Sustainable Development:

What is it, why care, and how can Korean businesses profit from it?

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Sustainable Development means growing things, including wealth, in the natural way, for the long term, efficiently, without destroying natural resources, realizing profits without consuming your natural and human capital. But what do those things mean? The best book I know on these topics is "Natural Capitalism" by Paul Hawken, Amory and L. Hunter Lovins (1). So we will begin by discussing natural capital, human capital, and how they relate to growing wealth.

All businesses are familiar with financial capital and how money helps businesses grow. Enlightened businesses are also familiar with human capital, the qualitative aspects of one's workforce in terms of knowledge, skills, enthusiasm, loyalty, hard work ethics, and so forth. Although business routinely uses human capital to transform natural resources into the products that they sell, relatively few businesses are familiar with natural capital, the accumulated stock of resources and living systems that provide essential services to our earth, like turning carbon dioxide into oxygen and fixed carbon, or purifying the water we all depend on for life, and so forth. Because those services are taken for granted in today's world, they have no established price or value. Until, for example, previously free, clean water becomes unavailable. After that, clean water can be sold at prices higher than oil, because humans can live without oil, but we cannot live without water. Hawken and the Lovins couple concluded that:

"Actually, an economy needs four types of capital to function properly:

-- **human capital**, in the form of labor and intelligence, culture and organization,
-- **financial capital**, consisting of cash, investments, and monetary instruments,
-- **manufactured capital**, including infrastructure, machines, tools, and factories,
-- **natural capital**, made up of resources, living systems, and ecosystem services."

They said that: "The industrial system uses the first three forms of capital to transform natural capital into the stuff of our daily lives: cars, highways, cities, bridges, houses, food, medicine, hospitals, and schools." Later they note that "The World Bank's 1995 *Wealth Index* found the sum value of human capital to be three times greater than all the financial and manufactured capital reflected on global balance sheets." There is no truly accurate way to account for the financial value of natural system services like turning carbon dioxide back into oxygen or producing food and clean water since we will all be dead if those things ever stop occurring.

Natural ecological systems are under great stress today. We are seeing examples every year of the costs of system failure, as global warming has hundred billion dollar effects like the Katrina hurricane in New Orleans, or wide-spread crop failures in Europe and Africa. Korea understands typhoons, and is well prepared, but you also know enough about typhoon power to be concerned for a future when they may become more frequent and even more powerful.

On another front, the Nobel Peace Prize winner in 2004 was not a politician or a general, but a woman from Kenya named Wangari Maathai. Her claim to fame was causing millions of trees to be planted in and around her native country, Kenya, to create new wealth for her people (2). A major fringe benefit of this endeavor was restoring some balance to the ecosystem of Kenya, which plays a big role in that oxygen / carbon dioxide cycle mentioned earlier, as well as by providing habitat for hundreds of species of birds and animals that have economic values of their own. Another major fringe benefit of restoring forests is retaining soil and water. In her part of Africa, desertification is a terrible force; hundreds of thousands of hectares have turned from forest into desert during our lifetime. So Wangari Maathai was thinking about how to save individual people in her villages at the same time as she was trying to save her part of our planet. This is the essence of the whole vision of Sustainable Development.

How is Sustainable Development Different from Ordinary Manufacturing?

First, Sustainable Development is more cyclical than linear. Second, Sustainable Development is very energy efficient. Third, Sustainable Development looks over the long-term and tries to add value over the long-term rather than just maximizing short-term profits. Key concepts are turning waste into new resources rather than expensive problems to dispose of, and preserving the productivity of natural systems so that they will continue to produce onto the "**seventh generation**" of descendents. That term comes from native peoples of North America, but it is understood by native peoples all around the earth. It recognizes our connection to nature.

Old-way manufacturing typically took raw materials from the earth, applied energy and intelligent human labor to those raw materials to produce, for example an automobile, and created many wastes along the way that had to be disposed of (like the ore from which iron was extracted). When nature was vast, and people were few, this was not very expensive. Steel manufacturers could leave mountains of crushed rock lying around without many complaints. But as people become larger (or expand over the earth) and as unspoiled nature becomes smaller, it becomes less and less practical to dump your wastes near where you found the raw material. After a while, cities begin to demand that wastes be disposed of in orderly ways, which costs money. At that point businesses must deal with a financial expense.

The Sustainable Development way tries to look at waste as an unexploited resource, and tries to find useful things to do with that waste. Sustainable businesses try to find marketable products that can be made from that waste, so that it produces a new financial stream and profit margin instead of just a cost for disposal. In America, this took the form of producing gravel and material for roads from mine tailings. The big rock mined for iron must be crushed to extract the iron, and we have huge needs for road building material. Gravel is abundant, but not distributed everywhere and we have great lakes and rivers near where the iron is mined, so transportation of heavy mass is less expensive than it would be elsewhere. Finally, as cities grow it becomes ever more expensive to dig up large areas near rivers to get natural gravel.

Energy is expensive no matter where you live, and it will be getting more expensive for the rest of our lives. We are very near to the peak of global oil production. This has profound importance for everything else we will discuss today, so we will spend a few minutes on what people are now calling "Peak Oil" and what that means for society and for businesses.

Peak Oil

Global oil production is peaking now. Whether the actual peak is this year, last year, or five years out is trivial compared to the fundamental fact that we are at the peak of a 100+ year curve of global oil production. A German study by an "Energy Watch Group" founded by the German MP behind the country's successful support system for renewable energy claims that the peak occurred in 2006, and that global production will decline faster than most others predict (at 7% per year for the near future). Hans Josef Fell said, "The world will not be able to produce all the oil it needs as demand is rising while supply is falling. This is a huge problem for the world economy." A huge problem for a world economy means huge problems for countries like Korea with limited domestic energy supplies.

In 1949 a geologist for the Dutch Shell Oil Corporation named M. King Hubbert published a paper that accurately predicted the peak of American oil production in 1979. The accuracy of his model could not be known then, of course, but it was based on hard data and a disturbingly simple rationale. Many natural resources are distributed according to "normal distributions" and people tend to use the easiest and cheapest supplies first. When his prediction proved to be more accurate than any other, his models were reexamined in detail.

America is now long past its peak of oil production, but our consumption continues to grow. In 2004 the USA produced about 8.7 million barrels of oil per day, but we consumed about 20 million barrels of oil per day, and that disparity grows each year. In a globalized world market we can buy all the oil we need, for a while. But not forever. China and India are rising; they want some oil too! How about you? For global business it is more important to know what happens during the down side of the global curve for exploitation of this critical natural resource.

Everything gets more expensive much more quickly on the downside of that curve. The imperatives to develop alternative sources of energy become far more urgent far more quickly. Why? Because the reality is that we will have consumed **more** than half of the truly available oil when he hit the peak of global oil production, because much of that downside curve is never really recoverable. You see, it takes more than money to produce oil; it takes energy too. When it takes more than a barrel of oil to extract, refine and distribute a new barrel of oil, most oil production must end even though there will be plenty of oil left in the ground.

The best book I know on this subject is "The Party's Over: Oil, War and the Fate of Industrial Societies" by my friend Richard Heinberg of California (3). No doubt there are many others by authors in Asia because the coming energy crisis has been seen by forward-looking people all over the world. Figure 1 at the end of this text provides the best graphic I can provide on the curves of discovery of oil reserves and consumption of oil reserves during the last century.

Examples from Recycling

Some excellent examples of the Sustainable Way can be found from those areas where material recycling has worked for a generation or more, so there are hard numbers to compare. Two that stand out are production of brown papers and of aluminum. In America, where we still have vast forests (and our Canadian neighbors have even more) it is still slightly more expensive to produce pure white paper from recycled stock than from fresh wood. Very slightly; less than 10%. But for brown papers (like newsprint or box paper) it is cheaper to use recycled stock.

The economics of aluminum are even more favorable for recycling. Because extracting aluminum ore is very expensive, and refining it requires vast amounts of energy, using recycled aluminum cans or other stock is MUCH less expensive. In fact, a recycled aluminum can in America today costs just 5% of the energy that creating a new aluminum can costs. This is such a huge savings of a principle cost of creation that one can pay for the labor intensive process of gathering old cans. In fact some of our poorer people make their entire living that way.

Recognizing this basic principle, forward looking institutions like our universities recycle many items other than aluminum and paper. Once a will exists to explore the recycling concept, many materials can be reprocessed at a profit relative to buying new. The net result is lower costs for disposal of wastes, and higher profits from the sale of what was previously considered waste, but now is recognized as a feed stock for other and sometimes completely new products. Clear plastics from containers, for example, are now routinely reprocessed to yield structural plastics where clarity is not essential but strength is.

Examples from Nature and the Concept of Sustainable Yields

The concept of "Sustainable Yield" is extremely important to Sustainable Development, and easy to illustrate in nature. It comes from management of forests and fisheries, but it can be applied to most living systems including wildlife and agriculture. If you cut down every tree in a forest, you get maximum wood today but you get nothing tomorrow. If you catch every fish in a pond or the ocean, you can eat well today, but starve tomorrow. All living systems can sustain some harvest, but not the total harvest that leaves no parents to produce offspring.

The maximum number of trees you can harvest each year without destroying the reproductive capacity of the forest is called its "sustainable yield." The maximum number of fish you can harvest from any body of water without destroying or significantly reducing the reproductive capacity of the pond or ocean is its sustainable yield. Those yields may be large, but they are always less than the maximum harvest possible if you take everything at once and destroy the long-term resource base.

Such destruction can occur in wholesale and retail forms. Some forest corporations in America, for example, own entire mountain ranges. Short sighted corporations mowed them down like grass, and then went out of business or were forced to move to other countries. Far sighted corporations adopted sustainable use and tree farming plans which included reforestation by replanting trees very soon after the harvest, whether harvest was by clear cutting or other methods. Those companies endure, and maintain hundred year and longer plans for the management of the productive forest lands they own. At a national level, our National Forest Service exits primarily to do this management task for our very extensive American forests.

In Korea, regrettably, the war between North and South during the early 1950's resulted in wholesale destruction of your forests which are only beginning to recover. The regeneration time for natural forests varies with climate and species, but it is seldom less than 100 years. Mountains last forever on the time scale of human beings, but forests can be destroyed in the blink of an eye on the time scale of mountains. Since they are living systems; forests can recover, but it takes time and the wise eyes of experienced managers of forest and wildlife resources.

First we must observe that destruction of natural resources can occur as easily by individual people taking just one tree at a time or just one fish. This is especially true when people are desperately poor, and are relying directly on nature to sustain their lives. The forests of Korea were not all cut down by large corporations or the government. Many people fleeing destruction from the north, just took their small bits of wood as they needed for cooking and heating as they fled toward the south. That combined with the general destruction of war did massive damage to the forests of Korea. But they can be renewed, and with them other, emergent income streams can be produced that go far beyond wood for fuel and fiber for paper.

Returning to Kenya for a moment, the purpose of Nobel Peace Prize winner Wangari Maathai was not just producing new wood for villages. Dr. Maathai's purpose was much larger. It was also producing fruit, and habitat for small game and birds that can be eaten. It was also producing employment for poor villagers, and preserving the soils which forests create, and her purpose was also preserving water resources which forests protect, and it was also preserving the wild game lands to the south which provide Kenya's largest source of foreign income, the tourism industry. Each of these can be an income producing stream of a healthy, living forest. All are lost if the productive forest is destroyed, whether that destruction comes from many desperate people each taking only what they need, or from large corporations taking all that they can to satisfy investors focused only on immediate return on investment.

So the Sustainable Development Way requires some investors with long-term vision for the welfare of their people. Thus the wise merchant has a business forever that he can pass on to his children, and the people are also enriched for generations. Sustainable Development requires enlightened government too. The wise investor or businessman can be greatly aided if the political structure is wise also, and thinks about the welfare of the community onto the seventh generation, instead of just about maximum immediate pleasures or power. Developing longer time horizons for political systems is one of the hardest tasks for Sustainable Development.

But those who do may see the tourists of the world flock to their well maintained natural areas, just for the pure joys of seeing plants and creatures different from their homeland, among people who are happy because they are prosperous over the long term, in the sustainable way.

The Importance of Diversity

There are many profound advantages to diversity in living systems that your geneticists and biologists may teach entire courses about. Diversity is the raw material that protects living systems from environmental change. But the two biggest advantages that apply to all natural

systems that have commercial application including especially agriculture which was derived from natural systems are: 1) resistance to diseases, and 2) multiple income streams.

To begin with, agricultural science relies on genetic diversity to find those combinations of genes that produce maximum yield in any crop. Without diverse beginning stocks they have nothing to hybridize or breed for larger yields or greater resistance to disease or easier harvesting or better taste or longer shelf-life or any of the many qualities that food producers or consumers would like to have. So they need diversity from the beginning. This is why maintaining seed banks of original types of all crops including trees and other forest resources is essential.

But experience has shown that diversity is essential long after that. Because even if you find the perfect hybrid that produces huge volumes of marketable agricultural products, they will still encounter the reality that everything on this earth is food for something else. And if you plant all your hectares in even the perfect rice or other crop, it is only a matter of time before some disease organism optimizes itself to eat the abundant food you have put before it.

Well, some industrial farmers say, we will just bomb those bugs and rusts and smuts with petrochemicals, pesticides and herbicides galore until they all die like bugs and fungi should. OK, that works for awhile, so long as you have massive amounts of money to pour into oil-based chemicals (remember, oil will be getting much more expensive sooner than you think). But also, bugs and fungi and diseases of every kind obey the laws of nature too. Eventually, they will develop resistance to your chemicals and come again for that monocrop you have provided them.

The greatest protection from this endless war with the smallest creatures on our earth is diversity. Diversity among the species you use for your agricultural production, and diversity WITHIN the genetic stock for every species that you use. Both diversities are extremely helpful for dealing with the ups and downs of disease organisms. In contrast, putting all your eggs in one basket, as our farmers say, is an invitation for disaster.

The other great virtue of diversity both in agriculture and in natural living systems is that when you have diverse food crops, they mature at slightly different times of the year and they contain different mixes of nutrients. These are essential both for security of your food supply and to robust nutrition for a diverse population which itself has slightly different needs among its individual members. From the economists' point of view, this yields multiple income streams. Multiple income streams protect against disaster affecting any one. This is the same whether the potential disaster is entirely market driven, or driven by locusts who decide they like your favorite crop this year.

It is possible to become too romantic about farmers. Of course, some of the wisdom of the ancients was not entirely wise. But those who seek the sustainable way should listen to their farmers because these are old insights to those who have worked the land for thousands of years. Remember, that without good soil you are doomed. That means one should also protect the forests that filter water and protect the soil and even create soil from the beginning. Remember that waste from animals is the natural food for crops. This is one of those primary cycles of nutrients I mentioned in the beginning. Remember, that multiple crops avoid catastrophic losses to unusual weather, disease, or market forces, and provide varying food of varying nutrition at varying times of the year. Thus no one starves when nature sends her problems, which she

undoubtedly will. So do not become too romantic about your farmers, but do not brush them off like dirt clods either. They provide the food without which you will certainly die. You can live without oil, but you cannot live without food and clean water. And Sustainable Development begins with the wisdom of farmers applied to the realities of modern markets and technology.

Global Warming and Energy Futures for Human Civilization

Global warming is a real phenomenon caused by increases in atmospheric carbon dioxide (CO_2) and other "greenhouse gases" like methane that are byproducts of industrial civilization. These have been building up for a long time, and it takes a very long time for them to disperse through the entire atmosphere, so it will take a very long time to change that situation. Carbon dioxide in our atmosphere has risen about 20% in the last 45 years, and the rate of increase is increasing. Meanwhile, the average surface temperature of the earth is rising slowly, which has profound consequences for the living system and the economies that ultimately depend upon it.

Other greenhouse gasses include sulfur oxides (SOx), nitrous oxides (NOx) that are also involved in acid rain, and a number of other chemicals that are released by industrial processes. For about one generation there has been debate in America over whether global warming was even real, and if real whether humans cause it. That debate was greatly prolonged by aggressive lobbying by large industrial interests like the coal, electrical generating and oil industries. These vested interests have some power over education and much greater power over our government. Therefore we have been terribly slow responding to this global problem. We are in denial.

The loss of over one million square kilometers of arctic ice cap is changing that. The smallest arctic ice pack ever recorded was in the summer of 2007. The loss of many of our glaciers is changing that; glaciers are melting all over the world. Corals in the sea and amphibians on the land are dieing all around the world. 7 of the hottest years in historic memory occurring during the last decade, so simple observation is changing the denial that global warming is real. Species moving north to areas they never lived before are changing that. Ice that no longer supports fishing on winter lakes, and winter events that were central aspects of Minnesota's northern culture, but which cannot be held now due to lack of ice or snow are making it harder every year to deny that something truly is warming the earth. So now we are trying to change. But massive change in energy use takes generations. So I will spend some time now on energy fundamentals that are essential for any society that wants to reconsider its large scale generation and use of energy.

Tradeoffs

A "Tradeoff" is where a system offers certain advantages, but also certain disadvantages to its users. For national energy, the concept of tradeoffs is essential since no energy source is infinitely abundant nor problem free.

Humans use many forms of energy to power civilization, oil, coal, nuclear, hydroelectric, wind, solar and other forms in lesser measure. But all forms of energy have two properties that matter for large scale energy futures. One is quality; the other is their "energy ratio." Quality has two main aspects. One is how polluting the energy is. The other is how useful the energy is,

the least valuable of which is simple low heat (which can be used for heating but little else). The most valuable energy is electricity, because that can easily be turned into heat, or transportation, or run computers and lights and so forth. Energy Ratios refer to how much energy it takes to create usable amounts of new energy. For example, to extract a barrel of oil from the ground and get it to market in the form of gasoline ready for your car, a great deal of energy must be spent on drilling and pumping, refining and transporting to a gasoline station. The total energy available at the pump is divided by the total energy required to do all those tasks PLUS energy needed to mine and melt the steel required to make the drill bits, to build the trucks, and pumps and so forth to create the infrastructure necessary to get new oil to market.

Thus when oil was abundant and close to the surface at locations easy for transportation (like Saudi Arabia) oil energy ratios were very high (e.g. 20). But as oil becomes less abundant, deep in the ground or sea-bed, and far from large markets like in the Artic Sea, it becomes more expensive to extract, refine and get to market (e.g. 3). It becomes more expensive in ENERGY as well as in dollars or yen, so resulting energy ratios are low. If a ratio ever gets near "1" there is no economic way to create that energy from present technologies.

Putting these two factors together, quality and energy ratio, yields this summary of options for nations to consider. The very best energy comes from hydroelectric sources because they are very high quality (electricity without pollution) and they have great energy ratios when large amounts of water are stored in high mountains (up to 50). The only problem there is that most of these rare locations have already been developed, so hydroelectric energy can not grow much at all. Nuclear energy also has high energy ratios (15-45) and produces electricity, so it is an option many nations consider. The obvious pollution tradeoff is radioactive waste and the link between nuclear power production and nuclear weapons production is a national security tradeoff. Those are very serious tradeoffs to consider.

All the hydrocarbon sources have one big negative quality now, which is that burning them contributes to global warming. They all produce carbon dioxide, and some produce significant quantities of sulfur oxides or nitrous oxides, especially burning coal. Energy ratios for hydrocarbon sources range from less than 1 to 20. Wind energy is just being commercialized in advanced economies, and is the next best with energy ratios ranging from 4 to about 20. Wind energy also produces electricity, which is good, and minimal pollution. But it has an obvious problem which is that the energy ratio is zero if the wind is not blowing. Second to this, there is a significant cost to transmitting electricity over long distances by wires, so energy sources must be near the energy users who will buy this electricity. Regrettably, the windiest places (like tops of mountains) are not often the same places where people place factories or large populations.

Solar photovoltaic electricity is very expensive to produce, and generally has low energy ratios but it is great for remote locations that have very small electricity needs. And ethanol has proven very effective in Brazil, where abundant sun and cheap, sugar-cane agriculture give it a large energy ratio. But ethanol not very effective in Middle America where large government subsidies are necessary to overcome a very low, corn based energy ratio of about 1.25. Such a low energy ratio means that it takes almost as much energy to make the ethanol as one gets when the ethanol is burned. Such low energy ratios can never solve the global energy crisis. This is a better example of distortions caused by government policy in America than of a real solution.

The Simplest Description of our Problem

Figure 2 shows two curves intersecting. One is aggregate global demand for everything we need for life and use for luxury, including oil, water, food, fiber – everything. It is rising exponentially due to ever rising populations AND rising per capita consumption where that is possible. The other curve is aggregate supply, which is not rising exponentially but rather is assuming a sigmoid shape familiar to biologists everywhere. As these intersect the ratio of supply to demand contracts, and economists everywhere know what that means.

It means rising prices for various commodities of which oil and water are the most relevant current examples. Oil is the main energy feedstock for modern, industrial civilization, and water is the stuff of life itself. Rising real prices for these vital commodities means rising conflict both within and between nations. With global markets, economic pain is widespread too. But oil and water intersect in the Persian Gulf of the Middle East. So the greatest danger for global war using "special" weapons is there.

Sustainable development shows a way to survive even this great challenge, by transforming economic visions from maximum short term profit to longer term plans to produce prosperity for all.

Conclusions

Sustainable development requires new technology for our modern world of interacting crises and globalized economies. But it is not mainly about technology. It is mainly about finding ways to grow wealth without damaging the earth which sustains us all. It is about growing economies for the long run of human civilization, and thus for our children's children.

Wangari Maathai observed that Sustainable Development requires caring for the welfare of the least among us also. We must care about idealistic concepts like democratic engagement of ordinary citizens in the process of development, so that they will add their energies and their creativity to the common endeavor, rather than sabotaging it as they can so easily do. So it is not just about technology or nature; Sustainable Development is about social equity also.

Blending the best wisdoms from Ecology, Technology and Society yields many benefits over the long run. But idealists can also be long on inspiration and short on practical delivery! So we need the wisdom of businessmen too. Businessmen are the masters of economy, and for large scale change to occur it must always be economical in the system that prevails at any time.

References:

1. Natural Capitalism: creating the next industrial revolution. By Paul Hawken, Amory Lovins and L. Hunter Lovins, Little Brown and Co. publishers of New York and London, 1999.

2. The Green Belt Movement: Sharing the Approach and the Experience. By Wangari Maathai, winner of the 2004 Nobel Peace Prize, published by Lantern Books of New York, 2004.

3. The Party's Over: Oil, War and the Fate of Industrial Societies. By Richard Heinberg, published by New Society Publishers of Gabriola Island, BC, Canada, 2003.

Figure 1 – Graph of the Discovery of Oil Reserves, and their Consumption, 1930 - 2030

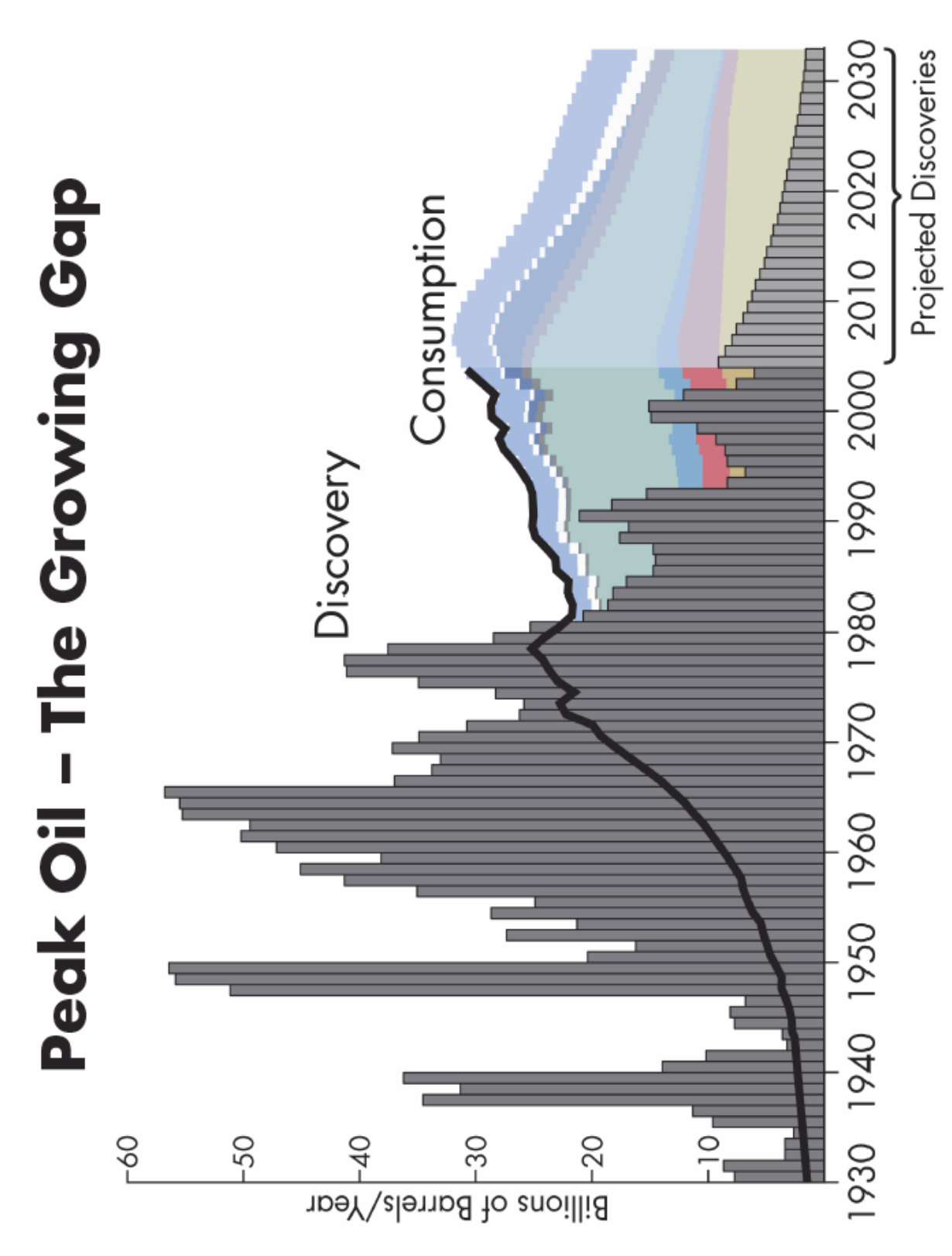
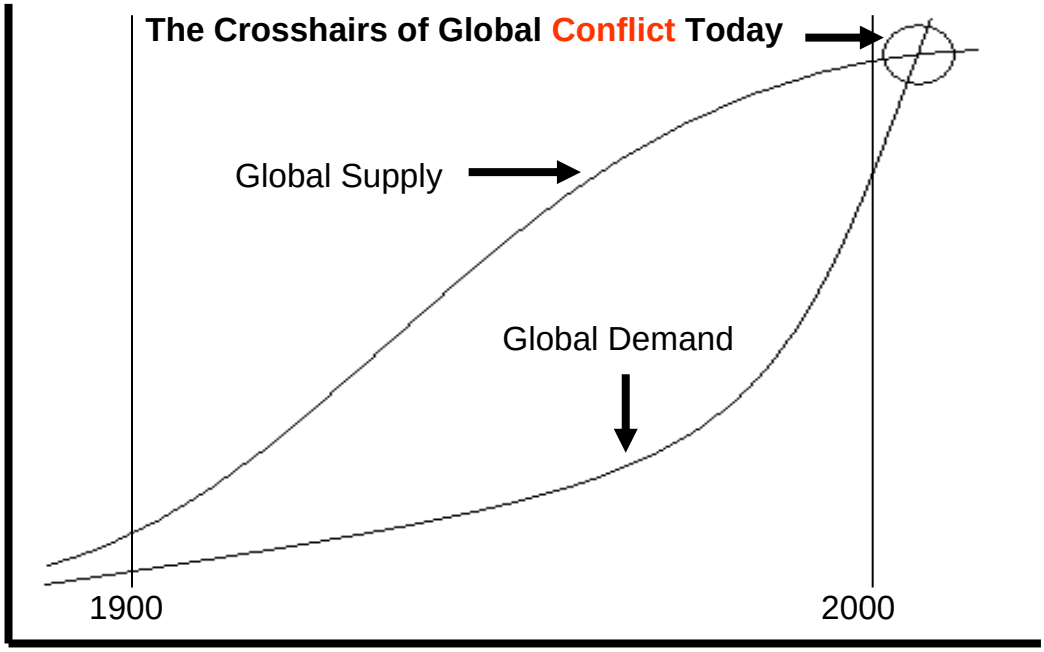


Figure 2 – Graph of aggregate global Demand and Supply over the last century.

The Simplest Description of the Problem



20th Century Global Supply and Demand Curves