Chapter 2
Factor 5: Towards an Affluent Society with Least Use of Resources

Ernst Ulrich von Weizsäcker

Dr. Ernst Ulrich von Weizsäcker founded the world's first research institute for studies on the global environment in Wuppertal in the Ruhr, Germany and became the first President of the Wuppertal Institute for Climate, Environment and Energy. After serving as Director of the Institute for European Environmental Policy and President of the University of Kassel, Germany, he became Member of the German Bundestag (parliament). In the late 1990s, he formed the Environment Committee in the Bundestag and served as its first Chair, and has been a key figure in implementing environmental policies in Germany ever since. He was later also invited to the University of California, Santa Barbara. He is currently a co-chair of the United Nations Environment Program International Resource Panel.

Like Dr. Dürr, Dr. Weizsäcker has been a member of the Club of Rome since its foundation. He is particularly known for having advocated the "Factor 4" concept. This was a call for doubling wealth and halving resource use. To achieve this, efficiency must be increased fourfold. He proposed this quite fundamental concept at the United Nations Conference on Environment and Development (UNCED), the so-called Earth Summit, held in Rio de Janeiro, Brazil in 1992. In 2012, the twentieth year since the Earth Summit, Rio + 20 was held. Thus, Dr. Weizsäcker has been a leading proponent of concerning modern environmental thinking.

Incidentally, his wife has also played a leading role in the field of environmental issues. She served as the leader of NGOs at COP10 in Nagoya, having contributed to the establishment of various protocols.

2.1 Countries Satisfying the Conditions for Sustainability

Some people told me that Factor 4 could imply "factor death," as four is a homonym of death in Chinese. They recommended Factor 8 instead, because eight is considered a lucky number as the shape of its Chinese character is a symbol of

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good luck. It is very difficult, however, to increase resource productivity eightfold. Knowing it to be impossible for us, we settled on Factor 5, instead of 4, and not 8.

Today's topic is Climate Change, Resource-Energy Use, and Sustainability of the Earth and Human Society. Before getting into this topic, we should know what we mean by sustainable development.

Figure 2.1 shows clearly what sustainability means. First, ecological footprints (the area of land required by a person to exist) should be small. The ecological footprint per person should be kept at 2 ha or below. I think this is not a very high target but quite a reasonable figure.

In terms of wealth, the Human Development Index, or HDI, has been developed by the UN. HDI is an index that represents the three aspects: economy, medicine/health and education. If HDI is 0.8 or higher, you are making a decent living. If HDI is less than 0.8, you are in poverty. The rectangle in the bottom right represents the sustainable range. How many countries are currently satisfying the conditions for a sustainable human society?

In fact, only one country is currently inside this sustainability rectangle. That is Cuba, as you can see in Fig. 2.2. This means that the most attractive country in the world is Cuba. This fact indicates a challenge facing us.

If 7 billion people had the current US American footprint level, we would need five Planet Earths (see Fig. 2.3). But we have only one Earth. This depends largely on our lifestyle. If, for example, we change our way of living, footprints can be reduced. But many people want the highly luxurious American lifestyle. Thus larger footprints are necessary. More land and more Earths are necessary.

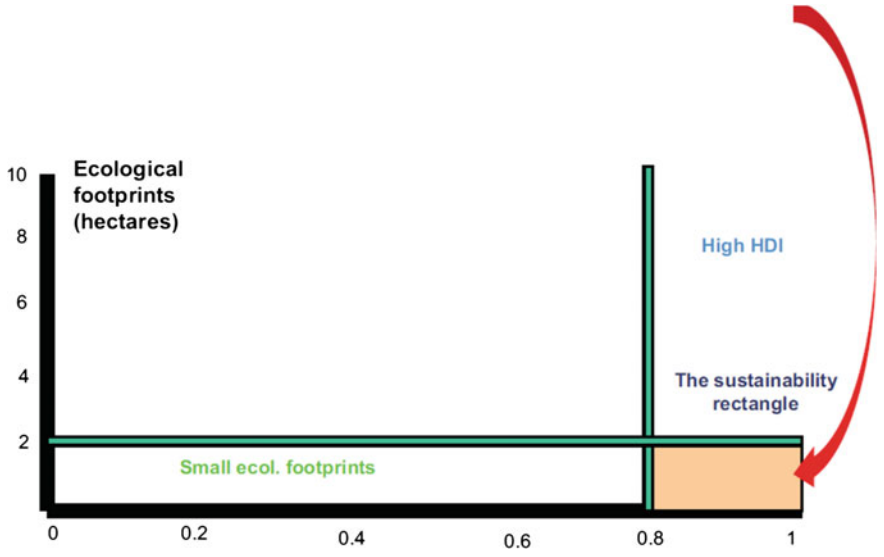

Fig. 2.1 Sustainable development means small ecological footprint and high Human Development Index (HDI)

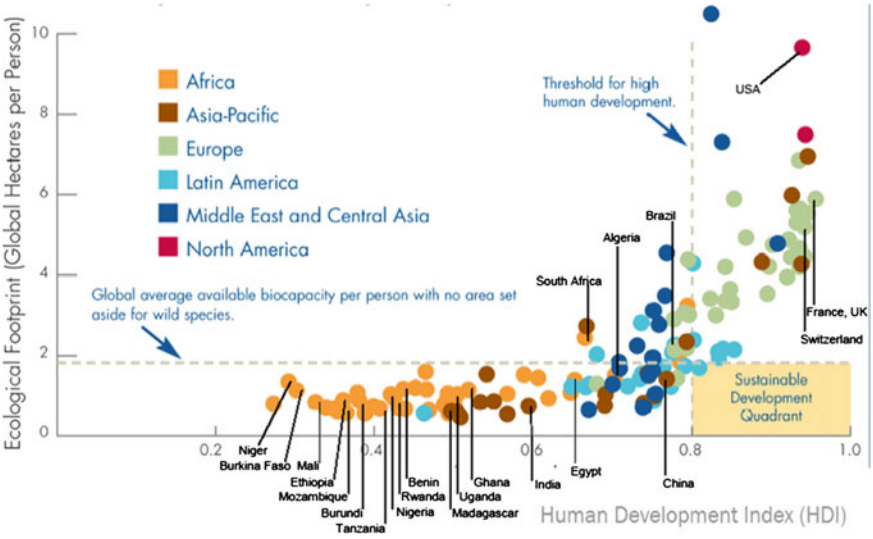

Fig. 2.2 Only one country currently populates the sustainability rectangle. *Source* The author

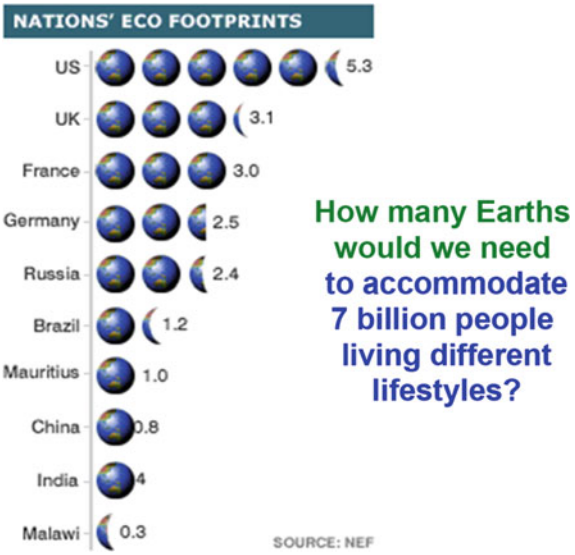

Fig. 2.3 Nations' ecological footprints. *Source* The author

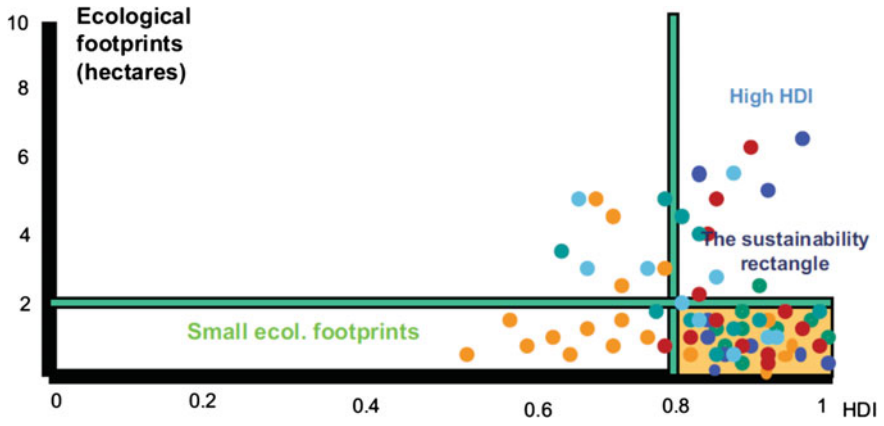

Fig. 2.4 A fivefold increase of resource efficiency could repopulate the sustainability rectangle. *Source* The author

2.2 Increasing Resource Efficiency Fivefold

Thus, from both technological and political viewpoints, we have reached the conclusion that the only way to solve this problem is to increase the efficiency of resource use. In other words, to make 1 kW of electricity, to obtain 1 barrel of water, or to gain 1 kg of iron ore, resource efficiency should be improved.

If resource efficiency can be increased fivefold, poor countries will move from the upper left to the lower right as shown in Figs. 2.2 and 2.4. They will get into the sustainability rectangle without increasing their ecological footprints. And these rich countries can also enter the sustainability rectangle without sacrificing HDI, or wealth.

Then, a single Earth would be enough. This is, however, a big challenge. And we have to tackle this challenge. This is the major philosophy that lies behind the Factor 5 concept.

We are required to maintain wealth while reducing footprints. I do not think this is just a dream only in the mind of crazy engineers. It is actually a sheer necessity if we want to maintain our current rich lifestyles. In Germany, Japan, Cameroon or Ecuador, no one wants poverty. Without exception, we all want to live a civilized life.

2.3 What Is Going on in Greenland?

Dr. Manabe gave a wonderful presentation on climate change and water. I want to add a little bit about climate. I want to discuss the situation of Greenland, where the areas that are covered with water in summer increased in a relatively short period of ten years. Figure 2.5 shows a comparison of Greenland in 1992 and 2002. The

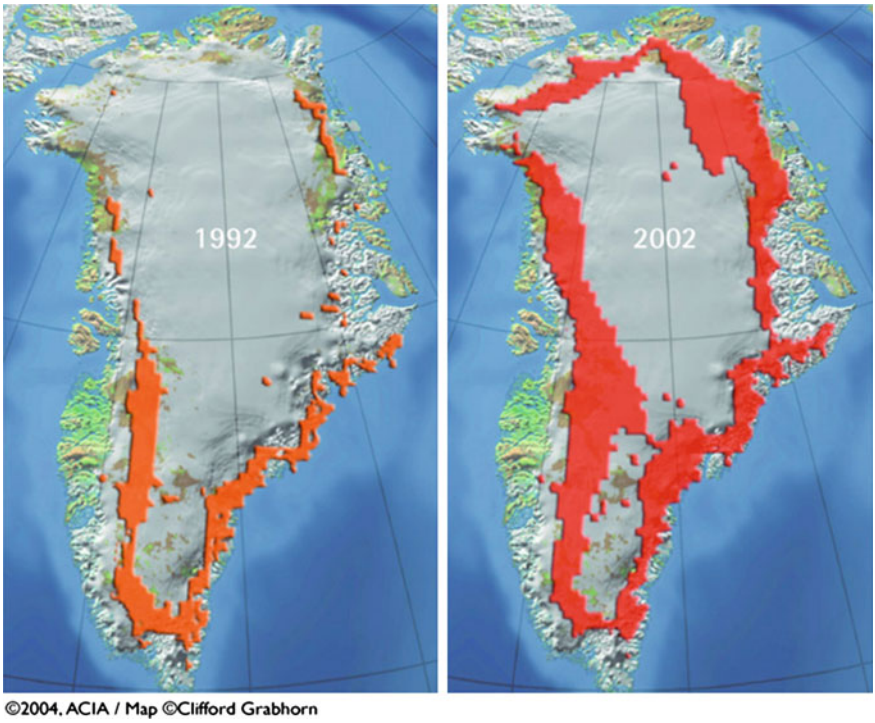

Fig. 2.5 Ice coverage of Greenland in summer 1992 and 2002. *Source* Clifford Grabhorn in: ACIA (2004)

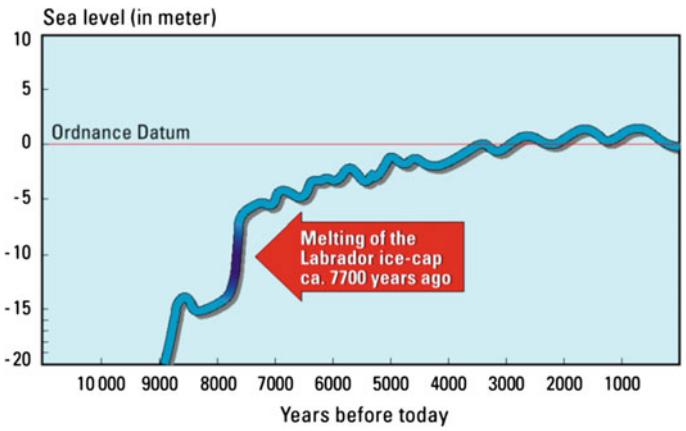

Fig. 2.6 Rise in sea level can be catastrophically fast!

situation is even more severe in Greenland today. Flows of melted ice running on the ground surface have been increasing, which is very dangerous.

In fact, the same thing happened on Labrador in Hudson Bay, in eastern Canada. Just as the ice coverage decreased in Greenland, ice melted in Labrador. Let's look at the sea level (Fig. 2.6). The sea level rose by 7 m in Labrador at that time. Although it did not have a big impact because no humans lived in Labrador 7,700 years ago, it caused a large rise in sea level. This is what is going on in Greenland today.

2.4 We Now Need a Kuznets Curve of Decarbonization

Figure 2.7 shows growth centers in Asia. Asia's vibrant growth centers are mostly located in coastal areas. So is Nagoya.

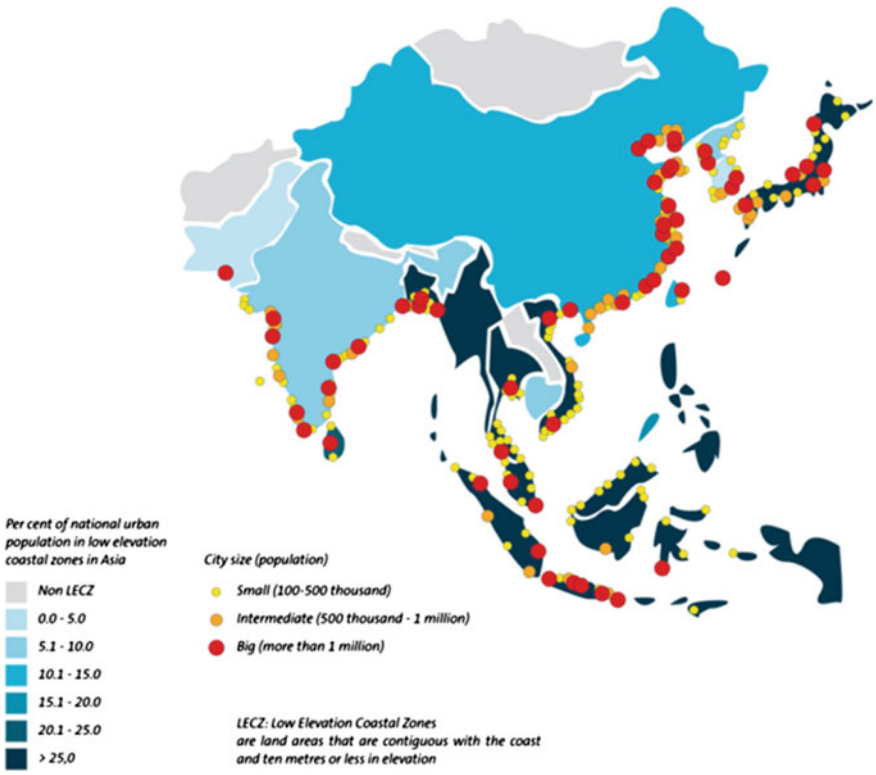

Fig. 2.7 Asia's vibrant growth centers are mostly at the coast! *Source* The author

Is this promising a brilliant future for you? I do not think so. The situation is different from in Europe. Why is climate policy making little progress despite the current critical situation?

Conferences of the United Nations Framework Convention on Climate Change (UNFCCC) over the past three years ended up with terrible results, with no concrete actions or achievements.

I think the reason for this is very simple; the higher the CO_2 emission intensity, the higher the degree of economic development. We must change this correlation. In other words, we must create a Kuznets Curve of decarbonization.

Japan once suffered pollution. Japan in the Edo period was a poor, but clean country. There was no pollution. But as it passed through the course of industrialization, the country became rich but dirty. Pollution occurred and made Japan dirty. Today, having overcome the pollution of those days, Nagoya, and Japan as a whole, has become rich but clean. This is what a Kuznets Curve represents. CO_2 emissions increased once and then decreased to the level in Japan today.

Meanwhile, the populations of China and India are nearly 2 billion and 1.3 billion, respectively. These developing countries are rapidly increasing their CO_2 emission intensity. And Greenland is showing a consequence of this.

We therefore have to help developing countries bypass the curve of increasing CO_2 emissions once and decreasing it later, and go along a better road (Fig. 2.8). We must make them reduce CO_2 emissions while allowing them to pursue economic development. This is our highly important task.

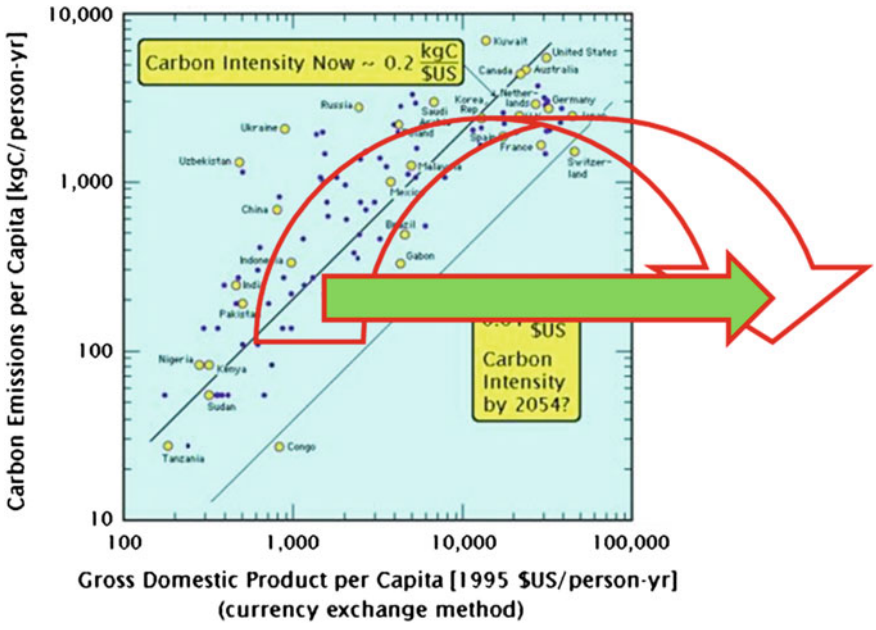

Fig. 2.8 It is necessary to help developing countries reduce CO_2 emissions

2.5 Three Methods of Decarbonization

I think there are three methods of decarbonization. Although there may be other methods, let us consider these three here. The first is to obtain energy without emitting CO_2. The second is to become wealthy without using energy. And the third option is not to seek wealth.

Which one would you choose? The first option "to obtain energy without emitting CO_2" probably seems to be the most realistic methodology. Examples of this choice include wind power, solar light and nuclear power. Some may choose "to become wealthy without using energy," in short, to increase efficiency, or even "not to seek wealth," but I think they are in a minority. This is why I said earlier that it is a big challenge. In fact, these options are not enough. Before explaining this in detail, let me show you what happened in Japan.

In 2011, Japan was hit by a big earthquake and tsunami, which were followed by a very serious nuclear accident. As a result, a radioactive cloud moved as shown in Fig. 2.9, which is even said to have reached California. This was really a big tragedy.

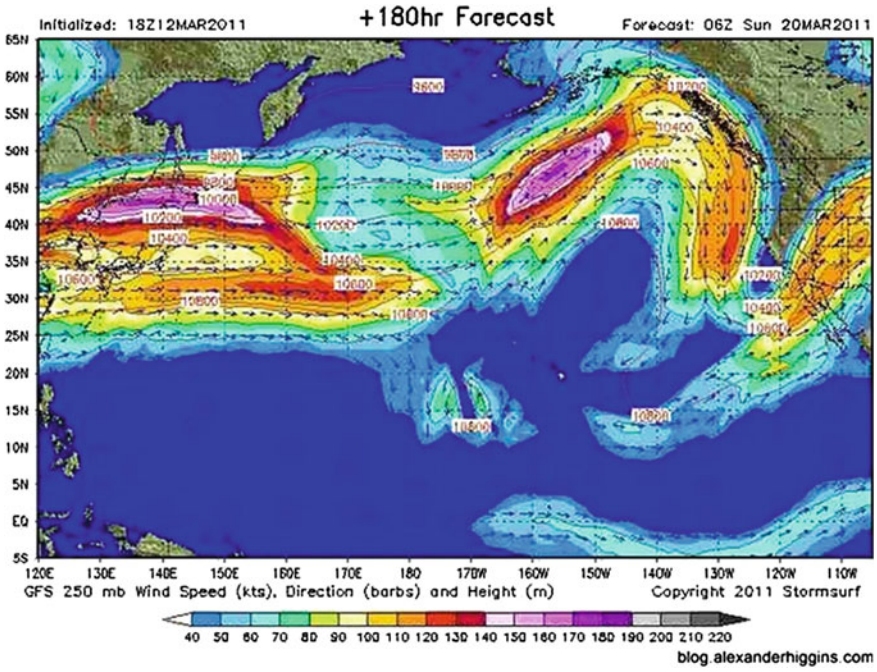

Fig. 2.9 The radioactive cloud 7 days after the Fukushima Daiichi Nuclear Power Station accident. *Source* The author

We should not resort to the option of obtaining energy without emitting CO_2. If we want to gain the same level of wealth without using nuclear power or burning highly dangerous methane hydrate, this option becomes extremely difficult.

How about CO_2 capture and storage (CCS)? It is of course possible to capture and store CO_2. But as shown in Fig. 2.10, it requires enormous cost to dig sufficiently deep into the Earth, and to store CO_2. We must call it a crazy idea.

How about bio-fuels? In Germany, we can see many large maize fields extending as shown in the left photo of Fig. 2.11. But from the viewpoint of biodiversity, this is wrong. Also, huge palm oil plantations seen in Indonesia, Malaysia, etc., as shown in the right photo, are just an ecological nightmare.

In Germany, photovoltaic power generation has also been increasingly promoted. As shown in the upper left photo of Fig. 2.12, even a photovoltaic power plant as large as an airport has been built. This is wrong. The situation is the same for wind power. Look at the rows of wind turbines in the upper right photo of Fig. 2.12. Is this what we want Germany to be like in the future?

When I was a parliament member, I was involved in establishing the Feed-in Tariff law. But today, complaints are arising about wind turbines.

There are also huge hydroelectric dams. The lower left photo of Fig. 2.12 is a dam in Austria. Mountain climbers complain that the scenery of the Alps has been

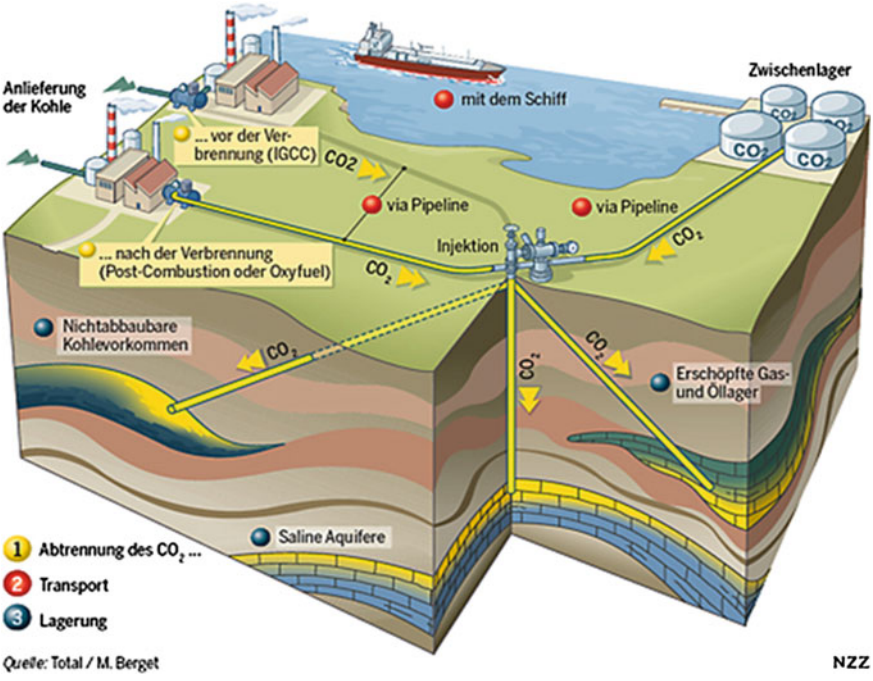

Fig. 2.10 CO_2 capture and storage (CCS) requires a lot of money. *Source* Total/M. Berger. NZZ

Fig. 2.11 Bio-fuels are an ecological nightmare! *Source* The author's archives

Fig. 2.12 Solar, wind, hydro and geothermal are fine on a small scale but can be nasty on a large scale. *Source* The author's archives

spoiled by power plants. They want no more hydroelectric plants or dams to be built, as they already have enough of them.

How about geothermal power? It may sound good. But we have to dig as deep as the height of the Alps to make effective use of geothermal power. It is unrealistic. It is a program that cannot be achieved without spending tens of billions of money.

2.6 What Can Renewable Energies Achieve?

Of course some renewable energies are easy to use and are actually being used effectively. Some of my friends are playing a leading role in exploring alternative energy sources. Another friend of mine received the Nobel Prize for research on renewable energy. This Nobel laureate, who pioneered photovoltaic power generation, has made wonderful achievements.

Photovoltaic power generation and offshore wind power generation seem to be good options. Or there is another option of encouraging the use of composting of biomass resources, which requires no electricity (Fig. 2.13).

In calculation, this seems to be a realistic option. It would be a big challenge for 1 billion people living in rich countries to make 20 % of their energy sources renewable ones. This means, however, only 1/35 of energy necessary for 7 billion people on the Earth.

While 1 billion people are living in rich countries, the total population of the Earth is 7 billion. To support all 7 billion people, efforts by 1 billion people are not enough.

If we have to increase 35-fold the examples I mentioned earlier—palm oil plantations, wind power, hydro power, or photovoltaic power—they will destroy ecosystems, which is an ecological nightmare.

What should we do to avoid this nightmare? Let's change the figure and assume that the target we have to achieve is 100 %. How about achieving 30 % of it by finding ways to obtain energy without emitting CO_2, 65 % by taking the option of becoming wealthy without using energy, and the remaining 5 % by quitting seeking wealth.

Then, a 5 to 10-fold increase of renewable energies would be enough. Let me remind you here that I am not an opponent of renewable energies. What I am pointing out is that excessive use of renewable energies may cause trouble to ecosystems.

Fig. 2.13 We need a lot more renewable energies—where they are ecologically benign! *Source* The author's archives

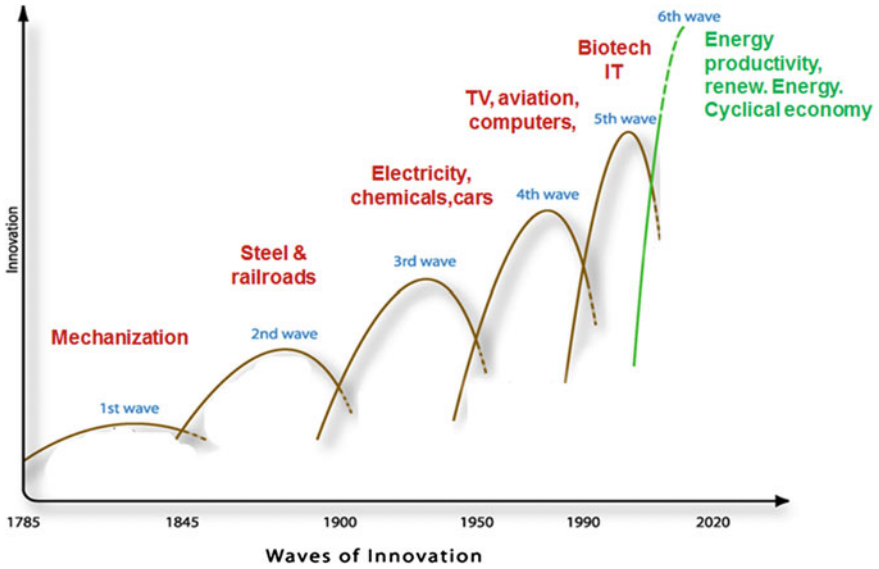

Fig. 2.14 Green Kondratiev Cycle, after five brown Cycles. *Source* The author

Therefore, a technological revolution is strongly needed. We have developed various technologies. Let's take a look at these technologies with reference to the so-called Kondratieff long waves (Fig. 2.14).

The past five cycles were all bad for the environment. We have already experienced five dirty cycles that have harmed the environment. Greenland shows an obvious result of those cycles.

2.7 Idea of Making Per-Capita Emissions Rights Equal

What is required now is a new green Kondratiev Cycle, which is friendly to the environment. In other words, we must find a way to help developing countries become rich without increasing their CO_2 emissions. As an answer to this, Indian Prime Minister Manmohan Singh proposed a wonderful idea of equal per capita emission rights. Germans, Americans or Japanese do not have more rights to emissions. People in India, Bangladesh, or the Philippines, or even in Nigeria, should have equal rights of CO_2 emissions, because they are all the same human beings. The concept of equal per capita emission rights is to make per-capita emission rights equal, so that the developed countries in the North should purchase emission rights from developing countries. By introducing this idea, CO_2 emissions in developing countries in the South such as India, in particular, will be reduced, as I describe the details later.

German Chancellor Angela Merkel expressed her agreement to Singh's idea on August 30, 2007 at the Nikkei Symposium in Tokyo, while the United States seems to dislike this idea and is opposing it.

With such an incentive, developing countries will make efforts to improve their energy efficiency, and then move to renewable energies. The market mechanism will automatically work, enabling renewable energy technologies to spread to developing countries in the South. No additional investment is necessary to achieve this, as developed countries will purchase CO_2 emission rights from developing countries. This incentive may also lead to the scrapping of ongoing plans to build many new coal power plants.

2.8 Task of Decoupling Prosperity from CO_2 Emissions

To this end, we must take a bold challenge in the real sense. In short, we must decouple prosperity from CO_2 emissions. Here, I want you to do a simple physics calculation.

How many kWh do you need to lift a bucket of water weighing 10 kg from sea level to the top of Mount Everest? Some may say 1,000 kWh and others may say 100 kWh. You are probably imagining a figure around them. But the truth is that it can be done with only 1 kWh.

Although it is probably hard to believe, it is true that only 1 kWh is enough. But we tend to think more and more power is required. It is ridiculous, in the first place, to lift a bucket of water up to the top of Mount Everest. However, this is what we are doing in seeking more and more energy and wealth.

Bob Lutz, former vice chairman of GM, who is called a US automobile guru, published a book titled *Car Guys versus Bean Counters* in 2011. In this book he points out how many MBA holders, or business school graduates, have been sent out into the US economy, and they are still increasing, while at the same time the power of American industry has been weakening.

In short, this book indicates that a greater number of MBAs from business schools cannot make the world better. Lutz says that we should let engineers run the show, not MBAs. I am sure that engineers are already playing major roles in Japan and probably in Germany.

An ordinary car runs 100 km with 6 to 12 L of gasoline. But a super-efficient car can run 100 km with 1.5 L of gasoline. And we should remind ourselves that we have the technology to bring that about.

The photo in Fig. 2.15 shows Mayor Boris Palmer of Tübingen, a university town in southern Germany. An electric bicycle is a better form of urban transportation than a car. You can get where you want to go faster by riding a pedelec than a Mercedes or Toyota.

Figure 2.16 shows passive houses, houses that require almost no energy. Most energy is generated by a heat exchanger, equipment ensuring high heat recovery efficiency, and the remaining energy requirements can be adequately covered by the

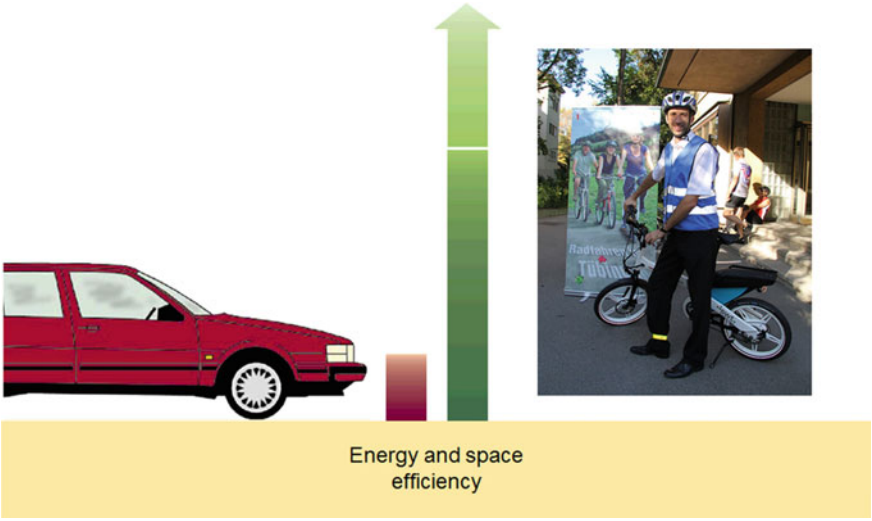

Fig. 2.15 Pedelecs are better for urban transport (as shown by Tübingen's Mayor Palmer). *Source* The author

Fig. 2.16 Passive houses: more heat efficient by a factor of ten. *Source* The author

solar panels installed on the roof. It is also possible to refurbish existing buildings into passive houses.

Look at the thermographs of Fig. 2.17. The left is before refurbishment. The house warmed up the atmosphere. But this situation dramatically changed after refurbishment. Replacing incandescent bulbs with LED lights increased energy efficiency ten-fold. This is widely known in Japan.

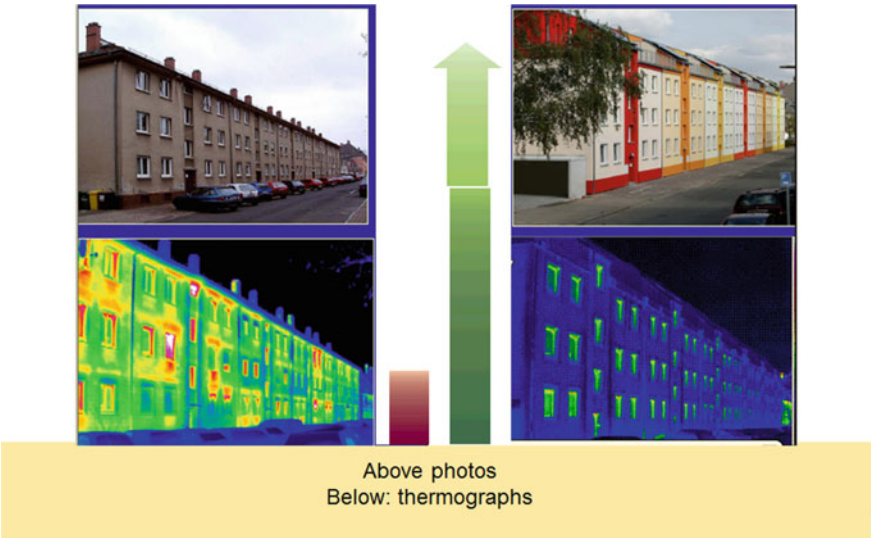

Fig. 2.17 Change in thermography as a result of refurbishing existing buildings. *Source* The author

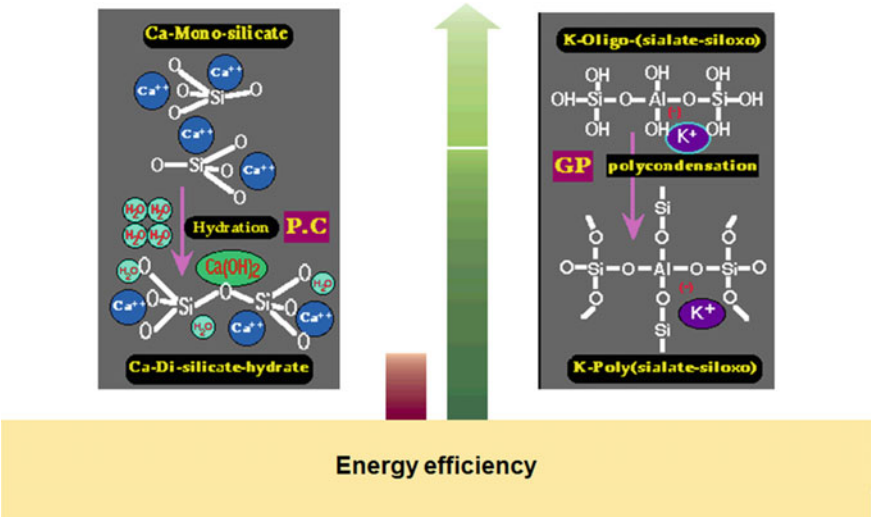

Fig. 2.18 Portland cement to geopolymer cement. (e.g. fly ash from coal power plants). *Source* The author

Figure 2.18 shows a comparison between Portland cement and geopolymer. Conventional cement consumes a large amount of energy. Portland cement is the type of cement currently in use. If cement can be produced using slag from

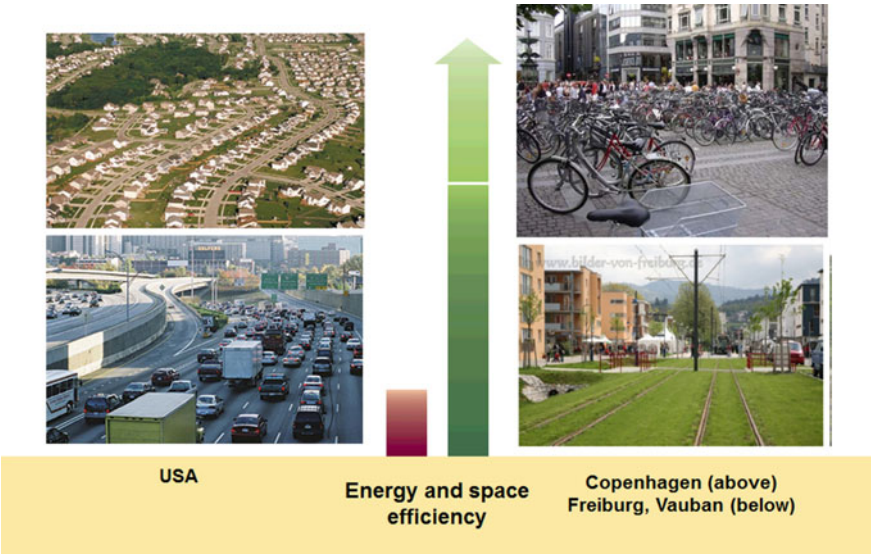

Fig. 2.19 City structure and energy efficiency. *Source* The author

ironworks or fly ash from coal power plants, for example, energy efficiency will be increased fivefold.

I once lived in the United States for six years. During that time I was frustrated that I was not able to go anywhere without a car. I now live in the neighborhood of Vauban, Freiburg. In Vauban, nine out of ten households have no cars. But the town is designed to enable residents to go wherever they want without a car. Figure 2.19 shows Vauban in the lower right, Copenhagen in the upper right and Atlanta, US, in the left.

Atlanta is 25 times as large as Barcelona, Spain. But Barcelona has a larger population. Nagoya is close to Barcelona; about the twice the size of Barcelona while the population is smaller (Fig. 2.20).

A shift from business trips to teleconferences is also effective. Or reducing consumption of cattle is another option (Fig. 2.21).

Logistics is another area with potential. Figure 2.22 shows the logistics of yogurt. A researcher named Balda studied the paths yogurt follows in becoming a product. Look at the chart on the left. It shows the terrible situation where trucks are running all over Europe. A total of 8,000 km routes have to be followed to produce strawberry yogurt. This is just crazy.

If aluminum is recycled instead of being produced from bauxite, resource efficiency will increase and the volume of mining can be reduced. I think having the principle of 3R, or Reduce, Reuse and Recycle, to eliminate waste is a wonderful culture.

The United Nations Environmental Programme (UNEP) set up the International Resource Panel in 2007, and since then the Panel has held annual meetings. We studied the recycling rates of metals, with support from Dr. Yuichi Moriguchi of the University of Tokyo (Fig. 2.23).

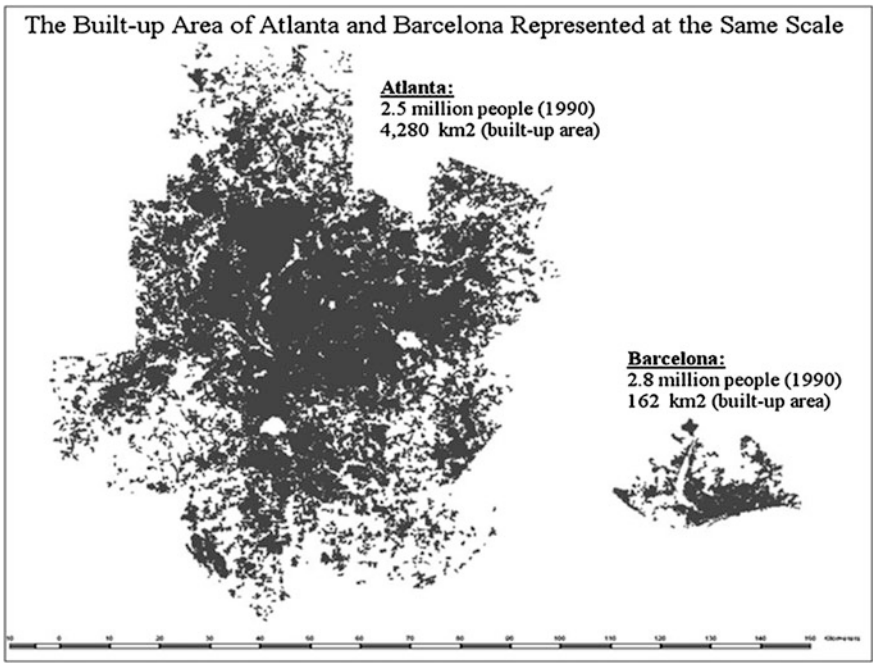

Fig. 2.20 Atlanta is 25 times larger than Barcelona, but has a smaller population. *Source* The author

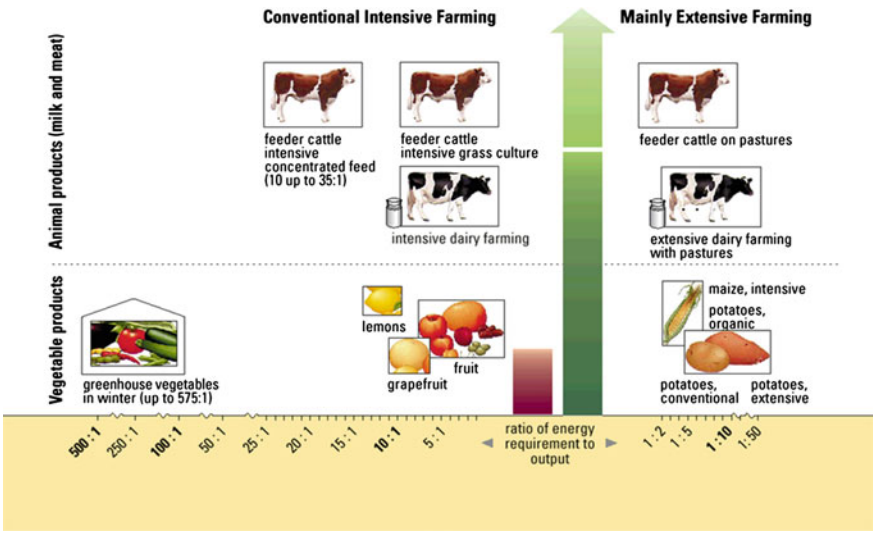

Fig. 2.21 Seasonal diets, organic farming, less beef consumption. *Source* The author

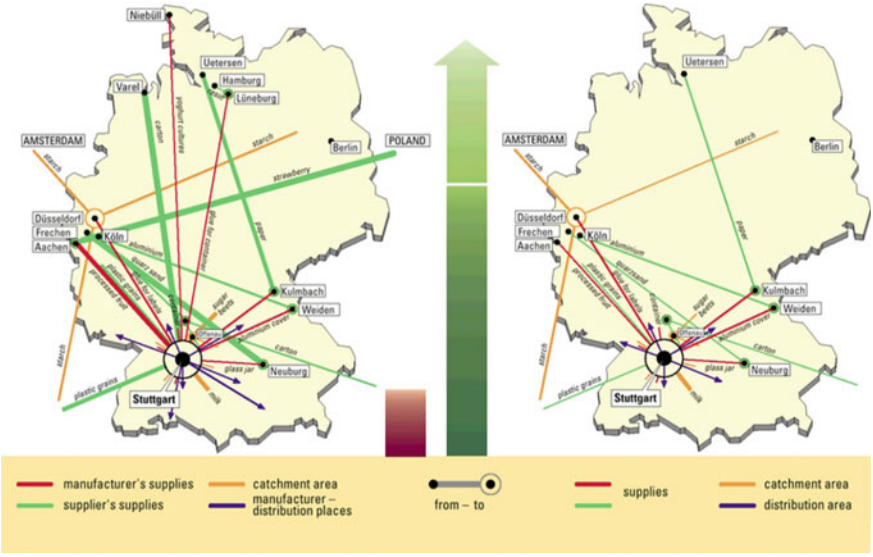

Fig. 2.22 Overcome crazy logistics (e.g. for strawberry yogurt). *Source* The author

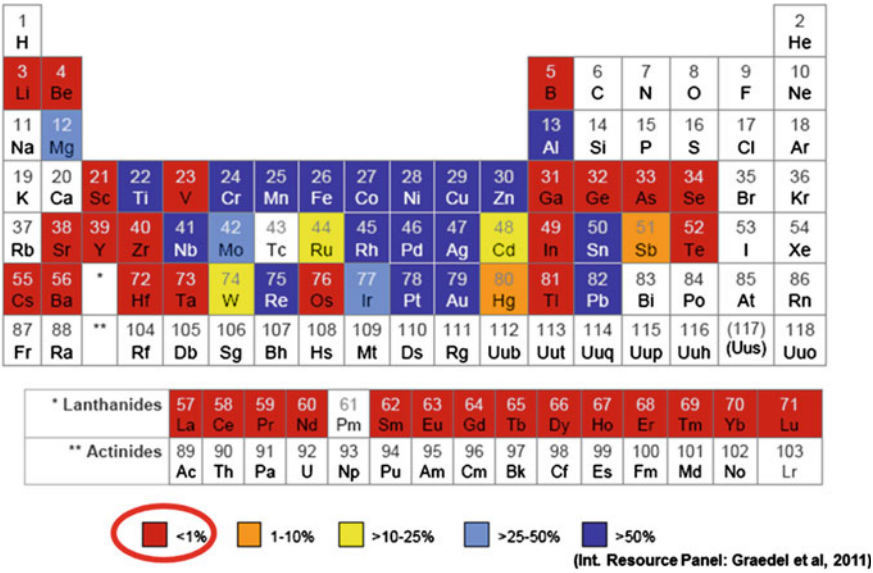

Fig. 2.23 Specialty metals recycling rates are below 1 %! *Source* Graedel et al. (2011). International Resources Panel of UNEP

Figure 2.23 shows the result of research on rare earths, in particular, the metals used for high technology. Their recycling rates were below 1 %. In other words, over 99 % of them are burned in incinerators or buried in the ground. Or they are

somewhere in the environment and polluting the environment, which is a terrible situation.

I know it is very difficult but it should be possible to recover rare earths since we have excellent technology.

2.9 Higher Energy Prices Are Necessary

Now, will the efficiency revolution occur naturally? I don't think so. I think our intervention is needed. Look at the reality. Look carefully at what is happening in this society. Then you will find the world is going in the wrong direction, because everything is left to the markets. Of course I do not think a controlling approach is good. It may be appropriate to leave prices to natural forces. But look at Fig. 2.24, which describes air traffic. Prices have declined while the volume of traffic has increased.

Figure 2.25 shows the price elasticity of fuel consumption. Japan and Italy are in the bottom right, meaning that their fuel costs have been very high over the past ten years, though this information is rather old. On the other hand, oil is always very cheap in the United States, meaning that gasoline is cheap. This explains the situation of Atlanta. Cheap fuel makes people feel that it's easy to use cars.

But Japan tries hard to minimize the use of cars and to reduce fuel consumption by making bullet trains, etc. Germany has introduced the so-called eco-tax. Surprisingly enough, they achieved favorable economic growth rate while decreasing CO_2 emissions.

Look at the US and Canada in Fig. 2.26. Their gasoline use is increasing. In Germany, the introduction of an eco-tax has not meant a heavy tax burden. Because the rates of other taxes were lowered after the introduction of the eco-tax, the overall tax burden decreased.

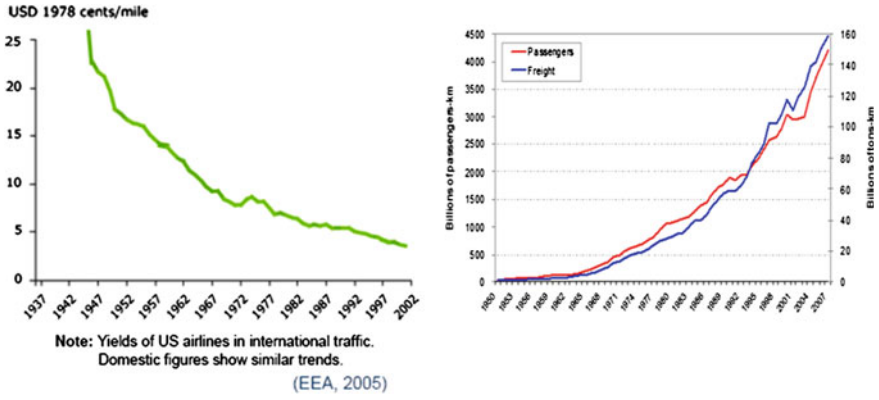

Fig. 2.24 Collapsing prices and corresponding explosion of air traffic). *Source* EEA (2005)

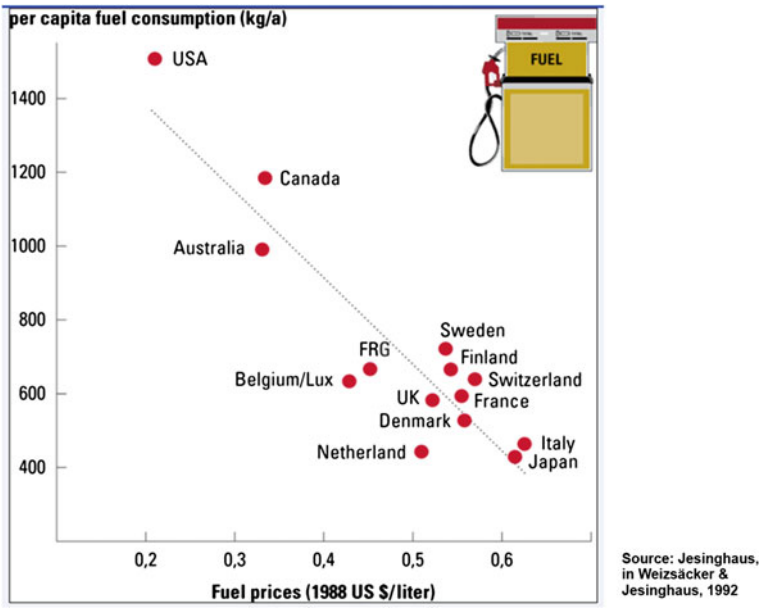

Fig. 2.25 The price elasticity of fuel consumption is very high! *Source* Jesinghaus/von Weizsäcker (1992)

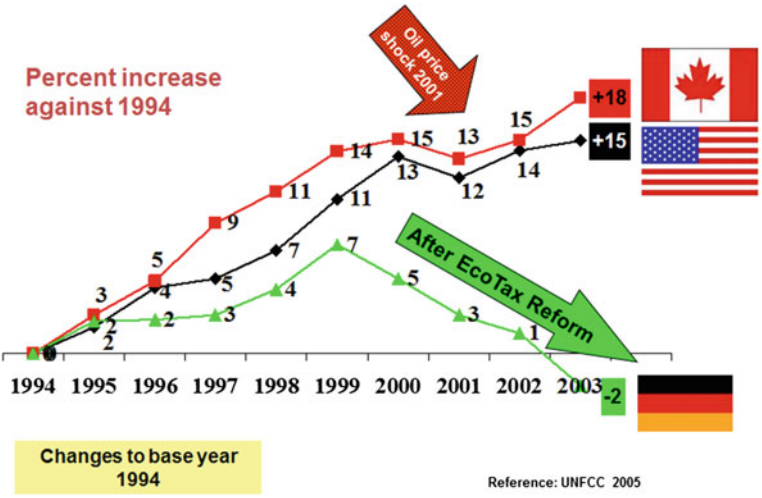

Fig. 2.26 Eco-taxes can reverse the trend in transport emissions. *Source* UNFCC (2005)

The Industrial Revolution increased labor productivity 20-fold. But in parallel with labor productivity, wages also rose. This is like a ping-pong game.

A rise in labor productivity causes a call for higher wages, resulting in an increase in wages. Then efforts for rationalization are made, leading to further improvement in labor productivity. Then wage negotiations start again. This process was repeated 200 or 300 times, until labor productivity was increased to 20 times higher.

This resulted in the accumulation of a large amount of wealth, which is a great success. On the other hand, however, the prices of resources have been falling. This means that resources are used wastefully (Fig. 2.27).

We therefore have to change this trend. Although this trend has actually been changing since around 2000, we must stabilize this ascending current. If we intentionally raise energy prices while improving energy efficiency, even by a small percentage, expenses for energy services will remain stable.

And then we will not need to raise the prices of what we call lifelines for poor people. Since what we really need is always necessary anyway, prices for such things should not be raised.

High fuel costs will probably not hurt the economy. Why not? For example, for 15 years after the oil crisis, although Japan refrained from importing energy, resulting in higher energy prices, the country showed a good economic performance. This was probably partly due to the contribution of nuclear power generation. But during the period from 1975 to 1990, Japan boasted unrivaled competitiveness. Japan's high economic growth was called a miracle. This boosted real estate prices and became a risk factor. Then the bubble economy collapsed, and Japan subsequently entered the stagnant economy stage.

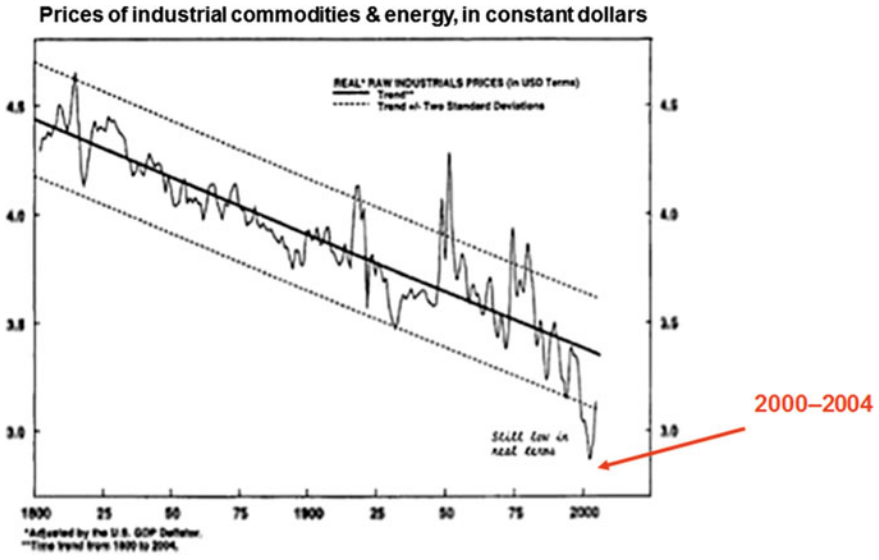

Fig. 2.27 Prices of industrial commodities and energy. *Source* The Bank Credit Analyst (year)

But we are pioneers. Pioneers need not decelerate nor wait for slower people to come. And who will win this game? I think high technology, engineers, culture, high quality or railroads, etc. will be the winners. This is truly the paradigm of Japan. So what kind of people are the losers?

2.10 Who Will Be the Winners?

The winners will be the countries in Europe and East Asia, as well as the developing countries with no resources, which account for 90 % of the total population (Fig. 2.28). So who will lose? It will be the people who ignore the idea of improving energy efficiency and not wasting raw materials.

The alliance of winners is those who take really effective climate policies, ecology policies, and ensure a good balance between government and the market. This means that we must relieve ourselves of the current Anglo-American cultural dominance. We should not follow the principle of Harvard Business School, which is that the government should leave everything to the control of the market. We must get rid of this almost religious belief in markets.

Let me review a little bit of history and introduce some Anglo-American heroes. Thomas Hobbes says that humans are selfish beasts. And therefore an authoritarian (Leviathan) must tame such beasts. 100 years later, Adam Smith appeared. He says that although humans may be beasts, markets can do the taming and therefore the Leviathan is not needed. Another 100 years later came Herbert Spencer, a friend of Darwin. He is an advocate of so-called Social Darwinism. He says that the state is not needed because the theory of evolution works and the strong will attack the weak so as to make everyone strong. He once went to New York and saw many immigrants, who were suffering from hunger. He proudly told his friends that they were seeing "evolution in action." What inhumane words they are! This historic trend

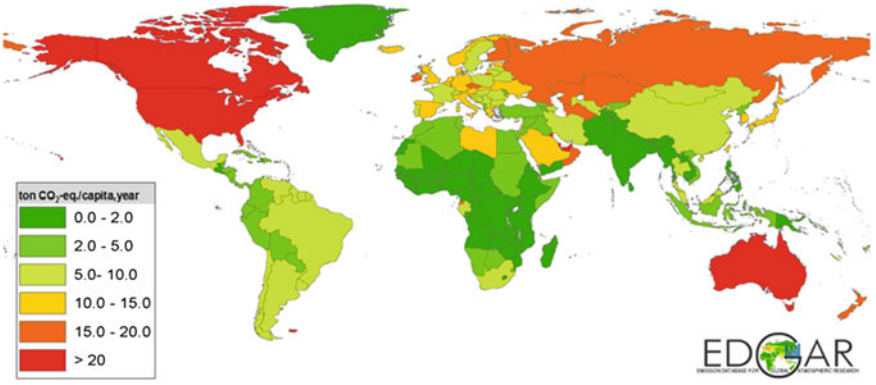

Fig. 2.28 Per-capita CO_2 emissions. *Source* RV-JRC/PBL. EDGAR version 4.0.; at: http://edgar.jri.eu/.20009

gave rise to the idea that dominates Wall Street Journal, which is the idea of Milton Friedman. He says that the state should withdraw and markets should take control. The ideas of their Chicago School stood behind the whole wave of deregulation.

My conclusion is: Factor 5 is needed, and available to us. The North-South issue, or so-called "carbon justice" is highly important. Prices should make the transition profitable. We must create an alliance of the winners while keeping a good balance between the government and markets. This is my message.

Eco-Lab Talk (2): Technology × Society = Transformation

Ernst Ulrich von Weizsäcker and Hidefumi Imura

Left: E.U. von Weizsäcker Right: H. Imura

2.11 Toward a Society that Coexists with the Environment, as Beautiful as a Butterfly

Imura: Professor von Weizsäcker, you have been active in various fields of environmental studies and environmental policies. Please tell me about your first encounter with environmental issues.
Weizsäcker: I have loved butterflies since I was a child.
Imura: Butterflies? That reminds me that you were wearing a tie with butterflies on it at our meeting yesterday.
Weizsäcker: Yes. I love to see a caterpillar growing and transforming itself into a beautiful butterfly. I think I am strongly attracted by their splendid molting, or transformation.
Imura: The idea of transformation is deeply related to environmental issues. If the conventional industrialized society is a caterpillar, a society that coexists in harmony with the environment is a butterfly that has undergone its final molting.
Weizsäcker: Absolutely. A society that has undergone sufficient dynamic changes and achieved sophistication is as beautiful as a butterfly.

2.12 Halving Resource Use, Doubling Wealth

Imura: One of your books is the world-famous *Factor Four*. Factor Four was a call for doubling wealth and halving resource use, and initiated a flood of discussions on the environment, resources and energy from the global viewpoint.
Weizsäcker: Over the past 200 years, labor productivity has increased 20-fold. This means that the same production volume (economic prosperity) can be maintained with less labor input.

How about applying this to energy resources? First, technological improvement itself can surely increase environmental efficiency. Meanwhile, the prices of energy and resources such as oil are rising. The price rise provokes technological/political efforts, which result in further increases in energy resource efficiency. In 2007, for example, although the oil price rose by 3 %, the fuel efficiency of automobiles also increased by 3 %, which absorbed the oil price rise.

If we can make an effective mechanism like this, efficiency in energy resource use will increase, enabling resource use to be halved and wealth to be doubled.
Imura: It is difficult to build such a mechanism by leaving everything to technology or market competition.
Weizsäcker: That's right. You mentioned this point in your book *Environmental Policy in Japan*, citing Japan's experience. Things will not move in a good direction through the efforts of industry alone. The government should take appropriate initiatives through such measures as introducing environmental taxes or emissions trading to control prices for energy use. It is important to ensure a good relationship between industry and the government.

Imura: Japan has addressed environmental issues based on negotiations between industry and the government. But now that politics and the economy are globalized, limitations to this conventional system have been pointed out.
Weizsäcker: As the economy is globalized, international financial systems may undermine the state, which is an unfavorable trend from the viewpoint of the environment and social fairness. During the Cold War years, on the other hand, not only pursuit of market profit but democracy, social fairness and commitment to environmental issues were also considered important in the US-Soviet confrontation. But in the post-Cold War globalized world, the highest priority is placed on markets.

2.13 Factor 5 Suggests the Form of Society We Should Have

Imura: I hear you are currently writing *Factor Five*. What made you advance from Factor 4 to '5'?
Weizsäcker: In the first place, the figure '4' was not good. My Chinese friend told me that '4' has the same pronunciation as 'death' in Chinese and therefore it is believed to bring bad luck. (Laughter) Anyway, I thought it was about time to move a step forward from Factor Four.

During the 12 years since *Factor Four* was published, the world has undergone substantial changes. One of them is technological advancement. *Factor Four* presented high-efficiency fluorescent lighting as an example of highly energy-efficient technologies. But today, LED technology is already spreading. Shuji Nakamura, well-known inventor of LED lighting, is at my university. Various other environmental technologies have been developed over the past ten years. If we make good use of these technologies, it is possible to make wealth × environmental efficiency '5'.
Imura: While technologies have been developed, government and policy should play a major role in making effective use of them.
Weizsäcker: Yes. Technology itself is not almighty. The government's role is to help establish mechanisms for promoting the spread of, or demand for, new technologies. Discussions in *Factor Four* focused mostly on technology. In *Factor Five*, I will get to the core of the significance of policies and systems. In other words, I will discuss the form of society we should have by presenting mechanisms that create multi-layered cycles of energy efficiency.
Imura: What you said now is certainly connected to 'transformation,' as you mentioned at the beginning of this talk. Technological advancement alone cannot improve the global environment unless the social foundations and systems to make use of it have been developed. Even if social awareness has increased, on the other hand, without technology practical action will bear no fruit. In short, it is very important that both technology and society undergo qualitative transformation and

harmonize well with each other. By ensuring this, we can achieve Factor 5, or go even further ahead.

Weizsäcker: Absolutely. If both technological efficiency and social systems work effectively like two wheels, we can aim at a goal higher than Factor 5.

Imura: You have promoted eco-tax reform[1] as a researcher and also as a politician. Do you think eco-tax reform is effective as a means to develop a framework to achieve Factor 5?

Weizsäcker: As a means to gradually raise the prices for stable energy use, eco-tax reform is effective. In the EU, a carbon emissions trading market was established, where the trading price fluctuates drastically on a daily basis. Unlike the stock exchange, such a game element is not needed in emissions trading, which may inhibit us from taking a consistent approach to address global warming. Eco-tax reform, on the other hand, will enable the industry to forecast long-term price fluctuations and take proper action.

2.14 Entering, and Emerging from, the Era of Global Warming

Imura: How do you see the actions taken by various countries in addressing global warming and climate change?

Weizsäcker: Among the EU nations, Germany has been making a particularly large commitment to global environment-related policies, strengthening its international presence. Japan is in danger of failing to achieve the reduction target of the Kyoto Protocol. But considering the substantial quantity of greenhouse gas emissions that Japan had already reduced before the standard year (1990), I am quite sympathetic to Japan.

In the United States, despite its constantly reluctant attitude, even the current president is beginning to take action, which makes us expect substantial progress when the next President takes office.[2] Before that, the G8 Summit in 2008 (held at Toyako, Hokkaido) has made climate change and energy efficiency central subjects of international forums, dramatically changing world trends.

Imura: Do you have any specific ideas about policies or systems to help solve the global warming issue?

Weizsäcker: I would like to suggest "per-capita equal emission rights for carbon." While making efforts to reduce their own carbon emissions, developed countries must also promote the establishment of a framework by which they will purchase emission rights from developing countries and make joint efforts with developing countries for climate stabilization. Developing countries, on the other hand, must

[1]The idea of raising energy tax in stages while at the same time lowering pension premiums.

[2]George W. Bush was the then President.

increase energy efficiency to five times what it is now, which is technically possible for sure.

Imura: Although the population increase in developing countries may be a problem, this seems to be a good idea if emissions rights quotas are set based on the population at a certain time.

What do you think about the situation in Asia, where rapid industrialization is taking place with environmental policies left behind?

Weizsäcker: I believe in the potential of Asian countries. We will soon see an era which can be called the Century of Green Asia. If they can avoid the paths that advanced countries once followed, they will be able to achieve economic growth in harmony with the environment. It is important to build collaboration and unity on a global scale to tackle global environmental issues, and to establish a fair system, led by the United Nations, not dependent on a single country.

Enlightenment and education are also important. I was impressed to hear that the Indian Supreme Court had made a decision to provide the people with environmental education. Such movement makes us believe that we still have a chance of recovery.

2.15 What Universities Should Do in Collaboration

Imura: In leading such pioneering approaches, I think universities should play an important role.

Weizsäcker: The Bren School (University of California, Santa Barbara) offers the Group Project, a unique program for student education. Students in groups study and research actual environment-related issues for a year, in response to requests from private firms or municipalities. I like this project very much because it helps to dramatically improve students' autonomy, initiative and analysis/research abilities.

Imura: The Graduate School of Environmental Studies, Nagoya University and the Bren School entered into an exchange agreement, which enabled us to invite you.

Weizsäcker: Let us start by actively promoting mutual visits between students or young researchers. I have already come up with some ideas for matching researchers of the two universities on several specific research themes.

Imura: That sounds great. Thank you very much.

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