Unit 3104 A conceptual framework for *exponential success* for environmental sustainable business

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Executive Summary

Approximately thirty years have passed since global cooperation on environmental protection policies began. Nevertheless the world has not yet reached agreement on environmental policies. There are many environmental problems unsolved. Among these, the global warming problem is the biggest problem we are facing now. Unfortunately the global warming problem is said to have reached the point of no return already. This might mean that the global warming environmental problem might from now on get worse exponentially. The world needs leaders especially in businesses in the private sectors which are working as the centripetal force of the capitalism. I tried to develop a conceptual framework to help companies in the private sector establish strategies to improve their energy and material efficiency exponentially to help solve the global warming problem.

1. What companies can do for the environment

1-1 Review of the global cooperation of governments

Global warming is obviously a problem beyond national boundaries, therefore the nations of the world should unite to solve it. The world started discussing global policies for environmental preservation more than three decades ago. The United Nations (UN) Conference on Human Environment, also known as the Stockholm Conference[1,] was held during 5th – 6th June 1972. This conference featured the first attempt by the international community to address the relationships between the environment and development at the global level. Indeed, the conference succeeded in putting the environment on the global agenda. The adoption of the Stockholm Action Plan, the first global action plan for the environment, provided the basis for a standard agenda and a common policy framework to deal with the first generation of environmental action. An important outcome of the conference was the subsequent establishment of the United Nations Environment Program (UNEP). UNEP was established by the conference and famous resolutions were decided afterwards, as shown in Table1-1.

Table 1-1

Name, year	Contents
United Nations Environment Program (UNEP)[2],1972	To provide leadership and encourage partnership in caring for the environment by inspiring, informing, and enabling nations and peoples to improve their quality of life without compromising that of future generations.
Washington Convention[3] (CITES),1975	Convention on International Trade in Endangered Species of Wild Fauna and Flora
RAMUSAR Convention[4] ,1975	Convention on wetlands of international importance, especially as waterfowl habitat
UNCD[5],1974	United Nations Conference on Desertification
LRTAP[6],1979	Convention on Long-range Trans boundary Air Pollution in Europe
WCED[7] : World Commission on Environment and Development 1987	Issued report titled “Our common future”, which used the phrase “Sustainable development” for the first time. （Brundtland report）
Vienna Conservation for the Protection of the Ozone Layer[8],1985	Countermeasures for the protection of ozone layer
Intergovernmental Panel on Climate Change(IPCC)[9] 1988	Recognizing the problem of potential global climate change, the World Meteorological Organization (WMO) and the United Nations Environment Program (UNEP) established the IPCC.
Earth summit[10] (UNEP2)1992	Riodejaneiro, Agenda 21, United Nations Framework Convention on Climate Change (UNFCCC)[11]
UNFCCC , 1990	Kyoto protocol 1997(COP3; Conference on Parties)
Gleneagles summit[12], 2005	Action Plan: Accelerate international cooperation to develop renewable energy. Brazil, India and China, participated in discussions on energy saving and prevention of global warming with G8.

Now, the Group of the eight(G8) [12] summit was created as a high capacity institution, to deliberate, take decisions, deliver them and develop global governance. In addition to this, Group of 20 (G20) is helping provide the governance in finance and related fields[13]. In June, 2004, the Kyoto Protocol was ratified. The ratification of the Kyoto Protocol itself can be said to be a milestone because it was the fist agreed global action to deal with the global warming problem, after thirty years of global cooperation to introduce effective countermeasures. The discussions have been well organized, and have given participants plenty of opportunities for reaching conclusions, but unfortunately the discussion itself could not reach effective conclusions until now.

The lack of participation by the leader of capitalism, the USA, and the representative of the emerging developing countries China and India, obviously deprives the Kyoto Protocol of much f its effectiveness because the total emission of CO_2 from those three countries is more than forty percent of the word emission[14], which cannot be ignored. The agenda of the current G8 summit and G20 summit held in Gleneagles, England (July, 2005), is how the world can cooperate to solve the energy and global warming problems without sacrificing the economy. This meeting succeeded in setting up international cooperation to develop renewable energy, but it failed to persuade emerging developing countries such as Brazil, India, and China (sometimes Russia is added and called the BRICs countries) to reduce their energy consumption and failed to convince the USA of the validity of the Kyoto Protocol.

As explained, the road to global cooperation on environmental preservation has not been smooth in the last thirty years and I foresee the same difficult long and winding road in front. I want to raise a question here. Can we wait for a long time for global agreement? Can we depend on governments to solve the most wanted solution –the environmental solution-? My answer is absolutely “No!”, because if we wait, the problem will rapidly worsen and the countermeasures to problems will become much more difficult. Companies in the private sector, especially those that advocate being leaders in environmental sustainability, should act now.

1-2 Excellent companies can change the world

Currently, developing countries have looser environmental regulations than developed countries. Unfortunately, in many developing countries, there are many corrupt practices related to the environmental regulations such as corrupt government officials allowing illegal emissions and dumping of polluted substances[15]. Knowing the differences between countries, what should companies in the developed world do? Multi National Companies (MNCs) may have a problem in establishing a common environmental policy. For example,

a plant in China does not have to consider the Kyoto Protocol, while its sister plant in Japan has to decrease the emission of CO_2 to comply with the Kyoto Protocol. Another plant in the USA may not be affected by the Kyoto Protocol, however there are other policies in the USA to be considered. I would like to argue that companies, especially MCNs, need to establish their own environmental policies by foreseeing the future necessity of the global environment and establishing better environmental strategies. There should be an environmental policy which can be used consistently as the common managerial value among all global business sites of the company, irrespective of their geographical locations and national environmental regulations. The world is not uniform in geography, resources, culture, and history, economy, and wealth so it is often difficult to overcome all the differences by political actions. However, companies in private sectors can unite to establish one environmental policy common to all businesses in the sector. Excellent companies in the private sector can be leaders and missionaries for environmental sustainability in the actual business field by providing excellent environmentally sustainable products, processes and services. Excellent companies can move much faster than governments and lead the global community by providing better environmental policies and solutions. In this meaning, I would like to argue that excellent companies can change the world.

2. Reaching TPNR(The Point of No Return) in the global warming problem

There are many kinds of environmental problems, however in this report I will focus on the problem of global warming because it is the largest and most urgent problem affecting everybody on earth. Unfortunately, the problem of global warming is already serious and it will get much more serious if we do not act soon.

Dr Rajendra Pachauri, the chairman of the official IPCC, held a lecture titled: *Global Warming: Approaching the Point of No Return, Warns Leading Climate Expert.* He told an international conference attended by 114 governments in Mauritius in Jan, 2005 that he personally believes that the world has "already reached the level of dangerous concentrations of carbon dioxide in the atmosphere"[16]. I understand that Dr. Pajendra's comment that the global warming approaching the point of no return is based on the population expansion as explained below.

Reason: The world population is expanding exponentially. If I fit two straight lines to simulate the exponential curve of the world population increase, the two straight lines cross around the mid 1950s and the population at the cross point was around two billions. The cross point of the two lines is the transitional point from where a linear phenomenon is transformed into an exponential phenomenon. The world population has already

reached this critical transformation point, which can be called the the Point of No Return (PNR) of the world population (Figure 2). Even if the energy consumption per capita remained the same, the total energy consumption and the total CO_2 emission would increase exponentially in proportion to the exponential increase of the world population.

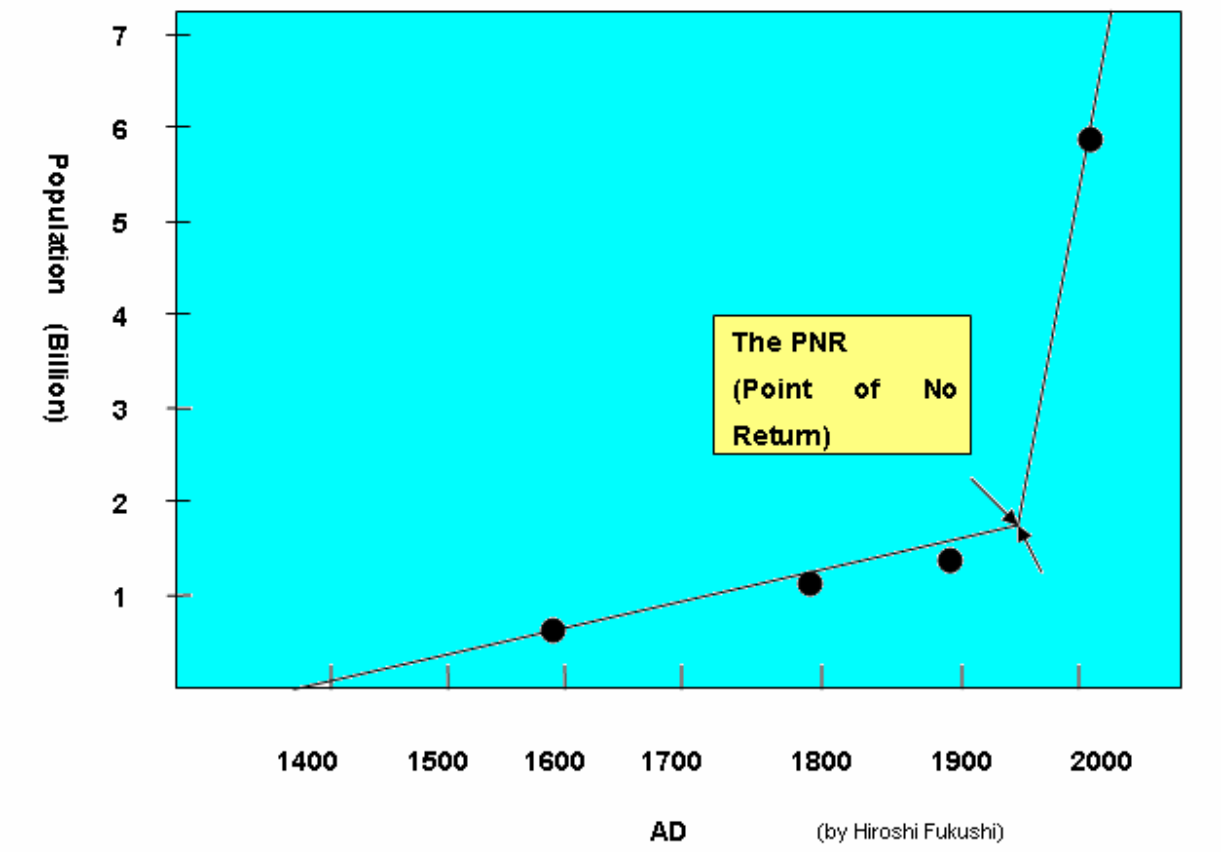


Figure-2 The PNR (Point of No Return) of the world population

3. Building a conceptual framework for exponential success in the environmental sustainable business.

As the rate of global warming is increasing exponentially, countermeasures must be similarly effective. The procedural framework for setting countermeasures should be applicable to a wide range of industries, because global warming is every industry's problem and responsibility. With this scope in my mind, I have built a conceptual framework for companies committed to environmentally sustainable business to help them set up countermeasures to global warming. As is the nature of a conceptual framework, it

tends to involve general theories and concepts. However, I have tried to show as many examples as possible for easier understanding. I introduce my conceptual framework in the following order.

- look at the problem of CO_2 emission from a wider perspective by explaining energy systems;
- define the environment value of products and services using the analogy of value defined in the marketing management and
- explain a conceptual framework by showing new design concepts of business processes which will give companies chances to review their own business processes and find exponentially efficient ways to cope with the global warming problem.

3-1 Look at the problem of CO2 emission from a wider perspective

Most of us, either individuals or companies, tend to think of ourselves as the end users of products and services. For example, most manufacturing companies receive electricity from a power plant and buy raw materials to make products, so when we try to save energy and material, we tend to focus on how to save energy, how to raise the product yield within our facilities. When companies try to reduce the emission of CO_2, they tend to think of the emission from their own manufacturing process only. However, if we take a wider view, the countermeasures will be very much different. We need to look at the entire picture of the energy flow around our business processes and plan the best efficiency throughout the entire system. Usually, companies buy energy from suppliers and use it to produce products and prepare services. Therefore to understand the entire picture, we need to understand how the energy is produced and delivered to us and how much energy we use and how much CO_2 we generate through the entire business process.

3-1-1 The energy supply chain

The energy supply chain consists of four steps from the supplier to the end users; 1. Extraction, 2. Transportation, 3. Conversion, 4. Delivery. The energy needs to be extracted from the energy source and then delivered to converters, who use the energy to

produce such energy utilities as steam and electricity. Then these energy utilities are delivered to the users by pipes and lines. I define the Energy Supply (ES) Chain:

> The ES (Energy Supply) Chain consists of four consecutive steps to deliver energy from suppliers to users (Figure 3-1-1a)

The current problem of the low efficiency of the energy system includes not only the low efficiency of the process at the user companies, but also the low energy efficiency of the ES Chain. In every step of the ES Chain, there is a loss of the energy. Today, most of the energy is derived from fossil fuel so the low efficiency of the total energy system directly means high emission of CO_2. Therefore, when we try to improve the energy efficiency, we should have a wider view: not only the efficiency of own process but also entire ES Chain.

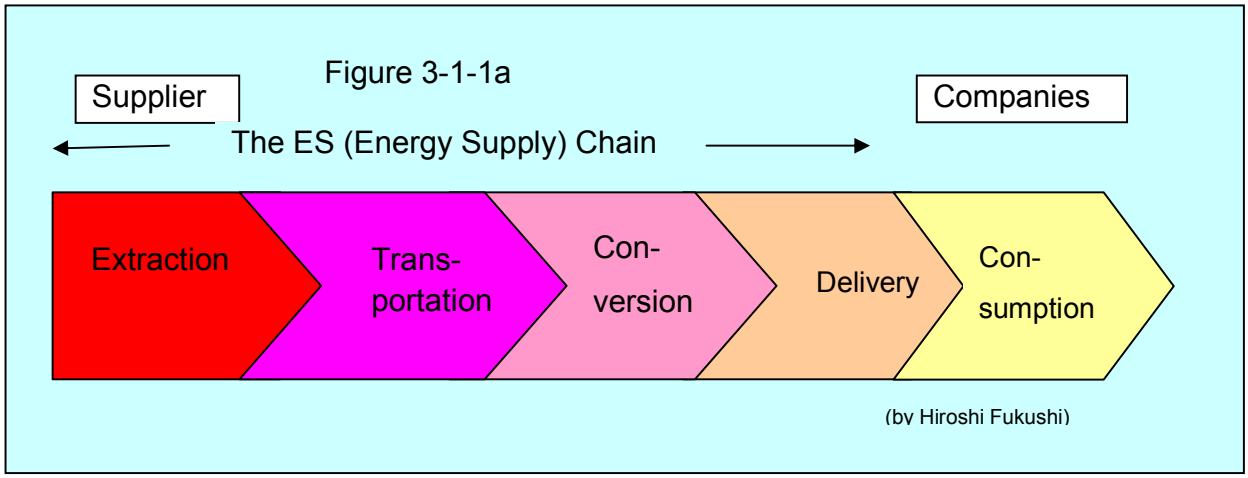


Figure 3-1-1a

I show an example of the ES Chain of coal in Figure 3-1-1 b

1. Extraction: Coal is mined and put on trucks.
2. Transportation: Coal is transported by railroads and water transportation (sea or river).

3. Conversion: Coal is used to generate energy, such as steam and electricity, at an energy plant.

4. Delivery: Steam and electricity are supplied to the users by pipes or lines.

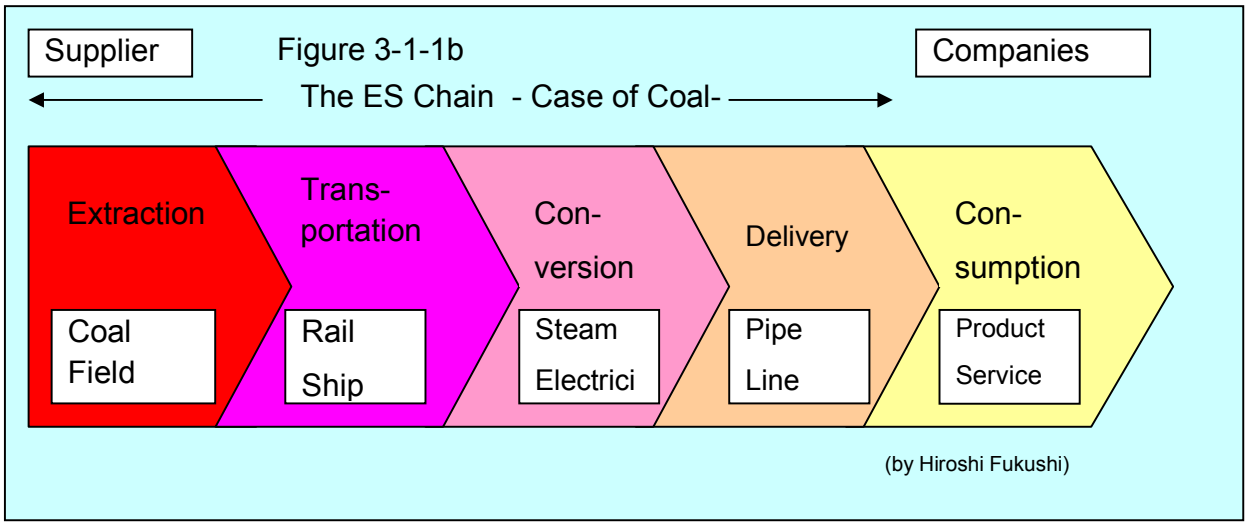


Figure 3-1-1b

If the efficiency of each of the five steps, including the ES Chain and user companies own process, were increased by 10%, the total efficiency would be increased by approximately 60%. If the efficiency of each step were decreased by 10%, the total efficiency would be reduced by approximately 40%. A small change in the efficiency at each step of the energy system makes a much larger change to the efficiency of the total system.

3-1-2 Cleaner production approach and FACTOR X CLUB

As I explained, a small improvement in each step of *the energy chain* will make a bigger total improvement. In this sense, the *Cleaner Production (CP)* approach can be a good step for companies aiming for better energy efficiency. CP is the continuous improvement of industrial processes and products in order to:

- reduce the use of resources and energy;
- prevent the pollution of air, water, and land;
- reduce wastes at sources; and
- minimize risks to the human population and the environment.

Factor X Club[17] was established in 1995 to promote CP. The principles of the club were laid down in the Carnoules Declaration[18] of October 1994. Many environmentally aggressive European countries gathered at Carnoules in France to declare their target factor for their reduction in material and energy use. . Factor X means to reduce the consumption of material and energy by X times. European countries are aggressively pursuing Factor X as the national policy:

> *The Netherlands hopes to achieve a Factor 4 reduction by halving resource use. Austria hopes to achieve a Factor 10 reduction over the next decade; and Sweden proposes a Factor 10 reduction in materials and energy use over the next 25-50 years. Germany has gone for a more modest Factor 2.5 reduction in non-renewable raw materials, to be achieved by 2020[19].*

3-1-3 Is Factor X enough to improve the environmental problem?

Factor X club argues that material utilization should be reduced by at least 50% on a worldwide basis. Since per capita consumption is something like five times higher in Organization for Economic Co-operation and Development (OECD)[20] countries than in developing countries, and further increases in world population are unavoidable, sustainable levels of material flows will not be reached unless and until the raw material intensity of OECD countries is reduced by a factor of ten. However, I have to say that even factor 10 is not enough to solve the global warming problem. Companies aiming for leadership in the environmentally sustainable business should aim for the theoretical best. I can offer two reasons to explain why even factor 10 is not enough.

The first reason the Factor X club is not enough is that the magnitude of the improvement of Factor X is too small. We need exponential success to overcome the environmental problem.

The second reason is that the Factor X club does not challenge developing countries to improve their CO_2 emission. A solution in the OECD countries only *is actually not enough* to solve the global environmental problem, therefore this should not be called the global solution; it should be called local optimization, whereas what we really need is the global solution. Today, there are companies all over the world and so companies that wish to become leaders of environmentally sustainable business need to perform optimally at all their locations. For example, I would be surprised if I were to find a global company operating a plant in China which emits a lot of CO_2, while similar plants in the USA operate with a higher efficiency resulting in the lower emission of the CO_2. In the global political arena, where we have to expect a lot of politics and compromise, Factor X might

be one of the better ideas. However, in the private sector, where compromise can be a fatal bad habit, the concept of using a low Factor X is not acceptable. In other words, Factor X is a “Stall”, which obviates further improvements. The Factor X concept will lead companies into complacency, thus I do not recommended applying it to companies that are aiming for leadership in environmentally sustainable business. We need to aim at *the theoretically best*, which allows companies *exponential success*. Professor Donald Mitchell, the author of "The 2,000 Percent Solution[21]", motivates business leaders to aim for the theoretically best to gain exponential success. This attitude, aiming for the solution which is theoretically best, should be the guideline of environmentally sustainable companies.

3-2 The environmental value

3-2-1 The life cycle of the energy system

Another important factor for making a conceptual framework for the environmentally sustainable business is the Life Cycle Assessment (LCA) of the products and services. The life cycle assessment of CO_2 for the products and services give a basic figure to design the lifetime emission of CO_2 of the products and services, therefore the LCA of CO_2 can be used to judge the impact of the products and services on the global warming problem. For example, people might think that solar batteries are free of CO_2 emission, however the fact is that fossil energy was partially used when solar batteries were produced, so solar batteries are not free from the emission of CO_2. $LCCO_2$ is the abbreviation of Life Cycle CO_2, which is widely used in Japanese energy and construction industries[22]. We are living in an era in which we have to depend on the consumption of fossil fuel so we need to continue to reduce $LCCO_2$. I compared the $LCCO_2$ between several electric generation systems. The results are shown in Figure 3-2-1. It is obvious that the solar battery generation system has the lowest $LCCO_2$, which is good for the environment, however the current problem with the solar battery system is that the cost of the equipment that runs on them is too high. If the cost of this system could be reduced in the future it would replace many electricity generation systems that are abased on fossil fuels.

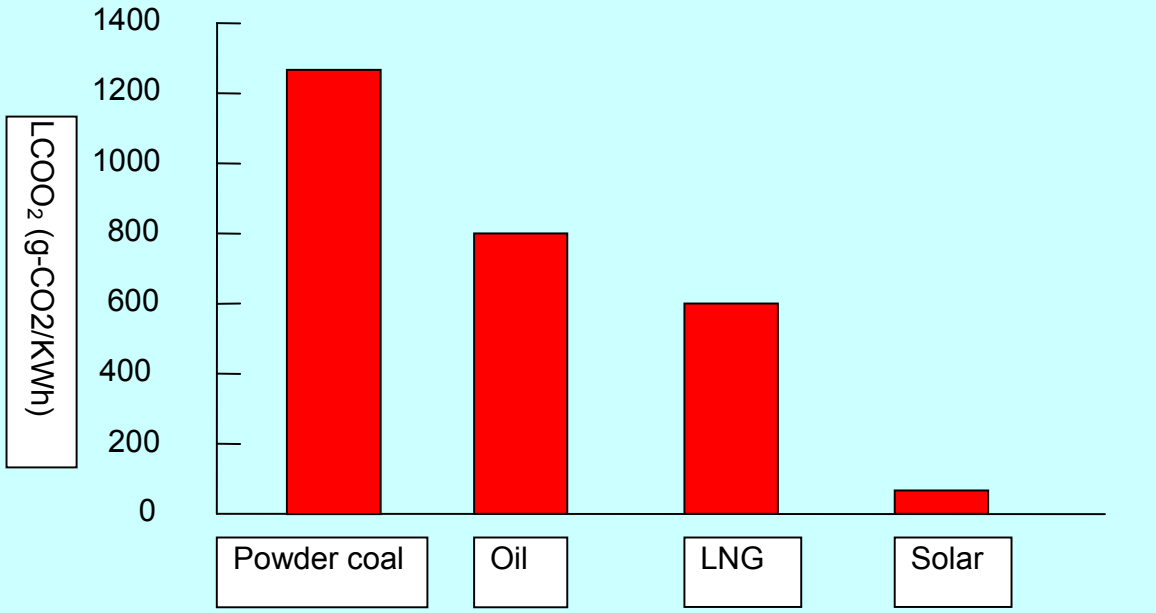


Figure 3-2-1 The comparison of the $LCCO_2$ between the electricity generation systems

Source: Ryuji Matsuhashi, The Kyoto protocol and the re-birth of the earth, NHK books, 2002, printed in Japan, ISBN4-14-001949-2 C1350 P65[23]

3-2-2 Analogy between the marketing strategy and the environmental strategy

Companies make products and offer services to deliver value to customers. This is what we learn from text books on marketing strategy[24]. I define The EV (Energy Value) Chain by adopting the value chain concept of marketing to the energy system of the business process.

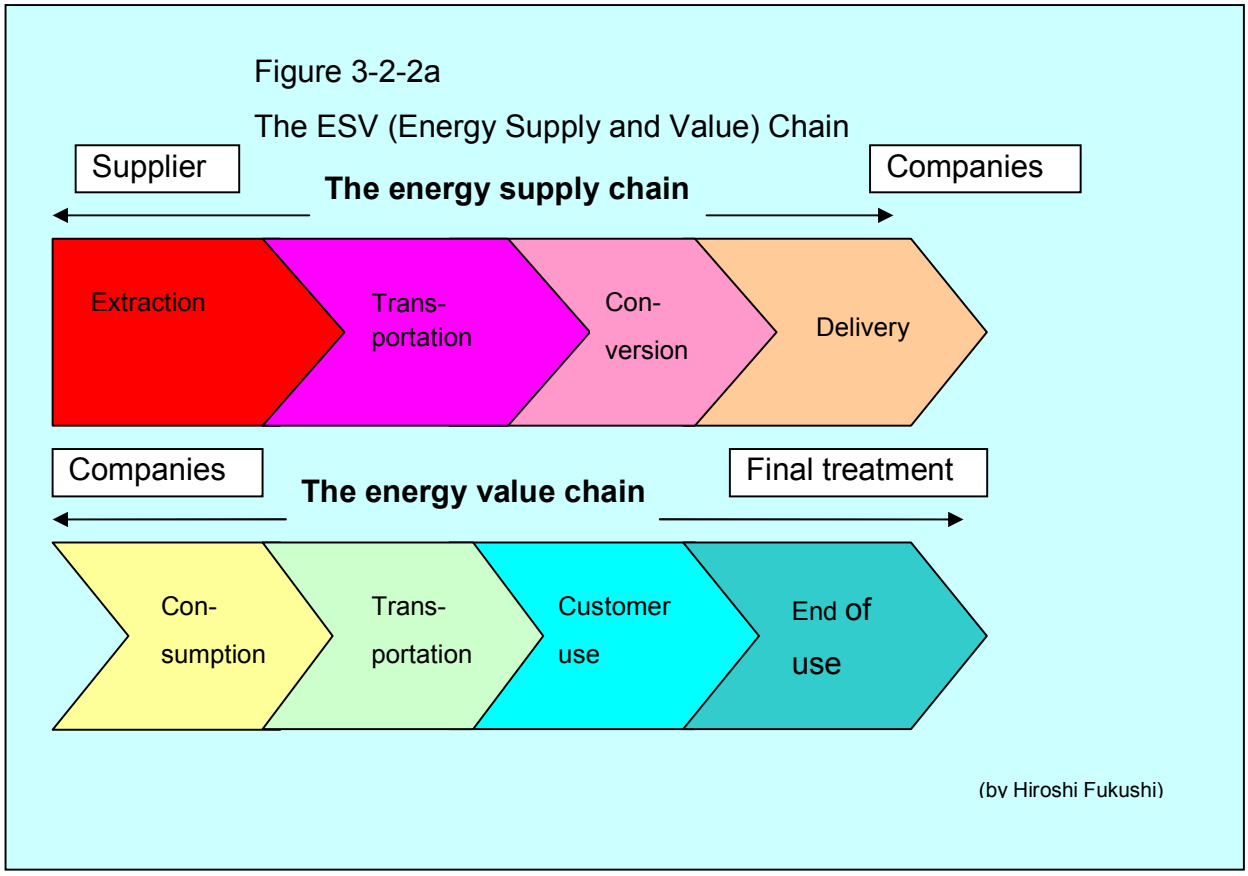
The EV (Energy Value) Chain consists of the four consecutive steps of the energy flow, which uses energy to create value by making products and service:

1. Consumption, 2. Transportation, 3. Customer use, 4. Final treatment

In the EV Chain, companies need to use energy to produce products and provide services. Products and services are delivered to customers and customers use those products and services and finally, at the end of the chain, products require final treatment for recycling, decomposing or dumping in the land fill. Products and services have their own purported value in marketing management. Similarly, in the era of environment awareness, when the price of the energy is high and when global warming is an increasing concern, $LCCO_2$ can be said to be the environmental value which has been incorporated into the products and services. The lower the $LCCO_2$, the lower the consumption of fossil fuel and the lower and the emission of CO_2, therefore the higher the value in the EV Chain. To evaluate $LCCO_2$, companies need to consider not only the EV Chain but also the ES Chain. The ESV (Energy Supply and Value) Chain is a combined chain of the ES and the ES, which consists of eight consecutive steps of energy consumption (figure 3-2-2a) in the production of the products and services.

Figure 3-2-2a

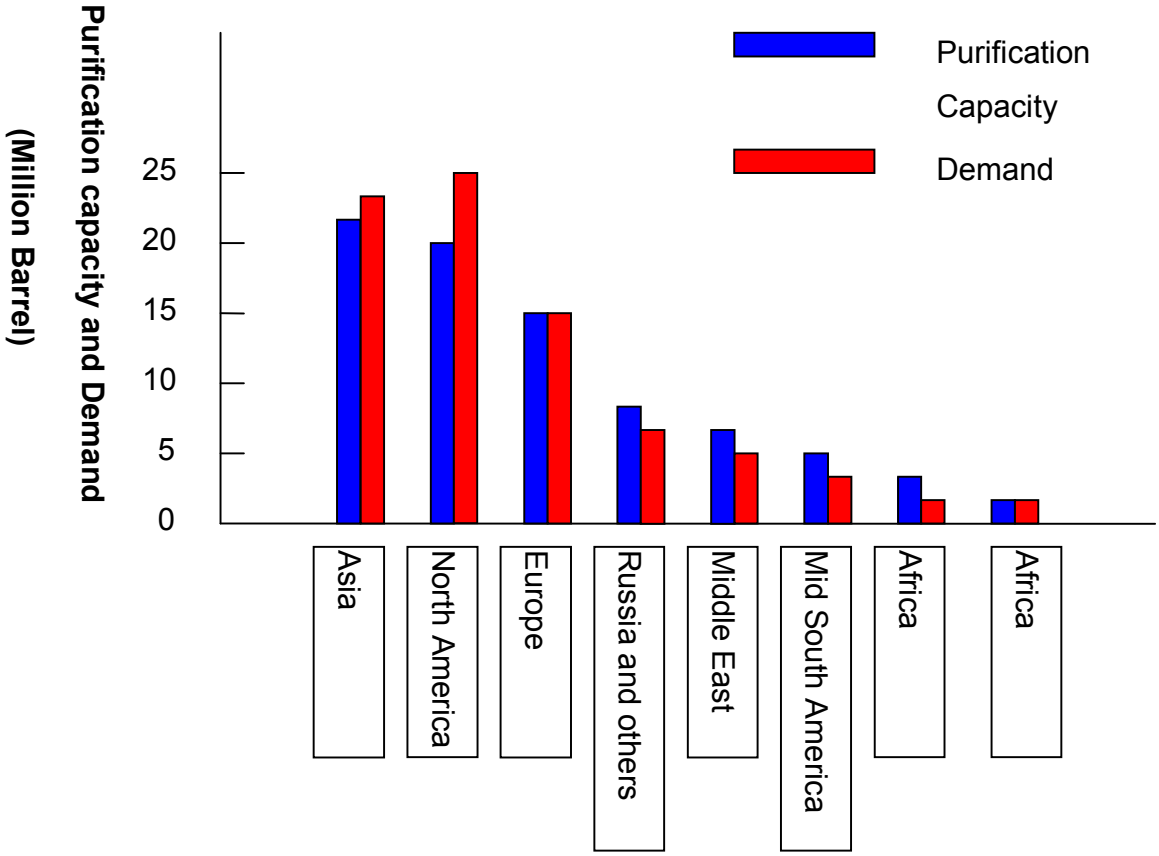
The ESV (Energy Supply and Value) Chain



Under the market economy, customers pay for the value so companies try to create higher value to win the market competition. The ESV Chain explains how scarce energy

has been used to produce products and services, therefore it explains the total process of delivering energy value to the customers. Similarly, $LCCO_2$ can be said to be the environmental value of the product, which indicates the level of the life time emission of CO_2. The best way for companies to t optimize their business processes is to reduce their energy consumption and CO_2 emission. The lower the $LCCO_2$, the higher the value that companies can offer to customers. Green purchasing is spreading worldwide and people can get environmental information about the products. The Japanese energy industry and home builders are aggressively using $LCCO_2$ as part of their marketing strategy. I would like to propose that such best business practice in environmentally sustainable business should be shared with other industries globally. $LCCO_2$ can also be used as the indicator of the energy cost. Companies can use this figure to control the cost of the business process.

The fossil fuel price is very high nowadays, because there is a gap between demand and supply (Figure 3-2-2b) and fund managers are looking for the opportunities to play money games. The International Monetary Fund (IMF) predicts that oil prices will continue to increase from now on[25].



Source: The Insutitute of Energy and Economics, Japan, cited in The Nikkei News, 1st, July, 2005

Figure 3-2-2b The purification capacity of oil and the demand

3-3 Conceptual framework

3-3-1 The PES (Point for Exponential Success)

Not every business process is designed to be 100% efficient because it is extremely difficult to design every the process to yield 100% efficiency. Sometimes it is even as low as 10%, therefore we can naturally assume that the eight consecutive steps of the ESV Chain will make the total efficiency low. If we can increase the process efficiency of each of the eight steps by 10%, how much improvement can we make to the $LCCO_2$? It is a 200% percent solution. In a similar way, I evaluated the relationship between the step improvement percentage and the total efficiency increase of the ESV Chain. In figure 3-3-1, I show the result of my calculation. You can see that the improvement of the efficiency of the ESV Chain increases exponentially to the improvement percentage of each step. Here again, two linear lines can simulate the exponential curve and the cross point of two lines is a transition point of a linear improvement into an exponential improvement. I define the crossing point as the Point of Exponential Success (PES).

> The PES (Point of Exponential Success) is a transformation point to exponential success.

The PES here is at 2,000 percent at 50% percent improvement of each step of the ESV Chain. Exponential success here means improvement of more than 2,000 percent in the total efficiency of the ESV Chain, which coincides with Professor Donald Mitchell‘s “The 2,000 Percent Solution[21]”.

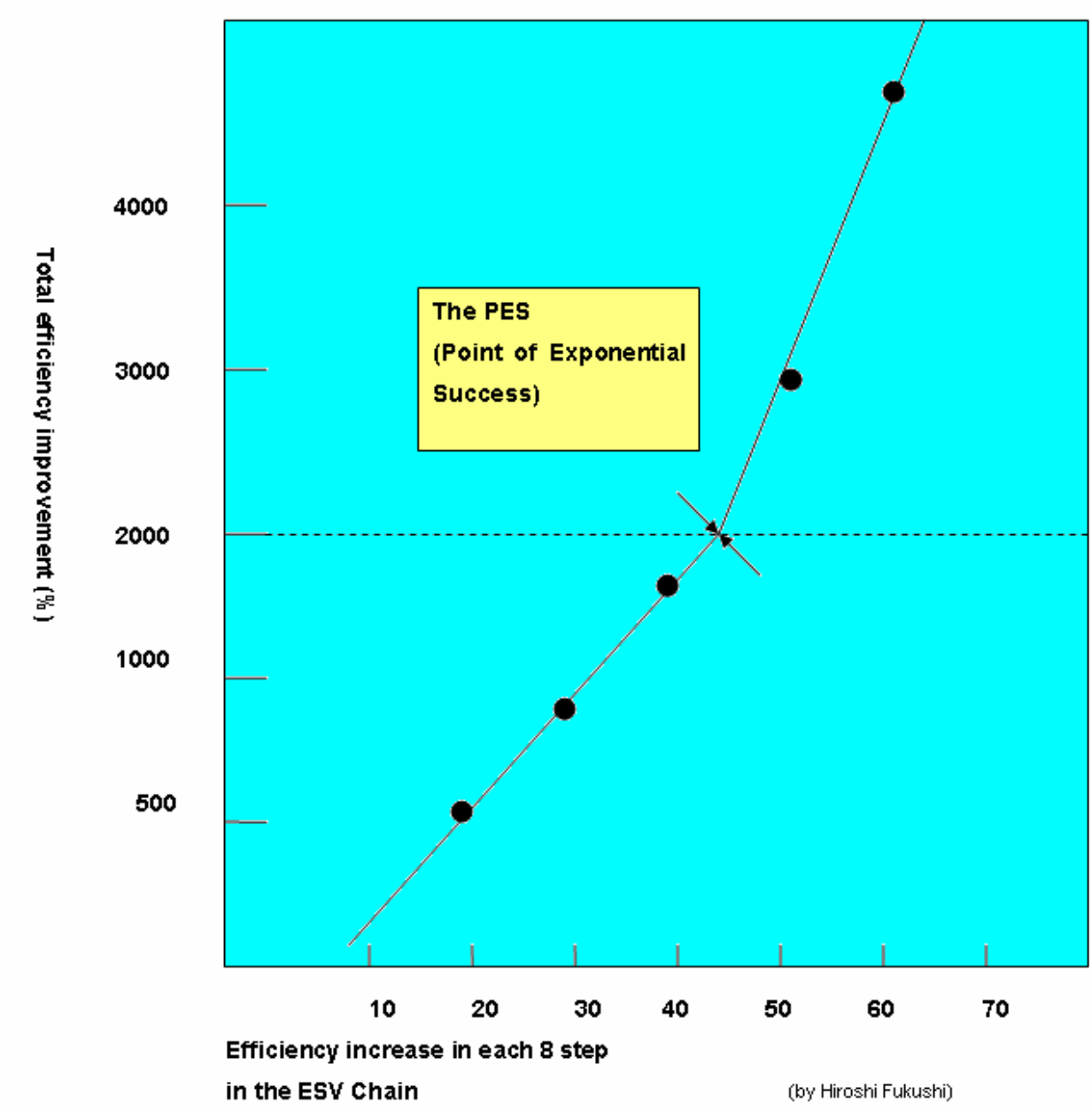


Figure 3-3-1 The relationship between Total efficiency improvement and Efficiency increase in each of the eight step in the ESV Chain

3-3-2 APC (All Product Concept)

The PES in Figure 3-3-1 is a 2,000 percent improvement in Total efficiency and 50% percent improvement in each of the eight steps of the ESV Chain. Companies may think that an efficiency increase of 50% at each step is impossible or too high, however if you think so that is a “Stall”. Professor Donald Mitchell emphasizes that we need to remove “Stalls” to achieve exponential success. We don’t always have to have high technology to achieve exponential success in environmental sustainability. Instead, we need to think seriously about what the theoretical best is and brainstorm ways to achieve it. I can offer several hints for improving the efficiency of each step in the ESV Chain in several ways as follows:

1) Back ward energy integration:

Companies should not position themselves as the end of the line, as the user of the energy. Companies need to look for shrewd ways of providing efficient and more economical energy by themselves. For this purpose, backward energy integration is an effective solution. For example, electricity and steam transportation are not highly efficient, so if we can eliminate the transportation we can improve the total energy efficiency a lot. Investment for the combined cycle or co-generation system, which takes advantage of no delivery loss of the energy, can be a good choice to save energy. Companies that used to be users of the energy can be self-sufficient in energy, and can even be an efficient suppliers of energy to neighboring companies if the local regulations permit.

2) APC (All Products Concept)

Almost all of the text books explain that a manufacturing process, whether it has chemical or bio-chemical reactions, has sub-reactions, by-products and wastes. I have a different view of the manufacturing process. I would rather view every output from a process as main products: All outputs from the process have precious value and there is no such thing as wastes and by-products. I would like to say that most of us blindly have “Stalls” about our process, which were incubated in school days and strengthened by past experience. I think we need to remove those stalls from our dogged thinking pattern and think creatively. I would like to recommend thinking this way: *We should design our process well so that all outputs from our process are valuable main products.* I define this concept as All Products Concept (APC):

APC (All Products Concept) is a concept to design a process which makes nothing but main products.

APC is a concept to design the process to produce neither wastes nor by-products, therefore all energy input to a process is used to produce products to minimize LCCO2, which raises the environmental value of the products. Companies should aim for the maximization of the environmental value of the main product by applying APC.

Companies tend to have “Stalls”, thinking that they are producers of only one product from a process and view the residuals of the process as wastes or by-products with less value or of no use. The design of the process tends to focus on how to maximize the yield of the main product. Sometimes even toxic substances are selected to perform the process to maximize the process yield of the main product, resulting in the residues from the process having to be land filled after treatment. This is a huge waste of $LCCO_2$ and material used. APC considers total maximization of the process. I show a comparison between a regular process and a process with APC in Figure 3-3-2.

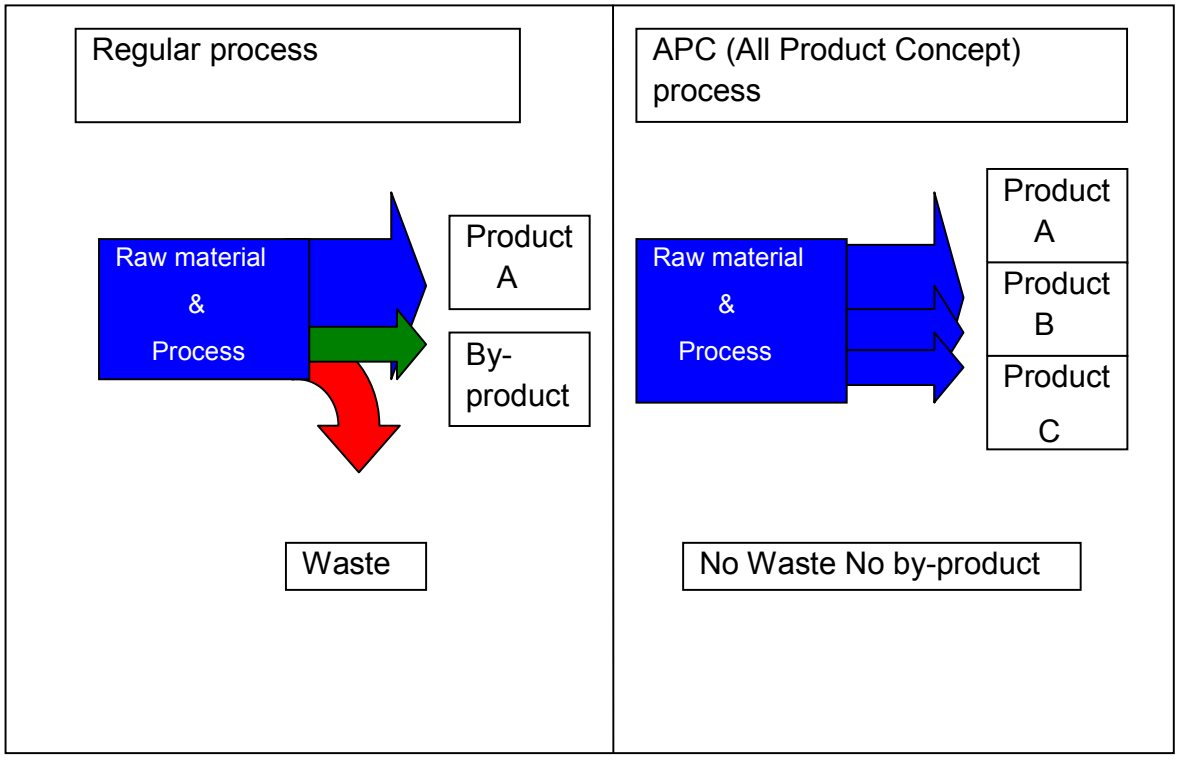


Figure 3-3-2

The comparison between Regular process and APC (All Product Concept) process

Green Chemistry is the utilization of a set of principles that reduces or eliminates the use or generation of hazardous substances in the design, manufacture and application of chemical products. Green chemistry places more emphasis on tending to environmental impacts at the earliest stage of innovation and invention. This approach requires an open and interdisciplinary view of materials design, applying the principle that it is better to not generate waste in the first place, rather than disposing or treating it afterwards.

Also, "Zero emission production"[27] is a similar concept to APC.

The Zero Emissions Forum is a United Nations University-based initiative promoting the realization of a more sustainable industrial-societal system. A core component of the Zero Emissions approach is the concept of integrated industrial systems in which waste products of one industry/sector become value-added inputs for another. This website contains resources pertaining to the research, development and capacity building activities of the Zero Emissions Forum.

However, I would like to stress that the value of APC is the proactive designing of the whole process to make all outputs from the process valuable products. It is a pursuit of *the theoretical best* process and it is not a countermeasure to utilize by-products from the process wisely to reduce the wastes to zero. It is the design concept of a business process to eliminate wastes and by-products at the design stage.

3) Backward energy integration

We can find many hints for raising the efficiency of each step of the ESV Chain. For example:

Product design:

Design no waste-products: light products, smaller products, long-life products:

recyclable products: reusable products: energy-efficient products: renewable products: and products with less infrastructure.

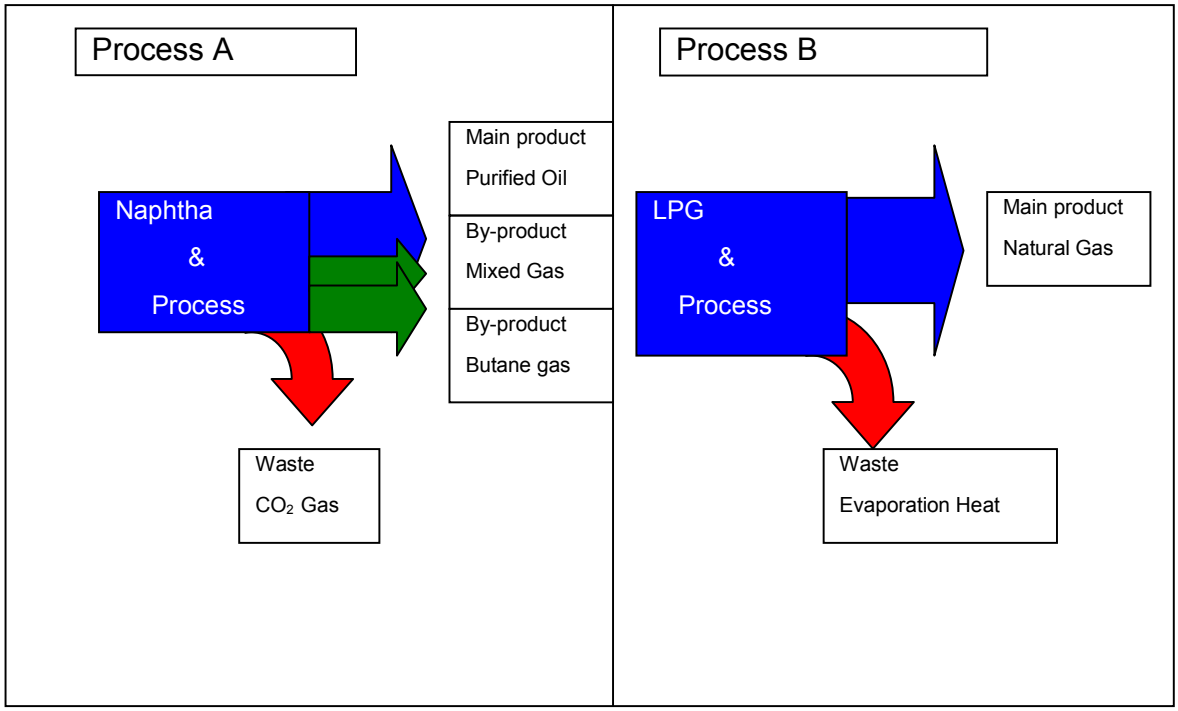
Services design:

Recycle service: efficient transportation: distributed service: transportation networking.

3-3-4 Example of APC

I show an example of a chemical process in Japan, which is planned to increase the energy efficiency. This method involves redesigning two processes as shown in Figure 3-3-3a. The first process A produces purified oil form naphtha, which has two kinds of by-products: the mixed gas (propane and methane) and butane and CO_2 as the waste. The second process B produces natural gas from Liquefied Petroleum Gas (LPG). In plant B, the heat of the evaporation (minus temperature) is available when LPG is vaporized, however it is not recovered now (i.e. energy waste).

Figure 3-3-3a Process A and Process B (Example)

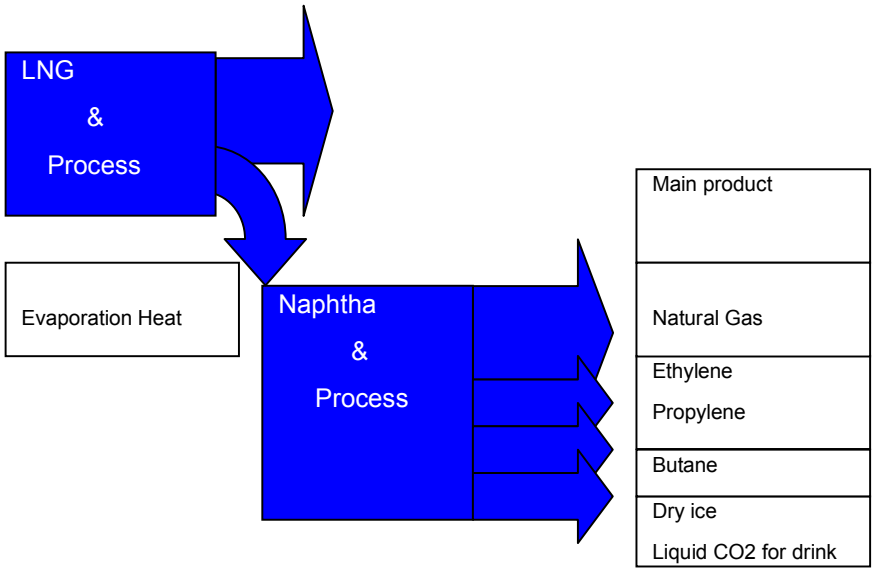


These two processes can be redesigned as one process which has no by-products and no wastes by applying APC concept. Plant A can use the waste energy of the plant B: evaporation heat (minus temperature):

- to recover ethylene and propylene as products from the by-product of mixed gas.
- to recover butane gas as LPG (Liquefied Petroleum Gas) product. and;
- to recover CO2 as liquefied carbon dioxide or dry ice as a product.

The total mass and energy balance are completely redesigned to maximize the efficiency of the energy and material as shown in Figure 3-3-3b. Here, evaporation energy (minus temperature) which used to be wasted is used as the energy source to convert wastes and by-products into main products. Such a model of APC is going to be introduced to chemical plants in Osaka, Japan[28].

Figure 3-3-3b Redesigned plant using APC (All Product Concept)



3-4 Finding the missing ring

3-4-1 The ESV (Energy Supply and Value) Circle

I defined the ES Chain and the ESV Chain to build better models to raise the efficiency to make exponential success in energy efficiency possible. However, as some may have noticed already, an important factor is missing to complete the modeling of the ideal energy system. The ESV Chain is designed as a straight chain, because it was a product of analogy from marketing management. If we can connect the beginning to the end, the total energy system can be expressed as a cycle and the efficiency of the process can be much higher. The ESV (Energy Supply and Value) Cycle considers not only connecting the end to the beginning but also seeks the possibility to connect every step of the ESV Cycle. In the ESV Cycle, the supply and the value chain are combined and the resulting cycle becomes a seamless connection of the supply and value. I define the ESV Cycle as a seamless cycle of the energy supply and value.

> The ESV (Energy Supply and Value) Cycle is a seamless cycle of the energy supply and value (Figure 3-4-1).

Combined with the concept of APC (All Product Concept), the total business process can form a perfect, seamless supply-and-value cycle for energy and material efficiency. We all have “Stalls” in our business processes. However, by taking a look at the ESV Cycle, we can imagine many possibilities for designing and managing materials and energy to maximize the total efficiency. In other words, the ESV Cycle is an idealistic model to review and remove all “Stalls” from the existing energy system to achieve exponential success in the environmentally sustainability. “Zero emission “, “Green Chemistry” and “3R (Reduce, Reuse and Recycle)”[29] and the Factor X Club comprise today’s’ best practices for energy and material efficiency. However, those are not enough to overcome the global environmental crisis, which has already passed the PNR (Point of No Return). We need to go for *the theoretically best* to resolve the environmental problem by removing “Stalls” from our mindsets and aiming for exponential success in environmental sustainable business. The conceptual models I proposed, can simulate new ways of thinking to eliminate “Stalls” in business process resulting in exponential success in the process efficiency.

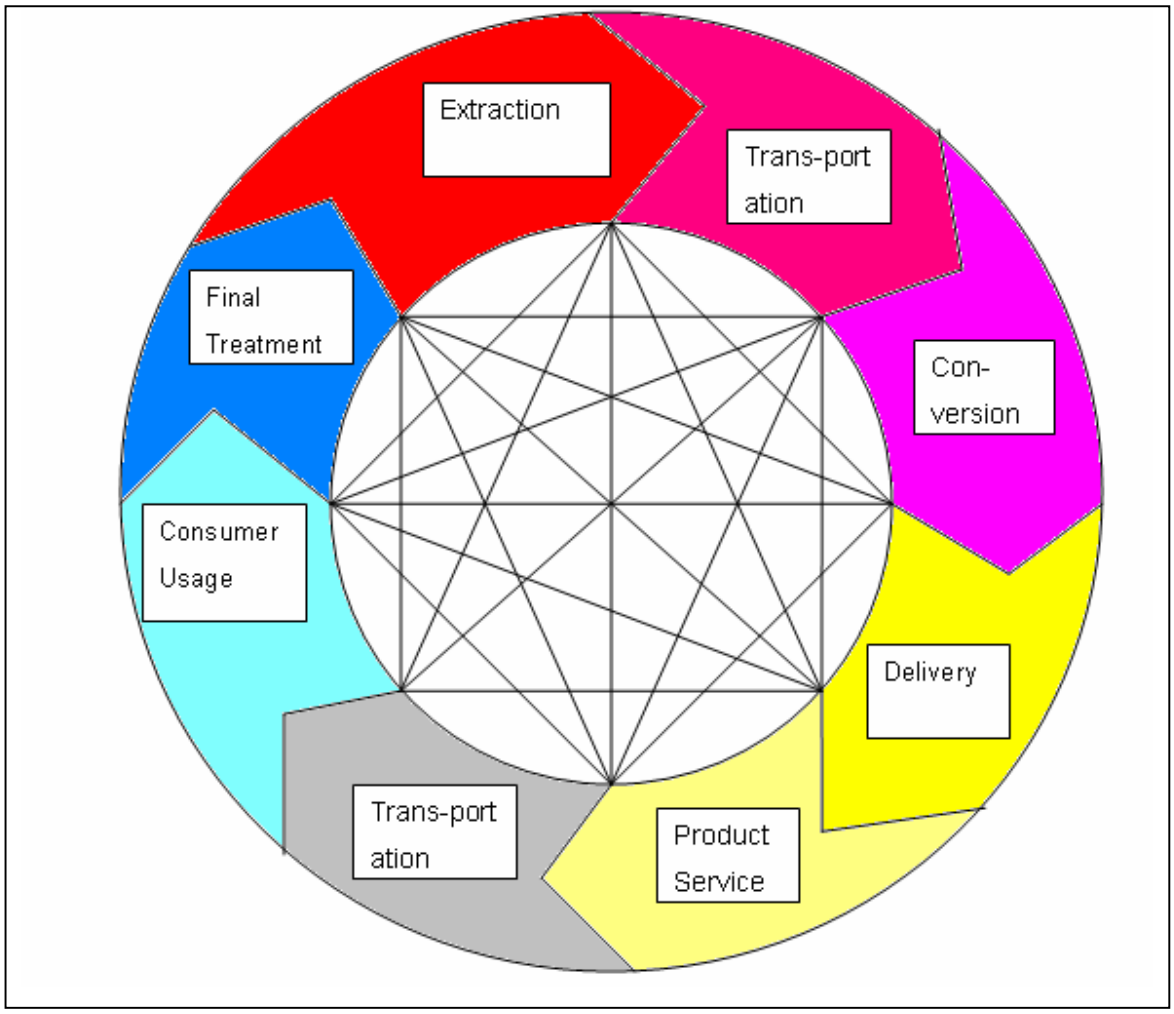
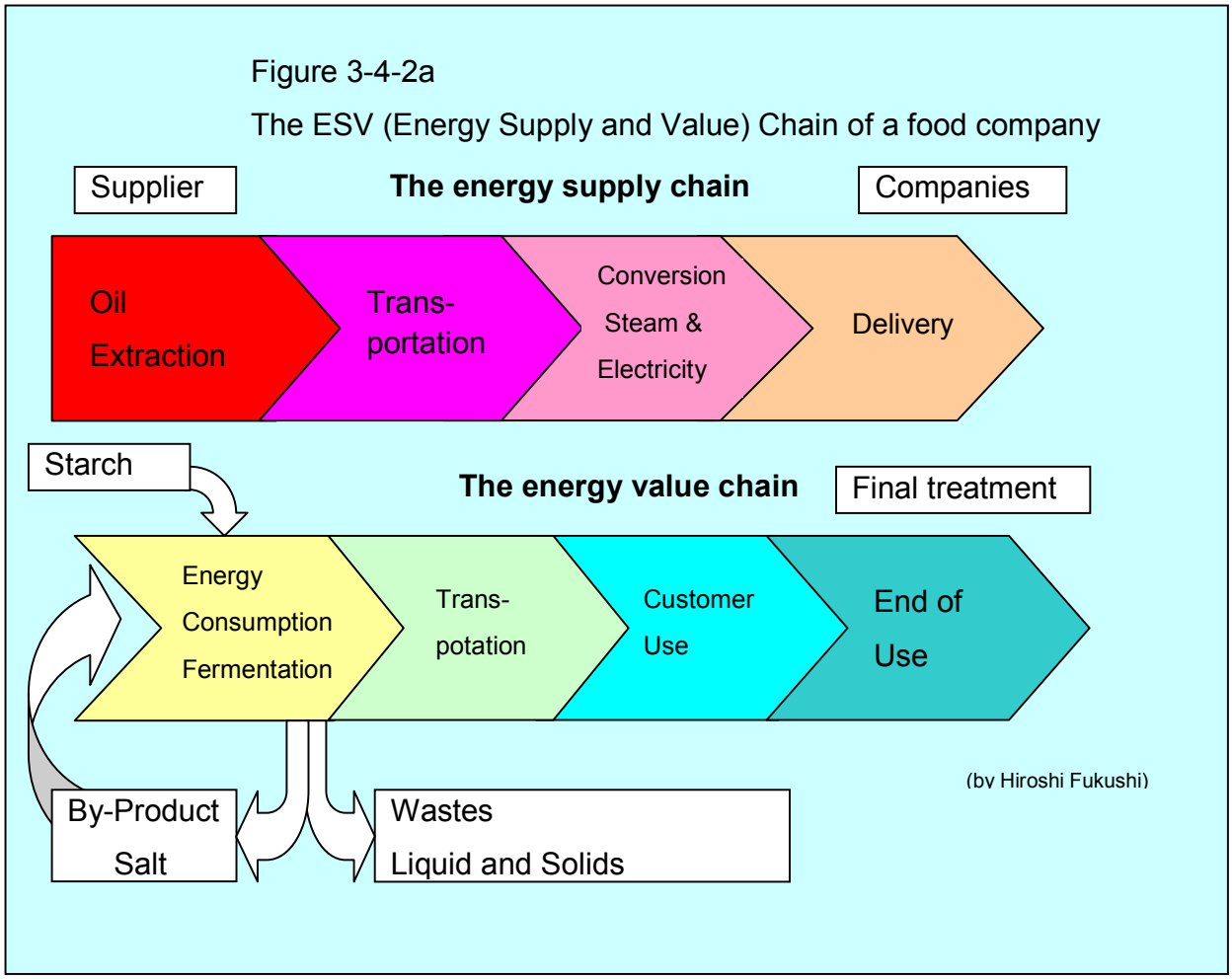


Figure 3-4-1 The ESV (Energy Supply and Value) Cycle

(by Hiroshi Fukushi)

3-4-2 Example of the ESV Chain

A food company produces a food product from starch by a fermentation method, however there are wastes and by-products. Oil is used to produce steam and the electricity is purchased from outside. In this case, the business process forms an ESV Chain as illustrated in the following Figure 3-4-2a.



However, if the process is properly designed, we might able to produce animal feed, fish feed and fertilizer products instead of wastes. Fertilizers can be applied to plants from which starch can be derived, and biomass from plants can be used as an energy source for generating steam and electricity and ash from it can be used to produce fertilizers. The energy and material flow of the new process can form an ESV Cycle, as shown in the Figure 3-4-2b.

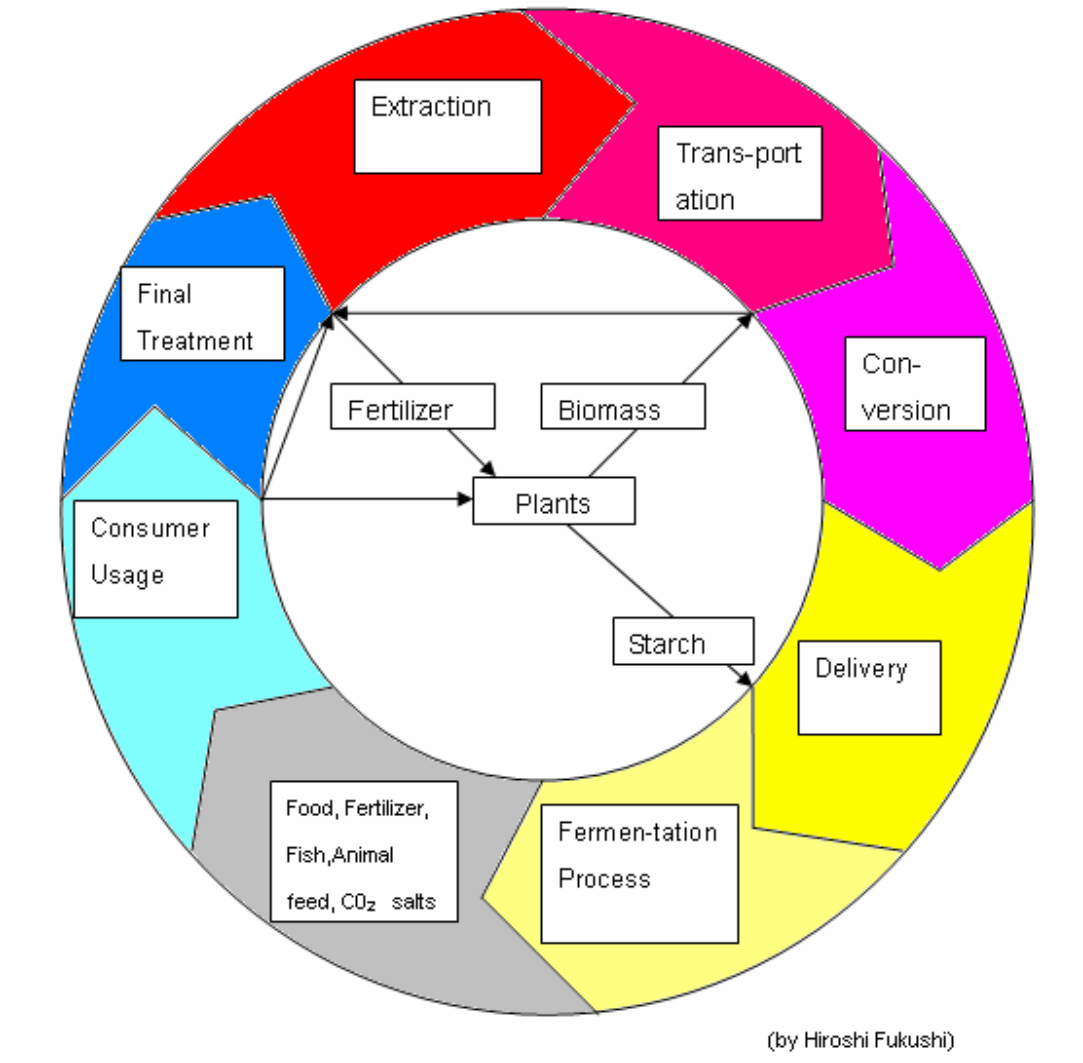


Figure 3-4-2b The ESV Cycle of a food company

4. Recent leaders in the fields

Governments are still struggling to reach a global agreement for countermeasures to the environmental problems such as the global warming problem. However I would like to argue that companies, especially MCNs as leaders of the market economy in the global business field, should play the roles of leaders and missionaries of the environmental sustainable business. Recently, many companies started trying to reduce CO_2 emission energy to reduce the global warming problem. Even though the government of the USA did not ratify the Kyoto Protocol, MNCs in the USA are positive about raising their energy efficiency and reducing the emission of CO_2 gas, trying to appeal to the stakeholders by telling them how much they care for the environmental problems by disseminating their plans to reduce CO_2 emission (Table 4). Even though their commitment does not yet reach the level of exponential success, MNCs' voluntary reduction of CO_2 emissions should be highly valued. I sincerely hope that companies will accept the challenge to achieve the theoretical best practice and aim for exponential success in the environmental sustainable business.

Table - 4. Recent commitment of CO2 emission of MNCs in the USA

GE[30]	Reduce the CO2 emission per sale by 30 % (Benchmark is the actual result in 2004). Reducer the gross CO2 emission by 1%, by the year 2012. Improve the energy efficiency by 30% by the year 2012.
Pfizer[31]	Reduce the CO2 emission per sales by 35 % (Benchmark is the annual result in 2000). Convert the electric source to solar generation and fuel battery by 30% by the year 2010.
GM[32]	Reduce the CO2 emission per a car produced by 8% by the year 2005 (Benchmark is the actual result in 2000).
Eastman Kodak[33]	Reduce the CO2 emission by 10% by the year 2008 (Benchmark is actual result in 2004)
Intel [34]	Reduce the emission of PFC (Perfluoro carbon) by 90% per unit production by the year 2010.

5. Conclusions

1. The global problems of the environment, especially the global warming problem, have already occurred. The seriousness of the global warming problem can be best expressed by the Point of No Return (PNR). We need to have immediate countermeasures to cope with the situation.

2. The nations of the world have not reached agreement with how to cope with the global warming problem.

However companies that wish to be leaders of the environmental sustainable business should not react to the differences in individual countries' regulations but should proactively develop better environmental policies to play roles as leaders and missionaries for a better environment.

3. As the rate of global warming is increasing exponentially, countermeasures must be similarly effective. I propose to use Professor Donald Mitchell's concept of "exponential success" as the theoretical base on which to set up countermeasures. I have developed a conceptual framework for *exponential success* in the environmental sustainable business by focusing on the energy flow of the entire business process, which will enable companies to raise the energy efficiency of their business process by eliminating existing "Stalls".

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Glossary

APC	**A**ll **P**roduct **C**oncept
BRICs	**B**razil, **R**ussia, **I**ndia, and **C**hina
CITES	**C**onvention on **I**nternational **T**rade in **E**ndangered **S**pecies
CP	**C**leaner **P**roduction
G8	**G**roup of **8**
G20	**G**roup of **20**
IMF	**I**nternational **M**onetary **F**und
IPCC	**I**ntergovernmental **P**anel on **C**limate **C**hange
LCA	**L**ife **C**ycle **A**ssessment
LNG	**L**iquefied **N**atural **G**as
LPG	**L**iquefied Petroleum **G**as
LCCO$_2$	**L**ife **C**ycle **C**O$_2$
LRTAP	**L**ong-range **T**rans boundary **A**ir **P**ollution
MNCs	**M**ulti **N**ational **C**ompanies
OECD	**O**rganization for **E**conomic **C**o-operation and **D**evelopment
PES	**P**oint of **E**xponential **S**uccess
PFC	**P**er**f**luoro **c**arbon
PNR	**P**oint of **N**o **R**eturn
ES Chain	**E**nergy **S**upply Chain
EV Chain	**E**nergy **V**alue Chain
ESV Chain, Cycle	**E**nergy **S**upply and **V**alue Cain, Cycle
UN	**U**nited **N**ations
UNCD	**U**nited **N**ations **C**onference on **D**esertification
UNEP	**U**nited **N**ations **E**nvironment **P**rogram
UNFCCC	**U**nited **N**ations **F**ramework **C**onvention on **C**limate **C**hange