

Keynote Speech 1

The Social Economy and Community Development: A Case Study of the Centre for Alternative Technology (CAT)

Center for Alternative Technology (CAT), UK
Peter Harper

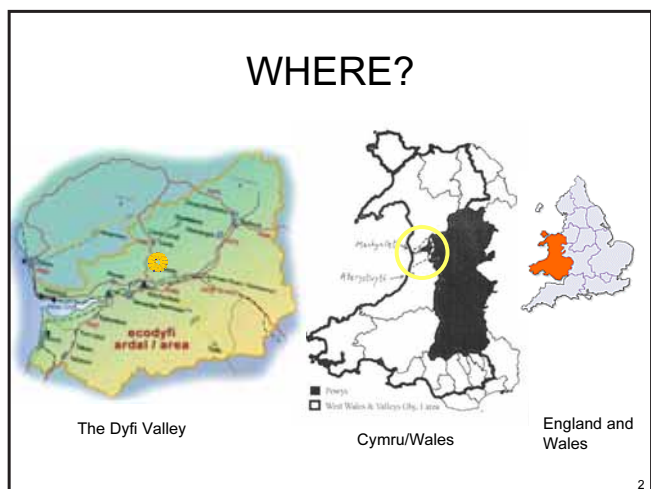
Good afternoon, everybody. I would first like to express my gratitude to the organizers for inviting me. It is lovely to have an excuse to come back to Japan, which I like very much-and I always meet with such wonderful, interesting people.

I am going to talk about the organization that I work for and the effects it has had on the surrounding community in the course of 30 years. It is not a story of instant success. It is a story of very slow success, but it is important that if you persist in doing the right thing, good results come out in the end.

These are pictures of some of my colleagues and "P'nawn dda, pawb", this is Welsh for 'Good Afternoon', 'Konnichiwa Minasan' (Slide 1). And you can see it is a sociable organization, with a



(Slide 1)



(Slide 2)

very informal style, a lot of women. We also have very low wages! You might think that is not very sustainable, but, everybody is smiling.

Where is CAT? (Slide 2) Here you can see a picture of England and Wales on the right. Wales is the red part. In the centre you see the whole of Wales, with the Dyfi Valley marked with a yellow ring. On the left is the Dyfi Valley, with CAT and the local town, called Machynlleth. The Dyfi Valley is an area with about 12,000 people living in it, not very heavily populated.

How did CAT begin? (Slide 3-4) It starts off as a community, or what we might these days call an eco-village. The site is an abandoned slate quarry, not an ideal piece of ground: in fact it is a piece of industrial dereliction. In 1974, a few 'pioneers' moved onto the site. Very difficult conditions at the beginning. And very little money, just a single capital sum provided by a benefactor, which does not pay wages, just pays running costs. No other income.

ORIGINS of CAT

- CAT was founded as experimental community, in the 'Utopian' tradition
- The site was an abandoned slate quarry
- The first staff moved onto the site in February 1974
- Conditions were difficult
- A single capital sum was provided by a benefactor for running costs
- There was no other income

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(Slide 3)



(Slide 4)



(Slide 5)

But the dream is self-sufficiency, a very common dream in the early 70's, of a pleasant, agreeable small community, growing vegetables and milking cows, bringing up children, working together to create a different kind of life, without too much worry about money. And then it changed very drastically (Slide 5).

In the second year, it was forced to change (Slide 6). Anybody who tries to organize a strictly self-sufficient community soon finds out that it is very difficult, and probably impossible. You do need some money, and CAT had none. So, the self-sufficient idea was more or less abandoned. And the site was opened up to the paying visitors. That was a good

idea because suddenly it generates income and at the same time it communicates ideas. That is what we want to do. We want not only to generate the correct ideas, but we need to communicate them. So this crisis actually initiated a completely different style in the organization: not inward-looking but outward-of-looking. It started the process of continuous growth that has been maintained ever since.

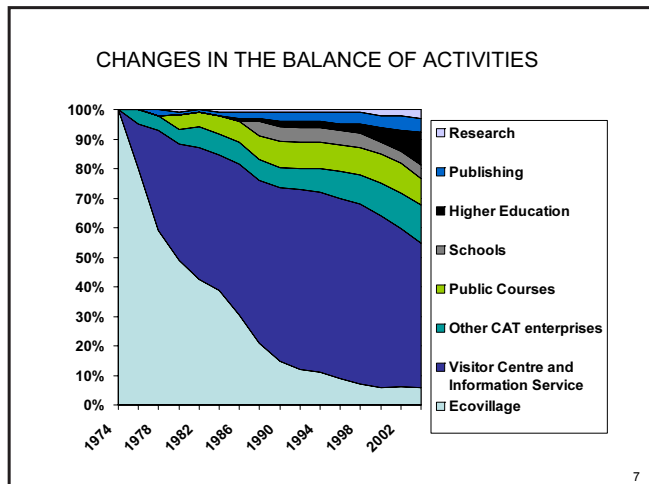
This diagram is to give you some idea of change in the patterns of activities (Slide 7). At the beginning, it was an eco-village, the light blue part of the picture. The eco-village very quickly declined as a proportion of the whole, to be replaced by the factor coloured in dark blue the visitor centre, tourism, and education of general public. And then, gradually other activities intruded until today, we have quite a wide spread of different activities. The eco-village side still exists in a small

A CRITICAL CHANGE

- The closed 'self-sufficient' model was quickly seen to be inadequate
- In Year 2 the site was opened to paying visitors
- This served two important goals:
 - To provide income for wages and running costs
 - To communicate the ideas to a larger public
- This started a long process of organic growth and change

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(Slide 6)



(Slide 7)

proportion of the total activities. Tourism is still important, but increasingly it is other activities that are growing most quickly.

The story I am telling you is about an organization that has experienced very dynamic changes over time (Slide 8). It responds to market conditions, just like a conventional enterprise has to do. It was of course always interested in technology, in particular environmental technology, or to use Professor Naito's terminology, *intermediate* technology. The original idea was that you should try to use very simple materials, eco-materials, if possible, local ones, natural ones, things you could readily find, things that have already

been used before. Old buildings were gradually improved, and 'ecologised', we might say. There were lots of experiments. I have to say most of them were failures, but failures are useful for learning as well as successes. And gradually you see a movement from very primitive kinds of technologies to more sophisticated ones, but-we hope-still very environmentally sound and probably more generalisable.

For example, here is a ruined building gradually being repaired and becoming a highly insulated building with a solar wall and solar water heating features, but still retaining a certain amount of a traditional charm (Slide 9).

Here are examples of natural and traditional materials used in various ways (Slide 10). Wood is excellent material for buildings, and you have used it wonderfully here in Japan over many centuries. That has been replaced by your present

'INTERMEDIATE TECHNOLOGY'

- Initial emphasis on simple techniques and natural or recycled materials
- Old buildings were repaired and 'ecologised'
- Many experiments, many failures
- Gradual shift to more 'generalisable' systems
- But always with environmental features

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(Slide 8)



(Slide 9)

love affair with concrete. I hope this will prove to be a passing fad!

We also have used straw as you see in the top right hand corner. And the wool, sheep's wool. This is an interesting story, because here we are trying to develop an industrial product. You might think that our underlying purpose is to *de-industrialize* things, but that is not the case. Wool is a local natural product: we are trying to make it into a *commercial* product so that it could be much more widely used. And we also have earth, which in this example forms a column in the middle holding up the roof of the building. And finally, living plants have lots of application for buildings.



(Slide 10)

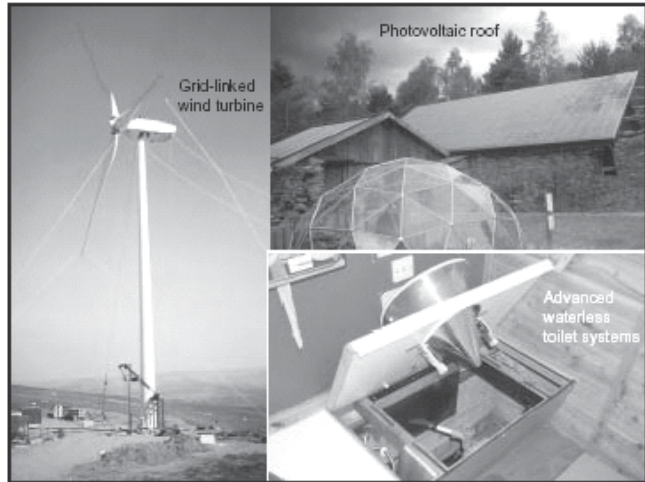


(Slide 11)

As far as solar energy is concerned, at the beginning, it was very primitive and used rather simple technologies (Slide 11). It was good to try all these things out to see how they all worked, but, generally speaking, it was not very successful. I mean these things do work, but you have to put in a lot of energy to get out a rather small amount of energy, and eventually you become tired of that. You eventually try to create systems that are more efficient and more automated. This is the kind of things you see at CAT today.

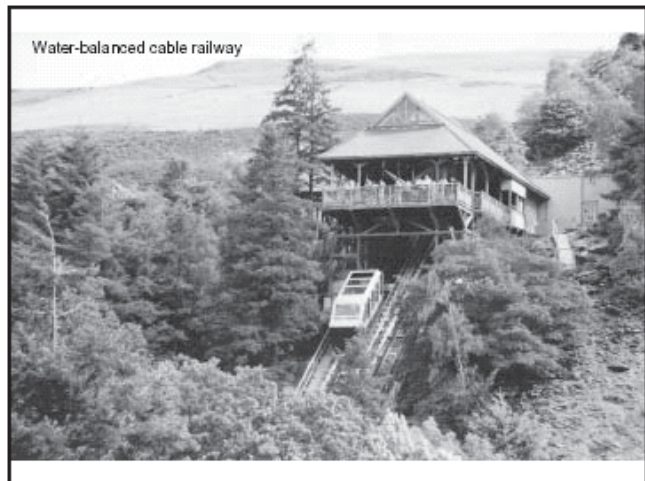
Things have moved along. Nowadays you would have much larger wind machines that are connected to the grid system (Slide 12). You do not necessarily produce electricity for your own use, you produce electricity which goes into the grid, and then you buy electricity from the grid, if you need to. And the same is

true of photovoltaic electricity. A similar pattern of development from the elementary to the more sophisticated form of eco-technology applies also to toilet systems. Waterless toilets moved from very primitive systems to something much more user-friendly with special devices for separating urine, such as the system shown in the bottom right picture,



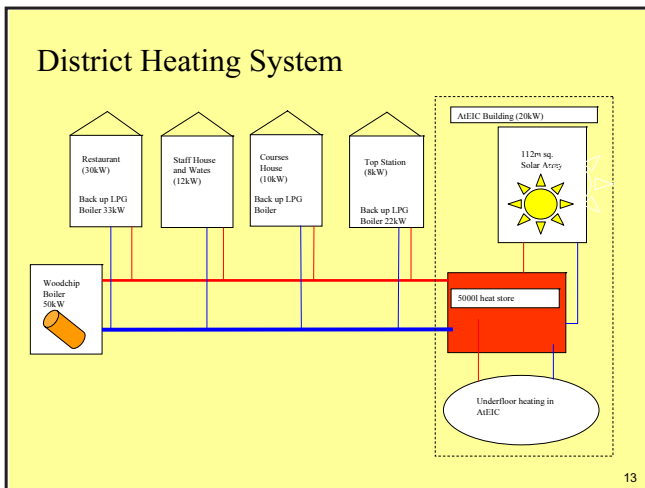
(Slide 12)

Then this is the main way that visitors arrive at the Centre (Slide 13). We have a water-balanced cable railway to bring visitors up to the main part of the site. Again, this is using a renewable energy source, but a rather interesting combination of Victorian technology and modern computer controls. We often like to use such hybrid systems combining something rather old and something more modern.



(Slide 13)

A district heating system can be a sensible solution for bringing heat to lots of scattered buildings (Slide 14). At CAT we use solar energy in the spring and autumn, and in the deep winter when there is



(Slide 14)

not much sun we use wood, which of course is a sort of congealed solar energy, and that goes into the district heating system to heat all the different buildings. So, it is more or less 95 percent renewable energy to provide heating for the buildings.

Other activities that we pursue are also important because we needed to diversify our activities for economic reasons (Slide 15). Of course, we practice organic land management. There are also lots of facilities for the visiting public. Remember, it is a 'drop-in' visitor centre. People can just come and visit all year around. And then we have displays in order to communicate the environmental ideas to the public. We run

OTHER ACTIVITIES

- Organic gardens and ecological landscaping
- Facilities for visitors that 'walk the talk'
- Exhibition displays
- Residential courses
- Media
- Research
- Consultancy

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(Slide 15)



(Slide 16)

residential courses. We have different media for communicating ideas: print media, Website and so on. We do research-in fact I am head of the Research Department myself-and have a consultancy service. So CAT undertakes lots of different activities with different income streams to try to produce a robust economy for the organization. It has got support itself, and does not depend on subsidies from outside.

In this frame there are the some examples of the environmental landscaping that we are trying to in order to maximize habitat creation (Slide 16). It is totally organic now. No agricultural chemicals are used in the maintenance.

These are the facilities for the visitors (Slide 17). Top left you can see the restaurant, a 'green' restaurant serving vegetarian food, whole-food, and lot of local produce. Bottom left is our Shop that sells green products. Bottom right is a

playground for children made of local recyclable materials.

At the top left is display to explain solar, electricity (Slide 18). At top right, small gardens without any soil, but with edible plants growing in compost. On the far right, a slightly 'jokey' display with as 'photo-opportunity'. At CAT we create displays like these in order to make green ideas accessible, and perhaps amusing, to the ordinary public.

We run courses at different levels (Slide 19). People can come to stay up the Centre usually just a few days, or maybe several weeks. We have courses for schools, and for the public, and also for undergraduate students from universities-not just British. At the bottom right you see students from Ritsumeikan University in Kyoto. Ritsumeikan students come and stay for five weeks every year in a hands-on course. They stay in the 'Eco-cabins' pictured in the centre here. We also have postgraduate courses. We run master's course in



(Slide 17)



(Slide 18)



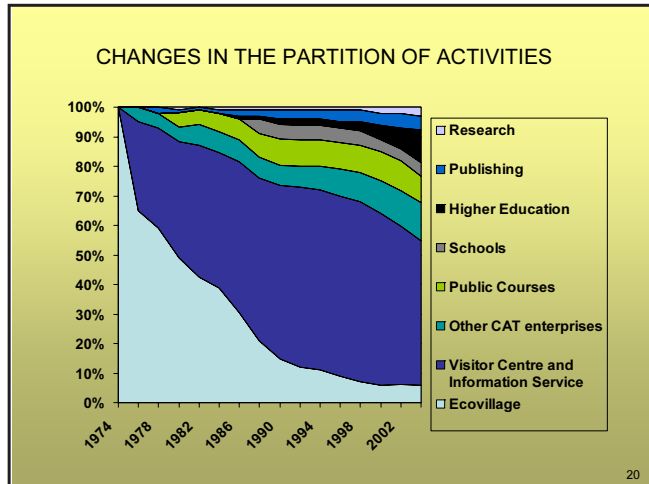
(Slide 19)

Environmental Building and Energy Management (see the picture at bottom left. And of course, we also teach outside CAT. The picture at bottom centre is of my graduate students at Ritsumeikan that I have been teaching this year. I teach a course in Sustainable Futures every September at Ritsumeikan University.



(Slide 20)

Media: At the back you can see the Website home page (Slide 20). The URL is www.cat.org.uk. We also have print publication, lots of books on various green subjects, also CDs, videotapes, and so on.



(Slide 21)

You can see the change of activities gradually taking place (Slide 21). We gradually diversified into a much wider range of different activities. The fastest growing area at the moment is higher education.

THE NEXT MAJOR PROJECT

- WISE—Wales Institute of Sustainable Education
- Principally for adult and postgraduate courses
- Cost of 8 million euro
- Accommodation, catering, laboratories, offices, seminar rooms and 200-seat lecture room
- State-of-the-art environmental building techniques
- Fully monitored throughout the construction phase
- Due for completion in 2006

(Slide 22)

The next big project has actually embraced that new market in higher education (Slide 22). This is typical of the way we operate. We see a new market coming. We start to prepare for it. So, now we are starting quite a

big project. It is known as the Wales Institute of Sustainable Education (WISE) and it aims at adults and the postgraduate level. The main thing about it is that it will be fully monitored. The full process for building it will be monitored in such a way that when it is finally completed, we will know what its environmentally costs have been. And then of course we can monitor its performance once it is complete, and we are hoping that we can gain a lot of information about how to build truly green buildings.

Here are some further computer-generated images of the WISE building (Slide 23). The architect is an admirer of Japanese architecture, and has specified a Japanese garden in the middle of the complex.

I myself an admirer of Japanese gardens, and as a former garden designer, I am hoping to design this little garden myself.

This is a cut-away view (Slide 24). It shows a 200-seat lecture room using the rammed-earth construction.

Just to say a few things about the structure of the organization, because it is rather unusual as a social enterprise (Slide 25). It has two parts. One part is an ordinary company structure, a public limited company; the other part is a non-profit charity. If you have two different kinds of legal structures within the same framework, it is quite flexible, and it allows you to do something you could not do if you are simply non-profit, or simply conventional business enterprise.

As far as business management is concerned, CAT is very democratic (Slide



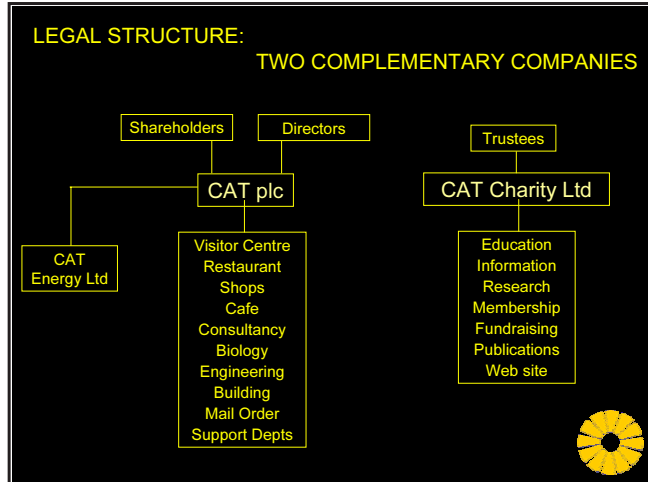
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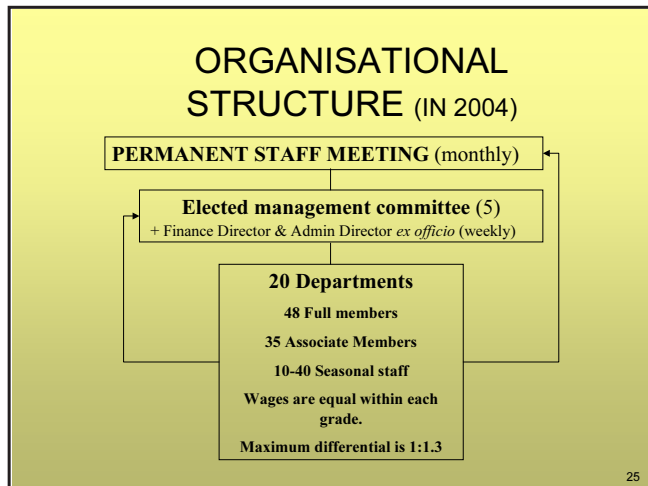
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26). We, the staff, are the final decision making body. But in practice, most high-level decisions are made by the Elected Management Committee. There is no permanent board of directors. It is a collective management system. There are many different departments and about 100 permanent staff at the moment. And a very flat wage structure, very little differential in wages between the top pay and the bottom pay. Businesspeople would say it is not a very sustainable system in an ordinary market terms. But it is something we have managed and maintained for quite a long time, and it worked for us.

Now I want to look at the effects of this rather strange organization on the surrounding community (Slide 27). And I want to observe that cultural regeneration is as important as economic stimulation. Usually economists and politicians are looking for *economic* regeneration, something we can measure, and we get a clap on the back from the government authority if



(Slide 25)

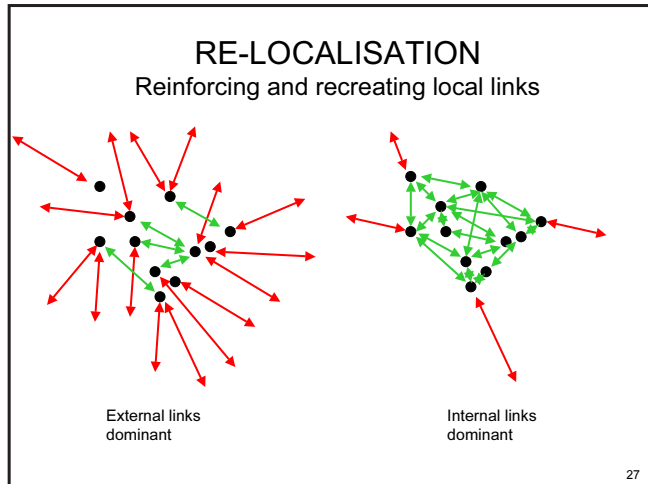


(Slide 26)

- EFFECTS OF CAT ON LOCAL ECONOMY AND COMMUNITY: SOME OBSERVATIONS**
- Cultural regeneration is as important as economic regeneration
 - The social economy builds social capital as well as financial capital
 - A regeneration process can be initiated (sometimes unintentionally) by a small, committed, dynamic—and lucky—organisation
 - There is usually a 'latency period' before wider effects are manifest, decades rather than years
 - Eventually other initiatives are started, either directly or through a process of 'inspiration'
 - These in turn catalyse other developments
 - The original social ethos propagates, ensuring that economic development is balanced by the growth of social capital

(Slide 27)

we manage to do that. Actually, *culture* is also in decline in some areas. It needs special attention of its own. So, the social economy builds *social* capital as well as *financial* capital. You can start a regeneration process by a small group. It can start very small. But you do need time. Of course, it does not always work. You do need a certain amount of luck, I think. There is a rather long latency period while the organization builds its structure and overcomes local resistance and inertia, and gradually it starts to bear fruit, then it inspires other activity. So, it is not that the original seed organization does everything itself. It does what it can, then it inspires other things and those in turn spark other activities. It is a kind of 'social cascade'.



(Slide 28)

HOW DID IT HAPPEN?

- **Direct spin-out enterprises**
 - Aber Instruments
 - Dulas Engineering
 - Two shops, a restaurant and a health-food shop
- **Members of CAT have left to start new green business**
 - Wind-power development company
 - Ecological water-treatment systems
 - Environmental architectural practice
 - Timber-frame construction company, using green-oak
 - Holistic medicine centre
 - Fund-raising organisation for green projects
- **Indirect stimulation of new start-ups**
 - Solar water-heating company
 - Two bicycle shops
 - Green bed-and-breakfast businesses
 - Ethnic tents and shelters manufacture
 - Oriental crafts importers
 - Ecological building company
 - Organic market garden enterprise
 - Youth Hostel
 - Wind-Farm (first in Wales)
- **Institutional and cultural 'inspirations'**
 - Environmental business park
 - Community arts organisation
 - Fair Trade campaign
 - Local economic development organisation

(Slide 29)

What we are trying to do is to move from a situation where local entities—whether they are households or businesses or local organizations of any kind—are mainly connected to the outside world (Slide 28). We are trying to move to a situation where the *internal* connections in the local community are much stronger than the *outside* connections. Of course, we do not want to abandon outside connections altogether. You cannot cut off completely. But we are trying to get away from the pathological overdependence on the outside with weak internal connections, and seek a greater strengthening of the internal links.

We sometimes call this strengthening of local links *relocalization*. How did the process happen in the Dyfi Valley? (Slide 29) CAT started some businesses itself

within the organization and then they later became independent enterprises. That is one mechanism. Another one is the members of CAT who left and started their own businesses using the skills and perhaps contacts and other resources that they acquired while they were at CAT. They can stimulate new start-up companies indirectly, partly by creating markets locally for products where there was no market before. You can *inspire* shifts in behaviour and enterprise. It means that certain things, which were unthinkable in the former context suddenly become thinkable and they can happen.

Here is an example of directly created new enterprises (Slide 30): Top right shows one of a couple of shops in the nearby town of Machynlleth. On the left you see the headquarters of a company (on the business park in Machynlleth) that was once a department of CAT, which is now quite a large business, creating renewable energy systems for developing countries. Bottom left is a device that was invented at CAT, and now made by another independent company founded by CAT, Aber Instruments. This is an electronic method of measuring the volume of live cells in a solution. It is very useful to the brewing and pharmaceutical industries, and is used all over the world. In Japan Kirin beer is all brewed with the help of these machines.

ECODYFI is the name of the local development organization, which has grown out of all these other initiatives in the town (Slide 31). It has focused and coordinated many



(Slide 30)

ECODYFI

- Started by an inter-sectoral partnership
 - Three county councils (Local Authorities)
 - Several local businesses
 - CAT and Dulas Engineering
 - Private individuals
- Originally founded to promote renewable energy in the area
- Important to be seen as independent of CAT
- Has catalysed a large number of local initiatives, building on the Dyfi Valley's image as the 'green centre' of Wales
- Most funding from public sources, especially regional development agency
- 'Eco' means *economy* as well as *ecology*

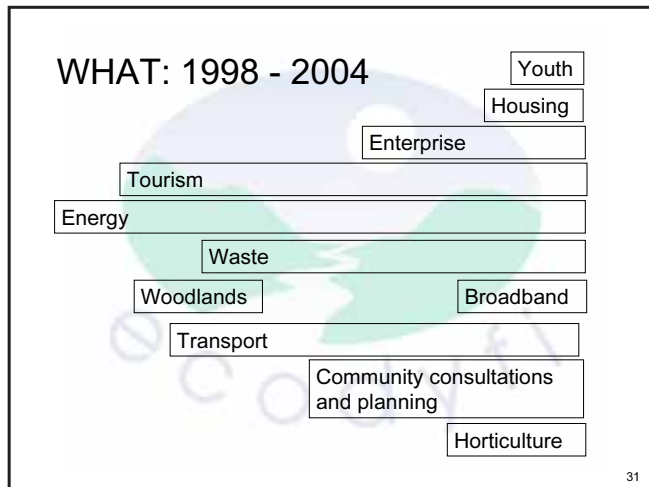
(Slide 31)

of these activities. And people now look to ECODYFI as the catalyst for a lot of local development. It is not a part of CAT. It is quite independent of CAT, but that is what we might call 'inspiration'. Something having being inspired by CAT. ECODYFI itself now starts to spin out lots of different initiatives and in turn they can start spin-out things themselves.

The ECODYFI was started by an inter-sectional partnership. That is quite important. Local authority, businesses, and local NGOs and private individuals started off with the idea of promoting renewable energies, because of CAT, and because this had become a well-known idea in the area. Incidentally, it is important that ECODYFI be seen as independent of CAT, because in the eyes of many local people CAT is a little bit too associated with wild experiments and cultural dissidence. But ECODYFI has catalysed of a lot of initiatives and we have got a situation now, that the Valley is regarded as the Green Capital of Wales.

Local development still needs funds from outside but it is quite good getting hold of the grants that do exist. And this is important. 'ECO' does just not mean eco: green, ecology. It means ECONomy. ECODYFI started with energy, then addressed tourism, transport; all those things necessary for holistic sustainability policy (Slide 32). More will come. So, one thing needs another.

Looking at transport, for example, it is quite often a simple matter of organisation, not necessarily, a new technology (Slide 33). For



(Slide 32)

TRANSPORT

Getting around The Dyfi Valley

Inter-modal guides, maps and timetables

New cycle routes

Car club
20 households, 3 cars
Biodiesel initiative

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(Slide 33)

example if you want to encourage people not to use private cars, you need to improve the public transportation system. But usually there is a bus timetable, and a separate railway timetable. There might be several different bus companies operating each with its own timetable. You can make a significant improvement simply by bringing all different timetables together, and links between the different modes of travel, railways and buses and so on. At bottom left you can see an initiative to encourage new bicycle routes, including a bridge across the river to avoid a dangerous traffic crossing.

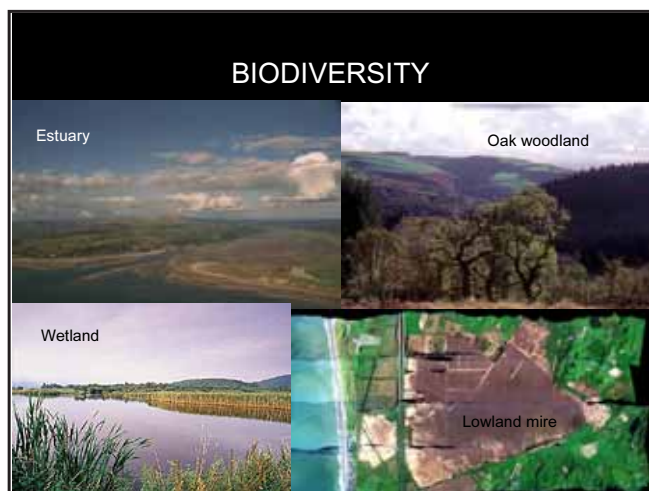
There is also a car club with 20 households sharing three cars, which means those particular households do not have to have car each. They can use bicycle and public transportation most of the time and then use cars when car travel is absolutely necessary. They are now starting to create a Biodiesel initiative in which they will use Biodiesel for their cars. And then gradually other people in the district will get used to the idea that you can use Biodiesel fuel instead of conventional diesel fuel.

Ecotourism, these are lots of activity holidays, but particularly bicycles and local hotels and guesthouses, a lot of them have interests in local foods, organic food, and that becomes something that tourists know about (Slide 34). In the Dyfi Valley, they find places that serve very distinctive, local organic food.

On the biodiversity side, there are lots of different habitats in the Dyfi Valley,



(Slide 34)



(Slide 35)

and we are trying both to conserve those habitats but also to help people to understand and appreciate them (Slide 35). We want to show how you can have lots of human activities and still preserve important habitats. It is often thought there is a total distinction between people and nature. But it not necessary to keep them separate. You can actually find ways of living together very well while maintaining habitats.

Fair trade is another important part of the ethos (Slide 36). We do not want just think about ourselves, because a part of global sustainability is to do with the relationship between the rich north and the poor south. So ECODYFI has campaigned for fair trade goods. At top left is the window stickers that we have created, and bottom left is a friendly demonstration in favour of Fair Trade: everybody is dressed up as bananas to try to persuade the local supermarkets to stock fair trade bananas, and other fair-trade goods. We also have a kind of twinning arrangement with a village in Tanzania of similar size where we exchange small items, and of course ideas, trippers, visitors in order to try to help everybody understand how it is in developing countries and what things we can do to help.

On the waste side, there are lots of different initiatives, leaflets for householders telling them how to sort their rubbish out and what can be done with it (Slide 37). We have initiated a curbside collection and projects on reusable diapers, home composting, and doing



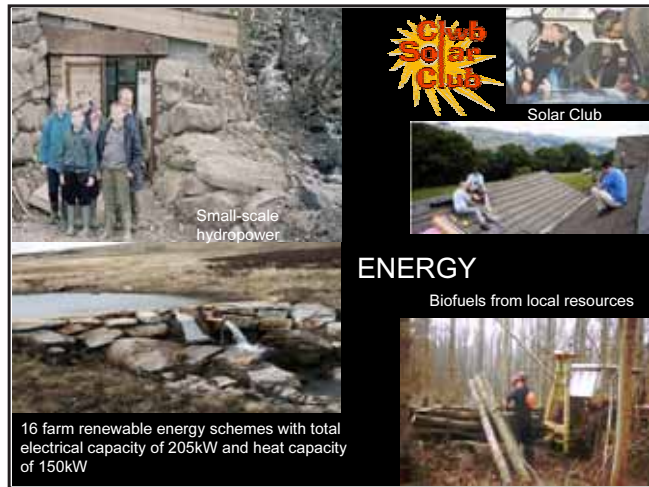
(Slide 36)



(Slide 37)

research on new methods on composting.

On the energy front, the important thing has been working with farmers to develop the energy resources on farms, because lots of small farms are struggling economically (Slide 38). It is difficult for farmers everywhere in the world. But, for farmers in Wales, it has been especially difficult. So, we are trying to show farmers how they can



(Slide 38)

diversify into energy production. It is very often a waterpower project or sometimes using forestry wastes for biofuels.

We have Solar Club where people get together to buy equipment which is cheaper when it is bought jointly; and we run training courses to show and tell people how to assemble and install solar water heating equipment. The most interesting thing recently is starting up a new enterprise to develop wind power in the area. We think it is very important, because our area should be a net exporter of energy. Any region can actually do this, and should do it if possible. It is no good just being energy neutral, because we have got to do more than that. If you have energy of any kind, you should try to work out ways in which you can actually export more than you use. We are interested in doing that, we do not want give the job away to companies outside area, because we have the skills and motivation to do it ourselves. So, a new company has been started called Bro Ddyfi Community Renewables. It has 59 shareholders.

Bro Ddyfi Community Renewables bought a second hand 75 kilowatt Danish wind turbine, installed it itself, and sells electricity to CAT (Slide 39). And there is a new machine about to be purchased, much larger at 500kW. This is the next development. You can start off small to see whether you can do it. If you succeed, go up to something bigger, so that after that you can carry on, but always stay in the area. And the profits from this new enterprise do not leave the area.

This is the 75kW machine (Slide 40). There was a great festival to celebrate its commissioning. Local children painted the tower. They painted the windmill

well, I think. On the bottom left you see the name of the machine. "Pwer Pobl" means 'people's power.'

Hereon the right are the shareholders waving their share certificates. They are not just wild-eyed radicals from the cities. It is everybody, local farmers, shopkeepers, officials, retired people. It is a complete cross-section of the community who own this machine now.

My conclusions are that in the right conditions social enterprises can out-perform conventional ones (Slide 41). CAT, for example, is the largest enterprise in the area by a very large margin. And a successful social enterprise can stimulate further activities in the surrounding community. What is surprising in these cases is that *culture* comes first, and economic development follows. The cultural changes probably have the greatest long-term significance.

Thank you very much.

LOCAL WIND-POWER DEVELOPMENT ENTERPRISE

- 'Bro Ddyfi Community Renewables Ltd'
- 59 shareholders, some institutional
- Bought, installed, and maintain a 75kW turbine
- All power purchased by CAT, surplus sold to grid
- Now planning a 500kW machine

Month	V17 production (kWh)	CAT elec. Usage (kWh)
Mar	~1000	~1000
Apr	~3500	~3500
May	~8500	~3500
Jun	~7500	~4000
Jul	~5500	~4000
Aug	~4500	~5500
Sep	~4000	~6500
Oct	~13000	~7500

The machine usually produces more than CAT needs

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COMMISSIONING FESTIVAL

Children painting the tower

Shareholders with their share certificates, celebrating the first such project in the UK

(Slide 40)

CONCLUSIONS

- In the right conditions it is possible for social enterprises to out-perform conventional ones
- They can stimulate further social and economic development in the surrounding community
- The cultural changes are prior to the economic developments, and probably have a greater long-term significance

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(Slide 41)

Keynote Speech 2

Businesses and Eco Services of a Sustainable Society –Present State and Future Outlook in Europe, USA and Japan–

Institute of Industrial Science, University of Tokyo
Ryoichi Yamamoto

As you just heard, I am Ryoichi Yamamoto of the University of Tokyo. Since we already heard about how eco services and PSS should develop in the future from Prof. Gunjima, I will be talking about how to solve the problems we face under the theme of "Businesses and Eco Services in a Sustainable Society".

Let me begin by saying, as Prof. Naito emphasized, correct strategies and policies are the most important factors for gaining a comprehensive understanding of the present state of the planet and completely resolving problems.

I would first like to introduce two books. One is "State of the Village Report" (Slide 1). It gives a static view of the world as if the world were a village of 100 people. In this 100-person village, 57 people are Asian, but the 6 Americans own 59% of all wealth, which tells of the frightening disparity between the rich and the poor. It also shines light on the fact that within the poor, there are a large number of people who are on the edge of starvation.

Over time, this planet we live on has gone through great changes. Last year, I edited a book entitled "Global Change in One Second", which was published by Diamond, Inc. (Slide 2). It introduces 60 instances, for example, in 60 seconds, 390,000 m² or 760 ton of coal gas, which is equivalent to about 32 gymnasiums,

If the world were a village of 100 people

by Donella H. Meadows

If we could shrink the earth's population to a village of precisely 100 people, with all the existing human rations remaining the same, it would look something like the following:

There would be

- 57 Asians
- 21 Europeans
- 14 from the Western Hemisphere, both north and south; and
- 8 Africans
- 52 would be female
- 48 would be male
- 70 would be non-white
- 30 would be white
- 70 would be non-Christian
- 30 would be Christian
- 89 would be heterosexual
- 11 would be homosexual
- 6 people would possess 59% of the entire world's wealth,

(Slide 1)

is released from the combustion of fossil fuels. Right now, there are 3 trillion ton of carbon gas in the atmosphere, but 12 billion tons are added every year. At the same time, the amount of oxygen in the atmosphere decreases by 710 tons every second. Population increases by 2.4 people every second or 200,000 a day. Put simply,

Global Chang in One Second

edited by Ryoichi YAMAMOTO (DIAMOND Co. 2003)

Per second ·····

- **390,000 cubic meters of CO2 are emitted,**
- **1,629 cubic meters of glaciers in Greenland melt,**
- **710 tons of oxygen are decreasing from the atmosphere,**
- **2,300 square meters of arable land disappear,**
- **3 cattle, 7 pigs and 1,100 chickens are consumed, the meat production sums up to 6.9 tons,**
- **5100 square meters of natural forest disappear**
- **1.3 motorcars, 4.2 television are produced,**
- **532 peoples go to Macdonald and consume more than 500 hamburgers,**
- **population increases by 2.4 persons (200,000 persons per day), ···**

(Slide 2)

the air is gradually getting heavier. This is because oxygen is decreasing and carbon gas is increasing, which lead to increasing in air pressure. Moreover, because oxygen levels are decreasing, it is gradually getting harder to breathe. In addition, because of global warming, it is gradually getting warmer.

This is the state of our planet. We are living in very changing times. Let me illustrate this a little bit. World super power, the USA, does not listen to the rest of the world and continues to consume large quantities of resources and energy as they place priority on economic growth. China and India also have begun an unstoppable onslaught that prioritizes economic growth, as they want to be more and more like the USA.

I have been to China 32 times in the past 21 years and served as a visiting professor at 30 universities including Lanzhou University. In places where economic growth is prioritized, it is prioritized on all levels from the scholars and politicians to the people. Even renowned economist and advisor to Chinese President Hu Jintao, Lin Inin of Peking University, says China's current annual growth of 9% will continue on after the Beijing Olympics and the Shanghai Expo. That means massive amounts of energy and resources will be consumed.

Amidst all of this, the problem is how to persuade these environmental emitting giants, the USA and China. As we question Japan's national strategy and vision, what I believe the importance is not to aim at being just an economic power but an ecological economic power. And that, by becoming an ecological super power, Japan could convey its vision and message to the world. As Samuel Huntington says, Japan is not an isolated civilization and should strive to be an ecological

economic power that the entire world would support.

In that sense, it is a wonderful blessing that the IGES Kansai Research Center has taken up this theme. I hope they can develop a strategy that can persuade the USA and China, and turn Japan into an ecological economic super power that does not live in isolation but which has the sympathy and support of the world. For example, as soon as you walk into the lobby of the hotel next door, you see written there "Let's go to Universal Studios Japan", but that is precisely what the trouble is. Dr. Harper's Centre for Alternative Technology (CAT) is more like the Ecological Studio Wales. Since I heard that, I have been wishing that they would build an Ecological Studios Japan in the Kansai.

Now for my strategy. Here, I think it is important to know the history. If you read your history, you will find that Japan's religious revolution took place 700 years before Europe's. This was written in the book "Buddhism and Capitalism" by Hideo Osabe. In construction of Todai-ji Temple, a monk named Gyoki, who rose to the highest position later, moved mass of soil and material. I see this "moving of the masses" as massive ecological action. As long as we do not start an ecological movement, we cannot solve the problems we face. The reason why Gyoki was successfully was, according to Osabe, that he thoroughly developed the argument of Heaven and Hell in Japan. We should learn from this example. In other words, residents and business leaders should tell and talk with the politicians in real, clear and scientific terms that today's business-as-usual business model and our technologies and lifestyles are sending us to Hell. We need to speak clearly based on scientific evidence.

I tried making a picture of global warming Hell (Slide 3-5). It paints the Hell as it was conceived by Buddhism in ancient Japan, but all of these pictures can be found on the internet. This is proof of the serious disasters caused by climate changes that are raging the globe.

Whichever photo you look at, you can tell



(Slide 3)

something unusual has happened. We must look straight at the situation and conduct studies and research, and devise policies and strategies.

In just one month, from February to March 2002, a large piece of the Larsen B Ice Shelf in the Antarctica broke off. It was 3,250 km² in area. A scientist from the British polar research station predicted 5 years earlier that a large piece would break off. The ice broke because global warming is progressing rapidly over Antarctica. Because of this, other sudden breaks are predicted in glaciers there because of lost support. According to an article in last month's *Science* magazine, the predictions of researchers are gradually coming true or, in

other words, the migration speed of glaciers will increase 10-fold in a few years. Based on the massive amounts of evidence, I fear that mankind has entered global warming hell. Given that global warming is not a theoretical prediction but the reality of the world, we need to reexamine our industrial, economic and social systems.

The problems here can be understood by looking at the Japanese economy. Japan has an annual GDP of ¥500 trillion. To generate this ¥500 trillion, it takes approximately 2 billion tons of resources and results in the release of 1.32 billion ton of carbon gas and 450 million ton of waste (Slide 6). Accordingly, anyone can figure out that there are only two strategies for sustaining this situation. One is to keep GDP at ¥500 trillion while reducing resource consumption, waste generation

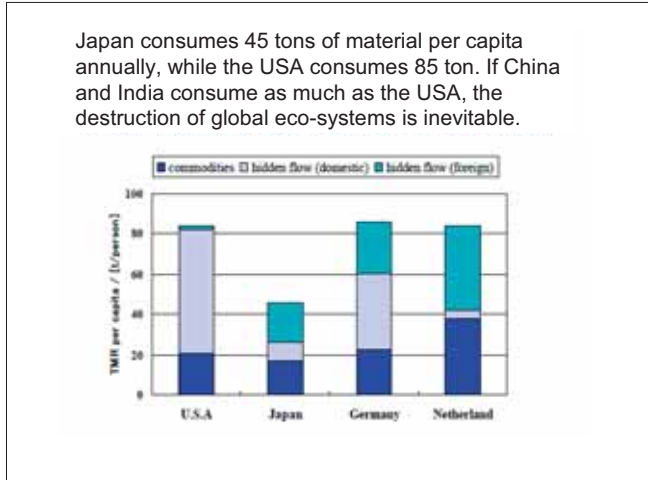


(Slide 4)



(Slide 5)

and carbon gas emissions. This means to increase either resource productivity or eco efficiency. The second strategy is to reduce GDP. Fortunately, GDP is not a true indicator of progress. It is GPI. One person calculated this GPI said it should be about ¥120 trillion, therefore this apparent ¥500 trillion can be lowered to about ¥120 trillion. The way to lower GDP is a "slow life strategy" with which only real affluence is kept while everything unnecessary is eliminated. So, if GDP is lowered, the amount of energy and resources consumed in generating this GDP will naturally decrease and consequently so will the amount of pollutants emitted. These are the two strategies. One is to develop an eco-efficient society while the other is to develop a slow paced society. I believe the biggest issue is the reduction of resource input.



(Slide 6)

Environmental Effect of Materials (Up till material production)

	Eco-indicator 99 (Pre, Holland) (milli-point/kg)	MI (Wuppertal institute, Germany) (Kg/kg)
Iron ore	100	7
Aluminum (Virgin)	790	85
Aluminum (Recycled)	74	3.5
Copper (Virgin)	1,400	500
Copper (Recycled)	-	10
Lead (50% recycled)	580	16
Platinum (Virgin)	3,700,000	320,000
Zn (Virgin)	3,100	23
HDPE	350	5.4
LDPE	390	-
PVC	300	8
EPDM rubber	380	5
Paper (Wrapping paper)	96	15
PET	480	-
Cement		3.2
Flat glass		3
Ti		1,000
Ag		7,500
Au		540,000

(Slide 7)

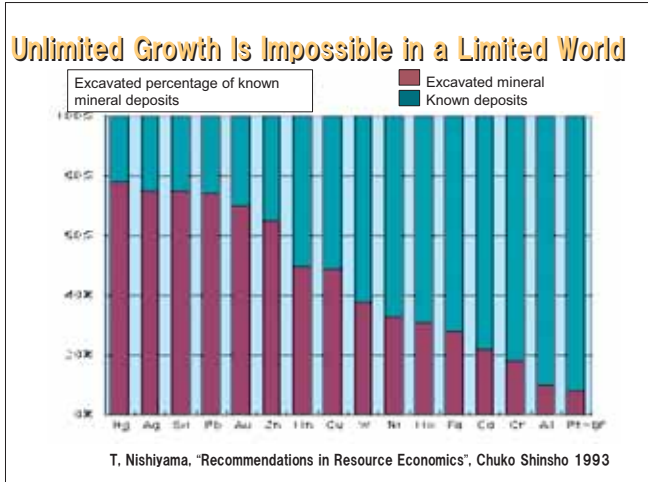
Here, a question is how to indicate the effects that materials have on the environment. One method is analysis based on LCA, while another is the Ecological Rucksack advocated by the Wuppertal Institute (Slide 7). It is known that resource input comes far more as indirect input than direct input. I believe we, scientific engineers, should increase resource productivity and eco efficiency.

In particular, we must reduce our dependency on non-renewable resources. Many nonferrous and ferrous metals such as high-grade iron ore may be completely depleted during this century. In particular, the depleted state of zinc and copper is

progressing (Slide 8). At an international conference in Shanghai two weeks before, Prof. Graedel of Yale University concluded that zinc could be depleted as early as 30 years from now.

On this point, decoupling is a global topic (Slide 9). It is the prime target of the social and natural sciences to decouple economic growth from the increase in environmental load. Nonetheless, the report of the Swedish Environmental Advisors Council concluded that there is not a single country that has been successful with decoupling in the true meaning of the word. Though there have been limited successes in some places, it has gone only as far as improving emission factors, so if the economy grows, the effect on the environment increases.

So, what kind of economy should we aim for? We must change from the old industrial economy of mass-production, mass-consumption and mass-generation of waste to a new knowledge-intensive service economy (Slide 10).



(Slide 8)

Decoupling

Report of the Swedish Environmental Advisors Council (2002.2)

Conclusions

(1) CO2 emissions increased in most countries in the survey period.

At US 225 MtonC/yr (1998), this is roughly equivalent to the emissions of all of Africa.

Emissions in Brazil, China and India increased 325 MtonC/yr in the survey period.

(2) A slight decoupling of CO2 emissions from GDP was noticed. (1970~1998)

EU: 2.1%/yr, Japan and USA: 1.8%/yr, China: 3.2%/yr

CO2 emissions in India increased 1.4%/yr of GDP.

(3) Obvious decoupling with regards to materials was not observed.

Plastic and aluminum rose more rapidly than GDP. Other materials, such as paper, increased at same rate as GDP.

However, iron increased slower than GDP.

(4) Materials that accumulate in society continue to increase in quantity.

(5) SO2, designated CFCs and other substances rapidly decreased in industrially advanced nations.

(6) No clear tendency towards decrease was seen with toxic chemicals and waste.

(7) Policy-makers should prioritize the dematerialization on problematic substances.

(Slide 9)

From an Industrial Economy to Service Economy

- Emphasize the usage value of products more than the exchange value.
- Emphasize the maximized effective use of products.
- Maximize system functions over the long-term.
- Change manufacturers business models from selling products to selling functionality, performance and benefits.
- Products are an opportunity to provide service. Service is the ultimate luxury.
- From ownership to service benefits, from ownership to usage.
- From an economy that emphasizes "commodity" consumption to one that emphasizes "service" consumption.
- Reduce environmental load using IT (Information Technology). Develop high quality digital assets.
- Build high quality public assets (education, medical care, security, parks, recreation, etc.).
- Greening the taxes and .

(Slide 10)

This idea has gained world-wide consensus. So, what can be done to attain this? One way is, as Prof. Gunjima already mentioned, to complete revamp the way products are designed, produced and distributed into environment-friendly systems and practices. A second way is to go the servicizing route of utilizing services rather than products. A third way is to use IT, information technology. A fourth way is to diffuse high quality public assets or, in other words, to manage things everyone uses to note education, medical care, security, parks, recreation, etc. Then, we must reduce the amount of resources, energy and land we use on the whole. Lastly, taxes and funding must be thoroughly reexamined from an ecological perspective. The entire world is pretty much agreed with these approaches.

So, what kind of strategies are there? In scientific engineering, there are three thinkable strategies: dematerialization, use of alternative materials, and decarbonization (Slide 11).

Strategy for Drastic Improvement in Environmental Efficiency and Resource Productivity

- De-materialization (or reduction of material quantity)
 - Resource and energy conservation
 - Longer lasting, servicing, reuse, recycling
 - Zero emissions
 - Switch to service (From products to service)
 - Use of IT
 - Reduction in land usage
- Alternative materials
 - Switch to abundant resources
 - Switch to recyclable resources
 - Switch to materials of lower toxicity
- Decarbonization
 - Switch to energy source of high heat value per carbon content
 - Switch to energy source that does not cause global warming

(Slide 11)

Eco-efficiency

1. Reduce the material intensity of products and services.
2. Reduce the energy intensity of products and services.
3. Reduce the release of toxic materials.
4. Increase the recycle possibilities of materials.
5. Maximize the sustainable use of recyclable resources.
6. Increase the durability of products.
7. Increase the service intensity of products.

The Business Link to Sustainable Development,
by L. DeSimone and F. Popoff (WBCSD)
The MIT Press (London, 1997)

(Slide 12)

Factor 4

At present, OECD nations, which account for only 20% of the world population, consume 80% of the resources and energy. 20% of the poorer nations consume 1%.

To correct this huge discrepancy, resource productivity should be increased 4x (80/20 = 4x) and OECD nations should decrease consumption to 1/4.

$$\text{Resource productivity} = \frac{\text{Product performance}}{\text{Material intensity}}$$

$$1 = \frac{1}{1} \longrightarrow 4 = \frac{2}{1/2}$$

Factor 4 can be attained by halving material intensity (or its environmental effect) and doubling performance.

(Weizsaecker, Amory Lovins)

(Slide 13)

Eco efficiency is a new concept that was advocated at the Rio Summit of 1992 (Slide 12). It means "ecological economic efficiency". No one is against an increase in eco efficiency.

The problem is by how much should it increase. An easy way to look at this is the "Factor 4" concept advocated by Ernst von Weizsaecker and Amory Lovins (Slide 13). The idea is to halve resource and energy consumption, while doubling product performance, to create a factor 4. The industrialized nations should be making a concerted effort to enhance productivity by a factor 4.

There are many examples of development of this concept (Slide 14).

However, Professor Schmidt-Bleek advocates a factor 10, meaning to enhance the effective use of resources 10-fold across all of society, because a factor 4 will be insufficient by the year 2050 (Slide 15).

There have been other ideas after that as well. One was factor 16 which says we

There Are Many Existing Technologies for Enhancing Energy Efficiency and Resource Efficiency by 4x (Factor 4)

- **Hyper vehicle of extremely high mileage**
- **Rocky Mountain Institute as a model of completely bio-office building**
- **Low energy apartment building built in Darmstadt**
- **Low energy lighting**
- **Chemical rental services by rental chemical companies**
- **Drip irrigation that is successful in deserts**
- **Newly designed "Freer" refrigerator -- Refrigerator for replacing freezers**
- **Video-conferencing to economize business travel**
- **Public transportation policy in Curitiba**
- **Vehicle sharing system**
- **California home with natural air conditioning in summer**

Ref: Factor 4, Weizsaecker & Lovins, translated by Sasaki (Energy Conservation Center, 1998)

(Slide 14)

Factor 10 and Factor 20

$$\text{Environmental impact} = \text{Population} \times \frac{\text{GDP}}{\text{Population}} \times \frac{\text{Environmental impact}}{\text{GDP}}$$

- 1 (1990) = 1 X 1 X 1
- 1 (2050) = 2 X 5 X 1/10 (Factor 10)
- 1/2 (2050) = 2 X 5 X 1/20 (Factor 20)

Environmental impact ∝ Resource intensity

$$\frac{\text{GDP}}{\text{Environmental impact}} \approx \frac{\text{GDP}}{\text{Resource intensity}} = \text{Resource productivity}$$

Even if the environmental impact is kept to 1990 levels or half of that, resource productivity must be improved 10x or 20x over.

(Schmidt-Bleek)

(Slide 15)

Factor 16

Explanation by Paul Ekins

Commoner-Ehrlich equation

$$I = P \cdot C \cdot T$$

I = Environmental impact (Ex. Emissions (ton))

P = Population

C = Consumption per capita (Ex. GDP)

T = Environmental impact per unit of consumption (Emission/GDP)

The challenge up until 2050 must be T = 1/16 x (16x the resource productivity) based on

I = 1/2x (for sustainability), P = 2x and C = 4x (GDP growing at 2~3%/year).

(Slide 16)

must increase the effective use of resources 16 times over (Slide 16). Using $I=P \cdot C \cdot T$ of the Commoner-Ehrlich equation, it is necessary to enhance resource productivity 16-fold for the reasons shown in the slide.

The same 16 times results when we use statistical data (Slide 17).

However, European researchers have not even touched upon how China and India should prolong their resource consumption. In contrast, I proposed five years ago a shift to a sustainable economy by having industrialized nations decreasing consumption to one-eighth and developing nations double their resource consumption, based on the thought that the advanced industrialized world is 40% over the sustainable level of consumption (Slide 18).

Incidentally, the latest data from ecological footprint analysis was announced this year (Slide 19). This ecological footprint or required biological productive area was calculated for 138 countries,

Factor 16

*J.M. Crower and A.c
Product Innovation and Eco-efficiency (Kluwer Academic Publishers, 1998)*

Environmental impact
= (Population) × (Consumption per capita [\$]) × (Impact per unit of consumption)

In a comparison of 1990 and 2040, if we assume the estimated population in 2040 and the consumption per capita (GDP) to be US\$35,000, and the impact per unit of consumption to be 1, the total environmental impact for 1990 and 2040 will be 20.75 and 329.18, respectively. Accordingly, to maintain the total environmental impact at that same level, it will be necessary to increase the impact per unit of consumption in 2040 by 0.06x or increase GDP per unit of impact (resource productivity) by 16x (Factor 16).
Some believe that a GDP of US\$13,000 is sufficient (increases above this would not improve social well-being). If all countries had a GDP per capita of US\$13,000 in 2040, the target can be attained by improving resource productivity by Factor 6.

(Slide 17)

Calculation of magnitude of dematerialization by Yamamoto

B/A=16 Current ratio of annual resource consumption per capita of developing nations A and industrialized nations (Ref.: Data that indicates industrialized nations have 20% of world population yet consume 80% of the world's energy resources)

At present, the economy cannot be sustained. **48A+12B=1.4S** Resource consumption of all mankind exceeds the sustainable level by 40%.

(Ref.: Ecological footprint analysis, sustainable energy analysis)

Enable economic sustainability by 2050. **78C+12C=S** The population in developing nations is predicted to grow by 3billion. Annual resource consumption (C) is presumed to be the same between the northern and southern hemispheres in 2050 based on the principle of equality.

$C/A = 240/126 \sim 2$

By increasing consumption 2x, developing nations can switch to a sustainable economy.

$C/B = 15/126 \sim 1/8$

By reducing consumption to 1/8, industrially advanced nations can switch to a sustainable economy.

(Slide 18)

Factor 5

Ryoichi Yamamoto, 2004

EF=Ecological Footprint in 2000

A Ecological footprint per capita in non-OECD nation (1.4 ha)

B Ecological footprint per capita in OECD nation (5.5 ha)

C Ecological footprint per capita in 2050 (Assuming the same level in non-OECD and OECD nations)

B=4A.....OECD nations use 4x the "environmental area" per capita of non-OECD nations.

$$\frac{C}{A} = \frac{91}{105.6} = 0.86, \quad \frac{C}{B} = 0.21 \sim \frac{1}{5}$$

47A+11B=1.2S.....20% over at present

77C+11C=S.....Reduce to sustainable level by 2050.

Non-OECD nations must reduce their EF by 24%. (It is necessary to increase resource productivity and environmental efficiency greater than OECD nations.)

OECD nations must reduce their EF to 1/5. (Factor 5 increase in resource productivity required.)

*ref. Ecological Footprint of Nations(2004)
Dr. J. Ventouille, D. Chazan and C. Gaudet
Redefining Progress(WWW.Redefining Progress.org)*

(Slide 19)

but the results of secondary calculations done with the latest data are frightening. Assuming the same ecological footprint per person or, in other words, when calculated on equal terms, by the year 2050, China and India must reduce their ecological footprint by 14% and advanced industrialized nations must reduce theirs by 80%. So, a factor of 5 would be good. What this simple calculation means is that developing nations such as China and India are using massive amounts of energy and resources inefficiently. Furthermore, if the population of Asia grows to 3 billion or more, for these two reasons, developing nations and non-OECD nations will have absolutely no room to increase their ecological footprint; instead, they will have to reduce it.

Here, the dematerialization of the industrialized world is very important, but as long as the resource productivity and eco efficiency of developing nations like China and India is not greatly improved, sustainable development on the global scale will be no more than a pie in the sky (Slide 20).

Sweden analyzed the possibility of a factor 10 by industries and concluded that it was sufficiently possible in many industrial sectors (Slide 21).

In a nutshell, we must shift from a disposable economy to a recycle-oriented economy and further yet to a sustainable economy (Slide 22). In the process, all society in OECD nations in particular must set improvement targets of a factor 10 by 2010 and a factor 20 by 2050, over 1990

"Industrialized Nations Must Greatly Reduce Material Consumption"

Researcher	Environmental efficiency and resource efficiency factor	Industrially advanced nation	Developing nation
Welzsäker	4	1/4	Not disclosed
Schmidt-Bleek	10	1/10	Not disclosed
Cramer&Tukker	16	1/16	Not disclosed
Weterings&Opshchoor	20	1/20	Not disclosed
Yamamoto	8	1/8	2

Statement On the pretext that annual resource consumption per capita is the same between industrialized nations and developing nations (principle of equality), environmental efficiency must be improved about 10x (Factor 10) at least in order to sustain the world. Targeting factor 10 in technology and system development would not be a mistake as an international competition strategy.

(Slide 20)

"The Possibility of a Factor 10 in Swedish Industry Was Investigated"

Industrial sector	Factor 10 possibility
Forestry	Low
Agriculture, food	High
Chemical, medicine	Very high
Steel	Low
Semiconductor	Extremely high
Machine	Sufficient
Energy, land, water supply	High
Transport, communication	Low
Waste	Sufficient

Ref.: Johanna Jones

Statement ... Japan should also investigate the possibility of improving environmental efficiency and resource productivity by industry and reflect findings in policy.

(Slide 21)

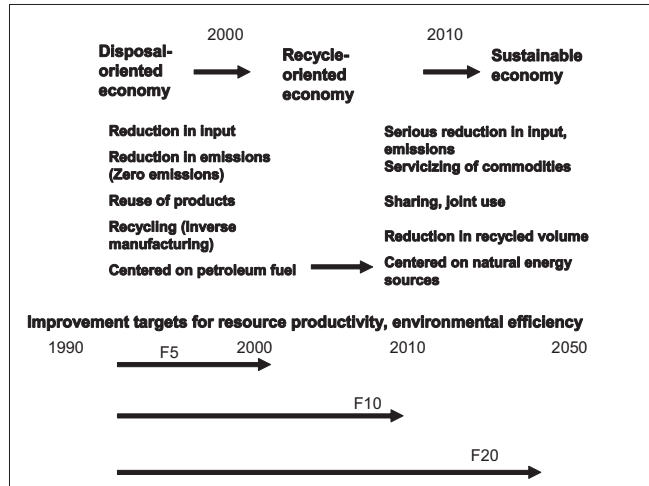
levels, for resource productivity and eco efficiency. However, the previous calculations gave a factor of 5 by 2050, therefore it will not be necessary to attain a factor of 10.

Here, the keyword is eco design, that is to say, how much ecological design is applied (Slide 23).

Eco design looks at the entire life cycle of a product, therefore it is also known as "Life Cycle Design" and "Life Cycle Engineering" (Slide 24).

Eco design is developed in four stages (Slide 25). Put simply, it is divided into two stages: that which improves eco efficiency and that which changes social systems. Technology is developed to improve eco efficiency, but the next stage requires sustainable technology. PSS and eco services are amongst the main targets of this sustainable technology.

Many eco products have been developed in Japan (Slide 26). Those related to functional innovation and system innovation in particular including the PSS and eco



(Slide 22)

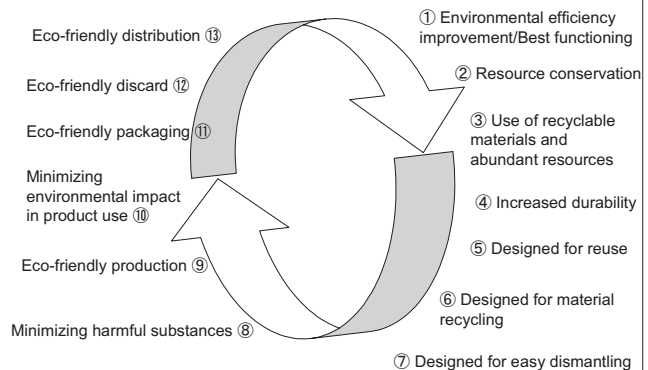
Overcome Obstacles of Material Elimination with Eco Design

- Many industrial products are made directly for users or in relation to user size. Size cannot be freely reduced.
 Ex.: Notebooks, desks, chairs, PCs, PDAs, keyboards, cell phones, housing, vehicles, trains, TVs, roads, traffic signals, etc. ...
 Ref.: Industrial Ecology, Graedel & Allenby (translated by Goto, Toppan)
- Eco design: Maximize environmental efficiency (energy efficiency and resource efficiency) over entire lifecycle of product.
 Resource conservation, energy conservation, longer-lasting durability, easy to repair, easy functional expansion, product reuse (remanufacturing), recycling, heat energy recovery, timeless design
- Alternatives via product services (Leasing, sharing, etc.)
- Zero emissions on various scales

Eco design will support technical competitiveness in the 21st century.

(Slide 23)

Eco Design=Lifecycle Design=Lifecycle Engineering

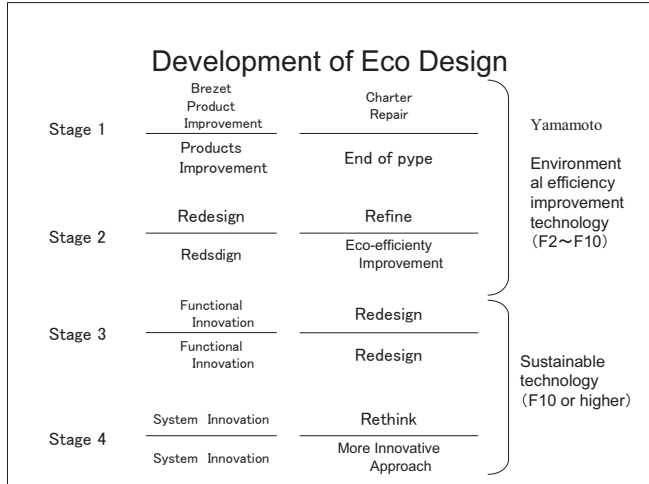


(Slide 24)

services were introduced at the international workshop yesterday.

Why is it good for society to spread eco products and eco services? A home appliance manufacturer in Sweden named Electrolux developed a software program called "Eco Eco Savings" that calculates the benefit (Slide 27). In short, diffusing eco efficient services throughout society generates large financial profits and reduces environmental burdens at the same time. For example, in London, EUR 2.2 billion can be saved every year, while reducing carbon gas emissions by 12.07 million ton. Moreover, it was calculated that water-savings equal to one day and six hours of flow off Niagara Falls are possible.

Now, I would like to talk about one of today's topics, business model innovation using PSS (Slide 28). I specialize in metals and the biggest surprise I ever had was the rental molecular business of the Dow Chemical Company. The idea is not to rent out cars but molecules.



(Slide 25)

Already Many Eco Products Have Been Developed in Japan

- **Product improvement**
Mg alloy TV, green cabling, centrifugal washing machine, Eco Ice mini, TULC 700 Series Nozomi, 209 Series Commuter Train, energy-saving long-life fluorescent lamp, energy-saving notebook computer, high insulation vacuum glass BJ printer, EcoKaratto, halogen-free printed board, chrome-free galvanized steel, TSOP, super long-life printer
- **Redesign**
LCD TV, hand-powered radio, hybrid vehicle, eco cement, heat-powered wristwatch, auto-powered wristwatch, high productivity copier, natural heating system for future communal housing, light bulb-size fluorescent lamp
- **Functional innovation**
Paper recycle system, super smooth no-stick toilet, portable foot-pumped generator, eco fund, wind power
- **System innovation**
Rental electric vacuum cleaner, zero emission beer brewery, local transport system (ICVS), package-free music transmission system

These eco products must diffuse rapidly in the society.

(Slide 26)

EcoEco Savings

(Comparison of annual environmental savings potential assuming best environmental efficiency product by Electrolux and current situation www.electrolux.com)

	Economic savings (•1 billion)	Energy savings (TWh)	CO ₂ emissions (10,000 ton)	Water conservation (1 million ton) (Flow rate of Niagara Falls)	
London	2.2	17	1207	216.7	1 day 6 hr
Greece	0.2	1.9	213	52.9	7 hr 21 min
Spain	1.3	7.1	386	241.6	1 day 9 hr
Czech	0.068	1.1	65	56.9	7 hr 55 min

(Slide 27)

With metals, they will have to go as far as the atomic level to the rental atom business.

There are still other developments. First of all, Pré of the Netherlands classified PSS into four categories: (1) adding services to products, (2) adding products to services, (3) fulfilling needs with an equal balance of products and services, and (4) system change (Slide 29).

In contrast, Ezio Manzini of the Politecnico di Milano classified PSS into (1) services providing added value to products, (2) services providing final result, and (3) services providing enabling platforms (Slide 30). This last one is an original idea of Manzini's. I don't have enough time to go in details, but releasing and enabling are very important concepts. Before, products were developed to eliminate the hardships of life, but that placed a serious load on the environment. Here, Manzini's idea does not completely eradicate the hardships; instead, it proposes product design and service design as the means for solving

Innovate Business Models to Build Sustainable Service Systems

- Rental molecular business by Dow Chemical/BioSafe (Rental of organic substances)
- Oil quality management of Exxon Mobil
- Washing machine leasing by Electrolux (Pay per Wash)
- Copier rebuilding using used copier parts by Xerox (Remanufacturing)
- Quality control service for ceramic valves in rolling system by Vulcan
- Carpet leasing by Interface
- Chemical quality management by Ashland
- Lubricant management by Castrol
- ESCO by Eastern Energy (Turnkey services for energy conservation)
- Furniture package leasing by Gispen
- Furniture remanufacture by Renew
- Car sharing by Statauto (Berlin)

(Slide 28)

Categories of Product - Service Systems (Pre Project, Holland)

Ps (Products that come with added service)

Service is provided when the product is delivered.

- ① Reserved purchasing of organic vegetables by ODIN

Services provided at the end of product life are determined in the product specifications.

- ② Layout planning, estimates and recovery services for EPS building insulation by Stybencz

Services provided at the end of product life are determined in the product specifications.

- ③ Hotel office services and general furnishing service that includes office furniture by Gispen

Sp (Services that come with added products)

Products provided by service providers

- ④ GMS cell phone service by Liberter. Cell phones are provided free to subscribers.

PS (When products and services are equally weighted in order to satisfy specific needs)

That which provides products, auxiliary equipment, content and services in order to completely satisfy the client

- ⑤ Coffee System International by Douwe Egberts ⑥ Modern washing machine leasing service by Electrolux

Part-time use, part-time ownership of products Part-time use of products, product sharing

- ⑦ Car sharing service by Greenwheels

- ⑧ Time-share of luxury yachts

Functional use of products, non-ownership

- ⑨ Coin laundry (self-service) by Electrolux

SC (System changes)

From coin-based to electronic distribution ⑩ Chipper Card by Postbank

From agrochemical sales to sales of disease/insect-free guarantees

- ⑪ Biological disease and insect extermination management by Koppert

(Slide 29)

Ezio Manzini Politecnico di Milano

PSS Categories

(1) Services that add value to products

Ex. S.A.T.E. mobile chemical lab by Kluber

Changed from simple sales of lubricants to system sales of quality maintenance, plant management, etc.

Ex. Casa Quick by Allegrini

Detergent sale by weight service that periodically visits home by mobile van

(2) Services that provide final result

Ex. Solar Heat Service by AMG

Service that provides hot water using solar power or methane. Billed according to consumption of hot water (kWh).

(3) Services that provide enabling platforms

Ex. Digodream (textile flooring) by Diddi&Gori

Provides complete services --design, equipment supply, recovery and recycling -- for textile flooring via tradeshows. Users purchase the benefit (utility).

(Slide 30)

problems. Take an earthquake for example. We could design and build a house to withstand any size of earthquake, but it would require a tremendous amount of money, resources and energy. Therefore, the idea is to build a home to withstand the first ten minutes of a magnitude 8 quake, during which time the homeowner can flee. This saves resources and energy.

This is a "Pay per Wash" project (Slide 31).

Last year, UNEP published a report on PSS. The idea is spreading around the world (Slide 32).

Let me say something about eco services in Japan (Slide 33). Research and development in this area have been active over the past four or five years. I myself published a book entitled "Sustainable Company" in which I classify and present 76 examples of sustainable business practices in Japan. However, Japan's eco services have not yet been analyzed in terms of profitability, social importance and the improvement in environmental

"Pay per Wash" Project

Electrolux, Sweden

Rather than sell washing machines, Electrolux sells wash time.

10 SEK/wash, ~ 1 kWh / wash

7,000 washing machines were lent free-of-charge to families in Gotland.

The washing machine's "Smart Energy Meter" is linked to the company's central database over the internet.

Families know how much they used the washing machine by electronic billing.

After 1,000 wash cycles (about 4 ~ 5 years for the average family), washing machines are upgraded or replaced. As a result, many families reported that their washing became highly efficient.

(Slide 31)

Features of Product Sales and Function Sales

(Source: PSS Report, UNEP)

Traditional product sales (Sales of tangible products)	Innovative alternative: Product Service System (Sales of function)	
The consumer purchases a vacuum cleaner to clean the home or office.	The consumer rents a vacuum cleaner.	The consumer purchases a service from a company that cleans houses. (The company determines machines and methods according to consumer demands.)
The consumer owns, uses and stores the vacuum cleaner. The consumer is responsible for vacuum cleaner maintenance and cleaning quality.	The company owns the vacuum cleaner and is responsible for maintenance. The consumer cleans the house and is responsible for cleaning quality.	The company owns, maintains and stores all cleaning equipment including the vacuum cleaner. The company is responsible for cleaning quality.
Initial costs are rather high for the consumer.	Consumer costs are spaced out over time.	Consumer costs are spaced out over time.
The consumer eventually discards the vacuum cleaner and purchases another.	Because the company is responsible for discarding the vacuum cleaner, there is incentive to pursue a long-lasting or recyclable design.	Because the company is responsible for discarding the vacuum cleaner, there is incentive to pursue a long-lasting or recyclable design.

(Slide 32)

Example Eco Services in Japan

Komatsu Forklift	Servicing of used forklifts	Big Wave	Information system of recycled parts for vehicle servicing
Citizen	Free servicing of natural trouble for 10 years from purchase	FootCall	Sales of "Call a Car"
Osaka-Nishikawa	Reforming of down futons	Sumitomo Realty & Development	Shinichiku Sokkurisan (Home renovation)
Fuji Photo Film	Reuse and recycling of Utsurundesu	Mitsuba	Order-made renovation
Fuji Xerox	Product reuse, global asset management	Toil	Carpet cleaning
Kokuyo	OSC (Centralized management of ecological office supplies)	Hitachi	ESCO
Am/pm Japan	Buy-back of electric products	Japan Natural Energy	Green power certification system
Catalog House	Servicing, reuse and recycling	Tokio Marine & Fire Insurance	Business package insurance, green fire insurance, etc.
Odyssey Technos	Electronic trading in industrial waste in West Japan	Sompo Japan	ESCO general insurance
Duskin	Leasing of mops, mats and electric vacuum cleaners	E-Square	Eco City 21 (Electronic trading of eco products)
Hiblya Kadan	Leasing of natural and artificial plants	Nippon Express	Effective collection and delivery by truck-mounted terminal
Itoki	Leasing and refurbishing of furniture	Fujita	Photo Road method
		Kobe Ecopassal Research Institute	Leasing of eco vehicles

(Slide 33)

burdens. Because of that, my lab gained the cooperation of many businesses so that we could do life cycle assessments on several PSS.

My conclusions are the same as Professor Gunjima's. Ultimately we must develop a sustainable society, or a sustainable economy. The question is: in order to achieve that, how these PSS should be utilized? As I mentioned earlier, the Japanese economy consumes 2 billion tons of resources, releases 1.32 billion tons of carbon gas and generates 450 million tons of waste in producing a GDP of ¥500 trillion. This is a far cry from an ecological super power. How well eco services, PSS, zero emissions and the similar concepts are used will be important.

I would like to say something about the CAT that Dr. Harper talked about earlier. I think it is an excellent example and offers much for us to learn from. It needs to be analyzed from both sides. One thing is that no one would agree to a simple way of life or an ecological way of life that keeps them in poor living conditions. In the end, CAT transformed a poor way of life into an affluent society, therefore most activities turned into education. In this regards, though there may be strategies to increase CAT on the local level, I think we need to resolve problems on the macro level. What needed is massive ecological action. Unless billions of people around the world take action, the problem will never be solved. In short, it would be insufficient if just one or two million people in Japan did something; the problem will not be solved unless tens of millions of people take action. To do this, I like to think that this picture of Heaven and Hell is important.

This concludes my presentation. Thank you for your attention.