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# EEA SIGNALS 2009

## KEY ENVIRONMENTAL ISSUES FACING EUROPE

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# What is Signals

Signals is published by the European Environment Agency (EEA) at the start of each year and provides snapshot stories on issues of interest both to the environmental policy debate and the wider public for the upcoming year.

We monitor the environment across our 32 member countries in partnership with our network. From researchers up to their knees in water to satellite imaging from space, we work with a huge amount of environmental data.

Finding, reading and understanding the range of 'signals' regarding the health and diversity of our environment is at the heart of what we do. Signals respects the complexity of the underlying science and shows awareness of the uncertainties inherent in all of the issues we address.

Our target audience is broad, ranging from students to scientists, policy-makers to farmers and small business people. Signals, which will be published in all 26 EEA languages, takes a story-based approach to help us better communicate with this diverse group of people.

The eight stories addressed are not exhaustive but have been selected on the basis of their relevance to the current environmental policy debate in Europe. They address priority issues of climate change, nature and biodiversity, the use of natural resources and health.

Signals uses several approaches to tell its stories. While each story has specific points to make, as a collection, they also illustrate the many inter-relations between seemingly unconnected issues.

We would appreciate your feedback on Signals. Please submit your comments through the EEA public enquiry form: http://www.eea.europa.eu/enquiries. Remember to write 'Signals' in the subject field. ■

# Editorial

Our natural world often provides a stunning backdrop to our daily lives. It may be a local stream, pond or stretch of beach. On a grander scale, we are struck by the beauty of the Alps or the Carpathian mountains, the ancient forests, the great rivers or the stunning coasts. Beyond Europe, images of the Arctic and Antarctic ice masses, the rainforests of the Amazonia and the safari plains of Africa are imprinted on our minds.

Much of our natural heritage is now under threat from unprecedented population growth and economic development. There were 3 billion people on earth when I was born. Today there are 6.7 billion of us and we expect the number to rise to 9 billion by 2050.

The world's economy, in terms of global gross domestic product (GDP), has grown at an unprecedented rate: in 1950 GDP was EUR 4 trillion. In 2007 it was over EUR 42 trillion. This ten fold increase has several key drivers, not least the movement of raw materials and goods — which come from our environment.

In contrast to this economic growth, our environment has suffered. Glaciers are melting in Europe's mountain ranges with more river flooding expected as a consequence and misery for millions of ordinary people. Arctic summer sea ice is receding and thinning faster than ever: in 2007 the extent of the sea ice was half that measured in the 1950s. Around the world, more than a billion, mostly poor, people rely on fisheries for their food and livelihoods. However, half of all wild fisheries have been fully exploited. The majority of today's commercial fisheries are likely to have collapsed by 2050 if current trends are not reversed. Back on land, rainforests are being decimated for developments that take no account of the many valuable ecological services they provide.

These trends may change our relationship with the natural world but not our reliance on it. The natural resources provided by the planet underpin our economic activity and the very cohesion of our societies.

However, the way we organise our economies does not give sufficient recognition to the dependent nature of this relationship — there are no societies without environments, but there are environments without societies. The lack of accounting for what matters in this relationship lies at the heart of the degradation we see all around us in our natural world.

In 2006 Lord Nicolas Stern put a price on the impacts of climate change. He estimated that the cost of climate change impacts could be massively reduced if emissions of greenhouse gases were cut immediately. Taking action now will be cheaper and more effective than actions later.

The Stern analysis has spawned initiatives in other policy areas, most notably biodiversity and ecosystem services. Initiatives like Stern have helped people to understand what is at stake if we continue our current consumption patterns. Above all, we need to regain a sense of humility about the natural world because, as indigenous peoples have long understood, we must ultimately answer to nature. Nature has rules and limits of its own. Our natural world is the bedrock — not the backdrop — of our society.

With Signals, we intend to contribute to this appreciation of the natural environment. We hope to influence thinking and attitudes and effect the decisions that all of us make every day.

This will be an historic year for the environment culminating in a major UN meeting on climate change in Copenhagen next December. The meeting, possibly the most important environmental gathering to date, must come up with a successor to the Kyoto Protocol.

Greenhouse gas emissions are just one symptom of a much deeper issue: our inability to live sustainably. However, the scale of these environmental problems should not paralyse us into inaction. It should raise our awareness and encourage us to develop new, more sustainable patterns of living, growing, producing and consuming. Ultimately, we are talking about revaluing the fundamental elements of life. At a time when money markets are looking for direction perhaps the environment can show the way.

*Professor Jacqueline McGlade,*
*Executive Director,*
*European Environment Agency,*
*Copenhagen*

# Not just hot air

## Global diplomacy and the search for a successor to the Kyoto Protocol

Every winter the gates of Copenhagen's famous Tivoli Gardens, an old world amusement park in the city centre, open to officially mark the beginning of the extended Christmas period.

This December the twinkling lights of Tivoli will most likely be outshone by COP 15 — the most important global climate change meeting ever — as thousands of diplomats, politicians, business people, environmentalists and climate experts from around the globe flock to the Danish capital.

> **“The challenge of climate change, and what we do about it, will define us, our era, and ultimately, our global legacy”**
> *UN Secretary-General Ban Ki-Moon*

The meeting is a crucial step in a process dating back to 1992 and the UN's 'Earth Summit' in Rio de Janeiro. It was here that the global effort to tackle climate change began in earnest.

The summit resulted in the United Nations Framework Convention on Climate Change (UNFCCC) which forms the legal basis for global efforts to address climate change. Meetings of the Convention, known as Conferences of the Parties (COPs), have taken place every year since 1994.

## Kyoto — a first step in cutting emissions

The Kyoto Protocol, signed in 1997 as an extension of the UNFCCC, is a first step in the long-term emissions reduction effort that is needed to prevent dangerous levels of climate change. The first commitment period of the protocol effectively runs out in 2012 and 'COP 15' will be expected to produce an ambitious successor.

Kyoto is significant because it set binding emission targets for the developed countries that ratified it. For example, the 15 countries who were members of the EU (EU-15) in 1997 have a joint target to cut emissions by 8 % compared to the Kyoto 'base year' ([1]). They must achieve this target during the period 2008–2012 ([2]).

Countries are expected to meet their Kyoto targets mainly by cutting emissions at home. However a range of other options are available to help them reach their target (see box: Get us to Kyoto on time).

'Kyoto' has been quite controversial mainly because the United States did not ratify it and because developing nations like China and India, which have rapidly developing economies, have no targets under the protocol.

## The EEA — one part of the puzzle

The EEA climate change team plays a role in the European effort, coordinating an accountancy job of enormous proportions. Data from around Europe on emissions of so-called greenhouse gases are collected, verified and then analysed in two key reports that feed into the Kyoto process.

This year, the numbers and the analysis they facilitate, have a particular significance in the context of the COP 15 meeting as they clearly show how the EU is doing with its own efforts to cut emissions of greenhouse gases. Countries that have not signed up or do not yet have targets will be especially interested in how well the EU is implementing the protocol.

## The inventory report — counting gases

The first EEA greenhouse gas report comes out each spring and is called the 'inventory' report. Greenhouse gases in this context refer to a collection of the most serious climate changing gases including: carbon dioxide, methane, nitrous oxide as well as fluorinated gases. The inventory report shows national trends: whether emissions are going up or down. Within each country it shows where the reductions or increases in emissions are coming from.

Each EU Member State must present an estimate of its emissions to the European Commission and the EEA. Consider the energy sector, which is responsible for more than 80 % of the total greenhouse gases emissions in the EU. Statistics on energy use, by type of fuel, are multiplied by 'emissions factors' and the energy emission is estimated by each country. Emissions from agriculture are estimated based on the area of cultivated soils, type of crop, use of fertiliser and the number of livestock (cattle, poultry, sheep, pigs, etc.) in the country.

Just as athletes are regularly tested to make sure they stay within the rules, there is regular monitoring. The data are added together to form an overall picture of emissions across Europe and sent to the European Commission, from where it is passed on as the official submission of the European Community to the UNFCCC.

Because data are first verified at a national level there is a one and half year delay. The latest report released in June 2008 is based on data from 2006. It shows that emissions from the EU-15 were 3 % below the 'base year'.

## What do the numbers mean?

The concept of counting gases is quite abstract. As a result it is also difficult to figure out what a percentage cut or increase in emissions means. It may help to imagine the cuts as days of the year. The EU-15 Kyoto target translates into 29 days worth of emissions.

For each of the 5 years between 2008–2012, EU-15 emissions should be on average, 29 days less than 1990 levels. In this way, emission reductions must occur consistently over several years.

The latest EEA data show that 10 days worth of emissions were cut between 1990 and 2006. The EU-15 must cut 19 more days to meet the target.

## Trends and projections

Immediately after the hand-over of the 'inventory' report, the EEA's climate change team begins its second major reporting exercise of the year culminating in the 'Trends and projections' report. The report is published in the winter just as the annual UN COP meeting is about to meet.

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([1]) Different gases have different 'base years' under Kyoto. For carbon dioxide, methane and nitrous oxide (99 % of all emissions) 1990 is used as the 'base year' for all EU-15 Member States. For fluorinated gases, countries can choose another year instead. Twelve EU-15 Member States have chosen 1995.

([2]) The EU-15 has a joint Kyoto target. Within this, each EU-15 Member State has a differentiated reduction target: some should reduce emissions while others are allowed a limited increase. New EU Member States have individual targets except Cyprus and Malta, which have no targets.

This report contains a deeper analysis of the emission trends outlined in the first report and pin points where the emissions and emission's reductions came from. Most importantly, the report looks ahead and evaluates projections of future greenhouse gas emissions as far as 2012 and beyond to 2020. This future perspective is invaluable in terms of seeing the extent of the problem ahead and developing policy to deal with it ([3]).

The latest Trends and projections report confirms that the EU-15 cut its emissions by 3 % between the 'base year' and 2006. A combination of approaches will be needed to fill the remaining gap, the report says.

Existing and planned 'domestic' efforts (happening on the ground in each country), Kyoto mechanisms, carbon sinks (such as planting trees to soak up gases) and trading carbon credits will all be used and could result in a potential emissions reduction of 11 % for the EU-15. However, countries must implement planned measures very soon or they will not impact in time to meet the target, the report says.

At a national level France, Greece, Sweden and the United Kingdom had already reached their Kyoto target in 2006. Austria, Belgium, Finland, Germany, Ireland, Luxembourg, the Netherlands and Portugal project that they will achieve their targets, but projections from Denmark, Italy and Spain indicate that they will not meet their emission reduction goals.

## Get us to Kyoto on time

Emissions from the EU-15 were 3 % below 'base year' levels in 2006, according to the latest EEA data.

Countries that have signed up to Kyoto must make substantial emissions reductions at home. However, having satisfied this condition, they can also use Kyoto Mechanisms, such as the 'Clean Development Mechanism' (CDM) and 'Joint Implementation', two schemes that allow a country to offset a share of its own emissions by investing in reduction efforts elsewhere.

The EU 'Emissions Trading Scheme' (EU ETS) is another tool, which helps industries to cut their $CO_2$ emissions in a cost-effective way. Limits have been set for all industrial sites that emit a lot of $CO_2$. Sites that cut emissions below their 'allocation' can sell the remainder as emission allowances to other companies who have not made sufficient reductions. In this way a carbon market has developed. The EU ETS is currently estimated to reduce EU-15 emissions by more than 3 % ([4]).

Following a proposal by the European Commission, the EU ETS could be expanded to include additional sectors, such as aviation, petrochemicals, ammonia and the aluminium sector, as well as new gases, so that approximately half of all EU emissions would be covered ([5]).

During the Kyoto period (2008–2012) developed countries can also trade emission allowances between themselves in order to meet their national targets.

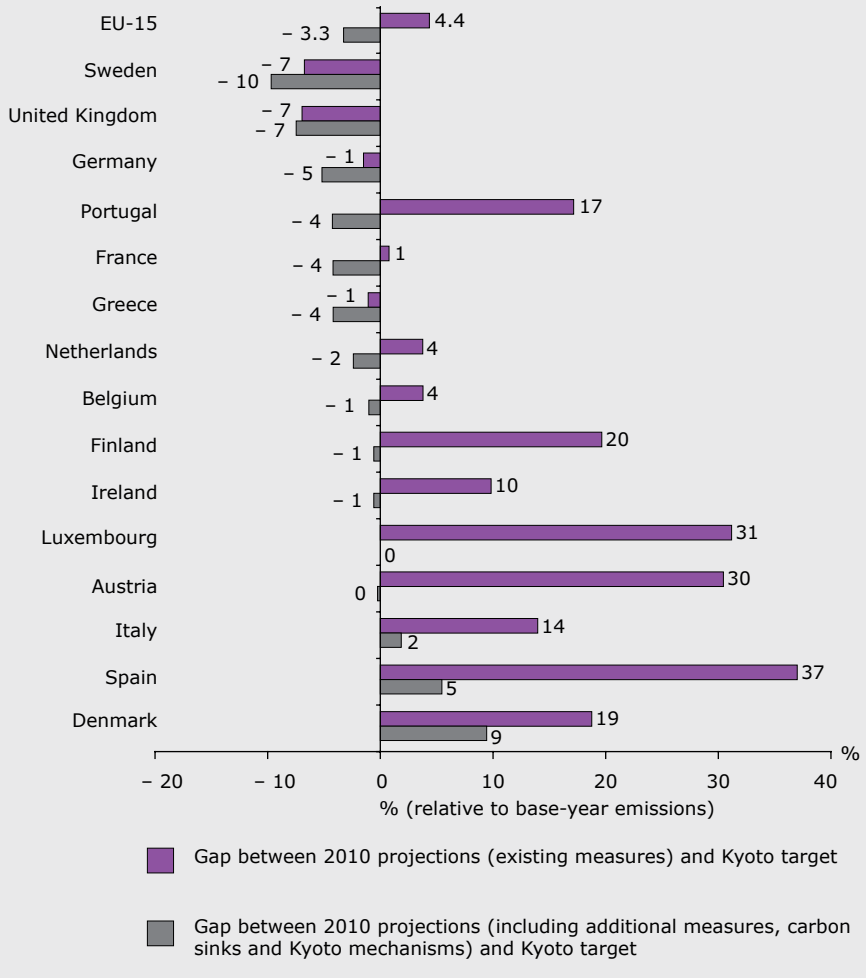


**Fig. 1 /** Gaps between EU Kyoto and burden-sharing targets and projections for 2010 for the EU-15 ([6]). Source: Trends and projections report, EEA, 2007.

([3]) Looking ahead to 2020, the report gives a long range estimate of the emissions situation in Europe. This is particularly relevant in the context of the 'Climate and Energy package' being proposed by the European Commission, which is proposing targets for 2020.
([4]) Compared to the Kyoto 'base year'.
([5]) Currently emissions from international aviation and shipping are not covered under the Kyoto Protocol or by EU law.
([6]) The full effect of the EU Emission Trading Scheme is not reflected in all Member States' projections.

## Looking ahead: beyond Kyoto

The buzz words, 'common but differentiated responsibility', first uttered at the Earth Summit in Rio, have popped up ever since in climate change circles. In simple language the phrase reflects the fact that developed nations have a greater responsibility for the greenhouse gases in our atmosphere. These countries have been more industrialised, have created more emissions and should have legal targets to cut emissions before developing nations.

It has proved very difficult to turn the concept into action acceptable to both industrialised and developing countries. Next December, a major task of the COP 15 will be to finally turn the rhetoric into a global emissions reduction effort. That means new targets for emissions reductions and most importantly the buy-in of America and major developing nations such as India and China.

We already know the EU's position on future emissions reduction efforts: a 20 % cut in emissions by 2020, growing to a 30 % cut if other developed nations sign up at Copenhagen. All EU-27 Member States will be included.

The EU's 2020 target is almost equivalent to removing emissions from all transport across Europe. Imagine every truck, bus car, train boat and aeroplane disappearing — in terms of emissions. It's ambitious, but it must be because the challenge is serious.

The most recent data show that global emissions of $CO_2$ increased four times faster since 2000 than during the previous decade. This growth is above the worst case scenario reported by the Intergovernmental Panel on Climate Change (IPCC) in 2007. Less developed countries are now emitting more $CO_2$ than developed countries. Natural sinks, such as the ocean, which soak up $CO_2$, have decreased in efficiency over the past 50 years, meaning that our efforts to reduce emissions from human activities will have to be even more effective if we are to keep atmospheric levels of $CO_2$ stable.

'The costs of inaction on climate change are immense both financially and morally. Poorer people will suffer first but the knock on effects will be felt by us all,' said Professor Jacqueline McGlade, executive director of the EEA.

'Climate change cuts across normal political and financial boundaries. It is no longer a matter for one or two ministers around national cabinet tables. It's a matter for heads of government and should be treated as such,' she said. ■

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# If the well runs dry

## Climate change adaptation and water

'Our water is shut off once or twice a month, sometimes more,' says Barış Tekin from his apartment in Beşiktaş, an historic district of Istanbul, where he lives with his wife and daughter.

'We have about 50 litres of bottled water in the apartment for washing and cleaning, just in case. If the water is off for a really long time we go to my father's place or to my wife's parents,' says Barış, an economics professor at Marmara University.

The old apartment does not have a water tank of its own so the Tekins' are directly connected to the city's water system. A drought in Western Turkey over the past two years means that water is regularly shut off by the city for periods of up to 36 hours.

Water shortages are not new — Barış remembers them from his childhood. Although improvements in the infrastructure mean less water wasted, the current drought is particularly serious and 'water rationing' during the summer months is a fact of life for the city's 12 million residents.

## Impacts of climate change

Extremes of heat and drought, rain and flooding are affecting many parts of Europe.

Last summer, while Spanish daily newspaper *El Pais* ran photographs of dry riverbeds, the Guardian in Britain ran alarming headlines about floods. While the local government in Barcelona made plans to import water by ship, the British government assessed its flood defences.

There are many causes but climate change is expected to increase both the frequency and the severity of these events. Even if we do reduce emissions, the historic build up of greenhouse gases will result in some level of climate change — so there will be impacts. Therefore, we will need to adapt — that means assessing our vulnerability and acting to lessen the risks. This analysis of adaptation to climate change focuses on water issues, mainly drought.

## Water scarcity and drought

As temperatures rise, southern Europe's reserves of water will drop. At the same time, agriculture and tourism will require more water especially in the hotter drier regions.

An increase in water temperatures and lower river flows in the south will also affect water quality. Increases in extreme rainfall events and flash floods will increase the risk of pollution from storm water overflow and emergency discharges from waste water treatment plants.

In the spring of 2008, water levels in the reservoirs supplying Barcelona were so low that plans were made to ship water in. At an estimated cost of EUR 22 million, six shiploads, each holding enough fresh water to fill ten Olympic swimming pools, were sourced. The fresh water was to come from Tarragona in southern Catalonia, Marseille and Almeria — one of the driest areas of southern Spain. Luckily, May was wet, the reservoirs filled sufficiently and the plans were shelved. However, discussions around diverting water from rivers such as the Ebro and even the Rhône in France continue ([1]).

Cyprus is experiencing a catastrophic drought. Water demand has been increasing over the past 17 years and is over 100 million cubic metres ($m^3$) of fresh water per year. Over the last three years only 24, 39, and 19 million $m^3$ have been available respectively.

To ease the water crisis water was sailed in from Greece last summer. By September 2008, 29 ships had arrived from Greece. Water shortages in Greece slowed the shipments. The Cypriote government has been forced to apply emergency measures which include cutting water supply by 30 %.

In Turkey, water levels fell consistently last summer, according to the state waterworks authority. The reservoirs supplying drinking water to Istanbul had 28 % of their capacity. The reservoirs supplying Ankara, home to four million people, had only 1 % of its drinking water capacity.

A report from the Water Office for Crete painted an alarming picture of groundwater resources on the island. Aquifers — underground reservoirs — have dropped by 15 metres since 2005 because of over pumping. Seawater has actually begun to creep in, polluting the remaining supplies.

## Crisis control is not adaptation

Current droughts and water crisis must be dealt with in the short term to ensure that people have water. However, long-term adaptation policies must also be developed. Governments at local and national level, desperate to boost water supply, are investing in projects such as reservoirs for storing water, water transfer and desalination plants, which make salt water fit for drinking.

## Mitigation and adaptation

Greenhouse gases are causing our climate to change. Southern Europe is expected to become warmer and drier while the North and North West will most likely become milder and wetter. Overall global temperatures will continue to rise.

EU Member States agree that global temperature increases should be limited to 2 °C above pre-industrial levels in order to avoid severe changes to our climate.

This is the main goal of the EU's 'mitigation' effort. Mitigation efforts are focused on cutting emissions of 'greenhouse' gases. Limiting temperature increases to 2 °C requires as much as a 50 % reduction in global gas emissions by 2050.

However, even if emissions stop today, climate change will continue for a long time due to the historical build up of greenhouse gases in the atmosphere. Impacts are already clear in the Arctic, for example. We must begin to adapt. Adaptation means assessing and dealing with the vulnerability of human and natural systems.

Climate change mitigation and adaptation are very closely linked. The more successful mitigation efforts are in cutting emissions, the less extensive our need for adaptation.

([1]) On 27 May 2008, the Department of the Environment for the Spanish region of Catalonia said that recent heavy rains have eased the drought in the regional capital of Barcelona, possibly allowing the government to lift restrictions on water use. Reservoirs that were at 20 % of their capacity in March are now 44 % full.

Mediterranean countries are increasingly relying on desalination to provide fresh water. Spain currently has 700 desalination plants, which provide enough water for 8 million people every day. Desalination is expected to double over the next 50 years in Spain.

Water shortages are not restricted to Southern Europe. The United Kingdom is constructing its first desalination plant in east London. At a cost of GBP 200m, more than EUR 250m, the facility could supply 140 million litres of water a day, enough to supply 400 000 homes. Ironically, the local water authority constructing the plant loses many millions of litres of clean drinking water everyday, through leaky pipes and poor infrastructure.

Desalination can have a legitimate role to play in long term water management but the process of turning salty water into drinking water is notoriously energy intensive. Some plants now make use of solar energy, which is a positive step. However, desalination is still expensive. Also, the salty brine, a by product of the process is difficult to dispose of and can harm the environment.

### Managing our water resources

'It is often over 40 °C here in the summer and the humidity can be very high,' Barış says from Istanbul. 'The local authorities are much better at warning us now and they can usually tell us how long the water will be off — so we can make plans. But, they don't seem to be doing much to deal with the shortage itself — they can't make it rain more, I suppose,' he said.

Regional and national authorities in Turkey, and all over Europe, could better 'manage' water resources. This means taking action to reduce and manage demand instead of simply trying to increase the supply of water.

The Water Framework Directive (WFD), the defining piece of legislation on water in Europe, obliges Member States to use pricing (charging money) for water-related services as an effective tool for promoting water conservation. Indeed water pricing is one of the most effective methods of influencing water consumption patterns. However, effective water management must also include efforts towards reducing water losses and information on water-efficiency.

## Better information will help us adapt

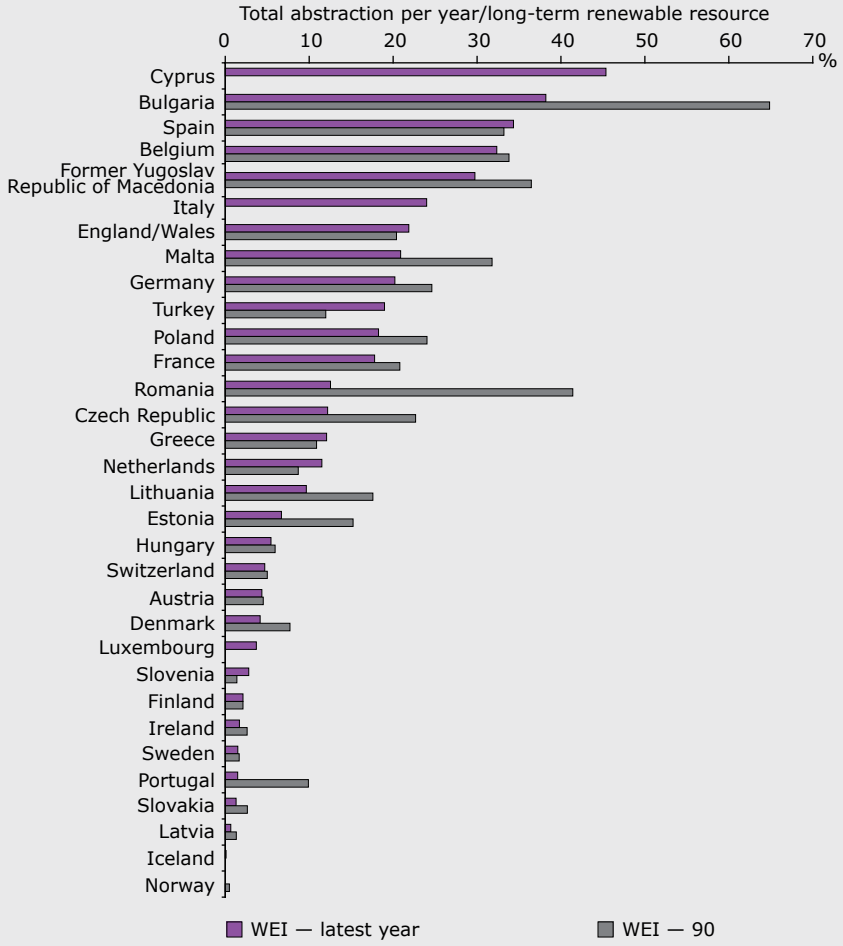


**Fig. 1 /** Water Exploitation Index (WEI). Source EEA, 2007.

The Water Exploitation Index (WEI) (Figure 1) is a good example of the type of information needed to give an overview of the scale and location of the problems facing us.

In simple terms, the index shows available water resources in a country or region compared to the amount of water used. An index of over 20 % usually indicates water scarcity. As the graph shows, nine countries are considered 'water stressed': Belgium, Bulgaria, Cyprus, Germany, Italy, the former Yugoslav Republic of Macedonia, Malta, Spain, and the United Kingdom (England and Wales).

WEI data are available for England and show that the South East and London are especially stressed. This level of information is key in terms of effective adaptation to climate change. By understanding how much water is available in a region, where it's coming from and who uses it, we will be able to build effective local strategies to adapt to climate change.

## Looking ahead

An upcoming EEA report considers the Alps, often described as the 'water tower of Europe' because 40 % of Europe's fresh water comes from the mountain range. The Alpine region has experienced temperature increases of 1.48 °C in the last hundred years — twice the global average. Glaciers are melting, the snowline is rising and the mountain range is gradually changing the way it collects and stores water in winter and distributes it again in the warmer summer months, the report says.

The Alps are crucial in terms of water supply, not only to the eight alpine countries, but to a huge part of continental Europe, feeding many of the major rivers. As such they act as an iconic symbol of the scale of the threat and the type of response required. Adaptation strategies and policies must include local, cross border, and EU-wide elements. Seemingly unconnected activities, such as farming and tourism, energy production and public health must be considered together.

Ultimately, adaptation means reconsidering where and how we live now and in the future. Where will our water come from? How we will protect ourselves from extreme events?

EEA studies focusing on land cover show that coastal areas are often where most building is going on. The EEA report, 'The changing faces of Europe's coastal areas' refers to the 'Med wall' and shows that 50 % of the Mediterranean coastline is built on. Water shortages and drought are already an issue in many of these regions. More apartments, more tourists and more golf courses mean increased demand for water. Coastal areas in the North and West of Europe, where increased flooding is expected, are also being rapidly developed.

The integration of adaptation into key EU policies has been limited. However, the European Commission is expected to publish a White paper on adaptation in 2009. A recent EEA report points out that only seven of the 32 EEA countries have actually adopted National Adaptation Strategies for climate change, so far. However, all EU Member states are busy preparing, developing and implementing national measures based on the observed situation in each country.

The joined up thinking necessary for effective adaptation is not well developed but the process is starting. ■

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# Killer slugs and other aliens

## Europe's biodiversity is disappearing at an alarming rate

Is gardening one of your interests? If so and you live in central or northern Europe, the 'killer slug' is probably one of your personal enemies. The slug, which attacks your herbs and vegetables relentlessly, seems immune to control measures.

The killer slug, known scientifically as *Arion lusitanicus*, is also called the 'Spanish slug' because it is native to the Iberian peninsula. The slug is hermaphrodite and can spread very quickly. More aggressive than the native black slug it eats weaker slugs.

The killer slug started to spread around Europe about 30 years ago, travelling as eggs in the soil of potted plants. This route is still a major source of infestation today.

The slug is just one example of a much wider threat to Europe's biodiversity as alien or non-native species establish and spread across the continent as a result of human activities. Most arrive as stowaways and are transported unwittingly around the globe. The UN Convention on Biological Diversity identifies the threat of invasive alien species as one of the major threats to biodiversity worldwide.

Alien species have been arriving in new places as long as people have been travelling and trading. Increased trade, exploration and colonisation from the 1600s started the invasion proper with notable species such as brown rats arriving for the first time on ships from Asia.

About 10 000 alien species have been registered in Europe. Some, such as the potato and the tomato, were introduced on purpose and remain economically important to this day. Others, called 'invasive alien species' create serious problems as pest species to gardening, agriculture, forestry as vectors of diseases or by damaging constructions such as buildings and dams.

Invasive alien species also change the eco-systems they live in and impact on the other species in those ecosystems. For example, a recent study of Knotweed, introduced to Europe in the 19th century from eastern Asia as an ornamental plant, has shown that the rapidly spreading invasive plant is causing serious damage to natural plant and insect species in the United Kingdom and France.

## Cost

Invasive alien species often exact a high financial cost from their new homes. Alien weeds reduce European agricultural yields and Dutch elm disease — caused by an introduced fungus — has devastated elm trees in the forests of central Europe. The American grey squirrel, introduced to the United Kingdom, not only out-competes the native red squirrel — an impact hard to value in monetary terms — but damages coniferous trees and reduces their value as timber.

The cost in terms of damage and control of invasive alien species in the United States has been estimated at EUR 80 billion each year. Initial estimates put the cost in Europe at more than EUR 10 billion per year. This is without considering the cost of major human pathogens (such as HIV or influenza) or exceptional outbreaks of animal diseases.

Management actions to reduce (or exterminate) established invasive alien species are difficult, cumbersome and

## Biodiversity — the wider context

Biodiversity refers to the variety of life on earth. It represents the planet's natural wealth and as such provides the basis for our lives and prosperity. It supports many basic services that we depend on such as the water we drink and the air we breathe. It helps to pollinate crops, put food on the table, regulate weather patterns and clean up our waste.

Without biodiversity we would not be able to survive. As such it can be seen as an insurance policy provided to us by the planet. Its value can be compared with financial markets, where a diverse portfolio of species stocks, as with business stocks, can provide a buffer against disturbances.

Currently, biodiversity is vanishing at an alarming rate mainly because of how we misuse nature to sustain production, consumption and trade in the globalized economy we live in. Habitat loss and fragmentation caused by clearing forests and natural areas for housing, roads and agriculture, the draining of wetlands and damning of rivers for agriculture, and clearing the seas of fish, is the primary cause of biodiversity loss.

Invasive alien species are considered by many conservationists to be the second greatest threat to biodiversity worldwide. Whether introduced deliberately or accidentally, such species can cause havoc to people, ecosystems and existing native plant and animal species. The problem of invasive species is expected to worsen in the coming century through climate change, increasing trade and tourism.

The other main threats to biodiversity come from pollution, climate change and over-exploitation of resources. As the world's population is forecast to grow from 6.7 billion people today to nine billion in 2050, it is expected that the impacts on biodiversity from the current main threats will grow and losses increase.

costly. The European Commission supports nature management projects in the Member States through the EU LIFE Regulation. The LIFE funds are increasingly being used for projects on invasive alien species and the budget is now approaching EUR 14 million per 3-year period.

## IAS and Europe — increasing impacts

Alien species can be found in all European ecosystems. Globalisation, particularly increased trade and tourism, have resulted in an upsurge in the number and type of alien species arriving in Europe.

Marine and coastal areas are being drastically affected as a result of increased shipping and the building of canals between isolated seas — the Suez canal is still a major source of new species entering the Mediterranean Sea. Released ballast water from ships is such a big source of new organisms that the 'International Convention for the Control and Management of Ships Ballast Water & Sediments' has been established to 'prevent, minimize and ultimately eliminate the transfer of harmful aquatic organisms and pathogens' in this manner.

## Control measures

The most efficient defence against invasive alien species is prevention — basically a border patrol blocking new species. A second step is early detection and control.

A striking example is the giant hogweed, Heracleum mantegazzianum, introduced to Europe as an ornamental plant in the 19th century. The plant is now subject to considerable local control efforts as the species has established in grasslands, along railways, roadsides and along river banks. Forming dense stands the hogweed crowds native plants out. It is also poisonous and direct skin contact can result in strong dermatitis. Today, the giant hogweed is most likely beyond eradication in Europe while early actions (up to the 1950s) probably would have had better prospects.

In line with this, the European Commission in the recent communication on biodiversity underlined the need for an 'early warning' mechanism for invasive alien species. In response, the EEA with its network of member and collaborating countries, is planning to establish a European-wide information system that will identify, detect, assess and respond to new and expanding invasions.

## The most-wanted list

Alien species come in all shapes and sizes. Some are deliberately introduced and economically important, others have little impact but quite a few have been a disaster. As a result, a first step in developing control and management measures, is to identify the most offensive species so that efforts are directed towards these.

In order to get better understanding of the invasive alien species and their impact on European biodiversity the EEA, supported by a number of experts, has established a list of the worst invasive alien species threatening biodiversity in Europe.

The list currently contains 163 species or species groups. Species are added to the list if they are very widespread and/or if they create significant problems for biodiversity and ecosystems in their new habitats.

Species on the list, of which vascular plants are the most common with 39 entries, have a significant impact on native biodiversity at the genetic, species or ecosystem levels. Many also affect human health and the economy. Since 1950, on average more than one of the listed species establishes itself each year and there is no clear sign that the situation is improving (Figure 1).

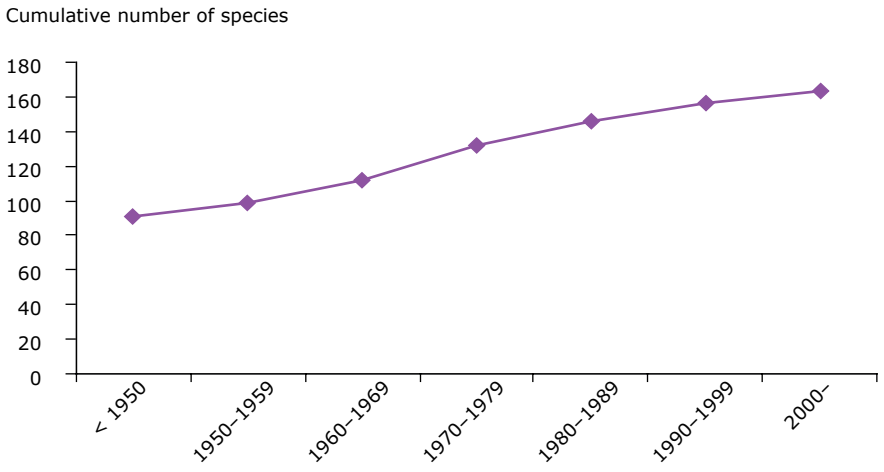


**Fig. 1 /** Establishment in the pan-European region of the worst invasive alien species threatening biodiversity. Source: EEA, 2007.

The species on the list originate from many parts of the world, most notably Asia and North America (Figure 2). However, many others have their origin in one part of Europe but have been transported elsewhere on the continent.

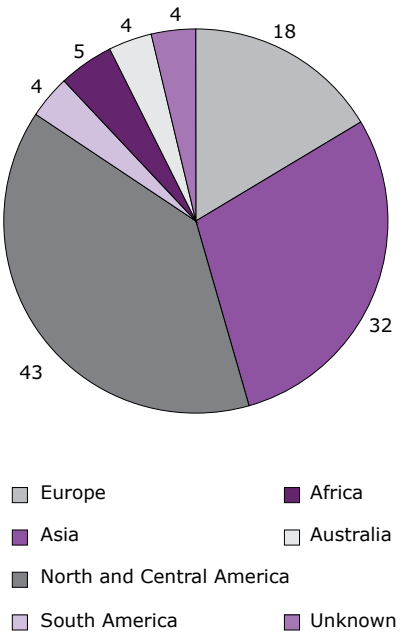


**Fig. 2 /** Area of origin of the terrestrial and freshwater species listed as worst invasive species threatening biodiversity in Europe. Source: EEA, 2007.

## Looking ahead

Actions necessary to counter invasive alien species include measures for management and restoration which are usually both difficult and costly.

For example, control measures against the killer slug have been cumbersome and often have only a local and temporary effect. However, they are still important.

Within the EU, attempts are already being made to counter invasive alien species through management and restoration measures, financed by the LIFE Regulation.

Between 1992–2002, EUR 40 million was allocated to projects dealing with invasive species and the investment is increasing. The EU also finances studies of these species within the 'programme for research and technological development'.

The problem of invasive alien species is not going away. Globalisation and climate change (species moving because of changes to the natural habitat) means that more and more of us will come into contact with these species. Increasing public and political awareness is thus needed to put resources to controlling the main pathways of introduction, monitoring of risk areas for early detection and being prepared for immediate action to eradicate undesirable species. ■

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# Every breath you take

## Air quality in Europe

* The characters in this story are fictional. However the data are real. The story is set on 27 July 2008 when an air quality warning was issued in Brussels

Anna is 37 years old and lives in the centre of Brussels. She and her young son Johan are planning a trip outside the busy city. Anna suffers from asthma and her doctor has warned of the dangers of air pollution, especially on hot summer days.

Anna has heard about the London fogs of the 1950s that killed 2 000 people in one week. She has childhood memories of evening news bulletins showing dead fish and dying trees as 'acid rain' first came to popular attention in the 1970s.

Motherhood and a recent asthma attack have quite rightly brought air pollution back to mind. The fact is that emissions of many air pollutants have fallen substantially across Europe since Anna's childhood. The air she and Johan breathe is much improved compared to the past, and air policy is one of the great success stories of the EU's environmental efforts. In particular, EU policy has dramatically cut emissions of sulphur, the main component of 'acid rain'.

In contrast, nitrogen — also a major component of 'acid rain' — has not been dealt with to the same extent and so continues to cause major problems. A significant proportion of Europe's urban population still live in cities where EU air quality limits, protecting human health, are regularly exceeded. Each year, many more people die prematurely from air pollution in Europe than die in traffic accidents.

The European goal of achieving levels of air quality that do not damage people's health or the environment has still not been reached. EEA analysis suggests that 15 of the 27 EU Member States will miss one or more of their legally binding 2010 targets to reduce harmful air pollutants.

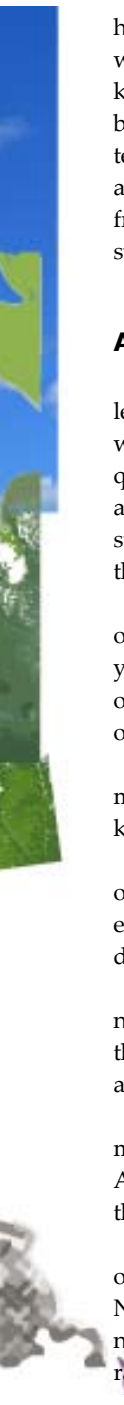
### Particulate matter and ozone

Two pollutants, fine particulate matter and ground-level ozone, are now generally recognised as the most significant in terms of health impacts. Long-term and peak exposure can lead to a variety of health effects, ranging from minor irritation of the respiratory system to premature death.

Particulate matter, a term used to describe a variety of tiny particles from sources such as vehicle exhausts and domestic stoves, affects the lungs. Exposure can harm people of all ages, but people with existing heart and respiratory problems are particularly at risk.

According to the latest EEA data, since 1997 up to 50 % of Europe's urban population may have been exposed to concentrations of particulate matter above the EU limit set to protect human health. As much as 61 % of the urban population may have been exposed to levels of ozone that exceed the EU target. It has been estimated that $PM_{2.5}$ (fine particulate matter) in air has reduced statistical life expectancy in the EU by more than eight months.

The EEA has noted that while emissions of these two key air pollutants



have dropped since 1997, measured concentrations in the air we breathe have remained largely the same. As yet, we don't know why there has not been a drop in ambient concentrations but it could be a combination of several factors: increased temperatures caused by climate change could be affecting air quality; perhaps we are on the receiving end of pollution from other continents or natural emissions of ozone forming substances released from trees, for example.

## A day in the country

Anna is planning a day in the country with Johan. Before leaving her apartment she logs onto IRCEL, a government web service providing a host of regular information on air quality around Belgium. Using maps, Anna can scan readings and forecasts for particulate matter, ozone, nitrogen dioxide, sulphur dioxide among many others. The data are relayed to the web from monitoring stations around the country.

Improvements in monitoring and availability of information on air pollution are another of the success stories of recent years. For instance, local data on ozone levels are now passed onto the EEA 'Ozone web' ([1]) service that provides an overview of the situation across Europe.

Anna scrolls across a map of Belgium, zooming in on a monitoring station in the centre of Brussels, less than two kilometres from her home.

The reading, taken minutes earlier, shows high levels of ozone in Brussels. Indeed the website forecasts that levels will exceed EU target values later that day and again the following day (Figure 1).

Anna leaves her apartment building and makes for the nearest Metro station, a 10 minute walk away. Out on the street, the full impact of the city's traffic problems are easy to see — and smell.

Exhaust emissions from cars in the centre of Brussels, and all major cities, irritate the respiratory tract and eyes and lungs. Anna and Johan turn into their local train station and head for the countryside.

Soon, Anna and Johan are entering a national park just outside Brussels. A sign tells them that they are visiting a Natura 2000 site — one part of a European-wide ecological network, set up to secure natural habitats and to maintain the range of plant and animal life.

## Nitrogen

But what's that smell? A tractor is spraying liquid manure onto a field not far away. This is irritating, Anna thinks, but it's also part of real country life which is shown in a rather more romantic way in Johan's picture books.

The pungent smell is caused by as many as 40 different chemical substances emitted from the manure. Ammonia ($NH_3$), a volatile nitrogen compound, is one of them. In very high concentrations $NH_3$ is caustic and can damage the respiratory tract. However, the levels here are not dangerous for human health. Anna can breathe a sigh of relief, albeit a stinky one.

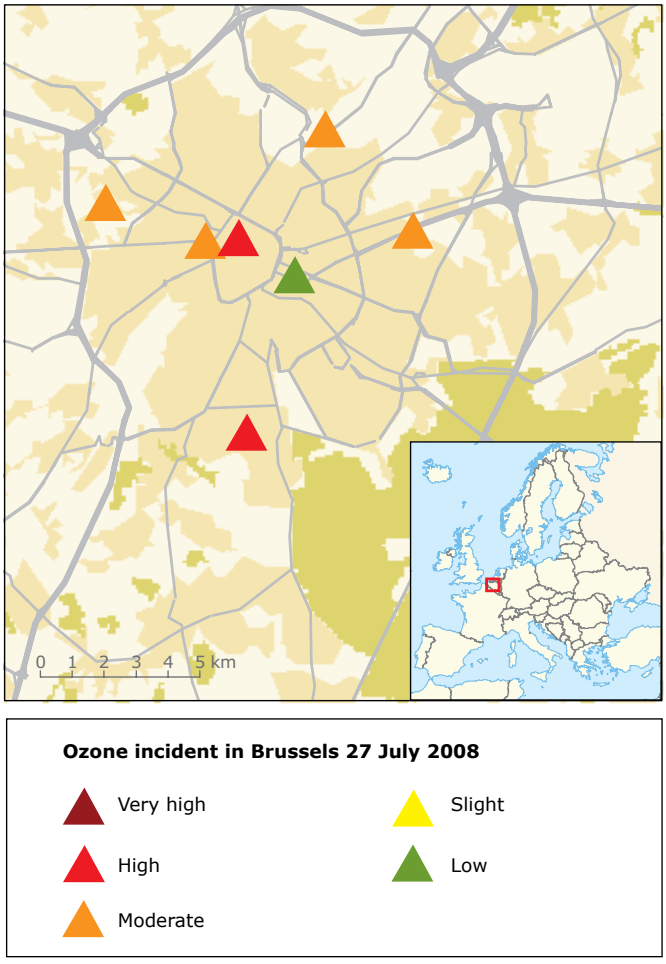



**Fig. 1 /** The location and levels of ozone at air quality monitoring stations in Brussels on Sunday 27 July 2008. When the ozone reading is above safe levels, a red triangle is displayed and the local government must notify the public and suggest precautions. Source: EEA, 2008.

([1]) Ozone pollution across Europe: http://www.eea.europa.eu/maps/ozone. A similar service, providing local information on particulate matter levels across Europe is being developed.

Nitrogen is an essential nutrient in nature. Reactive nitrogen forms are actually used by our bodies to produce proteins. However, excess nitrogen can lead to severe environmental and health problems.

'Acid rain' forms when high levels of sulphur and nitrogen oxides are present in the air. One of the great success stories of air pollution policy over the last decades has been the massive reduction in emissions of sulphur dioxide. The 32 EEA member countries reduced sulphur emissions by 70 % between 1990 and 2006. Nitrogen, on the other hand, has not been dealt with as successfully.

With sulphur emissions declining, nitrogen is now the principal acidifying component in our air. Agriculture and transport are the main sources of nitrogen pollution. Agriculture is responsible for more than 90 % of ammonia ($NH_3$) emissions alone.

Suddenly Johan, who has been walking unsteadily loses his balance and falls into a clump of stinging nettles. Having picked him up and brushed him off, Anna notices nettles everywhere. She has vivid memories of them as a child in a neighbour's garden. Then the nettles grew around a compost heap that was also used as a dump for poultry dung. That was no coincidence — the stinging plant is an indicator of high nitrogen concentrations in soils.

'Eutrophication' is the most likely cause of this explosion of stinging nettles surrounding Johan. It occurs when too many chemical nutrients (such as N) are available to an ecosystem either on land or in water. In water, excessive plant growth and subsequent decay occur, which in turn leads to further effects including oxygen depletion. Fish and other animals and plants ultimately suffocate as the oxygen supply is used up.

The abundance of the nettles here suggests that despite being a protected habitat, the Natura 2000 site is not immune from airborne nitrogen deposits. The fence protecting the area offers no defence — in fact building a greenhouse around the area would be the only way to protect it totally from airborne substances.

## Looking ahead

Because air pollution pays no regard to national boundaries the problem needs to be tackled internationally. The United Nations Convention on Long-range Transboundary Air Pollution (LRTAP Convention) agreed in 1979, has been signed by 51 countries and forms the basis of the international fight to tackle air pollution.

In parallel, the EU has developed polices limiting the total emissions of each Member State, setting legally binding limits. The 'National Emissions Ceiling Directive' (NECD) is a key EU policy. It sets 'ceilings' or limits for four pollutants: sulphur dioxide ($SO_2$), nitrogen oxides ($NO_X$), non-methane volatile organic compounds (NMVOCs), and ammonia ($NH_3$). Member States should meet these ceilings by 2010.

The EEA considers that further emission cuts are still needed in order to properly protect environment and health. An EEA analysis of the most recent NECD data ([2]) indicates that 15 Member States expect to miss at

## Climate change mitigation efforts will improve air quality

In January 2008, the European Commission proposed a Climate and Energy package to:

- reduce greenhouse gas emissions by 20 % by 2020;
- increase the share of renewable energy by 20 % by 2020;
- improve energy efficiency by 20 % by 2020.

The efforts required to meet these targets will also cut air pollution in Europe. For example, improvements in energy efficiency and increased use of renewable energy will both lead to reduced amounts of fossil fuel combustion — a key source of air pollution. These positive side effects are referred to as the 'co-benefits' of climate change policy.

It has been estimated that the above package will cut the cost of meeting EU air pollution targets by EUR 8.5 billion per year. The savings to the European health services could be as much as six times that figure.

([2]) The NEC Directive status report (EEA Technical report No 9/2008) documents the data officially reported by Member States at the end of 2007.

least one of their four ceilings; with 13 anticipating missing ceilings for the 2 nitrogen-containing pollutants $NO_X$ and $NH_3$ ([3]).

In 2009 the European Commission plans to publish a proposal to revise the current NECD, including stricter ceilings for the year 2020. National limits are likely to be proposed for fine particulate matter ($PM_{2.5}$) for the first time.

The NECD is mirrored by air quality directives setting limit and target values for major air pollutants. A new one called the Cleaner Air For Europe (CAFE) Directive was adopted in April 2008. For the first time it sets legally binding limit values for $PM_{2.5}$ concentrations (fine particulate matter), to be attained in 2015. The European Commission is also taking countries to task for having missed earlier limits and, where sufficient measures have not been outlined to improve performance, has begun infringement proceedings.

Later that evening Anna, while watching the evening news, sees that an air quality warning has been issued by the government in response to high ozone levels beyond the EU threshold. The warning advises people with breathing problems to take precautions such as avoiding strenuous exercise while the ozone levels remain high. ■

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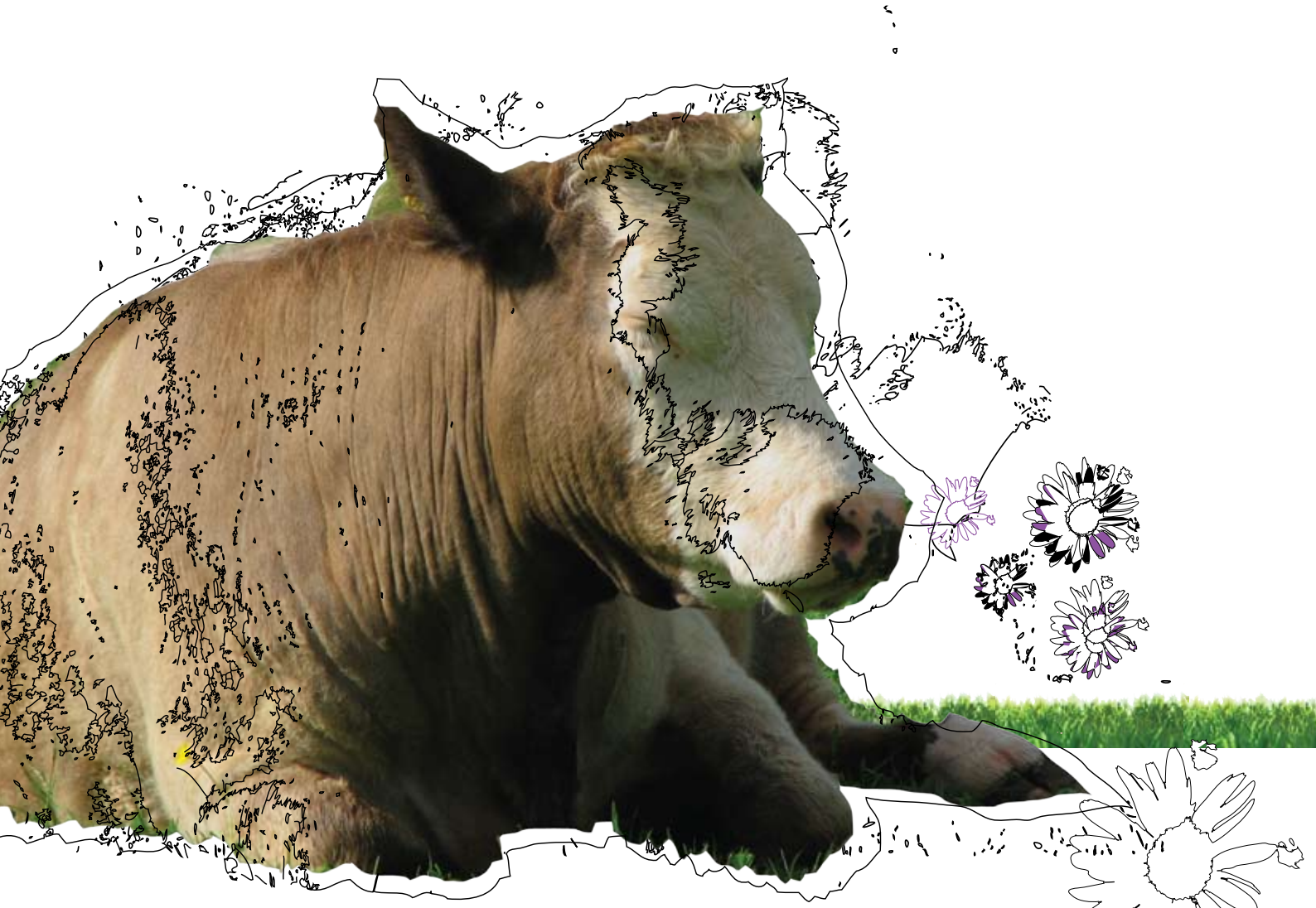
([3]) Belgium, France, Germany and the Netherlands believe that new policies and measures, not yet enacted, will help them reach their 2010 emissions ceilings. In addition, several other Member States believe they will over achieve their original ceilings.



# Taking CAP in hand

## Reform of the Common Agricultural Policy

**A shrinking resource** Almost 80 % of Europeans live in big cities, towns or the urban settlements between the two, far removed from the realities of agriculture. Our rural landscape nevertheless has a huge significance in terms of providing food, raw materials, fuel and recreational opportunities.

Farmers manage half of the EU's land area and have a huge impact on Europe's soil, water and biodiversity. Recent analysis shows that agriculture uses half of the water available in southern Europe. In the EU-15, farming causes almost half of the nitrogen pollution in rivers, 94 % of ammonia emissions and 9 % of total greenhouse gas emissions.

However, traditional agricultural practices have shaped our landscape and influenced the animals and plants living there. Many of our rarest species are actually dependent on the continuation of traditional farming practices.

High nature value (HNV) farmland is land that is particularly rich in habitats and species of conservation concern. It is often associated with traditional or low intensity agriculture, which is not very economical. Most farmers have intensified production or abandoned farming altogether — trends that threaten natural habitats.

An important agriculture policy challenge is to provide economic incentives to farmers for a continuation of wildlife friendly farming practices. The Common Agriculture Policy (CAP) has undergone a series of fundamental reforms since its birth in an era of post-war food shortages. The subsidy has increasingly been decoupled from its original goal of increasing food production and there is a stronger focus on rural development and environmental objectives.

CAP is currently undergoing a 'health check' by the European Commission, the European Parliament and Members States. In the context of the discussions on the future of the policy, the EEA is also preparing an analysis of the CAP focusing on 'targeting' of the subsidy's 'environmental' spending. Where is the money going and what effect is it having? What follows is a preview of some of our findings.

### CAP expenditure patterns

The EEA has analysed the current expenditure pattern to check how the CAP may contribute to maintenance of HNV farmland. Current data show the allocation of CAP funding at a national level. Information within countries is much less detailed. As a result the EEA has supported case studies in the Netherlands, Estonia, France, Spain and the Czech Republic in an attempt to evaluate spending in more detail.

The CAP is split into two pillars (see box). Pillar I provides direct aid to farmers and intervention in agricultural markets. Pillar II is dedicated to the development of rural areas and also funds environmental management schemes.

## The CAP in context

The CAP was introduced in 1962 and consumes 40 % of the entire EU budget. In 2007 this translated into over EUR 54 billion. Agriculture contributes to 1.2 % of EU GDP and 4.7 % of all jobs in the EU ([1]).

The CAP currently has two 'pillars':

- Pillar I provides direct aid and market interventions to secure food production and farmers' income, and making European agriculture more competitive. It is the dominant part of the budget, responsible for 77.5 % of the total CAP expenditure in 2006.
- Pillar II recognises the central role of farming as a supplier of food and goods, as the cornerstone of rural societies and as a potential environmental manager. The measures, implemented through Rural Development programmes, are aimed at restructuring the agriculture sector and encouraging environmental protection, diversification and innovation in rural areas.

([1]) Data for EU-25, 2006. European Commission, 2007b.

Countries with a high share of HNV farmland receive comparatively little under Pillar I of the CAP budget (Figure 1). This is not surprising given that this pillar was originally production-related and is most common in areas of intensive farming. Pillar II (rural development) expenditure per hectare generally increases with HNV farmland share. However, spending on agri-environment schemes — the element most related to conservation — is not strongly connected to the amount of HNV farmland in the areas studied (Figure 2). It should also be noted that this intervention accounts for less than 5 % of total CAP payments.

| | Lower share of HNVF | Higher share of HNVF |
|---|---|---|
| Higher than average spending | 6 Member States: Belgium, Denmark, France, Germany, Ireland, Netherlands | 2 Member States: Greece, Italy |
| Lower than average spending | 10 Member States: Czech Republic, Estonia, Hungary, Latvia, Lithuania, Luxembourg, Poland, Slovakia, Sweden, United Kingdom | 6 Member States: Austria, Cyprus, Finland, Portugal, Slovenia, Spain |

**Fig. 1 /** Cross-linking farm support (Pillar I) with an estimated share of high nature value (HNV) farmland per Member State.
Note: The HNV share is calculated on the basis of agricultural land area derived from the Corine land cover database. No data were available for Malta.
Source: Based on data from CAP Financial reports, various years.

| | Lower share of HNVF | Higher share of HNVF |
|---|---|---|
| Higher than average spending | 7 Member States: Belgium, Czech Republic, Germany, Hungary, Ireland, Luxembourg, Sweden | 5 Member States: Austria, Finland, Italy, Portugal, Slovenia |
| Lower than average spending | 9 Member States: Denmark, Estonia, France, Latvia, Lithuania, Netherlands, Poland, Slovakia, United Kingdom | 3 Member States: Cyprus, Greece, Spain |

**Fig. 2 /** Cross-linking agri-environment expenditure with an estimated share of high nature value (HNV) farmland per Member State.
Note: The HNV share is calculated on the basis of agricultural land area derived from the Corine land cover database. No data were available for Malta.
Source: Based on 2005 data, European Commission, 2007a.

If farm support and share of HNV farmland were correlated most Member States would be found in the top right and bottom left box. The fairly even distribution of Member States between all boxes shows that CAP support under the first pillar and for agri-environment schemes is currently not correlated with estimated share of HNV farmland when analysed at Member State level.

## Hiding in the tall grass

Black-tailed godwits are tall, long-beaked wading birds found along Europe's shoreline and in wet meadows. In 1975 there were 120 000 breeding pairs in the Netherlands. Today there are about 38 000. Numbers of breeding pairs are dropping across Europe.

Godwit chicks must eat about 20 000 insects in the first week of their life if they are to survive. Scientists agree that earlier mowing practices by farmers are at the root of the godwit population decline. The first grass cutting in the Netherlands happens three weeks earlier then 40 years ago, probably due to improved fertilisation. Insect populations are much higher in tall grasses and increase even further in grasslands that have not been heavily fertilised. In short grass, parent birds simply cannot find enough insects to feed their chicks in those crucial first days. Predators have also become a larger threat because chicks are easy prey in the open short cut grasslands.

In 2006 EUR 1.2 billion of the CAP budget was allocated for the Netherlands, some of which was used to encourage later grass-cutting. Studies have shown that the survival rate of godwits chicks doubles on pastures benefiting from the late cutting.

However, these measures are not sufficient to stabilise the godwit population. To increase survival sufficiently, payments for late mowing must become part of a comprehensive package that includes greater vegetation, lower nitrogen inputs and controlled water tables. Conclusions from this example could be applied to the entire CAP budget in terms of its environmental improvement efforts: the CAP is having an effect but it's not effective enough.

However, this 'package' of measures would be very expensive. Instead, the case study for the Netherlands, part of a forthcoming EEA report, concludes that agri-environment payments should be targeted at a limited number of pasture areas where godwit numbers are still high and predators are limited. In these areas a combination of measures should be taken such as late and irregular mowing, low nutrient inputs and maintenance of high water tables.

This in a nutshell sums up the challenge facing CAP where targeting of funds and design of policy at a local level is crucial. In 2006, EUR 1.2 billion was spent under Pillar I in the Netherlands; EUR 83.2 million was spent under Pillar II. The single farm payments, under Pillar I, are still very much targeted at farms with a high productivity because current support payments are linked to the historic distribution of subsidies.

## Consequences for biodiversity

Ultimately, the effect of the CAP payments on maintenance of HNV farmland is what counts in this analysis. The available information does not support a clear answer due to a lack of spatial detail. In addition, the interactions between types and intensity of farming and the nature value of farmland are complex and do differ from region to region.

HNV farms are more dependent on CAP funding for their income than intensive farms, which do not support biodiversity. The EEA case studies confirm that the majority of Pillar I subsidies are targeted to the most productive areas. Biodiversity is low here and the subsidy provides little incentive to environment-friendly production. Pillar II expenditure is more positively correlated with HNV farmland and this, in principle, is good news for the maintenance of these farms.

Assessing whether the subsidies are adequate to prevent both land abandonment on the one hand and intensification on the other, however, would need further study. The evidence regarding the implementation of agri-environment schemes suggests that their effectiveness could be improved. Some of the measures are promising whilst others show little effect. In addition, depopulation of the countryside and changing lifestyles may be posing overarching threats to traditional farming systems that in the long run cannot be solved through subsidies.

## Looking ahead

Funding for the CAP will be part of a major review of the entire EU budget in 2009–2010. Reconciling the different functions of the CAP (securing food production, supporting farm incomes, protecting the environment and improving quality of life in rural areas) and making sure that EU taxpayers' money is spent efficiently is challenging. The limited information available suggests that the current distribution of CAP funds is not very effective from the perspective of achieving EU environmental objectives, in particular on nature protection.

One further result of the EEA analysis is that the available statistical information on CAP spending patterns is still not sufficient to properly evaluate the effects of this important policy. In simple terms, even though we spend almost half the EU's budget on the CAP, we do not have enough information to say exactly where the money is going or exactly what it is achieving.

Pillar I support, although now partially decoupled from production, does little to enhance the biodiversity found on farm land. Enhancing Pillar II and targeting measures at high nature value farmland is a valid option, but requires careful design and evaluation to prevent unintended negative impacts. ■

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# Fish out of water

## Marine management in a changing climate

**A fisherman's tale** On the night of 6 October 1986 lobster fishermen from the small town of Gilleleje, north of Copenhagen, fishing the Kattegat Sea, found their nets crammed with Norway lobster. Many of the animals were dead or dying. About half were a strange colour.

Observations of dissolved oxygen in the water in combination with the dead lobsters told researchers at the National Environmental Research Institute in Denmark that an unusually large area on the bottom of the southern Kattegat was devoid of oxygen. The strange events were caused by 'anoxia' or lack of oxygen on the sea bed that night. Scientists believe the lobsters were suffocating!

Twenty-two years later, large parts of the Baltic are affected by anoxic areas or 'dead zones'.

### Collapse of the Bornholm fisheries

Bornholm, an idyllic Danish island situated at the entrance of the Baltic Sea more or less between Sweden, Germany and Poland, is well known for its smoked herring. For centuries the abundance of fish was the cornerstone of the local economy.

In the 1970s about half of the fisheries income came from cod. By the end of the 1980s cod fisheries had increased to 80 % of the total value. Many fishermen imagined a bright future and invested in new vessels. However, by 1990 the catch was on a steep decline. It has never recovered. This collapse put huge financial pressure on the local community.

The scale and rapidity of the collapse of cod stocks in the Baltic has meant that a lot of energy has gone into understanding what caused the boom and subsequent collapse. The region has become an international case study with lessons for other regions. The Baltic story is not a simple one — indeed the complexity of the situation illustrates the challenge facing policy makers in the marine environment.

### Fishing for data

Bornholm fishermen, just like their counterparts around Europe, are legally bound to tight restrictions under the Common Fisheries Policy that establishes how many fish of which kind can be caught where.

The International Council for the Exploration of the Sea provides the scientific advice on the biologically safe levels. Fisheries survey data, fish catch statistics and environmental monitoring of oceanographic conditions provide invaluable data in terms of assessing the health of the most fished commercial species. In particular, the number of fish of a certain age in an area is important. The more young fish that survive in a year, the more fish can be expected to be caught two to five years later when the fish are mature. And the more mature fish that are available, the more eggs that are spawned.

> **“If left alone for two years, the cod population in the Baltic would recover”**
> *Henrik Sparholt, ICES Advisory Programme Professional Officer*

Following the scientific advice, decisions on total allowable catches (TACs) are made by EU Member States. These decisions often reflect priorities other than the protection of stocks. In 2006, approximately 45 % of the assessed fish stocks in Europe's Seas were fished outside safe biological limits. These fishing levels were agreed at the ministerial level.

### Fish breathe oxygen dissolved in water

Particularly since the 1960s increased use of artificial fertilizers in agriculture as well as urbanization has led to a dramatic rise in nutrient inputs — pollution — into the Baltic Sea. This has lead to increased phytoplankton growth and fish production (more phytoplankton means more food for fish). However, it has also resulted in increased problems with anoxia in the deepest waters of the sea.

When water near the seabed becomes anoxic, hydrogen sulphide is released from the sea floor into the water. Hydrogen sulphide is toxic to most life forms, and it was probably a combination of hydrogen sulphide and lack of oxygen that killed the Norway lobsters in the Kattegat that night back in 1986.

The anoxic areas in the Baltic Sea are now so large that they have led to a reduction in the size of potential spawning areas in the Central Eastern Baltic. This reduces the spawning success of cod.

## Why were the early 1980s such good years for cod fisheries?

The high survival rate of cod eggs and larvae from 1978–1983 is explained by four factors. The primary explanation is that fishing pressure was reduced in the late 1970s. Secondly, climatic conditions brought inflows of high salinity water from the North Sea. The Baltic was actually a freshwater lake until sea levels rose about 8 000 years ago, allowing the North Sea to flow into the lake. Saltwater 'intrusions' into the Baltic are still important in terms of maintaining salinity and oxygen levels.

These inflows led to higher oxygen concentrations in the cod spawning areas and hence to high egg survival and thus more juvenile fish. Thirdly, there was an abundance of copepod larvae (*pseudocalanus acuspes)*, the major food source for cod, and finally, there was a shortage of predators such as sprat and seals. Sprat prey on cod eggs and seals prey on cod.

## And what went wrong?

Since the mid-1980s there have been fewer major inflows from the North Sea, leading to poor conditions for egg survival, and fewer juvenile fish. The reduced salinity has also led to reduced abundance of copepods, a staple food for larvae. Although the limit for biologically safe levels for fishing was reduced in the following years, the politically agreed catch (TAC's) has normally exceeded this level (Figure 1).

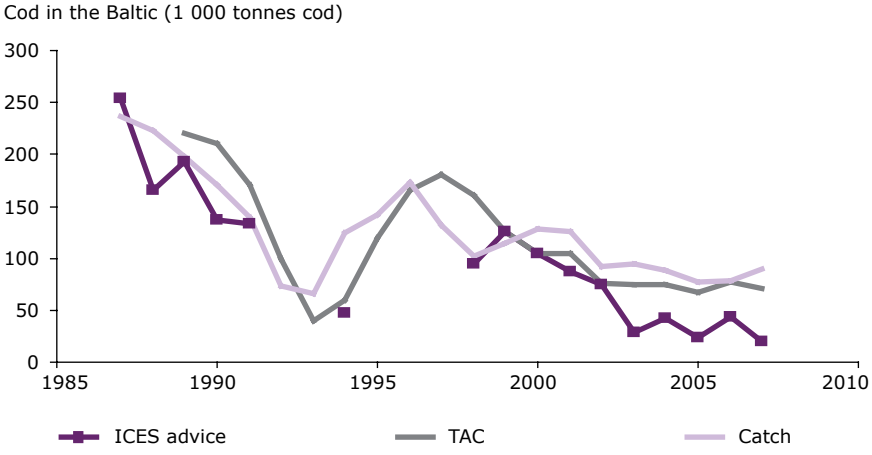


**Fig. 1 /** Scientifically recommended catch levels (based on ICES advice), agreed total allowable catch (TAC) and actual catch in the fishing areas around Bornholm, in the years 1989–2007. In almost every year when the cod stock has been assessed, the TAC has been set higher than the recommended level. The TAC exceeds the recommended level by more than 100 % in some of the most recent years. Interestingly, the actual catch is commonly higher that the TAC because estimated illegal fisheries are also included in the figures. Source: EEA, 2008.

Illegal fishing adds to the problem. It has been estimated that an additional 30 % is landed illegally in this part of the Baltic Sea. In the summer of 2007 the illegal landings by the Polish fishing fleet were so extensive that Polish fisheries were stopped by the European Commission in the second half of 2007.

## And then climate change!

Climate change is affecting both the temperature and the salt balance of the Baltic. Temperature rise in the deep water will increase the metabolic demand for oxygen and reduce solubility of oxygen in the water. In turn, this will contribute to the wider geographic spread of anoxia. Salinity in the Baltic has decreased steadily since the mid 1980s due to increased rain and reduced flows from the North Sea into the Baltic Sea.

Both factors are driven by climate. Quite a small reduction in the salinity is already tipping the balance and changing the composition of the Baltic habitat. Of the three major fished species, cod, herring, and sprat, cod is particularly sensitive to reduced salinity because salinity affects both their reproductive capacity and the availability of the preferred food for cod larvae.

Projections for the future ocean climate of the Baltic are for continuing increases in rainfall and decreases in inflows from the North Sea. This means that stocks of cod and other marine fish are likely to decline further unless fishing pressure is reduced.

## Hope for the future

In response to the complex and severe environmental problems in the Baltic Sea, the countries in the region have agreed a 'Baltic Sea Action Plan' to develop national actions towards integrating agricultural, fisheries and regional policies. This plan, adopted in

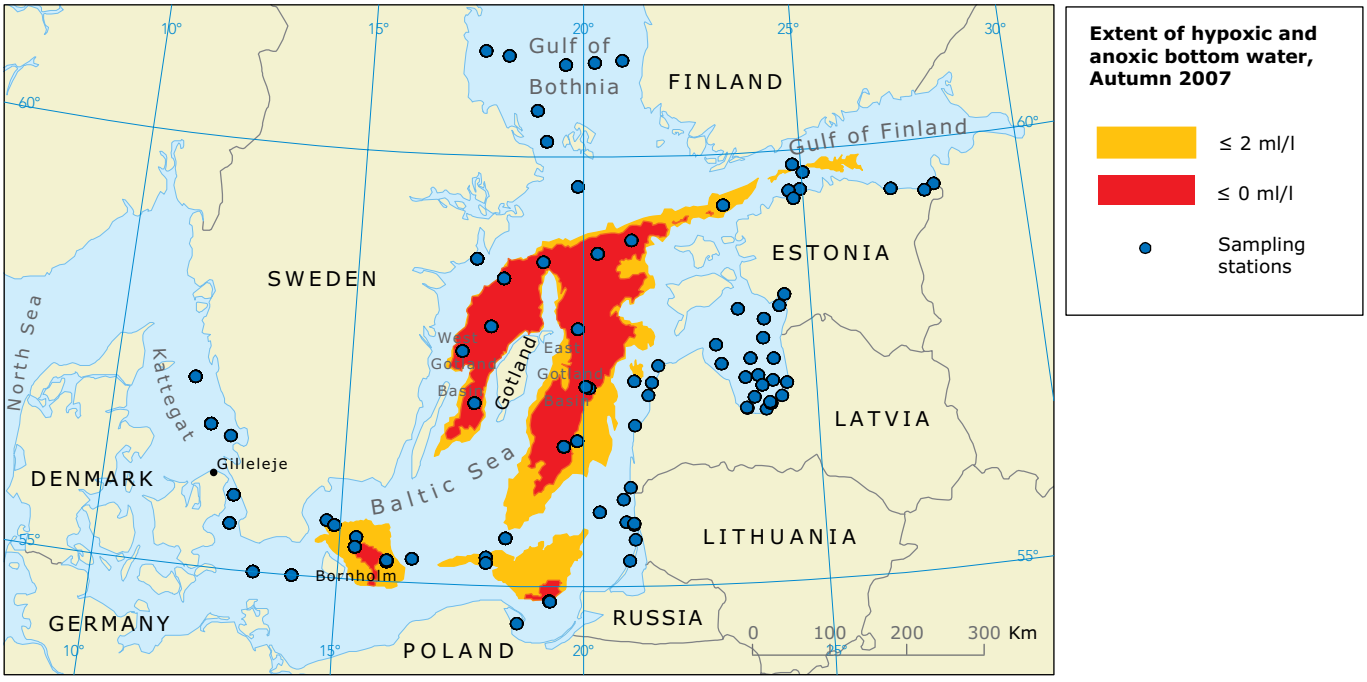


**Fig. 2 /** Estimates of the extent of hypoxia (oxygen content less than 2 ml/l) and anoxia (oxygen content nil; often with presence of hydrogen sulphide-which reacts with oxygen to produce sulphate. When this reaction occurs, oxygen concentrations are considered negative) in Autumn 2007. Over time, there has been a steady increase in the area affected by hydrogen sulphide in the East and West Gotland Basins, and the outer Gulf of Finland. Water from the Gulf of Finland does not enter into the Gulf of Bothnia. As a result, despite its depth, it remains well oxygenated, even during autumn.
Source: http://www.helcom.fi/environment2/ifs/ifs2007/en_GB/HydrographyOxygenDeep/.

> **“Climate change will alter the Baltic Sea and its ability to support exploitable cod populations. Management will need to accommodate these changes if the stock is to stay at a commercially relevant level”**
> *Professor Brian MacKenzie, DTU-Aqua, Technical University of Denmark*

November 2007, is an important basis for more effective implementation of EU policy in the area.

This includes the new Marine Strategy Framework Directive, according to which bordering countries should achieve a 'good environmental status' of the Baltic Sea by 2020, including a requirement that fish communities are brought back to 'a good state'.

In addition, the European Commission is developing a Baltic Sea Regional strategy which will lead to an action plan defining the key players, the financial instruments to be deployed, as well as a work schedule. This strategy's adoption by Member States will constitute one of the priorities of the Swedish EU Presidency, in the second half of 2009. Sweden has identified the Baltic Sea environment as one of its top priorities.

The Common Fisheries Policy (CFP) was designed to regulate fishing activities from an environmental, economic and social point of view. However, many of the most commercially valuable fish species in Europe have been heavily over fished and their populations are now below safe biological numbers. The nature of the legislation makes it costly and difficult to successfully prosecute Member States who over-fish.

The obvious lack of success in sustainable management of many of its fish stocks has led marine experts to call for major revisions to the policy, which is clearly the product of compromise between countries. The marine environment should be treated as an ecosystem rather than as sectors to be exploited.

The EU Commissioner for Fisheries and Marine Affairs, Joe Borg has even said that the CFP 'does not encourage responsibility by fishermen or politicians' and launched an immediate review of the policy in September 2008, four years ahead of schedule. ■

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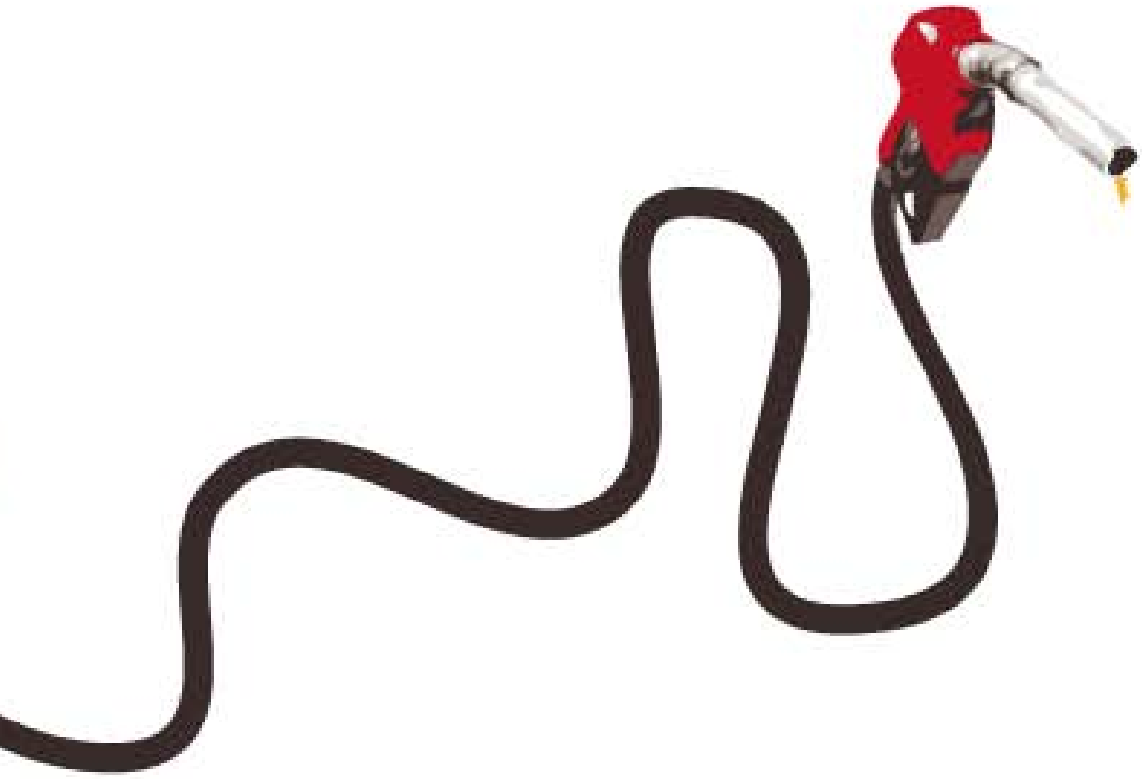
# If bioenergy goes boom

**The switch from oil to bioenergy is not risk free**

Bioenergy is not new. For millennia, people have been burning wood. The industrial revolution in the mid-1800s brought so called 'fossil fuels', mainly coal and oil, to the fore. However, fossil fuels are becoming more difficult to find and extract, more expensive, and subject to intense political debate.



Bioenergy is on the verge of becoming big business. It is already the dominant renewable energy source ([1]) in Europe and its production is likely to increase greatly in the coming decades. Biofuels have been hailed as a good way of greening transport and avoiding expensive oil imports.

The subject of biofuels made world headlines for negative reasons in 2008, mainly in association with rising food prices. The EEA's work on biofuels is restricted to the environmental pros and cons. Even here, there is controversy.

A move towards large scale bioenergy production bears considerable environmental risks, mainly in terms of land-use change. Soils and plants are the two largest stores of $CO_2$ on earth — containing twice as much carbon as our atmosphere. Converting forest, peat or grasslands en masse to biofuel crops would release more $CO_2$ than it would save.

Expanding arable crop production in Europe to satisfy the combined food and fuel demand would have serious impacts on Europe's biodiversity and damage our soil and water resources. Knock-on effects, so-called 'indirect land-use changes', would impact elsewhere in the world: as Europe cuts back on food exports, other areas of the world would increase food production to fill the gap. Impacts on global food prices could be significant.

However, risks within Europe could be lessened with the right choice of crops and management. Biofuels made from waste, from crop or forestry residues for example, do offer environmental advantages. In this context, the EEA has been looking at how the impending bioenergy boom might develop, and considering whether it can provide the energy we need without damaging the environment.

## Rushing to renewables

The European Commission has proposed a mandatory target: 20 % of all European energy should come from renewables (that's all renewable sources: wind, solar, wave, etc. as well as bioenergy) by 2020. At the moment, renewables account for 6.7 % of European energy consumption. Two thirds of this comes from biomass.

The European Commission is also keen to promote biofuels — fuel for transport — as diversification is particularly important in transport because of its dependence on oil. The transport sector is also increasing greenhouse gas emissions and eating up emissions savings achieved by other sectors.

The Commission has therefore proposed that biofuels make up 10 % of road transport fuel by 2020, providing they can be certified as sustainable. Data

## Bio-jargon

**Biomass:** refers to living and recently dead biological matter. This can be from crops, trees, algae, agricultural, forest residues or waste streams.

**Bioenergy:** all types of energy derived from biomass, including biofuels.

**Biofuel:** liquid transport fuels made from biomass ([2]).

([1]) Renewable energy includes energy derived from wind, sea, sun, hydropower, etc.
([2]) The term biofuel can be used for all fuels (solid, liquid or gas) for any purpose derived from biomass. However, in the context of this analysis it refers specifically to fuels for transport.

from 2007 show that biofuel makes up 2.6 % of road transport fuel in the EU.

To achieve 10 %, the European Union must increase production and imports of biofuel at a time when biofuels are at the centre of complex ecological and economic debates.

The EU biofuel target is surrounded by more and more debate. The European Parliament has recently called for a guarantee that 40 % of the 10 % target will come from sources that do not compete with food production. The EEA's own Scientific Committee has warned that increasing the share of biofuels used in transport to 10 % by 2020 is overambitious and should be suspended.

## Global impacts — food prices and land-use change

Promoting biofuels and other bioenergy in Europe inevitably triggers direct and indirect effects elsewhere. For example, in Europe we could produce biodiesel from rapeseed oil in a sustainable manner, but less rapeseed oil would be available for food production inside and outside Europe.

The gap is likely to be filled in part by palm oil. However, this would result in the loss of rainforest, as trees in countries such as Indonesia are felled to facilitate the extra palm crops.

Worldwide, biofuel demand is one of many factors contributing to the recent rise in food prices, along with droughts in key producer countries, increasing meat consumption and rising oil prices, etc. The Organisation for Economic Cooperation and Development (OECD) estimates that current and proposed biofuel support measures in the EU and US increase average wheat, maize and vegetable oil prices by about 8 %, 10 % and 33 %, respectively, in the medium term.

Increasing world food consumption, and the additional demand for biofuel, is leading to an expansion of world cropland at the expense of natural grasslands and tropical rainforest. This is important because deforestation and farming practices are currently responsible for an estimated 20 % of global greenhouse gas emissions. Large scale conversion of forests to cropland increases this share and has serious impacts on biodiversity.

Wildlife, and water quantity and quality could also suffer if large areas are converted from natural habitats or traditionally farmed areas, and brought into intensive production for bioenergy.

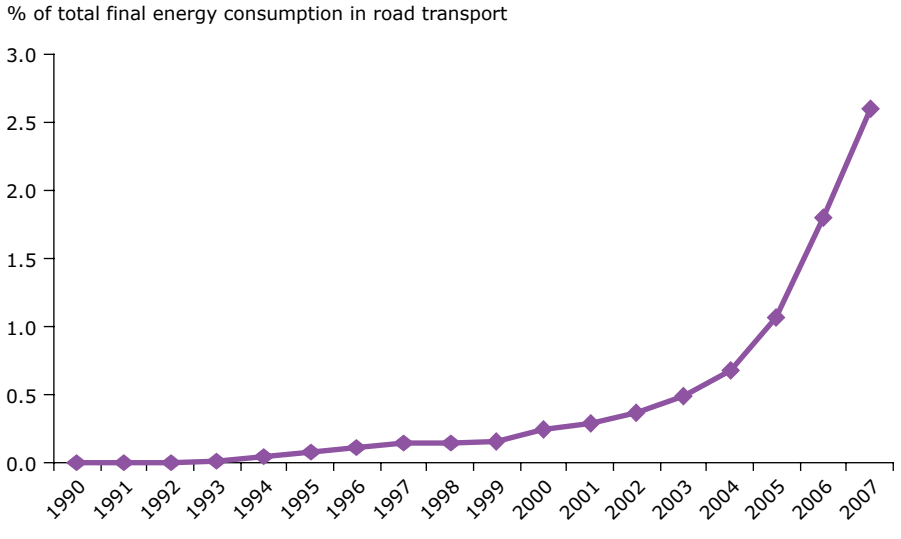



**Fig. 1 /** Final energy consumption of biofuels — as % of final energy consumption in road transport fuels, EU-27. Source: Eurostat, 2007; figure is derived from EurObserv'ER, 2008.

## Visible impacts

Recent scientific attempts to estimate the impacts of increased bioenergy production have started to show results and patterns and the EEA is keen to draw attention to these.

A study in Brazil used satellite images and ground surveys to show that the rate of forest conversion to cropland in the Amazon is correlated with global soy bean prices — the higher the price of soy, the more rainforest is felled. And there is little doubt that demand for bioethanol is driving up the price as soybean acres are converted to corn crops for US bioethanol.

Meanwhile, Tim Searchinger and researchers from Purdue University, USA, used a global agro-economic model to explore how large scale growth of corn and switchgrass for bioethanol in USA could shift production of food crops elsewhere in the world, where forests and grasslands are converted to arable to fill the food gap.

Their research estimates that greenhouse gas emissions associated with bioethanol will be higher than those associated with fossil fuel use, for 50 years or more. This is because grassland and forests act as $CO_2$ stores. Converting them to a crop type suitable for producing biofuel would

do away with this storage function. It would take decades for the benefits to outweigh the negatives.

The impacts on biodiversity and natural resources such as water are more difficult to measure. Increased corn production in the mid-West United States, for example, threatens marine life in the Gulf of Mexico, where a dead zone more than 20 000 $km^2$ has been created by the high nutrient inputs from the Mississippi. According to one recent study, meeting the 2022 targets in the US energy bill will increase nitrogen loads in the Mississippi by 10–34 %.

### Modelling the future

In 2006 an EEA study estimated that 15 % of projected European energy demand in 2030 could be met with bioenergy derived from agricultural, forestry and waste products, using only European resources. This estimate is referred to as Europe's 'biomass potential'. The study imposed a set of conditions protecting biodiversity and minimising waste to ensure the 'biomass potential' was not damaging to the environment.

Following this, in 2008 the EEA used the Green-$X_{ENVIRONMENT}$ model, originally designed to study renewable electricity markets, to analyse how to use this environmentally compatible 'biomass potential' in the most cost-effective way from an environmental point of view.

The study suggests that the most cost-effective way of using the 'modelled' biomass potential would be to supply 18 % of Europe's heat, 12.5 % of its electricity and 5.4 % of its transport fuel from biomass by 2030.

By decreasing fossil fuel use in all three sectors, this could cut 394 million tonnes of carbon dioxide emissions by 2020. Even greater emissions reductions would be achieved if policies were put in place to prioritise the use of Combined Heat and Power (CHP) technology in electricity and heat generation. This process harnesses the heat that is a by-product of energy production.

There are costs, of course. Enhancing bioenergy use is around 20 % more expensive than a similar model of conventional energy by 2030. Ultimately, consumers would bear this cost.

Developments since this work was started, especially increases in global food prices, indicate that the 'biomass potential' estimates are on the high side: less land is likely to be available in Europe for growing bioenergy crops. Also, high oil prices could also affect the results.

However, a clear message still emerges from the exercise: it would be better, in terms of costs and climate mitigation, to prioritise bioenergy for electricity and heat generation using CHP plants rather than focus on fuel for transport.

### Looking ahead

To avoid the negative impacts of a switch to bioenergy described above, we need strong policies at international level to prevent land-use changes adding to environmental problems in the pursuit of bioenergy. The challenge is clearly global, and we need a global debate on how to halt loss of biodiversity and address climate change at the same time, while taking into account the global need for increased food production and the daunting price increase in oil.

EEA researchers believe that Europe should actively seek to generate as much bioenergy as possible domestically whilst sustaining a balance between food, fuel and fibre production, and without compromising ecosystem services. We should move on from biofuels, and begin serious research and development of advanced biofuels (see box). And let's do it in a way that considers all the environmental impacts, including effects on soil, water and biodiversity as well as greenhouse gas emissions. In this way the EU can take the lead in building a truly sustainable bioenergy sector. ■

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## Promise of the next generation

Second generation biofuel production processes can use a variety of non-food feedstocks. These include waste biomass, wood, the stalks of wheat or corn, and special energy or biomass crops such as Miscanthus.

Second generation biofuels can lead to more substantial greenhouse gas emission reductions and can reduce other adverse effects such as fertiliser use but it is unlikely that they will be available in time to make a substantial contribution to the target of 10 % transport biofuels by 2020. A lot more research is needed on these production processes and their impacts and opportunities. Moreover, competition for land and water between dedicated energy crops and food crops will likely remain.

# Not in my back yard

## International shipments of waste and the environment

### Waste without borders

Zhang Guofu, 35, makes EUR 700 a month, a huge wage in provincial China, sifting through waste that includes shopping bags from a British supermarket chain and English-language DVDs. The truth is that waste placed in a bin in London, can quite easily end up 5 000 miles away in a recycling factory in China's Pearl River delta.

Waste of all descriptions is on the move. Increasing amounts, especially of waste paper, plastics and metals are being shipped from developed countries to countries where environmental standards are less stringent. Huge ships steam around the high seas everyday carrying goods from emerging markets in Asia to the West. Rather than sail back empty, and needing something to provide ballast, the ship owners are only too happy to take waste products from Europe to be recycled back in Asia.

That does not mean that shipments of waste are not regulated. Both the UN and the EU have strict rules on what can be shipped where. At the global level international trade of 'hazardous wastes' (waste that is potentially dangerous for people or the environment) is regulated by the UN's Basel Convention.

The ban contained in this Convention has not been signed by enough countries to bring it into force globally. However, the EU does have restrictions in place and only allows 'hazardous waste' be exported to 'developed countries' where the necessary technologies exist and sufficient safety and environmental laws are in place. A 'developed country', for the purpose of the restrictions, is defined as a member of the Organisation of Economic Co-operation and Development (OECD).

The EU's long term aim is that each Member State should dispose of its own waste domestically (the 'proximity principle'). However, as shipments of hazardous and problematic waste for disposal from EU Member States nearly quadrupled between 1997 to 2005, this aim has yet to be fulfilled.

The factors driving the export and import of waste vary: availability of special treatment technology; a shortage of materials; differences in prices for disposal or recovery.

EU policy, setting targets for recycling, also leads to waste shipments from Member States who cannot meet their targets at home. The volumes of waste on the market keep costs low for a country like China, which needs cheap raw materials. As long as this waste is not for disposal at its destination and does not contain hazardous materials, it is deemed to be an acceptable trade.

## Is your old TV better travelled than you are?

Europe has a body of legislation in place regarding the shipment of hazardous and problematic waste. However, further evidence is required as to the effectiveness of the legislation in terms of easing pressure on the environment.

Electronic waste, which is considered hazardous, is an important case. In Africa and Asia it is often dismantled with little or no personal protection equipment or pollution control measures. Components are often burnt in the open to retrieve metals and fly ash particulates laden with heavy metals and other toxic materials are usually emitted, resulting in increased human exposure, as well as contamination of food, soil, and surface water.

We do not have a clear picture when it comes to waste electrical and electronic equipment (WEEE) shipped within and out of the EU partly because ambiguous codes are used for the reporting of shipments of electronic waste. It is difficult to tell if a television is being exported as a second hand device, which is acceptable or as waste for disposal, which is not. In general, export of WEEE from the EU to non-OECD countries is prohibited. However, the export of a TV that still works is perfectly acceptable.

There have been well documented cases that break this ban. Indeed, it appears that a significant portion of the exported used television sets, computers, monitors and telephones to non-OECD countries are waste purchased with the intentions of retrieving the components and elements mentioned above.

If the EU cannot sufficiently enforce its own prohibition on exporting WEEE to non-OECD countries, this could seriously undermine the ratification of the ban at the global level under the Basel Convention.

## Tracking down good data on electric and electronic waste

Despite the difficulties associated with finding, checking and analysing data on waste, the EEA in partnership with the 'European Topic Centre on Resource and Waste management' has carried out an analysis of shipments of waste from the EU to other regions.

Using European trade statistics it is possible to identify the amounts, size and value of exports of used electronic and electrical products shipped from the EU to other regions (Figure 1).

In 2005, more than 15 000 tonnes of colour television sets were exported from the EU to African countries. In Nigeria, Ghana and Egypt alone about 1 000 TV sets arrived every day. The average value of exported colour television sets to Africa is very low: for Africa as a whole the price per unit was EUR 64 and EUR 28 on average for the three countries mentioned above. In comparison, TV sets traded within Europe have an average value of EUR 350.

The low value per unit for TV sets sent to Africa suggests that many of these exports are in fact used products, much of which is likely to be waste.

As these figures are for television sets only, the total export of used computers, mobile phones, CD players etc. to these regions is expected to be significantly higher. This suggests that the EU ban on the trade of hazardous waste with non-OECD countries is being broken.

## Non-hazardous waste

Between 1995 and 2007 (Figure 2), shipments of non-hazardous waste such as paper, plastic and metals shipped out of the EU also increased dramatically, mostly to Asia, particularly China.

The amount of waste paper exported to Asia increased by a factor of ten. For plastics the increase has been a factor of eleven and for metals a factor of five. The shipped waste has also increased within the EU, but at much lower level.

In 2007 as much waste paper was shipped to Asia as was shipped from one EU country to another. The quantity of metals shipped within the EU was larger than the amount shipped to Asia. However, the EU shipped more plastic waste to the Asian market than within the EU.

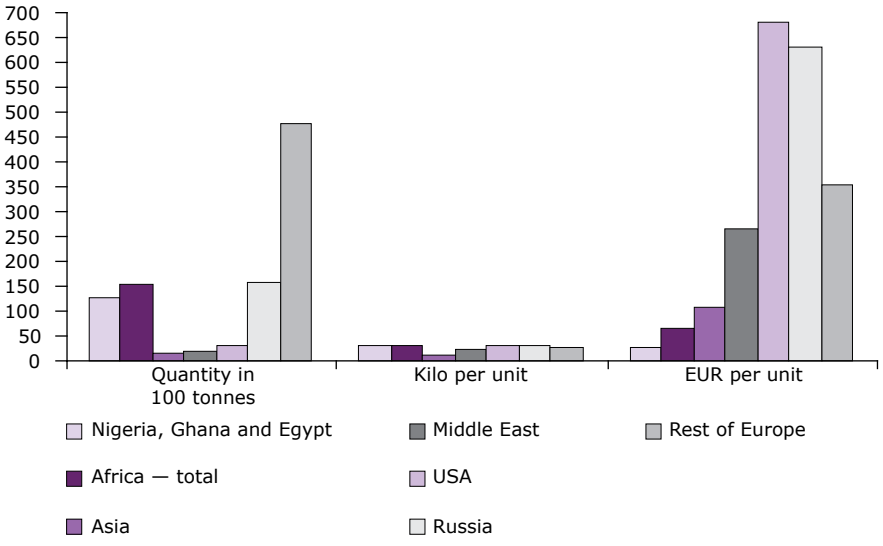


**Fig. 1 /** Export of colour television sets from the EU-25 to Africa, Asia, the Middle East, USA and other European countries, 2005. Source: EEA.

## Driving forces behind recycling

For over a decade, the cost of raw materials has been very high and this, in turn, has increased the value of secondary raw materials reclaimed through recycling.

Waste metals, paper, plastics and other waste materials from Europe are feeding the booming Asian economy, which cannot be met by 'virgin' material.

EU legislation (such as the Packaging Directive) requiring Member States to achieve levels of recycling, also indirectly encourage the shipment of waste material for recycling.

The EU requirements for specific recycling rates have led to increasing amounts of recyclable waste materials on the market. For example, the amount of paper and cardboard 'packaging waste' that is recycled increased from about 24 to 30 million tonnes between 1997 and 2005. The amount of plastic packaging recycled has increased from about 10 to 14 million tonnes in the same period.

Is it good for the environment?

The use of recycled waste materials instead of virgin materials is generally good for the environment. For example, a kilo of paper made from recycled raw materials uses half the energy of production using virgin materials. Aluminium produced from recycled aluminium can use as little 5 % of the energy needed using virgin materials.

In general, recycling therefore contributes substantially to the reduction of energy-related emissions of $CO_2$ and other environmental pressures.

However, because we often don't know what happens to waste after it has left a European port, we cannot say whether an individual shipment, and thus shipments in general, are good or bad for the environment.

## Looking ahead

Within the EU, transboundary shipments of waste for disposal, as well as 'hazardous and problematic' waste for recovery, must be notified to the national authorities. This 'national' notification is very detailed. However, a summarised version of the data on the shipments is all that is passed onto the European Commission, so the overview at an EU level is unclear.

If more detailed information, especially on the types of waste shipped, were reported, the overview would allow a much better assessment of the environmental and economic consequences of the shipments. It could help us to tell whether waste shipments are driven by better treatment options, greater capacity or effective pricing. We would better understand the role of lower standards, missing legislation and poorer enforcement as drivers of shipments to less developed regions. A clearer view of legal shipments at the EU-level would also give a better indication of illegal shipments.

As this level of reporting is already going on at national levels — many countries already generate more detailed national statistics on import and export of waste — the increased reporting would not increase significantly the burden on the Members States. ■

## The EU — a common market for waste

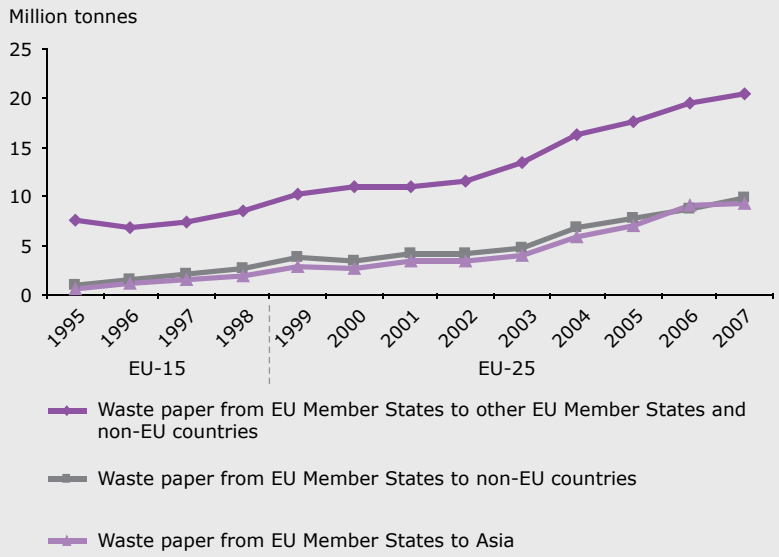


**Fig. 2 /** Developments in shipments of paper waste as an example of non-hazardous wastes out and within the EU from 1995 to 2007. Source: EEA.

Within the EU it is possible to ship all kinds of wastes for disposal or recovery between Member States. Everyday a freight train carries 700 tonnes of municipal waste from Naples in Italy to Hamburg in Northern Germany for incineration (with energy recovery) This eases the waste 'situation' in Naples in the short term, but a more sustainable solution will have to be found.

A key aim is that each EU Member State should dispose of its own waste. However, this has yet to be achieved. In 2005 20 % of the waste shipped was for disposal while 80 % was shipped for recovery operations.

The EU is increasingly acting like a common market in terms of hazardous and problematic waste treatment. Indeed, from 1997 to 2005 the export of these types of waste from one EU Member State to another quadrupled.

The data do not facilitate an analysis of whether the shipped waste receives better treatment at its destination, so we don't know whether it is bad for the environment. More detailed reporting of national data to the EU could facilitate this.

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# Environmental stories for 2010

Signals is an annual publication from the EEA. Here are some topics that may feature in 2010:

## Better policy needs better information

Passengers on ferries sailing between Northern Denmark and Norway can view information on the sea water below relayed on TV screens. The data are collected by specialised equipment on the ships and are used by researchers to monitor the marine environment in the area.

The simple act of making environmental information, gathered for research purposes, available to the passengers is a simple but important step — one that must be replicated on a much grander scale if we are to make full use of the data and engage and empower the public environmentally.

Robust, far-sighted policy also requires better, more detailed information. The European Environment Agency wants to help drive technology, particularly the Internet, in new directions in terms of its interaction with the environment.

Two new EU initiatives, in which the EEA is playing a leading role and which will be further developed throughout 2009, are at the heart of this drive. They are the Global Monitoring for Environment and Security (GMES) and the Shared Environmental Information System (SEIS).

GMES will use satellites and sensors on the ground, floating in the water or flying through the air to monitor our natural environment. The information provided through the GMES initiative will help us understand better how, and in what way our planet may be changing, why this is happening, and how this might influence our daily lives.

SEIS is a collaborative initiative of the European Commission, EU Member States and the EEA. It will harness the wealth of data collected locally and at national level by connecting one system to another until a European wide network exists with which the public can interact via the Internet.

## Arctic Ocean

As temperatures rise and sea ice melts, expectations of large undiscovered oil and gas resources are already driving the focus of the oil industry and governments northwards towards the Arctic Ocean, according to the EEA report, 'Impacts of Europe's changing climate', published in 2008.

As marine species move northwards with warmer sea and less ice, fishing fleets will follow. It is, however, difficult to tell whether the fisheries will become richer or not. Fish species react differently to changes in marine climate, and it is difficult to predict whether the timing of the annual plankton blooms will continue to match the growth of larvae and young fish.

Shipping and tourism are likely to increase, although drift ice, short sailing seasons and lack of infrastructure will impede a rapid development of transcontinental shipping. Traffic linked to extraction of Arctic resources on the fringes of the Arctic sea routes will most likely grow first. While these activities offer new economic opportunities, they also represent new pressures and risks for an ocean that has until now been protected from most economic activities by the ice. ■

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