources only. Table 5 has emergy per person obtained by dividing the national total by population. Large environmental resources of underdeveloped areas provide many free services, life support, low taxes, and land costs, etc. that are more properly estimated with the emergy measure than with dollars or fuel energies. Where populations are excessive as in India, the emergy per person is low. The emergy use per person in Korea indicates a moderate emergy standard of living, even though the indigenous resouce is very poor. Korean people receive mainly imported emergy from Middle East countries. When the net benefits to countries are estimated in emergy units, results such as those in Table 6 are obtained. Countries like Holland, West Germany and Japan are getting four times more emergy than they are returning in exchange. Little wonder that these countries have a high standard of livlng. Korea is getting 3.4 times more emergy than returning in exchange.

5. Discussion

The magnitudes of the energy sources in Table 1 characterize the forcing presssures to which the culture and economy of Korea is being developed.

Next in importance to the large fuel import and emergy in goods and services that went into imports, solar emergy in rainfall is most important, even though a heavy rain visited in the summer. Waves and tides although large when considered for a coastal province, are not large when prorated over the area of the whole country. Where flows have a common source

Table 3. Summary flows for Korea

Letter in Figure 3	Item	Numerical value
R	Renewable sources used,sej/y	335.72 E20
N	Nonrenewable sources flow from within the country, sej/y	123.20 E20
F	Imported minerals and fuels, sej/y	2951.04 E20
P_2I	Imported goods $ services,sej/y	963.20 E20
I	Dollar paid for imports, $/y	8.15 E10
E	Dollar paid for exported, $/y	7.19 E10
P_1E	Exported goods & services, sej/y	1118.97 E20
X	Gross National Product, $/y	2.81 E11
P_2	Ratio emergy to dollar of imports (sej/$, U.S.A., 1990)	1.40 E12
P_1	Ratio emergy to dollar within the country and for its exports,sej/y	1.56 E12

Table 4. Indices using emergy for national overview of Korea

Name of Index	Expression	Value
Renewable emergy flow	R	335.72 E20 sej/yr
Flow from indigenous nonrenewable reserves	N	123.20 E20 sej/yr
Flow of imported emergy	$F + P_2I$	3,914.24 E20 sej/yr
Total emergy inflow	$R + N + F + P_2I$	4,373.16 E20 sej/yr
Total emergy used	$U = N + R + F + P_2I$	4,373.16 E20 sej/yr
Total exported emergy	P_1E	1,118.97 E20 sej/yr
Fraction of emergy used devided from home sources	$(N+R) / U$	0.10
Imports minus exports	$(F+P_2I) - P_1E$	2,795.27 E20 sej/yr
Ratio of exports to imports	$P_1E / (F+P_2I)$	0.29
Fraction used, locally renewable	R / U	0.08
Fraction of use purchased	$(F+P_2I) / U$	0.90
Ratio of concentrated to rural	$(F+P_2I+N) / R$	9.88
Use per unit area (9.93 E10 m^2)	U / (area)	4.40 E12 $sej/m^2/yr$
Use per capita (43.3 E6 people)	U / (population)	10.01 E15 sej/yr/cap.
Renewable carrying capacity at present living standard	(R / U) (population)	3.32 E6 people
Developed carrying capacity at same living standard	8(R / U) (population)	26.59 E6 people
Ratio of use to GNP	$P_1 = U / GNP$	1.56 E12 sej/$

and are by-products, such as winds, waves, and rain generated by the weather system, only the largest is used usually the rain energy to avoid double counting two inputs which ultimately came from same source (Odum, 1983).

The summary in Fig. 3 shows the preponderance of the economic basis in outside imports (90%). The ratio to indigenous matching resources from the environment (9.9) is large, representing a high degree of economic and development environmental loading. The total emergy input per person and per area is large. The ratio of concentrated emergy to rural emergies is higher than United States. These indices indicate the high degree of development of available environmental resources, perhaps indicating little basis for attracting additional investment. The emergy per dollar circulating is somewhat more than that of the United States (1.40 E12 sej/$ in 1990). Only one-tenth of the present standard of emergy per person is based on indigenous resources, making the present economy dependent on continued symbiotic relationship with Middle East oils. Comparing rates of total emergy use (4.37 E23 sej/yr) with total reserves in Table 2 (10.25 E23 sej) indicates little way to sustain current economic levels without fossil fuel imports. The total emergy reserve would last only 2.3 years. The carrying capacity without outside imports would be 3.3 million people at present standard of living.

The present economy is highly dependent on a favorable balance of emergy with Middle East, at current prices receiving net emergy of 7 to 1 relative to emergy of dollar trade. Future availability may depend on an integration of economic and non-economic feedbacks of service to Middle East to reinforce the mutual advantages of continued fuel supply.

Because nuclear plants are only competitive in supplying electricity, their use depends on electric demand. If general growth is not possible, and emergy per person not likely to go higher, then demand for high quality energy of electricity is not likely to increase. Hence further investment in nuclear plants is not good policy. Nuclear plants are not good net emergy for supplying general heating or substitution for solid and liquid fuels used directly (Odum, 1983).

Whereas underdeveloped countries with large undeveloped environmental energy attractions may develop further attracting investments in competition with developed and overdeveloped nations, Korea is already among those countries that may turn down as Middle East net emergy of oil declines early in the next century or sooner.

Although the Korea had a negative dollar trade balance, it profited from about 3.4 times more than exports of emergy. This is the very reason why the performance of the Korean economy has been outstanding.

In terms of the emergy analysis introduced in this paper, the future works will be conducted as follows for the best combination of economic development and environmental protection in Korea.

1. Simulating the future in Korea with resources declining in availability.

Table 5. Standard of living for different countries (1990) and Korea (1991)

Country	Emergy per yr E22 sej	Population E6 people	Emergy per person per yr E16 sej
Australia	88.5	15.0	5.9
Sweden	41.1	8.5	4.8
U.S.A.	660.0	240.0	2.8
Netherlands	37.0	14.0	2.6
Taiwan	175.0	20.0	2.5
Italy	126.5	57.5	2.2
Japan	153.0	121.0	1.3
Korea	43.7	43.3	1.0
Ecuador	10.3	9.6	1.0
Poland	33.0	34.5	1.0
China	719.0	1100.0	0.7
World	2024.0	5250.0	0.4
India	61.0	626.0	0.1

Table 6. Emergy self sufficiency and trade

Nation	Emergy from within %	Emergy received / Emergy exported
Netherlands	23	4.3
West Germany	10	4.2
Japan	31	4.2
Korea	10	3.4
Switzerland	19	3.2
Spain	24	2.3
U.S.A.	77	2.2
Taiwan	24	1.89
India	88	1.45
Brazil	91	0.98
Dominica	69	0.84
New Zealand	60	0.76
Poland	66	0.65
Australia	92	0.39
China	98	0.28
Soviet Union	97	0.23
Liberia	92	0.15
Ecuador	94	0.12

2. Application to the environmental policy (e.g. ocean dumping system, incineration, wastewater and solid waste management, etc.).

3. Applicaton to the public policy (e.g. nation's development plan, foreign trade, structure transformation, etc.).

References

Huang, S.L. and H.T. Odum, 1991, Ecology and economy; Emergy synthesis and public policy in Taiwan, J. Env. Mgt., 32, 313-333.

Korea Meteorological Administraton, 1992, Annual climatological report, 160pp.

Odum, H.T., 1967a, Energetics of food production, in The world food problem, Report of the President's Science Advisory Committee, Panel on world food supply, The Whitehouse, Vol. 3, 55-94.

Odum, H.T., 1967b, Biological circuits and marine systems of Texas, in Pollution and marine ecology, T.A. Oslon and F.J. Burgess, eds., Wiley Interscience, N.Y., 99-157.

Odum, H.T., 1972, An energy circuit language for ecological and social system: its physical basis, in System analysis and simulation in ecology, B. Patten, ed., Academic Press, vol. 2, 39-211.

Odum, E.C., G. Scott and H.T. Odum, 1982, Energy and environment in New Zealand, Joint Centre for Environmental Science, Univ. of Canterbury, Christ-church, N.Z., 129pp.

Odum, H.T., 1983, Systems ecology, Introduction, John Wiley, N.Y. 644pp.

Odum, H.T. and E.C. Odum, eds., 1983, Energy analysis overview of nations, Working paper WP-83-82, International Institute for Applied System Analysis, Luxemburg, Austria, 469pp.

Odum, H.T., 1988, Self organization, trans-formity, and information, Science, 242, 1132-1139.

Odum, H.T., E.C. Odum, M.T. Brown, D. LaHart, C. Bersok and J. Sendzimir, 1988, Energy, environment and public policy: A guide to the analysis of system, UNEP Regional Seas Reports and Studies, No. 95, United States Environment programme, Nairobi, Kenya, 109pp.

Odum, H.T. and J.E. Arding, 1991, Emergy analysis of shrimp mariculture in Ecuador, Working paper prepared for the Coastal Resources Center, Univ. of R.I., Narragansett, 114pp.

OECD/IEA, 1992, Energy policies of the Republic of Korea, OECD, Paris, 123pp.

Pillet, G. and H.T. Odum, 1984, Energy externality and the economy of Switzerland, Schweiz. Zietschrift fur Volkswirtschaft und Statistik; Revue Suisse D'economie Politique et de Statistique, 120(3), 409-435.

SaKong, Il, 1993, Korea in the world economy, Institute for International Economics, washington, DC, 302pp.

The Korean Statistical Association, 1992, Korea statistical yearbook, National Statistical Office, Vol. 39, 611pp.

The World Resources Institute, 1990, World resources 1990-1991, A guide to the global environment, Oxford University Press, 383pp.

Ulgiati, S., H.T. Odum and S. Bastianoni, 1992, Modeling interaction between environ-ment and human society in Italy: An emergy analysis, in Proceeding of the 36th annual meeting of International Society for the Systems Science, Denver, CO, July 11-17, L. Peeno, ed., 1121-1133.

한국의 자연환경과 경제에 대한 EMERGY분석

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(1994년 5월 5일 접수)

환경개발과 경제발전을 조화롭게 하여 지속가능한 것으로 발전시킬 수 있는 EMERGY 분석법을 이용하여 한국의 환경과 경제에 적용하였다. 1991년 한국이 사용한 총 EMERGY량은 4,373 E20 sej/yr 로서 이중 약 90%가 외국에서 수입해 온 원유, 광물자원 그리고 상품 등으로부터 비롯된 것이다. 국내의 환경자원으로부터의 EMERGY 사용량은 강수량과 지질학적 작용이 유사한 다른 국가와 동일한 수준이었다.

환경자원에 대한 경제적 이용률은 선진국의 이용률과 같은 수준이어서 제한된 환경자원에 대한 압박이 클 수밖에 없음을 알 수 있었다. 인구 1인당 사용량은 부존자원이 빈약하고 무역수지의 적자에도 불구하고 약 3.4배의 EMERGY교역의 흑자로 인하여 경제선진국의 값과 비슷하였다. 그러나, 현재의 소비수준으로 국내의 환경자원에만 의존할 경우 약 2년 정도밖에 지속될 수 없으며, 정상상태에서의 인구 수용능력은 '91년 현재의 인구 4천 3백만명에 비하여 3백3십만명에 불과하다.

EMERGY 분석을 통해서 볼 때 한국의 경제활동은 환경에 지나친 압박을 주고 있으며 성장의 지속은 중동국가를 비롯한 산유국과 경제적인 수지가 아닌 EMERGY 수지의 관점에서 얼마나 효율적으로 상호관계를 유지하느냐에 달려있다.