Matsushita Sustainability Report

–TV's and Refrigerators–

The Natural Step
2002

Contents

Executive Summary

TV

Matsushita has reached far – probably providing a benchmark for the rest of the world – when it comes to the dematerialization aspects of TV's in the modern industrialized society. This goes for lean production, compact and light materials, energy efficient end-product, and "pre-cycling" i.e. preparing TV's for recycling already at the production level. A very proactive and promising practice of Matsushita is their offer to customers to have their TV's repaired. Due to today's distorted relationships between labor-costs on the one hand, and costs on resources on the other, it is difficult to get pay-offs from repair. However, there is no doubt that the economical as well as ecological potentials for the future of saving resources from repairing is great, and to that end Matsushita's initiative is a truly good example for the rest of the world. The issues below remain critical aspects from a sustainability perspective. It is important to state, that though many of those aspects will inherently need many years until they are finally solved in concrete terms, it is mandatory that they are – as soon as possible – made part of top-executive planning of Matsushita. Since most industrial companies are far away from sustainability, it is the *top executive empowerment* of the process towards sustainability that is the currently most essential sustainability aspect of a company. To that end it is continuous top executive awareness and planning, encouraged by the fine achievements of Matsushita that have already been reached, that has the greatest potential of improving on Matsushita's present status. These are the main critical aspects:

- To reach far above 55% recycling of TV's, and to obtain so pure fractions that they can be used for new production of TV's.
- To develop more consciousness, and active plans, for TV as an asset to dematerialize the global society at large. It is important that TV is not only regarded as a sustainability problem that needs to be tackled, but also as a potential for sustainability. As it is now, the theoretical potential for TV is acknowledged by Matsushita, but the full potential of laying out strategic plans for the future on this essential aspect of TV must be evaluated by Matsushita top executives.
- To develop more consciousness, and active plans, for the developing world. The future market for IT, taking needs to curb rebound-effects from IT into account, must increase as an *asset* for sustainable development. This awareness may not lead to any immediate actions, but should be made explicit part of Matsushita's long-term executive plans.
- To develop more consciousness, and active plans, for new business models that will support further control of dematerialization as well as substitution aspects of sustainable TV production. If, for instance, the function "TV use at home" is leased to the customer as part of the "intelligent home", this provides an opportunity of a much stronger control of the material flows.

- A lot remains as regards the substitution aspects of Matsushita's TV production. It is good that a number of heavy metals are going to be phased out, including Cd, but new heavy metals are going to be introduced instead of lead, even as alloys which poses extra problems from a sustainability perspective, without any further comments from Matsushita. The switch to Mg needs to be analysed from a sustainability perspective, i.e. with regard to possible side-flows of other elements, the current use of fossil fuels in the mining, the strip-mining perspective, social aspects from the site of extraction, and with regards to the potentials of improvements on those aspects.

- Chemicals need to be analysed from a sustainability perspective – phasing out of chemicals that appear on lists of "dangerous compounds" will not be sufficient in the long run. From a sustainability perspective, all compounds that are persistent and foreign to nature need to be phased out, and to that end a more rigorous analysis of chemicals need to be done.

- The switch to "phosphorous" to replace anti-flammables needs to be critically assessed from a sustainability perspective. PVC – a material that has anti-flammable characteristics in it self, or other future polymers – could be an alternative to adding anti-flammables to flammable plastics such as polyethylene. This is on the condition that the suppliers to Matsushita shares Matsushita's sustainability plans for the future and develop – step by step – in that direction. PVC does not need to be produced from fossil raw materials, PVC does not shed PVC molecules to nature, stabilizers need not be heavy metals in the future, and future PVC need not contain persistent compounds foreign to nature. To use inherently anti-flammable materials may be an advantage in relation to making more complex materials by adding anti-flammables.

- The supply chain is not explicitly mentioned in Matsushita's answers. It should probably be involved more in rigor as regards Matsushita's long-term vision of complying with the system conditions of a sustainable society. Are there any plans to involve suppliers in a dialogue on long-term goals, and to support those suppliers that are going in the same direction as Matsushita? Examples are questions as regards heavy metals, compounds foreign to nature, strip-mining and restoring of natural systems after resource extraction, long term social goals and so on.

- Social sustainability aspects are only indirectly – from the current market perspective – accounted for by Matsushita. From a sustainability perspective, the global societal perspective should be brought into focus from a top-executive perspective. There are, for instance, enormous business opportunities for the future in supporting and cooperating with the developing world, to help them become sustainable, and to help them avoid repeating many of our mistakes

- Though Matsushita has some very good examples on outreach aspects, such as helping customers to save energy, and to help customers get their TV's repaired, it seems that Outreach is a relatively unexploited field where Matsushita could do much more.

Refrigerators

From a sustainability perspective, it is likely that Matsushita has not reached as far for refrigerators as for TV's when it comes to dematerialization aspects. Though refrigerators are made lighter today, it seems that plans for even lighter refrigerators are somewhat immature. Furthermore, more remains to be done until recycling, and preparing refrigerators for recycling, has exhausted its full potential. The issues below present more critical aspects from a sustainability perspective. It is important to state, that though many of those aspects will inherently need many years until they are solved in concrete terms, it is mandatory that they are – as soon as possible – made part of top-executive planning of Matsushita. Since most industrial companies are far away from sustainability, it is the *empowerment* of the process towards sustainability that is the currently most essential sustainability aspect of a company. To that end it is top executive awareness and planning, encouraged by the fine achievements of Matsushita that have already been reached, that has the greatest potential of improving on Matsushita's present status. These are the main critical aspects:

- To recycle all refrigerators, and to obtain so pure fractions that they can be used for new production of refrigerators.
- To develop more consciousness, and active plans, for the developing world. This awareness may not lead to any immediate actions, but should be made explicit part of Matsushita's long-term executive plans.
- To develop more consciousness, and active plans, for new business models that will support further control of dematerialization as well as substitution aspects of sustainable production of refrigerators. If, for instance, the function "cold food at home" is leased to the customer as part of the "intelligent home", this provides an opportunity of a much stronger control of the material flows.
- A lot remains as regards the substitution aspects of Matsushita's production of refrigerators. It is good that Cd has already been phased out, and that a number of other heavy metals are going to be phased out. The use of copper needs to be assessed from a sustainability perspective, and alternatives considered. Cupper is a problem both as regards S.C. I (Cu increasing in sludge for instance, and in water if acidity is high enough), and as regards S.C. IV (economical margins of Cu are decreasing in the world).
- Chemicals need to be analysed from a sustainability perspective – phasing out of chemicals that appear on lists of "dangerous compounds" will not be sufficient in the long run. All compounds that are persistent and foreign to nature need to be phased out, and to that end a more rigorous analysis of chemicals need to be done. Though the new coolant R 600a is a good example of a strategically sound substitution - Isobutan is not a persistent compound foreign to nature – Matsushita need to exert a thorough analysis of all its chemicals in use. -What other chemicals appear in paints, plating etc.?

- Social sustainability aspects are only indirectly – from the current market perspective – accounted for by Matsushita. From a sustainability perspective, the global societal perspective should be brought into focus from a top-executive perspective. There are, for instance, enormous business opportunities for the future in supporting and cooperating with the developing world, to help them become sustainable, and to help them avoid repeating many of our mistakes Though Matsushita has some very good examples on outreach aspects, such as helping customers to save energy, (and to get refrigerators repaired?), it seems that Outreach is a relatively unexploited field where Matsushita could do much more.

Introduction

Why are we doing a Sustainability Analysis on Refrigerators and TV's?

Matsushita™ has a long and proud history of a commitment to excellence, continued learning and improvement in all that they do. This is not only seen in the products they design and produce, but also in the way they do so. Matsushita's dedication to continued environmental improvement is no exception. Building on that commitment, Matsushita contracted The Natural Step™ in 2001 to conduct a Sustainability Analysis™ on the entire company, in order to benchmark themselves against their competitors. Matsushita also wanted to ensure that they were headed in the right direction with regards to their work on environmental improvement and sustainability.

The Natural Step's role is that of an advisor, where they seek to guide Matsushita as together they probe the questions, challenges, and opportunities that come from tackling sustainability in the only way possible: through a structured, methodological approach based on backcasting from scientifically valid principles for sustainability.

The Natural Step Framework™ (TNSF)[1] is the original and unique method that has helped numerous companies successfully navigate the treacherous waters of sustainability, which have formerly been inadequately mapped out by limited Life Cycle Assessments and lost in the complexity of impact and cost-benefit analyses. The strength of the TNSF is that it allows companies to relate today's investments to the vision of where the company wishes to be in the future, in a systematic and sound way. The TNSF is the basis for the Sustainability Analysis™, which Matsushita and The Natural Step will together apply to two of Matsushita's environmental success stories: the TV and refrigerator.

Matsushita succeeded in eliminating the use of CFCs in both the manufacturing and running of their refrigerators, solving one of the biggest environmental problems with today's refrigeration technology. Likewise, they eliminated the use of plasticisers in the polymers used in their televisions- also a known environmental concern. The question Matsushita now finds itself asking is: what more? Is there anything else we can improve upon, and in the process strengthen our company and distinguish ourselves in the market?

The following text outlines the methodology The Natural Step will use with Matsushita to define how to be successful industry and societal leaders in the field of sustainability. There then follows a description of the general format of the Sustainability Analysis, and lastly a series of questions regarding Sustainable Product Development.

[1] The Natural Step Framework[1] is presented at length in Appendix 1

Sustainability Leadership based on the TNS Framework: The ABCD Analysis

A. **A shared mental model**. Leadership towards sustainable business (doing the right things), Management (doing things right), and Tools for monitoring of the transition towards sustainability, should all be aligned with the same overall objective and its principles – Matsushita wants to become a successful sustainable business corporation. To that end, Matsushita's objectives are shared within the corporation, and within project groups in the corporation, so that all essential elements of sustainable development – leadership, management and tools – are supported by the same intellectual structure for strategic progress towards sustainability. To use the game of chess as an example, it is like sharing the principles of checkmate with each other, to get a team that is pulling in the same direction.

B. **Analyzing "today" for Matsushita**. *Current situations* regarding actual projects or products (such as TV and Refrigerators) are analyzed with regard to Matsushita's objectives with respect to sustainability.

    a. *Critical flows and management routines* are listed. The question is: "How does Matsushita, today, violate their own long-term sustainability objectives?

    b. *Assets*, such as previous achievements, and corporate competence, are considered. The question is: "What achievements and competences can we build on to reach our own ultimate objectives?"

C. **Analyzing "tomorrow" for Matsushita.** The future is *the most* essential aspect of making a relevant sustainability analysis for Matsushita today. In a *sustainability analysis*, "today" should be viewed, analyzed, and reported from "tomorrow's" perspective. Yet, this essential point[2] is mostly not considered at all in traditional "sustainability reports". *Visions and possible future measures that can comply with the system conditions are analyzed in a brainstorming activity.* It is important that business people are included – not only technicians and sustainability experts. In this step[3], everything that is theoretically feasible is considered, freeing the mind from current costs and market preferences and other restrictions.

    a. The future market (for services provided by TV's and for Refrigerators), further ahead in the funnel, is considered. The question is: "How is it likely that the market will change in the future, due to the funnel, with regard to service our market (TV's and Refrigerators)?"

    b. Possible flows and management routines and business ideas that can comply with the system conditions are listed. The question is: "How can Matsushita provide this service to people (from TV's and Refrigerators) tomorrow *without* violating its ultimate sustainability objectives?"

D. **Prioritizing measures to make smart business strategies**. Options that follow from the analysis in C are prioritized by three questions. When one answers "yes" for all three questions, this option becomes a high priority for early investing.

[2] C
[3] C

a. Does it move towards complying with all system conditions?

b. Can it be further developed later on, to complete compliance with the system conditions?

c. Is it already a good business idea now, i.e. is it likely to give a good return on investment? (Economic sustainability is different from Social and Ecological sustainability in many ways. Social and Ecological sustainability are future objectives, but Matsushita must be economically sustainable now, and throughout the transition process).

TNSF applied for product development

The A,B,C,D analysis presented above, is applied not only for leadership and management, but also for the developing of all kinds of tools including *product development*. This is the bottom line perspective when it comes to a relevant *sustainability analysis* – how can Matsushita utilize a *sustainability analysis* to strategically improve and develop its lines of production in line with its "ultimate" objectives?

Imagine that Matsushita can, in the future, deliver the *services of its products of service* (e.g. *TV's and Refrigerators) to people* in a way that complies with the its sustainability objectives. From that perspective, the *question* that should guide a relevant sustainability analysis is: "How did the sustainability analysis help us get here?"

The A,B,C,D analysis can be applied in a systematic way[4] when developing new products. It is done by learning and sharing how to inform all five stages of a traditional product development cycle with the A,B,C,D scheme. Below the three relevant stages for the sustainability analysis for Matsushita is described:

1. **Analyzing the market**. This is the broad overview:
    - **a.** "Which services to people is it that the actual product(s) (e.g. TV's and Refrigerators) *in general* (not specifically Matsushita products) are providing?"
    - **b.** "What are the critical flows and management routines that are currently, *and in general*, linked to those type of services from a full life cycle perspective?"
    - **c.** "How could these services – in principle – be provided by Matsushita in a way that will make it easier to comply with the system conditions?"
    - **d.** "What are – in principle – some smart and prioritized ways of moving in that direction?" The result of the market analysis leads to the next step in the product development cycle.
2. **Creating a "principle product".** Produce a sketch of a sustainable product, or products, building on Step 1, above. Scrutinize the sketch in a similar way as in the

[4] Byggeth SH. Integration of Sustainability Aspects in Product Development. Licenciate thesis, Göteborg: Department of Physical Resource Theory, Chalmers University of Technology and University of Gothenburg, Sweden 2001.

first step of the five-step cycle. "What services do the new type(s) of products that we are considering provide, and what are the critical flows and management routines that are likely to be linked to its full life-cycle – from resource extraction through production and transport and use, to final disposal?" Identify large, wasteful and inefficient flows for each Matsushita objective– and dematerialize later on. Furthermore, identify materials and management routines that are particularly problematic under each Matsushita objective. Do this by looking at the need for dematerializations and substitutions respectively, for each system condition:

Dematerializations: Consider large flows such as fossil fuels and large material- and support-flows in production, and all examples of inefficient and wasteful resource management throughout the product life cycle. This includes wasteful management during resource extraction, transports, the supply chain, in the production within Matsushita, and after Matsushita has sold the product.

Substitutions (Transmaterializations): Consider qualitatively critical management routines and flows. Examples are:

Objective I: Heavy non-ferrous metals and various kinds of alloys that are not strictly recycled in pure fractions,

Objective II: Persistent compounds foreign to nature,

Objective III: Materials from poorly managed ecosystems like forests and area-intensive transport systems such as vast road networks and

Objective IV: Socially critical aspects from all kinds of stakeholders including employees, clients, and suppliers, also from other countries, and people who are indirectly influenced by Matsushita decisions – for instance future generations in all countries – are considered.

(C) What possible future steps could improve this situation?

(D) Which of these possible future steps should have a high priority to do now, i.e. steps that can be further improved later on, while being a good business-idea already now? The result leads to the next step in the product development cycle (steps 3 and 4 can just be scanned – they refer to concrete development steps that will follow from the sustainability analysis, and are not included in the template section with questions)**.**

3. **Launching and marketing of the new product(s).** "What are the critical aspects of all the supply-flows and management routines and marketing within society when the product is used large scale – considering the full life-cycle of its societal use? Are there, for instance, infrastructures and recycle routines?" (C) "How can these critical aspects be resolved by future means including cooperation with politicians and various kinds of business partners and institutions in society, and how could Matsushita utilize the new product to create even larger possibilities as regards changing the future market in line with Matsushita's objectives?" (D) Which of these possible future steps can be further improved, while making sufficient business?

In a thorough product development cycle, integrated groups with different competences from the technical sphere, purchase and marketing should participate. The more time

that is spent on the early steps, the smoother will the process be in the subsequent steps. An the same time, for each step, all later steps "should be kept in mind" so that the creativity in each step is fed by the subsequent steps. This means being mindful of preceding design stages, even when being at final product launch and marketing steps.

Templates

This section contains the questions to Matsushita that are aligned with the steps 1, 2, and 3, of the previously described process for product development. The three steps discuss the larger perspective: an overview of how you create a principal product and the importance of already considering infrastructure and recycling routines when you design a product. In a normal product development cycle, another two steps are considered: creating a model of the product and preparing the new production line.

Each question is followed by an answer provided by TNS. This is partly to present an overview of TV and Refrigerator production *in general* (not specifically Matsushita), partly to present the format and style of a reply. The TNS answer is followed by the questions to Matsushita. It is up to Matsushita, to decide if you want to (i) simply agree with TNS' general answers as accurate also for Matsushita, and/or (ii) want to add or change the TNS's general answers into a Matsushita specific answer that complies better with your current perspective.

(As a guide to help refresh the reader's memory of the four step ABCD Analysis, footnotes denoting the relevant step(s) appear at the end of certain points and questions throughout the document.)

Guidelines for filling in the answers:

- Read through the whole text and all questions – we get the best result if the full context is clear before questions are answered.
- The most important part of Matsushita's answer is to reflect on the *typical Matsushita perspective on the question:* "how is Matsushita *currently* dealing with this issue in comparison to TNS's general view on the question[5] and how is Matsushita *planning* to deal with it either long term[6], or already soon[7].
- A *very* important aspect of a sustainability analysis is when there is no easy-to-find answer, either because Matsushita has no data to give an answer, or because the answer is to be found outside the domains of Matsushita. Unknown relevant aspects of sustainability are as important to identify as aspects that have concrete and detailed answers. Therefore, such unknown and relevant aspects should be specifically

[5] Questions relating to step "B"
[6] Questions relating to step "C"
[7] Questions relating to step "D"

commented on, e.g. “there are no available data to respond to this question”, or “we only know part of the answer to this question – etc.”

- Refer answers to policies, business plans, new production lines under establishment, statements from top-management etc. Verify when Matsushita has long term and short term plans for improvement[8].
- For a sustainability analysis, it is more interesting to find out the *overall picture*, so that important aspects do not drown in too much information about relatively less important details. The Matsushita answers do not need to be very long and specified as regards exact %-figures and other data. However, a somewhat longer and more specific answer is requested under *step 2* of the three-steps in the production cycle.

[8] Answers to questions relating to C and D

TELEVISION (including monitors)

* Matsushita's answers are made on the assumption that TV sets are cathode-ray tube types.

STEP 1 – ANALYSING THE MARKET

Question: ***"Which <u>services</u> does TV currently provide to people, and what are the overall sustainability problems linked to these services?"***

TNS' answer:

a. TVs as a medium of communicating information and knowledge as a component of a larger human-machine interactive system.

b. News, education, entertainment, shopping via broadcasts, programs, storage media, networks, and other means

c. Computer and/or network interface

d. Video-conferencing, e-mail, web surfing

e. Games, films, music and education

Most of those services to people are mainly assessable in developed countries like Japan and other industrialized countries. At this point in time, IT in general, including TV, has not played a very clear role in saving societal resources, or been part of a conscious strategy to reach sustainability. The market for such TVs is likely to increase in "the funnel". Furthermore, current production and use of TVs waste resources, also resources that turn into pollution in the biosphere. Examples are heavy TVs, transports, lack of recycling, scarce metals that are wasted and that pollute in the same time, chemicals that remain in nature and so on.

Matsushita's answer:

"Which services to people is it that TV in general is currently providing?"

- TNS' answers are all applicable to Matsushita.
- In addition, shopping and mutual communication has been enabled with TV sets adapted for digital TV broadcasting from 2000 onwards.
- Depending on TV programs, but TV services can report current situation on global environment to people so realistically that the TV services are regarded as one of influential media to enlighten viewers on environmental protection and/or sustainability.
- There are some minorities who can send and receive information with multilingual and sign language services.

- It compared with newspapers, magazines, radio and personal computers, TV broadcasting has an advantage that news and so on will be broadcasted to huge number of people with moving pictures without delay.
- It sometimes helps people be relax or relieved that TVs are left on and not actually viewed.

"…and what are the overall sustainability problems linked to these services?"

- Recycling used TV sets just started from April 2001 in Japan, and we have been making a lot of efforts for infrastructure, technology and design suitable for recycling. However, we have to admit that the amount of material recycled in practice is still small.
- The current recycling rate is about 55%, and the rest is unavoidably disposed of as waste. And, the collected amount is far small in comparison with the number of TV sets sold to date.
- Problems to be solved on the way to sustainability, is to improve energy efficiency even more, to eliminate harmful chemical elements and to use materials from used TV sets for new TV set production. (Ultimate perspective is that TV sets are made from and of TV sets.)

Question: *"Could the applications of TV above, or new applications of TV, be developed to support sustainability, in any way, for the future market "in the global funnel", and/or are there any trends in the market that point in that direction?*

TNS' answer:

We can use TV for:

a. Video-conferencing, education, e-mail, web-surfing to save resources from transporting people or information
b. Computer communication in companies for leaner production
c. Computer communication on the market –utilizing the TV set for customer purchasing and coordinated transporting of goods and people
d. Intensified communication between industrialized countries and developing countries. TV to enable the saving of resources from various kinds of business models such as licensing, franchising and leasing. To develop such functions for TV, and to "walk the talk" by producing TV in new ways, through means of *dematerializations* and *substitutions* for each system condition, seems to be a good business idea in the funnel.

Matsushita's answer (including verified top-management statements and/or plans and progress as regards long term possibilities[9] and measures that will soon be launched or are already under development[10]):

- Network-type communication system like television conference, which can save resources needed for transportation of people and goods.
- Remote controlled monitoring system which restrains transportation and labor of people.
- Seeking a business model, which is not confined to sell TV sets conventionally, through substitution.
- Aiming for TV set production in which Reduction and Recycle is pursued thoroughly.
- A trend in the market shows that broadband market via internet is about to take off
- TNS' answers are all applicable to Matsushita.
- The most influential issue in the life cycle of TV set is to reduce its electrical energy consumption, and we will develop products with even higher energy efficiency.
- In addition, we will proceed to develop TV sets with high recycle performance. The market trend is defined by a regulation which is known as "home electronics recycling act".

STEP 2 – CREATING A NEW "PRINCIPLE TV" FOR MATSUSHITA

Question: "*What are the critical flows and management routines that are currently, and in general, linked to the above described types of TV services from a full life cycle perspective?* "

TNS' answer:

TNS answer relating to ***dematerialization*** aspects (each S.C. is affected): TV's are produced of materials such as metals, plastics, chemicals, woods, ceramics and perhaps new types of materials as well. In relation to a perfect future, and perhaps also in relation to some best practices already established by some companies on the market, the main stream activities on the market represent a wasteful handling of these materials for TV production. This wasteful management occurs through *material waste* (ending up as waste deposits or incineration) and/or *low resource productivity* as regards service utility to society and customers. Examples are (S.C.'s I, II, III, IV):

a. Purchase of virgin materials for production (recycled materials will be used in the future),

[9] C
[10] D

b. wasteful methods of resource extraction for instance in mining industry,

c. logistically unnecessary long transports of production materials as well as of the heavy TV's,

d. using unnecessary large amounts of materials in the production of the heavy TV's,

e. not recycling the materials of the production into so pure fractions that they can be re-used on the same functional level for new TV production, and

f. not recycling the TV's so that the materials can be used on the same functional level for new production.

TNS answer relating to ***substitution*** aspects (each S.C. is affected): The *qualities* of materials are often critical to sustainability. When such materials are wasted in line with the above, it is an even more pronounced problem:

S.C. I: Fossil fuels and nuclear energy is often used as energy-source from extraction through the whole life cycle of TV's, which today give rise to increasing concentrations of waste in the biosphere. Some non-ferrous heavy metals in the production of TV's (e.g. in main structure, glass, plastics, electronics) are scarce in nature leading to high risks for increasing concentrations in the biosphere such as cadmium, mercury, silver, copper, and zinc. Lighter metals like aluminum and titanium are very abundant in nature, and poses relatively minor problems regarding this system condition. The same is true with the heavy metal iron that is very abundant in nature, and poses a relatively smaller problem for this system condition. The same is true for stainless steel though it contains some problematic metals like nickel. The reason is that stainless steel – through its contents of nickel, does not shed metals to the environment and that large proportions of stainless steel are normally recycled due to economical reasons. An important example is that copper often can be substituted for by aluminum. Finally, wasting of metals is a problem for system condition 1 regardless if the metal as such is scarce or not, because mining and production of the metals generally consume large amounts of fossil fuels.

S.C. II: TV's are often containing persistent unnatural compounds such as anti-flammables (bromine organic compounds), and plasticisers and other chemical additives in plastics such as PVC.

S.C. III: Minefields are not always restored ecologically after mining, which – together with unnecessarily long road-transports lead to physical encroaching on ecosystems. This is particularly problematic for some light metals like aluminum and titanium. TV's are sometimes built from woods from rain forests or other forests where the management routines are contributing to physical destruction of the environment.

S.C. IV: TV's could be used more for the benefit of people in the funnel. When scarce metals are wasted or loose their purity through mixing with other materials, it hampers the possibilities for future generations to – for instance – produce and recycle very efficient photovoltaics and fuel cells. Sometimes, appropriate dialogues with developing countries that provide raw materials for TV are not held, and the prices in the purchase of scarce metals and wood from such countries are not always embedding social costs.

Guidelines for Matsushita's answer:

a. Think broadly – bird's eye perspective – about the whole life cycle including resource extraction, transport, purchase and Matsushita production upstream in the life cycle, and use of and disposal of TV's downstream in life cycle. Which are the most critical flows referring to the TNS described problems above?

b. Only the overall picture is interesting. Need for dematerializations? Wasteful use of materials through losses or low resource productivity are considered. Examples are low recycle rates of purchased materials, low purity of recycled materials, unnecessarily high weights of products and material flows. Need for substitutions? Use of problematic types of materials are considered. Examples are fossil fuels and heavy metals (S.C. I). Other examples are compounds that are persistent and foreign to nature in the supply chain, or occurring during production or in incineration processes downstream (sometimes we don't know, which should also be noted) (S.C. II). Area consuming transports, and poorly managed ecosystems in the supply chain – for instance of wood or in minefields (or lack of data on this) (S.C. III). All kinds of critical aspects affecting people – suppliers, clients, employees, people who are indirectly affected by Matsushita including people from other countries and people not yet born (S.C. IV).

Here follows some overall guidelines for some materials, taking the points above into account. The same type of questions can be asked for Glass, Woods, Ceramics, Plastics, Chemicals. Are there other types of materials as well?:

S.C. I. Metals:

- Proportion of metals Matsushita purchases that are recycled and virgin respectively.
- Comments as regards the kind of metals purchased in relatively large volumes for production of TVs (metals that are scarce in the biosphere such as many non-ferrous heavy metals)
- Is the TVs design allowing the recycling of metals after use of the TVs?
- If so, what are the current return rates?
- What is the purity of the recycled metals (can they be used for the same purpose in a second production cycle of TVs)?

S.C. II. Persistent Compounds:

- Are persistent compounds foreign to nature involved anywhere in the management of metals for instance in the processing of the metals?
- Are there any comments as regards the site of extraction of the respective metals?

S.C. III. Restoration of natural systems after mining

S.C. IV. Social responsibility for the suppliers at these sites...

Matsushita's answer:

Based on Matsushita's interpretation of TNS questions, each issue is raised.

***Dematerialization*:** "Dematerialization" is here interpreted as "reducing quantity of materials", and our attempts to improve material efficiency are listed.

On the assumption, material composition of a TV set is: Glass: a little more than 60%, Resin: a little less than 20%, Metal (iron, copper, aluminum, etc): a little less than 10%, components of electrical circuits: a little more than 10%

Lightening the weight:

- Circuit units have been becoming more dense and compact.
- The most effective is lightening the weight of a cathode-ray tube, and Matsushita is, in this regard, on the top level among competitors.
- Further lightening is possible if display device is changed to PDP or LCD.

Reducing quantity of resinous material: The "hollow forming" technology enabled us reduce quantity of resinous material by 26% while keeping its strength. The accuracy of strength was improved thanks to CAE analysis.

Reducing expanded polystyrene: Tackling the reduction of package materials leaded us to remarkable achievement. For instance, in 2001, the package materials for 36-type TV set are reduced by 54% in comparison with that of 1993. This result were produced thanks to the accuracy improvement of structure and package design caused by lightening the weight of products, making products more compact, and CAE analysis.

***Substitution*:** Our attempts to substitute for following materials (extracted from the earth's crust) are listed.

System Condition I

Iron: Substituting light metal like aluminum for iron

Aluminum: Substitution is not considered

Glass: Substituting plastic partially for plate glass

Plastic: Along with reduction of quantity of resinous material, the number of plastic components was reduced from 39 of year 1984 model to 8 of year 2000 model. Besides, type of plastic were also reduced from 13 to 2 during the same period, and 97% of all plastic is made of polystyrene.

We focused on "Mg" as new option for plastic and started producing on a commercial basis from 1998. "Mg" is both light and tough, which enabled us design more compact thanks to the toughness. And it has better performance than resinous material in respect of heat radiation and electromagnetic wave shield.

Copper: None

Lead: We are trying to eliminate all the lead contained in solder. Solder which consists of "Su-Ag-Cu" or "Su-Zn-Bi" will replace all the conventional solder containing lead by March 2003 globally.

Mercury: We are considering to stop using mercury (e.g., for a fluorescent lamp for LCD).

Cadmium: We are not using cadmium and will not use it in future.

Electric power: We have been reducing electric energy consumption needed while TV set is switched on. Annual electric energy consumption was reduced by 30% in the period from 1995 to 2000. And, especially regarding electric energy consumption needed while TV set is remote-controlled stand-by, we succeeded in reducing it by one-fiftieth, from 5W to 0.1 W.

System Condition II

***Substitution*:** Our attempts to replace following materials (which cannot be decomposed ecologically) are listed.

In compliance with our guideline, we classify 1413 chemical elements to be prohibited, reduced or managed adequately, and have been tackling them.

Fluorocarbon: We are not using fluorocarbon and will not use it in future.

Anti-flammable material made of bromine or chlorine organic compounds: We have already replaced vinyl chloride covering electrical wire inside TV sets with anti-flammable inorganic materials made of basically polyethylene compounds.

We have partially adopted "FR-1"and "FR-4" containing phosphorus compound which replaces bromine anti- flammable material contained in printed circuit board.

Various kinds of resinous materials used for main structure of TV sets were unified, and polystyrene (PS) which consists of bromine anti-flammable material is used for it. Now we are proceeding to replace it with PS+PEE which consists of phosphorus anti-flammable materials. The possible cost increase caused by the substitution was managed by the measure to make the main structure thinner by 20%, but some problems remains.

System Condition III

Our attempts to keep natural infrastructure and diversity of creature are listed.

Preventing forest destruction: Recycled paper is used for instruction manuals and corrugated cardboard for package.

Preventing ecosystem destruction : We have been reducing chemical elements which have negative influence on nature, and also improving the energy efficiency and the efficiency to utilize natural resources. We believe that these can, even indirectly, contribute to preserve ecosystems.

Restoring the nature after mining minerals : We do not investigate the impact of mining on the ecology and also do not request our suppliers to do it.

System Condition IV

Our attempts to recycle our products are listed.

Improving the performance to be dismantled: Aiming to recycle each material respectively, we have been improving the performance of products to be dismantled. It took 140 seconds to dismantle a TV sets into 4 units, namely : "cathode-ray tube from glass mainly", "main structure from resin mainly", "speaker unit structured with metal and resin" and "chassis from electrical circuit components and metal". However, it now takes only 78 seconds. In order to shorten the time, we put printed circuit board together in one place so that circuit unit can be dismantled and removed easily after opening the cover on the back side. In addition, the direction to drive screw is arranged in the same order, and the number of screws is also reduced.

Recycling circuit board and components: Chassis unit is the most difficult part to recycle. In order to sort out components in accordance with their material, we developed a equipment named "Parts-separator". The equipment enable us to dismantle and remove components such heat sink, shield case, tuner and so on as they almost keep their form. And, in this consequence, we have been able to recycle components or parts in accordance with their materials although they were wasted before.

Utilizing materials collected from used products: We started to collect resinous materials from main structure of TV sets and recycle them as non-halogen anti-flammable resinous materials. The recycled materials are now applied for 33% of all polystyrene in the production for new products.

In this recycle process, it is necessary to distinguish sorts of collected resinous materials accurately. Therefore, we developed a equipment named "Pla-selector" to do it. The equipment can, with almost 100% accuracy, distinguish sorts of resinous materials and anti-flammable additives contained in the materials, sorts of painting and/or plating, and materials adhering to a surface.

Besides, we have started to collect glass out of cathode-ray tubes of used TV sets and recycle them for about 10% of all glass for new TV sets production.

Question: *"Could the above described critical flows and management routines, be developed into a state that could comply with the system conditions, and help society at large to do so?"*

TNS' answer:

In the future, TV's do not contribute to increasing…

S.C. I Concentrations of elements from Earth's crust

S.C. II Concentrations of pollutants such as chemicals

S.C. III Physical degradation of nature and

S.C. IV Disempowerment of people and social structures. It is the opposite, TVs provide services to society at large to avoid such problems. To that end, TVs can be produced and used and disposed of with much less materials, and with new types of materials that are less likely to violate the principles for sustainability.

Dematerializations: For all the materials in TV production, the current *wasting* (I, II, III, IV) can be improved through

a. Smarter logistics of production materials as well as of the heavy TVs
b. Using less amounts of materials in the production of the TVs
c. Recycling the materials in the production into so pure fractions that they can be re-used on the same functional level for new TV production
d. Recycling the TVs so that the materials can be used on the same functional level for new production.

Substitutions: Furthermore, the *qualities* of material flows can be improved through:

S.C. I. Fossil fuels and nuclear energy can be changed to sustainable energy-sources and other metals such as aluminum and iron or steel, or other materials such as new types of polymers or ceramics can substitute for some scarce and toxic metals such as cadmium, mercury, silver, copper, and zinc.

S.C. II. Plastics and polymers can be developed (by suppliers that can be "supported" by Matsushita by conscious business agreements) to develop new types of polymers that do not require heavy metals anywhere in the production cycle, or persistent compounds foreign to nature such as certain additives in PVC and anti-flammables.

S.C. III. Suppliers of wood from poorly managed forests can be exchanged for other suppliers, or supported to step-by-step improvements by Matsushita.

S.C. IV. Working conditions for suppliers as well as for Matsushita's own factories, purchase of scarce metals and wood from developing countries can take social responsibilities also regarding social costs for purchased materials.

Matsushita's answer (regarding these and other examples, and verified plans and progress as regards long term possibilities[11] and measures that will soon be launched or are already under development[12]):

We can agree to TNS' answers except for two issues described below.

1) Substitution III: The meaning of "support from Matsushita for suppliers' improvements" is not concrete. We won't make any deal with suppliers, which are regarded as inadequate in accordance with our principles for green purchase and procurement.

2) Substitution IV: The meaning of "taking social responsibilities regarding social costs" is not concrete. We believe that materials we purchase from suppliers are transacted in price reflecting social costs rightfully, and are willing to take the responsibility to comply with social regulation like green tax to be introduced in future.

We as a leading manufacture of home electronics products, admit our role to bring forth sustainable products such as TNS has been advocating, and also to create a trend toward sustainable products in our industry. We believe it is our responsibility to contribute to building sustainable society through such products and production.

Plans and progress in and out of Matsushita are listed below on condition that they are verified.

Dematerialization: "Dematerialization" is here interpreted as "reducing quantity of materials", and our attempts to improve material efficiency are listed.

Lightening weight: Substitute PDP (plasma display panel) or LCD and so on for conventional display.

Reducing quantity of resinous material:

Reducing expanded polystyrene:

Substitution:

Our attempts to substitute for following materials (extracted from the earth's crust) are listed.

[11] C
[12] D

System Condition I

Iron: -

Aluminum: -

Glass: -

Plastics: We are aiming to replace all plastics with metal such as Mg.

Copper: -

Lead: Lead contained in solder will be eliminated globally by March 2003. We are aiming to abolish the usage of lead by March 2006.

Cadmium: We are aiming to abolish the usage of Cadmium by March 2006.

Cr (VI): We are aiming to abolish the usage of Cr (VI) by March 2006.

Electrical Power (from thermal power to ecological energy etc): we are proceeding to reduce electrical energy consumption.

System Condition II

Our attempts to replace following chemical substances (which cannot be decomposed ecologically) are listed:

Fluorocarbon: -

Anti-flammable material made of bromine or chlorine organic compounds: We are aiming to abolish the usage of anti-flammable materials containing bromine or chlorine by March 2006.

Vinyl chloride: We are aiming to abolish the usage of vinyl chloride by March 2006.

System Condition III

Our attempts to keep natural infrastructure and diversity of creature are listed.

Preventing forest destruction: -

Preventing ecosystem destruction : -

Restoring the nature after mining minerals : -

System Condition IV

Improving the performance to be dismantled: -

Recycling circuit board and components: -

Utilizing materials collected from used products: In the 1990's, we were in the phase of "all plastics" movement with measures such as reducing number of components and unifying sorts of resinous materials. Currently, we are in the phase to proceed "hybrid" with measures such as substitution with metal like Mg and orienting non-halogen material. In future, we

intend to improve recycle efficiency more, make products more compact, and tackle "all metal" to replace chemical materials. Our ultimate perspective is to produce all new TV sets from materials collected from used ones.

STEP 3 – LAUNCHING AND MARKETING NEW TV-MODELS

Question: *"What are the critical aspects of all the societal supply-flows and management routines of produced TVs on today's market?"*

TNS' answer:

a. Societal infrastructure for transports of production materials, products and waste for disposal and/or recycling are often too long due to poor logistics and, and unnecessarily resource consuming also from the types of transports (trucks and flights rather than boats and trains). This leads to the emitting of compounds such as green house gases and heavy metals and NO_x etc. that are increasing in concentration in the biosphere.

b. Recycling is not at all times efficient in society, with too few and too disperse recycling plants, and without keeping recycled fractions pure enough to allow reconstruction of new products.

c. The previous problem is due to that society often fails to put prizes on "waste" that are relevant from a future sustainability perspective. On the contrary, it often costs to "get rid" of waste.

d. Authorities are often not clear about the system conditions, and how those ought to guide criteria for resource extraction, production, materials, products, transports and disposal of products. Often, authorities rather shape rules that build on reactions to damage and impacts that have already occurred in society and ecosystems from previous violations of the system conditions. In this way the "solving of problems" often lead to the creation of new problems. Therefore, it is sometimes difficult for a company to know how to communicate proactive and new and smart products, that comply with a path towards compliance with the system conditions, unless the changes are accompanied by also other advantages of the products, outside the domains of sustainability.

Matsushita's answer (regarding the current situation in Matsushita):

- § We believe that critical aspects of "impact on global greenhouse effect through CO_2 emission" which is accompanied at energy consumption during usage of products.
- § "Insufficiency to effectively utilize resources" which are used for products. Especially in Japan, capable space for landfills is now in short critical.
- § "Eliminating any harmful chemical substances" which are problematic when used products are recycled or disposed of as waste.
- § "Negative impact of production process and transportation on the environment"
- § Regarding transportation, our task is to improve efficiency in logistics for products and to change current transportation methods to other methods which have smaller negative impact on environment.
- § We recognize our responsibility to accurately recycle plastics which we use a lot so far, and invented the technology to recycle plastics from main structure of used TV set and produce halogen-free anti-flammable plastics, which we succeeded in introducing in our year 2001 model.
- § We have started to sell equipment named "Pla-selector" which was developed to realize the above mentioned recycle process and distinguishes plastics accurately.

Question*: "Could the above described problems on the market and in society at large be developed into a state that could support Matsushita's "ultimate" sustainability objectives?"*

TNS' answer: The above problems can be dealt with by many means.

a. Better options today? One possibility is to simply switch to leaner societal support systems (transports and recycling) when those already exist.

b. Networking and cooperation with other companies? It is possible to merge forces with other companies to either implement new possibilities on private ground, or reduce the costs for utilizing already existing infrastructures?

c. "Teaching of market" so that competitive advantage from proactive production can occur.

d. Influencing authorities? Yet another possibility is to directly contact authorities, for instance to discuss increased taxes on "old-timer" products (have been done by Electrolux regarding old-timer batteries with Cadmium, and by the Fossil Fuel industry as regards taxes on fossil fuels).

By such ways:

b. Societal infrastructure and logistics for transports of production materials, products and waste for disposal and/or recycling can be improved by development of more train- and boat traffic, better integration of those new types of transports with city- and rural planning, and political measures such as taxes that can foster less resource consuming and less polluting means of transport.

c. Recycling can be improved by increasing the number of less dispersedly located recycling plants with the ability to keep recycled fractions pure enough to allow reconstruction of new products.

d. Authorities can learn, from contacts with Matsushita, how a principle approach to a sustainable society can be strategically planned.

e. Authorities can – through various means such as subsidies and taxes – increase the value of pure "waste-" fractions.

f. Authorities can be helpful in developing criteria for resource extraction, production, materials, products, transports and disposal of products that are guided by the system conditions.

Matsushita's answer:

We have considered following measures to resolve problems regarding the aspects mentioned in the answer to the preceding question.

- Regarding the first aspect of "impact on global greenhouse effect through CO_2 emission", we have been saving energy further more with technical breakthrough for each product. To put it concretely, we realized to reduce electric energy consumption per 1 liter by 81% in 2001 in comparison with that of 1995, thanks to improvement of refrigeration system and development of insulation panel and so on. Besides, we developed new type of refrigerator whose cooling material was changed from HFC-134a to hydrocarbon T600a, and started to sell the refrigerators from February 2002.
- Regarding the second aspect of "insufficiency to effectively utilize resources", we have started to recycle resinous material from used products and make components of the recycled material for new products, which are on sale. Besides, we have been also tackling with recycle of metal parts from compressors.
- Regarding the third aspect of "eliminating any harmful chemical substances", we have started not to use any lead for circuit board, and to adopt resinous materials which do not contain anti-flammable bromine and/or chlorine materials.
- Regarding the fourth aspect of "negative impact of production processes on the environment" we have been proceeding with various activities to aim for effective and lean production, namely we proceed to reduce CO_2 emissions, emission and transfer of chemical substances, quantity of waste, and quantity of water.
- Regarding "negative impact of transportation", it is necessary to improve efficiency in logistics and to change current transportation methods to other methods, which have smaller negative impact on environment. We are promoting to improve carrying capacity

and make package smaller for trucking. In future, we believe it is necessary to change trucks to low pollution type. Besides, “modal shift” to change transportation method from trucking to rail transport is promoted positively in Japan from 1998 onwards.

The same questions will now be asked for Refrigerators. This means that the manual for responding, structure, and specific questions are the same. The reason is that Refrigerators are relatively similar to Refrigerators as regards amounts and types of materials and the options for improvements with regard to those aspects. The main differences are relating to the use (mainly step 1 in the product development cycle).

REFRIGERATORS

STEP 1 – ANALYSING THE MARKET

Question: *"Which services does refrigerators currently provide to people, and what are the overall sustainability problems linked to these services?"*

TNS' answer:

a. Avoiding microbe-growth and disease

b. Maintaining food fresh and microbe-free to allow longer storage times and thereby make life easier through less frequent purchasing,

c. Cooling of foods such as liquids to make them taste better. At this point in time, refrigerators in general have not exhausted its role in saving societal resources. The market for such needs of refrigerators are likely to increase in "the funnel". Furthermore, current production and use of refrigerators waste resources, also resources that turn into pollution in the biosphere. Examples are relatively heavy refrigerators, transports, lack of recycling, scarce metals that are wasted and that pollute in the same time, chemicals that remain in nature and so on – e.g. persistent compounds foreign to nature used as coolants and for production of insulation.

Matsushita's answer:

a. Avoiding microbe-growth and disease (same as TNS)

b. Maintaining food fresh and microbe-free to allow longer storage times and thereby make life easier through less frequent purchasing. (In addition to TNS' answer.) Preventing waste of resources by reducing the rate of food or vegetable to be disposed of. This is enabled by the improvement of freshness of food in a cold room where the temperature is cooler in comparison with conventional type (4-1 degrees centigrade) and also the improvement of preservation performance, which is resulted from higher humidity (90%) in "vegetable room".

c. Cooling of foods such as liquids to make them taste better, and providing ice by ice-maker. Those functions bring us the variety of diet and convenience, and in this consequence, refrigerators are contributing to a development of dietary culture. Besides, refrigerators have recently become energy-saving and lightweight more and more, and are providing a lot of value to human being with less resources.

d. Refrigerators become almost valueless when they are disposed of as waste in their product life cycle. Recycling them is not enough yet, and heavy metals like lead, is still used partially. Besides, heat insulators and coolants remain in nature.

Question*: "Could the applications of refrigerators above, or new applications of refrigerators, be developed to support sustainability, in any way, on the future market "in the global funnel", and/or are there any trends on the market that point in that direction?*

TNS' answer:

Even more resource efficient refrigerators requiring less materials for production, enabling effective recycling for production of new refrigerators, and production of refrigerators that require less energy for their function could be produced. Refrigerators could be produced by alternative ways of making business in order to save resources such as licensing, franchising and leasing. Other examples are to help also the developing world to keep food fresh to avoid disease and epidemics. To develop such functions for refrigerators, and to "walk the talk" by producing refrigerators in new ways, through means of *dematerializations* and *substitutions* for each system condition, seems to be a good business idea in the funnel.

Matsushita's answers:

Matsushita answers including verified top-management statements and/or plans and progress as regards long-term possibilities (C) and measures that will soon be launched or are already under development (D):

It is important to develop refrigerators whose electric consumption at actual usage, which is most resource consuming in all product life cycle of refrigerators, is minimized and performance to be recycled after the usage is improved. Besides, future refrigerators must last more than 20 years although current refrigerators last about 11 years. It will be an interesting business opportunity to reuse parts and supply replacement parts.

Wasting food can be less to limiting value, thanks to more longer preservation period, which will be enabled by more sophisticated technology t maintain them freshness. And, "freeze-cooking" function, which is already equipped with some refrigerators, can make cooking time shorter so that those refrigerators can create more free time and reduce gas energy consumption necessary for cooking.

STEP 2 – CREATING A NEW "PRINCIPLE REFRIGERATOR" FOR MATSUSHITA

Question*: What are the critical flows and management routines that are currently, and in general, linked to the above described types of refrigerators services from a full life cycle perspective?*

TNS' answer:

TNS answer relating to ***dematerialization*** aspects (each S.C. is affected): Refrigerators are produced of materials such as metals, plastics, chemicals, woods, ceramics and perhaps new types of materials as well. In relation to a perfect future, and perhaps also in relation to some best practices already established by some companies on the market, the main stream activities on the market represent a wasteful handling of these materials for refrigerators production. This wasteful management occurs through *material waste* (ending up as waste deposits or incineration) and/or *low resource productivity* as regards service utility to society and customers.

Examples are (S.C.'s I, II, III, IV)

a. Purchase of virgin materials for production (recycled materials will be used in the future)
b. Wasteful methods of resource extraction for instance in mining industry
c. Logistically unnecessary long transports of production materials as well as of the heavy refrigerators
d. Using unnecessary large amounts of materials in the production of the heavy refrigerators
e. Not recycling the materials of the production into so pure fractions that they can be re-used on the same functional level for new refrigerators production
f. Not recycling the refrigerators so that the materials can be used on the same functional level for new production.

TNS answer relating to ***substitution*** aspects (each S.C. is affected): The *qualities* of materials are often critical to sustainability. When such materials are wasted, in line with the above, it is even a more pronounced problem:

S.C. I: Fossil fuels and nuclear energy is often used as energy-source from extraction through the whole life cycle of refrigerators, which today gives rise to increasing concentrations of waste in the biosphere. Some non-ferrous heavy metals in the production of refrigerators (e.g. in main structure, glass, plastics, electronics) are scarce in nature leading to high risks for increasing concentrations in the biosphere such as cadmium, mercury, silver, copper, and zinc. Lighter metals like aluminum and titanium are very abundant in nature, and poses relatively minor problems in this system condition. The same is true with the heavy metal iron that is very abundant in nature, and poses a relatively smaller problem for this system condition. The same is true for stainless steel though it contains some

problematic metals like nickel. The reason is that stainless steel – through its contents of nickel, does not shed metals to the environment and that large proportions of stainless steel are normally recycled due to economical reasons. An important example is that *copper* often can be substituted for by *aluminum*. Finally, wasting of metals is a problem for system condition 1 regardless if the metal as such is scarce or not, because mining and production of the metals generally consume large amounts of fossil fuels.

S.C. II: Refrigerators are often containing *persistent unnatural compounds* such as coolants, chemicals for production of insulations, and antiflammables (bromine organic compounds), and plasticisers and other chemical additives in plastics such as PVC.

S.C. III: Minefields are not always restored ecologically after mining, which – together with unnecessarily long road-transports lead to physical encroaching on ecosystems. This is particularly problematic for light metals such as aluminum and titanium. Exceptionally, refrigerators are sometimes built from woods from rain forests or other forests where the management routines are contributing to physical destruction of our environment.

S.C. IV: Refrigerators could be used more for the benefit of people in the funnel. When scarce metals are wasted or loose their purity through mixing with other materials, it hampers the possibilities for future generations to – for instance – produce and recycle very efficient photovoltaics and fuel-cells. Sometimes, appropriate dialogues with developing countries that provide raw-materials for refrigerators are not held, and the prices in the purchase of scarce metals and wood from such countries are not always embedding social costs.

Guidelines for Matsushita's answer:

a. Think broadly – bird's eye perspective – about whole life cycle including resource extraction, transport, purchase and Matsushita production upstream in the life cycle, and use of and disposal of refrigerators downstream in the life cycle. Which are the most critical flows referring to the TNS described problems above?

b. Only overall picture is interesting. Wasteful use of materials through losses or low resource productivity are considered. Examples are low recycle rates of purchased materials, low purity of recycled materials, unnecessarily high weights of products and material flows. Use of problematic types of materials are considered. Examples are fossil fuels and heavy metals (S.C. I), Compounds that are persistent and foreign to nature in supply chain or occurring during production or in incineration processes downstream (sometimes we don't know, which should also be noted) (S.C. II). Poorly managed ecosystems in the supply chain – for instance of wood or in minefields (or lack of data on this) (S.C. III). All kinds of critical aspects affecting people – suppliers, clients, employees, people who are indirectly affected by Matsushita including people from other countries and people not yet born (S.C. IV).

Here follows some overall guidelines for some materials, taking the points above into account. The same type of questions can be asked for Glass, Woods, Ceramics, Plastics, Chemicals. Are there other types of materials as well?

Metals –

- § Comments on the proportion of virgin and recycled metals Matsushita purchases, respectively.
- § Comments as regards the kind of metals purchased in relatively large volumes for producing refrigerators (metals that are scarce in biosphere such as many non-ferrous heavy metals)
- § Does refrigerator design allow metals recycling after their use (at the end of their life-cycle)?
- § If so, what are the current return rates?
- § What is the purity (grade) of the recycled metals (can they be used for the same purpose in a second refrigerator production cycle?)?
- § Are persistent compounds foreign to nature involved anywhere in the management of metals (for instance in the processing of the metals)?
- § Finally, are there any comments regarding the extraction site of the respective metals – handling or overburden, tailings, the restoration of natural systems after mining and social responsibility for the suppliers at these sites?

Matsushita's answer:

***Dematerialization*:** "Dematerialization" is here interpreted as "reducing quantity of materials", and our attempts to improve material efficiency are listed.

Material composition of ordinary refrigerator is: Metal (iron, copper, aluminum, etc.): a little more than 50%, Resin: a little less than 40%; heat insulator: a little more than 10%.

Lightening weight: We have proceeded to lightening refrigerators through reducing the number of parts and unifying some parts. Further lightening is possible if compressor, fan motors and cooler will be optimized.

Reducing quantity of resinous material: -

Reducing expanded polystyrene: -

System Condition I

Iron: We have adopted iron as its recycle performance is good, and do not consider to substitute anything for it.

Aluminum: We have adopted aluminum as its recycle performance is good, and do not consider to substitute anything for it.

Glass: Not used currently

Plastics: Plastics were unified according to sort of resin so that the number of types of plastics was reduced.

Copper: We have adopted copper as its recycle performance is good, and do not consider to substitute anything for it.

Lead: We are trying to eliminate all the lead contained in solder. We developed and started to sell some products, which use lead-free solder, and will adopt lead-free solder for other products further.

Cadmium: Not used currently

Cr (VI): Not used currently

Energy: We have been proceeding to improve the performance to save energy and recycle as we regard indirect influence on consumers as critical environmental aspect from the perspective of all LCA. Especially regarding saving energy, we realized to reduce electric energy consumption per 1 liter by 81% in 2001, in comparison with that of 1995, thanks to 1) twin-valve trile refrigerator system, and 2) by superior evacuated heat insulation panel (S-VIP), and etc.

System Condition II

Our attempts to replace following chemical substances (which cannot be decomposed ecologically) are listed:

Fluorocarbon: We developed new type of refrigerator whose cooling material was chaged from HFC-134a, which has most critical impact on greenhouse effect to hydrocarbon R600a, which has smaller coefficient of greenhouse effect, and started to sell the refrigerators from February 2002.

Anti-flammable material made of bromine or chlorine organic compounds: We started to adopt cords which do not contain vinyl chloride, and intend to reduce vinyl chloride further.

System Condition III

Our attempts to keep natural infrastructure and diversity of creature are listed.

Preventing forest destruction: Recycled paper is used for instruction manuals and corrugated cardboard for package.

Preventing ecosystem destruction : We have been reducing chemical substances which have negative influence on nature, and also improving the energy efficiency and the efficiency to utilize natural resources. We believe that these can, even indirectly, contribute to preserve ecosystems.

Restoring the nature after mining minerals : We do not investigate the impact of mining on the ecology and also do not request our suppliers to do it.

System Condition IV

Improving the performance to be dismantled: The performance to dismantle refrigerators has been improved by minimized-bloc design in order to seek for easy dismantling. Components of a cooler, defrosting heater, sensor, temperature fuse and duct are structured in one bloc and fixed with screws so that time to dismantle is shortened.

Recycling circuit board and components: The operation of functional components of W500 series refrigerators is recorded, and it is judged from remaining product life if the components can be reused or not.

Utilizing materials collected from used products: We collect components made from PP-resinous material manually from used refrigerators, break them into fragments, remove foreign particles, make injection forming and recycle them as board at the bottom of refrigerators. We started to consider how to recycle metal parts of compressor.

Question: *"Could the above described critical flows and management routines, be developed into a state that could comply with the system conditions, and help society at large to do so?"*

TNS' answer:

In the future, refrigerators do not contribute to increasing (S.C. I) concentrations of elements from the Earth's crust, (S.C. II) concentrations of pollutants such as chemicals, (S.C. III) physical degradation of nature and (S.C. IV) disempowerment of people and social structures. It is the opposite, refrigerators provide services to society at large to avoid such problems. To that end, refrigerators can be produced and used and disposed of with much less materials, and with new types of materials that are less likely to violate the system conditions. There are two key ways of achieving these outcomes:

Dematerializations: For all the materials in refrigerator production, current *waste* (S.C. I, II, III, IV) can be improved through:

a. Smarter logistics of material use in production and transport of refrigerators
b. Using less materials in refrigerator production
c. Keeping the grade of recycled materials in production so high (pure) that they can be re-used on the same functional level for new Refrigerator production
d. Recycling the refrigerators so that the materials can be used on the same functional level for new production

Substitutions: Furthermore, the *qualities* of material flows can be improved through:

S.C. I: Changing from fossil fuels and nuclear energy to sustainable energy-sources; by substituting some scarce and toxic metals (such as cadmium, mercury, silver, copper, and zinc) for by other metals (such as aluminum and iron or steel), or other materials such as new types of polymers or ceramics.

S.C. II: By developing plastics and polymers ("supported" by Matsushita through conscious business agreements with suppliers) to develop new types of polymers that do not require heavy metals at any point in the production cycle, or persistent compounds foreign to nature (such as certain coolants, insulation materials, additives in PVC and anti-flammables).

S.C. III: Suppliers of wood from poorly managed forests can be exchanged for other suppliers, and/or Matsushita can support suppliers' continued improvement in management practices.

S.C. IV: Working conditions for suppliers as well as for Matsushita's own factories, purchase of scarce metals and wood from developing countries can take social responsibilities also regarding social costs for purchased materials.

Matsushita's answer:

Matsushita answers (regarding these and other examples, and verified plans and progress as regards long term possibilities[13] and measures that will soon be launched or are already under development[14]):

We can agree to TNS' answers except for two issues described below.

3) Substitution III: The meaning of "support from Matsushita for suppliers' improvements" is not concrete. We won't make any deal with suppliers which are regarded as inadequate in accordance with our principles for green purchase and procurement.

4) Substitution IV: The meaning of "taking social responsibilities regarding social costs" is not concrete. We believe that materials we purchase from suppliers are transacted in price reflecting social costs rightfully, and are willing to take the responsibility to comply with social regulation like green tax to be introduce in future.

We as a leading manufacture of home electronics products, admit our role to bring forth sustainable products such as TNS has been advocating, and also to create a trend toward sustainable products in our industry. We believe it is our responsibility to contribute to building sustainable society through such products and production.

Plans and progress in and out of Matsushita are listed below on condition that they are verified.

[13] C
[14] D

System Condition I

Iron: -

Aluminum: -

Glass: -

Plastics: -

Copper: -

Lead: Lead contained in solder will be eliminated globally by March 2003. We are aiming to abolish the usage of lead by March 2006.

Cadmium: We are aiming to abolish the usage of Cadmium by March 2006.

Cr (VI): We are aiming to abolish the usage of Cr (VI) by March 2006.

Electrical Power (from thermal power to ecological energy etc): we are proceeding to reduce electrical energy consumption (especially for the actual usage).

System Condition II

Our attempts to replace following chemical substances (which cannot be decomposed ecologically) are listed:

Fluorocarbon: -

Anti-flammable material made of bromine or chlorine organic compounds: We are aiming to abolish the usage of anti-flammable materials containing bromine or chlorine by March 2006.

Vinyl chloride: We are aiming to abolish the usage of vinyl chloride by March 2006.

System Condition III

Our attempts to keep natural infrastructure and diversity of creature are listed.

Preventing forest destruction: -

Preventing ecosystem destruction : -

Restoring the nature after mining minerals : -

System Condition IV

Improving the performance to be dismantled: -

Recycling circuit board and components: -

Utilizing materials collected from used products: -

STEP 3 – LAUNCHING AND MARKETING OF THE NEW TYPES OF REFRIGERATORS

Question: *"What are the critical aspects of all the societal supply-flows and management routines of produced refrigerators on today's market?"*

TNS' answer:

a. Societal infrastructure for transporting production materials, products and waste for disposal and/or recycling are often too long due to poor logistics and, and unnecessarily resource consuming also from the types of transports (trucks and flights rather than boats and trains). This leads to the emitting of compounds such as green house gases and heavy metals and NO_x etc. that are increasing in concentration in the biosphere.

b. Recycling is not at all times efficient in society, with too few and too disperse recycling plants, and without keeping recycled fractions pure enough to allow reconstruction of new products.

c. The previous problem is due to that society often fails to put prizes on "waste" that are relevant from a future sustainability perspective. On the contrary, it often costs to "get rid" of waste.

d. Authorities are often not clear about the system conditions, and how those ought to guide criteria for resource extraction, production, materials, products, transports and disposal of products. Often, authorities rather shape rules that build on reactions to damage and impacts that have already occurred in society and ecosystems from previous violations of the system conditions. In this way the "solving of problems" often lead to the creation of new problems. Therefore, it is sometimes difficult for a company to know how to communicate proactive and new and smart products, that comply with a path towards compliance with the system conditions, unless the changes are accompanied by also other advantages of the products, outside the domains of sustainability.

Matsushita's answer (regarding current situation in Matsushita):

- We believe that critical aspects of "impact on global greenhouse effect through CO_2 emission" which is accompanied at energy consumption during usage of products.
- "Insufficiency to effectively utilize resources" which are used for products. Especially in Japan, capable space for landfills is now in short critical.
- "Eliminating any harmful chemical substances" which are problematic when used products are recycled or disposed of as waste.
- "Negative impact of production process and transportation on the environment"

- Regarding transportation, our task is to improve efficiency in logistics for products and to change current transportation methods to other methods which have smaller negative impact on environment.
- We recognize our responsibility to accurately recycle plastics which we use a lot so far, and invented the technology to recycle plastics from main structure of used TV set and produce halogen-free anti-flammable plastics, which we succeeded in introducing in our year 2001 model.
- We have started to sell equipment named "Pla-selector" which was developed to realize the above mentioned recycle process and distinguishes plastics accurately.

Question*: "Could the above described problems on the market and in society at large be developed into a state that could support Matsushita's "ultimate" sustainability objectives?"*

TNS' answer:

a. Better options today? One possibility is to simply switch to leaner societal support systems (transports and recycling) when those already exist.

b. Networking and cooperation with other companies? It is possible to merge forces with other companies to either implement new possibilities on private ground, or reduce the costs for utilizing already existing infrastructures?

c. "Teaching/informing the market" so that competitive advantage from proactive production can occur.

d. Influencing authorities? Yet another possibility is to directly contact authorities, for instance to discuss increased taxes on "old-timer" products (have been done by Electrolux regarding old-timer batteries with cadmium, and by the Fossil Fuel industry as regards taxes on fossil fuels).

By such ways,

a. Societal infrastructure and logistics for transports of production materials, products and waste for disposal and/or recycling can be improved by development of more train- and boat traffic, better integration of those new types of transports with city- and rural planning, and political measures such as taxes that can foster less resource consuming and less polluting means of transport.

b. Recycling can be improved by more and less disperse recycling plants with the ability to keep recycled fractions pure enough to allow reconstruction of new products.

c. Authorities can learn, from contacts with Matsushita, how a principle approach to a sustainable society can be strategically planned.

d. Authorities can – through various means such as subsidies and taxes – increase the value of pure "waste-" fractions.

e. Authorities can be helpful in developing criteria for resource extraction, production, materials, products, transports and disposal of products that are guided by the system conditions.

Matsushita's answer:

We have considered following measures to resolve problems regarding the aspects mentioned in the answer to the preceding question.

- Regarding the first aspect of "impact on global greenhouse effect through CO_2 emission", we have been saving energy further more with technical breakthrough for each product. To put it concretely, we realized to reduce electric energy consumption per 1 liter by 81% in 2001 in comparison with that of 1995, thanks to improvement of refrigeration system and development of insulation panel and so on. Besides, we developed new type of refrigerator whose cooling material was changed from HFC-134a to hydrocarbon T600a, and started to sell the refrigerators from February 2002.
- Regarding the second aspect of "insufficiency to effectively utilize resources", we have started to recycle resinous material from used products and make components of the recycled material for new products, which are on sale. Besides, we have been also tackling with recycle of metal parts from compressors.
- Regarding the third aspect of "eliminating any harmful chemical substances", we have started not to use any lead for circuit board, and to adopt resinous materials which do not contain anti-flammable bromine and/or chlorine materials.
- Regarding the fourth aspect of "negative impact of production processes on the environment" we have been proceeding with various activities to aim for effective and lean production, namely we proceed to reduce CO_2 emissions, emission and transfer of chemical substances, quantity of waste, and quantity of water.
- Regarding "negative impact of transportation", it is necessary to improve efficiency in logistics and to change current transportation methods to other methods which have smaller negative impact on environment. We are promoting to improve carrying capacity and make package smaller for trucking. In future, we believe it is necessary to change trucks to low pollution type. Besides, "modal shift" to change transportation method from trucking to rail transport is promoted positively in Japan from 1998 onwards.

Sustainability Analysis

Introduction

Matsushita's lines of TV and Refrigerators have been analysed from a sustainability perspective, utilizing the TNS framework (A, B, C, D analysis). After (A) an explanation of the framework, TNS has presented a sustainability template for the analysis, containing questions to Matsushita. Based on Matsushita's answers to these questions, (B) the current situation as well as (C) the visions and plans for the future and (D) early steps in that direction have been analysed for:

1. *Global market situation (human desires and demands now and expected human desires and demands further ahead in the "funnel").* (B) How does the global market look like today from a sustainability perspective, (C) what are the Matsushita executive plans to advance this situation, and (D) what are the early steps to put the visions into practice?

2. *Principle product* (*concrete sustainability impacts from the life-cycle assessing of materials and use of product*) (B) How does today's TV's and Refrigerator's look like from a sustainability perspective, (C) what executive plans exist to advance this situation and (D) what are the early steps to put the visions into practice?

3. *Marketing and social outreach (Matsushita influence on society at large as regards support of sustainable TV's and Refrigerators).* (B) How does Matsushita play it's role as a member of society today, communicating its role as forerunner in society, and (C) what are Matsushita's executive plans to further advance this role and (D) what are the early steps to put the visions into practice?

Analysis

Occasionally, there is not enough data to respond to certain questions, for instance within the supply chain such as the mining-industry. However, it is important to notify lack of answers as critical from a sustainability perspective, and to undertake measures for the future to find out.

The analysis is solely based on the answers provided by Matsushita, i.e. TNS has not studied any other documentation to verify the drawn conclusions. This is a minor problem, since the prime objective of the analysis for Matsushita is not marketing, but to serve as a platform for further improvements to become a socially, ecologically and economically sustainable company. Any missing comments in our analysis, or any injustices as regards the TNS evaluation of the Matsushita answers, can be completed at a later stage. Furthermore, TNS can produce yet another version of our sustainability report in case Matsushita wants to complete its responses to our questions after having reviewed our analysis below.

TV

1. ***Global market situation***. It is concluded that Matsushita has a positive view on the applicability of TV as a potential saver of resources in the modern society – IT conferences, remote controlled monitoring systems, global communication to achieve a sustainable society and so on. Notion is made by Matsushita of "seeking a business model which is not confined to sell TV sets conventionally" but this is not commented on in more detail. We leave it to Matsushita to determine how far towards the boardrooms these plans have proceeded. Executive plans of this kind are of particular interest since the recycling rate by Matsushita is reported to only be 55% - new business models may improve on those figures to a high extent. Indeed it is commented by Matsushita that the plans for the future are to build all TV's on recycled materials, but no comments on the exact ways of doing so are presented. Furthermore, there are no comments on rebound-effects from the use of IT – so far we have seen few examples of IT actually saving resources in society. This is in particular of interest when it comes to the developing world, where concrete plans from firms like Matsushita to save resources on the global level are profound. No comments at all about the business potentials of TV in the developing world are presented.

2. ***Principle product***. It is concluded that Matsushita has reached global top-level technologies when it comes to making TV's lighter and more compact and more energy-efficient. The dematerialization aspects are also on the top through the consideration of the recycling aspects already at the construction level. An example is the reduction of the number of various types of plastics from 13 to 2. Matsushita is planning to improve on those standards even more. From a sustainability perspective, the most critical flows seem to be connected to the types of materials used:

   S.C. I

   It is good that Cd has already been phased out. And plans are underway to get rid of lead and mercury completely. However, it seems that Matsushita is planning to introduce alloys including metals such as Ag, Cu, Zn and Bi. Those metals are already a problem from an environmental perspective – many of them increasing in concentration in sewer sludge, and from a future perspective they are even more problematic – particularly as alloys which make recycling even more problematic/expensive if pure fractions are to be obtained at return rates close to 100%.

   Finally, it is an exciting fact that Matsushita is considering Mg as a future material. Mg will not pose a long-term sustainability problem in natural systems as such because the metal is so abundant in natural systems that increased concentrations will most likely not occur. From a backcasting perspective, it is desirable that new methods and materials are brought in as assets to sustainable development (since the phase out of many inherently unsustainable materials will require substitutes). To utilize the full future potential of Magnesium, it is essential that the current practices regarding this metal are critically assessed from a sustainability perspective so that critical flows and practices can be corrected: (i) are there any side-flows from the mining, for instance other metals, and if so – what are the sustainability

characteristics of those (scarce or abundant in nature – S.C. I), and how can this situation be improved? (ii) How energy/fossil-fuel demanding is the mining of Mg, and how can this situation be improved? (S.C. II) (iii) To what extent could the energy demand be reduced through recycling of Mg? (iv) Is strip-mining a big problem for Mg, and what are the mining-industry's practices when it comes to restoring land after mining? (S.C. III) (v) What are the potentials for extracting Mg from the sea, for instance as regards energy demands? These questions are essential from a backcasting perspective. If we – for instance – would compare with a similar evaluation of PVC, PVC can be produced with relatively smaller resource flows than most other materials, it can be produced from renewable sources such as alcohols or charcoal, it inherently does not need to leak any persistent compounds to nature, and it is very easy to recycle. This does not mean that Mg, from a sustainability perspective, needs to improve on all those aspects because – as is already stated – for functionality of the sustainable society we need many kinds of different materials. But we need to make fair comparisons, and when it comes to a sustainability analysis, it is important to use the toughest possible benchmarks for improvements. This needs to be elaborated in future sustainability analyses.

S.C. II

It is good that anti-flammables containing bromine are going to be phased out, and that such progress has already started in concrete terms. However, the replacement to "phosphorous compound" need a thorough sustainability analysis and is at present to be regarded as a critical flow. Phosphorous is a life-sustaining mineral that belongs on agricultural land to give people food, and the natural reserves of Cd-pure phosphorous are declining. It is doubtful that the use of this material in anti-flammables is a long-term sustainable solution. Furthermore, chemicals should be tackled by Matsushita in more rigor. From a sustainability perspective it is not enough to prohibit "1413" chemical compounds. Such lists are based on known impacts, but from a sustainability perspective also "future" impacts must be taken into account. To that end, all compounds that are persistent and foreign to nature should be phased out (recycling will not help for such compounds). It is possible that Matsushita are lucky and that only the commented chemicals are of interest. However, until a more thorough analysis of all chemicals that are involved in the production of TV's have been made, this remains a big question mark and must be noted as a "critical flow of chemicals at Matsushita". What are – for instance – the directives of Matsushita as regards the purchase of chemicals – are they based on impacts and known toxic effects, or the sustainability criteria "persistent and foreign to Nature"? What are the additives in the applied plastics? Are there any questions posed to suppliers as regards *their* use of various chemicals that are persistent and foreign to nature? What about persistent compounds foreign to Nature in paints, lacquers, plating, and all kinds of resinous materials?

S.C. III.

It is good that papers for packaging are made from recycled materials. However, suppliers should also, for the future, be made aware by Matsushita that forests need to be handled in a sustainable way. Finally, it is important to – for the future – extend Matsushita's concerns to the effects on natural systems by the mining processes. Many mining companies have started to restore natural systems after mining, and

from a sustainability perspective such development in the mining industry should be supported by big purchasers like Matsushita. It is done by asking questions of this kind, and being aware of the situation. The switch to Magnesium from plastics should be regarded also in this context – what about strip mining in the magnesium industry?

S.C. IV.
From a human point of view, many of Matsushita's plans are very promising. Energy-efficiency and reduced emissions of CO_2 is an important issue from a global human perspective, not the least because – it is poor countries in the world that seem particularly at risk when it comes to this problem (which is an indirect problem related to S.C. I). It is also good that Matsushita has long-term plans to further its already high standards as regards recycling of materials, amongst other things because scarce metals and the prices of those will be a future constraint for the developing world. However, the developing world is not commented on. No comments at all are provided as regards restoring ecosystems after strip-mining in developing countries, social costs on raw-materials from developing countries, or the future design of TV's and TV infrastructures to fit the needs of the developing world

3. Sustainable marketing and societal outreach. The focus on "marketing from a sustainability perspective" is on the social outreach by individual companies – actively influencing society at large to support sustainable development. Examples are dialogues with universities and business partners that can lead to governmental committees implementing (i) legislation against problematic materials and practices, (ii) influencing tax-reforms to support sustainable development, (iii) getting prices high enough on the depositing of scrap and on extraction of virgin materials and fossil fuels, (iv) the value high enough on recycled materials, (v) and more efficient societal infrastructures for recycling. Other examples are marketing campaigns to promote customer awareness of sustainable development, implementing new business models with for instance leasing systems, and cooperation with other firms to push prices down on sustainable alternatives etc. A very good example of outreach from Matsushita is the offered possibility to repair TV's – an important and efficient, yet poorly exploited way of dematerialization for the modern world. Customers can look at Matsushita's home page and find out the nearest Matsushita shop, where they can leave their broken TV. To enable this, Matsushita has built a new factory for the purpose. This is a very proactive measure, not the least because today's prices and costs are such that the relatively labor intensive repairing is often considered more expensive than for wasting of natural resources. Such things are not yet traditional mainstream activities for most business corporations, but the for the future the picture is very clear – the sustainable company must have societal outreach as one of its main strategic assets. For sustainability, it is essential that Matsushita elaborates – on top executive level – the full potential of societal outreach.

Refrigerators

1. ***Global market situation***. It is concluded that Matsushita has a good view on the applicability of refrigerators as a potential saver of food-resources in the modern society, and to keep food healthy and nutritious at home. For the future, freeze cooking provides an interesting resource saving alternative. From Matsushita's answers, it seems that recycling of refrigerators is currently a greater problem than for TV's. No notion is made as regards plans of Matsushita to "seeking a business model which is not confined to sell Refrigerators conventionally". This is of particular interest in light of the currently low recycling rates. It is good that Matsushita has developed plans to make lighter and more energy efficient refrigerators, but this is not enough. It is not commented by Matsushita if there are any plans for the future to build all refrigerators on recycled materials. No comments at all about the business potentials of Refrigerators in the developing world are presented.

2. ***Principle product***. It is good that Matsushita is working more on making refrigerators lighter. Further lightening is possible if compressor, fan motors and coolers can be made lighter, but there is no notion made on concrete plans along those lines. It is also desirable that Matsushita has made remarkable progress as regards energy efficiency – modern refrigerators using 81% less energy than in 1995. The dematerialization aspects as regards preparing refrigerators for recycling are not mentioned. The number of plastics are reduced to enable recycling, but no figures are mentioned. Besides the comments on dematerialization aspects, the following comments regarding substitutions of materials can be made:

   S.C. I
   The use of Fe and Al are ecologically relatively benign materials. Recycling of metals does not work yet, but it is good that Matsushita has started to make plans for recycling of metals. Plans are under way to phase out Pb. Hg and Cd are already phased out. Cu is presented by Matsushita as a benign material too, in consideration of that it is relatively easy to recycle. Cu poses a future sustainability problem, since it is relatively scarce in nature and since it is already increasing in concentration in many societies' sewer sludge and soils. Furthermore, Cu may pose a sustainability problem also from an availability perspective, since its natural reserves are declining. Future generations may perceive Cu as such a scarce and important material, that it shouldn't be used today but for very controlled and technically tight systems where no better alternative exists – electronics for instance.

   S.C. II
   It is good that Fluorocarbons are phased out. And the switch to R600a is an example of a satisfactory substitute, since it is degradable and therefore – in the planned production volumes and realistic leakages in the future – will not increase in concentration in ecosystems. However, for the future it is important not to evaluate chemicals only with reference to their current impacts, such as their "index on the green house effect". There are two reasons for this – if compounds are easily degradable and will only leak out in small amounts, there will be no impacts. Second, if compounds are not degradable and still will leak out, there are risks that they will

increase in concentration in the future. Such compounds are inherently not sustainable, even if we don't know their "impacts" yet. To that end, all compounds that are persistent and foreign to nature should be phased out (recycling will not help). It is possible that Matsushita are lucky and that only the chemicals they have commented on are of interest. However, until a more thorough analysis of all chemicals that are involved in the production of refrigerators has been made, this remains a big question mark and must be noted as a "critical flow of chemicals at Matsushita". What are – for instance – the directives of Matsushita as regards the purchase of chemicals – are they based on impacts and known toxic effects, or the sustainability criteria "persistent and foreign to Nature"? What are the additives in the applied plastics? Are there any questions posed to suppliers as regards *their* use of various chemicals that are persistent and foreign to nature? What about persistent compounds foreign to Nature in paints, lacquers, plating, and all kinds of resinous materials? Finally, plans to phase out PVC is noted specifically. It cannot be excluded that this material holds a sustainability potential for the future, since it is possible to produce it without heavy metals or persistent additives that are foreign to nature, and since PVC does not shed PVC molecules to nature. The notion of future PVC potentials is made by TNS as an alternative to other materials – such as cupper – that are more difficult to justify as a sustainable alternative.

S.C. III

It is good that papers for packaging are made from recycled materials. However, suppliers should also, for the future, be made aware by Matsushita that forests need to be handled in a sustainable way. Finally, it is important to – for the future – extend Matsushita's concerns to the effects on natural systems by the mining processes. Many mining companies have started to restore natural systems after mining and from a sustainability perspective such development in the mining industry should be supported by big purchasers like Matsushita. It is done by asking questions of this kind, and being aware of the situation.

S.C. IV

From a human point of view, many of Matsushita's plans are very promising. Energy-efficiency and reduced emissions of CO_2 is an important issue from a global human perspective, not the least because it is poor countries in the world that seem particularly at risk when it comes to this problem (which is an indirect problem related to S.C. 1). It is also beneficial from a human point of view, that Matsushita has long-term plans to improve its standards as regards recycling of materials, amongst other things because scarce metals and the prices of those will be a future constraint for the developing world. However, the developing world is not commented on. No comments at all are provided as regards restoring ecosystems after strip-mining in developing countries, social costs on raw-materials from developing countries, or the future design of refrigerators and societal infrastructures to fit the needs of the developing world.

3. Sustainable marketing and societal outreach. The focus on "marketing from a sustainability perspective" is on the social outreach by individual companies – actively influencing society at large to support sustainable development. Examples are dialogues with universities and business partners that can lead to governmental committees

implementing (i) legislation against problematic materials and practices, (ii) influencing tax-reforms to support sustainable development, (iii) getting prices high enough on the depositing of scrap and on extraction of virgin materials and fossil fuels, (iv) the value high enough on recycled materials, (v) and more efficient societal infrastructures for recycling. Other examples are marketing campaigns to promote customer awareness of sustainable development, implementing new business models with for instance leasing systems, and cooperation with other firms to push prices down on sustainable alternatives etc. Examples of Matsushita outreach is that the development of freon-free refrigerators occurred together with another firm – Hitachi. Another example is outreach to customers – Matsushita is displaying on the door of refrigerators how much Electricity they use, and in the catalogue customers can read about different ways of saving energy. It seems that Matsushita could do much more along these lines. They are not yet traditional mainstream activities for most business corporations, but the for the future the picture is very clear – the sustainable company must have societal outreach as one of its main strategic assets.