Background Report on the Natural Resource Strategy for Finland:

Natural Resources – An Opportunity for Change

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FOREWORD

As a result of population growth and the rise of living standards, land, clean air and water, energy sources, and fibres and metals have become more valuable and environmental problems have multiplied. Societal and political interest in the use of natural resources is increasing, and natural resource policy is gaining space on the international policy agenda. This supports the notion that environmental and market changes can be variously reflected in countries with different natural resources, consumption structures and population bases. This gives rise to alarming threats, but also to demand and opportunities for new forms of business activity.

Relative to population, there are abundant natural resources in Finland. There are opportunities for Finland to act wisely in this respect in a world of otherwise scarce natural resources. We have the brains, land, biomass, water and minerals that are needed. By utilizing domestic natural resources sustainably we can generate employment and new enterprises. This demands that ecosystems are cared for.

The economic, technological and political links between various natural resources and their forms of use are becoming more complex. The solutions to one set of problems, without a vision of the broader ramifications and interactions, can give rise to new difficulties concerning a second group of problems. This is why there is a need for a strategy that comprehensively scrutinizes the different natural resources. The Natural Resource Strategy for Finland, which brings together various natural resources and transcends sectoral boundaries, is one of the first such initiatives in the world. The strategy will seek to create the volition, which will lead to the cooperation of business life, the public administration, research and civil society, from the perspective of Finland's future success, in a development project on the necessary use of natural resources.

We have many sound reasons to make an integrated resource strategy in good time. It is important to Finland to be at the forefront of international developments on natural resources. Our approach now in developing the strategy, as with the multi sector composition of the strategy group, is of broad interest.

The idea of compiling the Natural Resource Strategy for Finland came about as a result of the private and public sector preliminary report of the Luodin project. Sitra, the Finnish Innovation Fund, assumed responsibility for the planning and coordination of the strategy work, as well as related reporting. The strategy has been published separately. This background report brings together material and lines of approach generated during the work. Eero Mikkola, of the Finnish Forest Research Institute was in charge of preparing the report.

The Natural Resource Strategy for Finland was drawn up in broad collaboration with policy makers, the administration, business, research and organizations, and with representatives of the media. Representatives from different natural resource sectors played a versatile role in the work. I offer my warm thanks to the members of the strategy group and to the specialists (see Appendix) who took part for their enthusiasm and active input in compiling the strategy amidst a tight schedule during winter 2008-09.

Much credit goes to Sitra for making this strategy process, which deals with a crucial issue from Finland's perspective regarding the future, possible. On behalf of the strategy group my thanks go to Sitra's natural resources team – Eeva Hellström (project director), Eero Mikkola, Tapio Anttila, Jaana Roos, Jonna Stenman and Johanna Soininen – for their excellent organization of the workshops and their competent support at all stages of what was an intensive working process.

26 March 2009

Sirkka Hautojärvi
Chairperson of the strategy group
Natural Resource Strategy for Finland

SUMMARY

As a result of population growth and the increase in consumption, the use of natural resources is increasing and the global competition for raw materials is becoming tougher. This increases the negative impacts on the environment. Rapid changes in the operational environment emphasize the need to reform production and consumption structures. It is important to be able to make wellbeing and prosperity more sustainable. This requires new global operational models in business activity, policy and daily behaviour.

The Natural Resource Strategy for Finland was prepared during winter 2008-09 as a project coordinated by Sitra. A strategy working group, comprising a diverse representation from policy, administration, business, research, organizations and the media prepared the strategy . A broad network of experts was convened to help with the work, and all those who were interested were offered the opportunity to take part via the open web tool. The strategy has been published separately. This background report comprises material compiled during the work and in support of the strategy.

Climate change, the carbon cycle and greenhouse gasses represent a crucial global challenge. Though it may be possible to halt climate change, the growing demand for the Earth's natural resources represents an important economic, ecological and social problem. Businesses and societies can no longer build their success on the basis of traditional relative advantage – such as abundant natural resources – as the key inputs are non-material and circulate internationally. Many natural resources are not traded on traditional markets or else the markets for them are in some respects fragmentary. It is hard to predict what the important natural resources of the future will be and what amount of individual natural resources will be used. The manufactured products and the services derived from them are constantly changing.

There is a need for a comprehensive systematic approach in natural resource issues that takes account of different phenomena and the mutual linkages and interactions of individual actions on both national and multinational levels. The process of examination must be holistic and the nature of the activity must be flexible. There are six key areas that were identified in drawing up the natural resource strategy, the structures of which must simultaneously alter in order to be able to reach the desired direction and to realize the objectives. This report describes the present state of their areas of change and their developmental needs.

1. In the **bioeconomy** of the new generation the wide range of fibres and chemical compounds derived from biomass, as well as biological processes act as sources forinnovations that offer diverse opportunities for bringing about added value and wellbeing.

2. In an efficient **material cycle** the natural resources taken into use by society are considered within the sphere of the economic system as producing the greatest possible added value and that as few valuable materials as possible permanently leave the economic system.

3. Many natural resources are geographically fixed and of great regional and local importance. Production models for **regional resources** reduce the need for natural resource transport, increase security of supply and safeguard wellbeing at local levels.

4. Issues concerning natural resources do not comply with national or organizational boarders. Lively **international cooperation** and activity increase Finland's global partnerships and create opportunities for business activities and competitive advantage.

5. In order for Finland to be a favourable and attractive operating environment for firms able to use natural resources successfully and sustainably, the innovation system, physical infrastructure, economic policies, **administration and coordination** must provide the necessary conditions.

6. **Expertise and communications** play a central role in identifying the need for change and in accomplishing change. There is a growing need for holistic understanding, expertise and incentives for consumers concerning issues of natural resources.

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1 INTRODUCTION

1.1 Natural resource questions as future issues

Natural resources satisfy immediate needs in terms of people's well-being and the economy. The use of natural resources increases and negative impacts on the environment multiply due to the growth in population and consumption. For instance, biodiversity is declining, the functioning of ecosystems is being impaired and greenhouse emissions are increasing. Climate chance affects the quantity, quality, spatial distribution and usability of many natural resources.

Global competition for raw materials is becoming tougher. There is a scarcity of productive land and fresh water. Competition is intensifying the growth of demand on the biomass. The competition for natural resources is altering the nature of global power relations and can undermine common security. It is important to make welfare and prosperity more sustainable than in the past. This requires that we renew global operational models in business activity, policy and daily use.

> **Swift changes in the operational environment highlight the need for a reform of production and consumption structures**

Finland's well-being is heavily dependent on wood and minerals for supporting export products, and in this natural resources play an important part. The availability and reasonable costs are decisive in terms of the economic stability of both Finland and the EU. The EU has many raw material deposits, the exploration and extraction of which are facing increased competition for different land uses and a highly regulated environment.

Climate and energy issues strongly determine the discourse on environmental policy. Natural resource policy, in which attention is paid to the different facets of sustainable development – ecological, social and economic – supports climate policy, but there is a need and demand for it independent of climate policy.

It is more difficult than ever to anticipate natural resource use and to understand the inter-linkages between materials flows, environmental factors, climate change and supervision, which is why there is a growing need to scrutinize multiple interactions and changes. This sets challenges and opportunities for sustainable development and competitiveness that greatly affect both the international community and Finnish society and economic life. The international community has already started to pay attention to the issue, with the creation of the UN expert panel on the exploitation of natural resources. The EU has also acted proactively in natural resource issues.

Swift changes in the operational environment highlight the need for a reform of production and consumption structures. In the future there will be a need for investments for successful sustainable production and cherishing natural resources, and for expertise that support competitiveness, employment and regional development. At the same time, we can export our high-level expertise, take the initiative in international policy settings and bear our share of global responsibility.

The use of natural resources is affected by the functionality of markets, production factors, national and international guidelines and consumer demand. Urbanisation weakens people's ties to nature, and yet climate change and the impoverishment of biodiversity are increasing people's environmental awareness.

Finland does not, however, have a natural resource strategy that at the same time considers all natural resources and their inter-linkages, though there are many natural resource processes underway at both national and international levels.

The responsibility for directing natural resource use is divided among various administrative sectors. Issues of natural resources are to an increasing extent being touched on in national, regional and sectoral strategies and programmes. From the perspective of sustainable development and national competitiveness, it is important that programmes make up a whole, the different parts of which support one another.

Perspectives on natural resource issues define the problems, observed limits, prioritizing and model solutions concerning natural resources. Experts agree on many of the viewpoints concerning natural resources. They see the need for multivariate sustainable use, because the traditional outlook associated with the economy and competitiveness are insufficient, and in addition natural resources must be examines from environmental and social perspectives. The strategic significance of natural resources is seen to be growing, and Finland has much strength in the management of natural resources, including, for example, natural resource preponderance, technology, experts and a high quality environment.

Divergence in the viewpoints of experts in the natural resource sector emerges particularly over matters of individual natural resources, for instance concerning the sufficiency of various natural resources. Opinions on the state of biodiversity and the general need for environmental protection also vary greatly among different experts.

There is a need for a shared vision on natural resource use and the objectives and means of related controls, for safeguarding national well-being and bearing global responsibility. This requires the creation of a common strategy, in which different natural resources are examined together in the long-term and in which the sustainable development and national competitiveness viewpoints support each other.

1.2 The strategy as Finland's response

The Natural Resource Strategy for Finland was prepared during 2008-09 as a project coordinated by Sitra in broad cooperation with various partners. In drawing up the strategy there was a focus on the kinds of aims and measures to safeguard well-being in Finland based on diverse natural resources. The aims of preparing the strategy were:

- to draw up a long-term vision of well-being based on the sustainable use of natural resources;
- to set the goals that support this vision;
- to define the measures and means that support the goals, and
- to commit key actors to implementing development projects.

The main points of departure that emerged in drawing up the strategy were a predictive and innovative grasp of matters and the collaborative commitment of the different actors. The need for a comprehensive vision, on the other hand, emphasised natural resources in producing welfare services, the impact of their use and the growing multiplicity of global linkages in the use of natural resources. The aims was also to promote the bringing together of different views, setting shared goals, coordinating different processes and increasing the cooperation of actors for attaining goals.

The following starting points guided the preparation of the strategy:

- **Setting goals and defining means** sought to safeguard both the sustainable use of natural resources and the competitiveness of business activity based on natural resources.
- **The subjects examined** were natural resources that originate in or are used in Finland.
- Natural resource use was examined within **dynamic and systematic frames** of reference. It was important to be able to respond swiftly to the challenges set by a changing world and to understand natural resource use in aggregate, in which attention was paid to the main interactions of natural resource use within the framework of the strategy.
- Issues concerning natural resources were examined **over the long term**, thereby enabling prediction and innovative solutions.

The strategy working group, convened to prepare the strategy, comprised policy, administrative, business, research institution, interest group and media representatives (Appendix, the strategy group). The strategy was prepared mainly in the strategy working group's workshops, held between October 2008 and February 2009 (Figure 1). During this period the group worked for a total of 12 days. Early on in this period, an excursion to the US and Canada was made for the purposes of fact-finding for the strategy.

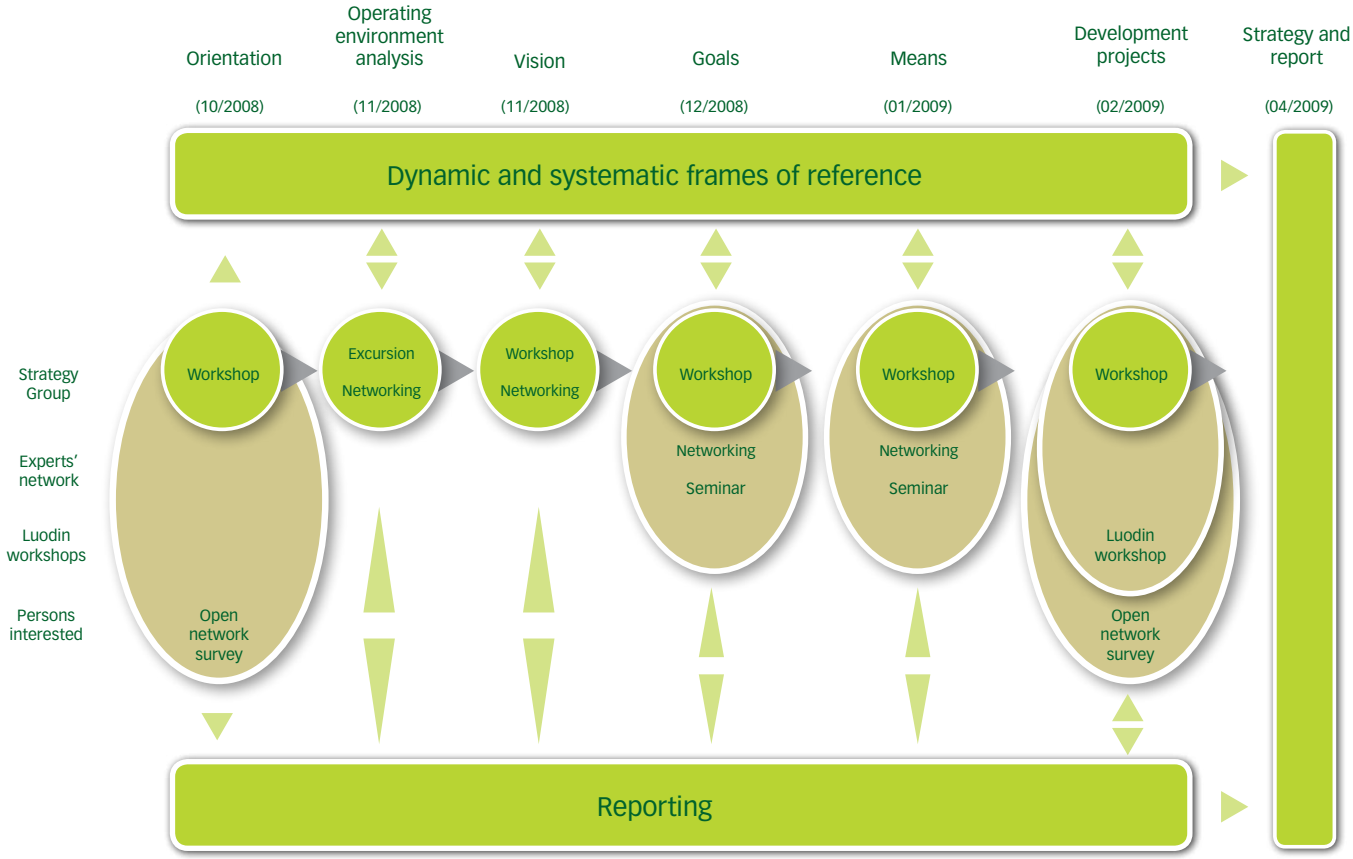


Figure 1. *The preparatory process of the Natural Resource Strategy.*

An **experts' network** was convened to support fact-finding, which supported the work of the strategy group, through networking and pre-workshop seminars, (Appendix, the experts' network).

Two seminars were arranged to further the interaction between the Strategy Group and the experts' network, in which the results of background reports were presented, presentations from experts were heard and a compilation of background materials produced by the experts' network was submitted.

Several background reports were drawn up to assist with the work. These dealt with issues such as worldviews associated with natural resource use and styles of argumentation, conceptions of natural resources, global trends and weak signals, and natural resource control and administrative structures. The results of the background reports and the experts' presentations at the seminars were published on the project's website.

Everyone interested in the subject matter of the strategy was offered the opportunity to convey points of view to the strategy working group using an open web tool. With the network tool one could familiarize oneself with the strategy's basic issues: what questions should the Natural Resource Strategy answer, and what development action does a strategy demand.

The strategy work drew on the results of the thematic study days of the Luodin communications campaign, jointly funded by a number of business and administrative sectors.

The results of the strategy work were submitted to the Prime Minister of Finland, Matti Vanhanen, and published in April 2009. Both the strategy and the background report produced for the project were published. This background report was drawn up as an ongoing process, in order that the strategy working group and the experts' network had a chance to comment on it during the working process.

The preliminary report on the development of dialogue and expertise on natural resources in Finland by the Luodin communication campaign, carried out by the Finnish Forest Association in broad collaboration with different administrative and business sectors, forms the background to the preparation of the Natural Resource Strategy. The Luodin steering group, representing a broad range of business and administrative sectors, proposed unanimously on the basis of a report prepared in 2008 that a Natural Resource Strategy for Finland be produced.

The Finnish Innovation Fund Sitra took charge of the preparation of the strategy. Its role in the strategy process was to plan the work, amass strategic information, invite the participants, arrange facilities for work, coordinate the work, and compile and report the results.

Responsibility for realization and development of the strategy lies with political decision-makers, those involved in the work and societal actors broadly.

1.3 Renewing concepts of natural resources

Traditional definitions of natural resources are often based on standpoints concerning raw materials. These reiterate the following three key points: the existence of natural deposits, being of value to people, and consisting of material (Figure 2). In the new definitions the commercial and productive exploitative perspective is supplemented with the environmental impact perspective. We are now at a point of transition to a comprehensive perspective that takes into account the economy, production and the environment, and their links to social and societal factors. The ecosystem approach is part of this transition.

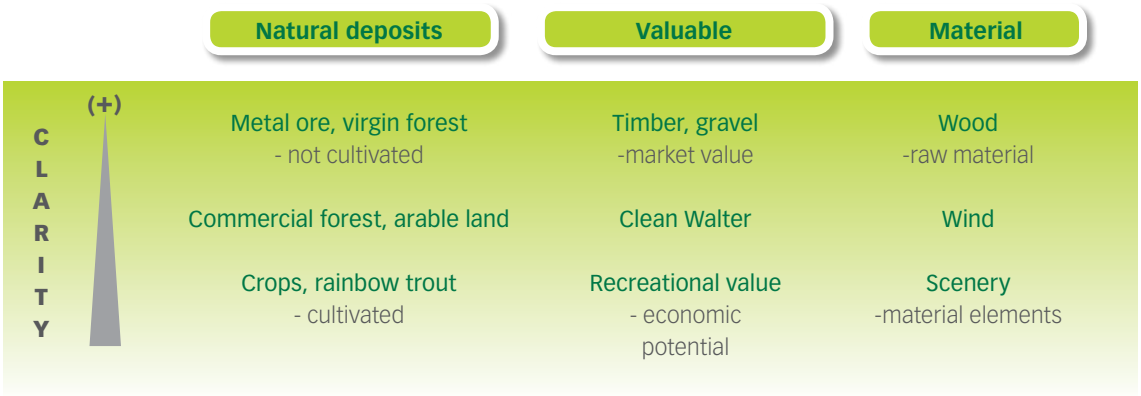


Figure 2. *Three key points in defining natural resources (Vuori & Kohonen, GTK, 2008).*

The ecosystem approach refers to the strategy for the use and conservation of natural resources, in which particular emphasis is given to the functioning interaction of ecosystems, and in which people and cultural diversity is regarded as a crucial aspect of ecosystems. Using the ecosystem approach we can tend to and manage organic and inorganic natural resources nearly entirely. Its purpose is to promote the equitable conservation and sustainable use of natural resources. According to the ecosystem approach organisms are considered according to the central processes, functions and interactions of their environments at all levels of natural diversity.

The multidimensionality of natural resources and their use is seen in premises of different classifications and definitions. Conceptions of natural resources can be seen as having a variety of needs and user groups.

In **natural science** the concepts have research as their starting point, and they relate to the origin of natural resources (non-renewable versus renewable natural resources), their composition (chemical, physical qualities), and location (vegetation or climatic zones).

In **social sciences** the concepts have research and management starting points, and they concern the value of natural resources (measurable monetarily, sustaining culture, production volume) commodity quality (legal angles, freely exploitable or under ownership, questions of possession), legislation (Land Extraction Act, Water Act), national economy, taxation, environment (matters essential to people, material – non-material) and physical space (land use planning).

In **production and the economy** the concepts are specific to fields of activity and production, and concern use (food, materials, energy production), availability (presumed, known, proven raw material resources), price (limiting value of utilization standard), dispensability, raw material classification and commerce.

Environmental concepts of natural resources are dynamic, target based and multidimensional. They involve ecological (ecosystems services, natural processes), conservation and use impacts (intrinsic value, numbers and biodiversity).

There is an increasing need for natural resource knowledge that surpasses sectoral fields. If we wish to improve the understanding and overall vision across sectoral limits, natural resource concepts need to be harmonised, and statistics and data systems upgraded.

The ecosystem approach offers the means to produce such information systematically. The functionality of ecosystems services, and ecological and social processes are at the heart of the approach. In this way social information becomes defined as a part of natural resource information. In the ecosystem approach attention is paid above all to the various administrative and institutional structures, and operational terms, within the frameworks of which knowledge is produced and controlled, and decisions taken.

1.4 Finland's natural resources and material flows

In terms of amount, overwhelmingly the most important disposable natural resource in Finland is water. Public waterworks pump some 400 million cubic metres of it each year. This roughly corresponds in volume to all other natural resource use in material and energy output. Aside from water, the most important natural resources are rock and soil materials, biomass and flows of by-products. These are predominantly obtained from domestic sources (Figure 3).

Over 120 million tonnes of rock and soil materials a year. Rock materials are needed in all areas of construction – road, rail track, bridge and housing construction, and it is the basic composite for materials such as concrete, plaster, glass, cement and asphalt. Finland's bedrock is rich in mineral deposits. This is the basis for the country's long history of mining, which is also a crucial feature of our overall industrial history. The mining industry has provided good conditions for increasing employment and well-being, particularly in remote areas, as well as for the formation of so-called downstream industries. As a result of the historic background and development of this expertise in mining, Finland also enjoys a high level of expertise by international standards, which has been exported successfully to other parts of the world. Important new mining operations have been started in recent years.

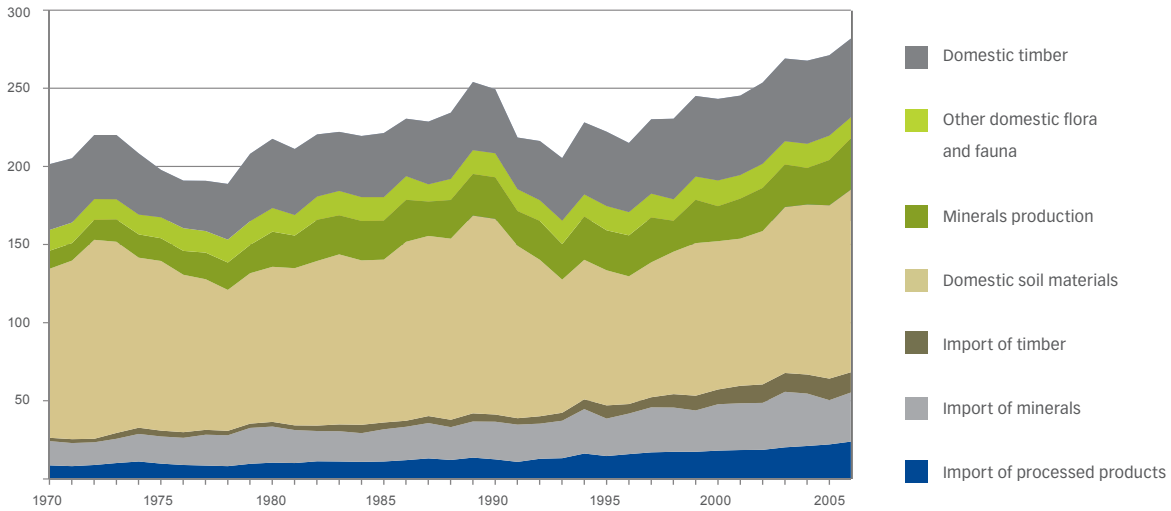


Figure 3. *Finland's direct material inputs by type of material, million tonnes (source: Thule Institute).*

Forestry accounts for 86%, or 26 million hectares, of Finland's total land area. Of this 20 million hectares comprises forestland with a growing potential ideally suited to timber production. In recent years the Finnish forest industry has been increasingly oriented towards sustainable forestry practices. Forests are tended, used and protected so that they provide as much work and livelihood as possible for people in Finland, develop their viability and variety and provide people with both mental and physical recreation.

Finland's national economy is strongly linked to global material flows

Wood is a more important natural resource to Finland than to any other country in Europe. Though Finland's forests only account for a small part of the world's forest cover, Finland is a leading exporter of paper. Efficient use of raw materials by the forest industry has led to Finland being a European leader in the use of bioenergy. A quarter of Finland's annual energy consumption is produced by various biofuels. The forest industry's share of biofuel production is 80%. Biofuel is often used as fuel in the joint production of heating and electricity, in which Finland is a world leader. Joint production is an efficient and environmentally friendly way of producing energy, because its efficiency coefficient is 85-90%. The burning of fuel peat for energy is also a facet of Finland's use of natural resources. Fuel peat accounts for about six percent of energy production in Finland, the second highest in the world after Ireland where it is about 10%.

However, almost 70% of energy used in Finland is imported from abroad as non-renewable natural resources, because Finland does not possess fossil fuels. These are found in abundance in neighbouring Russia. This represents both an advantage and disadvantage. On the one hand, energy resources are available within fairly short transport distances and Finland benefits from their further refining. On the other, the proximity of Russia has made Finland highly dependent on its energy deliveries. In order to improve security of supply, Finland is trying to use as many different energy sources as possible, and several domestic natural resources are being used for energy production. Many of these are still in trial use or significant investments need to be made to expand their application.

Agriculture is practiced throughout Finland. Arable land accounts for about eight percent of land cover. The proportion of arable land varies greatly from one part of the country to another. In the agricultural centres of southern and western Finland, arable land accounts for about 30% of land cover, some 10% in the central part of the country, and less than five percent in the north. Climatic conditions and the regional location of livestock farming are clearly reflected in the division of arable land use throughout the country. In terms of Finland's biodiversity arable land holds a greater importance than could be deduced from their land cover.

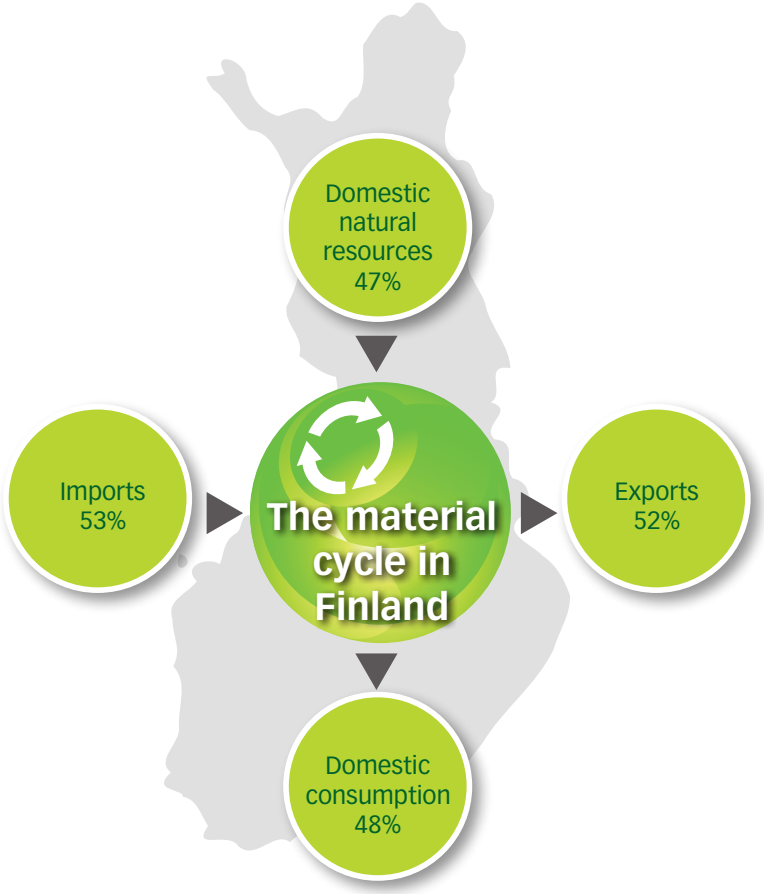


Figure 4. *Material flows in Finland 2005. The material cycle includes flows of both materials and energy (Source: ENVIMAT 2009, Finnish Environment Institute).*

The use of different natural resources in Finland in the last few years has, with the exception of coal, remained the same or has increased slightly. There has been a significant annual fluctuation in the production of peat fuel and coal as a result of climatic factors and the need for substitute fuels. According to Customs' import and export figures, in 2007 raw materials (fuel) worth €6,330 billion were imported to Finland, while exports of them amounted to €3,854 billion in value. The proportion of raw materials imported in terms of overall production was 10.6%. There was appreciably more electricity imported to Finland than was exported from it to other countries. The net import of electricity has amounted to between 12-20% of electricity consumption. Over half of electricity imports are from Russian nuclear energy. Most electricity produced by the Nordic countries comes from hydroelectric power stations, though some comes from coal.

Finland's national economy is strongly linked to global material flows. The flows of materials via Finland are extensive. Half of the materials needed for the country's production and end use come from abroad and about half from natural sources in Finland (Figure 4). The most important imported raw materials are metals, minerals, chemicals and fuel needed by the forest, metal and chemicals industries. Correspondingly, half of the material flows we use go into exports and half are used domestically.

Strategic natural resources are resources that make possible long-term competitive advantage, the added value of the economy and societal wellbeing. The largest material flows of current domestic strategic natural resources are based on soil materials, minerals, wood and peat. Of these, wood and minerals are manufactured chiefly for export, while soil materials and peat are mainly used in Finland. Other strategically important domestic natural resources include clean water and air, natural products, the fertile surface area of arable land and unbuilt-up land.

Imported raw materials that we process for market can also be strategic in importance, if there is an important added value in their processing when in Finland. These may include such things as durable manufactured products, safety, purity, a reputable name or innovative technology, and high-level expertise. The largest material flows of our strategic imported natural resources are metals, minerals and chemicals for the forestry, metal and chemical industry.

Critical natural resources are necessary for life itself, the functioning of society or for the use of strategic natural resources. The majority of Finland's critical natural resources are imported natural resources. They include many fuels, the raw materials of fertilizers, and high tech metals. Domestic natural resources may also be critical when imported ones cannot easily replace them. During a dry season, for instance, water can be a critical natural resource locally even in Finland.

We are living in a time of transition, in which the control of natural resources requires a new way of combining the economy of resources and expertise. Finland has the opportunity to achieve a competitive edge, create wellbeing and shoulder its global responsibility. There is a need for a long-term vision of the means and objectives by which Finland can prosper in the future.

As a country relatively rich in natural resources and a high degree of expertise, Finland has a particularly strong interest in promoting the sustainable and innovative use of natural resources. There is a need for a long-term vision of the means and objectives by which Finland can prosper in the future.

2 THE FUTURE IS THE SUM OF MANY PARTS

2.1 Climate change – a challenge for energy and water management

Human activity is changing the composition of our planet's atmosphere. The heating-up of the climate refers to the rise in the average temperature of the lower atmosphere and the oceans and the estimated continuation of this increase. The term climate change is also used for this phenomenon in general discourse.

According to the Intergovernmental Panel on Climate Change, atmospheric warming is irrefutable on the basis of direct observation. In all likelihood it is caused for the most part by greenhouse gas emissions caused by humanity. These come about from, among other things, the burning of fossil fuels, from land clearance and agriculture. Increasing levels of greenhouse gasses lead to the warming of the earth's surface and the lower atmosphere by the accelerating greenhouse effect. On a global level the increase in temperatures has numerous effects on natural resources, such as the rise in sea level and changes in rainfall, estimated to result in more frequent and powerful extreme weather conditions. Other consequences include changes in cultivation zones, the shrinking of the ice sheets and the extinction of animal species. As a result of these changes, some natural resources will become abundant while others will become scarce.

The trade in carbon emissions means that it is possible to trade the emission allowanced. The trade in emissions is based on the thinking that emissions can be reduced at the point where it is most cost effective – cheapest – to do so. EU member states have set a common maximum limit of greenhouse emissions, in accordance with the UN Kyoto Protocol. Other countries, such as Japan, also have their own emission trading scheme. Under the EU's Emission Trading Scheme production plants causing greenhouse emissions can apply for emission allowances, and can buy more of them or sell them. More such allowances are bought if the production plant produces more greenhouse gases than it is permitted, while on the other hand emission allowances can be sold, if fewer emissions are produced. Because most countries are a part of emission trading schemes, admission allowances are gradually acquiring a world market price, which corresponds to the cost levels of abatement opportunity in use at each moment.

> **“ As a result of these changes, some natural resources will become abundant while others will become scarce**

The term carbon footprint refers to the impact on global warming of each individual person, organization, event or product. Each person has an effect on the global warming, and nearly every human activity leaves a carbon footprint, signifying the quantity of greenhouse emissions have been produced by our actions. Personal greenhouse gas emission quotas have been most actively taken up in the UK. Quotas work in the same way as carbon trading. Those who pollute the least can sell off their quotas to another person, who can then pollute more.

Peak oil has been under discussion in recent years, referring to the point at which the maximum rate of oil production is reached, after which it inevitably starts to go into decline for physical and geological reasons. The actual peak year is only realised when oil production has already been declining for several years. Peal oil does not mean that oil is running out, rather the achievement of maximum oil production, after which oil cannot be produced as abundantly as before. At the same time, while the exploitation of oil and gas deposits around the world is hampered by reserves running dry, there are long-term plans to exploit oil and gas deposits in the Polar Regions. It is estimated that a fifth of the world's as yet undiscovered oil and gas reserves are to be found in the Arctic.

Climate change and the extreme fluctuations in the price of oil and natural gas hinder the demand for and the broader use of renewable energy, which is expected to multiply by 2050. Renewable energy sources based on environmental considerations are particularly favoured in countries that aim to cut greenhouse gas emissions. The coming of personal greenhouse gas emission quotas will probably further strengthen the popularity of renewable energy sources. Political decisions to increase the use of renewable energy in electricity production support the development of renewable energy while its price is not yet competitive compared to fossil fuels. It is estimated that the demand for renewable energy will increase by 2.1% a year.

Weak signals – Congested Finland shift to Lapland

Weak signals are signs, observations and phenomena that in the future could emerge as important, definite trends or in coming about strongly affect decision-making or the work of systems in the natural resource sector. The usual feature of weak signals is that there are conflicting opinions on the probability of their being realized and their impact. There have been many sudden events in history the advent of which only a few people would have been able to guess or predict, but which have had significantly broad impacts and have altered the course of daily existence. Weak signals are by definition extremely difficult to recognize, but the effort to think the impossible can be repaid in the form of new ideas and provision for new courses of development. At the start of the strategy process possible, though improbable, future developments that might affect Finland's use of natural resources were roughed out.

One scenario depicted the shift of traffic congestion in Finland to Lapland. With the continued climate change the Earth's temperatures would continue to rise, a result of which would be that the Arctic Ocean would melt. This would cause the opening of the Northeast Passage. The Northeast Passage is the shortest sea route from north Europe to Asia, and because of this a considerable portion of Asian cargo traffic would shift to northern ports. Shipping companies would proliferate and ports would expand. The rise in temperature would improve farming conditions in Lapland. Cities in southern Finland would suffer heavily from the rise in sea level, which would cause large areas to become submerged.

Finland would become oriented more from south to north: in Lapland there would be more industry, jobs and infrastructure, and people would move there from other parts of Finland. Because the climate would have heated up and cultivation in many places in Asia would have become impossible, environmental refugees would stream from Asia to Finland, and particularly to the north. Many areas in southern Europe would be without clean water, due to climate warming and the rise of sea level: water refugees would also come to Finland from within Europe. There would be a surfeit of job seekers. The sea route to Asia would draw travellers, because air travel would have diminished. Northern travel would increase.

According to a report of the Finnish Environment Institute, the increase in the use of renewable energy may affect biodiversity. The impact of solar energy and wind-power on biodiversity are minimal, in part even positive. However, a heavy increase in the use of forest and field energy could cause problems.

Less than one percent of water in the world is useable fresh water. According to the UNDP, in the future many of the places in the world that suffer from lack of clean water will become worse afflicted. In addition, it is increasingly hard to predict the predisposition to extremes of rainfall and water availability. It is reckoned that climate change will reduce the availability of fresh water throughout Asia, especially in the regions of great rivers. Agricultural output and food availability will be seriously weakened throughout Africa. In some countries, crops that depend on rains may be reduced by up to 50% by 2020. Precipitation will become less and evaporation will increase, hindering water availability.

The water footprint is the analogue of the carbon footprint in water management. The water footprint means the amount of water needed for all consumption. The footprint can be calculated for a single person, for a company or an entire country. The average water footprint of a person in Finland is on average 1,700 cubic meters a year. Of this only 3% accounts for an individual's use of the domestic water, while the remaining 97% is indirect water, which means the water used for goods throughout his/her life cycle. If global consumption and growth forecasts come about, the lack of water will worsen throughout the world. Used water is returned to nature, but not necessarily to its own ecosystem's cycle. Furthermore, water returned to nature may be polluted.

2.2 Material flows are growing and becoming more complex

The per capita consumption of materials in the industrial countries is 31-74 tonnes. Already, humanity as a whole uses 30% more natural resources each year than the Earth is able to produce. If everyone starts to use as much materials for the next 50 years and if the world's population grows in that time to nine billion, the consumption of the world's resources will be 279-666 billion tonnes. This would mean an increase in material flows by two-fold or even five-fold.

Continued population growth is a central threat to the future of the planet and an obstacle to sustainable development. Increasingly more natural resources are needed to feed and support the growing population. The greatest pressure is on food production. A particular problem with population growth is that it is focussed mostly on those areas where the socioeconomic situation is worst and technology least developed. Consequently, pressure on the environment and natural resources is pronounced. Technological and economic development often leads to an increase in households. People can increasingly afford their own home, and so fewer people live in a single household. This further increases the use of natural resources. The global demand for raw materials and competition is getting tougher.

The amounts of natural resources used, the manufactured products and services from them and technological applications are constantly changing. Due to technological innovation, some natural resources can be taken out of use, while on the other hand the use of others is increasing. For instance, the development of information technology has increased the demand for rare metals. Most reports suggest that there are significant differences in the development trends concerning materials, energy and different natural resource groups.

Calculations of material flows have indicated that the efficiency of the use of materials is growing. They do not, however, indicate what are the material effects on the environment. The compilation of comprehensive data and the updating of know-how concerning material flows are necessary activities, which could identify changes taking place concerning material flows in structures and in their environmental impact (Figure 5).

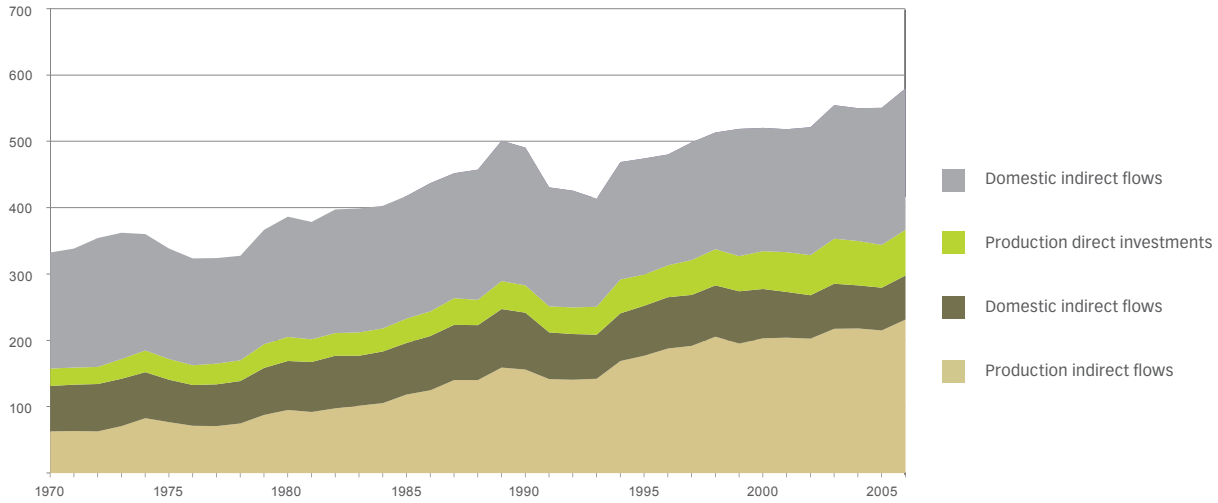


Figure 5. *The material flows of production are continually increasing, million tonnes (Source: Thule Institute).*

Energy is the primary resource of our economy, and it is estimated that the absolute quantity of its total demand and consumption will grow significantly in coming decades. In order to understand the potential effects of this development on the environment, careful assessment must be made of the impacts of different energy alternatives on material flows, and their interaction with different environmental contributory factors.
The use of physical space (land and water) for construction or infrastructure has increased in Europe, with the result that the number of producer countries is decreasing, competition for various alternative forms of land use is increasing and natural areas are becoming fragmented.

Natural resource policy tries to ensure the renewal of natural resources and their sustainable use. Anti-pollution policy and waste management policy, on the other hand, tries to reduce as much as possible the amount of hazardous materials spread to the environment. The life cycle of natural resources used in the economy involves several stages, and it has only been recently that attention has started to be paid to the initial and end stages, in addition to the intermediate stage. There is a need to understand the beginning, end and middle stages of the life cycle of environmental impacts of natural resource use in their entirety.

“ **It is important that information concerning material flows is easily available to decision-makers and that knowledge gaps are filled.**

The flow of natural resources directed at our economy is well known on a general level. However, any raw material that is brought into the economy splits up into several branches, the knowledge of which is scattered among many different actors. At the same time, many important gaps come about in the knowledge of material flows. It is important that information concerning material flows is easily available to decision-makers and that knowledge gaps are filled.

2.3 Markets in flux

Businesses and societies can no longer build their success on the basis of traditional relative advantage – such as abundant natural resources – as the key inputs, such as knowledge and expertise, are intangible and circulate internationally. In Finland, this change is seen in the production orientation of the forest industry and as changes in the raw materials base. At the same time, the rapid fluctuation in demand for minerals industry products is altering the use of soil materials and metals.

Many natural resources are not traded on the traditional markets, or their markets are in certain respects fragmentary. Almost all such natural resources, which do not come within the sphere of the market economy, are immaterial natural resources that are not owned. They include the atmosphere, most water and part of the ecosystems services provided by nature. Some natural resources are nevertheless in private ownership, for example mineral mines, and they can trade in the usual way. The sizeable public ownership of natural resources interferes with most natural resource markets. On the other hand, countries try to direct the use of natural resources in private ownership by various takes and duties. Governments can also direct marketing by distributing information on the products they seek or by funding the kinds of research they want.

Natural resources traverse the world and they are traded extensively. The natural resources for markets are strongly polarised in character. For instance, the EU is the world’s largest user of metals, and yet only 5% of the world’s mineral industrial production originates from the EU area.

Despite noble efforts, international trade is not always egalitarian. For historical reasons the international trading system has been constructed on the terms of industrial countries. The needs of developing countries trading natural resources as industrial raw materials are quite different from those of countries exporting highly refined products, such as high-level electronics. Furthermore, it is a particular challenge for developing countries to manage to increase their international trading in such a way that the benefits are distributed evenly and increase the wellbeing of the whole population.

International trade is of crucial importance to Finland: exports make up about a third of our entire domestic product. With the exception of wood and a few minerals, Finland is dependent on imports of raw materials, energy and components. Finland's trade policy has been traditionally directed at removing obstacles to trade and investment and on active involvement in the open global economy. In international trade decisions Finland has put an emphasis on multilateralism. Multilateral solutions enable the best opportunities on the field of play for a small and open economy like Finland's.

The short-term price fluctuations of raw materials, which are difficult to predict, have proven themselves to be particularly sensitive to change. Uncertainty in the international market further complicates forecasting the natural resources markets.

It is hard to tell what will be the most important natural resources in the future. The demand and supply of future natural resources are impeded by such things as climate change, mounting regulations, global political power relations and technological innovations. Due to this the availability of some natural resources may ease and other become more difficult. In addition, we may learn to identify and make use of quite new natural resources. For instance, the importance of non-material natural resources will increase in the future. Society is trying to direct material flows in many ways. Choices must be rooted in an understanding of what are important natural resources both from the perspective of today and the future.

2.4 Concern for security of supply

The scarcity of natural resources is nowadays less a cause for concern than the environmental impacts of their use. For example, the greenhouse gasses caused by fossil fuels are more of a problem than the depletion of their reserves. At the same time, the scarcity of certain non-renewable natural resources can constitute a serious threat to sustainable development. Notwithstanding the sufficiency of global reserves, the availability of natural resources may be weakened for geopolitical reasons, and the possibility of this needs to be taken into account from the perspective of sustainable development even in Finland.

> **“ The EU is dependent on high-tech metals**

The EU is dependent on high-tech metals, such as the production of cobalt, platinum, rare earth metals and titanium. These are in a decisive position in the development of innovative environmental technology, by which energy efficiency can be improved and greenhouse gas emissions reduced. Furthermore, Europe's traditional energy reserves are scarce and their exploitation is costly. Because of this, the majority of energy needs have to cover production, which is why security of supply is an important policy issue.

The greatest worry over the running out of natural resources concerns the depletion of non-renewable natural resources, such as oil and minerals. Recent discussion has also pointed to renewable natural resources, too, such as clean fresh water and grain crops. Their sufficiency is threatened due to population growth, consumption patterns and the uneven distribution of natural resources.

Analysts are of different opinions about the future. For some the significance of resource wars as an image of a future threat is growing, because population growth and rising standard of living expectations are at variance with the availability of natural resources. For others the significance of resource wars as a future threat is receding, because technical solutions replace some important natural resources and provide natural resources that were previously techno-economically unavailable.

Increasingly, developed economies aim by their industrial strategies to protect the interest of their own raw material reserves for their own processing industries. This is seen by the increase in government measures that distort raw materials in international trading. The rising economies of countries also implement strategies

Images of the future affect decision-making

The images of the future of the actors of natural resource policy crucially affect their understanding of what is at present considered important, what goals to set, how to develop practices and what means should be used to accomplish the goals and development guidance. On the basis of an expert interview, Saarinen (2008) described the following imaged of the future concerning natural resources.

I The continued boom of natural resource use in the global economy is based on the understanding that despite the world economic recession the demand for raw materials will long continue concerning all such materials. Environmental concerns are exaggerated. There is strong technological and economic optimism. The open global economy will solve problems. Industry is quickly seeking a new balance amidst global economic change.

II Development programmes and operational models will alter due to climate change and climate policy, because people must change their ways of production and consumption. National economies and technological developers are making an input in the switch from non-renewable to renewable energy resources and efficient material cycles. The foundation of knowledge and concepts will hurriedly be built on a new basis, because the traditional ideas of institutions are crumbling, though a new structure is not always needed for a basis of knowledge to exist.

III Technological optimism is highly environmentally aware and at the same time very optimistic concerning technological solutions. The severity of global environmental problems is recognized and at the same time the situation is felt to be a technological challenge. It is believed that the solutions will be found from technology, whereby there will be no need to greatly interfere with consumption patterns and lifestyles. Environmental concerns related to natural resource use will also be solved together with development.

IV The increasing power of general threat depictions is based on the idea that as a consequence of severe environmental changes the global situation may completely change. The upheavals are powerful and the consequences incalculable. This means that the attitude towards natural resource use will change radically, because society is in no respects prepared for changes of this kind.

concerning their natural resources towards rich countries, the apparent purpose of which is to secure the privileged supply of raw materials. For instance, China and India have in recent years significantly increased their economic trading with Africa.

Security of supply refers to the ability of a country to survive disruptions and crises with the minimum of special arrangement and disruption. This preparedness is created in advance through planning and by clarifying risks and their impact as well as by performing the measures regarded as necessary and relevant. The familiar system of old was the storage of grain and energy products "for a rainy day". In addition, it is necessary to plan how to act in times of crises and exceptional circumstances and how scarce resources are to be shared, regulated and consumed. The state is obliged by law to take charge of the development and implementation of security of supply.

The foundation of the EU's activities constitutes legislation binding the member states and inter-governmental cooperation. Community legislation has yet to cover security of supply matters in any comprehensive way, though the importance of this subject has been emphasized in the Union's strategic plans. An exception is oil products, which on the basis of a directive concerns stockpiling of a quantity corresponding to 90 days' supply. Operational security in part covers what in Finland is termed security of supply. Finland has sought to promote the issue of security of supply by raising it for comprehensive examination in the EU. The approach is that of ensuring that the markets are operational, including in the event of crisis, which relates to the EU's directive on safeguarding critical infrastructure.

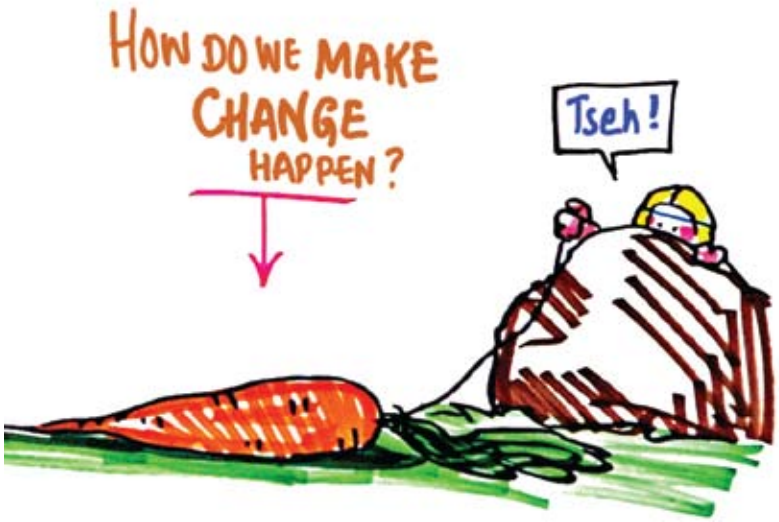
At present there is no common policy at EU level that would be able to ensure the sufficient supply of raw materials at balanced and undistorted prices. The EU's raw materials initiative proposes that the EU agrees on a joint strategy on raw materials.

The critical dependence of the EU on certain raw materials underlines that a shift towards a more resource efficient economy and sustainable development is becoming even more pressing. Securing reliable and undistorted access to raw materials is increasingly becoming an important factor for the EU's competitiveness and, hence, crucial to realizing the Lisbon strategy for growth and jobs.

Climate change, the carbon cycle and greenhouse gasses represent a global challenge. The use of natural resources may nevertheless rise in importance alongside climate questions. Even if climate change can be halted, the growing demand for the world's natural resources will entail important economic, ecological and social problems. Sustainable development therefore requires that natural resources be examined as both a part of the climate question and separately from it.

In drawing up a natural resource strategy it is essential that the reciprocal dependency of natural resources be understood as comprehensively as possible. It is hard to envisage all the interlinkages that natural resources involve. For this reason, when we give an idea of how the future will look we need to go into both the possible and improbable perceptible scenarios and investigate the faint signals associated with natural resources that could emerge as important development trends in the future.

An operational strategy can reduce pressures on the environment and transform environmental challenges into economic opportunity.



3 THE CONTROL OF CONTINUAL CHANGE

3.1 Changing systems as the starting point

Modern society is a network comprised of the interaction of different actors and actions. The various natural resource sectors and their actors are a part of this network. The reform of this network requires a comprehensive approach that tales account of the mutual connections and interactions between different phenomena and individual actions at both national and international levels.

Amidst this systemic change the structural and practical operational changes created from above are in dynamic interaction with and support one another. What is central is not only the improvement of previous operations, but rather the quest for new, more workable solutions.

> **During a time of change societies that adapt rapidly and extensively under construction are able to attain a cycle of positive development**

During a time of change societies that adapt rapidly and extensively under construction are able to attain a cycle of positive development. In this way the different sub-systems of society complement one another well and fit together with the changing operational environment. This development leads to a growth of productivity, a durable and hard to copy systemic competitive edge as well as rapid economic growth. On the other hand societies that are slow to renew themselves structurally do not achieve these advantages but instead have to struggle with disintegrating competitiveness and slow productive growth.

The systemic change of the natural resource sector means that the optimal efficiency and productivity of the growth and use of one natural resource has altered many natural resources – the whole natural resource system – at one time into a multi-objective challenge of management. There must be space in the natural resource sector for new thinking, operational models and actors, in which stripping away ridgidity and changing attitudes requires tangible measures.

Systemic reforms also require as radical a change as possible of present policy, which may be difficult to bring about. Long-term structural and systemic changes are complex and time-consuming procedures, the results of which may be seen only after a decade. The challenge of long-term procedures is that the political and financial support for the process aiming for reform nevertheless requires firm results in the short-run.

To prepare the National Natural Resource Strategy a systemic frame of reference was drawn up, which formed a chart that was continually made more precise and in the framework of which strategic choices were made (Figure 6). The frame of reference depicts the main elements related to the natural resource strategy and their mutual relations and temporal dimension.

Many interlinked changes of the operational environment require that the use of natural resources is examined as a whole, in which Finland's competitiveness and welfare, as well as Finland's global role and responsibility, support each other. On this basis the methods of application of natural resources and the management of material flows will be directed. Changes will be able to be assessed continually with the help of a developed system of expertise and coordination, so that goals and courses of action can develop flexibly for the needs of tomorrow and the day after.

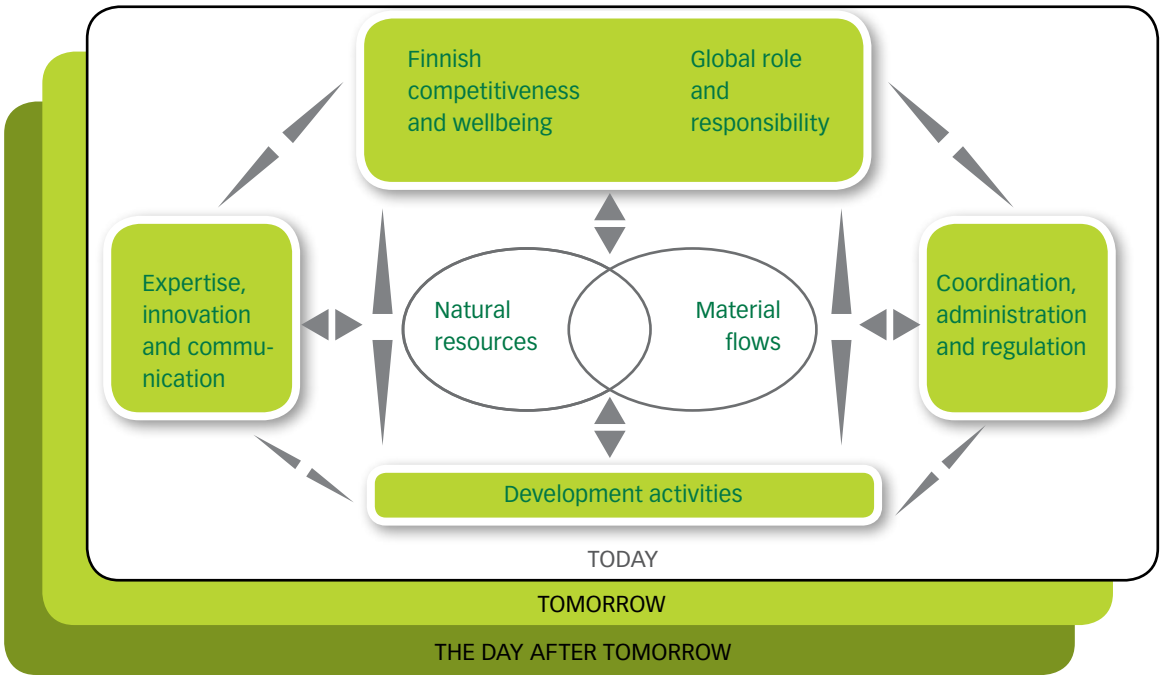


Figure 6. *The systemic and dynamic frame of reference of the Natural Resource Strategy.*

The Dutch model of change under control

In Holland at the turn of the millennium a new approach for planning and making policy was developed and put into use. This approach was called the Dutch Model, a term that refers to the name Transition Management developed by Dutch technology researchers, sociologists and, later on, political researchers.

The approach acts as a framework that provides guidelines for policy makers. It was developed particularly for situations in which there was a need for fundamental change in policy, for example due to changes in the operational environment, and where structural change was already underway. The approach has been applied in Holland's energy policy.

In the TM approach the goal is to help manage the structural changes of the operational environment and to find solutions to new challenges they bring. The basis is long and short-term coordinated planning, a broad perspective, innovation between different interest groups and a continual striving for learning and developing.

To begin with a basic vision is formed of the dimensions of the whole entirety where work is carried out and of the possible problems that could be encountered. Next, long-term goals are created and prepared, which might at first comprise rough goals that will be specified later. There should be many goals, because too few will be a constraint. It is also advisable to retain the various goals for as long as they are not mutually exclusive. From each of the goals a so-called transition area is created, for which space is made for innovations, discussions and solving problems. In the arenas more focused goals are added to make up transition paths, which are long-term programmes.

3.2 Flexible long-term goals

In order to respond to significant changes in the operational environment there is a need for change not just in policy but also in society's different systems and ways of thinking. To manage systemic and structural change requires new working models, in which arrangement, implementation, assessment and development are regarded as a uniform whole.

In preparing the Natural Resource Strategy a vision was formed of the direction in which we want change to lead in the long-term, and its expression in the strategy's vision and goals. Following this, the main areas were identified whose structures must simultaneously change, in order for us to reach the desired direction and realize the goals.

Following the main areas of change, the steps were identified that each area of change must first take. Because there are many uncertainties in the operational environment it is important in realizing the strategy to proceed calculatedly and flexibly (Figure 7). The strategy is adapted by identifying obstacles, experience and continual learning.

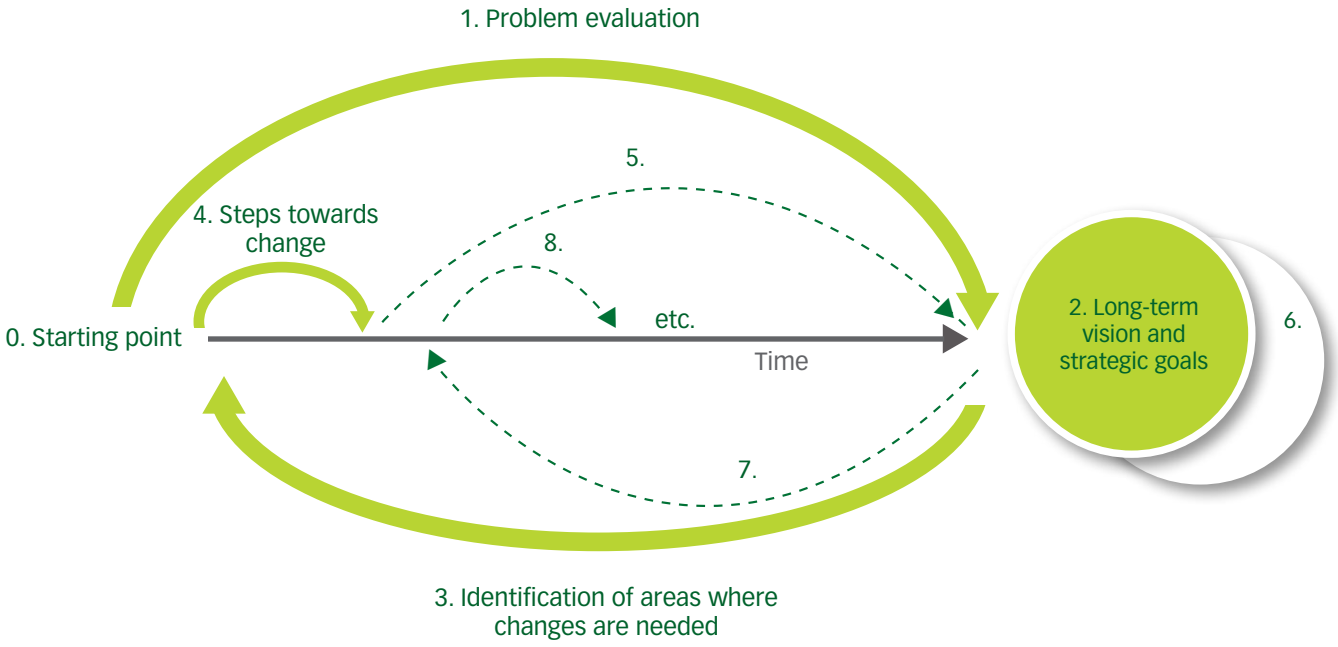


Figure 7. *Implementation of the strategy through selected steps leading towards long-term goals.*

4 AREAS FOR CHANGE

This chapter describes those areas where structural changes are required and their developmental needs from the perspective of the Natural Resource Strategy: 1) bio economy, 2) the material cycle, 3) regional resources, 4) international cooperation, 5) administration and regulation, 6) expertise and communications. After establishing the principle areas where change is needed, the strategic process identified the steps that must first be taken in each area of change.

In addition to the steps for change presented by the strategy working group, proposals for a development project for the use of natural resources were made during the Luoti thematic days arranged by the Finnish Forest Association, and using the open web tool. This chapter gives some examples of these project proposals

4.1 The bioeconomy – new added value and sustainable wellbeing

Sources of biomass

The Earth's most important biomass, in order of quantity, consists of algae, trees and cultivated plants. The most important biomass for the Finnish economy is wood. Annual growth of forest biomass (raw wood, branches, tree stumps etc.) corresponds to about 56 million tonnes of biomass, while the corresponding annual production of traditional crop cultivation is about six million tonnes (including grain husks and straw). In terms of quantity, Finland's clearest biomass reserve is peat, but its annual growth is only about seven million tonnes (including dry mass).

The total annual growth and production of many portions of biomass goes for industrial processing, though on the other hand there are also portions of biomass in Finland that go unused, such as the remains of harvests, manure, grasses and the sediments of lakes and ponds, the uses of which as raw material sources for the bioeconomy are now being investigated. Biomass production could to some extent increase the efficiency of arable land use.

New products and processes

In the future the biomass fibres will be separated in biomass processing into precisely separate parts, even of nano proportions. For instance, in the in the process of cellulose production the final products, aside from cellulose itself, include biodiesel, ethanol, bio-based chemical combinations, and, in the future, various products for the cosmetics, medical, food and natural products industries. It is likely that existing biomass sources will yield many substances with health uses and products to replace oil-based products.

In Russia, natural medicines make use of many forest plants. A wide range of trees and their various parts are used as remedies: the annual growth of pine trees, resin, the buds of linden, pine and silver birch trees, the female inflorescence of alders, oak, rowan, buckthorn and juniper. Berries that are used include raspberry, blueberry, lingonberry, wild strawberry, cranberry, bog whortleberry, cloudberry, bearberry and arctic bramble. Other medicinal plants include marsh tea (wild rosemary), heather, fern, St John's wort and common wood sorrel. Chaga (cinder conk) is also used. A project of the Finnish Forest Research Institute and the faculty of medicine of the University of Tampere is currently investigating the medical significance of tree and mushroom compounds, as well as other possible uses of forests for health and wellbeing.

There is an abundant need for expertise in bioprocesses in the preparations for new bioeconomy products. A major change is underway in the chemical industry, because many chemical processes are being replaced by biotechnological ones. In the development of new products there is also a need for close cooperation between many sectors, for example the minerals and mineral-based raw materials of fertilizers needed in making paper. Because bioeconomy decisions are often based on decentralised solutions, the importance of a working infrastructure will be further emphasized in the future.

The Finnish Funding Agency for Technology and Innovation (Tekes) is running the BioRefine programme for New Biomass Products 2007-2012, the goal of which is to develop business related to new value-adding products or new process or business concepts. The programme seeks to promote technologies, equipment production and services related to these. These goals guide the networking and collaboration of different actors. The aims are, for instance, for the creation of multiple uses but also of specialised bioprocesses, the use of existing industries and the improvement of profitability and the creation of new lines of business. The focal points of the programme include the forest, chemical and food industries, and process and equipment providers.

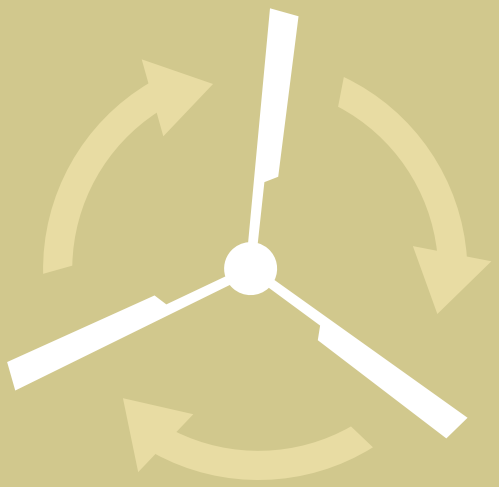
The goal of the Bio-Refine programme is also to open up the market for Finnish expertise with the help of funding, the promotion of national and international cooperation and other programme services. The programmes key areas of activity are the European Union, North America and South America. International cooperation is very important on many levels in the development of the bioeconomy. For example, the EU and China have signed a joint declaration committing the two sides to the development of the knowledge- based bioeconomy.

The research strategy on Finland's forest cluster sets out the main emphases of research until 2030 in terms of the forest cluster and customer solutions. The aim of the research strategy is that in order for the cluster to be developed and competitiveness to be maintained, new products, services, business models and income methods must be developed, as well as models of cooperation with other clusters. The research strategy contains seven priorities, the aim of which is to produce wholly bio-based innovative products and solutions.

The European knowledge-based bioeconomy

The aim of the European Knowledge-Based Bioeconomy (KBBE) is to produce new and ecologically more sustainable products by making use of nature's own mechanisms. There are similar expectations in Europe for the knowledge-based bioeconomy there were for the industrial revolution and the age of chemistry. Compared with the EU's Sixth Framework Programme, funding for the KBBE is in the increase. One strong area is its non-food applications. It also includes areas of new possibility, such as marine biology applications.

The KBBE is regarded as having an important role in achieving the goals of the EU's Lisbon strategy. The main problems in Europe concern the sector's operational requirements and the fragmentation of the operational environment. In addition, many applications are still economically unprofitable. For instance, there is a need for development work in the area of biofuels before their use is truly worthwhile. Amidst the decreasing need for fossil fuels the economic applications of biofuels are nevertheless increasing.



Project proposals

The domestic option of biofuels

The proportion of biofuels for transport fuel should, in line with the EU's commitment, be increased to 10% by 2020. This represents a great opportunity for Finland, whose biomass raw material deposits are considerable. The development of wood-based energy production offers an alternative for the domestic forest industry, whose paper and mass production is in a deep profitability crisis. The emphasis in biofuel production must establish second and third generation biofuel production, whose profitability and climate level best meet the needs of the future. The start up of the project requires state investment support and feed tariffs for using forest-based energy production potential.

The more varied use of renewable natural resources and the development of product processing

Renewable natural resources, which in Finland include waste wood material, the remains of harvests and straw, as well as others such as lakeside reeds and the bottom sediments of lakes and ponds, will be used as a source of raw materials and energy.

The processing of wood and peat into new products will be promoted and developed in older existing products. This would, in addition, succeed in creating a more natural form of industrial activity. It nevertheless needs an impartial research institute to standardize methods and guide activities.

(Project proposals of the Luodin thematic days arranged by the Finnish Forest Association and the open web tool of the strategy work.)

Challenges and opportunities

According to the Finnish Funding Agency for Technology and Innovation's study on market and business opportunities, Finland as a biomass market area and operational field is limited by the fact that by global comparisons Finland's territorial markets are small, and the country's cold climate and lack of abundant daylight annually do not generally favour biomass production. In addition, the demand for renewable energy is intensifying competition for biomass resources throughout the world.

One of the most important societal challenges of the bioeconomy is the controlled transition concentrating on a single product maximizing the economies of scale for fragmentary or integrated production. For example, the proportion of commodity volume of the forestry sector will decrease and the share of specialised products produced in small amounts will increase in the coming years due to products based on the bioeconomy. It may be that in the future there will be many different income flows within large plant integrations.

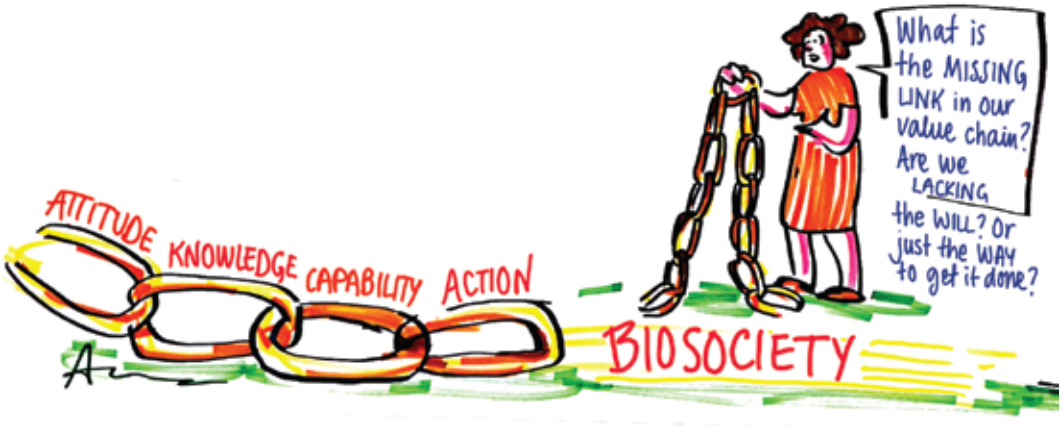
According to the Funding Agency for Technology and Innovation's report, a country the size of Finland should carefully consider where its public research input on chains of value and technology should be focused. The goal must be to be a world leader in select areas. In deciding on the select areas and the production frameworks required it is crucial to identify our present expertise in both research and business and to estimate comprehensively the potential knowhow on offer. From the perspective of new business competitiveness, integration into the mainstream of current biomass processing (via the routes of the forest industry and farming) often offers important integration advantages, such as in logistics and the energy and materials economy. Bio processing business activities bringing new added value can significantly improve the competitiveness of industries located in Finland, on the international markets.

Added value and wellbeing are primarily generated through efficient, vigorous, adaptable and innovative private enterprise. Businesses develop and provide the products and services valued by their customers. A bioeconomy for the new generation can provide a wide range of business opportunities, applying innovations based on the conversion of different kinds of biomass into various fibres and chemical compounds, and on innovations based on biological processes.

Biomass production can be increased sustainably, providing biofuels that can then be used to generate energy instead of imported fossil fuels. The bioeconomy should however be seen as providing a wide range of opportunities to utilize natural resources by applying and reproducing biological processes in sustainable ways. Applications are possible throughout society, in areas including the production of energy, materials, foodstuffs, and also health services.

National reserves of wood, water, and other plentiful renewable natural resources are a major asset for Finland in the context of building up the bioeconomy. High quality materials and equipment made out of mineral resources will also be needed in the bioeconomy, but biotechnologies can also be utilized in the mineral economy.

Bio-business and its products gain added value from the safeness, purity and responsible management of the environment from which their raw materials are obtained. The bioeconomy also encompasses the development of services, know-how and business activities based on the non-material values associated with natural resources. Natural resources and processes must be cherished for the production of such added value to be sustainable.



4.2 The material cycle – towards efficient material cycles

The use and sufficiency of natural resources

Finland's overall use of natural resources was 520 million tonnes in 2005, which was one and a half times greater than in 1970. The amount of soil and rock material was nearly 100 million tonnes, because a sizeable portion of their use is devoted to the construction and upkeep of the country's infrastructure. The level of the domestic use of natural resources has remained fairly stable, but the volume of imported materials has almost quadrupled. Finland's economic impact on global resources has thus grown vigorously. Gross use per capita was 100 tonnes.

One of the goals of sustainable development is to decouple the use of materials from economic growth. This has been carried out in Finland since the end of the 1990s. Between 1970 and 2005 the use of natural resources grew 1.5 times, national product grew 2.5 times, while the population grew by only 14%. Though the growth in the use of materials has slowed, Finland clearly uses more materials relative to its population than the EU average. The decoupling of economic growth and the use of materials has also not necessarily led to an overall decline in environmental harm, because the import of natural resources has simultaneously grown. An increasingly large proportion of the harm is directed at the countries from which the materials originate. (Mäenpää, I. & Härmä, T. 2007. Suomen talouden luonnonvarojen kokonaiskäyttö, Thule-instituutti, Oulun yliopisto.)

Though humanity uses 30% more natural resources each year than the Earth is able to produce, it is hard to predict precisely the sufficiency of individual natural resources, because sufficiency depends on developments in the price of technology and resources, and on the discovery of new reserves. Recycling and reusing also have an appreciable impact on the sufficiency of natural resources.

Natural resource efficiency as the basis of development

Natural resource efficiency refers to the overall use of natural resources in relation to the unit value of a product group or function. Its goal is that in the future it must be possible to natural resources more efficiently, and this brings together the promotion of competitiveness and the reduction of harm to the environment. Natural resource efficiency can be measured by natural resource intensity concerning the quantity of natural resources consumed by a product or functional unit.

Natural resource efficiency can be examined from several vantage points. Material and energy efficiency is an aspect of natural resource efficiency. Ecoefficiency refers to the environmental load caused by a product or function measured in a different way. Natural resource use may be just one factor of environmental load.

Land use efficiency can be sought by concentrating, for instance, on natural resource production. The point of departure for examining natural resource and ecoefficiency is global. Globally, Finland and other industrial countries use increasingly more natural resources.

The present situation of natural resource use globally and in Finland varies by sector. The level of first generation use is often more wasteful, while more developed processes and products are generally more efficient. Attention must be paid to the production of materials, recycling and investment. The purpose of imitating the action of nature is to achieve the effective closing of the materials and energy cycle and to reduce the load on the environment caused by industrial activity.

Natural resource efficiency is improved by the long-term frugal and recycled use of natural resources, with many service purposes, and by raising the degree of processing. Furthermore, some material products can be replaced by services.

The growing importance of material efficiency

The decoupling of materials from economic growth, the reduction in the total volume of materials and efficient use and substitution are objectives in accordance with the EU's sustainable development strategy. This requires the growth of expertise and innovations, in order for production processes to gain more material and energy efficiency.

Material efficiency means that products and services are produced competitively with a smaller material input, and so that harmful impacts are reduced throughout the product life cycle. The efficient use of materials also produces significant cost savings.

Material efficiency is usually examined throughout the life cycle of a product. An effort is made to reduce the accumulative environmental impacts of a product throughout its life cycle. In examining a product's life cycle the different stages involved are considered, from the raw material source, through processing and manufacture to consumption and utilization (material, energy) after use and, finally, disposal. Examining the life cycle of a product takes account of all the inputs (materials, energy, water) of the life cycle and its outputs (emissions into the air, water and soil, by-products and waste).

> **"Material efficiency is usually examined throughout the life cycle of a product**

The public sector can promote material efficiency with the help of public projects, various means of guidance and policy programmes. The basic units of production and consumption are manufactured and consumed products.

The rise in the prices of natural resources in recent years already sets major challenges for our material-dominant industry. In the future the demand for raw materials will grow and the depletion of non-renewable natural resources along with rising waste and chemicals costs make the goal of material efficiency even more worthwhile.

The use of materials can, according to the sector, directly or indirectly comprise up to over half of a company's movable expenses. Companies need to pay greater attention to the systematic efficiency of the uses and flows of materials. Practical measures to improve material efficiency may be related to, apart from the use of raw materials and improvement of production practices, the development of innovations throughout the who product chain. Companies should exploit this savings potential, for instance with the help of new technological solutions and business models established for scarce resources. Attention paid to the efficient use of energy and raw materials in business models, value chains, services, processes and equipment solutions support the goals concerning scarce resources.

The benefits for businesses of material efficiency are

- cost savings in acquisitions, processes and waste disposal costs,
- reduction of emissions and emission risks,
- the fulfilment of tighter authorization conditions,
- the rising market value of the business.

In addition to bringing about direct benefits to companies, the development of material efficiency creates opportunities for new kinds of service transactions, which develop the overall management of material flows. These new kinds of services are related, for instance, to increasing the efficiency of the chain of delivery, directing processes, waste management, resource management for services, cooperation of service providers and approaches for ecoefficiency analysis.

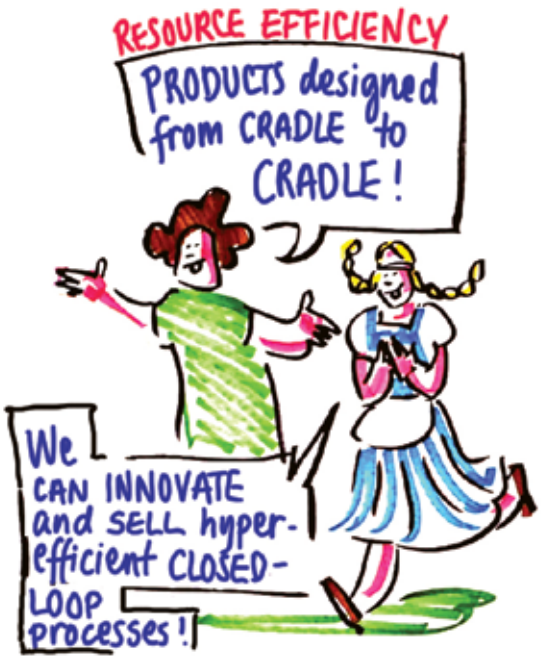
Recycling as a part of the material cycle economy

Some 28% of all the waste produced by society is recycled (nearly 590,000 tonnes). Thus far, material that must be recycled mainly comprises paper and cardboard. The amount of waste cardboard that is recycled is growing. In addition, metal, glass, electronic and electrical waste, tyres and plastic are recycled. Plastic packaging originating from small industry and sizeable units are amassed for separate material recycling. Waste plastic from shops, small businesses, public services and industry is used, in addition to recycled plastic products, for composting applications, in which waste plastic is combined with other materials and which is used as substitute material in the manufacture of concrete, boarding and impregnated wood.

In addition to traditional recycling, the electronics industry, for example, has developed the remanufacturing of equipment, in which and ever-larger part of the original parts is reconditioned for reuse. Remanufactured machines are made up of renewed and completely new parts. Unworn parts can be used again as they are. This production method expends appreciably less energy and raw materials than traditional production. Due to remanufacturing it is possible to cut all waste from operations that would otherwise be dumped in landfills to zero. For example, in 2003 all of Canon's production plants in Japan reached this goal.

Previously, used consumer electrical devices were thrown out as worthless. Nowadays, for instance the precious metals are collected from discarded cell phones, including gold, silver, copper and many others that are incorporated into the electronics of cell phones. This urban mining, in which the precious metals in consumer electronics are collected and reused, is a part of the growing recycling industry.

> **Due to remanufacturing it is possible to all waste from operations that would otherwise be dumped in landfills to zero**



Raw materials from waste

The goals of the National Waste Plan until 2016, and the necessary main guidance measures for attaining it are grouped into eight goals. These objectives concern most waste management sectors, such as municipal waste management, industry and mining production, construction, agriculture, businesses' and services' waste management. The goals of material efficiency also widely concern the various activities of society. The National Waste Plan incorporates a national waste prevention programme.

The goal of the National Waste Plan is, among other things, to stabilise the volume of municipal waste (about 2.3-2.5 million tonnes a year) and then reduce it to the level at the beginning of 2000 by 2016. The aim is also that 50% of municipal waste will be recycled, and energy will be recovered from 30% and a maximum of 20% will be landfilled. The goal is also that all manure produced in rural business activities will be utilized.

Japan's 'Sound Material-Cycle Society' model

Japan generates a total of 470 million tonnes of waste a year, which is the cause of massive challenges for realizing material efficiency. To overcome the dual challenge of increasing waste and constraints of resources, Japan has implemented the 3R (Reduce, Reuse, Recycle) policy since the start of he millennium, the aim of which is to make Japan a "Sound Material-Cycle Society".

In order to accomplish the goals of this, Japan has implemented programmes and a series of laws, all of which support efficient material cycles. Calculations of material flows and natural resource accounting are key instruments for achieving goals of the Sound Material-Cycle Society.

Japan's goal is also to promote the Sound Material-Cycle Society model internationally in neighbouring countries in Asia and among the G8, in which Japan has acted as an initiator in 3R policy.

Project proposals

Report on the means whereby waste does not end up in landfills at the end of the product life cycle, but is reused or utilized

The purpose of the project is to reduce the burden on landfills and on the need for virgin raw materials. The methods include investigating material flows, awareness raising among consumers, and the reform of waste legislation.

Tax-free public transport use and electric private vehicles

The aim is to activate business and other employers for promoting the use of public transport by their employees for journeys to and from work. To make it possible to pay the portion of wages tax-free that is to be used for public transport.

Promotion of rechargeable hybrid cars. The electric engine is noticeably more efficient than the combustion engine. An appreciable improvement in the end use of energy is achieved, if there is a shift from combustion engines to electric engines, and especially if they can be recharged from the national grid. The main car producers will produce rechargeable hybrids for the market within a couple of years. Finland should draw up its own programme whereby this technology starts to be decisively brought into use in Finland. The technology reduces emissions and dependence on oil, increase energy efficiency and improve air quality and reduce noise.

(Project proposals of the Luodin thematic days arranged by the Finnish Forest Association and the open web tool of the strategy work.)

The total accumulation of waste in 2006 was 69,2 million tonnes, of which 40% was used as materials and energy. In addition to the use of mineral land mass the goal has been to utilize metal and wood waste. Altogether 12.7 million tonnes of wood waste were used in energy production and the forest industry, which was almost all the waste created. The majority of municipal waste, including hazardous waste, was landfilled.

> **“ The utilization of biowaste, or recycling by composting into nutritious soil and gasifying or burning for energy has grown rapidly this decade**

The accumulation of waste from mining in 2006 accounted for a third of the total, and the volume of waste, with the exception of quarry fill, 21.5 million tonnes. Increasingly more attention is paid to mining waste, because the aggregate of waste is strongly increasing due to the opening of new mines. Almost the same quantity of waste was generated by the construction sector. There was 18 million tonnes of waste generated by industry, while service sector and household waste totalled 2.9 million tonnes. The amount of waste ash rose by 70% over the previous year with the return to the normal level of coal burning.

The utilization of biowaste, or recycling by composting into nutritious soil and gasifying or burning for energy has grown rapidly this decade. In 2007 it grew by 20%. Utilized biowaste consists of waste from households and service sectors, and rapidly biodegradable food and garden waste. However, there is still a large amount of biowaste that goes to mixed waste in landfills. The amount of graded sorted mixed waste in landfills in 2007 was 1 387,000 tonnes. The biodegradable portion of mixed waste produces methane when it decomposes, and landfills are responsible for about 3% of greenhouse gas emissions.

The amount of municipal waste inn 2007 was 2.6 million tonnes, an increase over the previous year of 3.3%. About two thirds of municipal waste is generated by households. The most municipal waste from the service sector comes from retail trading and healthcare. The sorting and collection of municipal waste for utilization has expanded to other types of sorted waste in addition to biowaste. Some 53% of municipal waste was placed in landfills. Five years earlier the corresponding figure was 62%. A contributory factor here are waste fired power plants, special facilities where municipal mixed waste is burnt. Some 30% is utilized as material and a little under 10% as energy. Nearly all waste glass (99%), metal waste (nearly 100%) and paper and cardboard waste (over 90%) which was separately collected ended up as utilized materials. About 80% of biowaste was utilized as material. The majority of plastic and wood waste was utilized for energy. The amounts of municipal waste that are recycled and used for energy have grown rapidly, as has the overall volume of municipal waste. Last year, there were 47 operational landfills for municipal waste in Finland. A decade earlier there were five times as many.

There are a tenth of the landfills that there were a decade ago, and building new ones is extremely costly. Changes in use and consumption, and new obligations and handling methods have brought about transformations, especially in the amounts of separately collected waste. The biggest has been the growth of electric and electronic waste. In two years the amount of this has risen nearly fourfold. In addition, separately collected waste for energy has grown rapidly.

The unambiguous overall growth issue of Finland's gross volume of waste and the direction of its development are impeded by the fact that the broad groups of natural materials, such as manure used in normal nutrient cycling, the remains from forest logging, soil material from mineral mining, waste rock and leftover soil and rock material from construction, dominate the total waste volume and its course of development. Waste accounting complies with the waste classification used in EU waste statistics, in which the production remains recycled as raw materials at the waste source are not classified as waste. The EU demarcation of waste statistics observed in waste accounting reduced Finland's total amount of waste to under half of what it would be in the use of a broad definition of waste.

Building up an efficient material cycle requires an approach that encompasses the whole system of material flows throughout society. Products, services and energy have to be produced in resource-efficient ways, with environmental impacts minimized. The resources to be utilized by society should be kept within the economic system for long periods, so as to maximize added value and minimize the quantities of valuable materials that permanently leave the economic system. Wastes, for instance, should in this sense be seen as raw materials that happen to be in the wrong place.

The product-planning phase is critical for material use throughout product life cycles, for products' overall sustainability, and with regard to opportunities for recycling. At the level of communities, tools useful for this type of far-sighted planning include spatial planning processes. A shift towards the production of service and know-how concepts can support a sustainable material cycle.

Sustainable production patterns, innovative technologies and high levels of know-how all improve resource efficiency. The accumulation and utilization of expertise related to material cycles can open up new business opportunities based on resource scarcity both in Finland and internationally. From the perspective of global resource efficiency, it is prudent to manufacture goods where resources can be used effectively.

4.3 Regional resources – local natural resources production

Important rural natural resources

The distinctive features of the Finnish countryside are its non-uniform scenery and the abundance of islands, surface waters and forests. Rural Finland is heterogeneous in two respects: habitation in the north and east of the country is more scattered and a larger proportion of the population live in rural municipalities than in the southern and western parts of the country. The different rural challenges and opportunities vary greatly in the municipalities close to the large cities, in those deep in the countryside and in sparsely populated ones.

The populations of rural municipalities close to cities are growing more rapidly; the birth rate is the highest and the age structure the youngest in the country. The populations of sparsely populated rural and remote municipalities on the other hand are declining. The age structure of inhabitants is weighted towards older people, and the death rate is highest than the birth rate. Calculations of the net numbers of people moving away in both are falling and are even close to zero in remote rural municipalities. Forecasts suggest that the population will decline in the majority of areas in Finland by 18-54% by 2040, while the population in cities and their surrounding municipalities will grow by 15-60%.

According to the OECD's assessment of Finnish rural policy, "place quality" has an important effect on an area's competitiveness and particularly on its possibilities to attract and keep moveable resources, such as investments and an educated workforce. Rural development policy is attempting to make better use of attraction factors, or natural advantages and solutions that people have achieved, which vary according to each rural area and which produce raw materials for economic activity, such as tourism, the entertainment industry, special products and foodstuffs.

> "Interaction especially puts the emphasis on the versatility of rural activities and livelihoods in the pursuit of rural development

Increasing the value of and marketing the natural environment and culture each of rural municipality and district could promote the development of business. The strengths of nature and culture may the important – even the only – competitive edge of each rural area. In addition, raising the value of attraction factors is often the best means of conserving them. According to the OECD report, a crucial question is how decision-makers will be able to internalise the positive effects of the attraction of the countryside so that it is economically worthwhile to conserve the attraction of the countryside and offer different users – both individual visitors and in many cases society as a whole – the opportunity to make use of these attraction factors at a reasonable price. A second key question is how peripheral areas, particularly sparsely populated and remote areas, can succeed in the knowledge economy.

EU membership and globalization have narrowed the role of the state as a pilot of regional development and linked regions more closely as part of the international economy and policy. The connections between rural and growth centres are becoming more complex, which broadens the linkages of regions in the sphere of influence. This interaction especially puts the emphasis on the versatility of rural activities and livelihoods in the pursuit of rural development. On the other hand, it appears that large cities and their populations are less oriented towards interaction with rural areas, because they are becoming part of the national and global city network.

The problem in Finland has been that growth has been centered on only a few urban districts, and so the majority of rural areas have remained beyond the immediate impacts of their growth centres. At the same time, differences in development between cities and rural areas have increased generally. Successful regions, comprising both growth centres and rural areas, can be created within global competition by functional regional interaction.

One of the policies recommended by the OECD for improving the competitiveness and business environment is for the expansion of knowledge networks between rural and urban areas. Rural and urban links should be supported flexibly making use of movement between work and home, holiday homes, the strong rural roots of city dwellers and other means of urban and rural interaction, so that outside networking can compensate for the lack of close local networks in rural areas and facilitate the transfer of knowledge beyond nearer areas.

Including natural resources in rural strategies

A municipal union is a consortium of municipalities that acts as a regional development authority and is responsible for the general development of its municipality and the municipal planning of its region. Municipal unions have voluntary duties and ones that are regulated by legislation. Those regulated by law include preparing municipal town planning, the municipal plan and municipal programme, and activity as a regional development authority according to legislation on regional development. One of the goals of the government Reform Project for Regional Administration is to increase the steering powers of municipal unions in the use of natural resources. The influence of municipal unions in implementing state supported business investments and infrastructure projects will grow.

The municipal unions have already implemented, or are in the process of doing so, municipal strategies and plans, in which natural resources are present and stressed in many respects. For example, the municipal strategy of the Päijät-Häme union for 2001-2003 listed the following assessments concerning changes to the environment and natural resources: the value of clean water will increase and the demand for eco-produce will grow, the importance of eco-efficiency will increase (services will become more important than goods, and eco-marketing, eco-brands and producing eco-products will increase), the use of wood as a material will become widespread and the importance of housing as an environmental factor will become pronounced.

In drawing up municipal plans and strategies it is important that matters are examined beyond municipal boundaries, that resource efficiency perspectives are taken into account in processes, and that strategies are developed to support reserves of raw materials and local strengths.

Towards decentralized production models

In order for natural resource production to achieve a regionally sustainable and locally important impact on employment, the wellbeing of the population and permanence of settlements, decentralized production models need to be developed, which means relatively small sized production facilities that operate close to points of consumption. In order for decentralized production models to be made to work in practice, regulatory obstacles need to be examined and overcome. The demand for biomass-based products will grow and new methods that utilize material, by-product and waste flows will require open networks of enterprises and farms and the eradication of administrative obstacles.

Decentralized energy production refers to production models in which relatively small electricity, heating and refrigeration facilities are decentralized near to points of consumption. The challenges of decentralized energy production lie above all in managing the quality and amount of energy. In decentralized working models practices have to be applied by which consumers are assured of an energy supply.

Business activity based the model of decentralized production frequently requires operational networking and partnerships among actors, which will come about only if they have common goals and confidential joint operations. It is possible to develop Finnish business culture to achieve functional partnerships. Finnish business activity is mostly proportionate to subcontractual activity and often also weighted to production.

Developing nature entrepreneurship

Finland's diverse natural environment offers abundant opportunities for business activities that support nature. The demand for nature conserving products and services has also increased. This creates the conditions for enterprises based on nature, in which in addition to a customer-centred approach there is a commitment to the principles of sustainable development. There is already a long tradition of the use of some natural resources in entrepreneurship, but in recent years there has come about new enterprises that utilize nature in a more varied manner than earlier. Many opportunities offered by nature are nevertheless still unused.

Nature business refers to enterprises based on the natural products and the experiences offered by nature. The sector comprises many different fields of activity, including food, handcraft and tourism businesses. However, the central and common production factor of all these fields of business is Finnish nature. Nature entrepreneurship in particular emphasises the non-material values of nature and the use of renewable natural resources. The latter are used sparingly and use nature as little as possible.

> **"Finland's diverse natural environment offers abundant opportunities for business activities that support nature**

Nature tourism and recreational services are based for the most part on private business ownership. The utilization of natural products has for long depended on the everyman's right, which refers to the overall rights and restrictions of access in nature. These rights established a good practice and they are a generally accepted custom.

Finland's business idea in the Finnish tourism strategy as a place of tourism is linked to the notion according to which Finland is profiled "as a country of variety and tourist recreation based on a high quality and clean natural environment". In university textbooks too Finland is considered "as a country of activity holidays with an emphasis on nature, which complement work and cultural travel." There is much regional variety, but in Lapland, northern Finland and the country's remote communities the major role of nature in the tourism, its appeal, business activities and more broadly in the whole regional economy is undeniable.

Natural resources also play an important role in many livelihoods related to tourism. In particular, the non-material natural resources of nature tourism, such as beautiful scenery and clean nature are their lifeblood. There has been an effort to clarify operational models of non-material values, for instance by developing economic aspects of forest-based environmental and recreational services. About a quarter of Finnish tourism is nature tourism. Nature is of central importance in tourism, particularly in north and east Finland and in the archipelago. The regional economic impacts of nature tourism are in some places highly significant.

In 2000, jobs related to nature recreation and nature tourism corresponded to about 32,000 man-years. About three quarters of jobs were produced by domestic demand, and the rest by foreign demand.

Several scores of thousands of people take part in the commercial harvesting of forest berries. Berry pickers from abroad, of which there were about 3,000 to 4,000 in recent years, come nowadays from Asia and east Europe and harvest about half of the forest berries. It would be possible to increase the quantity harvested, because the demand for raw materials cannot be fully met.

Project proposals

Regional natural resources prioritizing in Finland

The project will assess the importance of different natural resources in different parts of the country and a SWOT (Strengths, Weaknesses, opportunities and Threats) analysis will be made of the characteristics of natural resources of different areas. Based on the results, leading regional natural resource models will be developed, on the basis of which natural resource business activities can be developed in a more logical manner in different parts of the country. Existing information on forest reserves, bedrock, game stocks, the pressure of tourism etc will be used as base materials. A national 'natural resource plan' will be drawn up as a result, according to which, for example, state support to different areas will be directed. It is also important to coordinate activity on a EU level, so that activities are not developed here that elsewhere in the EU are being developed more feasibly, and vice versa.

Promoting renewable decentralized electricity production

Electricity production in Finland nowadays is based on centralized mass production, which during times of possible upheaval may be extremely vulnerable. Decentralization would ensure the self-sufficiency and reliability of electricity production, create jobs and give people in Finland a concrete opportunity to take part in helping the climate and producing their 'own' electricity. In particular, in times of crisis this could have an appreciable significance from the viewpoint of society as a whole. All that is needed is political will for the development of legislation so that the national grid is suitable for the energy input of small producers, as well as a supply tariff, or other price guarantee, to ensure that the monopolies are unable to 'buy' the small producers out. The necessary technology is already on the market, and the organization of product marketing would give a further incentive to its development.

Sustainable and profitable nature tourism

At present, non-material natural resources are not specifically marketed. The goal of the project is to increase sustainable nature tourism in Finland. This would keep rural areas inhabited and create new livelihoods for them. At the same time, it will support the preservation of valuable natural destinations, from the viewpoint of tourism. The project will establish quality criteria for sustainable and quality tourism (upgrading signs – tourists should not enter areas of sensitive natural resources). Marketing will be carried out with the help of the quality criteria.

(Project proposals of the Luodin thematic days arranged by the Finnish Forest Association and the open web tool of the strategy work.)

There are about 800 enterprises involved in the natural product sector, of which about ten are industrial class harvesting or berry processing companies. The harvesting, processing industry and the sector's different businesses employ some 3,000 people throughout the year. The growth of the sector is based on the rise of the level of processing and the utilization of new natural products, such as blueberry and juniper shoots, in collaboration with the foods and chemicals industry, and so an examination of the income derived from harvesting no longer gives an accurate picture of the sector's economic significance.

Hunting is a traditional form of using and tending nature. Hunting is nowadays a recreational activity rather than a means of subsistence, attracting some 300,000 hunters. The calculated value of the game economy was about €71 million in 2005. Hunting tourism is a developing livelihood in the rural areas, and there are about 150-200 businesses in Finland providing these services. Fishing tourism is also growing and an aspect of the fishing economy that is becoming more international. There are about 1,200 – 1,400 enterprises involved in this, of which about 120 have clearly focussed on fishing tourism services.

In 2003, the government took a decision-in-principle on an action programme on the development of outdoor recreation and nature tourism. According to the decision, the number of jobs connected to nature tourism could be doubled by 2010. At the same time the preservation of the viability of remote rural areas will be promoted. The development programme contains 30 measures by which to promote outdoor recreation and nature tourism. These measures are grouped into the following four main goals.

1. Responsibility and the division of tasks in the sector working together must be defined and reconciled. The sector's administration and enterprises will receive common national, provincial and local guidelines. The action programme will among other things promote the creation among ministries of a working group on nature recreational use.

2. The preconditions for activities in nature will be developed and the attraction of nature preserved, for instance by improving services in recreational and nature conservation areas.

3. Tourism service products and cooperation to be developed. A programme of measures to be drawn up for the development nature tourism services, and the Ministry of Agriculture and Forestry to set up a working group on wilderness tourism.

4. The sector must be developed on the basis of demand. From the perspective of businesses it is important to identify and monitor the uses of services and potential customer needs. There must also be better information on services.

Many natural resources are geographically fixed. They may be used either locally, regionally, nationally or internationally. The interrelationships between these different levels in the context of resource use are an important starting point for sustainable processes. Natural resources in rural areas are both a considerable asset for society, and an important basis for industrial activities. Assets associated with larger settlements include economic resources, universities and polytechnics, and concentrations of private enterprise. Future success will be based on our awareness of the interlinkages between different areas, and the ways these different resources can be combined.

National resource production often has pronounced impacts on regional and local employment, public wellbeing, and the permanence of settlement patterns. Regional production models reduce the need to transport natural resources, while also increasing the security of supply, and ensuring local wellbeing. Local natural products and the non-material values associated with natural resources (e.g. landscape and recreational amenity values) also create many opportunities for business and increased well-being. Demand is rising for services based on aspects of the environment such as beauty, purity, silence, and health impacts.

4.4 International cooperation – proactive natural resource policy

Global natural resources policy

The dependency of Finland's internal and external security on the international situation has increased due to globalization. Social, economic and environmental problems can transcend state borders in the emergence of a crisis, link up with one another, assume new forms and spread rapidly manifest security threats. The goal of sustainable development is the foremost guide for the use of natural resources, a universal political objective, to which the UN, EU and Finland are committed. Under sustainable development strategies, natural resource use has been steered by different policies at different times.

Environmental policy is an older policy sector in the strategy of sustainable development. It already has an established place, and environmental matters are a part of our daily lives. Both the UN and the EU have long had their own environment programmes. In Finland too there are numerous progressive programmes in the field of environmental protection. Despite its established position, environmental policy is still developing vigorously. A good example of this is the Strategy for the Protection and Sustainable Use of Biodiversity 2006–2016, in which Finland seeks to stabilize the favourable development of the state of the country's natural environment over the period 2010-2016.

During the last decade environmental policy has dealt with many climate and energy issues, and there has been a lively debate that has led to large-scale reforms, for instance on limiting emissions and the use of energy. Climate and energy policy are increasingly seen as an integrated whole. Climate policy also nowadays strongly determines the discussion on environmental policy, but there is a need and space for natural resource policy globally and nationally. The sustainable use of natural resources will, in the coming decades, probably become the centre of environmental policy, in strengthening the UN International Panel for Sustainable Resource Management, and if international negotiations on reducing the use of natural resources begin.

There are many inter-linkages and synergies in climate and natural resource policy, but also contradictions. A sustainable and effective natural resource policy supports climate policy. The transition to a carbon neutral society also supports the sensible and frugal use of natural resources. From the perspective of natural resource and climate policy the identification of common risks is important. Natural resource policy can help support national climate policy, but in line with sustainable development the impacts on the economy, employment and societal policy must be taken into account.

The grasp of the effects of climate change on the availability and quality of natural resources is uncertain. On the other hand, the use of natural resources has impacts on climate change. In the strategy on natural resources the effects of climate change must be taken into account predictively, and an effort made to try to connect in a crosscutting manner the different changes that affect natural resources.

> **“ The grasp of the effects of climate change on the availability and quality of natural resources is uncertain**

The UN International Panel for Sustainable Resource Management, established in November 2007, is an environmental programme of UNEP. Its aim is to 1) collect, analyse and synthesize information on the sustainable use of natural resources, and the environmental impact over the full life cycle, 2) prepare scientific assessments as advice and recommendations for governments and international organizations, and 3) promote the increase of knowhow and the international exchange of information on the sustainable use of natural resources.

In its work, the panel has emphasised the concept of decoupling and the clarification of definitions, the prioritization of products and natural resources from the perspective of sustainable development, global metal flows and biofuels and the sustainable utilization of natural resources.

The economic profit of an organic natural product is estimated to be at least one and a half times that of the profit produced by people. This is based on the store of biodiversity. The importance of eliminating the global socioeconomic challenges of biodiversity, such as poverty in developing countries, has increased. The broader application of biodiversity has influences Finland's activities in international biodiversity agreements and has led to the development of cooperation in the EU. A communication of the EU Commission proposes that the active synergy at the community level and of member states be strengthened and that cooperation between all actors be increased (COM (2006) 216): Halting the Loss of Biodiversity by 2010 – And Beyond. Sustaining Ecosystem Services for Human Wellbeing).

The EU's natural resource policy

The European Union has taken the initiative this decade in natural resource policy. The goals of the EU's decisions concerning natural resources have been the decoupling of natural resource use from economic growth, increasing the efficiency of natural resources, and the examination of natural resource issues from a global perspective. The goal has also been to examine matters from the viewpoint of the full life cycle.

The aim of the EU's strategy on the sustainable use of natural resources (KOM(2005) 670) is to reduce the negative environmental impacts that derive from the use of natural resources – depleting reserves and spoiling the environment – and at the same time to promote the achievement of the goals of strengthening economic growth and increasing jobs affirmed at the meeting Lisbon European Council. The Finnish Presidency of the EU in 2006 drew up the decisions on the European Council on the sustainable use of natural resources. The decisions formed the basis of the EU's strategy on the sustainable use of natural resources, and in them the Council called on the Commission, among other things, to draft a long-term ecological vision and to set goals by 2010 on eco and impact efficiency concerning natural resources.

The EU raised energy and climate issues as one of the main points of emphasis of the Commission's programme of work for 2008, which was in this respect a natural continuation of the decisions made earlier by the European Council. In addition to climate and energy policy, sustainable consumption and a production action programme on the agenda of the Commission in 2008 were important from the perspective of of the EU's strategy on natural resources and achieving the goals the climate and energy policies.

Industrial countries, such as Japan and the United States, have understood that they are decisively dependent on certain raw materials and carry out precisely planned policies to secure the availability of natural resources, In autumn 2008 the Commission published its raw materials initiative, the aim of which was to ensure the availability of raw materials to the EU from world markets and to promote the efficiency of the use of natural resources and recycling in the EU. The initiative proposed that the EU agree on a common strategy on raw materials, which would be based on the following principles:

1. ensure **access to raw materials** from international markets under the same conditions as other industrial competitors;

2. set the right **framework condition**s within the EU in order to foster the sustainable supply of raw materials from European sources;

3. boost overall resource efficiency and promote recycling to **reduce the EU's consumption of primary raw materials** and decrease the relative import dependence.

From the perspective of EU competitiveness and therefore the implementation of the growth and employment goals of the Lisbon strategy, the reliable and undisturbed availability of raw materials is increasingly important.

The export and import of natural resource expertise

Finland nowadays enjoys a high degree of expertise in many areas of natural resource use, for example technological consultancy of the forest industry, the export of industrial mining and metallurgical technology, which improves energy and material efficiency around the world. In developing natural resource businesses Finland has a further opportunity to promote exports and natural resource business activity aimed at internationalization. In selecting fields of natural resource expertise, areas should be sought whose commercial knowhow could create export-designed products for certain sectors or regions. In addition to technological production, export products could also be knowledge intensive consultant and training services and productivity models of business activity. The successful export of natural resource expertise cannot be based on natural small-scale consultancy or equipment production. If we wish to develop natural resource expertise on an internationally significant scale, the division of labour has to be planned and forces sensibly combined. A significant part of the public research input should focus on carefully selected areas in which Finland can take a leading role globally – competition is global and success demands technological leadership.

> “Finland nowadays enjoys a high degree of expertise in many areas of natural resource use

In the initial phase, the access to the market of natural resource expertise will require training and information, public funding and the commercializing of technologies. The promotion of exports and internationalization in particular requires the protection of long-term risk funding and using the opportunities for cooperation with international organizations, including finance organizations.

Because Finland is in global terms a fairly small country and we have limited possibilities to create new resources, it is important to have effective information and knowhow on natural resources when reaching out internationally and on the basis of this to develop models for cooperation.

A global role and responsibility

World trade has gradually opened up, and economic interdependency has increased. The movement of production factors is less impeded than before, but with lowering of borders domestic and international regulations on the illegal trade in such things as natural resource organisms, wood products, diamonds or radioactive material become more important. Over 50% of mineral reserves are located in countries where the per capita GDP is no more than US$10 a day. Globalization presents many new opportunities to those who in time perceive faint signs of change and who accordingly alter their operational methods. In the discussion on natural resources it is impossible to avoid the tensions between developing and industrialized countries, and on the other hand between owner and user countries. Globalization increases wealth, but distribution between countries and within societies leads to serious drawbacks. Problems, risks and threats may acquire new forms. These can be forecast and thwarted only by tenacious international collaboration. There is a growing importance of global networking in all activities. (Strategy of the Ministry for Foreign Affairs, 2005)

The impact of environmental factors and natural resources in conflicts has been irrefutably established. An abundance and scarcity of natural resources can trigger a conflict, particularly when the state concerned is vulnerable. There needs to be a better focus on the links between environment and security in international crisis management and post-conflict situations. It is particularly important that the capacity to manage natural resources is developed in post-conflict settlements.

At the UN Security Council in 2007, the UK and Belgium discussed the issues of natural resources and climate change in relation to security. Cooperation by the Security Council, General Assembly and ECOSOC was emphasised especially from the viewpoint of strengthening development. Finland supports the regular discussion of security problems related to environment by the UN Security Council and other international forums concerned with the issue.

Project proposals

The EU's Baltic Sea Coordinator

The object of the project is to coordinate all programmes (research, protection, natural resource use) concerning the Baltic Sea. At present, the individual projects communicate ineffectively, which is why there is an overlapping in the use of resources. The responsibility of coordinator, for follow up and updating, will be the member states implementing the EU's Baltic Sea strategy. The coordinator will identify deficiencies and needs for protection and research. The aim is also to exert an influence on political decision-making in countries where there is little such protection and research. Active cooperation with Russia must also be developed. The project must become an integral part of the Baltic Sea strategy by exerting an influence on the Council, Commission (DG Regio) and the European Parliament. In addition, Sweden must be lobbied on this, as it will hold the EU Presidency for six months from the beginning of July.

Global awareness of Finnish natural resource sustainability

Finland has important water, peat and wood resources that are well known and used sustainably. Finland must provide information on its activities more openly and gain a broader acceptance of its use of natural resources. At the same time, Finland must develop a benchmark system whereby the use of natural resources by different countries can be developed and statistics compiled commensurately.

(Project proposals of the Luodin thematic days arranged by the Finnish Forest Association and the open web tool of the strategy work.)

Rather than being compliant, Finland must be actively involved in determining the frameworks of natural resource policy in the EU and the UN. Influence can be exerted by, among other things, creating a model for a predictive national natural resource policy, for which there is also an international demand, and by actively utilizing international channels of influence. By influencing international natural resource policy it is possible also to promote the development and use of international sustainability criteria, standards and calculation methods that estimate the use of natural resources as a whole. In this way it would be possible to further market based and other international means of guidance by which all the expenses of natural resource use can be incorporated into pricing.

Natural resources are used as part of the global economy, and natural resource issues are not constrained by national borders or organizational boundaries. Material flows must therefore be examined and controlled across such boundaries. Climate and energy issues are today largely defined through international environmental policy forums. A sustainable and effective global natural resource policy will support climate policy, but would also be needed and set up regardless of climate issues. Natural resources also have inherent linkages with stability and security.

Active international involvement and campaigning will provide more global partnerships for Finland, and create business opportunities and competitive advantages. International co-operation can help to lessen the disadvantageous fragmentation of controls, and ensure that international rules support the sustainable utilization of natural resources in Finland.

By taking initiatives, Finland can highlight the need for a global natural resource policy and shared responsibility, while also influencing the handling of natural resource issues in international organizations including the EU, UN, and WTO.

4.5 Administrtion and control – the need for coordination in natural resource managment

The strongly sectoral character of natural resource management

Natural resource management in Finland is scattered among various government ministries – the Ministry of Agriculture and Forestry, the Ministry of Employment and the Economy, and the Ministry of Environment. Each ministry is responsible for a slightly different aspect of natural resources as a whole. The division of responsibility among these ministries does not, however, cover all natural resources. For instance, there is no clear ministerial responsibility for the management of fuel peat.

> **“ An operational natural resource administration requires that matters concerning natural resources are examined holistically and planned on a sufficiently long-term basis**

In addition the foreign ministry administrative sector covers the linkages of natural resources concerning foreign and security policy, trade policy and development policy. The foreign ministry plays a coordinating role when Finland participates in the discussions and decision-making of international forums.

The fields of activity of the different ministries closely converge, so that that the Ministry of Environment is responsible for all environmental matters concerning natural resources, and the Ministry of Employment and the Economy is responsible for economic matters. The Ministry for Foreign Affairs is responsible for European Community environmental matters related to trade policy. Despite the differences of emphases in these, in its activities each ministry, as a representative organ of government, has to balance naturally different ecological, social and economic and foreign trade-related perspectives.

In October 2008, the Ministry of Agriculture and Forestry and the Ministry of Environment signed an agreement of cooperation by which there will be a closer collating of environmental and natural resource research by the creation of an Environment and Natural Resources Consortium. The essential bodies in the consortium are the research institutes of the two ministries’ administrative sectors, but the door is also open for others to take part. The consortium operates as an independent body in the field of natural resource and environmental research and as joint expertise and service unit, and is an administrative centre for integrating research, expertise and information resources. The work of the consortium is progressively getting underway during 2009.

The policy lines of the government programme of the second administration of Prime Minister Matti Vanhanen forms the basis for the Reform Project of the Regional State Administration, which aims to improve the public and client oriented nature, productiveness and efficiency of the regional administration. The reform will clarify the role, duties, guidance and regional distribution of state regional administrative authorities. The State Provincial Offices, employment and economy centres, regional environment centres, environmental licensing authorities, road districts and occupational safety and health districts will be disbanded and their tasks collated and reorganized from the beginning of 2010 into two new structures, the regional administration authority and the centre for economy, transport and environment. This new structure will in the future form the basis of other new arrangements of the tasks of the regional state administration. The centre for economy, transport and environment will support regional development by taking charge of implementation and development tasks of the public administration. Their areas of responsibility include environment and natural resources.

Finland's management of natural resources and research is strongly sectoral in nature, because the organization of administrative and research is based mainly on the division of different natural resources. An operational natural resource administration requires that matters concerning natural resources are examined holistically and planned on a sufficiently long-term basis. This in turn requires that there is an examination of the responsibilities related to natural resources by the different administrative sectors, and that cooperation and a division of labour are developed concerning the ministries and other authorities responsible for the use of natural resources.

Natural resource strategies concerning Finland

The only integrated natural resource strategy that concerns Finland, which deals with the use of all sectoral natural resource use, is the EU's strategy on the sustainable use of natural resources. In addition, we can say that the UN natural resources panel deals with matters in this sphere, even though it does not have actual strategic policy lines. Both deal with natural resources as a whole and emphasize their sustainable use. The EU strategy puts a separate emphasis on the need to halt negative environmental impacts that come about with the use of natural resources in the growing economy.

"The EU, like Finland, must safeguard the availability of raw materials, especially by means of diplomacy and international cooperation

International and national thematic strategies examine many natural resources simultaneously from certain angles. They mainly deal with renewable natural resources. The strategies focus on goals concerning better natural resource management and productivity, and material and energy efficiency. Most stress the favouring of renewable natural resources in relation to non-renewable ones. They also emphasize promoting and efficiency of recycling. Concerning energy and climate issues, emphasis is placed on increasing the use of renewable energy sources, which in national strategies means, in particular, increasing the use of biomass and wood-based fuels, wind power and solar power.

Finland's strategies directed at natural resources deal especially with forests, waters and water reserves, and soil. The aim of the sectoral strategies is not usually concerned with reducing the use of natural resources. For instance, the strategies on forestry and rural development give priority to increasing domestic wood use and promoting bioenergy. Strategies on water reserves do not give any emphasis at all to reduction goals. Two rural development strategies stress reducing the environmental load in relation to surface and ground water and air. Most strategies dealing with natural resources take account of increasing the preservation of biodiversity.

Other thematic strategies' points of emphasis include waste prevention and reducing the environmental impacts of waste management, energy consumption and cutting greenhouse gasses, limiting the need for traffic and halting the impoverishment of biodiversity. In particular, the EU's initiative on raw materials, its natural resources strategy, the EU's and Finland's sustainable development strategies, the Finnish KULTU programme and Finland's development policy programme emphasize the broader importance of shifting to more sustainable production and consumption patterns. The national strategy on sustainable development and the KULTU programme also emphasize that welfare produces energy and saves on natural resources. The ecological and ethical use of natural resources are especially emphasized by the natural resource strategy of the Ministry of Agriculture and Forestry and by Finland's strategy on the protection and sustainable use of biodiversity.

The EU initiative on raw materials hones in especially on the problem of the availability of natural resources. The availability of raw materials for EU industry is a political issue, because different countries are competing for the same raw materials. Due to this, the EU, like Finland, must safeguard the availability of raw materials, especially by means of diplomacy and international cooperation.

Sectoral-focused strategic need

The use of individual natural resources is guided within different sectoral strategies, which have been built up around some natural resource or field of production. In the EU, the character of the strategies and programmes influences the sort of mandate the EU has to act on different issues. At the national level, the character of the strategies and programmes varies according to local conditions.

> **The need for a strategy on minerals and rock materials well illustrates the fact that if rock raw materials were not available, construction and building renovation would be halted in Finland within the next ten years**

Forests have always been an important natural resource in Finland, and, regardless of the availability of energy, the use of the forests has meant a few sources of livelihood for Finland. Forests and wood are still the natural resources whose use, development and research involves several large programmes and strategies.

From the perspective of the comprehensive management of natural resources, it is important that strategies for different sectors are drawn up and updated – for instance strategies on minerals and rock materials and on bog and peat. Sectoral strategies must be drawn up and updated, prepared on a broad base. There must also be an active public discussion of the issue.

The need for a strategy on minerals and rock materials well illustrates the fact that if rock raw materials were not available, construction and building renovation would be halted in Finland within the next ten years. Reserves of rock material must be set aside for construction by a long-term national-level decision, in order that we can safeguard the development of Finnish society and the sustainable use of natural resources.

Land use planning steers the use of natural resources

In addition to the development of management, it is important that we clarify the planning development needs of land use. Land use decisions determine what natural resources are to be used and how they can be utilized. A natural resource can even become a second land use decision. In land use policy it must be noted that the geographical location of different natural resources varies. Land use planning and management can be increasingly better reconciled with the sustainable use of natural resources. This is a challenge that has an impact on various political levels and sectors. Nowadays, the most important priority of decision-makers is to follow up the negative effects of land use on the environment to influence them indirectly while maintaining the conditions for economic performance and resource production.

The need for geological information is increasing, particularly in social planning, construction, raw material management and environmental protection, as the volume of construction grows. Town planning, building highways and rock buildings, the availability of raw materials, groundwater use and protection, landfill locations and environmental impacts require diverse planning and geological data. The EU's initiative on raw materials emphasises that the stable availability of raw materials located in the EU requires that the knowledge base concerning EU mineral deposits needs to be improved. In addition, the long-term possibilities to exploit the deposits referred to need to be taken into account in land use planning. For this reason, the Commission proposes that national geological research centres be more closely involved in the land use plans of the member states.

Finland's main statute regulating construction and land use was the 1958 Building Act, which was replaced at the beginning 2000 by the law on land use and construction. The goal of this law is to create the conditions for good living environments and to promote ecologically, socially and culturally sustainable development.

Economic incentives need natural resource accounting and models

Because the environmental harm associated with problems of the availability and use of natural resources is on the increase, there is also a growing need to find the means to direct natural resource use. These constitute the activities of authorities by which people and businesses try to steer the sustainable use of natural resources and by which they try to curtail detrimental practices. The means guidance used by the authorities can be classified as legal, economic and educational ones.

The economic means of guidance used by the authorities may include, for instance, taxes or financial support. Economic guidance is nowadays often tied to the EU, for instance in the form of incentives, sanctions, such as taxes on energy, securities, and various forms of project support and funding. Nowadays, for instance, there is an effort in environmental protection guidance to shift increasingly to economic means of guidance. The intricacy of the matter complicates this means in guidance related to natural resources, as in environmental problems. The economic and legislative problem with guidance mechanisms is how to get a sufficiently broad vision of natural resources and their linkages. In drawing up economic means of guidance it is important to develop models of the material flows of the national economy and the environmental impacts for assessment, and national resource accounting methods as a part of those of the national economy as a whole. Using working models it is possible to try out economic guidance means at different levels of administration and in business activities.

Economic motives can be more effective compared to legislative means of guidance. In market derived means public support is directed at processes whereby more sustainable natural resource use or better technology can put on the market and become a point of competitiveness. This is known as a catalyst means of guidance, the cost effectiveness of which is better than by traditional subvention or volume support, which are directed at the product itself.

Project proposals

An advisory board on natural resource research

The goal of the project is to combine research and knowledge from various natural resource sectors. This would be a matter of having a data bank of research, the characteristics of different natural resources, their location and usability. This would make it possible to search for new solutions within natural resource research and the accomplishment of new innovations crossing divisions. Recycling would be made more effective (one person's waste is another's raw material) and research on materials developed. The advisory board needs a sufficiently strong mandate and it should have the financial muscle to allocate research resources for creating broad, cross-sectoral research programmes (the establishment of the SHOK initiative for concentrating strategic expertise).

Environmental regulation accounting

In none of the existing laws are there the goals of sustainable development, even in the manner demanded by the Finnish Constitution, environmental criteria for approving projects, public access to information, participation and initiative-taking and rights of appeal. This amendment list should be applied to all sectoral legislation.

(Project proposals of the Luodin thematic days arranged by the Finnish Forest Association and the open web tool of the strategy work.)

Funding new societal solutions can nevertheless be even harder than the creation of new innovations. Financial means of guidance also involve various conflicts of interest, as a result of which decision-making can be complicated and drawn out. A fear of negative impacts can easily prevent experimentation that would eventually produce good results.

> **It is good to seek, together with industry and commerce, and in addition to official means of guidance, independent measures to prepare for both the natural resource market and impending changes in policy**

In addition to incentives, there is a need for basic regulation. For instance, mineral natural resources cannot be exploited if there is no regulation, making it possible to use risk capital for searching for deposits, the transfer of deposits is clear for those discovering them and the rights of prospectors are secure.

In 2005 a proposal was made in Finland for a programme to promote sustainable consumption and production – the first of its kind in the world. This was drawn up by the KULTO Committee, which was set up by the Ministry of Environment and the Ministry of Trade and Industry in 2003. The goal is that in Finland in the future the eco-efficiency of production will improve throughout the entire product chain and that eco-efficiency takes the lead in the world. The KULTU programme proposed that long-term policy lines be set out for an overhaul of the taxation structure, which would promote sustainable development, practices conserving natural resources and the reduction of environmental harm. There are several reports on financial means of guidance being prepared in the public administration.

Because appreciable changes are expected in the natural resource market, it is good to seek, together with industry and commerce, and in addition to official means of guidance, independent measures to prepare for both the natural resource market and impending changes in policy. These measures require a predictive grasp of matters, innovation and the development of best practices.

International competition is getting tougher with regard to the exploitation of opportunities provided by natural resources. For Finland to be a favourable and attractive operating environment for firms able to use natural resources successfully and sustainably, our innovation system, physical infrastructure, economic policies, legislation and administration must provide the necessary conditions. To support change and improvements in resource efficiency, we need legislation and controls that provide incentives and break down barriers, as well as active influence over EU decisions.

Society's choices must be based on sufficient information and the careful inspection of material flows. The planning and steering of natural resource use is today highly sectorised in the spheres of administration, legislation and research. The use and conservation of natural resources should instead be examined as a single entity, and planned over a sufficiently long time frame. This will require service models that enable the producers and users of information to meet each other. Increasing competition for productive land, mineral reserves and the various usages of different kinds of biomass will also create international demand for such planning expertise.

4.6 Expertise and communications – developing learning systems and consumer guidance

The development of a learning and innovation system

World-class research is being conducted in Finland on the evaluation of natural resources. For instance, the Geological Survey of Finland's trailblazing work on our bedrock and soil is the best known in the world. The national forest inventory procedures developed at the Forest Research Institute for satellite mapping provides a precise picture of the numbers of trees and of forest growth. Apart from the fact that we are familiar with our reserves of natural resources, we also know how to make use of them sustainably and efficiently. Finland also possesses top range environmental research. Finland is, for example, a leading country in ozone and aerosol research, which is closely linked to climate research.

Every few years, the Academy of Finland conducts a comparison of science in Finland and other countries. The last such report was issued at the turn of the year 2006-2007, entitled Finnish Science in International Comparison. Finland excels in agronomy and medicine by comparison with other countries. Finland comes first in agronomy in the comparison of 30 OECD countries.

Each natural resource sector has, in addition to its strengths, its own larger and smaller points of development. The common problem facing all sectors is that multisectorial qualities are deficient in all parts of the chain of production: research collaboration between different branches of science is meagre and often only apparent. Other sectors are not known about and there is no understanding of how to search out cooperation. There are some cooperation forums available nowadays for collaboration in fields of natural resources. But cooperation between natural research and commerce is not as smooth as, for example, in the field of trade.

Research needs to be able to respond better to the central and current information needs of the public administration. This requires that administration and research jointly forecast what sort of natural resource issues would be important in the future, in order that research information can be produced within the necessary time schedule. The development of predictive activity is closely linked to the integration of natural resource sectors into research and training and their closer collaboration.

The development of the system of learning departs from the idea that the emphasis on natural resources is to be increased in all levels of teaching. The collaboration of universities, vocational colleges and sectoral research institutes can be further increased and make possible interdisciplinary studies, including by allowing broader individual curricula. For example, the focus on renewable natural resources in the teaching of the natural resource sector and teaching in the technological sector are separated from one another. Forms of cooperation for theoretical and applied teaching should also be increased.

> **“ The development of the system of learning departs from the idea that the emphasis on natural resources is to be increased in all levels of teaching**

The starting point for the development of the whole system of expertise should be to increase the influence of research, satisfy changing client needs, making national coordination more effective and to develop cooperation between research and teaching. In the future there will be a need for the whole chain (initial production, processing, material characteristics and product development) to be more interdisciplinary, and geared to longitudinal expertise, where there is a combination of university level instruction and applied skills. The importance of international training is also increasing, and this requires a greater readiness to study and work abroad, and for foreign students and employees to be brought to Finland. In the near future there will be an increase in the importance of recycling, life cycles, production method guidance (e.g. certification) and expertise linked to the principles of sustainable development, and of identifying the various interactions linked to them. In addition, there will be a need for expertise in comprehensive assessment.

Concerning innovative activity, it is important that alongside the emphasis on technology in EU and domestic innovation policy there is a more visible natural resource perspective, which hinges on the philosophy of sustainable development, as the technological focus of innovation policy has put the emphasis on the notion of continuous growth. There is a need for a tighter connection between the strategies and programmes of national innovation policy and the operations of the EU's Lisbon strategy in research framework programmes and structural funding policy.

Bringing about innovations frequently demands support from many different directions, and various factors influence the creation of innovations in their own manner. The probability of invention becoming innovation grows exponentially when it is supported consistently from many different directions. The central requirement for many innovations is that there is an appraisal of the use of natural resources in the development of activities.

> **Bringing about innovations frequently demands support from many different directions**

The advisory body dealing with sectoral research coordinates the overall guidance of sectoral research, and one of its goals is for research on environmental and natural resource structural development.

Strategic centers for science, technology and innovation

SHOK, the Finnish acronym for Strategic Competence Clusters, refers to the close cooperation started at the beginning of 2008 by enterprises, universities and research institutes. The concentrations established the initiative of the Research and Innovation Council (formerly the Science and Technology Council) to improve the system of funding Finnish innovations. These clusters are responsible for responding on research and product development activities, and in this respect the importance of the Strategic Competence Clusters for enabling strategies on natural resources are great. The goal of the activities is to speed up the utilization of research results and thereby to maintain the competitiveness of enterprises and society from the perspective of the most crucial areas.

Those areas that are being started up in the initial phase by the concentrations concern energy and the environment, metal products and machine building, the forest cluster, health and welfare, and information and communications and communications services. The activities have already started Forestcluster Ltd, the Strategic Centre for Science, Technology and Innovation in the field of ICT, the Finnish Metals and Engineering Competence Cluster, and the Energy and Environment Strategic Centre for Science Technology and Innovation. In addition the activity has begun the building of environment cluster. Health and welfare clusters are still in their preparatory phase.

It would also be important to create a competence cluster for strengthening expertise in utilizing and recycling mineral raw materials. This field is now one of Finland's strong areas, representing world-class technological applications and manufacturing.

The need to comprehend impacts and linkages

In addition to the reserves of natural resources and their utilization, we need to know about the impacts of their use, because the global inter-linkages often remain unnoticed and the various deleterious effects are not criticized. For example, there is not a sufficient understanding of concealed flows and logistics. From the perspective of strategy implementation it is important to recognize the chains of material flows, their impact on the environment and society and the actual costs they incur. It is especially important that consumers are given sufficient information and encouragement supporting resource efficiency options. The Finnish Centre for the Environment's ENVIMAT (environmental impacts of material flows caused by the Finnish economy) project has investigated the environmental impacts of production and consumption material flow life cycles according to each field of activity and product group. In addition to the domestic environmental burden, this work has taken account of the environmental impacts of product transmission across Finland's borders.

Guiding consumer choices

When it comes to the sustainable use of natural resources the possibilities for ordinary people to exert an impact are mainly to do with making personal choices. The consumer's choices in turn also influence the manufacture of products and in this way the materials and technologies used at the manufacturing stage.

The consumer can support sustainable development and his/her wellbeing by preventing the creation of waste by reducing needless consumption, and by avoiding disposable products in favour of reusable ones. In order for consumers to be able to take note of the sustainable use of natural resources in their own activities, they must be informed about it in terms of their own housekeeping. This requires that the consumer should have understandable and reliable information at his or her disposal, as well as the tools with which to follow and compare the impact of purchasing decisions on the sustainable use of natural resources.

Project proposals

Interdisciplinary programme for researcher and advanced training on natural resource use and policy

The goal of the project is to establish an interdisciplinary researcher and advanced training programme linked to natural resource use that combines applied and basic research. The purpose is to improve the flow of information and discourse between different sectors of research. The means of realizing this would be to coordinate a programme that arranges researcher training in various forms, such as a compulsory course in which different disciplines are genuinely combined in a multidisciplinary way. In addition, international experience and researcher exchanges between various research institutes would be promoted.

Information campaign for young consumer education

The goal of the project would be to improve the energy efficiency of consumer behaviour (for example, disconnecting cell phone chargers from the mains when phones are not being charged; reducing the energy use of electric devices for entertainment use, prohibiting standby modes, turning off computers and computer screens). Means would include the 'Just click!' magazine, and TV, radio and internet advertising. This would be an easily used means that a youth celebrity would market.

(Project proposals of the Luodin thematic days arranged by the Finnish Forest Association and the open web tool of the strategy work.)

Cognitive means of guidance based on consumption habits also involve means of guidance for voluntary behaviour, which include information campaigns, standard and certification systems, and environmental labelling arrangements. The current standard and certification systems could be developed so that they would, in one or more phases of the product life cycle, in general have globally or regionally significant impacts on the sustainable use of natural resources. This standards and certification system could have an important effect on sustainable natural resource use by guiding consumer choices and by encouraging manufacturers and service providers to aim for a competitive advantage so that they provide products that fulfil the requirements for meeting natural resource standards or granting certification. It is important when planning these means of guidance to take account of the needs of people's different age groups, outlooks and consumer expectations. For instance, guidance of the consumer expectations of children and youth could have a significant impact on sustainable natural resource use in the future. It is important that campaigns directed at children and youth are conducted on their own terms and from their own starting points.

The need to understand the forces of change that affect natural resources and their inter-linkages is increasing, together with the need for forecasting. Expertise, innovations and enterprise related to natural resources are spread out across several sectors. To develop the bioeconomy and the material cycle, Finland's learning and innovation system must produce world-class natural resource expertise across such boundaries. Experts' mobility and collaboration is needed internationally, among different sectors, and between business life, research and the administration.

Many of the costs incurred due to the environmental impacts of natural resource use end up being paid by other countries or future generations. Global linkages are often overlooked, and harmful impacts unrecognized. The importance of hidden flows and logistics in impacts is not yet sufficiently understood, for instance. From the perspective of the implementation of the strategy, it is important to identify chains of material flows, their impacts on the environment and society, and the real costs they entail. It is vital that consumers should get enough information and incentives to support resource efficient choices. Environmental education must be intensified to make children and young people more aware of the significance of natural resources.

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APPENDIX

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