



## ***Four Scenarios for Europe***

**Based on UNEP's third  
Global Environment Outlook**

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ISBN: 92-807-2334-0

This study was commissioned by the United Nations Environment Programme and the Netherlands' Ministry of Housing, Spatial Planning and the Environment.

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For bibliographic and reference purposes this publication should be referred to as:

UNEP/RIVM (2003). Four scenarios for Europe. Based on UNEP's third Global Environment Outlook. UNEP/DEIA&EW/TR.03-10 and RIVM 402001021.

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RIVM, the National Institute of Public Health and the Environment in Bilthoven, The Netherlands, is a supporting scientific organisation for the ministries in the Netherlands who deal with public health, the environment and nature. Since the late 1980s, a core task of RIVM has been integrated assessment in environment and public health, on the basis of extensive monitoring, modelling, scenario analysis and an active dialogue with the scientific community and those using the assessments in policy making. RIVM fulfils specific roles in its relations with various international organisations. To UNEP, RIVM has been a Collaborating Centre for Environment Assessment, Reporting and Forecasting since 1994.

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## The GEO-3 scenario work

*The third Global Environment Outlook (GEO-3) was published on the eve of the Johannesburg summit. At that moment in time (autumn 2002), GEO-3 looked back thirty years and forward thirty years. As set of what-if scenarios was used to explore the ways our society can advance, including implications for environmental and social goals. Characteristically, GEO-3 examines in a relatively deep fashion how its global scenarios can be interpreted in the context of each of the world's regions.*

*This brochure presents the pan-European elaboration of the four GEO-3 scenarios. It focusses on the scenarios proper and their impacts in environmental terms. Unlike a GEO report, it does not assess the findings in the light of policy questions.*

Much of what will happen over the next 30 years has already been set in motion by policy decisions and actions taken in past decades. However, the policies emanating from new decision-making processes will also have a vital role to play in the process of shaping the future. By exploring different future scenarios, today's decision-makers can get a clearer picture of what tomorrow might bring in terms of human and environmental health, and what the impact of their decisions is likely to be. They can determine more accurately what they can do to create a more desirable future. Scenarios do not predict, rather they paint pictures of possible futures and explore the outcomes that might result if basic assumptions are changed. As a way of exploring the unknown, scenario analysis can result in surprising and innovative insights.

The following two forms of scenario analysis are applied.

- Descriptive written narratives (*qualitative scenarios*), exploring relationships and trends for which few or no numerical data are available, including shocks and discontinuities. These can relatively easily incorporate human motivations, values and behaviour, and create images that capture the imagination of those for whom they are intended.
- Tables and figures of numerical data, often generated by computer models (*quantitative scenarios*): providing greater rigour, precision and consistency. Assumptions are explicit and conclusions can be traced back to the assumptions. Statistical uncertainty analysis can be applied by systematically changing assumptions. Order-of-magnitude estimates of past, present and future trends like economic growth or resource use can be provided.

In GEO-3 qualitative narratives take centre stage, with quantitative tools playing a supporting role. A set of four scenarios has been developed, drawing on the experience and work of various scenario and modelling groups, including the Global Scenario Group led by SEI in Boston, and the expert knowledge of other GEO Collaborating Centres. The scenarios are described below.

- The *Markets First* scenario envisages a world in which market-driven developments converge on the currently prevailing values and expectations in industrialized countries;
- In a *Policy First* world, strong actions are undertaken by governments in an attempt to achieve specific social and environmental goals;
- The *Security First* scenario assumes a world full of large disparities, where inequality and conflict, brought about by socio-economic and environmental stresses, prevail;
- *Sustainability First* pictures a world in which a new development paradigm emerges in response to the challenge of sustainability supported by new, more equitable values and institutions.

See the box below for a brief description of these four future scenarios. The GEO-3 scenario material which provided the groundwork for this Europe-specific analysis has developed from global stories into regional dynamics, linkages and impacts. For Europe this involved expert consultations in Budapest (November 2000) and Moscow (summer 2001). It is in particular this regional expansion that advanced the GEO-3 analysis worldwide much further than any of the earlier global scenario work.

The second section describes “the pan-European tale of the four futures” in a predominantly qualitative manner. Section 3 presents a regionally differentiated examination of the environmental implications of the scenarios. The tools used here are:

- the IMAGE model, developed by RIVM;
- GLOBIO, developed by NINA, UNEP-GRID-Arendal, UNEP-DEWA and UNEP-WCMC; and
- the WaterGAP model, developed by CESR of the University of Kassel.

Key subjects, acting as driving forces behind the scenarios, are listed below. These were considered in formulating assumptions and constructing the four scenarios.

- demography,
- economic development,
- human development,
- science and technology,
- governance,
- culture and
- environmental pressure.

Details on input material, assumptions and methodologies applied, and actual results, can be found in Chapter 4 of GEO-3 “Outlook 2002-32” and in the Technical Background Report on GEO-3 Scenario Work (in preparation under the co-ordination of RIVM and UNEP).

Critical areas driving development in the pan-European region are agricultural policy and the relationship between climate, energy and transport/migration. In the following section drivers are described for each of the four GEO-3 scenarios, followed by a section exploring the environmental impacts of the scenarios. An attempt has been made to link these environmental impacts with the six main clusters of threat, as identified in the EU Strategy for Sustainable Development (SDS):

- Climate change caused by emissions of greenhouse gases from human activity
- Potential threats to food safety and public health, for instance from hazardous chemicals
- Pressures on vital natural resources, such as biodiversity, water and soils
- Poverty and social exclusion
- The aging population
- Congestion and pollution from current patterns of mobility

Because GEO reports focus on the environment dimension of sustainability, the scenario analysis relates most closely to the EU SDS clusters on “climate change”, “pressures on natural resources” and “congestion and pollution from transport”. The other EU SDS clusters are certainly relevant in this scenario analysis and were indeed used to shape the general context for the scenarios. However, the actual modelling work did not focus on generating outcomes on them. Looking ahead, the current unsustainable trends (threats) identified in the EU SDS are seen to develop in different

directions in the four futures. Links to the EU SDS clusters are highlighted in Section 3 on environmental impacts of the scenarios in attempt to list the most dominant threats first.

### **BOX Brief general description of the four GEO-3 scenarios**

#### **Markets First**

Most of the world adopts the values and expectations prevailing in today's industrialized countries. The wealth of nations and the optimal play of market forces dominate social and political agendas. Trust is placed in further globalization and liberalization to increase corporate wealth, create new enterprises and livelihoods. In doing so, people and communities can be supported in paying for and insuring themselves against - or pay to fix - social and environmental problems. Ethical investors, citizens and consumer groups try to exercise growing corrective influence but are undermined by economic imperatives. The powers of state officials, planners and lawmakers to regulate society, the economy and the environment continue to be overwhelmed by increasing demands. By 2032, many of the same questions that were posed at the turn of the 21st century remain unanswered.

#### **Policy First**

Firm decisions are taken by governments in an attempt to attain specific social and environmental goals. A co-ordinated pro-environment and anti-poverty drive balances the momentum for economic development at any cost. Environmental and social costs, and gains, are factored into policy measures, regulatory frameworks and planning processes. All of these are reinforced by fiscal levers or incentives such as carbon taxes and tax breaks. International "soft law" treaties and binding instruments affecting the environment and development are integrated into unified blueprints and their status in law is upgraded, while provision is made for open consultation processes to allow for regional and local variants. By 2032, the current forces driving the world in unsustainable directions appear to be coming under control. However, improvements have often been very expensive and improving lifestyles continues to intensify demands for water, food, forest resources and space.

#### **Security First**

This scenario assumes a world of striking disparities, where inequality and conflict prevail. Socio-economic and environmental stresses give rise to waves of protest and counteraction. The more powerful and wealthy groups focus on self-protection, creating enclaves akin to the present day "gated communities". Such islands of advantage provide a degree of enhanced security and economic benefits for dependent communities in their immediate surrounding but exclude the disadvantaged mass of outsiders. Welfare and regulatory services fall into disuse, but market forces continue to operate outside the walls. In an atmosphere of rising social, environmental and economic tension, violence is endemic, leading, among other things, to massive movements of refugees. By 2032, an air of uneasy stability has begun to settle, but forces for further breakdown are ever present. Nonetheless, a better world for all might yet emerge.

#### **Sustainability First**

A new environment and development paradigm emerges in response to the challenge of sustainability, supported by new, more equitable values and institutions. A more visionary state of affairs prevails, with radical shifts in the way people interact with one another and with the world around them. This stimulates and supports sustainable policy measures and accountable corporate behaviour. There is much fuller collaboration between governments, citizens and other stakeholder groups in decision-making on issues of close common concern. A consensus is reached on what needs to be done to satisfy basic needs and realize personal goals without beggaring others or spoiling the outlook for future generations. By 2032, sustainability has not yet been achieved, but the world is moving in the right direction and there is no turning back.



# The four GEO-3 scenarios for pan-Europe

## Introduction

Over the next 30 years the pan-European region is dominated by the development of closer links between its sub-regions. In all four scenarios, the relationships between the countries in the European Union and those outside of it, notably the Russian Federation, are significant in determining, among other things, the state of the environment. The differences in the evolution of such bodies as the European Environment Agency, which is likely to become much stronger in a world of *Policy First* or *Sustainability First*, also play a role.

A significant expansion of the EU features in both the Markets First and Policy First scenarios, with a number of countries being added in waves of accession. In a Security First world only a few more countries are admitted into the Union, and persistent tensions related to taxes, subsidies, immigration, freedom of movement and other issues slow the integration process. In a Sustainability First world the growth of the EU takes on a very different form. It proceeds with true deference paid to maintaining and improving relationships with the Russian Federation.

In a Markets First and Policy First scenario economic interdependence between nations continues to grow, along with widespread adoption of the euro and harmonization of financial systems. Political union proceeds more slowly, as countries prove less willing to forego their sovereignty in other areas. For example, there are differences over taxation or the pace at which social safety nets should be cut back. In a Security First world serious disagreements linger on between countries that wish to move towards much greater integration and others that prefer a looser European Union. Meanwhile, countries in Eastern Europe and Central Asia generally make little economic progress in this world filled with severe tensions and internal conflicts. Integration and collaboration develops most strongly in a Sustainability First world. In Western Europe the notion that the prevailing market-oriented wisdom is insufficient and undesirable gains more and more support. In Eastern Europe there is a move away from reliance on exported raw materials towards producing more local added value.

A Markets First world shows a general shift in governance away from the nation states. Europe drafts regional conventions that deal primarily with transboundary pollutants and the burdensome environmental legacy of the Former Soviet Union (long-range transboundary air pollution west of the Urals decreases sharply). In a Policy First world the stage is set for ambitious, comprehensive and successful policy reform in energy, governance (especially in relation to EU enlargement), agriculture, transport and the preservation of natural areas. In a Security First scenario local interest replaces vision; differences in terms of prosperity and governance remain too large for too long. The environmental situation is serious. In a Sustainability First world the achievements of the Policy First scenario are followed by even larger successes in terms of the environment. Major efforts, for instance, in the whole region, are made to establish large-scale networks of protected areas and green corridors. Regions like the Arctic are increasingly recognized as being part of a common global heritage.

## The pan-European scenarios

### Markets First

A Markets First scenario is characterized by the continuing processes of liberalization, privatization and globalization. Despite occasional political disagreement and resistance, the European Community develops into a strong, competitive economic bloc; Central Europe and, later, countries of Eastern Europe and Central Asia gradually join in. Technological and business innovations spread quickly, both within the region and between the region and the rest of the globe. Europe remains an important player in an increasingly competitive world economy.

Immigration into Western Europe and parts of Central Europe, as well as internal migration in the Russian Federation, partially make up for the shortages in the workforce. At the same time, the size and partial illegal character of the immigration cause difficulties.

Above all, the period up to 2030 is characterized by a combination of much stronger links within the region. The changes are most pronounced -almost unprecedented in modern history - in the first half of the scenario period, as the integration within the European Union speeds up and a steady flow of countries develop institutional ties through the European Union. By global comparison, the European region continues to take a special place in regional institution-building. In the environmental domain, this combines existing mechanisms, for example, in the framework of regional conventions, along with new features developed during the dynamic first half of the scenario period. An example of the latter is the current expansion of the European Environment Agency to include virtually all Central European countries irrespective of their membership status in relation to the European Union.

Agricultural land use increases in Western Europe as a consequence of this sub-region remaining a major exporter of temperate cereals and due to its increasing production of biofuels. The most intensive forms of agriculture in Western Europe disappear. Consequently, the characteristic large imports of fodder are replaced by imports of meat, largely from Latin America. In Central Europe the agricultural area decreases slowly due to demand levelling off and eventual subsidy reforms (decreasing areas for crops and grazing), even though biofuels become more important. In contrast, the agricultural area South-East of the EU expands. In Eastern Europe and Central Asia a slow shift occurs in the scenario period from grazing-dependent livestock to reliance on concentrates; this leads to a small increase in agricultural area.

The agricultural sector in Central Europe, especially in Poland and the Baltic States is restructured. It also becomes more high-tech-oriented and finds its place in the expanded EU market. The restructuring takes its toll on traditional landscapes in these parts of the region. In Eastern Europe and Central Asia, land ownership is increasingly private and land management accordingly varied. In the south of the Russian Federation, water- and pesticide-intensive practices persist for a long time. Eventually, agriculture becomes more water-efficient here too and inefficient sites are finally abandoned.

Transport, both of passengers and of freight, increases very sharply, reflecting a combination of global trends, growth in disposable incomes and region-specific factors such as the expansion of EU membership. Frequency and the average distance per trip increase, both for passengers and freight.



In terms of environmental problems (air pollution, noise, airport safety), advances in transport technology are clearly outpaced by the growth in volume. Volume increases for 1995-2030 are projected to be by a factor of two, six and almost six in Western, Central Europe and Eastern Europe plus Central Asia, respectively.

Long-range transboundary air pollution decreases very sharply west of the Urals, following the ambitious 2000 Gothenburg Protocol. Summer smog remains a problem in north-western Europe – partly because of a persistent background of long-range pollution in the whole northern hemisphere. Air pollution in cities decreases as well in all three sub-regions, but sizeable numbers of urban inhabitants remain exposed to pollution levels exceeding health guidelines. Nevertheless, halfway through the scenario period exposure exceeding the guidelines has decreased from two-thirds to one-third of the urban population in Western Europe, and from about 90 to 50 per cent in Central Europe and Eastern Europe, and Central Asia.

Pollution and degradation inherited by Central Europe and Eastern Europe, and Central Asia, is only partially cleared up or contained as a function of budget priorities. Consequently, some pollution spreads and occasionally a “chemical time bomb” goes off. In other words, environmental hazards remain large and unevenly spread.

Under this scenario, tourism exercises an ever-increasing pressure on coastal zones throughout the region, leading to an increase of local environmental problems such as salinization. In addition, second homes exercise a considerable footprint in some areas, for instance, around the Baltic Sea. Especially in Eastern Europe and Central Asia coastal zones are increasingly left to local authorities to manage, with somewhat unpredictable outcomes.

Energy prices remain rather low, as the oil and gas supply available from low-cost producing regions is abundant – Eastern Europe and Central Asia becoming a major oil and gas exporter to Western and Central Europe. Yet, autonomous trends and strategic concerns still lead to rising energy productivity, especially in industry. All in all, the greenhouse gas emissions of all three sub-regions continue to grow up to 2030, with the demand for energy services outweighing gains in energy efficiency and low-carbon energy sources. By 2016, the 2008-2012 Kyoto target has still not been met by Western Europe and practically not met by Central Europe. Eastern Europe and Central Asia do reach the Kyoto target – the width of the margin depending on trade in emission credits.

## **Policy First**

Alternatively, climate policies and EU enlargement set the stage for ambitious and comprehensive policy reform, starting in the early 2000s. In particular, the large co-benefits between climate policy and other environmental policies prove convincing. Moreover, trade in emission reductions conveniently directs funding towards further economic restructuring and renewal of capital stocks in Eastern Europe and Central Asia. In addition, stakeholders whose interests will be at risk from climate change are becoming a political factor.

Building on this, government and business policies become increasingly ambitious and confident in introducing better technology and better management in pursuit of broad social and specific environmental targets in the various parts of the region. Within this broad and interconnected

development, targets for the climate-energy-transport nexus are the most ambitious and thus dominate policies.

After a series of crises in intensive and government-sponsored agriculture in the EU during the early 2000s, and concomitant with EU enlargement, sustainable agriculture practices in the form of integrated management techniques and selective application of biotechnology gradually penetrate the agricultural sector. In economic terms, countries in Central and Eastern Europe and Central Asia benefit most through the opening up of markets and technology transfer. As under Markets First, agricultural land taken out of production in Western and Central Europe is typically assigned a “nature” function. However, this will only constitute a significant reparation of the region’s biodiversity value long after 2032. In Eastern Europe and Central Asia, the effect of government policies on natural habitat decreases, with population dynamics and developments in ownership status remaining as determining factors in many places.

For reasons of habitat protection, carbon sequestration and consumer pressure, logging of primary forests is restricted to sustainable practices. Eventually, most wood throughout the region is produced from plantations according to Scandinavian practices. To safeguard biodiversity large forested areas are converted into conservation areas.

In Western Europe and parts of Central Europe, the Water Framework Directive is fully implemented, as well as the agreements on regional seas. In the rest of the pan-European region, EU-style water management becomes the standard, including application of zoning.

Coastal zones in Western Europe are acquired by the government to give them full protection status. In Eastern Europe and Central Asia, basic legislation on coastal zone protection is established and zoning plans are revitalized.

The overriding aim in climate policies and the energy system is to realize equal global per capita emissions of greenhouse gases globally by 2050, stabilizing concentrations at approximately 450 ppmv carbon dioxide and 550 ppmv carbon dioxide equivalents for all six gases of the Kyoto Protocol. A key element is the careful integration of energy/climate measures in policies for industrial renewal, for growth of and change in transport systems and for an ambitious decrease in air pollution. In fact, the policy packages evolve over time and differ sharply according to sub-region. The share of natural gas, a convenient and relatively climate-friendly fuel for which Eastern Europe and Central Asia are the major suppliers, is increased in the fuel market even further. However, with the exception of the transport system, a large-scale transition to carbon-free energy systems does not occur anywhere in the region.

Management measures in the transport system are targeted at eliminating the exposure of the urban population to air pollution and summer smog levels exceeding WHO guidelines by 2030. Typically, that requires cutting back emissions by 80-90 per cent in Western and Central Europe –eventually also in the more densely populated areas of Eastern Europe and Central Asia. On the basis of detailed work for OECD, a typical strategy geared to achieving the targeted cutback in emissions is described below.

Technical measures and measures aimed at decreasing mobility are combined for a cost-optimal approach. A trend breach in both technological development and behaviour is successfully pursued: technological change in the scenario period is much greater than in the past, mobility patterns show

a great change (i.e. shorter distances and less reliance on road transport). Patterns in freight transport change, i.e. fewer goods transported, shorter distances, less reliance on road transport.

A radical change takes place with respect to speed and type of policy instruments applied in order to realize the large improvements necessary. Measures are taken and new instruments developed in the short term. Their timely implementation does mean a radical change compared to the current policy life cycle. Pricing instruments, regulations, land-use instruments, infrastructure policy instruments for education and information, and instruments outside the transport sector are all mobilized for support or facilitation and to increase social, political and economic feasibility.

## **Security First**

Alternatively, in a Security First scenario, differences within a pan-European context in terms of prosperity and governance remain too large and last too long. Stop-and-go movements towards convergence eventually give way to renewed polarization and a climate of uncertainty. The transition fails. In particular, the enlargement of the EU proves to be too complex an undertaking. As local interest replaces vision, the process loses momentum. Negotiations continue for another decade, but effectively the process stops after the first cohort of countries has entered.

In Eastern Europe and parts of Central Europe, rural to urban migration keeps increasing over the course of the scenario period, driven by differences in prosperity. Within the Russian Federation, the demographic distribution becomes even more uneven than it was in 2000. In fact, the population decreases in most sub-regions of Europe through a combination of decreasing birth rates and internal migration.

Notwithstanding the aging population, immigration within and into the region is met only by reactive policies. These are unsuccessful on all aspects, including the avoidance of tensions. In a climate of stagnation and continued high unemployment as well as pension crises, uncertainty and a widening gap between haves and have-nots become important – the most extreme forms outside the EU. Trans-national crime, corruption and violent nationalism blossom and spread, unsolvable for many individual pan-European nation states in different parts of the continent. A siege-mentality gradually develops among law-abiding citizens.

In East and West alike, the trajectory of economic development is influenced by high uncertainty and a host of other negative factors including trade barriers. Complex EU regulations, designed to achieve collective social, economic and environmental goals, discourage business innovations. Subsidies to newer and poorer members keep taxes high. All of these factors, added to the growing burden of (old- age) pensioners and the need to support a large number of unemployed, hamper economic growth.

As the EU resorts to tariffs again to protect its market, trade conflicts increasingly sour the relationship between the EU and the USA. In addition, climate change becomes an even more important reason for conflict in the second half of the period, as political pressure builds up for the EU to compensate for the loss of jobs and cost of adaptation in the agricultural and service sectors in the southern EU countries. Eventually, EU agricultural subsidies are restored to the same level as in the early 1990s under the denominator of adaptation to climate change.

In fact, agriculture in the region returns to being highly subsidized and as a consequence is re-intensified. In Eastern Europe and Central Asia, subsidies are geared not only to adapting to climate change, but also to the “rebirth” of large-scale agrarian enterprises and the accompanying infrastructure. However, the aspiration to increase domestic food production is confronted with many problems, including continued soil erosion and huge water losses in distribution systems, making agriculture more water-intensive. This is the reason for the slow progress in the “rebirth” of large-scale agrarian enterprises.

Strengthening of the trade barriers by the EU and an aging population result in slow economic growth in some Central and Eastern European, and Central Asian countries. This not only keeps unemployment levels high but because the diffusion of resource-efficient technologies has slowed down enormously since the early 2000s; it also contributes to a continued large consumption of natural resources and environmental degradation.

Sea-level rise, changing river flow patterns (from snow-fed to rain-fed) and severe storms cause heavy damage and staggering financial costs. More ice-free periods in the north and a wave of privatization, extending to the control of natural resources, result in a burst of resource exploitation in the arctic parts of the Russian Federation and the Nordic countries.

The environmental pressures from transport are a case in point. Transport volumes grow relatively moderately, albeit more dynamically in Central and Eastern Europe, and Central Asia, than in Western Europe. However, environmental pressures from transport increase substantially, in particular, in Central and Eastern Europe, and Central Asia. This is a result of growth in car ownership, a shift in favour of freight transport by road, some decrease in the share of public transport and a relatively slow penetration of cleaner transport technology.

Although water withdrawals stabilize, some river basins remain in a high-stress category, with sharp competition among industrial, domestic and some agricultural users. Typically, water-stress situations and pollution are met with a blame-your-neighbour attitude, especially for transboundary basins. Increasing water pollution also worsens conflicts between upstream and downstream regions in Russia. This is exacerbated by the lack of conflict resolution measures and institutions.

Coastal zones in Western Europe see a continuation of industrial and tourist-industry development, airport construction and the like. In Central Europe, coastal zones remain by and large as they are in 2000. In Eastern Europe and Central Asia, coastal zones are re-militarized (meaning restricted access) but also used for new port development. On balance, pressures remain at approximately the same level as in 2000.

As the fortress world develops, investment in technology development is increasingly driven by the wish to be less dependent on key resources from other elsewhere. In some areas, this generates extra large improvements in resource efficiency, such as in the energy sector in Western and Central Europe. However, benefits for environment and safety are essentially spin-offs from strategies aimed at reducing interdependence. That does not mean that some of these environmental spin-offs cannot be surprisingly large, such as the application of thermal hardening to produce wood from temperate origin with durability characteristics of tropical hardwoods. This virtually eliminates all European import of the latter. But generally, environment and safety are no priorities in technology development, as exemplified by the continuing problems with aging nuclear plants and waste in Eastern Europe and Central Asia.

Seen against the background of these priorities, terrestrial biodiversity and natural landscapes throughout the region are therefore degraded due to the combined power of agricultural re-intensification, land-intensive settlement patterns, transport growth, oil and gas extraction and climate change.

## **Sustainability First**

Conversely, under the Sustainability First scenario, the achievements of the Policy First scenario are followed by even larger successes in terms of the environment. This builds on an “inclusive” rather than “exclusive” European spirit, and firm arrangements between the EU and Russia, for example. Here, one assumes creative and effective migration policies in West and East. For example, in Eastern Europe, the large influx of often well-educated urban immigrants from Central Asia is considered an opportunity to boost life in provincial towns.

The “greening of business” experiences an unexpected boom as business and government leaders support eco-efficiency initiatives to de-couple pollutant release and resource use from economic activity. Capital markets become better informed about environmental performance and respond negatively to adverse environmental incidents of firms.

Economic production is increasingly service-oriented: health and child care, public transport, local repair facilities and new education and entertainment services maintain or expand their roles. Europe’s demographic pattern changes as people put more value on children and leisure. The value pendulum slowly shifts away from the 1990 values – competition, consumerism, individualism, materialism – as people perceive the side-effects of unbridled market forces or search for more rewarding and meaningful lives with more emphasis on such aspects as the arts and relationships.

Governments, businesses and the general public are genuinely concerned about the threat of social unrest, conflict and environmental issues. The subsidiarity principle is a guiding light in the difficult and sometimes tedious negotiations between different regions, involving trade-offs between the different aspects of sustainable development. The expanding bureaucracy is seen as a necessary evil in managing a densely populated region. Information technology is constantly challenged to keep decision-making transparent. Internet becomes the medium par excellence.

To solve environmental and congestion problems, there is an active policy to invest in subways in large cities and cycle lanes on roads, etc. Gradually, plans are formulated and implemented to build a pan-European infrastructure of fast intercity trains with excellent local connections, and freight transport by rail and via underground pipelines. One rationale for this is to internalize costs. Air traffic is mainly intercontinental. The private car remains the dominant transport mode as cleaner, more efficient cars enter the market as a consequence of agreements with major manufacturers.

The leading consumer trend is away from a high-meat diet, reflecting growing awareness of risks and appreciation of health. Organic food and supplements become standard. Sustainable agriculture practices in the form of integrated management techniques and selective application of biotechnology gradually penetrate, with Central and Eastern Europe benefiting most from the opening up of markets and technology transfer. Although most governments opt for some degree of (regional) food self-sufficiency, food trade is large and takes place in a safe world. In some regions

various forms of land use (agriculture, second homes, natural parks, tourism) become more integrated but generally there is increasing specialization.

Logging of primary forests is restricted to sustainable practices; most wood is produced from plantations according to Scandinavian practices. In some parts of Europe, production of commercial biofuels becomes big business. Large forested areas are converted into conservation areas to safeguard biodiversity. Human settlements are controlled by promoting compact cities and major transport/communication corridors based on improvement of current infrastructure, rather than extension.

The energy and material intensity of economic output declines significantly (“dematerialization”), especially in Central Europe and in most of Eastern Europe and Central Asia because of the transition to a service and information economy, changes in values and lifestyles, technological leapfrogging etc. Tele-working, Internet-oriented education and info/entertainment, more efficient hybrid and fuel-cell based electric cars and public-transport oriented travelling all contribute to this decoupling. Nanotechnologies become a spearhead in Research and Development, sparking off a revolution based on development of new materials and an ever-decreasing use of materials per function. The 10-15 materials which make up 80 per cent of industrial energy demand are produced ever more energy efficient. European firms gain a competitive edge in global materials recycling as national governments enforce intra-regional waste management laws and guarantee decent profitability.

Gradually, provision of energy services becomes a key factor in the energy systems throughout the region, inducing waves of efficiency improvements. Increasing energy prices, reflecting environmental awareness and regulation as well as physical and political scarcity, consolidate this trend, in particular in the EU. Coal is phased out in almost all sectors. Fuels and energy-intensive materials are increasingly replaced by or derived from renewable sources.

The interest in and funding of solar energy research and investments rapidly increases as it becomes evident to multinational firms and to governments that their case is sufficiently strong in economic terms, even if global environmental concerns turn out to be less serious than many people think. In combination with further penetration of co-generation and rapid development of transmission and distribution technology, a European Vision for “Green” Power, based on decentralized options, starts to materialize.

Water quantity problems in Eastern Europe and Central Asia are gradually addressed through the use of efficient irrigation systems and installation of adequate supply lines, so that unproductive losses of water are reduced to a minimum. In Western and Central Europe, the EU Water Framework Directive keeps its guiding role, albeit with a large degree of variation between drainage basins, depending on local context. In Western and Central Europe, integrated coastal zone management schemes are applied, increasingly on the basis of voluntary partnerships and participatory arrangements.

Human health significantly improves, particularly in Eastern Europe and Central Asia, due to improvement of drinking-water quality and sanitation facilities. A marked decrease in respiratory diseases is also achieved, thanks to improved air quality resulting from efficient use of energy.



Initiatives such as the current EU Natura 2000 help improve biodiversity management in Western and Central Europe. Pan-European networks of protected areas and green corridors are among the new initiatives launched to effectively protect biodiversity. Former agricultural land is rehabilitated into additional habitats for wildlife in Western Europe and parts of Central Europe. However, it takes until well after the scenario period for biodiversity in these areas to recover. In Central and Eastern Europe, and Central Asia, biodiversity regulations are applied to all existing areas of relatively untouched or slightly spoilt landscapes. On balance, by 2032 natural habitat and historical landscapes are not too different from what they were in 2002.

## Environmental impacts

### Impacts on energy-related sulphur dioxide emissions

Links with EU SDS clusters:

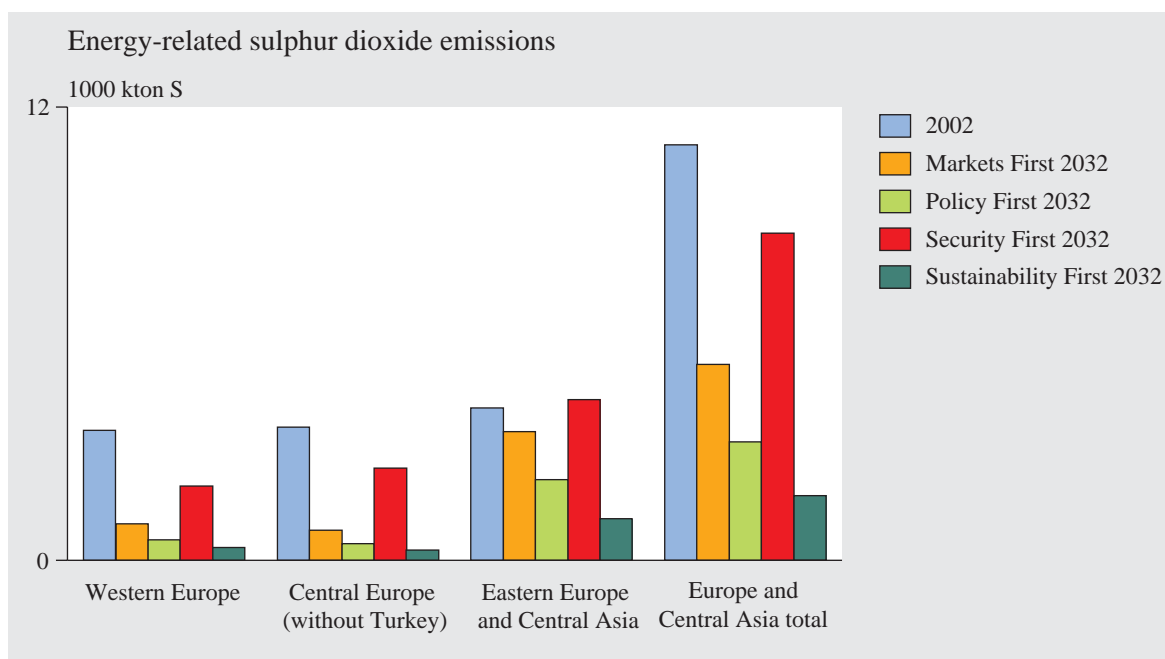
- Congestion and pollution from current patterns of mobility
- Climate change caused by emissions of greenhouse gases from human activity
- Potential threats to food safety and public health, for instance, from hazardous chemicals

Europe's scope in addressing issues of large-scale air pollution and greenhouse gas emissions depends heavily on developments in energy use and transportation. Whereas top-priority, ambitious policies to improve public transportation and energy efficiency can be expected in most sub-regions in *Policy First* and *Sustainability First* worlds, these advances are unlikely in *Security First* or even *Markets First* circumstances. In the *Markets First* case, some economic policies, such as road and carbon taxes, are likely and technological developments will continue to improve energy use per unit of activity. Growth in volume of travel, both for passengers and freight, and economic activity in general is, however, expected to outweigh per unit improvements in response to these policies in most sub-regions. In a *Security First* situation, lack of economic development, especially in Eastern Europe and Central Asia, restrains energy use in general. However, from a security point of view, pursuing the aim of self-support in energy supply will increase the use of coal. These changes in energy use, along with shifts in fuel use, are reflected in sulphur dioxide and carbon dioxide emissions.

Differences in sulphur dioxide emissions between the scenarios and between Western and Central Europe, on the one hand, and Eastern Europe and Central Asia on the other, are large (see Figure - "Energy-related sulphur dioxide emissions").

Although Europe by 2002 still falls under the larger emitters of sulphur dioxide, emissions in the region are falling sharply due to the existing emission reduction policies under the umbrella of the 1999 UN-ECE Gothenburg Protocol. In Western and Central Europe emissions will continue to fall sharply, with the Gothenburg Protocol aiming at considerable reductions by 2010. In Eastern Europe and Central Asia reductions are less pronounced, and mainly due to inherited industrial problems that will take much time (and money) to resolve. The trends will be continued after 2010 in all scenarios and most sub-regions, although clearly less intense in a *Security First* world. Under *Security First* the reduction trend is even nullified in Eastern Europe and Central Asia due to slow economic growth and increased use of coal.

Decreases of sulphur dioxide emissions form a classic example of pollution abatement that is in close conformance with policy measures. Measures such as fuel-switching or desulfurization are typically large-scale and have an all-or-nothing character. However, switching from air pollution to climate change, it should be noted that sharp decreases in sulphur emissions lead to a reduced regional cooling effect. Therefore careful co-ordination with climate policies will be needed, especially in the next decades.



*Emission factors applied to energy consumption and production for nine energy sectors and five energy carriers.*

Source: RIVM

## Impacts on energy-related carbon dioxide emissions

Links with EU SDS clusters:

- Climate change caused by emissions of greenhouse gases from human activity
- Congestion and pollution from current patterns of mobility
- Pressures on vital natural resources, such as biodiversity, water and soils

The changes in energy use, along with shifts in fuel use, are also clearly reflected in carbon dioxide emissions. However, where sulphur dioxide emissions continue to decrease in most regions for all scenarios, carbon dioxide emissions will continue to increase for many years due to strong existing policy (see Figure—“Energy-related sulfur dioxide emissions”). The shorter-term target of the Kyoto Protocol may be met in Europe in *Policy First* and *Sustainability First*, but not in the *Markets First* or *Security First* scenarios. Again, there are some striking differences between scenarios and sub-regions. For all scenarios, emission increases are larger in Central and Eastern Europe, and Central Asia, than in Western Europe, a pattern linked to larger relative growth in energy consumption resulting from growing economic activity in the currently lower income sub-regions.

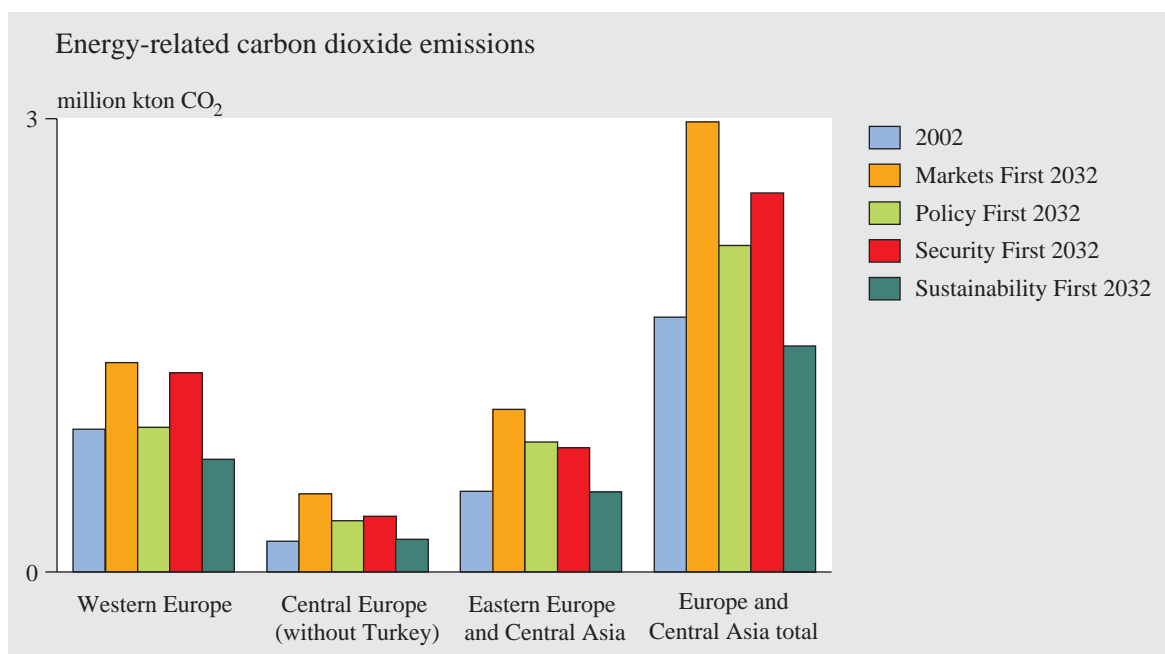
The growth in emissions in the next 30 years is most significant in all sub-regions in *Markets First*, mainly due to the increase in energy use, with transport contributing the major share. Technological advances can not reverse this trend, which is further reinforced after 2032.

In the *Security First* scenario levels of emission increase in all sub-regions when compared to 2002. In Western Europe investment in technological development is increasingly driven by the wish to be less dependent on key resources from elsewhere; environment and safety are not a priority and emission levels compare to the still large emission increase of *Markets First*. In Central and Eastern

Europe and Central Asia economic difficulties (lower energy use) result in much lower emission increases than in *Markets First* and in levels that are even comparable with *Policy First*.

In 2032 Western Europe *Policy First* already shows an emission level comparable to 2002. In Central and Eastern Europe, and Central Asia, levels of emission still increase, despite more proactive policy action prompting improved energy use and a switch to non-carbon fuels.

In a *Sustainability First* situation, sharp policy on efficiency improvement, replacement of coal by renewables, nuclear energy and biofuels, and changes in lifestyles (including the willingness of more people to shift to public transport) brings about a significant emission reduction in Western Europe and levels comparable to 2002 in the other sub-regions. These trends herald a turning point in the battle against human-induced climate change and mark the long-awaited de-coupling of carbon dioxide emissions and energy consumption.



*Emission factors applied to energy consumption and production for nine energy sectors and five energy carriers.*

Source: RIVM

## Land area impacted by infrastructure expansion

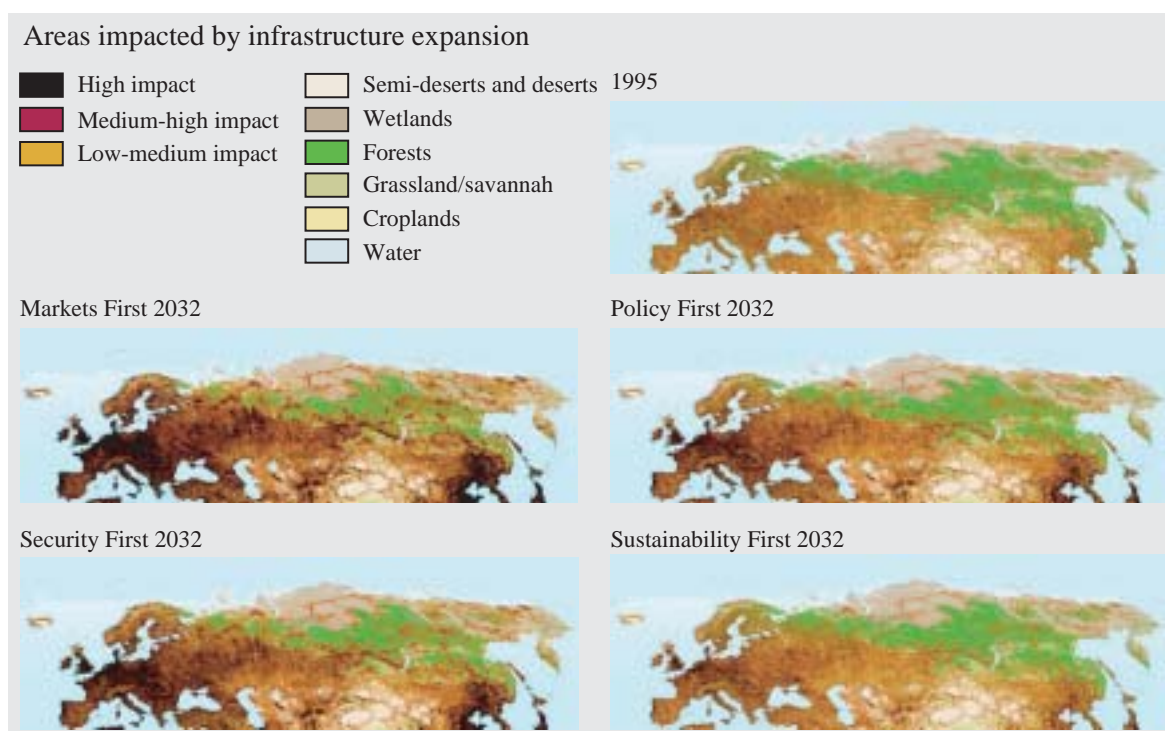
Links with EU SDS clusters:

- Congestion and pollution from current patterns of mobility
- Pressures on vital natural resources, such as biodiversity, water and soils
- Aging population

Land-use change in the pan-European region is affected by spatial planning in development and transportation policies, the evolution of agricultural policy, including changes in agricultural trade regimes, and the reform of the Common Agricultural Policy. Furthermore, land-use change is also

affected by population trends (such as aging) and economic trends (such as increased oil, gas and mineral extraction). Continued development of roads and other human-induced activities will lead to the extension of infrastructure throughout the region in all scenarios. Even so, careful policies can help to lessen the effect of this expansion. Management policies can be introduced, such as restrictions on the siting of (industrial) infrastructure, improving public transportation, stimulating lifestyle changes, thereby changing passenger attitudes and mobility patterns (i.e. fewer goods and passenger transport over shorter distances and less reliance on roads).

In *Security First* transport grows relatively moderately, albeit more dynamically in Central and Eastern Europe and Central Asia than in Western Europe. Nonetheless pressures on land from expanding infrastructure increase substantially, in particular in Central and Eastern Europe, and Central Asia, as a result of growth in car ownership, a shift in favour of freight transport by road, some decrease in public transport and slow progress in transport technology.



*Pressure on and loss of habitat can be projected as a function of distance to infrastructure under the following assumptions: infrastructure expands away from existing infrastructure; development of additional infrastructure will continue at a certain rate depending on the scenario; relatively high growth rates will occur in areas with a high current population density, known oil, gas and mineral resources, and/or in coastal areas.*

Source: GLOBIO

In *Markets First*, transport volume and related infrastructure clearly increase in Western and Central Europe, and even very sharply in Eastern Europe and Central Asia. Increases concern both passengers and freight and both frequency and average distance per trip. These increases reflect a combination of global trends (such as more trade), growth in disposable incomes (more leisure and tourist travel, second homes, etc. ) and region-specific factors such as the expansion of the EU membership. Advances in transport technology are clearly outpaced by growth in volume.

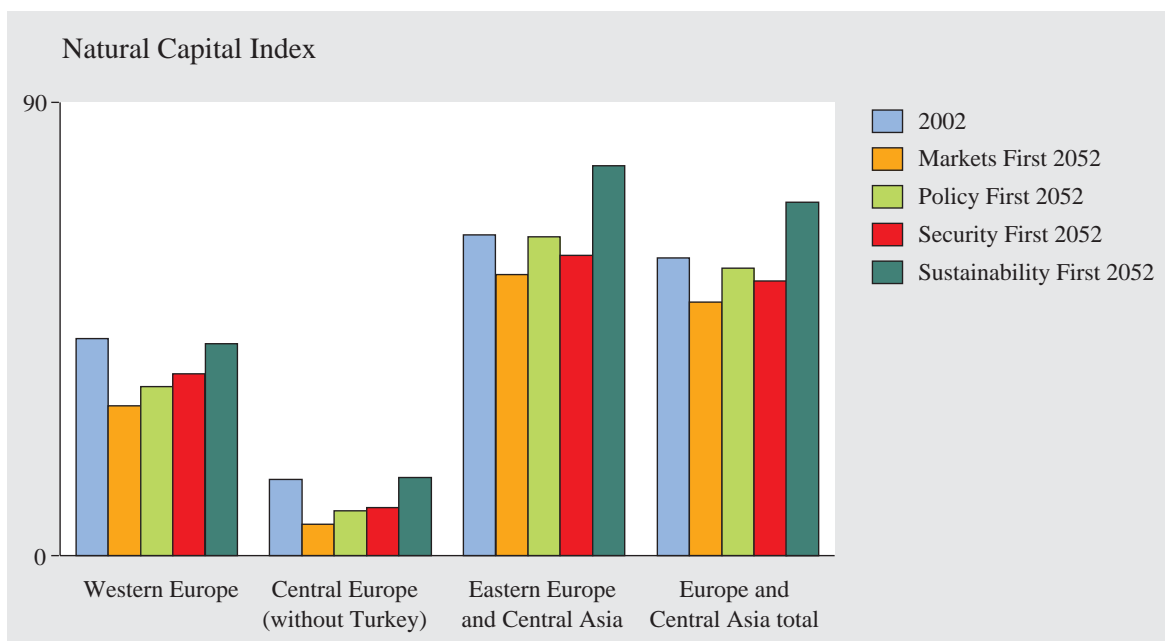
The potential of policy reforms is most evident in Eastern Europe and Central Asia, where the increase in land impacted by infrastructure expansion is very clearly lower in *Policy First* and *Sustainability First* situations. But also in Western Europe increases are more modest under *Policy First* and *Sustainability First* due to ambitious transport policies and changes in attitude. In general, limiting the damage in the entire region will require *Sustainability First* conditions.

## Impacts on terrestrial biodiversity

Links with EU SDS clusters:

- Pressures on vital natural resources, such as biodiversity, water and soils
- Congestion and pollution from current patterns of mobility
- Climate change caused by emissions of greenhouse gases from human activity

Rising pressures in terms of increased consumption, emissions and exploitation of natural resources result in more and more conversion of natural areas into domesticated land (reduced quantity) and in more and more disturbance in still relatively natural areas (reduced quality). A Natural Capital Index (NCI) was developed to assess combined changes in ecosystem quality and quantity, providing a crude indication of the state of biodiversity or natural ecosystems.



A *Natural Capital Index (NCI)* of 100 % indicates a situation where the total area under consideration is undomesticated and the pressures do not exceed minimum thresholds. A NCI lower than 100 % indicates a certain habitat and/or biodiversity loss. The time horizon for this variable has been extended to 2052, as differences between the scenarios become more pronounced by that time. The aggregates shown are based on IMAGE output on a spatial grid of  $1/2 \times 1/2$  degree longitude x latitude.

Source: RIVM



Overall, differences between the scenarios are small, owing to the delayed effect of climate changes initiated in foregoing decades and to the fact that much (semi-)natural area in the region has already disappeared or is already heavily affected. Furthermore, biodiversity in cold and temperate natural areas is already relatively modest. Trends become more pronounced by 2052, explaining why the scenario period in the graph has been extended for this variable.

Differences between sub-regions are more significant. On average, current nature quality is moderate in Western Europe, lower in Central Europe and fairly high in Eastern Europe and Central Asia. Future biodiversity *losses* are clearly the largest in Central Europe for all scenarios.

In Central and Eastern Europe, and Central Asia, biodiversity will be most reduced in a *Market First* world, followed by *Policy First*, going on to *Security First* and, finally, *Sustainability First*. In Western Europe the picture is more complex. By 2032 lost habitat in a *Sustainability First* world will only be somewhat restored in Eastern Europe and Central Asia.

Clearly, present-day initiatives such as the pan-European networks of protected areas and green corridors mainly take effect in a *Sustainability First* world and possibly in *Policy First*. Effective action to rehabilitate former agricultural land as additional habitats for wildlife also plays an important role, as reflected in the somewhat better results in *Sustainability First*.

A continuation of current trends will not only impact biodiversity negatively in the directly foreseeable future, but also limit possibilities to effectively restore biodiversity in the long-term. Unfortunately, policies and actions taken now do not have an immediate effect. Often, the desired results only become apparent in the long term.

## Impacts on natural forest excluding re-growth

Links with EU SDS clusters:

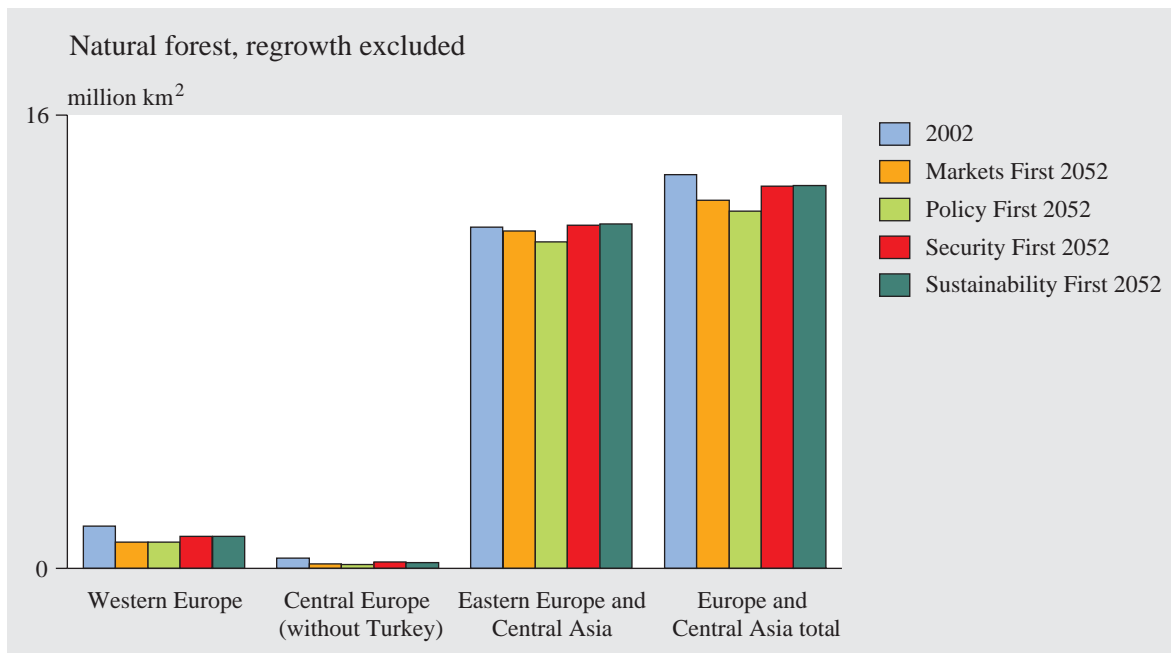
- Pressures on vital natural resources, such as biodiversity, water and soils
- Congestion and pollution from current patterns of mobility
- Climate change caused by emissions of greenhouse gases from human activity

Western and Central European forests show highly comparable developments under the four scenarios: decreases in mature forest area in varying degrees depending on the scenario. The largest mature forest area is clearly found in Eastern Europe and Central Asia; decreases in and differences among the four future situations can be ignored. Note, however, that although the mature forested area will be maintained in north-eastern Europe, it is not the most valuable forest from a biodiversity point of view, for instance, in comparison to tropical forests). Besides, differences will become more pronounced in the long term.

The mature forested area in *Markets First* decreases. However, due to technological advances in agricultural efficiency and efforts of government and business to protect forests, the need to convert forests into agricultural land from 2020 onwards is even less than in *Policy First*. Economic forces, such as rising prices of timber and other forest products, slow down decreases in forested area. Economic instruments introduced to improve conservation reinforce this trend.

The trend in *Policy First* is less positive than in *Markets First* due, for example, to carbon taxes and investments in non-fossil-fuel energy sources, which result in increased use of biomass as energy source. Although this is good environmental practice from a pollution and climate-change point of view, it does have adverse effects on the forested area since modern, large-scale cultivation of biofuels puts upward pressure on the demand for arable land.

In *Sustainability First*, the behaviour of consumers changes in favour of natural forests. There will be government policies to protect natural forests and their biodiversity, as well as local initiatives like community-based natural resource management programmes. This is why the decrease in mature forested area is slow.



*Natural forest is defined as the area of mature forest (excluding plantations) that has not been harvested using clear cutting for at least a 100 years (the minimum time considered necessary for forest re-growth to regain its ecologically value). So, even though the forested area will increase in certain scenarios due to re-growth after clear cutting or after abandonment of agricultural land, the scenario period is not long enough for such re-growth to sufficiently restore biodiversity values). The time horizon for this variable has been extended to 2052, as differences between the scenarios become more pronounced by that time. The aggregates shown are based on IMAGE output on a spatial grid of  $1/2 \times 1/2$  degree longitude x latitude.*

Source: RIVM

In *Security First* we see the smallest decrease in mature forest area in Western Europe. This is due to a slower pace of increasing demand on the world food market, slower growth in per capita income, resulting in slower growth in regional demand for wood, and less use of biofuels. The result is thus a correspondingly smaller increase in crop area. In Central Europe forested land conversion is also smaller, but is driven by less clear cutting for timber (not considering re-growth).

## Impacts on the extent of the area where the risk of water erosion of soils is large

Links with EU SDS clusters:

- Pressures on vital natural resources, such as biodiversity, water and soils
- Climate change caused by emissions of greenhouse gases from human activity

Overall, changes in areas where the risk of water erosion of soils is large are clear within a 30-year period. Especially mountainous areas are at risk, with a consequent downstream sedimentation and flooding risk. Only in Central Europe does the area of risk decrease slightly, mainly due to gains in agricultural efficiency larger than in other sub-regions. In Eastern Europe and Central Asia agricultural land makes up only a tiny fraction of the total area, explaining why changes in absolute terms are marginal.

By global comparison, differences between scenarios are small in the pan-European region. Changes are driven mainly by expansion of cultivated areas for (i) food (to meet demands for changing diets) and/or (ii) large-scale biofuel production. Although, the production of biofuels itself is not regarded as high risk in terms of water erosion, increased biofuel production still translates indirectly into *some* more agricultural land with a high risk of water erosion.

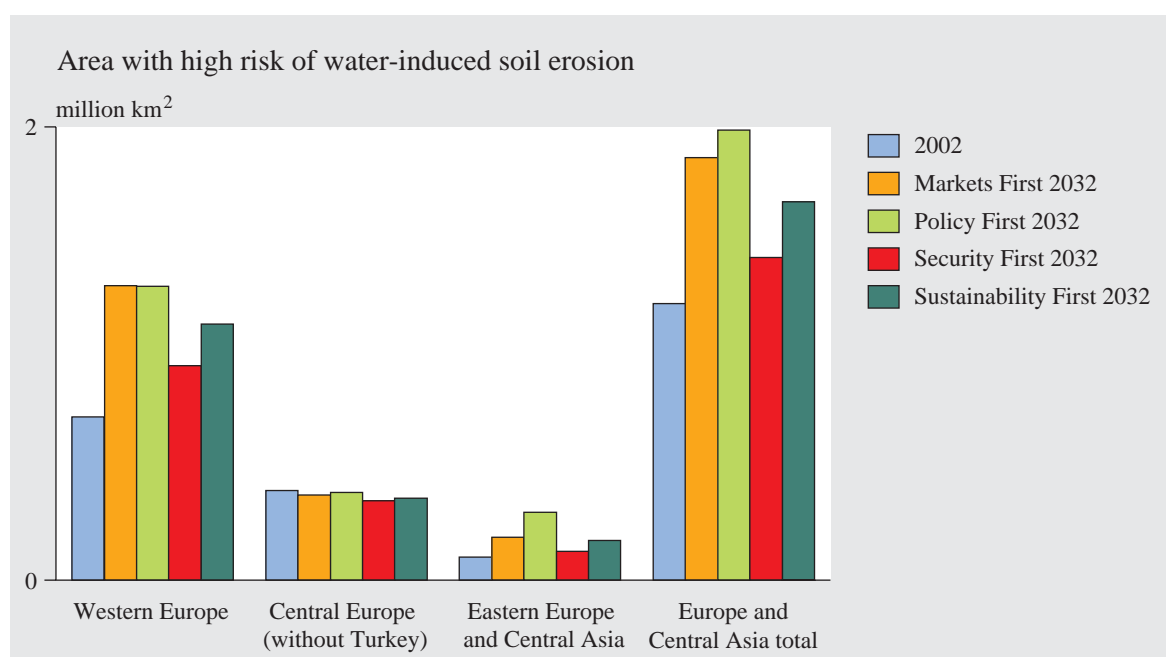
In the coming 30 years effects of climate change are more or less the same for all scenarios because the changes result from emissions in past decades. In a *Policy First* and *Sustainability First* situation this implies somewhat higher increases in risk area than might be expected. Differences become clearer in the longer term.

In *Markets First* economic growth and lifestyles in Western Europe result, for example, in dietary changes (more meat). Despite the improvement in land-use efficiency through agricultural technology and the decrease in grazing land, more agricultural land is required for feed and fodder crops, for biofuels and for cereal production for export. In Central Europe *Markets First* shows slightly decreasing agricultural area at high risk of water erosion due to small decreases in the area for crops and grazing and small increases in land used for biofuels. In Eastern Europe and Central Asia a slow shift from grazing-dependent livestock to reliance on concentrates leads to a small increase in agricultural area at risk.

Developments under *Policy First* are comparable to the *Markets First* situation, except that land used for biofuel production increases faster, especially in Eastern Europe and Central Asia.

In comparing *Security First* with *Markets First*, a slower increase is shown in agricultural land at risk. In Western Europe this is due to slower increases in cropland and land for biofuel production, along with similar declines in grazing area. In Central Europe, especially the production of biofuels increases less, while in Eastern Europe and Central Asia the decrease in grazing land is less rapid.

In *Sustainability First*, agricultural land at risk increases less than in the *Markets First* and *Policy First* situations because per capita consumption of meat and milk is lower. In all sub-regions this leads to a smaller area being required for grazing, and feed and fodder production.



Water erosion is one of the soil degradation processes occurring most extensively across the globe. Water erosion risk is calculated through a combination of three variables: terrain erodibility, rainfall erosivity and changes in land use and land cover. Note that this is a simplification of the issue, because, given the changing risk, management practices can make an enormous difference in actual erosion. The aggregates shown are based on IMAGE output on a spatial grid of  $1/2 \times 1/2$  degree longitude  $\times$  latitude.

Source: RIVM

## Population living in areas with severe water stress

Links with EU SDS clusters:

- Pressures on vital natural resources, such as biodiversity, water and soils
- Potential threats to food safety and to public health, for instance from hazardous chemicals
- Climate change caused by emissions of greenhouse gases from human activity

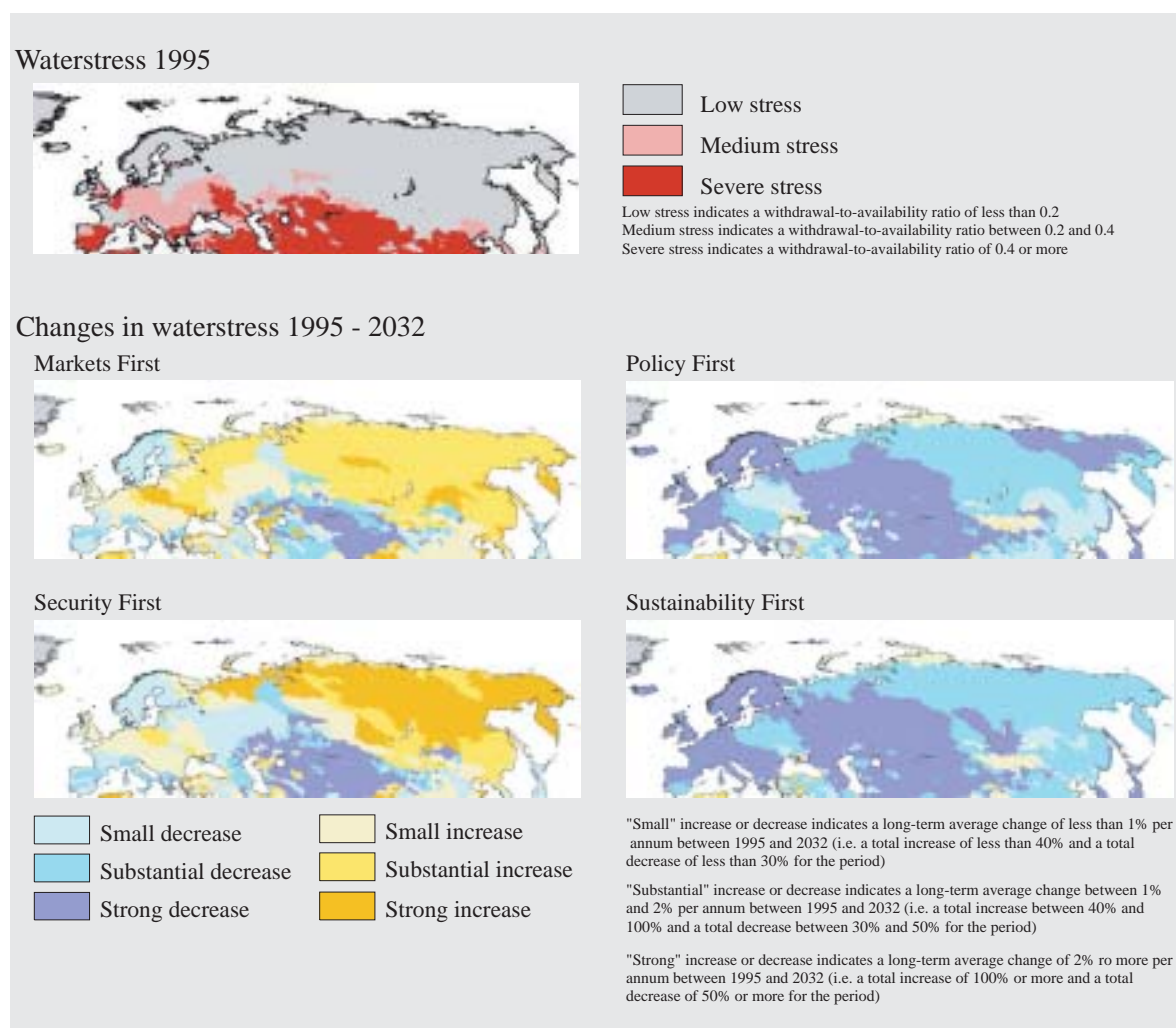
High levels of pan-European water stress are mainly related to high levels of withdrawals for industry or irrigation. Currently, water stress is most serious in the southern part of the region.

Climate change leads to a change in water availability across all scenarios. Due to the long delay in response of the climate system to changes in emissions, the geographical patterns and magnitudes of change are similar in all scenarios. Water availability is assumed to increase in Central Asia and to decrease substantially in the Mediterranean region. The combination of the trends in changing water withdrawals and water availability leads to significant changes in water stress. Overall water stress decreases are estimated to occur in Northern Europe and Central Asia.

Shifts in crop choices, along with improved technologies and management practices reduce water demand in agriculture in all scenarios except *Security First*. Large technological improvements under *Markets First* decrease overall water withdrawals in Western Europe. Water withdrawals are

also estimated to decline in Central Asia due to declining needs for irrigation. However, economic development in *Markets First* still leads to clear increases in overall water demand, and thus in areas with severe water stress in Central and Eastern Europe.

In *Security First* overall water demand is comparable to *Markets First*, although a higher demand by a larger population is somewhat offset by lower increases in production. In general, water stress problems intensify and, with an integrated policy perspective still lacking, lead to conflict over water and to contamination from uncontrolled industrial activity.



*Water stress is defined by the long-term average of annual withdrawal-to-availability ratio (withdrawal for human purposes - in households, industry, agriculture and livestock sectors). Driving forces considered are temperature, precipitation, population, electricity production, income, irrigated area, number of livestock, structural changes and technological changes. The higher the ratio, the more intensively the waters in a river basin are used, which reduces either water quantity or water quality, or even both, for downstream users. When more than 40 per cent of the renewable water resources of a river basin are withdrawn for human use, the river basin is considered to be under severe water stress.*

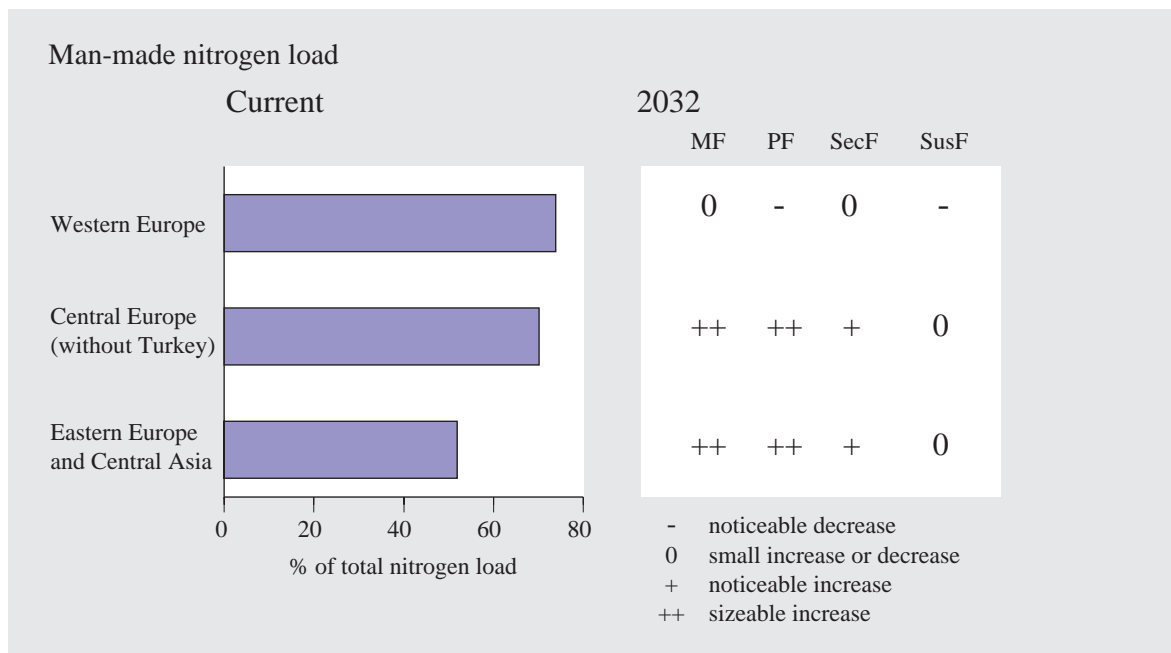
Source: WaterGAP - CESR

The situation is very different for *Policy First* and *Sustainability First*, where structural changes through the full implementation of the Water Framework Directive and regional seas agreements lead to reductions in water withdrawals in all sectors across the region. Some of the river basins currently experiencing severe water stress no longer do so in these two future scenarios. The number of people who live in areas with severe water stress drops significantly. These changes are most prominent in *Sustainability First*, where the decrease in water use as a result of lifestyle changes, e.g. less meat consumption, adds to the effect of direct policies. Differences in the amount of wastewater treated and in industrial recycling of water amplify differences between scenarios. Especially in areas where water use is dominated by industrial demand, water can often be extensively re-used, mitigating the effects of severe water stress.

## Impacts on nitrogen loading in coastal marine ecosystems

Links with EU SDS clusters:

- Potential threats to food safety and to public health, for instance from hazardous chemicals
- Pressures on vital natural resources, such as biodiversity, water and soils



*Shown here is the man-made load of nitrogen compounds at the river mouths of the region, as a percentage of total load (natural plus man-made).*

*Current loads were estimated quantitatively, building on outcomes of the IMAGE 2.2 model. The estimates account for the transformation of nitrogen compounds emitted by diffuse and point sources and were eventually aggregated over all drainage basins of the regions.*

*For the four scenarios, sizes and direction of change in the man-made loads were composed from qualitative expert estimates of changes in: meat production, handling of animal manure, fertilizer use, emission and deposition of nitrogen oxides and ammonia, per capita human emission considering changes in diet, urbanization, sanitation coverage and sewage treatment.*

Source: RIVM



The anthropogenic nitrogen loading in high-income Western Europe typically changes only slightly in *Markets First* and *Security First*, but decreases in the *Policy First* and *Sustainability First* scenarios. This decrease is due especially to agricultural efficiency and an air pollution abatement policy resulting in decreased output from fertilizers and reduced deposition from the air. However, since current nitrogen loading is already very large, future pressure on coastal waters will nonetheless be serious in this sub-region.

In Central Europe too current nitrogen loading is already large and will increase in all scenarios, despite good progress in the degree of wastewater treatment in all futures. Future pressure will therefore be even more serious than in Western Europe. Sizeable increases for *Markets First* and *Policy First* are mainly due to higher income, resulting in more meat consumption and thus in meat production, fertilizer use and per capita emissions. In *Security First* only a noticeable increase will occur, mainly due to slower economic growth, resulting in a somewhat lower increase in demand for and thus lower production of meat, and related lower fertilizer use and per capita emissions. In *Sustainability First* more progress in reducing depositions from the air and changing diet (less meat) result in only a small increase.

In Eastern Europe and Central Asia current nitrogen loading is moderate but will increase according to the same overall pattern as in Central Europe (sizeable increases in *Markets First* and *Policy First*, a noticeable increase in *Security First* and a small increase only in *Sustainability First*). The causes leading to this pattern are different though. Deposition from the air and per capita emissions are often smaller than in Central Europe due to still lower production and incomes. But the level of sewage treatment can not keep up with urbanization and sanitation coverage, and so give increases in terms of nitrogen loading.

The Mediterranean (bordered by a mixture of higher- and lower income countries) comes under special pressure through a combination of large current loading and future trends like urban growth with inadequate wastewater treatment, tourism and intensive farming close to major river mouths. The *Sustainability First* world shows somewhat smaller increases than in the other scenarios, especially in West Asia. Increases in loading are very large or large for all scenarios in North Africa.

## Annex I: Pan-European country groupings for UNEP's GEO-3 scenario work and EEA's Kiev Report

WESTERN EUROPE		CENTRAL EUROPE		EASTERN EUROPE AND CENTRAL ASIA	
UNEP – GEO-3 scenario work	EEA – Kiev	UNEP – GEO-3 scenario work	EEA – Kiev	UNEP – GEO-3 scenario work	EEA – Kiev
Western Europe (20 countries)	Western Europe (18 countries) <b>EU15 + EFTA 4 + Andorra + Monaco + San Marino</b>	Central Europe (17 countries) *	Central & Eastern Europe (18 countries)	Eastern Europe and Central Asia (12 countries)	NIS (7 countries)
Andorra Austria Belgium Denmark Finland France Germany Greece Holy Sea Ireland Italy Luxembourg Malta Monaco Netherlands Portugal San Marino Spain Sweden United Kingdom	Andorra Austria Belgium Denmark Finland France Germany Greece Ireland Italy Luxembourg Monaco Netherlands Portugal San Marino Spain Sweden United Kingdom	Albania Bosnia-Herzegovina Bulgaria Czech Republic Croatia Cyprus Estonia FYR Macedonia Hungary Latvia Lithuania Poland Romania Yugoslavia Slovak Republic Slovenia Turkey *	Albania B-Herzegovina Bulgaria Czech Republic Croatia Cyprus Estonia FYR Macedonia Hungary Latvia Lithuania Malta Poland Romania Yugoslavia Slovak Republic Slovenia Turkey	Armenia Azerbaijan Belarus Georgia Republic of Moldova Russian Federation Ukraine  Kazakhstan Kyrgyzstan Tajikistan Turkmenistan Uzbekistan	Armenia Azerbaijan Belarus Georgia Republic of Moldova Russian Federation Ukraine  Kazakhstan Kyrgyzstan Tajikistan Turkmenistan Uzbekistan

\* In most model-based analyses shown, Turkey is included in West Asia; this is always indicated in the graphs.

## Acronyms used

CESR	Center for Environmental Systems Research, University of Kassel, Germany
DEWA	Division of Early Warning and Assessment of UNEP
EEA	European Environment Agency
EFTA	European Free Trade Association
EU	European Union
GEO	Global Environment Outlook (periodic report of UNEP)
GLOBIO	Global methodology for mapping human impacts on the biosphere
GRID	Global Resource Information Database of UNEP
IMAGE	Integrated Model to Assess the Global Environment
NINA	Norwegian Institute for Nature Research
RIVM	National Institute for Public Health and the Environment, the Netherlands
SEI	Stockholm Environment Institute
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environment Programme
WaterGAP	Water - Global Assessment and Prognosis
WCMC	World Conservation Monitoring Centre



## **Acknowledgements**

### *Storyline input, 2000:*

- Jan Bakkes of the National Institute for Public Health and the Environment, The Netherlands
- Nadezhda Gaponenko of the Analytical Centre on Science and Industrial Policy, Russian Academy of Sciences, Russian Federation
- Ruben Mnatsakanian of the Central European University, Hungary

### *European synthesis, 2001*

- Jan Bakkes of the National Institute for Public Health and the Environment, The Netherlands

### *Editorial work, 2002*

- Mirjam Schomaker, consultant, France

The compilation of this publication has been supported by the European Environment Agency and by the Netherlands' Ministry for Spatial Planning and the Environment.

The overall Third Global Environment Outlook (GEO-3) builds on the collaborative effort of UNEP's network of 37 Collaborating Centres as well work by 1000 individuals.

