

# Building an Intelligent and Responsible Natural Resource Economy

Natural Resources Report Submitted to  
Parliament by the Finnish Government

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<b>Tiivistelmä   Referat   Abstract</b> <p>In comparison with other industrialised countries, Finland's national economy is based to an exceptional extent on value added to natural resources. In addition to abundant forest resources per capita, Finland also has significant reserves of mineral aggregate, mineral ores and peat. Other important natural resources include clean water, extensive areas of cultivable and undeveloped land, and many natural products. The cultural and recreational amenity values of natural ecosystems additionally provide opportunities for sustainable activities in the fields of tourism and well-being services. In the increasingly competitive global economy, Finland's natural resources represent a great opportunity, but we have to learn how to create wealth and well-being in more sustainable ways. Our natural resource policies must be based on a deep understanding of the ways we should utilise and conserve natural resources to ensure success in the future. This report is partly based on existing strategies covering the bioeconomy and minerals, but it also brings together many other aspects of natural resource utilisation, including the water economy, ecosystem services, material efficiency and energy efficiency.</p> <p>Contact person within the Ministry of Employment and the Economy: Strategy and Foresight/Mika Honkanen, tel. +358 10 606 4904</p>		
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# Summary

In comparison with other industrialised countries, Finland's economy is based to an exceptional extent on value added to natural resources. In addition to abundant forest resources per capita, Finland also has significant reserves of mineral aggregate, mineral ores and peat. Other important natural resources include unpolluted water, extensive areas of cultivable and undeveloped land, and natural products such as berries, mushrooms, fish and game. The cultural and recreational amenity values of natural ecosystems additionally provide opportunities for sustainable activities in the fields of tourism and well-being services.

Finland's plentiful natural resources and the related expertise constitute considerable opportunities for the responsible production of added value for the national economy and well-being for future generations. They also entail considerable potential for new forms of production for newly expanding markets, as well as opportunities for the export of Finnish expertise. Vital opportunities particularly relate to developments in the bioeconomy, mineral economy and water economy. To succeed, we must first effectively take responsibility for material and energy efficiency, safeguard vital ecosystem services, and ensure local well-being.

Competition on global natural resource markets is getting tougher, but at the same time international natural resource policies are only just beginning to take shape. Natural resources represent a great opportunity for Finland, but we have to learn how to create wealth and well-being in more sustainable ways. Our natural resource policies must be based on a deep understanding of the ways we should utilise and conserve natural resources to ensure success in the future. This is an opportune time to seek answers to these questions. To ensure that we lead the way in the future natural resource economy, we must prioritise measures that need to be taken urgently in each sector, and also build a new model for the comprehensive management of natural resource policies.

This report is partly based on existing strategies for the bioeconomy and minerals, but it also brings together views on many other current issues related to natural resources, including the water economy, ecosystem services, material efficiency and energy efficiency.

The report defines a vision for 2050 with Finland seen as pioneering the development of a responsible natural resource economy. The strategy for realising this vision incorporates the following goals: 1) Finland's natural resource economy and the related knowhow and services constitute a significant source of added value and well-being; 2) Natural resources are utilised with material and energy efficiency, striving to create closed material cycles, in ways that reduce greenhouse gas emissions and waste, and do not endanger ecosystem services; 3) Finland's security of supply of vital natural resources is ensured, and solutions involving local

production create local well-being; and 4) Finland is internationally respected and influential thanks to its expertise on natural resource issues.

Fulfilling the report's guidelines will increase Finland's well-being and competitiveness, to improve the security of supply, and also help to realise many other goals related to natural resource use in contexts including climate and energy policies, the conservation of biodiversity, and the restructuring of Finland's forest sector. The report sets out guidelines for actions in four key areas for change: 1) the responsible management of natural resource policies; 2) anticipating the future and finding innovative solutions; 3) enabling structures; and 4) mainstreaming and everyday solutions.

To achieve the desired changes, the public sector, businesses and civil society must all pull together in the same direction. Active public debate on natural resource issues must be encouraged. Pioneering businesses and non-governmental organisations can play a key role in this context.

# 1 Introduction: Making Finland into a pioneering sustainable natural resource economy

## 1.1 Future natural resource issues

Natural resources are vital to our well-being, and their sustainable use forms the basis for the economy. The health and productivity of ecosystems limit the scope for our use of natural resources. But population growth and rising levels of consumption have increased both the use of natural resources and related harmful environmental impacts. Without purposeful measures, biodiversity will continue to decline, the functional capacities of ecosystems will be weakened, and greenhouse gas emissions will increase further. At the same time, global competition for raw materials is intensifying. The availability of productive land and fresh water are becoming limiting factors. Competition is increasing the demand for biomass and mineral resources. Competition for natural resources is also changing geopolitical relationships and reducing global security.

In comparison with other industrialised countries, Finland's national economy is based to an exceptional extent on value added to natural resources, and demand for our resources will increase in the future. We have abundant forest resources per capita, and wood is used to manufacture highly refined products for export. Finland also has significant reserves of mineral aggregate and peat, which are mainly used within the country, as well as extensive deposits of mineral ores. Our other important natural resources include clean water, extensive areas of cultivable and undeveloped land, and natural products such as berries, mushrooms, fish and game. The cultural and recreational amenity values of natural ecosystems additionally provide opportunities for sustainable activities in the fields of tourism and well-being services.

In Finland the rate of consumption of natural resources per capita is higher than in other EU countries. The ecological footprint of an average Finnish citizen is large. But on the other hand, Finland's biocapacity is extremely large by international standards. This gives us the opportunity to create value by meeting the growing global demand for natural resources, but we will not succeed in future natural resource markets unless we set an example by using natural resources sustainably.

Natural resources represent a great opportunity for Finland, but we must create wealth and well-being in more sustainable ways. Our natural resource policies must be based on a deep understanding of the ways we should utilise and conserve natural resources to ensure success in the future. New practices are required in policy-making, economic thinking, business and everyday consumer behaviour. By investing

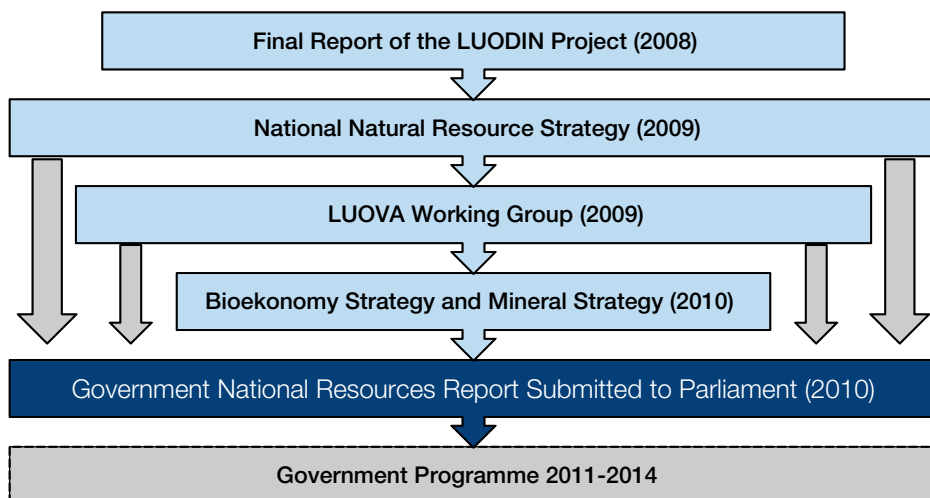
in sustainable production and expertise, we can enhance Finland's competitiveness while boosting employment and regional development. Our sustainable use of natural resources, the extension of knowhow for the green economy, and exemplary pro-active participation in international policy-making can facilitate exports of world-class Finnish expertise. At the same time this will help us meet our global responsibilities.

This Government report aims to set out comprehensive guidelines for the use of natural resources, linking the various sectors where natural resources are used and the different aspects of sustainability through a common framework. Fulfilling its recommendations will give Finland excellent opportunities to become a global forerunner on natural resource issues.

## 1.2 The role of this report

This natural resources report is part of a series of reports (see Fig. 1) that commenced with the launch in spring 2007 of the LUODIN project, initiated by the Finnish Forest Association to develop dialogues and expertise on natural resource issues. This project resolved that Finland should purposefully prepare to adapt to fundamental changes in natural resource markets and global developments that are reshaping natural resource use. The project's broadly-based working group proposed in January 2008 that Finland should prepare a national natural resource strategy.

**Figure 1.** The role of this report in the historical shaping of Finland's natural resource policies.



Sitra, the Finnish Innovation Fund, took a leading role in the preparation of Finland's **national natural resource strategy**. This work began in April 2008 and involved a broadly-based 35-person strategy group as well as an extensive network of expert contacts. All interested parties were able to influence the shaping of the strategy through online communications. The strategy, subtitled "*Using natural resources intelligently*" was among the first of its kind anywhere in the world to address all natural resources within a single strategic framework. The strategy was presented to Prime Minister Matti Vanhanen in April 2009.

The strategy's key guidelines had already been considered during an interim review of the ongoing government programme. A government statement issued on 24.2.2009 stated that: "*The basis for our future recovery is provided by Finland's plentiful renewable natural resources, their sustainable use, and the development of modern technologies for their utilisation. [...] Preparation work must begin to strengthen the coordination of natural resource policies with the aim of making Finland into a leader in the sustainable and economic utilisation of natural resources and materials.*"

In autumn 2009 the LUOVA working group, made up of representatives from various ministries, prepared a Prime Minister's Office memorandum on the coordination of natural resource policies across the national administration. On the basis of Prime Minister Matti Vanhanen's proposals, a **climate and energy policy ministerial working group** led by Minister of Economic Affairs Mauri Pekkarinen resolved on 15.12.2009 to launch and coordinate the preparation of a **government natural resource strategy**. Two further working groups were set up: a bioeconomy working group appointed to draw up a description and strategic evaluation of concepts related to the bioeconomy and developments as far ahead as 2050; and a second working group assigned to draft a national mineral strategy. Both working groups submitted reports to Minister Pekkarinen in October 2010.

In addition to the strategies shown in Figure 1, Finland and other countries have additionally drafted various strategies and programmes covering natural resources in general or in specific sectors (see Annex 1). Many other government documents also affect natural resource policies. The Government Foresight Report on Long-term Climate and Energy Policy, adopted in 2009, maps out how Finland can become a low-emission economy, setting a target that Finland's greenhouse gas emissions should be reduced by at least 80% of their 1990 levels by 2050 as part of international efforts to mitigate climate change.

This **Government report for Parliament** brings together the viewpoints included in the above-mentioned processes. Annex 2 lists the visions, strategic goals and proposed measures set out in three related strategies which concern many common factors of importance to Finland's wider natural resource policies (Table 1).

**Table 1.** Key elements of Sitra's national natural resource strategy (2009), the national bioeconomy strategy<sup>1</sup> (Prime Minister's Office 2010) and Finland's mineral strategy (Min. of Employment and the Economy 2010).

Vision and strategic goals	Key measures
<ul style="list-style-type: none"> <li>• Long-term (2050)</li> <li>• National and local well-being</li> <li>• Global solutions, Finland as a forerunner, responsibility</li> <li>• Sustainable utilisation of natural resources, efficient material cycle and reductions in harmful environmental impacts</li> <li>• Business activities and an innovative environment that boost Finland's competitiveness</li> <li>• Cross-sectoral thinking and the pro-active development of expertise as factors enabling success</li> </ul>	<ul style="list-style-type: none"> <li>• Natural resource policies prominent onto the national agenda</li> <li>• New financing solutions</li> <li>• Favourable developments in land use planning, standard setting and administrative practices</li> <li>• New models for corporate and risk financing</li> <li>• Influence over international policies and processes</li> </ul>

The national bioeconomy strategy and mineral strategy form the backbone to this report. But certain other key resources remained outside the scope of these two strategies, including water, undeveloped land, biodiversity, ecosystem services, and certain renewable resources based on inexhaustible flows (e.g. wind and solar power). Moreover, the two strategic reports focus only on natural resources inside Finland and the potential for their utilisation. In reality about half of the total natural resource use within the Finnish economy involves the use in other countries of the resources contained in goods imported to Finland. This resource use can be linked to considerable hidden material flows that burden the environment in other parts of the world. The same applies to the impacts of Finland's exports. The two strategic reports mainly emphasise product development, and do not address natural resource consumption levels in Finland.

### 1.3 Background, objectives and limitations

The main strategic basis for this natural resources report is formed by the guidelines set out in the national natural resource strategy, which was produced in 2009 by experts from many sectors, coordinated by Sitra. The strategy aims to encourage favourable changes throughout society in operating practices and attitudes concerning natural resources and their utilisation.

In preparing this natural resources report consideration has particularly been given to Finland's strategic goals:

- to become a green economy where ecosystem services and the sufficiency of natural resources are prioritised
- to harmonise sustainable development, Finland's competitiveness and well-being, and goals related to global responsibility

<sup>1</sup> In this report, the "national bioeconomy strategy" refers to the final report of the bioeconomy working group: The Bioeconomy in Finland – an evaluation of the need for a national strategy, Prime Minister's Office 15/2010.

- to bring together Finland’s strengths based on the resource economy and the knowledge economy
- to address natural resource issues, climate and energy issues and biodiversity together coherently
- to change the ways we think and operate with regard to natural resources

This natural resources report aims to:

- map out the main drivers and trends reshaping natural resource policies, review the present state of natural resource use, and examine progress on earlier strategies and challenges related to their implementation
- bring together the main guidelines from the national natural resource strategy, the bioeconomy strategy<sup>2</sup> and the mineral strategy to form a framework for Finland’s natural resource policies, taking into consideration key issues highlighted in these strategies
- bring added value to the existing strategies by filling in gaps left due to their limited scope, by identifying the linkages between different natural resource sectors, and by reinforcing the links between natural resource policies and climate and energy policies
- define the Government’s guidelines for steering Finland’s natural resource policies
- propose key measures that need to be taken over the next few years

Progress on setting targets for the different areas covered by this natural resources report has not been uniform, so it has not yet been feasible to define common indicators for natural resource policies. It is imperative that indicators measuring progress towards common goals should be defined and adopted as soon as conditions make this possible.

There is no generally accepted definition for the term **natural resources**. The concept can be variously defined from economic, social, natural science or environmental science perspectives. The earliest and most traditional definitions were often closely linked to the concept of raw materials, seen from an economic standpoint. Natural resources are thus seen as a form of wealth that can be utilised. This kind of thinking is however being replaced by more modern interpretations related to the concepts of sustainable development and the green economy. Natural resource use is so inextricably linked to the major changes facing humanity – such as population growth, international conflicts, climate change and declining biodiversity – that natural resources should clearly be understood and defined from ecological and social perspectives as well as an economic standpoint.

Natural resources are seen in this report within the framework of **ecosystem services**. Ecosystem services include all of the material and non-material benefits people obtain from the natural environment. Material benefits include natural raw materials. Non-material services include benefits derived from biodiversity

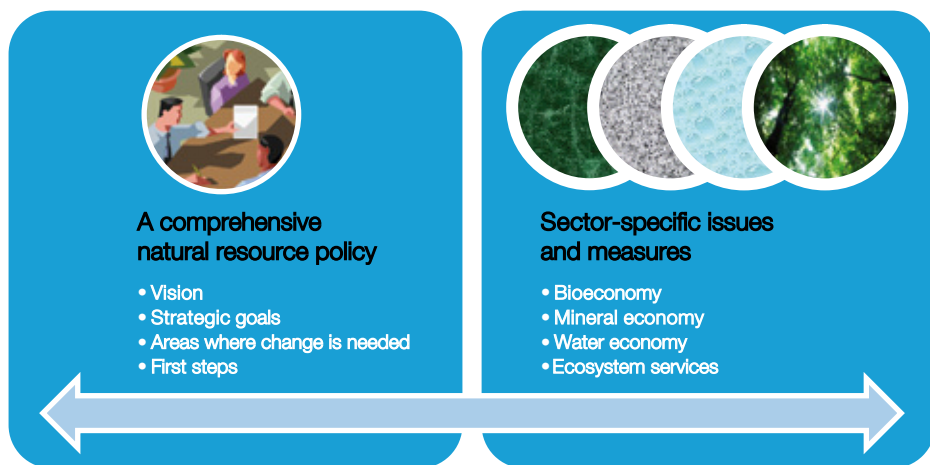
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<sup>2</sup> In this report, the “national bioeconomy strategy” refers to the final report of the bioeconomy working group: The Bioeconomy in Finland – an evaluation of the need for a national strategy, Prime Minister’s Office 15/2010.

and landscapes, including amenities for recreation and tourism. The significance of ecosystem services for our well-being is increasing, creating new opportunities for enterprise. These opportunities must nevertheless be exploited in ways that safeguard the functioning and diversity of natural ecosystems. Adopting an ecosystem approach involves the strategic planning of the use and conservation of natural resources with an emphasis on interactions between different elements of natural systems, and the realisation that humanity is part of nature.

Ecosystem services are provided by both biological and geological systems. Biological systems operate on the basis of nature’s biological diversity at the genetic, species and habitat levels. Geological systems are based on nature’s geological diversity: landforms and landscapes, climatic factors, hydrological basins, soil moisture content, and the availability of mineral nutrients. The boundaries between biological and geological systems are not sharp. Water and the topsoil are involved in interactions with both systems. The ground and the bedrock may also provide a source of renewable energy (ground-source heat).

**Figure 2.** The structure of the strategy.



This report strives to set out a comprehensive vision of the key common issues that relate to all natural resources. It also examines sector-specific issues (see Fig. 2). For practical purposes it is necessary to define the following limitations and priorities:

- The report will focus on ecosystem services that people use directly as a source of material or psychological well-being. Where material natural resources are concerned, the report focuses on three key resource types: **bioresources**, **mineral resources** and **water resources**. The report also examines opportunities related to the utilisation of the **cultural and recreational amenity values provided by ecosystem services**.



- Other ecosystem services provided by natural functions and processes (e.g. nutrient and hydrological cycles, regulation of the climate) are seen as being the fundamental basis for all biological activity. These processes must be safeguarded to enable all other forms of natural resource utilisation.
- In addition to the above-mentioned factors, **land** may also be seen as an exhaustible natural resource for which there will be increasing demand in the future. Space is in many ways an asset in the context of Finland's natural resources. But land as a natural resource is left outside of the scope of this report, although this issue is touched on in the contexts of regional economies and land use.

The use of natural resources is also steered by many national and international agreements, strategies and programmes. The following limitations therefore apply to Finland's efforts to achieve its goals related to natural resources (for more details see Annex 2):

- Natural resource policies must account for Finland's international commitments including EU strategies.
- Natural resources must be utilised in ways that also safeguard biodiversity in Finland and support Finland's efforts to realise climate targets and energy policies.
- Natural resources must be utilised sustainably and within limits defined by their biocapacities, so as to safeguard biodiversity and other ecosystem services.

# 2 Trends shaping the natural resource economy

## 2.1 Global markets and policies

The world population is expected to grow to 9 billion by 2040. The related urbanisation and rising living standards also mean that demand for water, metals and minerals will continue to climb, reshaping global markets over the coming decades. The growing need for food means that agriculture must be intensified, and the demand for (mineral-based) fertilisers, machines and equipment will also keep on rising.

Trends in global markets are vital in the context of Finland's natural resource economy. In national and international natural resource policy-making Finland should use its influence at the highest level to promote price stability, reduce demand and safeguard vital supplies. Extensively used raw materials such as oil, gas and phosphorus are becoming scarce. In many regions shortages of fresh water will further worsen.

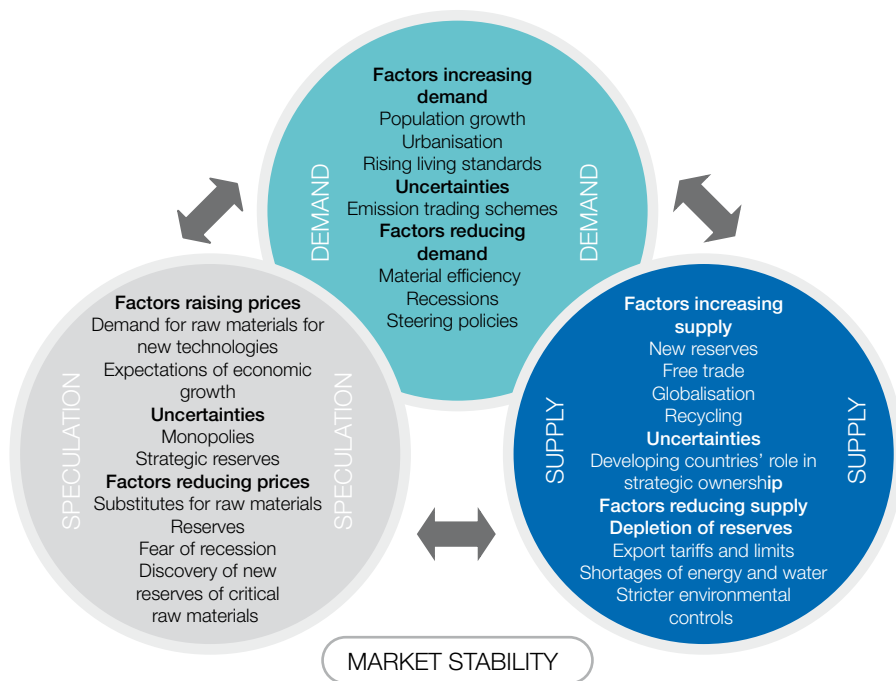
The future demand for and availability and quality of natural resources will be shaped by legislative controls, trends in international trade, economic conditions and technological innovations, as well as by population growth and rising consumption levels. Climate change will particularly affect the quantities, quality, spatial distribution and accessibility of natural resources. Climate change, declining biodiversity and changing demographics will be reflected in changing production and consumption patterns. Such future trends will inevitably increase the strategic significance of natural resources use and energy production globally and at national level. This will further increase the opportunities open to Finland as a country blessed with plentiful renewable natural resources.

The EU is one of the largest users of metals on natural resource markets, but the region accounts for less than five percent of global metal production. Short-term fluctuations in raw material prices have proven to be hard to predict. Uncertainty concerning the global economy has made it even harder to forecast trends in natural resource markets.

Natural resource use has particularly been steered at international level through sustainable development strategies. Sustainability in the use of natural resources is likely to become a key issue in international politics later this decade, as the work of the UN natural resource progresses, and if international negotiations targeting reductions in natural resource use are initiated. The EU has often taken the initiative in natural resource policy-making in recent decades. The EU has aimed to decouple natural resource use from economic growth, increase natural resource efficiency, and promote global natural resource policy-making. Key EU strategies relating to natural resources include the community's sustainable development strategy, natural resource strategy and raw materials initiative.

The need to combat climate change has become a key factor shaping policy-making, actions and investments. Energy policies are shaped by the need to reduce greenhouse gas emissions, improve energy efficiency, and favour renewable energy sources. Measures to limit greenhouse gas emissions have been economically cumbersome but unavoidable. If such actions are not taken, the consequences will become even more costly. Special challenges in the context of bioenergy concern competition for the same resources for food production and as raw materials for the forest industry. One prime consideration is that the capacities of natural systems should be accounted for and safeguarded in all natural resource use. Although curbing emissions increases costs in the short term, the actions taken to mitigate climate change also represent new opportunities for the producers and exporters of the related technologies. We are faced with rapidly increasing global demand for technologies related to bioenergy, wind energy and energy efficiency. This can result in new enterprise and new jobs. It is inevitable that we must shift away from an economy based on fossil fuels to a bioeconomy, and use renewable raw materials instead of non-renewable natural resources. It is important to emphasise that natural resources should be used sustainably and material cycles should be closed.

**Figure 3.** Factors affecting the stability of natural resource markets.



In 2010 the World Economic Forum published a set of three alternative scenarios for the mining industry looking ahead to 2030. Alternative models for future development can be based on these scenarios. In one scenario the world becomes more environmentally aware and uses natural resources more sparingly, with indicators of sustainability given a high importance in developments throughout society alongside measures of economic production. Such trends will be hard to realise in all developing countries, however. In the second scenario, a new form of globalisation occurs with the developing countries, led by China, in the driving seat. Free global trade continues, but the big mining companies and technology manufacturers are increasingly owned by the developing countries. In the third scenario, the developing countries and their alliances gain the upper hand and through self-interest replace free trade with a system characterised by protectionism and bilateral agreements. It is unlikely that any of these scenarios will be realised as such, but China's increasingly powerful role in natural resource markets will undoubtedly become more significant. If China and other developing countries form their own trading bloc, its policies could radically reshape the balance in global competition for natural resources.

## 2.2 Society and productive structures in transition

Natural resource issues resemble climate and energy issues in that they extend into all sectors of society. To solve the related problems and exploit consequent opportunities, we will need comprehensive policies that cover different natural resources, different sectors, and all aspects of sustainability. This will not be possible without comprehensively rethinking natural resources policies and operational models.

Such changes are examined in three recent reports that have focused on change in Finnish society and the economy (Vital Finland, Industrial Finland, and Where is Value Created?). The central messages of these reports point in the same direction: In striving to promote sustainable economic growth and employment Finland should not focus only on present problems and hang on to old ways of thinking, but instead map out the way forward through a deeper and longer-term process of renewal. Comprehensive change is needed in relation to all of society's structures as well as individual actors, but above all in operational practices. Crucial factors in a new, competitive natural resource economy will include eco-efficiency and energy efficiency, innovative solutions, renewed services, and detailed foresight concerning future trends.

In the aftermath of the global economic crisis the UN, the EU and the OECD have all realised more clearly that opportunities related to the green economy represent a way to create well-being sustainably and climb out of recession. Economic and environmental problems can be solved simultaneously if the economy

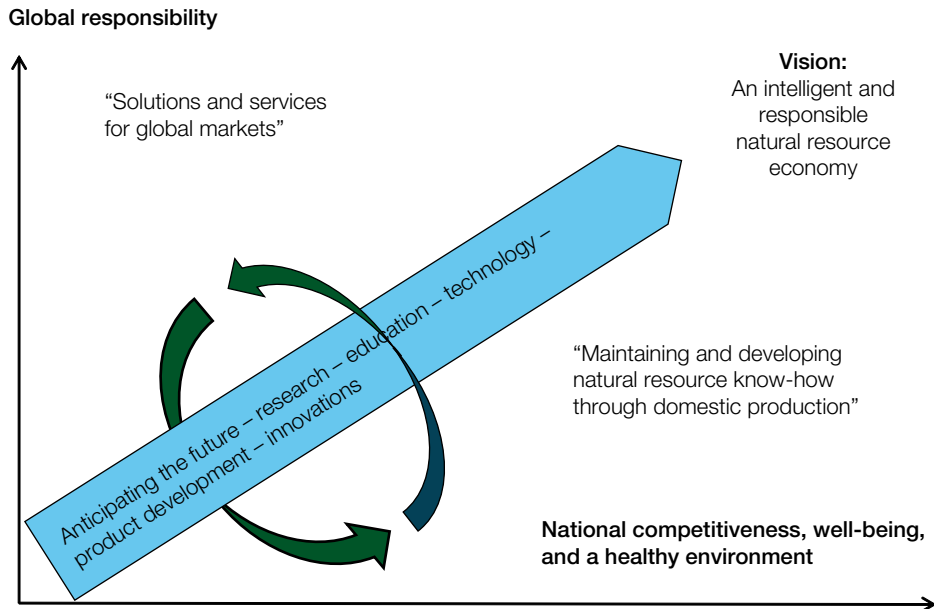
is reconstructed in ways that reduce emissions and save on natural resources. In the green economy growth, jobs and well-being are created in ways that minimise harm to the environment, the climate and nature. The creation of economic growth and jobs can be promoted by finding ways to use natural resources and energy more efficiently, and by applying new green technologies and modernising existing technologies.

In the green economy the innovative integration of the resource economy with the knowledge economy, environmental expertise, material and energy efficiency, and the preservation of the balance of nature are all vital prerequisites and enablers for success. To create the green economy we need investments in know-how, education, research and development as well as measures to improve the overall basis for enterprise. Various long-term economic mechanisms such as subsidies and taxes can be applied to create demand in markets. Such measures can be vital for the extensive commercialisation of innovations.

A global transition is under way away from the production-based society of the age of industrialisation towards a service-based society focused on solutions. This does not mean that industry will be totally replaced by services, but that industrial production will adopt structures and practices from the modern service society. Industry will still be needed, with natural resources as its fundamental basis. But new business models and operating practices will arise alongside innovative products and technologies as bases for success. Added value will increasingly be created from services linked to production. This is not just a question of companies' internal service operations, but of completely new kinds of services – for producing solutions. The key issue is to determine which of the new needs created by climate change and natural resource shortages can be met by the natural resource economy – by focusing on customers and solutions.

In an open global economy Finland's role should be examined as part of the global material cycle and the international allocation of work. As a country that is relatively well-off in terms of natural resources and has high levels of expertise, Finland has special strengths and interests in the context of promoting the sustainable and innovative utilisation of natural resources. On this basis of high levels of know-how, material and energy efficient products, technologies and operating practices can at the same time create national added value and help to solve global problems (see Fig. 4). In the longer term this should also encourage us to examine opportunities related to agriculture and food production within the global framework.

**Figure 4.** Know-how in the future natural resource economy.



To anticipate the future and coming changes in the operating environment, it is increasingly important to predict and monitor discontinuities, megatrends and risk scenarios, and create comprehensive strategies. In the natural resource economy there will particularly be an ever greater need for an understanding of the complex linkages related to interdependencies between different natural resources, the impacts of natural resource use, and natural resource markets.

To make the sustainable natural resource economy into a pillar of Finland’s future success, various structures will need to be established to enable and support the kinds of changes described above. Most of the institutions, norms and practices that shape natural resource use today have been devised for separate sectors through thinking based on products, production and resource utilisation. Although practices and the related thinking have in many cases been modernised, this old type of thinking is still evident in areas including the fragmentation of natural resource know-how, administration and the norms controlling natural resource use, and particularly in the way the functioning and preservation of ecosystems have been neglected.

## 2.3 Security of supply and local resources

Concerns about the exhaustion of natural resources most often relate to non-renewable resources such as oil and minerals. But recently such worries have also

arisen in relation to renewable natural resources including clean fresh water and cereal harvests. The sufficiency of these resources may be endangered due to factors including population growth, consumption patterns, natural disasters and the uneven distribution of such natural resources. Regardless of the overall sufficiency of global reserves, the availability of certain natural resources may also be reduced by geopolitical factors. This is a significant issue in the context of safeguarding Finland's access to vital resources.

Safeguarding vital supplies generally involves ensuring that society will be able to maintain its essential economic functions and meet the basic material needs of the population in terms of food, security and defence even during emergencies.

Emergency supply systems must analyse threats and risks facing critical functions, and find ways to manage vulnerable areas. In emergency situations the aim is to maintain economic functions in as close to their normal state as possible. In Finland the concept of security of supply also encompasses maintaining the functional capacity of systems that are critical for society.

Increasing numbers of developing economies are strategically striving to protect their own reserves of raw materials to safeguard their own vital supplies. This is a significant issue for the EU, which is highly dependent on imports of the metals used in high tech products. Such raw materials are crucial to the development of all high-tech products, including the innovative environmental technologies applied to enhance energy efficiency and reduce greenhouse gas emissions. Europe's own long utilised energy resources are now in short supply, and expensive to utilise. Consequently most of Europe's energy needs are met using imported raw materials. Security of supply can be improved through international agreements, by increasing the usability of land areas for natural resources production, by enhancing material and energy efficiency, by promoting recycling, and by replacing imports with domestic production.

Many natural resources are geographically fixed. Natural resource production therefore has varying regional and local impacts on employment, well-being and changing settlement patterns. Effective mineral prospecting is needed to identify deposits that may lie deep inside the bedrock. Minerals may only be produced precisely where they occur, even if they may eventually be used far away from the mine. There is growing global demand for Finland's mineral resources, and this could particularly benefit the regional economies of Northern and Eastern Finland. Biomass, contrastingly, is fairly evenly distributed around the country. This means it can be produced, refined and used in many alternative localities. The related opportunities have not yet been fully exploited with regard to regional economies, however.

Distributed production patterns enable local resources to be refined sustainably, near where they will ultimately be used. This reduces the need for transportation, enables different raw materials to be used flexibly, increases the efficiency of the material cycle, boosts regional economies, and enhances security of supply. To meet the growing demand for biomass-based products and exploit new ways to utilise

material, residual and waste streams, businesses and farms must establish common value chains, and administrative barriers must be removed.

Commercially viable biofacilities today include operations that produce products with high added value, while also resolving local waste management problems and producing energy for local use. Sourcing raw materials locally eliminates the need for costly long distance transportation which would also result in emissions. Bottlenecks limiting the development of the distributed bioeconomy include production and commercial structures that favour centralisation, inflexible bureaucratic procedures, and a lack of vision and open-mindedness among actors in the sector.

Electricity production in Finland is today based on centralised large-scale generation. Distributed energy production would involve production models where relatively small electricity, heating and cooling plants are distributed so that they are located closer to where energy is finally consumed. Such distribution could enhance the self-sufficiency and reliability of electricity production, while also bringing jobs and giving citizens greater opportunities to contribute to efforts to curb climate change and produce “their own” electricity. Particularly during times of crisis this could be very significant for society as a whole.

Finland’s diverse natural environment provides plenty of opportunities for local enterprise utilising the country’s natural assets. There is increasing demand for services based on the beauty, purity, peacefulness and beneficial health effects of natural settings. There is already a long tradition of enterprise based on certain forms of natural resource utilisation of this kind, but new businesses based on the more diverse utilisation of natural assets have also been springing up in recent years. Many such opportunities still remain unexploited, however.

The aesthetic aspects of a location also significantly affect its competitiveness, particularly in the context of attracting footloose resources such as investments and highly qualified personnel. Boosting and marketing each region’s unique valuable natural and cultural features can promote the development of local businesses for this reason. Such factors may constitute major - or in some cases the only - competitive advantages for rural regions. Highlighting an area’s natural actions as economic assets in this way is often the best way to promote their protection. Finland’s regional councils are implementing or have already implemented regional strategies and plans that emphasise the importance of natural resources in many ways. In drafting and examining these plans and strategies it is important to ensure that they are truly based on local strengths and raw material reserves, that resource issues are also assessed from a wider perspective beyond regional boundaries, and that resource efficiency considerations are duly accounted for.



# 3 Finland's role in the global material cycle

## 3.1 Finland's material cycle and its environmental impacts

The industrialised countries' material consumption totals 40-70 billion tonnes a year. Renewable natural resources are already being used around the world at a rate 30% higher than their annual global production capacity. If the world population grows over the next 50 years to nine billion and natural resources are used at the same rate, total material flows could double or even quintuple.

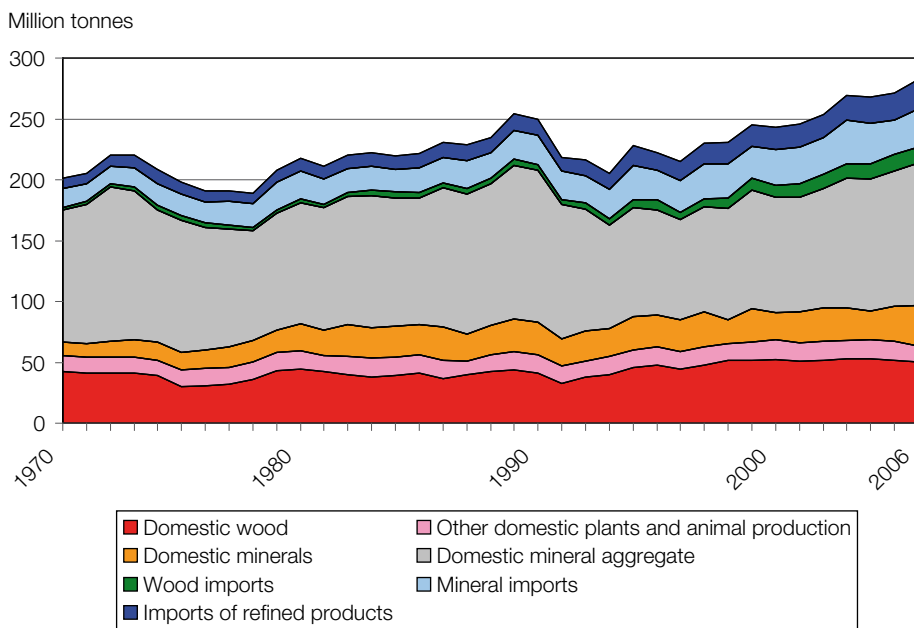
The material flows within the Finnish economy are well known by international standards. The ENVIMAT project, run by the Finnish Environment Institute and the University of Oulu, has combined a detailed input-output analysis with life cycle analyses. This has produced a clearer picture of the environmental impacts caused by different material flows and products, and of Finland's role in the global material cycle. The calculations have also included hidden flows (e.g. earthworks and logging residues), which are not utilised economically.

The Finnish economy is connected to global material cycle through both imports and exports. About half of all the material flows in Finland result from the production of exported goods, and the rest are related to domestic consumption. Finland used roughly equal quantities of imported natural resources and domestic natural resources. The largest material flows within the country involve mineral aggregate; and the largest international flows concern the forest industry's raw materials and products, fuels and products. Domestic consumption levels have been fairly stable. Savings in terms of material efficiency have however been exceeded by increased material consumption. The material flows linked to imports and exports have grown steadily. The environmental impacts of imports are of the same order as the environmental impacts of domestic activities.

It is hard to realise the concept of fair burden sharing between countries with regard to production. Countries with plentiful reserves of raw materials, like Finland, tend to consume more energy, and have greater material flows than countries more specialised in producing finished goods. For this reason, emissions generated during production should not be assessed purely according to national boundaries, but globally, with emission rights shared out according to environmental capacities at various stages of the whole production life cycle. This would minimise the burden on the environment more effectively than country-based allocations. Allocating emission rights country by country is however fair in the sense that income from exports tends to be used in the exporting country itself, so such an allocation is in line with the principal that "the polluter pays".

Finland's natural resource consumption exceeds the limits of sustainability, and large quantities of materials are used by Finland. This is above all due to land use in connection with construction, and particularly the use of mineral aggregate used for road construction (see Fig. 5). These factors are related to Finland's northerly location and scattered settlement pattern. Since roads need physical protection against groundfrost damage, the construction of new roads involves huge quantities of mineral aggregate (50 billion tonnes/year). Finland's material consumption is at such a high level that increased recycling and waste utilisation alone cannot reduce consumption to a level nearer the European average.

**Figure 5.** Finland's use of natural resources is steadily increasing.



Source: Ilmo Mäenpää, Thule Institute

Finland's industries nevertheless still produce certain types of wastes which new innovations could prevent or utilise. Potentially usable wastes generated in material intensive industrial sectors include: organic wastes and packaging materials in the foodstuffs industry and retail trade; waste rock and tailings generated in the mining industry; slag and other process residuals from the metallurgical industry; sodium precipitates and ash from the pulp and paper industry; calcination residuals and gypsum wastes from the fertiliser industry; mixed wastes from reconstruction; and surplus materials from earthworks and hydrological engineering construction. In Sweden, for instance, the extraction of mineral aggregates is subject to a modest level of taxation, with the aim of reducing the use of virgin material and encouraging recycling.

If consumption is examined from the angle of different needs, then housing and food, motoring, and leisure activities account for both the highest levels of material consumption, and the greatest environmental impacts. Leisure activities are ranked third in terms of environmental impacts. The productive sectors with the highest emission levels are cement, foodstuffs, fertilisers and steel. The lowest emission levels are generated by services and raw timber production.

Services including housing, wholesale and retail, education and health care generate almost a third of the greenhouse gas emissions caused by human activity in Finland. The extensive nature of these services and their predicted growth and productivity will result in greenhouse gas emissions levels comparable to those of larger industrial sectors. Little attention has yet been paid to the environmental impact of services, since their impacts have been considered to be limited due to their low energy intensiveness. But in future the relative importance of services will only increase as the population ages.

## 3.2 Material and energy efficiency

The key factors behind material and energy efficiency can be divided into the economy and competitiveness, the sustainable use of natural resources, and environmental issues. Enhancing material and energy efficiency is an extremely cost effective way to work towards these three vital goals.

To decouple the use of natural resources from harmful environmental impacts, material and energy efficiency must be improved considerably, and material consumption should be rechanneled to utilise less harmful material cycles. The productivity of natural resource use must be multiplied over the coming decades to give everyone access to sufficient food, energy and raw materials and to improve living standards without exploiting global ecosystems beyond their capacities.

Using natural resources sparingly can greatly reduce harmful environmental impacts. This will consequently reduce both the threats facing biodiversity, and the quantities of renewable natural resources needed to mitigate climate change and maintain existing systems.

Finland's natural resource policies should separately examine the export industry sector and domestic consumption in the export industries. Important goals include improved material and energy efficiency in production, and the generation of well-being in domestic consumption using smaller material inputs and resulting in lower environmental impacts.

There has not yet been a detailed assessment at the level of the national economy of the potential for enhancing the economy and environmental protection by improving material efficiency. The current state of material efficiency has only been assessed through relatively crude economic indicators based on material masses. The Finnish economy is largely based on the use of large quantities of materials. Finland's total material requirement (TMR) in relation to gross national product (in kg/euro) has

declined steadily since 1970, but this parameter does not describe the significance of the total use of natural resources in terms of the sustainability of natural resource use.

The sustainability of natural resource use can be enhanced, for instance by setting targets for material and energy efficiency, and through policy mechanisms including financial subsidies, fees and taxes. One goal should be that voluntary material efficiency agreements should be widely adopted in each key sector. Practical ways to increase efficiency may relate to the use of raw materials, improvements in production processes, and even the development throughout production chains of innovations which help to reduce and optimise natural resource use.

Finland is among the leading countries in Europe in terms of energy efficiency, particularly in the industry and commercial sectors, where measures including energy audits and energy efficiency agreements have been very effective. Finland also exports expertise related to the management of material flows. The global markets for energy efficiency and energy saving technologies are today even larger than those for energy production, so preserving our strengths and developing new areas of expertise is one of the main challenges currently facing Finland in the field of material and energy efficiency. We must also actively influence the ways the theme of material and energy efficiency is addressed in European raw material policies. The preparation and implementation of the national resource efficiency programme proposed in Finland's natural resource strategy are vital, since the steps taken to promote material and energy efficiency in Finland have so far still been relatively limited considering the potential benefits to both the economy and the environment.

### 3.3 Linkages with climate and energy issues

Climate change and the use of natural resources are closely interlinked. Most of the greenhouse gas emissions that have harmful impact on the climate are caused by the use of natural resources. Increasing reserves of biomass contrastingly serve as carbon sinks. Additionally, climate change will have considerable effects on the availability of natural resources.

In the context of the material cycle, climate and energy policies and natural resource policies form a complex and inseparable whole, where material and energy are continuously interacting. Energy production requires materials including equipment and fuels. Material production in turn requires energy in forms such as electricity or heat. Energy production gives rise to differing levels of greenhouse gas emissions, depending on which natural resources and production methods are used. Material production gives rise to collateral material flows and wastes on varying scales, depending on which natural resources and energy sources are used.

Increases in **energy efficiency** can be achieved by striving to reduce the amounts of natural resources used to generate a unit of energy. Increases in material efficiency are correspondingly sought through measures aiming to reduce the amounts of natural resources used to produce each material unit. The principle behind the combination of

material and energy efficiency is to get “more from less”. If increases in total production exceed improvements in material and energy efficiency, however, this will result in increases in greenhouse gas emissions and the quantities of waste generated.

**A closed cycle** can be said to exist when natural resources are used to produce energy or material goods in ways that do not result in net greenhouse gas emissions or waste. Applying the principle of the closed cycle can prevent climate change. Small-scale, local processes within the bioeconomy enable us to approach closed cycle systems that require fewer external inputs. Examples include local-scale production of bioenergy combined with the recovery of nutrients. Local forms of production that depend as little as possible on various external inputs are also important from the perspective of security of supply. In an open global economy, Finland will still form part of the global material cycle, however, which will limit opportunities to create completely closed cycles. This goal can nevertheless be approached step by step.

The amounts of greenhouse gas emissions and wastes generated by natural resource use can be decreased by reducing consumption levels, by increasing material and energy efficiency more rapidly than production, by developing closed cycles, by binding and storing carbon, or by developing new ways to reuse wastes (e.g. urban mining). In practice all of these measures will be needed to create a sustainable natural resource economy, together with effective climate and energy policies.

So far natural resource policies and climate and energy policies have been implemented as separate processes. This has been justified because climate and energy policies were already well established before work commenced on natural resource strategies, and natural resource issues would probably not have been prioritised sufficiently if they had been bundled in with climate and energy policies. Natural resource policies and climate and energy policies should nevertheless form a coherent synergic whole.

The wide-ranging package for promoting renewable energy approved by the Finnish Government in April 2010 is very timely with regard to the linkages between climate and energy policies and natural resource policies. Through this support package Finland aims to meet its obligation within the EU to increase the share of total energy consumption derived from renewable energy sources to 38% by 2020. In transportation, the share of renewable energy should be increased to 20% by 2020. The plans envisage that the largest proportion of the increase in renewable energy use (about 50%) will be obtained from wood. Three other energy sources will each account for about 15% of the increase in renewable energy use: liquid biofuels for transportation, heat pumps, and wind power. Other forms of renewable energy that will be increasingly utilised in Finland include biogas and solar heating. By 2020, subsidies amounting to an estimated 340 million euros will be used to support renewable energy use, as well as investment support amounting to 50-70 million euros annually. One target is that biofuels will be used to replace half of the coal presently used to generate electricity and heat around Finland. The construction of wind power facilities will be encouraged by providing guaranteed feed-in tariffs for wind power.

# 4 Finland's natural resources as a strategic opportunity

## 4.1 The bioeconomy as a new basis for activities

The bioeconomy involves the sustainable management and use of renewable natural resources to make products and services. The key issue is to decide which kinds of refining and use available and identified reserves of biomass should be channeled. The bioeconomy also includes biological processes based on enzymes and bacteria that can be used in industrial production. Since the products of the bioeconomy are of organic origin, they are also biodegradable, and characterised by renewability at the beginning and end of their life cycles. In the envisaged sustainable bioeconomy all by-product flows are either utilised or returned to natural cycles. The bioeconomy thus involves integrating production into natural cycles.

Sectors inherently well suited to the bioeconomy include agriculture, forestry, fisheries, food production, the chemicals industry and biofuel production. Today the leading user of biomass, largely in the form of wood, is the forest industry. In addition to paper and timber products, the forest industry also produces bioenergy and biofuels, and future biorefineries are expected to produce a range of useful biochemicals. The bioeconomy also brings many different opportunities in relation to products including pharmaceuticals, cosmetics, animal fodder, foodstuffs, adhesives, coatings, biofuels, biocomposites and other extensively refined products. The bioeconomy does not only involve using large quantities of biomass in low value added forms of production (such as bioenergy), but also contrasting small-scale forms of high value added production known as biospots (including bio-based medicines).

In the bioeconomy, different forms of biomass, their utilisation and marketing, and the related services must all be examined comprehensively. The bioeconomy represents a new way to do things, and will require the adoption of new forms of cross-sectoral thinking and working. The development of the bioeconomy is still inhibited by focuses limited to single raw materials, established ways of working and narrow sectoral thinking. In agriculture, for instance, the bioeconomy could lead to a shift away from a narrow focus on food production to a new way of thinking that sees agriculture and food production as part of wider systems of production and consumption based on biomass. The forest cluster can likewise be seen as part of a wider bioeconomic system.

Solutions based on the bioeconomy will play a key role in meeting challenges related to climate change and the need to use natural resources sustainably. The bioeconomy strives to find new solutions that will reduce our dependency on fossil

fuels, avoid the impoverishment of ecosystems, and promote economic development while creating new jobs. It is inevitable that at some stage the world economy must shift away from its dependence on fossil fuels to become a bioeconomy. Any country that leads the way in developing the bioeconomy will build an enduring competitive advantage. Finland has an opportunity to do just this on the basis of its resources and cultural factors.

Finland's reserves of biomass are among the most extensive in Europe. But we have so far only realised part of the potential for effectively utilising the biomass reserves present in our forests, peatlands, farmland and organic waste materials. Little is known about the potential amounts of unutilised by-products. It would be at least theoretically possible to double the present biomass utilisation rate. Limitations are set by costs and price-competitiveness and the need to develop new product, supply and use chains and business models that are sustainable with regard to environmental impacts. The increased use of biomass from forests, for instance, must not lead to long-term reductions in the quantities of carbon stored in forest soils and vegetation. The great present interest in the bioeconomy has not yet been reflected in studies or statistical examinations that would be justified by the importance of this subject. No official statistics are available at present to illustrate the scope of the bioeconomy as a whole.

Finland's timber reserves grow by approximately 100 million cubic metres every year. It would be possible to use much more wood than at present, since timber reserves are increasing steadily, and in recent years timber harvesting levels have only amounted to about 75% of maximum potential sustainable harvesting levels. There is also plenty of unrealised potential for the utilisation of other forest products such as wild berries, mushrooms, lichens and other forest plants. Finland has a total of almost 10 million hectares of peatlands, of which about 5 million hectares have been drained and 1.1 million hectares are protected. About 1.2 million hectares of peatland are suitable for peat production (this figure also includes some protected peatlands). Finland's total reserves of peat amount to an estimated 69 billion cubic metres. Finland also has about 2.3 million hectares of farmland, of which approximately 1.8 million hectares are needed to ensure safeguard Finland's self-sufficiency and to supply the foodstuffs and animal fodder industries. This means that approximately 500,000 hectares of farmland could be used for other forms of production if necessary. The agricultural sector also produces large quantities of manure that could be utilised to generate bioenergy. Finland additionally has extensive shallow coastal waters and about 10% of the country's land area is covered by inland waters. In 2008 Finland's fisheries and fish farms produced 162 million kilos of fish. In 2009 as many as 7 million crayfish were caught in Finland for consumption. Approximately 80% of the municipal waste generated in Finland is biodegradable. Large quantities of wastes and by-products that could be beneficially utilised still end up at landfill sites.

The technologies and logistics needed in connection with biomass refining will be developed as domestic markets take shape within the emerging bioeconomy. Encouraging developments in the related know-how, technologies, business expertise and exporting can make Finland a significant actor on a global scale. Finland is already the EU's leading country in the use of wood and other forms of biomass to produce energy and refined products, mainly due to developments in the forest industry sector. But technological breakthroughs and new globally replicable solutions combining raw material chains and material flows still need to be achieved before a full transition to the bioeconomy can be achieved and Finland can take a leading role.

## 4.2 Increasing opportunities in the mineral economy

Metals, industrial minerals, mineral aggregates and natural stone are essential raw materials for almost every kind of economic activity. Demand for such materials and their prices have increased greatly due to rising living standards in populous developing countries. In addition to growing demand for steel and base metals, new technologies have increased the need in high-tech applications for many rare earth metals which were not previously produced widely. Accelerating urbanisation has meanwhile led to shortages of mineral aggregates for use in construction.

Finland has 47 working mines, most of which are open cast quarries. A total area of 288 km<sup>2</sup> has been set aside for mining activities. Most of the 22 companies running these activities are under foreign ownership. Finnish mines' total turnover in 2010 amounted to some 808 million euros (as anticipated by the Research Institute of the Finnish Economy) and this figure is rising steeply. Finland has considerable proven reserves of valuable minerals (including nickel, chromium, copper, zinc, cobalt, phosphorus, gold, platinum metals, carbonates and talc), as well as good potential for the discovery of new deposits. In recent years several significant new mines have been opened, production is due to be boosted at existing mines, and new mines are being built or planned especially in Northern and Eastern Finland. It is expected that the total production of Finland's mining industry will be multiplied over the next decade. The locations of mines depend on the locations of exploitable mineral deposits within the bedrock. Mines must compete in terms of land use options with many other activities including tourism and nature conservation. Mining activities can also benefit other local economic activities through improvements in services and infrastructure.

The minerals mined in Finland are also refined within the country. The mineral sector's main client sectors include construction and the metallurgical, pulp and paper, chemicals and non-metal products industries. Local mining activities have led to the development in Finland of highly advanced and competitive businesses working in metallurgy, equipment manufacture, process know-how and various



related services. About 70–90% of the mining technology used around the world originates from Finnish and Swedish companies. Rapid growth in the mineral sector has led to shortages of both skilled labour and expertise in Finland and on a global scale.

Finland's reserves of mineral aggregate and natural stone are considerable by European standards. Deposits of sand and gravel cover about 5% of Finland's land area, with concentrations in broad belts of glacial deposits stretching across Southern Finland known as the Salpausselkä zones. Production of crushed rock aggregate is increasing, and accounts for about half of the total use of minerals in Finland, which amounted to 114 million tonnes in 2008. Most of these aggregates are used the construction of built-up areas and transport infrastructure. About 4 million tonnes of natural stone, mainly granite and soapstone, is quarried every year in Finland. The related businesses are Finnish-owned and generally meet local needs. The stone industry produces various products for construction in addition to dimension stone. About half of its turnover comes from exports. The long-term availability of mineral aggregate in the surroundings of larger growing urban centres has not yet been assured, and this could hinder the sustainability of future urban development. If aggregates need to be transported further, costs and emissions related to transportation will rise steeply. Since the present system of legislation and permits is not sufficient to duly control and ensure the regional availability of mineral aggregates, there is a need to improve regional land use planning procedures so as to harmonise different land use needs. The reuse and recycling of mineral aggregates must also be enhanced.

Mineral resources are distributed unevenly around the world, and more than half of all mineral production is based in politically unstable regions. Europe is totally dependent on imports of many critical metals and minerals, and the potential for disruption to supplies of raw materials is a considerable threat. The EU has addressed this problem through a raw materials initiative launched in 2008, which aims to preserve and promote openness in global raw material markets. Production and consumption patterns should promote the sparing and sustainable use and recycling of raw materials. The EU and its member states should act to promote the exploitation of Europe's own raw material reserves and to develop the related expertise and new technologies. Legislation and permit and planning procedures should all be shaped to provide favourable conditions for Europe's mining sector. The raw materials initiative also aims to build a common mineral policy for the EU and its member states. This policy could in turn serve as a basis for future global mineral policy actions.

The ongoing global changes in the mineral sector represent an opportunity for Finland, and our mineral sector could form a new pillar of the national economy, particularly in terms of regional development. The systematic and sustainable utilisation of our own reserves can safeguard the national supply of raw materials and create suitable conditions for balanced development well into the future.

Jobs created in the mining sector are permanent in the long term and also have a considerable knock on effect in terms of other employment. Finland's present and potential mineral reserves should enable the significant expansion of mining activities particularly in Northern and eastern Finland. Mineral production can ensure both regional development and the long-term availability of vital industrial raw materials.

New opportunities will also arise for exports of Finnish expertise. The mineral sector has a long-term objective to realise the concept of green mining, which involves maximising material and energy efficiency through intelligent processes, and increasing production while minimising environmental impacts. It will be possible in future to conduct some mining operations completely underground with no visible environmental impacts. New businesses providing the necessary comprehensive know-how will be based on the combination of expertise related to environmental protection, mining production, process technologies, metallurgy and recycling.

## 4.3 The future importance of water resources

Water is globally a vital resource in terms of our well-being, economic development and the environment. Its availability is a critical factor in efforts to reach the UN's millennium development goals in the contexts of poverty reduction, guaranteeing human dignity, providing food for a growing world population, promoting health and equality, and education. The lack of sanitation and clean water are key factors behind the illnesses and malnourishment suffered by millions of people in developing countries, particularly including women and children.

Where water reserves are scarce, there is an increased need to assess the impacts of the water footprints of different activities. Material and energy efficient solutions are needed to improve the availability of water and enhance its use and recycling. About 40% of the water footprint of the average Finn concerns the use of water outside Finland, even though we are one of the world's richest countries in terms of water resources.

Water is an irreplaceable natural resource asset for Finland. More than 10% of the country's land area is covered by water. Finland largely lies within the catchment area of the Baltic Sea, and we share transboundary river systems with Russia, Norway and Sweden. In per capita terms our water reserves are plentiful by global standards, amounting to around 22,000 cubic metres per person per year.

Groundwater reserves are valuable natural resources for the water supply and ecosystems. About 60% of Finland's municipal water supplies originate from natural or artificial reserves of groundwater. Finland's lakes, rivers and marine waters have important amenity values for recreation and enhancing residential environments. Our inland and coastal waters are also assets that promote the development of tourism, cultural activities and other services, and they increase

Finland's attractiveness around the world. Most of the approximately half a million holiday homes around Finland have waterside locations. Almost two million Finns enjoy recreational fishing. In 2008 the national register of commercial fishers included 2,079 people, of whom about a third obtained at least 30% of their income from fishing. Many other commercial activities such as energy generation, water transportation and the fish trade also utilise and depend on our water resources. Biodiversity must be safeguarded to ensure the future availability of the vital services provided by ecosystems. The importance of the ecosystem services provided by aquatic environments for people and nature should be recognised and valued.

Thanks to long-term water protection work the pollution of water bodies from point sources declined through the 1970s and 1980s, improving the state of many formerly polluted lakes and rivers. The need to curb diffuse loads of pollutants from farmland and commercially managed forests remains a considerable challenge in the field of water protection. The river basin management plans required under EU legislation represent the most extensive developments related to water resources ever realised in Finland. In December 2009 the Government approved a set of river basin management plans to be implemented across the whole country until 2015. These plans set out the actions and policies required in various sectors to safeguard the good ecological status of water bodies. According to the plans, good ecological status should be maintained or achieved by 2015 for more than 90% of assessed lake waters, about 70% of river reaches, and almost all groundwater reserves around Finland. Good ecological status should be achieved for coastal waters and rivers by 2027 at the latest. It should be possible to reach the target for groundwater reserves by 2015, as long as the measures needed to address identified risks are duly implemented. To maintain and achieve ecological status targets for surface waters and groundwater reserves it is essential that river basin management plans are implemented through wide-ranging collaboration using funding levels secured on the basis of an implementation programme currently under preparation.

The state of the Baltic Sea is worrying, due to excessive inputs of nutrients from its catchment area and the consequent eutrophication, risks associated with intense shipping and high levels of hazardous substances, and the impoverishment of its biodiversity. Finland's own Baltic Sea action plan and the EU's Baltic Sea strategy both define goals for the state of the Baltic Sea, and the necessary measures. Finland must continue to work actively through the EU, HELCOM, the International maritime Organisation, international financial institutes and bilateral cooperation to improve the state of the Baltic Sea.

Floods are expected to become more frequent in Finland in winter and after heavy rainstorms due to climate change. This will cause problems in areas including municipal wastewater treatment. Climate change will also increase the amounts of various substances entering watercourses via runoff, and consequently reduce water quality in water bodies. Preparing to cope with climate change is a vital issue in all sectors working with water. Improvements in the management of flood risks

should particularly be realised through the flood risk management plans that must be drawn up by 2015 in accordance with the EU flood directive. Land use planning can also play a crucial role in the management of storm water.

There is an increasing need to manage and harmonise all of the factors affecting water resources and their impacts comprehensively at river basin level, with linkages to the planning of the management of the marine environment. Such efforts are particularly needed to reduce eutrophication, to restore water bodies, to improve conditions for fish, to protect groundwater, to conserve biodiversity and to manage flood risks. Water management work should also focus more on risks related to waterborne epidemics and other emergency situations.

As global water resources become scarcer it will become ever more important to evaluate the water footprint impacts of different activities. Material and energy efficient solutions will be needed to improve the availability of water and make the use and recycling of water more effective.

Finland has been highly rated in several international comparisons of the water sector. Finnish expertise should also be utilised in future international cooperation in the water sector. In 2009 an international strategy for Finland's water sector was drawn up under the leadership of the Ministry for Foreign Affairs, defining strategic guidelines for related international cooperation, with an emphasis on the wide concept of water security. Water technology is one of industry's fastest growing sectors. Finland's high levels of expertise should be utilised to promote exports of water technologies and to turn related services into marketable products. TEKES's Water Programme (2008-2012) represents a major investment designed to boost the international expansion and success of Finnish businesses working with water technologies. The Finnish Water Forum, established in 2009, also constitutes an important tool for promoting collaboration by bringing together know-how from different players working with water issues.

Finland has more than 200 hydropower plants with a total capacity of almost 3,000 MW. The increasing utilisation of wind power, which is not evenly available due to variations in wind conditions, increases the demand for the regulation of other electricity generation capacity. Hydropower is best placed of the non-fossil energy source to fill in the gaps in wind power capacity. To increase the potential for hydropower production it is worth examining how watercourses that have already been harnessed for hydropower could be used more effectively by extending existing plants and improving potential for the storage of flood water. This would also help to improve flood risk management. Hydropower production does not result in harmful emissions, but the construction of power plants, dams and reservoirs leads to changes in aquatic environments, and also requires water levels to be artificially regulated, which can have harmful impacts on aquatic ecosystems, fish stocks and the recreational use of inland waters. If hydropower schemes are implemented sensitively, however, such harmful impacts can be reduced considerably.

## 4.4 Nature as a source of non-material values, benefits and services

Traditional definitions of natural resources are often based on the concept of raw materials, with three key defining characteristics: their natural occurrence, their value to people, and their material form. At the moment a transition is under way towards a more comprehensive understanding of natural resources that accounts for economic factors, production, the environment and the linkages between these aspects and social factors. One key element of this new thinking is the ecosystem approach, which involves the strategic use and conservation of natural resources in ways that particularly prioritise the functional interactions within ecosystems, with people and our cultural diversity seen as an integral element of ecosystems.

The ecosystem approach can be used to assess natural resources from the perspective of ecosystem services, for instance. Ecosystem services include biodiversity and a range of "cultural services" encompassing non-material values and benefits associated with natural resources. Such assets include the recreational amenity values of natural resources (e.g. in connection with hunting, fishing, hiking and picking wild berries), nature tourism, the use of natural settings for research and teaching, and even the use of the non-material aspects of nature as cultural values providing inspiration for the arts. In this report the perspective of ecosystem services is mainly applied in the context of the non-material benefits produced for people by ecosystems.

The non-material goods, services and values derivable from natural resources are typically freely available goods whose value cannot be directly measured in financial or market terms. The UN report on the Economics of Ecosystems and Biodiversity (TEEB) calls on corporations and countries to publish calculations quantifying the natural values they consume annually. This would mean assigning prices to different kinds of natural ecosystem services, which would then affect corporations' accounts and national budgets, and serve to encourage reductions in the overuse of natural environments. If natural values remain unaccounted for, the UN report predicts this could soon lead to a wave of extinctions with far-reaching economic repercussions. The goal behind this idea is to make corporations and countries liable to compensate for their overuse of natural ecosystems.

Natural resource production often has a significant impact at the regional and local scale on employment, well-being and the permanence of settlement patterns. Locally available natural products and the non-material goods, values and services associated with natural resources (e.g. landscapes and recreational amenities) also bring many opportunities to increase well-being and create new businesses. There is growing demand for services based on the beauty, purity, peacefulness and health benefits of natural environments.

Nature-based enterprises are businesses based on the responsible utilisation of natural assets and related experiences. This sector includes various business areas

such as tourism, foodstuff production and handicrafts. The common factor behind all of these forms of enterprise is their utilisation of Finland's natural assets. Nature-based enterprises emphasise both the utilisation of non-material values and services derived from natural resources, and the use of renewable natural resources.

Natural resources also play a vital role in many businesses related to tourism. Non-material natural resources such as picturesque landscapes and unspoilt natural settings are particularly crucial assets to nature tourism in Finland. Attempts have been made to give such features concrete values by developing an experimental scheme for the trading of scenic and recreational values. About a quarter of tourism in Finland can be classified as nature tourism. Natural settings particularly have a key role in tourism in Northern and Eastern Finland, and in Finland's Baltic archipelagoes. In some areas the impacts of nature tourism on regional economies are considerable.

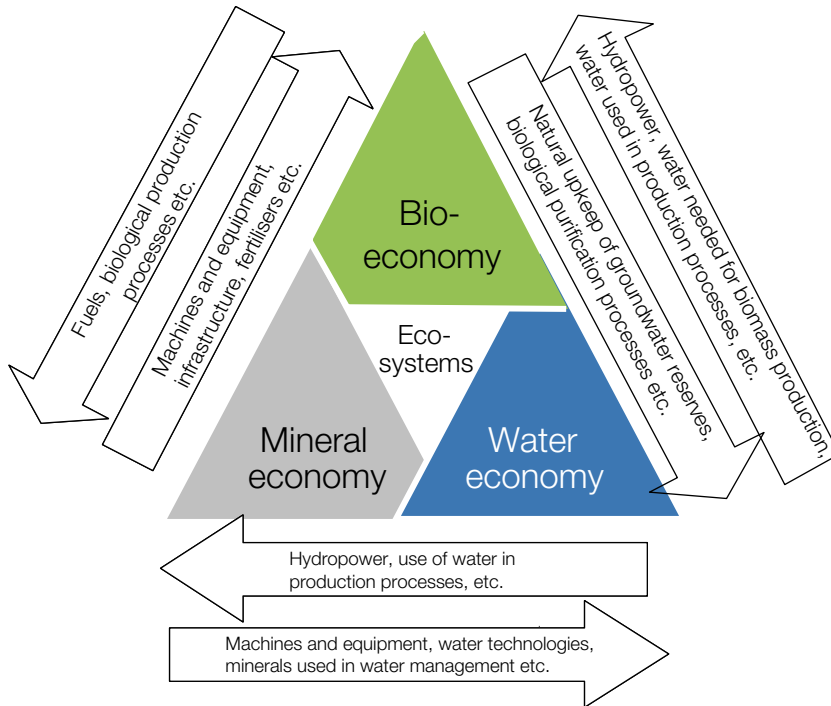
Nature tourism and services based on experiences are largely based on the use of private property. Natural products are largely utilised under Everyman's Right - a set of liberal legal rights that gives everyone access to the land and certain natural products, regardless of who owns the land. Everyman's Right is based on a long-standing Nordic tradition, and these legal rights are widely appreciated and accepted.

One key proposal for change within the national natural resource strategy drawn up by Sitra is that Finland should promote services based on non-material natural resources and the related expertise, innovations, product development, marketing and business activities. The strategy also calls for the development of market-based mechanisms that take into account controls and ownership rights over natural resources. Research institutes working under the Ministry of Agriculture and Forestry are running several research projects focusing on the non-material values, services and benefits provided by natural resources, but there is still a need to find out more about possible market-based controls and new business opportunities, particularly related to recreation and tourism products. Little or no quantitative information has so far been compiled on the non-material services and benefits provided by natural resources.

## 4.5 Synergies from previously separate sectors

The bioeconomy, the mineral economy and the water economy are closely interlinked in many ways (see Fig. 6). Assessing these sectors separately in a blinkered way will not create optimal results for society. The availability of water directly affects biomass production, for instance. The sustainability of the mineral economy can be increased by utilising bioenergy and biological processes. It is not possible to utilise biomass without equipment produced by the mineral economy. The sustainability of the bioeconomy can be increased using material and energy efficient technologies, which also requires an advanced mineral economy.

**Figure 6.** The main elements of natural resource policies, and examples of their interlinkages.

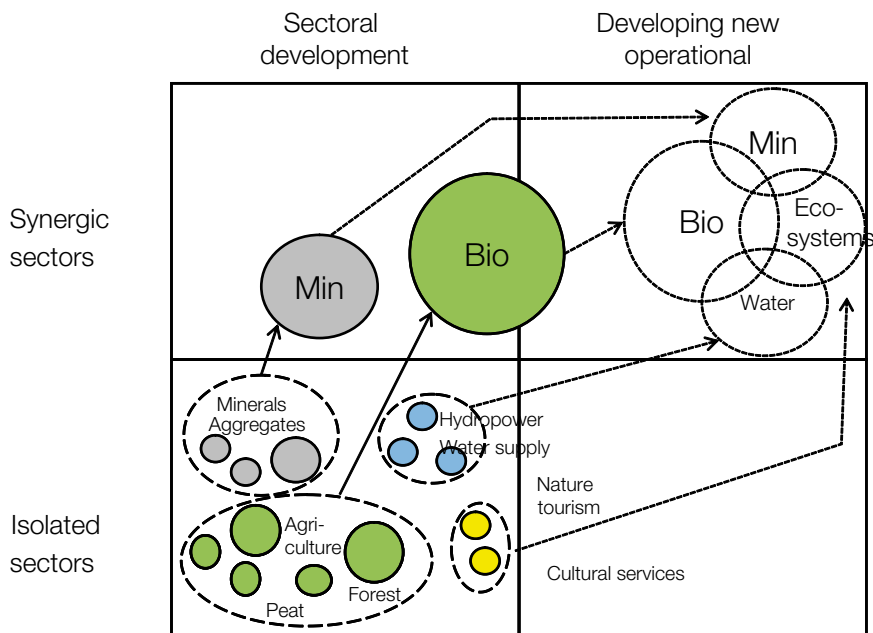


Different natural resource sectors can no longer be examined in isolation from each other. Comprehensive assessments covering all natural resources and all aspects of sustainability within a common framework are needed. In this type of analysis ecosystem services form the core of a natural resource triangle, which can be effectively managed to produce both material natural resources (raw materials) and landscape and recreational values, and also enable their utilisation.

The need to examine different natural resources through a common framework is increased by the blurring of the boundaries between different natural resources and the ways they are utilised. Biomass, for instance, can easily be used to generate energy, as a material or as food. The utilisation of biomass with nutritional value for energy production is a major issue of global contention. In Finland another such issue concerns the production of energy from wood fibre which could instead be processed by the forest industry to make material products. As oil prices rise, the use of oil in higher value added processes within the chemical industry is likely to increase at the expense of the use of oil for energy. Renewable natural resources can also become non-renewable if they are used unsustainably. But contrastingly, non-renewable natural resources may come to resemble renewable materials more if they can be increasingly effectively recycled.

We are presently at a stage in the development of natural resource policies where synergies are emerging within the bioeconomy and the mineral economy, but not yet in the overall field of natural resources (see Fig. 7). The bioeconomy working group has brought together representatives from many stakeholders working in different aspects of biomass production and refining, while correspondingly the mineral strategy group has brought together actors from throughout the mining sector. This process has served to significantly integrate different players in the wider natural resource field. But the bioeconomy and the mineral economy have so far been assessed in relative isolation, and synergies between them have generally not been identified yet. The measures so far proposed have largely been based on existing tools applied in new sectoral scopes, however, and the kinds of significant shifts in operational practices envisaged in Section 2.2 of this report have not yet been initiated on a sufficiently large scale.

**Figure 7.** Natural resource policies today, and a vision for the future where isolated sectoral developments are replaced by the development of new synergistic operational practices.





# 5 Challenges for natural resource policy-making

## 5.1 Managing natural resource policies

To build a successful natural resource economy, all of the related issues should be examined as a single entity and planned with a long-term perspective. Today both the administration of natural resources and the related research remain fragmented and inadequately coordinated. For example, the administration of natural resource issues in Finland is shared out largely between three ministries: the Ministry of Agriculture and Forestry, the Ministry of the Environment, and the Ministry of Employment and the Economy. Each of these ministries is responsible for slightly different though closely related natural resource issues, and they see natural resources from differing viewpoints. Moreover, the present allocation of responsibilities between ministries overlooks certain natural resources, such as peat.

In the absence of a unified natural resource policy, different kinds of policies are applied in different natural resource sectors. Finland's new bioeconomy and mineral strategies are largely compatible with the guidelines and overall objectives set out in this report. The current national forest programme, which will remain in effect until 2015, was assessed during 2010 particularly from the perspective of the bioeconomy. Policies addressing single natural resources should in future be routinely assessed within such a wider common framework. The same is true at the regional and local levels. Many regional councils and municipalities have various strategies focusing on natural resources, but the variations in their contents are much wider than regional differences in conditions. A common framework for natural resource strategies is also required at the regional level.

In recent years Finland has put a lot of effort into strategic planning related to natural resources (see Section 1.2). The ingredients needed for a comprehensive and sustainable natural resource policy already exist. This report strives to bring them together, but as yet the responsibility for leading or coordinating national natural resources policies has not been clearly defined. This hinders the development of the kind of comprehensive policy thinking called for in this report. Strategic work related to natural resources has been conducted effectively thanks to the shared understanding between different ministries. This is now an opportune time to intensify such cooperation and further strengthen collaboration on natural resource issues.

Finland recognises the importance of striving to influence EU policies and global negotiations related to natural resources policies. For this purpose the Government and its key ministries need a shared agenda. By addressing natural resource issues comprehensively and proactively Finland can increase its international influence as a forerunner in the field of natural resource policies.

Managing natural resource policies involves administering a wide range of national and international issues, harmonising different policies and sectoral goals, and managing change. The long-term goals of natural resource policies can and should be challenging. It is difficult to forecast which natural resource issues might become more important in the future. Today we have only a small fraction of the information that should be available to us by 2050. Because of the great importance of natural resource issues and the constant changes in related factors, natural resource policies must fundamentally incorporate both continuity and flexibility. Due to the close and crucial linkages between natural resource issues and climate issues, the horizon of natural resource strategy must be equally broad. Continuity requires a systematic approach to natural resource issues across party political boundaries and successive governments. Flexibility requires the ability to identify trends and predict the future, and the capacity to make changes to meet objectives over shorter timescales within a single administration's period in office. The continuous nature of change also adds to the strategic importance of information and know-how related to natural resources.

## 5.2 Anticipating the future and finding innovative solutions

Natural resources are being consumed at an increasing rate both as materials and as energy, and their availability and production have become crucial factors behind wealth and economic success. The need to ensure the availability of sufficient natural resources for future generations and the need to reduce greenhouse gas emissions have become major guiding factors behind decision-making alongside economic issues. The significance of technologies based on innovations that support the sustainable use of resources has increased. By developing natural resource know-how targeted according to assessments of needs and markets, Finland can contribute to a global natural resource economy that will use materials and energy efficiently, and create new international businesses in the service, technology and product refinement sectors.

The costs incurred in connection with the environmental impacts of natural resource use are shared out unequally, and in some cases will only be borne by future generations. Genuine global linkages often go unconsidered, and some harmful impacts are not included in evaluations. Impacts related to hidden material flows and logistics are not sufficiently understood, for instance. In the context of implementing Finland's natural resource strategy it is important to identify entire chains of material flows, their impacts on the environment and society, and their real costs.

The ability to anticipate future trends is essential in building a successful natural resource economy, since changes in the global operating environment are often rapid and hard to predict. At the moment forecasting and innovation work related to natural resource issues is mainly conducted within specific sectors or themes. The

Ministry of the Environment's environmental innovation panel focuses on mitigating climate change, enhancing material efficiency, and finding ways to prevent waste and utilise wastes. The national forest programme includes a five-year Future Forum for the Forest Sector, which is to be continued under the coordination of the University of Joensuu. The strategic programme for the forest sector launched by the Ministry of Employment and the Economy meanwhile aims to initiate and implement change processes by applying the outcomes of forecasting and research, development and innovation work to improve the viability and competitiveness of the sector's value chains. During 2010 a networked forest sector forecasting forum has been formed through collaboration between these programmes, including producers and users of forecasting data.

In recent years cooperation between different natural resource sectors has increased significantly, however. One example of this is the natural resource and environmental research network LYNET, which is currently running four research programmes examining climate change, bioenergy, the Baltic Sea, and sustainable land use. Another example is the YLE2 working group which has been assigned by the Ministry of Finance to prepare for the enhancement, compilation and regionalisation of statistical data, with the aim of supporting the development and implementation of the national natural resource strategy. This working group is due to finalise its work during 2011, on the basis of the final report submitted by its predecessor YLE 1 in March 2010. The Ministry of Finance is also assessing opportunities to combine the ENVIMAT input-output model, which describes the environmental impacts of material flows within the Finnish economy, with the VATTAGE general equilibrium model of the Finnish economy.

Finland must further strengthen its existing globally significant expertise and business know-how related to the bioeconomy, the mineral economy and the water economy. The related research, development and innovation work is spearheaded by Finland's strategic centres for science, technology and innovations (SHOKs), particularly the centres CLEEN Ltd. and the Finnish Metals and Engineering Competence Cluster (FIMECC). CLEEN's vision is that by 2050 the energy and environment sector will be Finland's leading industrial sector and a global market leader in certain business areas. FIMECC particularly focuses on developing service businesses, user experiences, global networks, intelligent solutions and breakthrough materials. A third significant strategic centre is Forestcluster Ltd., whose focus areas include intelligent production technologies that use resources sparingly, biorefineries to meet future needs, and client solutions for the future. It has been proposed that Forestcluster Ltd could be reshaped into a wider strategic centre for the bioeconomy, by expanding its operations and ownership base. In the mineral sector a parallel mining cluster has been set up to promote research and serve as a strategic centre of expertise.

Alongside these strategic centres, Tekes, the Finnish Funding Agency for Technology and Innovation, is running three significant programmes closely related

to natural resources: BioRefine, Symbio and Water. The BioRefine programme is developing expertise related to new ways to refine biomass on the basis of Finland's identified strengths in this field. The Symbio programme aims to reshape industry by applying biotechnologies so as to create new business opportunities in the environmental sector. The Water programme aims to enhance applicable research and product development supporting technology transfers, and to boost business activities and their international competitiveness in Finland's water sector.

The sectoral fragmentation of know-how is also evident in education, where training related to the utilisation of renewable and non-renewable resources is typically provided separately for each resource type. In some cases the wider field of renewable natural resources is covered by "natural resources" or "bioeconomy" units or training programmes, but all too often such training does not apply a strong common framework. It is necessary to integrate more comprehensive natural resource thinking onto all training in all natural resource fields. It is also important to profile and scale training with a view to the need to satisfy the growing need for labour and skills in the natural resource sectors, particularly the mineral sector.

## 5.3 Enabling structures

The sustainable use of natural resources can best be promoted by setting ambitious measurable targets, through predictive policy-making, by internalising external environmental costs, through systematic informative guidance, and through flexible policy instruments that enable cost-effective actions.

One key conclusion of all of the three strategies used as a basis for this report (the national natural resource strategy, the bioeconomy strategy and the mineral strategy) concerns the need to reshape society's norms, permit procedures, land use planning processes and administrative practices to enable the creation of a sustainable natural resource economy. Collaboration and work-sharing between different ministries and authorities should be shaped to help reach natural resource policy objectives. Legislation and administrative procedures should also facilitate these objectives, or at least not include any barriers hindering their realisation. Natural resource policy objectives should particularly be accounted for when new legislation is drafted. The crucial issues cannot only be resolved at national level, however, and action at the regional level is also essential.

During the formation of the above-mentioned strategies one significant barrier was considered to be the long processing times for mining permits and the fragmented nature of the related hearings. The permit procedures for local biorefining facilities were also seen as a hindrance. To promote developments in the bioeconomy and the mineral economy, the necessary logistics and infrastructural solutions need to be accounted for in land use planning. Land use planning procedures also constitute barriers inhibiting the recycling and local use of mineral aggregates. The national natural resource strategy proposes that an assessment should be made of the

legislative and administrative barriers to the development of the bioeconomy and the closing of the material cycle, also addressing the need to enhance land use planning.

Many of these existing practices and the related administrative cultures were shaped during a time when natural resource use was seen as limiting environmental protection rather than a way to enable it. In the green economy, social planning and administrative procedures should support efforts to reach the objectives defined for the sustainable natural resource economy. Administrative practices should be continuously changed in such directions. Several related changes are already being prepared, but this work should be purposefully continued.

Environmental permit procedures have been eased by simplifying processes, reducing the number of different permit authorities, developing electronic transaction processes, and drafting reports on best available technologies (BATs). In September 2010 new legislation on environmental protection in the context of rock quarrying and crushing came into force, defining general minimum environmental protection standards for such activities, harmonising procedures across the country, and increasing the predictability of decisions.

The preparation of national BAT reports is still ongoing. A report on BATs for biogas facilities was completed in spring 2009. Two BAT reports for rock quarrying and crushing and environmental protection practices for the mining industry were due to be completed in autumn 2010. These reports will help businesses working in these areas to apply for permits.

The Ministry of the Environment is currently renewing the Environmental Protection Act, and this process will involve simplifying and otherwise enhancing permit procedures. A working group has been assigned to define which environmental information should be collected from businesses in future, and to assess whether some reporting requirements could be removed to reduce the administrative burden on businesses. The possibility of combining mineral aggregate permits with other environmental permit procedures should also be assessed to ease such processes.

Energy and waste taxes directly affect the material and energy efficiency of natural resource use. But natural resource taxation as such has only been applied in very limited ways.

Investments and industries seek out locations with the most favourable conditions for success. There is a need for corporate financing models specifically designed to promote the sustainable and innovative natural resource economy. At the same time it is important to ensure that sufficient ownership of operations in natural resource sectors remains in Finland. The mineral strategy notes the importance of assessing the role of state ownership in investments in the mining sector. The state can particularly contribute in the context of bearing risks and accelerating or even enabling projects. The bioeconomy strategy particularly calls for public support mechanisms directed at SMEs, including tax incentives for R&D&I and the assessment and development of risk support.

## 5.4 Mainstreaming and everyday solutions

The ways natural resources are used in the future will largely depend on the extent to which society can encourage consumers to make responsible choices in their everyday lives. To promote sustainable choices, natural resource issues must be mainstreamed into public debate, as has already happened with climate issues. Extensive and varied communications and dialogues will be needed to this end. It is particularly vital that consumers should be given sufficient information and economic incentives to encourage choices that promote material and energy efficiency. The public's "natural resource literacy" must be purposefully increased. Environmental education is needed to increase awareness of the importance of natural resources among children and young people.

In August 2010 the Finnish National Board of Education published on its website [www.edu.fi](http://www.edu.fi) a special series of web pages about the creative use of natural resources designed for schoolteachers to use as background material, aiming to encourage teachers to cover topical natural resource issues and include in their teaching examples illustrating positive developments and the importance of innovations. These materials show using natural resources not as a problem, but as providing opportunities and solutions when resources are used intelligently and responsibly. Teaching pupils about the sustainable use of natural resources is a good way to examine the interactions between people and the natural environment comprehensively across subject boundaries.

The challenges that must be overcome to mainstream natural resource thinking are similar to the challenges generally faced when managing change. Natural resource issues often have many dimensions and deal with new topics, so it may take some time to understand them. New ways of thinking and working also generally require cultural changes. Pioneering companies and non-governmental organisations can play a significant groundbreaking role in this context. It is therefore important to manage the necessary changes in inclusive ways, involving citizens and stakeholder groups, as part of a future natural resource policy management model.

Competition for natural resources and the land needed to produce them is a potential source of conflict, which could hinder the mainstreaming of natural resource thinking. Many countries have good experiences of successful systematic and voluntary conflict resolution processes. Such processes should also be developed in Finland with support from society. The recent experiences of Metsähallitus should be fully utilised in developing the necessary conflict resolution models.

# 6 Guidelines defined by the Finnish Government

## 6.1 Background

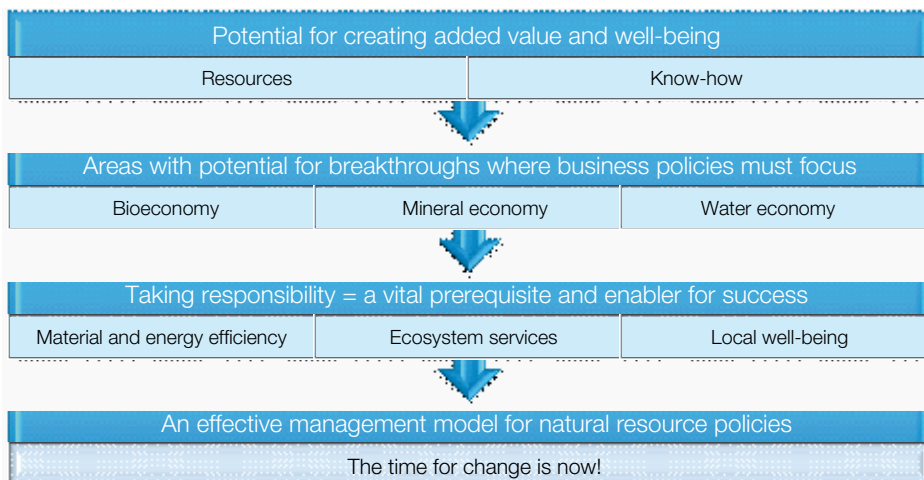
The guidelines defined in this report have been based on the following key resolutions, which are also summarised in Figure 8.

- 1 **Finland's plentiful natural resources and related expertise constitute considerable opportunities for the responsible production of added value for the national economy and well-being for future generations.** They also entail considerable potential for new forms of production for newly expanding markets, as well as opportunities for technological leadership and the export of Finnish expertise. These opportunities are based on three vital pillars made up by sectors where business policies should especially strive to promote breakthroughs in identified areas:
  - a. The Bioeconomy includes various forms of sustainable production based on renewable natural resources. Its starting points and new operational models involving new ways of thinking represent one crucial way forward in terms of the global use of natural resources. Thanks to Finland's plentiful and diverse biological reserves, know-how, and forest industry and agricultural sectors that are willing to take on new ideas, we have all the assets needed to become a leading country in the global bioeconomy.
  - b. The Mineral Economy has considerable potential for growth, particularly in Eastern and Northern Finland. New raw materials and processing chains will provide a basis for this growth. Thanks to its leading know-how in mining operations, Finland can become a global forerunner in terms of developing sustainable green mining activities.
  - c. Fresh water is becoming a scarce resource around the world, and it may become the most valuable resource of all. The strategic use of water reserves and water expertise will be vital issues for Finland in the future.
- 2 **Taking responsibility is a vital prerequisite and enabler for success.** By working responsibly with regard to the following vital issues Finland can both enhance well-being and develop sustainable solutions for global problems.
  - a. Material and energy efficiency is an area that will be vital for future success, and also one of Finland's most significant opportunities. Developing our own material and energy efficiency know-how and closed cycle forms of production will boost both sustainable domestic production and the development of new solutions for global markets.
  - b. Ecosystem services form the core of the sustainable natural resource economy, and they must be safeguarded in all activities. At the same

time ecosystem services are the basis for our enjoyment of the cultural and recreational values of natural environments. The importance of such factors for the well-being of the Finnish population is increasing, and they also enable the creation of sustainable new service enterprises.

- c. Local well-being. Natural resources are generally spatially fixed and distributed around the country. Local communities must take responsibility for creating the well-being enabled by the local availability of natural resources. The bioeconomy's distributed production models represent an opportunity to enhance local material cycles while also ensuring regional development and improving security of supply.
- 3 The time for change is now.** Internationally emerging natural resource policies are still in their first stages. New models are being sought to build a green economy. There is a need for global forerunners to take the lead in utilising natural resources and related technologies in line with sustainable development. The time is ripe for the shaping of a common vision and intensifying our efforts to influence international trends. Now is also the time to renew our production and service structures, create new competitiveness factors in the context of natural resource use, and develop new market areas where Finland will be a forerunner.
- 4 To achieve success, Finland will need a dynamic model for managing natural resource policies.** Natural resources are a key issue for Finland's future. They must be given considerable weight in national policy-making. This requires a comprehensive assessment of the various natural resource sectors, the establishment of linkages between coordinated natural resource policies and climate and energy policies, the creation of enabling structures, and the mainstreaming of natural resource thinking through policy-making with the extensive involvement of stakeholders from different sectors of society.

**Figure 8.** Background behind the Government guidelines.





A comprehensive overview of the various special issues and needs for action in different sectors is set out below in Table 2. In the sections for the bioeconomy and the mineral economy the table only lists the most crucial and current issues defined in the respective national bioeconomy and mineral strategies. These points strive to account for both the needs of the national natural resource economy, and the goal of increasingly exporting globally needed solutions based on Finland's natural resource expertise.

**Table 2. Special issues and needs for action by sector.**

	Bioeconomy	Mineral economy	Water economy	Ecosystem services
Influencing international trends and exporting expertise	Finland should prepare its own agenda for the international bioeconomy. Steps must be taken to strengthen the potential for exports based on Finnish expertise in the bioeconomy.	Finland must work towards the goals of the EU raw material initiative and the EU-2020 initiative. Expertise and innovations should promote the development of green mining that is material and energy efficient on a global scale, and create new international businesses.	Expertise on water resources is a strategic asset for Finland. This expertise should be increasingly utilised in international cooperation on water issues and the promotion of related exports.	The commercialisation and domestic and international marketing of non-material services based on natural resources must be supported and enhanced.
Developing expertise	Expertise in the bioeconomy must be strengthened by focusing resources. In line with the proposals of the bioeconomy working group, a new centre of expertise on the bioeconomy should be created by expanding the owner base of Forestcluster Ltd. A new strategy for developing a system of bioeconomy training and education across conventional boundaries should be established, covering all levels of training.	R&D&I activities in the mineral sector should be strengthened by setting up a Tekes programme designed to promote innovative solutions, products and services at all stages of the sustainable mineral utilisation chain. Critical gaps in expertise in the mineral sector must be identified by assessing and profiling the training programmes offered by universities and other educational institutes so as to meet the sector's growing needs.	Factors affecting water resources and possible measures to address them must be comprehensively assessed with regard to the impacts of climate change and adaptation measures. The knowledge base needed to support the comprehensive evaluation of impacts and risks must be strengthened.	Multidisciplinary research supporting the sustainable utilisation of ecosystem services and the knowledge base on the costs and benefits of ecosystem services must both be strengthened.
The role of the authorities and necessary actions	The development of the bioeconomy must be continued as a national initiative. To this end an operating environment enabling and encouraging favourable developments must be created through new trials and financing models and by promoting the commercialisation of products. Financial systems should encourage the establishment of biorefineries. Local biorefinery activities should be created as networks and the risks associated with related enterprises should be reduced. Opportunities to support new distributed bioeconomy concepts through R&D&I tax incentives should be examined.	Extremely rapid growth in the ore and minerals sector creates a greater national interest in the sector, so the state should become significant player. Domestic ownership of mining activities and particularly the role of the state should be increased. The availability of mineral aggregate in the surroundings of growth centres should be ensured at regional level through long-term land use planning procedures that harmonise different interests.	An implementation plan for increasing the hydropower productivity of water courses that have already been harnessed should be prepared, duly accounting for the need to use more renewable energy and enhance river basin management. The impacts of increased production on flood risk management, fisheries and the ecological state of water bodies should also be duly considered.	New methods should be developed to define ownership rights and values more clearly in the context of the non-material values provided by natural resources. New policy options should be developed to provide alternatives to market-based instruments.

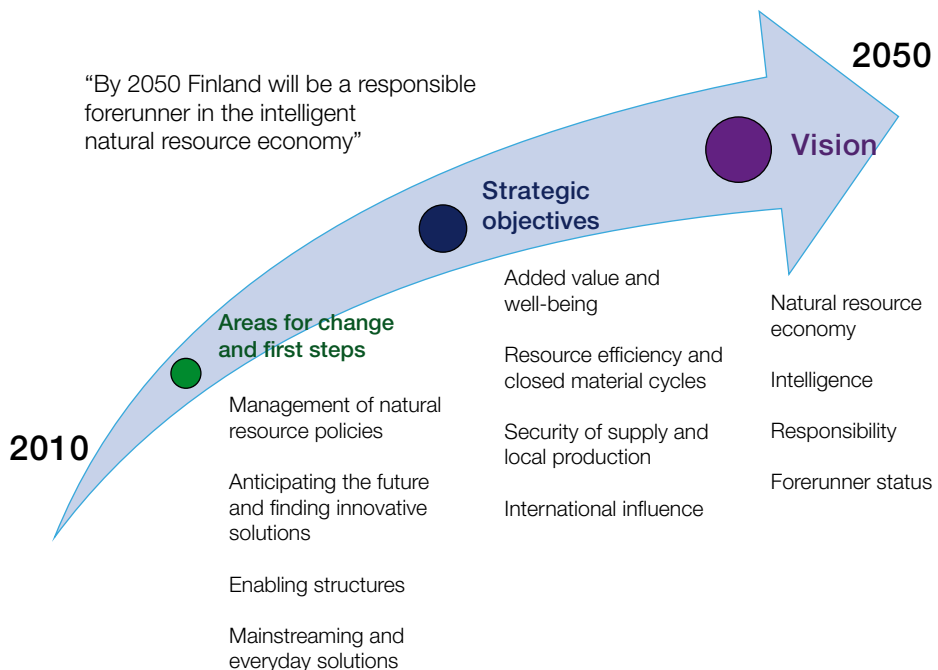
	Bioeconomy	Mineral economy	Water economy	Ecosystem services
<p>Ways to develop natural resource reserves and material flows</p>	<p>The increasing use of biomass for energy and as raw material creates significant logistical challenges. Biologistics systems should be developed with an emphasis on the procurement, transportation and storage of different kinds of biomass around Finland.</p>	<p>Conditions for more effective mineral prospecting and the development of prospecting, mining and ore enrichment technologies must be enhanced. The more extensive utilisation of mining by-products and wastes, and the reuse of building materials and mineral product, should be encouraged by removing barriers to recycling and developing databanks and incentives. Surveys should examine the potential for establishing storage facilities for surplus mineral masses at a level higher than municipal level. A demonstration programme should be set up to show how material can be reused in earthworks.</p>	<p>Reserves of good quality fresh water are strategically important natural resources. Programmes designed to protect inland waters and the sea must be fully implemented to ensure that high water quality levels can be achieved or safeguarded for Finland's surface waters and groundwater reserves.</p>	<p>Ecosystems' vital structures and functions must be safeguarded to ensure they preserve their capacity to produce important services.</p>

## 6.2 A strategic core: vision, goals and areas for change

The resolutions described in Section 6.1 can be realised by creating a comprehensive natural resource policy for Finland together with a related policy management model. The dynamic approach to change management set out in the national natural resource strategy (Sitra 2009) can be summarised as follows:

Initially a vision must be defined for the desired direction of change over the long term, and expressed in a long-term vision for natural resource policy (2050) with strategic objectives for coming decades also defined to form a road map towards the long-term vision. Key areas for change must be defined to reach these objectives. In these areas structures must be changed at the same time to enable developments to proceed in the desired directions. First steps to be taken over the coming years must then be defined for each area of change (see Fig. 9).

**Figure 9.** Key terms used in the guidelines set out in this report.



Progress must be made with constant reassessments and flexibility, due to the many uncertainties in the operating environment. The journey towards long-term objectives must be made step by step, with directions checked regularly as our knowledge and understanding are improved. The recognition of barriers, experimentation and continuous learning are all key parts of this process.

## **Vision for 2050: Finland as a responsible forerunner in the intelligent natural resource economy**

- **The natural resource economy** involves the sustainable utilisation of natural resources in ways that safeguard ecosystem services and biodiversity while creating well-being and enabling sustainable business activities.
- **Intelligence** refers to expertise, anticipating future developments, and creating innovative solutions. Intelligence also enables solutions through which natural resource use can be steered utilising smart technologies.
- **Responsibility** involves building future success through operations that are truly sustainable. Finland must utilise its biocapacity and mineral reserves prudently, to meet global demands for sustainability and human needs both now and in the future.
- **Forerunner status** means that Finland must be recognised for its expertise while also playing an influential and appreciated role in shaping international natural resource policies and business activities. It also involves seeking new solutions to resolve global natural resource issues and environmental problems.

### **Strategic objectives**

- 1 The natural resource economy and the related expertise and services should form a significant source of added value and well-being.**

The bioeconomy, the mineral economy and the water economy should produce added value competitively. Material and energy efficiency and services based on high-level expertise should form a significant part of this added value. Services based on the non-material values associated with natural resources, such as landscape, cultural and recreational amenity values should enable new sustainable business activities and enhance well-being.

- 2 Natural resources should be utilised with high material and energy efficiency, striving to create closed material cycles that will reduce greenhouse gas emissions, wastes and the threats facing ecosystem services.**

Natural resources should be utilised within limitations defined by biocapacity and the need to ensure sustainability and safeguard biodiversity and ecosystem services. Finland must strive to further decouple natural resource use from economic growth and greenhouse gas emissions. The share of production coming from closed material cycles must be increased. Finland should take international responsibility for developing the sustainable natural resource economy and closed material cycles.

- 3 Finland's security of supply of critical natural resources must be assured, with local production solutions creating local well-being.**

The availability of critical imported natural resources should be safeguarded to ensure security of supply. The need for imported natural resources should be reduced by domestic production. Finnish agriculture and forestry should

operate in accordance with the principles of the bioeconomy to ensure the sufficient supply of the raw material ingredients needed for further processing, so as safeguard the national food supply. The natural resource economy should create local well-being, with local forms of production enabling closed cycles.

**4 Finland should be respected internationally for its expertise and influence on natural resource issues.**

Finland should work actively to shape international natural resource policies. Natural resource diplomacy must be an essential element of international trade and development policies. Finland should be a leading exporter of intelligent and responsible solutions for the natural resource economy.

Achieving these objectives through the measures set out in this report will increase well-being in Finland as well as the country's competitiveness and security of supply. Following these guidelines will result in the creation of suitable conditions for establishing closed material cycles and decoupling economic growth from increases in natural resource use or harmful environmental impacts. These will be key issues when it comes to measuring the achievement of the objectives set out here. Following the guidelines set out in this report will also help Finland to realise many other goals related to the use of natural resources, for instance in the context of climate and energy policies, efforts to safeguard biodiversity, and the need to renew Finland's forest sector.

**Key areas where change is needed to achieve strategic objectives**

The guidelines set out in this report are to be implemented in four key areas for change, where new ways of thinking are required. In each of these areas for change actions be taken to work towards all of the four strategic objectives outlined above. The areas for change have been defined on the basis of the four central challenges facing natural resource policy-making (described in Section 5).

**A. The responsible management of natural resource policies:** A long-term but flexible model must be created for the management and implementation of comprehensive natural resource policies with close linkages to economic, environmental and climate and energy policies.

Actions should be designed to create an administrative and operational model for comprehensive natural resource policies that will help Finland to reach the objectives set out in this report. This model should closely integrate natural resource policies with energy and climate policies. The model should strengthen natural resource policies and their coordination at the national, international and local levels, and also enhance coordination between different natural resource sectors. It must have a long-term perspective, but at the same time be dynamic and flexible to enable continuous learning and improvement.

**B. Anticipating the future and finding innovative solutions:** Multidisciplinary expertise and foresight on natural resource issues must be strengthened as a basis for innovative solutions.

Concerns about the sufficiency of natural resources for future generations are becoming a crucial factor shaping the need for expertise. The concept of expertise has to be interpreted in new ways due to the complex and rapidly changing nature of natural resource issues. There is a need for comprehensive thinking across sectoral boundaries, a better understanding of likely future trends, and an improved spatial database covering natural resources and the environmental impacts of their use. Developing new concepts and services for utilising natural resources is becoming an important way to create added value alongside technical expertise. At the same time there is also a need for intensified R&D&I activity to further enhance excellence in material and energy efficiency and the related product development.

- C. Enabling structures:** Conditions for sustainable natural resource business activities must be improved by reshaping structures and operating models through society.

The developing natural resource economy needs to be supported by an enabling operating environment where legislation, land use planning, environmental impact assessments, permit procedures and administrative practices all facilitate efforts to reach the objectives set out in this report in all value chains associated with the management and use of natural resources. New kinds of enabling structures are increasingly needed alongside structures that control developments. Land use planning processes play a vital role in the sustainable utilisation of natural resources, safeguarding the supply of vital resources, and preventing environmental problems. There is a need to improve the availability of risk financing particularly through financing models suitable for the SME sector, so as to support innovative new kinds of business activity. Prospects for the utilisation of strategic natural resources can be enhanced by increasing Finnish ownership and considering where state ownership or controls over ownership would be worthwhile. Taxation changes and financial incentives are also needed to steer the behaviour of consumers and companies in desirable directions.

- D. Mainstreaming and everyday solutions:** Sustainable natural resource thinking must be mainstreamed into everyday choices and solutions.

The comprehensive and environmentally responsible natural resource thinking envisaged in this report must be mainstreamed into actions throughout society. The increasing risks associated with sectoral thinking and natural resource conflicts must be addressed through robust cross-sectoral communications and new structures designed to enhance collaboration. Economic incentives and other instruments are needed to ensure that promoting the sustainable natural resource economy becomes part of people's everyday choices and solutions. Active public debate and improved public participation will be needed to encourage prudence in the everyday use of natural resources.

## 6.3 First steps for the coming years

One key challenge for natural resource policy concerns the need to work across the boundaries between sectors, form a shared vision, and create national added value by increasing the synergies between sectors. For this reason, in addition to the sector-specific measures described in Section 6.2, it is important to implement measures that will strengthen such synergies and natural resource policies in general and integrate the whole natural resource field.

The measures set out below address the development of the natural resource economy as a whole. They represent only the first steps that must be taken towards long-term objectives. During their implementation objectives must be continuously revised and new steps defined.

In addition to these measures, a programme must be prepared for the implementation and financing of climate, energy and natural resource policies that will examine alternative target levels for natural resource use and bring together climate and natural resource issues. The programme should be evaluated during its preparation in accordance with Finnish legislation covering impact assessments for plans and programmes. The economic impacts of future climate, energy and natural resource policies must also be assessed. Issues related to the need for financing will be resolved through the state administration's national budgeting framework and budget evaluation processes. The ministries will implement measures in their respective administrative spheres within this budget framework, reallocating funds where necessary, and also taking into account the goals of the national government productivity programme. The implementation of measures will be scheduled with regard to factors including cost effectiveness.

- 1 Managing natural resource policies.** The status of natural resource policies must be strengthened by appointing a high-level government body responsible for the overall development and coordination of natural resource policies, who will report directly to the Prime Minister. Opportunities to combine the existing Economic Council and the Council for Natural Resources should be assessed, together with other possible ways to integrate knowledge on economic and natural resource issues. Cooperation and the sharing of work between the various ministries and government agencies responsible for the use of natural resources should be enhanced to support efforts to reach the objectives defined in this report. The new body responsible for natural resource policies should ensure that the guidelines set put in this report are duly considered in regional natural resource strategies and updated sectoral strategies. Sectoral strategies should ensure that enterprises based on the production of natural resources are viable and competitive. It is notable that the bioeconomy does not yet benefit from the same kinds of supportive administrative structures that already exist for the mineral economy and the water economy.



- 2 **Influence within the EU.** Finland must play a prominent role in the development of EU natural resource policies, and strive to ensure that the EU Commission gives priority to natural resource issues. To facilitate this, a common natural resource economy agenda should be prepared for the Government and key ministries to follow in dealings with the EU and in international negotiations. A natural resources attaché should be appointed to Finland's Permanent Representation to the EU. Steps should particularly be taken to ensure that material and energy efficiency are duly considered in the EU's raw material policy, and that the EU's Integrated Product Policy is effectively applied nationally and across the EU.
- 3 **Global natural resource policies.** Finland must act responsibly and take initiatives in helping to create international natural resource policies that will promote global sustainability, justice, security and equitable conditions for corporate business. Finland should promote the development and adoption of international sustainability criteria, standards, calculation and monitoring methods, and agreed rules that consider natural resources comprehensively. Natural resource diplomacy should be integrated into foreign policies, particularly in terms of trade and development policies and wide-ranging security policies. Trade policies and bilateral relations with countries that produce natural resources should ensure the availability of strategic and critical natural resources from international markets. Finland's development policies must promote the responsible use of natural resources and the related governance on a global level. Finland should also participate actively in the work of the International Panel on the Use of Natural Resources and utilise its findings in developing national natural resource policies.
- 4 **A national natural resource panel.** Finland must appoint a national natural resource panel made up of experts in fields of life cycle analysis, material and energy efficiency, mitigating climate change, ecosystem services, and the use of bioresources, mineral resources and water resources. The panel's task will be to compile and analyse research findings and provide recommendations for decision-makers. The panel should particularly coordinate forecasting, monitoring and evaluation work related to the use of natural resources. To support the panel, improvements must be made in data compilation and evaluation methods to enhance our understanding of the added value, employment impacts and main environmental impacts associated with the various sectors of the natural resource economy. Scenarios describing the impacts of different resource utilisation levels and controls should be produced and examined with regard to the consequent impacts on economic sectors and on the economy at regional and national level. The panel's findings and recommendations can be used to influence developments within the EU and in international negotiations, as well as in shaping national policies.
- 5 **Natural resources accounting and expertise.** Statistics on material flows in the national economy and models for evaluating environmental impacts must be

developed, together with new environmental and natural resource accounting methods to be integrated with national economic accounting. It is particularly important to ensure that data on the bioeconomy is effectively compiled. New calculation methods and measures must be developed to describe natural resource use and material flows, also covering hidden flows, transportation and storage. Trials of new calculation methods and measures should be conducted at different administrative levels and in the business sector. Finland's strategic centres and networks of expertise must be made aware of the importance of the objectives defined in this report. Expertise on the overarching aspects of natural resource issues should be strengthened through training, with more resources provided for university-level teaching in the various natural resource sectors. The Finnish natural resource and environmental research consortium (LYNET) and the Geological Survey of Finland should create scenarios and impact assessments for different ecosystem utilisation levels for different economic sectors, and for the economy at regional and national level. The climate impacts and other environmental impacts of alternative resource utilisation scenarios should also be assessed to facilitate the development of criteria for sustainable utilisation.

- 6 Material and energy efficiency programme.** A national material and energy efficiency programme must be drawn up and launched, identifying potential ways to use natural resources and energy more effectively in Finland, and also defining targets and indicators. The programme should also account for EU issues and interactions, and find ways to integrate material and energy efficiency issues into public sector purchasing policies and the funding criteria for programmes financing regional development. The programme should evaluate material cycles in different sectors and at different administrative levels, find ways to remove the related barriers and develop systems that support the effective recycling of materials. It should also examine opportunities for reshaping the taxation system to facilitate efforts to reach material and energy efficiency objectives. The economic incentives for material and energy efficiency agreements should also be increased.
- 7 Legislation, administrative procedures and permit processes.** Current legislative and administrative barriers hindering the development of the sustainable natural resource economy and material cycles must be examined. The objectives defined in this natural resources report must be considered when new legislation is shaped. The duration of permit procedures for mining activities and bioeconomy facilities must be reduced, and permit processes should be made more effective. One goal must be to increase collaboration between the different authorities involved, and coordinate the scheduling of hearing processes. The guidelines set out in this report must be considered in issues related to the ownership of land by the state.
- 8 Land use planning.** Land use planning must be based on the need to ensure the sustainable utilisation and availability of natural resources with reference

to updated data covering the whole country. The logistical solutions and infrastructure necessary for the sustainable natural resource economy must be accounted for in land use planning.

- 9 Risk financing and corporate funding.** Opportunities to utilise international and EU support must be fully exploited through collaboration between the state, international corporations, financial institutions and other organisations. New models for supporting R&D&I activities, guaranteeing the availability of risk finance, and promoting product commercialisation must be developed and adopted. Measures must be taken to promote the development and marketing of new products and service concepts that improve material and energy efficiency. Business opportunities involving recycling material flows and closing cycles must also be promoted.
- 10 Models for distributed SME production.** New expertise and innovation potential must be created by helping SMEs working in the natural resources sector to get better integrated into open innovation environments and the national innovation system. Opportunities to improve the utilisation of targeted national funding by SMEs working to enhance local material cycles should be examined, together with the need for new funding models. Collaboration on issues related to the green economy between SMEs and research institutes should be promoted on issues including material flows, value chains, risk management, land use planning and the development of good administration.
- 11 Mainstreaming and everyday solutions.** Future natural resource use will largely be shaped by the extent to which people make responsible choices in their everyday lives. Consumers should be given sufficient information and economic incentives to encourage choices that promote material and energy efficiency. Robust cross-sectoral communications and new structures for cooperation are needed to address the increasing risk of natural resource conflicts.

To achieve these desired changes, the public sector, businesses and civil society must be committed to a shared vision and pull in the same direction. Public debate on natural resource issues must be activated. Pioneering companies and non-governmental organisations can play a key role in this respect. Through voluntary agreements, for instance, companies can commit themselves to enhance their environmental work by doing more than simply complying with official controls, and thus establish themselves as international forerunners by developing innovative solutions.

The natural resource economy and related future opportunities for Finland are so important that activities must be planned in the long term to create a favourable and enabling operating environment for natural resource use. The Government therefore believes that it is important to incorporate the main guidelines defined in this natural resources report in the programme of the next Finnish Government, due to be elected in April 2011.

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## Annex 1

### Measures proposed in key strategies

Visions and strategic objectives defined in Finland's key natural resource strategies.

Strategy/report	Vision
National natural resource strategy, Sitra 2009	Vision for 2030: By using natural resources intelligently Finland thrives and leads the way
The Bioeconomy in Finland – assessment of the need for a national strategy, Prime Minister's Office 2010	In 2050 Finland will be a leading country in terms of building a bioeconomy, where well-being is based on the sustainable and diverse use of renewable natural resources, high levels of product refinement and creative know-how.
Finland's mineral strategy, Ministry of Employment and the Economy 2010	Vision for 2050: Finland as a global leader in terms of the sustainable utilisation of minerals, and the mineral sector forms one of the key pillars supporting the national economy.
Strategy / report	Strategic objectives
National natural resource strategy, Sitra 2009	<ul style="list-style-type: none"> <li>to create a successful bioeconomy producing high added value</li> <li>to utilise and recycle material flows efficiently</li> <li>to use regional resources to create national added value and local well-being</li> <li>to take the initiative and be a forerunner on natural resource issues</li> </ul>
The Bioeconomy in Finland – assessment of the need for a national strategy, Prime Minister's Office 2010 *	<ul style="list-style-type: none"> <li>to develop new cross-sectoral ways of thinking</li> <li>to become a sustainable bioeconomy by anticipating trends and through innovation</li> <li>to enhance competitiveness as a vital basis for a productive bioeconomy</li> </ul>
Finland's mineral strategy, Ministry of Employment and the Economy 2010	<ul style="list-style-type: none"> <li>to find solutions for challenges related to global mineral utilisation chains</li> <li>to promote growth and well-being in Finland</li> <li>to reduce harmful environmental impacts</li> </ul>

\* This report does not define specific goals, but proposes areas for action.

Issues and objectives covered by the measures proposed in Sitra's national natural resource strategy, bioeconomy strategy and mineral strategy.

GOAL  AREAS FOR ACTION	0 Wide-ranging actions that help to achieve goals	1 The natural resource economy and related know-how and services form a major source of added value and well-being	2 Natural resources are used with high levels of material and energy efficiency, striving to develop closed cycle processes that do not add to greenhouse gas emissions or create wastes.	3 Finland's security of supply of critical natural resources safeguarded, with local forms of production creating local well-being.	4 Finland's appreciated role in shaping international natural resource issues
A Managing natural resource policies	Government programme N0, M1 Coordination of natural resource policies N0, N14, B1	Sectoral strategies B2, B14, M1	Material and energy efficiency programme B10	Regional natural resource strategies N10	Influence within the EU N4, N12, N13, B3, M2 Global natural resource policies and diplomacy B3, M2
B Anticipating the future and creating innovative solutions	National natural resources panel: forecasting, monitoring and evaluation N0, B10 Natural resource accounting and statistics N16, B9 High levels of multi-disciplinary expertise N17, B6, M11, M12	Renewable and sustainable sources of raw materials B15 Profiling, scaling and steering of education and training N17, B5, B6, M12 Centres and networks of expertise B4, M11	Sustainable raw material procurement N3, N5, B13, B15, M2, M5 Material and energy efficient products and production processes N5, B8, B10, B11, M4, M8, M11	Concepts for the distributed bioeconomy N1, N2, N8, B11 SME enterprise in the green economy and enhancing the innovation environment N7, B12, M9, M11	International cooperation on utilising expertise, and exports of Finnish expertise N4, N11, B4, M2
C Enabling structures	Legislation, administrative practices and permit processes N15, B2, M6 Land use planning B10, B13, M7	State ownership and controls over owners M3 Risk financing and corporate financing N11, B12, M3, M4	Favourable material cycle systems and supportive tax reforms N3, N4, N5, N6, B10	Concepts and trials for the distributed bioeconomy, N1, N2, B12	Natural resource panel B10
D Mainstreaming and everyday solutions	Public debate and environmental education B7, M12 Training for decision-makers and journalists N18, B7	Corporate communications and consulting B7	Economic incentives, product labelling and awards N4, N6, N16, B12, M8		

N = national natural resource strategy, B = bioeconomy strategy, M = mineral strategy. The numbers indicate which of the strategies' measures address each issue.



### **Limitations and commitments in relation to the natural resource economy**

#### **Safeguarding biodiversity**

The 10th Conference of Parties to the UN Convention on Biological Diversity defined strategic targets for the conservation and sustainable use of biodiversity for the period 2011-2020. This resolution called for urgent and effective actions to halt the ongoing decline in biodiversity by 2020. Progress towards this ambitious target will be monitored using indicators.

On 21.12.2006 the Finnish Government approved a national strategy for the conservation and sustainable use of biodiversity in Finland over the years 2007-2016. A national action plan was prepared by several ministries for the same time period. The strategy and action plan, jointly entitled "Saving nature for people", form a mechanism for integrating the strategic guidelines set out in the CBD into policy-making in Finland. Finland will assess progress on the strategy and action plan during 2011 in accordance with the guidelines defined in the convention's 10th conference of parties.

#### **Greenhouse gas emissions**

A common EU climate and energy package was agreed in December 2008, aiming to reduce greenhouse gas emissions, increase the use of renewable energy sources and improve energy efficiency. The EU aims to reduce its total greenhouse gas emissions to a level at least 20% below their level in 1990 by 2020. Finland's target for sectors not included in the EU's emissions trading scheme, including transport and agriculture, is to reduce emissions to a level 16% below their level in 2005 by 2020. In October 2009 the Finnish Government approved a target defined in a foresight report on long-term climate and energy policy that Finland should reduce its greenhouse gas emissions to a level at least 80% below their level in 1990 by 2050.

#### **Renewable energy**

The share of renewable energy sources in the EU's total energy consumption should be raised to an average of 20% by 2020. Finland's national target for this period is to increase the share of renewable energy to 38%. For transport fuels a target has been set that 10% (SUOM orig 20%) of transport fuels should be derived from renewable sources by 2020. Directives define both criteria for the greenhouse gas emissions of biofuel production and use chains, and limitations to the utilisation of raw materials for a country whose ecosystems are rich in biodiversity and contain large quantities of carbon. The Fuel Quality Directive (2009/30/EC) additionally defines a target for reductions in the life cycle greenhouse gas emissions of transport fuels, maximum limits for concentrations of FAME compounds and ethanol, and

sustainability criteria for biofuels. A Finnish Government decision on sustainable choices in public sector purchasing (8.4.2010) resolves that central government agencies should purchase electricity produced using renewable energy sources. Electricity from renewable sources is to account for at least 30% of the electricity purchased by the national government in 2010, and at least 60% by 2015, with the origins of the purchased electricity certified by third parties.

## **Wastes**

The recycling targets set out in the Waste Framework Directive (2008/98/EC) require that the amounts of waste materials such as paper, metal, plastic and glass from households and other sources with comparable waste streams that are recovered for reuse and recycling should be increased to at least 50% of their total quantities by weight by 2020. A target of 70% (by weight) recovery for reuse and recycling by 2020 has been set for non-hazardous construction and demolition waste (with the exception of waste soil and stones of type 17 05 04 as defined in the European List of Waste), including the possible use of wastes in land use actions in place of other materials. The Landfill Directive (1999/31/EC) stipulates that the amounts of biodegradable municipal waste sent to landfill should be reduced to a maximum of 35% of the total amounts of biodegradable municipal waste generated (by weight) by 2016. The benchmark year for this target is 1995 or the last year before 1995 for which the relevant standardised Eurostat data is available.

Finland's current National Waste Plan, which extends to 2016 and was approved by the Government on 10.4.2008, sets a target that the total amounts of municipal waste generated should start to decline by 2016. Another target stipulates that 50% of all municipal waste should be recycled for material use, and 30% utilised to produce energy. A maximum of 20% should be sent to landfill. Additionally 70% of construction wastes and all of the manure generated in rural enterprises should be utilised.

## **Commitments made in different sectors**

The table below summarises various commitments made by Finland which will shape the future use of natural resources. It is noteworthy that most of these commitments concern the bioeconomy and the water economy. Few of the commitments directly affect the mineral economy, although many may have indirect implications for mineral utilisation.

## Finland's commitments with implications for natural resource use.

Issues		Targets
Safeguarding biodiversity	European Council resolutions (2001 and 2010)	Halt the decline in biodiversity and ecosystem services in the EU by 2020.
Greenhouse gas emissions	European Council climate and energy package (December 2008)	Reduce greenhouse gas emissions to a level at least 20% below their 1990 level by 2020.
Energy efficiency	European Council climate and energy package (December 2008)	Increase energy efficiency by an average of 20% compared to underlying trends by 2020.
Increasing the share of renewable energy in energy use	RES Directive (2009/28/EC)	Renewable energy to account for 20% of EU final energy consumption by 2020
	Government decision on sustainable choices in public sector purchasing (8.4.2009)	Central government agencies to shift purchasing to electricity produced using renewable energy sources.
Renewable transportation fuels	RES Directive (2009/28/EC)	Renewable energy (biofuels + renewable electricity) to be used to power 10% of transportation by 2020.
Fuel quality	Fuel Quality Directive (2009/30/EC)	Target for reductions in the life cycle greenhouse gas emissions of transport fuels. Maximum limits for concentrations of FAME compounds and ethanol. Sustainability criteria for biofuels.
	Act amending section 5 of the Act promoting the use of biofuels in transportation (1056/2009)	In 2009 4% of the fuels used in transportation should consist of biofuels, and this share should rise each subsequent year. (((OK??? Suom orig epäselvä???)
Waste materials	Waste Framework Directive (2008/98/EC)	The amounts of waste materials (e.g. paper) recovered for reuse and recycling should be increased to at least 50% of their total quantities by weight by 2020. The amounts of non-hazardous construction and demolition wastes recovered for reuse etc should be increased to 70% (by weight) by 2020.
	National Waste Plan to 2016 (approved by the Government 10.4.2008)	50% of the material content of municipal waste to be recycled; 30% to be used to produce energy; and at most 20% to be sent to landfill. 100% of the manure generated in rural enterprises to be utilised. 70% of construction waste to be utilised.
Biodegradable waste	Landfill Directive (1999/31/EC)	Obligation to reduce the amounts of biodegradable waste sent to landfill. Share of biodegradable municipal waste sent to landfill to be reduced to 35% (by weight) by 2016.
By-products	Regulation 1069/2009/EC on health rules as regards animal by-products and derived products not intended for human consumption, and repealing Regulation 1774/2002/EC on animal by-products	Foodstuffs production results in large quantities of by-products which are costly and laborious to dispose of. New ways to utilise such material should be found without endangering human health or the safety of the environment.
Water	EU Water Framework Directive (2000/60/EC)	In December 2009 the Finnish Government approved seven river basin management plans drafted in the basis of the directive to be implemented until 2015. These plans define the measures that need to be taken in different sectors to ensure that water bodies have a good status.

## Annex 3

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## Annex 4

### Definitions of key concepts

Biodiversity	Biodiversity, or biological diversity, includes the whole variety of living things (e.g. plants, animals, genetic resources, biotopes and ecosystems), and thus in its widest sense encompasses all life on Earth.
Biodiversity Convention	The UN Convention on Biological Diversity covers the protection and sustainable use of biodiversity, as well as the benefits humanity derives from biodiversity and their equitable sharing.
Bioeconomy	The bioeconomy involves the sustainable management and utilisation of renewable natural resources, the production of the goods and services derived from natural resources, and the biological and technical methods used in production.
Biosystem	A system of living things functioning in interaction.
Ecosystem	Ecosystems are coherent and functional systems that encompass organic and inorganic environmental features (biosystem + geosystem), as well as natural processes (e.g. growth, reproduction, succession, decomposition, erosion, volcanic activity, tectonic movements etc.). Ecosystems thus include all the local elements of biodiversity and geodiversity.
Ecosystem approach	This planning method involves participative consultations and multi-objective land use planning with the goal of safeguarding and equitably sharing benefits derived from ecosystem services and biodiversity. This approach to the utilisation and conservation of natural resources emphasises the interactions between different natural features, as well as the fact that humanity is part of nature.
Ecosystem services	Ecosystem services (including biosystem services and geosystem services) include all of the material and non-material benefits people obtain from natural systems. The survival and well-being of humanity and the availability of ecosystem services are dependent on biodiversity and the functions that maintain it.
Geodiversity	Geodiversity, or geological diversity, includes the bedrock, soil, landforms and all of their related variations and processes. It thus encompasses rock types, minerals, peat, esker formations, bedrock outcrops, dunes and moraine landforms. The geological processes that shape the Earth's crust include

erosion, sedimentation, volcanic activity and tectonic plate movement.

Geosystem

A functioning system of inorganic geological features.

Green economy

The OECD defines the Green Economy as an economic system that fully accounts for the well-being of ecosystems. The main aims of the Green Economy are to reduce dependency on fossil energy and developments that impoverish ecosystems, to promote the global economy, and to create new employment in accordance with the principles of sustainable development.

Green mining

Forms of mining and quarrying that apply material and energy efficient solutions throughout production chains. Green mining minimises harm to the environment and local communities, while enhancing safety at work and job satisfaction. Efforts are also made to rehabilitate disused mining facilities for other uses.

Natural diversity

Natural diversity includes the diversity of both organic and inorganic natural features (biodiversity + geodiversity).

Sustainable development

Sustainable development is development that meets the needs of the present without compromising the ability of future generations

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<b>Julkaisun nimi   Titel   Title</b> Älykäs ja vastuullinen luonnonvaratalous – Valtioneuvoston luonnonvaraselonteko eduskunnalle		
<b>Tiivistelmä   Referat   Abstract</b> <p>Suomen kansantalous perustuu teollisuusmaaksi poikkeuksellisen vahvasti luonnonvaroista saatavaan arvonlisään. Met-sävaramme asukasta kohden ovat runsaat. Kiviaines-, mineraali- ja turvevarantomme ovat merkittävät. Muita tärkeitä luonnonvarojamme ovat mm. puhdas vesi, viljelykelpoinen ja rakentamaton maa sekä monet luonnontuotteet. Myös ekosysteemipalvelujen kulttuuriset ja virkistysarvot tarjoavat kestäviä hyödyntämismahdollisuuksia matkailun ja hyvinvointipalvelujen aloilla.</p> <p>Globalisti kiristyvässä kilpailussa luonnonvarat ovat Suomelle suuri mahdollisuus, mutta meidän on luotava hyvinvointia ja vaurautta kestävämmiin. Luonnonvarapolitiikan tulee pohjautua ymmärrykseen siitä, mitkä toimintamallit luonnonvarojen käytössä ja suojelussa luovat tulevaisuuden menestystä. Selonteko perustuu biotalousstrategiaan ja mineraalistrategiaan, mutta se kokoaa näiden lisäksi yhteen lukuisia muitakin näkökulmia (mm. vesitalous, ekosysteemipalvelut, materiaali- ja energiatehokkuus) yhtenäiseksi kokonaisuudeksi.</p> <p>Työ- ja elinkeinoministeriön yhteyshenkilö: Strategia- ja ennakointi/Mika Honkanen, puh. 010 606 4904</p>		
<b>Asiasanat   Nyckelord   Key words</b> luonnonvarat, biotalous, mineraalit, vesi, energiatehokkuus, materiaalitehokkuus, kestävä kehitys, ekosysteemipalvelut		
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<b>Julkaisun nimi   Titel   Title</b> Smart och ansvarsfull naturresursekonomi – Statsrådets naturresursredogörelse till riksdagen		
<b>Tiivistelmä   Referat   Abstract</b> <p>Den finländska samhälls ekonomin baserar sig på ett för ett industriland exceptionellt starkt sätt på mervärde som fås av naturresurser. Vi har rika skogsresurser per invånare. Vi har betydande reserver av stenmaterial, mineraler och torv. Andra viktiga naturresurser som vi har är bl.a. rent vatten, odlingsbar och obebyggd mark samt många naturprodukter. Även ekosystemtjänsternas kultur- och rekreationsvärden erbjuder hållbara möjligheter inom turism och må bra-tjänster.</p> <p>I den globalt sett hårdnande konkurrensen utgör naturresurserna en stor möjlighet för Finland, men vi måste skapa välfärd och välbefinnande på ett mer hållbart sätt. Naturresurspolitiken bör bygga på förståelse för vilka handlingsmodeller för utnyttjande och skydd av naturresurser som skapar framtida framgång. Redogörelsen baserar sig på den bioekonomiska strategin och mineralstrategin. Utöver dessa aspekter samlar redogörelsen ett stort antal andra perspektiv (bl.a. vattenhushållning, ekosystemtjänster, material- och energieffektivitet) till en enhetlig helhet.</p> <p>Kontaktperson vid arbets- och näringsministeriet: Strategi och prognostisering/Mika Honkanen, tfn 010 606 4904</p>		
<b>Asiasanat   Nyckelord   Key words</b> naturresurser, bioekonomi, mineraler, vatten, energieffektivitet, materialeffektivitet, hållbar utveckling, ekosystemtjänster		
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# Building an Intelligent and Responsible Natural Resource Economy – Natural Resources Report Submitted to Parliament by the Finnish Government

The report was prepared under the steering of the government's ministerial working group on climate and energy policy. The report defines a vision for 2050 with Finland seen as pioneering the development of a responsible natural resource economy. Finland's plentiful natural resources and related expertise constitute considerable opportunities for the responsible production of added value for the national economy and well-being for future generations. They also entail considerable potential for new forms of production for newly expanding markets, as well as opportunities for the export of Finnish expertise. Vital opportunities particularly relate to developments in the bioeconomy, mineral economy and water economy. To succeed, we must first effectively take responsibility for material and energy efficiency, safeguard vital ecosystem services, and ensure local well-being. By working actively in these issues Finland will take her share of global responsibility and develop solutions for global challenges.

Fulfilling the report's guidelines will increase Finland's well-being and competitiveness, to improve the security of supply, and also help to realise many other goals related to natural resource use in contexts including climate and energy policies, the conservation of biodiversity, and the restructuring of Finland's forest sector. This report is partly based on existing strategies for the bioeconomy and minerals, but it also brings together views on many other current issues related to natural resources, including the water economy, ecosystem services, material efficiency and energy efficiency.

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