JRC Scientific and Technical Reports

Soil Country Analyses
Austria

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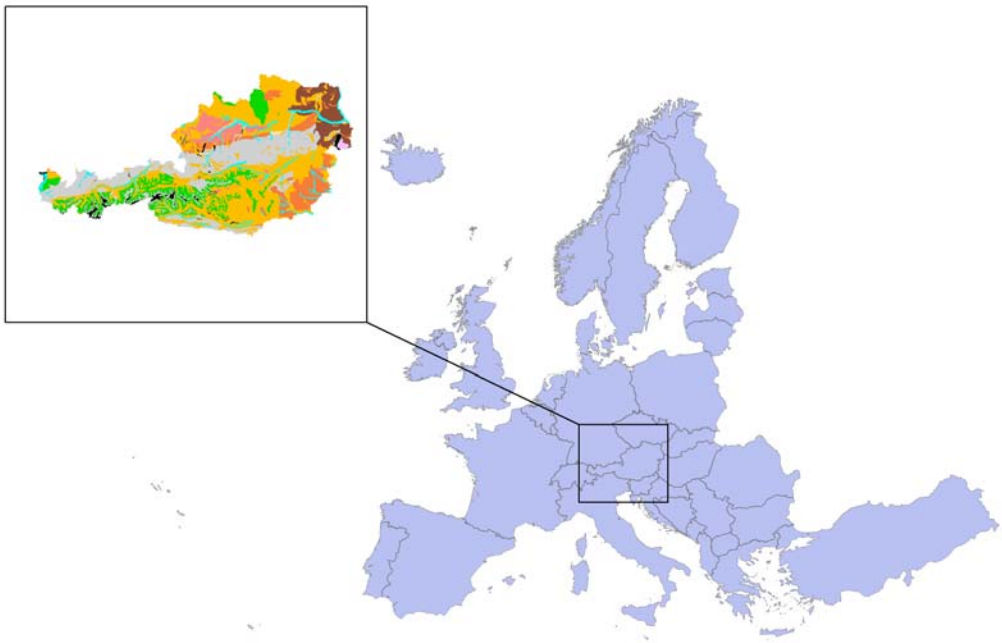

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Soil Country Analyses
Austria

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Introduction

The state of soil in Europe is influenced by its diversity, distribution and specific vulnerabilities across the region, as well as the diversity of geology, climate, topography and the availability of other natural resources. Soil conditions are also determined by the spatial distribution and intensity of the economic activities, together with the underlying social political, legislative, financial, scientific and institutional frameworks within individual countries. Given the cross-cutting nature of the soil environment and the many users and sectors exploiting soil resources, providing comprehensive assessments on soil in Europe or at the national level is a difficult task.

The DPSIR (Driving forces-Pressures-State-Impacts-Responses) approach has been widely used to carry out integrated environmental assessments. This approach requires the integration of socio-economic information on driving forces and pressures with: media-specific information on state and impacts; information on the impacts of environmental degradation on society and information on responses and their effects.

On the other hand, data on the different aspects of soil at the pan-European scale are scarce and patchy. In particular, the information currently available is not sufficient to cover all the soil threats nominated in the EU Thematic Strategy for Soil Protection[1] and socio-economic aspects are in general not taken into account. This scarcity of the policy-relevant information has prevented so far the production of a comprehensive assessment on soil in Europe.

In order to approach this challenge, in early 2007, the European Environment Agency (EEA) initiated the preparation of soil country analyses in close collaboration with the EIONET.

The EEA started the process by putting together available information on the different soil aspects. This information was loaded into a customised questionnaire for each country. The countries were then asked to review the information and provide additional data where possible.

The so-called “Soil Country Analyses” reports are the final outcome of this process. Each report offers an overview of the status of soil resources at the national level and touches the aspects presented in the Soil Thematic Strategy. These include the main soil threats, the different soil policy instruments (also economic instruments) in force, and the specific soil management programmes and monitoring activities implemented or planned in each country.

Putting together this wide range of information from diverse sources has not been an easy exercise, and the EIONET countries have made considerable efforts over a period of two years.

The completeness and quality of the information which underpins the analyses is variable, reflecting the range of resources and information available at the national level. The positive outcomes of the exercise are many:

- The information provided by the countries filled many of the existing data gaps and provided the basis for preparing the soil country reports;
- For the first time, soil information spanning across the aspects of the EU Soil Thematic Strategy is available from one place, thus facilitating analysis and further use;
- The completed questionnaires plus the country reports are available as input to national activities (e.g. preparation of national State of the Environment Reports);

[1] COM(2006) 231. Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions – Thematic Strategy for Soil Protection. Commission of the European Communities. Brussels, 22.9.2006

- Comprehensive lists of national data sources have been collected and can be used for further processing in European and national projects;
- The Information provided by the countries helped the validation of the data already available and has in some countries led to improvements in data reporting processes, in particular by enhancing the contacts between national institutions;
- Information is now available to support the European State of the Environment Report.

In parallel to this exercise, the European Commission's DG Environment (ENV), DG Joint Research Centre (JRC) and Eurostat, together with the European Environment Agency (EEA) decided at the end of 2005 to establish "Environmental Data Centres" to ensure the provision of robust data and information on the state of the environment for the development of environmental policies at European Union level. In that context, the European Soil Data Centre (ESDAC) was established at the JRC.

In the "EIONET Workshop on Soil" held on 18 September 2007[2] with representatives from DG ENV, the EEA and the JRC, together with representatives from the EIONET 'National Reference Centres for Soil' and members of the Steering Committee of the 'European Soil Bureau Network', the EEA and the JRC jointly decided that all soil data management activities carried out by the EEA in collaboration with EIONET were to be transferred to the JRC.

Following that decision, in the "EIONET workshop on Soil" organized by the JRC IES on the 4-5 of March, 2009[3], the representatives of the EIONET National Reference Centres for Soil agreed on the joint JRC-EEA publication of the Soil Country Analyses under the "Scientific and Technical Reports" series of the JRC. The final edition of the reports and the inclusion, where relevant, of additional soil information available at the SOIL Action was the contribution of the JRC to the publication of the Soil Country Analyses. They are also made available online at the European Soil Portal (http://eusoils.jrc.ec.europa.eu/).

[2] All the material from the workshop can be found at http://eusoils.jrc.ec.europa.eu/library/data/eionet/Workshop2007.htm
[3] All the material of the workshop can be found at http://eusoils.jrc.ec.europa.eu/library/data/eionet/Workshop2009.htm

Organization of the report

Section 1 presents a brief description of the general situation in the country. It is aimed at capturing the main context features which have an influence on the environment, with specific reference to the status of soil resources.

Section 2 contains a summary of the status of soil resources, including priorities, challenges, problems, and success stories. It presents information on the following specific issues:

- the eight threats identified in the Soil Thematic Strategy (compaction, contamination, erosion, depletion of soil organic matter, loss of soil biodiversity, salinisation, floods and landslides, and soil sealing)
- cross-cutting and complex issues such as desertification (where relevant)
- impacts of sectors of activity that are relevant in the country
- case studies/success stories. Specific documentation that is related to issues of particular interest or that describes an emergent or underestimated issue that is worth telling (e.g. surface mining in Germany)

Section 3 provides a brief overview on legislation, market-based and in general economic instruments to protect soils (e.g. remediation funds, subsidies, etc.), as well as international activities.

Section 4 contains information on management and monitoring programmes with particular reference to programmes aimed at soil resources (e.g. the water basin management programmes, national inventories of contaminated sites) and major factors that hinder the access to relevant information (e.g. confidentiality issues, etc.).

Section 5 presents information on the status of the main environmental issues in the country, including priorities, challenges, problems, success stories.

Section 6 presents brief overviews and relevant statistics of main sectors of activity and main industries and a snapshot of the social features, including characteristics of the population such as lifestyles and consumption patterns. The sectors that are likely to be relevant to soil are agriculture, energy production, transport, tourism, households, chemical industry, etc. It includes information on industrial development and economic evolution (historical).

Section 7 presents information on land use changes.

The report has four appendices. The first one details information on local soil contamination. It is the only topic for which a reporting process has been going on in the EEA since 2000 and more detailed information is available. The second appendix provides a detailed factsheet on the different Market Based Instruments detailed in section 3, when this information is available. Finally, the third and fourth appendices offer some comments provided by the country experts on different datasets available at European level: on soil threats in appendix 3 and socio-economic information in appendix 4.

Authors and contributors

This report was prepared by Anna Rita Gentile, European Environment Agency, on the basis of the information available in December 2006. Comments and additional and recent information were provided by Austria through an ad-hoc questionnaire.

Sara Barceló-Cordón and Marc Van Liedekerke, Joint Research Centre, completed and revised the report for its publication.

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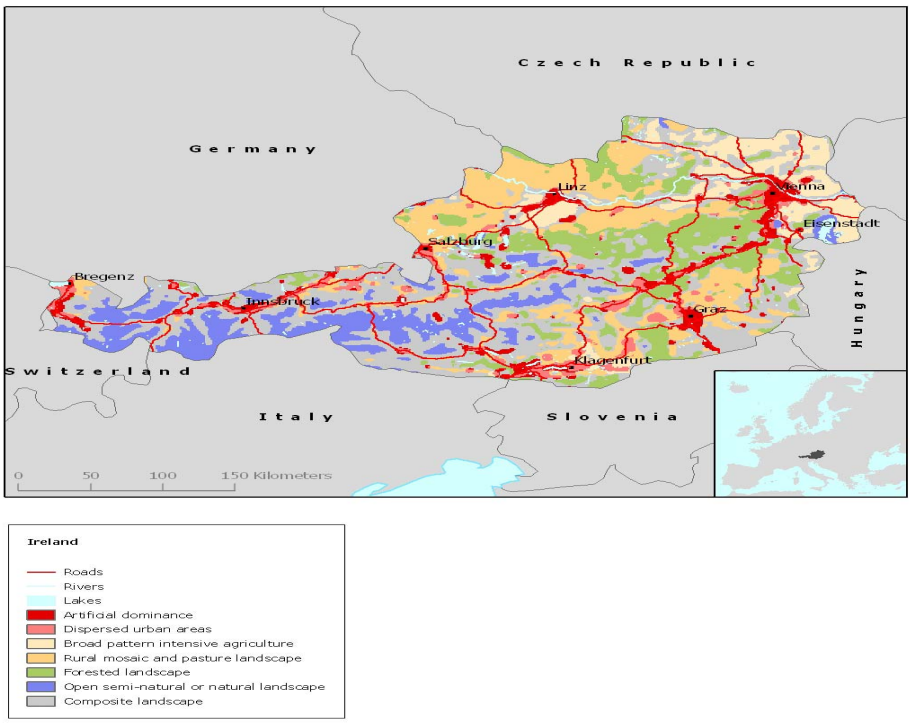
1. THE GENERAL CONTEXT

Austria is a relatively small country that is land-locked in central Europe and shares borders with eight countries. Austria's location in the middle of Europe gives rise to specific environmental issues such as the pressures from intensive freight transit traffic (e.g. air emissions, habitat disruption) and the trans-boundary exchange of acidifying air pollutants and tropospheric ozone precursors (e.g. damage to forests and soil). In addition, only 37 % of the national territory is suitable for permanent settlements. This is due to the country's geo-morphological conditions with more than 60 % of the territory occupied by mountains. As a consequence, urban sprawl and land consumption occurs in restricted areas, with resulting high pressures on the environment.

On the other hand, the variety of landscapes, altitude and climate engenders a diversity of vegetation. In the mountains, forests help prevent debris flows, avalanches and flooding (text compiled from OECD, 2003 and other sources).



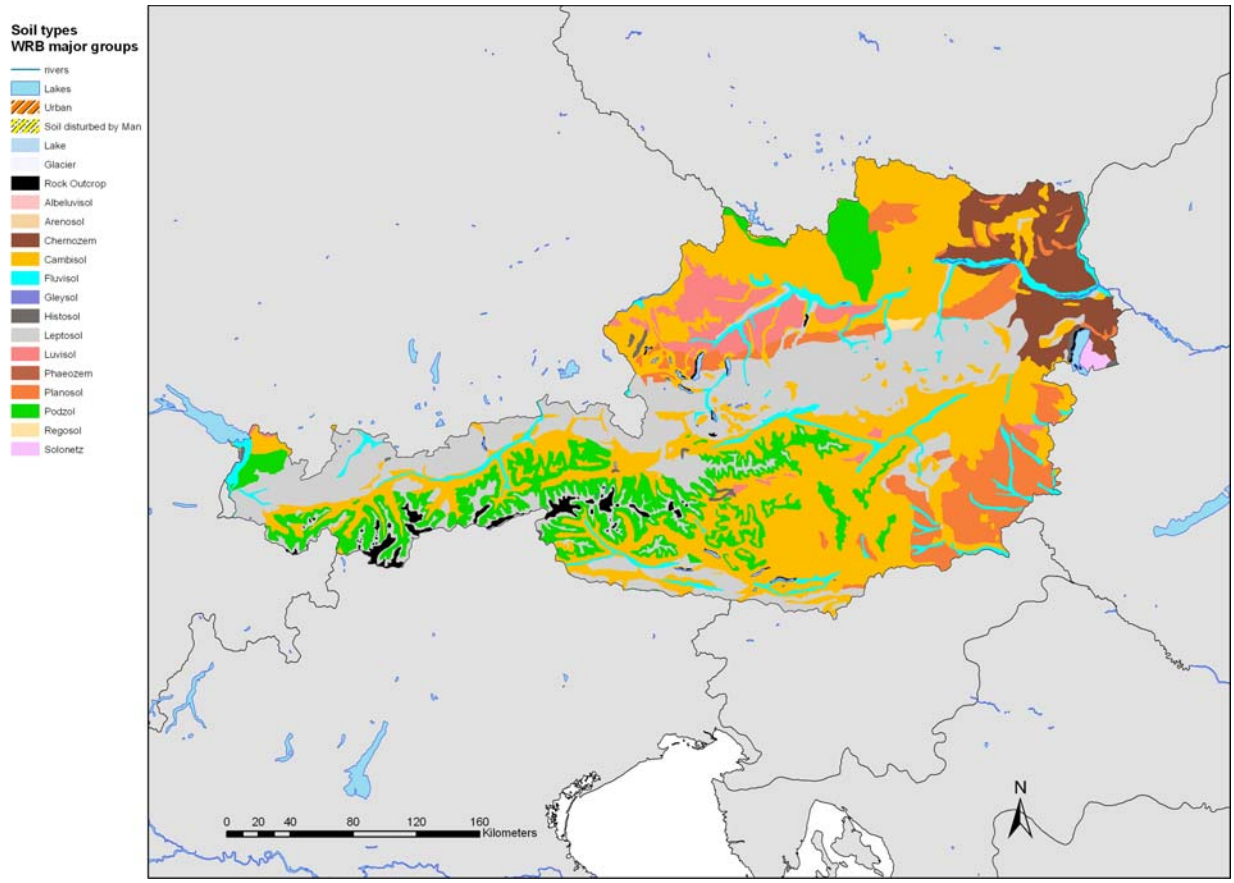
Map 1. Dominant landscape types of Austria. *Source: EEA (Year: 2007)*

1.1. Soil description[4]

Austria is predominantly a mountainous country, with an average elevation of about 900 m with most of the land falling within the Alpine range. In general the major mountain ranges of Austria run in an east-west direction and are separated from one another by rather broad valleys. The principal areas of Austria that are not within the Alps are the northern and eastern border sections, consisting of rolling hills and the Danube River. The Austrian climate varies with elevation with mountainous regions experiencing more precipitation than the eastern lowlands, which are under continental influences.

Rich *terra rossa* (red) Calcisols predominate in the Austrian valleys which, at higher elevations, associate with forested Podzols and, higher again, calcareous Leptosols and bare rocks. The Leptosols in the map correspond to the Hohe Tauern, which contains the highest point in Austria (the Grossglockner reaches 3 797 m), and the NiedereTauern mountain ranges. Alpine meadow soils are usually found in high-elevation regions and are locally important for pasture and related agriculture. Acidification of soil and erosion caused by loss of forest cover are the two main soil degradation threats in Austria.

The coverage of the main soil types in the country is reported in Table 1.



Map 2. Soil Map of Austria. ***Source: elaborated from European Soil Database v.2***

[4] Extracted from European Soil Bureau Network, 2005.

Table 1. Facts and figures

Item	Data and information	Sources
Population (inh)	8 211 359	*3*
Population density (inh/km^2) [1]	98	*2,3*
GDP (Million EUR) [2]	232 167	*2*
GDP (EUR per capita)	28 274	*2,3*
Administration	Federal republic with 9 states (Bundeslaender, singular - Bundesland); Burgenland, Kaernten (Carinthia), Niederoesterreich, Oberoesterreich, Salzburg, Steiermark (Styria), Tirol, Vorarlberg, Wien (Vienna)	*4*
Geography	Landlocked; strategic location at the crossroads of central Europe with many easily traversable Alpine passes and valleys; major river is the Danube; population is concentrated on eastern lowlands because of steep slopes, poor soils, and low temperatures in mountain areas.	*4*
Borders	*Land:* Total: 2 562 km Border countries: Czech Republic 362 km, Germany 784 km, Hungary 366 km, Italy 430 km, Liechtenstein 35 km, Slovakia 91 km, Slovenia 330 km, Switzerland 164 km	*4*
	Coastline: 0 km (landlocked)	*4*
Climate	temperate; continental, cloudy; cold winters with frequent rain and some snow in lowlands and snow in mountains; moderate summers with occasional showers	*4*
Land use [3][8]	*Landuse type* / *Km^2* / *Reference year* *Total agricultural land* 33 899 2000 *Arable land* 13 953 2000 *Total land under forest and other wooded land* 34 333 2000 *Built-up and related land* 4 800 2007 *Land used for transport and communication* 1 807 2000 *Wet open lands* 184 2000 *Total dry open lands* 10 200 2000 *Waters* 1 426 2000 *Land area* 82 433 2000 *Total area* 83 859 2000	*2*
Dominant landscape types [4]	*Landscape type* / *% of total area* *A1 - Urban dense areas* 6 *A2 - Dispersed urban areas* 5 *B1 - Broad pattern intensive agriculture* 9 *B2 - Rural mosaic and pasture landscape* 19 *C1 - Forested landscape* 15 *C2 - Open semi-natural or natural landscape* 12 *D1 - Composite landscape* 35	*1*
Elevation	In the West and South mostly mountains (Alps); along the eastern and northern margins mostly flat or gently sloping; lowest point: Neusiedler See 115 m; highest point: Grossglockner 3 798 m	*4*

Table 1. Facts and figures

Item	Data and information	Sources
Elevation Breakdown (%total area) [5]	*Elevation class* — *% total area* *1 - Low coast* 0 *2 - High coast* 0 *3 – Inlands* 6 *4 – Uplands* 31 *5 – Mountains* 63	*1*
Soil resources [6]	*Major soil type or ground cover type* — *% total area* *Cambisol* 36 *Leptosol* 24 *Luvisol* 11 *Podzol* 7 *Fluvisol* 6 *Planosol* 5 *Chernozem* 4 *Gleysol* 4 *Rock outcrops* 2 *Other soil and ground cover types (7)* 2	*5*
Hydrology	River network and lakes: ~ 2140 lakes >= 1ha, river network length: 100 000km; Groundwater: rich groundwater resources, 99 % of drinking water derived from groundwater (49 %) and springs (50 %).	*7*
Seas	No seas (landlocked)	*6*
Water resources	Annual volume of usable water (84 billion m³) of which 1/3 groundwater	*8*
Natural resources	Oil, coal, lignite, timber, iron ore, copper, zinc, antimony, magnesite, tungsten, graphite, salt, hydropower	*4*
Natural risks	Landslides; avalanches; earthquakes, floods	*4,7*
Protected areas	Category — Number — Area (km²) — % total area European Protected Area — 88 — 5 160 — 6.15 Nature Reserve — 400 — 2 995 — 3.57 Landscape Protected Area — 244 — 12 929 — 15.41 National Park — 6 — 2 426 — 2.90 Protected Part of Landscape — 334 — 90 — 0.11 Nature Park — 43 — 3 687 — 4.39 Nature-Landscape Protected Area — 4 — 506 — 0.60 Other Protected Areas (without natural monuments) — 47 — 1 864 — 2.22 All Categories* — 1.166 — 29 657 — 35.35	*8*
Products	*Agriculture:* grains, potatoes, sugar beets, wine, fruit; dairy products, cattle, pigs, poultry; lumber	*4*
	Industry: construction, machinery, vehicles and parts, food, metals, chemicals, lumber and wood processing, paper and paperboard, communications equipment, tourism	*4*

Notes	[1] [See also section 6 Economy and society [2] at 1995 prices and exchange rates. Source: ESTAT on EEA dataservice; Reference year: 2006 [3] Source: ESTAT data on EEA data service. Reference year varies. [4] EEA Major landscape types (EEA, 2006bc) [5] EEA Elevation classes (EEA, 2006bc)

	[6] Soil classification based on the reference soil groups of the World Reference Base for Soil Resources-WRB (FAO AGL, 2003). EEA elaboration based on JRC Soil Map of Europe 1:1M data v.2. Only soil and ground cover types covering at least 1 % of total area are explicitly included. [7] % area less or equal 1 % [8] UBA estimates an amount of 4 800 km^2 of built-up areas (or about 6 % of total area) from national statistics

Sources:

1. *EEA*
2. *ESTAT*
3. *World Bank*
4. *CIA World Factbook Web, updated 7 September 2006*
5. *European soil map 1:1,000,000.*
6. *World atlas*
7. *UMWELTBUNDESAMT, 2004. 7th Report on the State of the Environment in Austria. Vienna*
8. *Umweltbundesamt website (update Dec. 2006)*
   http://www.umweltbundesamt.at/en/umweltschutz/naturschutz/schutzgebiete/

2. THE STATUS OF SOIL RESOURCES

2.1. A snapshot of the status of soil in the country

Overall, the Austrian soils are in a good condition, but their ecological functionality is at risk from diffuse and local accumulation of pollutants, intensive use of land, sealing and erosion. The more affected areas are located in the Alpine region, where forest soils are threatened by air deposition, and in urban areas, where sealing and contamination put urban soils under a growing pressure. Sealing is also present in rural areas due to the increasing urban sprawl and new road construction. In arable land, soil erosion causes considerable stress due to a combination of insufficient erosion protection measures and inappropriate soil management. Soil erosion is higher on steeper slopes and land under permanent crops (vineyards, orchards), as well as on land cultivated with maize, sugar beet, potatoes and vegetables.

The use of heavy machinery, especially in case of wet soil conditions, often results in the compaction of the topsoil, which can reach in some cases the subsoil layer. Soil compaction mainly occurs in areas with intensive agriculture and, locally, in other areas due to forest management activities.

Floods happen occasionally in the floodplains of eastern Austria after extraordinary weather conditions (heavy rainfalls) whereas landslides occur quite often in the alpine regions with steep slopes. Adequate management measures for the protection of forests and afforestation, as well as technical engineering measures, are being implemented to prevent the consequences of such events and reduce the risks.

Salinisation is found in the areas around the lake Neusiedl, which is located in the north-eastern part, at the Hungarian border. Salinisation is causing problems only in small areas with intensively managed and irrigated agricultural soils. Information on decline of organic matter is scarce. Some areas of arable land show low organic matter content.

Contamination from heavy metals is mainly due to long-range trans-boundary air pollution, especially in forest soils due to the high filter capacity of vegetation cover and the barrier effects of the Alps to air mass circulation. Contamination by heavy metals and persistent organic pollutants can also be found in restricted areas originating from local industrial or agricultural sources.

The restructuring of the industrial sector and in particular the decline of the heavy industry in the 1990s did not have observable effects on environmental pressures. Despite the decrease of the overall production, the contribution of this sector to the overall emissions is still considerable (see sections 5 and 6). Adverse effects of soil degradation are still to be

expected, despite the continuing improvement in the implementation of regulations and the reduction of pollutant emissions, since many pollutants (e.g. heavy metals) are accumulating in the soil. The major indirect impacts are on biodiversity and the quality of groundwater resources.

The measures included in the national Agri-Environmental Programme are contributing to the reduction of soil degradation, especially erosion, compaction and decline in organic matter content.

Investigations and monitoring of historical contamination are quite advanced. More is known on contaminated sites but remediation activities are progressing slowly. If current trends are maintained, it will take decades to clean-up a legacy of contamination. In Austria, remediation is aimed at removing the source of contamination and restoring the soil functions to a certain extent. The objective is to make the soil fit again for specific uses, in particular for the protection of groundwater resources (ultimately, the source for 99 % of drinking water supplies: see Table 1). Further progress with the clean-up of historical contamination and brownfield redevelopment will also provide opportunities for the reduction of land consumption, economic and technological development and job creation.

An overview of the status of soil with respect to the soil threats identified in the European Soil Protection Strategy can be found in the next section. A country review of European datasets relevant to the soil threats is provided in Appendix 3.

2.2. The threats to soil

2.2.1. Contamination

2.2.1.1. Diffuse contamination

Soil surveys targeted at the four most relevant heavy metals (mercury, lead, cadmium and copper) showed increased lead and cadmium concentrations in topsoil with respect to background values in the regions of the Northern and Southern Limestone Alps[5]. This may be attributed both to local sources of pollution and to long-range trans-boundary air pollution.

Lead enrichment is particularly relevant in grassland and forest soils - the latter due to the high filtering effect of the vegetation cover. In these sites, the guidance values for lead established by the Austrian Standard (ÖNORM L 1075, 2004) were exceeded in more than 5 % and over 3 % of the monitored sites respectively.

Cadmium concentrations exceeded the guidance value in 5 % of the monitoring sites in forests and in 6 % of the sites in grassland areas.

[5] Maps of the distribution of heavy metal contents in topsoil can be found in the Umweltbundesamt website: https://secure.umweltbundesamt.at/boris/cgi-bin/p07/frameset.pl

Soil pollution with mercury and copper only occurs in restricted areas. In particular, copper contamination can be found mostly in the surroundings of industrial sites processing copper ore and in areas with intensive animal husbandry. The latter is due to the application of high amounts of pig manure with high copper content, originated by the use of copper-enriched ready-made food. Other sources of copper inputs in soil are sewage sludge and compost as well as the application of pesticides containing copper. About 2 % of the forest and grassland monitored sites exceeded the guidance value for copper.

Contamination from Persistent Organic Pollutants (POPs) was found in a limited number of sites, some of which required to be cleaned-up. POP pollution is mainly occurring in urban areas and around industries. It can also derive from long-range trans-boundary air pollution.

Emissions of POPs have been substantially reduced in the past years, which should have resulted in lower concentrations in the soil. However, a systematic survey targeted at organic pollutants in soil has not been carried out. For this and other reasons, such as the low mobility of these pollutants and the appearance on the market of new chemical products, the importance of the problem may be expected to increase in the future (Umweltbundesamt, 2004 and 2007b).

2.2.1.2. Contamination from local sources

In Austria, soil contamination requiring clean-up may be present at 2 500 sites. Potentially polluting activities are estimated to have occurred at 80 000 sites[6] (including the 2 500 sites already mentioned) and investigation is needed to establish whether remediation is required. By contrast, approximately 70 heavily contaminated sites have been cleaned up in the past two decades. Industrial production and commercial services, municipal and industrial waste treatment, and oil storage are reported to be the most important sources. National reports indicate that heavy metals, polycyclic aromatic hydrocarbons, cyanides and mineral oil are the most frequent soil contaminants at investigated sites. Nearly two-thirds of the remediation expenditure come from public budgets. Although considerable efforts have been made already, it will take decades to clean up a legacy of contamination. New contamination is not expected due to the implementation of prevention measures in place. A detailed assessment can be found in Appendix 1.

2.2.2. Salinisation

In Austria, salinisation is of little relevance as compared to other soil threats. According to a survey carried out in the period 1958-1970 (agricultural soil mapping), the areas where soil is affected by salts amounted to only 2 500 ha. In addition, soda-containing soils are estimated

[6] This figure has been amended by the Soil Eionet National Reference Centre during the preparation of this report (November 2007; Umweltbundesamt, 2007a). Earlier communications (Eionet priority dataflow on contaminated sites, 2006) reported that in Austria potentially polluting activities have occurred at 30 000 sites.

to cover 2 000 ha. In these areas, strict rules for agricultural production apply, due to nature protection issues. Finally, conditions for salinisation occur in small areas in Eastern Austria. In particular, these are areas with a negative water balance, salt-sensible soils, low groundwater table and salty groundwater. Future changes in climate and land management practices could lead to the salinisation of soils also in these areas. More recent information is not available.

2.2.3. Erosion

Soil erosion in Austria is mainly caused by unsustainable agricultural practices, construction of buildings and roads, and the use of leisure infrastructures. Recent estimates report that about 13 % of the agricultural land or more than 5 % of the total territory is potentially under a high risk for water erosion. The spatial distribution of potential erosion risk is very heterogeneous. The most affected areas include the productive areas of the southeast and northeast plains and hills, the Alpine foreland and the Carinthian basin (Strauss & Klaghofer, 2006).

Except for the results of some scientific studies, Information on wind erosion is scarce. Loss of soil by wind has been observed in the lowlands of Eastern Austria. The areas at risk are the areas with sandy soils and, in the dry season, some areas covered with black soils (chernozems). In the past, some measures, such as reforestation of lowlands, were carried out to protect soil against wind. New windbreaks are planted annually, thus increasing the protected areas by several thousand hectares per year. The presence of wind erosion risk in sandy areas has been acknowledged since the 18th century. This early recognition of the problem and the measures adopted have resulted in the stabilisation of the erosion in these areas. (Strauss & Klaghofer, 2006).

Soil erosion is not expected to increase in the future due to the implementation of prevention and reduction measures (such as the measures included in the national Agri-Environmental Programme). However, major pressures may come from future climate and land use changes (conversion of grassland into arable land) or significant changes in crop rotation, although these are not very likely to occur. More details on policy measures undertaken to control soil erosion by water are provided in sections 3 and 4.

2.2.4. Decline in soil organic matter

According to the results of a recent monitoring programme[7], more than half of all grassland and forest sites have a content of humus in topsoil of over 8 % (high). On the other hand, in arable land, most of the monitored sites show a humus content ranging from 2 % to 4 % (medium), while a low or very low content (< 2 %) is found in a quarter of the sites. In the areas with low humus content, the natural soil functions will be at risk in the long run

[7] Monitoring consisted in particular in measuring the content of humus (dead organic matter in the soil with the exclusion of soil fauna and roots) in topsoil (0-20 cm depth).

(Umweltbundesamt, 2004). Measurements of humus content in topsoil also provide an indication of the content in soil organic carbon.

There are significant regional differences in the humus content of topsoil. A significant east-west gradient has been found, with lower humus content in arable land in eastern Austria. In regions with forestry and grassland, such as in the foothills of the Lower Austrian and Upper Austrian Alps and in the Alpine region in western and central Austria, the topsoil shows higher humus content. In the Alpine region, the high content of humus may be related to the management of mountain pastures and lower mineralization rates, controlled by temperature.

Overall, the organic carbon stock in Austrian soils is not expected to be reduced in the future, due to the implementation of soil organic matter preservation measures in agriculture. However, there is currently a lack of sound data for the assessment of changes of soil organic matter. Major pressures may come from future climate and land use changes (e.g. conversions of grassland into arable land and urban expansion).

2.2.5. Sealing

Following a generalised trend in Europe, the sealing of the soil due to the increase of built up areas and transport infrastructures has shown a growing trend in Austria in the past decades, against a slight increase in population.

In total, about 6 % (or around 4 800 km²) of the country area is occupied by buildings or transport infrastructures, and about 40 % of this area is sealed[8]. About half of the new residential buildings in 2001 were single family dwellings or semi-detached houses which, in comparison to multi-family residences or other high-density structures, occupy a considerably larger surface area (Umweltbundesamt, 2006).

In the period 2001-2006, the average increase in built-up areas was about 17 ha/day[9]. This resulted in a daily increment of the soil actually sealed of 5 ha in 2005 and 2006. Although slightly decreasing year after year since 2001, this figure still exceeds by a factor five the relevant policy target (see section 3.2.2; Umweltbundesamt, 2007a). These high rates may

[8] According to the land use data in Table 1 (ESTAT), the total land occupied by built-up areas and transport infrastructure is 30 % higher: 5 624 km^2. UBA note: the national statistic give in 2006 the value of 4 280 km² for built up areas. Including also other land take related areas, a total of 4 800 km² can be derived. This figure includes leisure infrastructures (public parks, gardens, etc.) Tourist infrastructure is included as far as buildings are concerned. However ski slopes and ski lifts are not included, as they do not constitute a major land use. In general, land used for skiing is accounted for as grassland in statistics.

[9] The amount of sealed area in Austria is not directly observed, but estimations can be given from the data provided by the real estate database. The extent of built-up areas or land uptake can be used as a proxy indicator, bearing in mind that the proportion of actually sealed area may be variable, depending on the urbanisation pattern (e.g. it may be only 1/3 of the total built-up surface in rural districts). On the other hand, the negative effects of sealing may extend well over the sealed area (e.g. as in habitat fragmentation). Past trends and yearly estimates are affected by a certain degree of uncertainty as the real estate database for the whole country is updated only at irregular intervals and the definitions of the categories used changed in 1995.

lead to the saturation of the available space in some regions. In Vorarlberg, for example, one fifth of the permanent settlement area is already built-up.

These increases are due to changes in the standard of living and lifestyles, as well as associated settlement and transport activities, rather than population growth. This is particularly evident in rural regions where the built-up area continues to grow despite a net decrease in population. See section 7 for more details on land use changes.

2.2.6. Hydro-geological risks

Erosion and erosion control have been a major issue for a long time in Austria, due to its specific geo-morphological configuration, for which more than 60 % of the territory is occupied by mountains and presents extremely high relief energies (elevation differences). The focus of past and current activities has been on the control of torrents and avalanches, as these are major threats to human life in alpine environments (Strauss & Klaghofer, 2006).

According to BMLFUW (2001), about 67 % of the territory may be classified as either part of a torrent watershed, avalanche watershed or a general risk area. The regional coverage ranges from 16 % in Burgenland to 91 % in Tyrol. The amount of budget available for measures against these risks increased of more than 45 %, from 70 million EUR in 2001 to 102 million EUR in 2005 (BMLFUW, 2006).

In case of extraordinary weather conditions (heavy rainfalls), floods happen occasionally in the floodplains of eastern Austria. The flood events in August 2002 affected large parts of the national territory. Particularly Upper Austria and Lower Austria suffered heavy damage, as floods reached areas that were previously considered safe. More details on this event can be found in the special chapter on floods of the 7th State of Environment report (Umweltbundesamt, 2004).

2.3. Cross-cutting issues

2.3.1. Brownfields

In general, the remediation of contaminated sites based on fit-for-use remediation goals should be seen not only as bringing an improvement to the status of the environment through the restoration of soil functions but also as bringing benefits to economy and society. In Austria, there is a potential for brownfield redevelopment. The average consumption of greenfield areas for housing and traffic was 17 ha/day in the period 2001-2006. If the present trend for land consumption continues at the same rate, the areas allocated for housing and traffic would be doubled in 50 years. On the other hand, only 37 % of the national territory is suitable for permanent settlements.

The number of brownfield[10] sites in Austria is in the range of 3 000 - 6 000, covering an area between 8 000 and 13 000 ha. According to estimates based on their previous use, about 85 % of the industrial brownfield sites may present no or little contamination and could be revitalised and reused without public funding for remediation.

Considering an increase of industrial brownfield sites of about 3 ha per day, about a quarter of the annual land requirement for housing and economic activities could be saved by reconverting brownfields to a productive use[11]. To this purpose some measures have been proposed. These include policy measures, sustainable and innovative land management, and mechanisms for the involvement of all stakeholder groups[12]. However, redevelopment activities are yet to be started. For more details see Umweltbundesamt (2007b).

2.4. Soil services

The main soil services in Austria include:

- protection of groundwater and spring water in mountain areas, resulting in general in the availability of water in sufficient quality and quantities (about 99 % of drinking water supplies originate from groundwater);
- high diversity and mosaic distribution of geology and soils, enabling a high level of diversity of landscapes and biodiversity[13];
- availability of highly productive soils for agricultural and forestry production[14];
- availability of soils for building purposes, which is limited due to the relatively small available area for permanent settlement (37 % of the total territory).

Main impacts of soil degradation in Austria:

- biodiversity decline from soil sealing and contamination;
- impairment of groundwater quality from diffuse pollution and local contamination (there may be 2 500 sites in Austria needing remediation, of which less than 3 % have been cleaned-up since 1989; see section 2.2.1 and Appendix 1 for more details);

[10] There is no official definition of the term “brownfield” in Austria. In this context, the Cabernet definition applies. Brownfields are sites:
- of formerly industrial or commercial used land, now derelict or underused;
- have been affected by former uses of the site or surrounding land;
- require intervention to go back to beneficial use; and
- may have effective or suspected contamination problems

[11] This estimate is related to land for housing and economic activities. An area of around 2 200 ha of land is developed to these uses every year. Taking into account the location, it was calculated that around 600 ha or one quarter of brownfields could be used for fulfilling these land requirements.

[12] This means that the property market should not be left alone with the development of brownfield sites but that it is necessary to build up a network of all stakeholders, which should be consulted in relation to the project implementation, financial support, legal requirements, insurance, administrative procedures etc.

[13] A national soil map and a geological map are available with German legends.

- destruction of natural landscapes from soil sealing and unsustainable agricultural practices.

2.5. Hot spots

The Alpine region is an environmental sensitive area with a high level of diversity of landscapes, soils, flora and fauna. This region may be under risk for acidification and contamination from deposition of air-borne pollutants, erosion and landslides (see section 2.2 for more details).

Some industrial areas are seriously contaminated from diffuse sources. These include, in particular, the city of Linz, the Inn valley in Tyrol and Arnoldstein in Carinthia. In addition, a high concentration of sites which are potentially contaminated can be found in the most urbanised and industrialised regions, in particular the cities of Vienna, Linz and Salzburg, the Inn valley in Tyrol and the Mur and Mürz valley in Styria.

2.6. Outlooks

Soil resources in Austria are on average in a good condition, however soil functions are still being threatened by the deposition of airborne pollutants, a legacy of contamination in industrial and urban areas and the continuing increase of built-up areas.

There are some uncertainties on future trends of soil contamination due to the lack of data on the presence in soil of organic pollutants and the appearance on the market of new chemical products whose effects on the environment are not fully understood (Umweltbundesamt, 2004 and 2007b). However, the inputs of pollutants (in particular lead, cadmium and POPs) in the soil are expected to decrease, since emission and thus depositions are diminishing due to the implementation of regulations and preventive measures in place (see sections 3.1, 3.2 and 4.1). On the other hand, acidifying substances, in particular NO_x from traffic sources, are expected to increase (see sections 5 and 6.2.2). Moreover, soil contamination and its adverse effects are still to be expected in the long run since many pollutants (e.g. heavy metals and POPs) have low mobility and a high persistence and accumulate in the soil. In addition, the increase of the emissions of acidifying substances may result in an increase of the pressures on forests and forest soils. The major indirect impacts will be in terms of the loss of biodiversity and the quality of groundwater resources.

In urban and industrial areas, no new contamination is expected due to prevention measures in place. Nevertheless, the clean-up of historical contamination will continue to pose a challenge. In fact, although considerable efforts have been made already, in particular in the investigation and monitoring of contamination, a slow progress is made in the implementation

[14] An estimate of the amount of highly productive soils in agricultural areas could be calculated on the basis of the agricultural soil management survey. Similar statistics could not be calculated for forest soils.

of remedial measures. If recent trends continue in the future, it will take decades to clean-up a legacy of contamination.

The amount of soil actually sealed through the construction of buildings and infrastructures is currently increasing at a rate of 5 ha/day. This figure exceeds five times the 2010 sustainability target (see sections 2.2.5; 3.2). If the observed trends continue, the 2010 target will not be met. As in Austria only 37 % of the territory is suitable for permanent settlements, high increases of built-up areas may also lead to the saturation of the available space. This is more likely to occur in some regions currently registering the highest rates, especially in rural areas. On the other hand, the redevelopment of brownfields and the clean-up of historical contamination are expected to provide opportunities for the reduction of the consumption of greenland, as well as opportunities for economic and technological development, and job creation. Brownfields in Austria could cover about one quarter of the current needs for land (see section 2.3.1).

Soil degradation in agricultural areas, especially erosion, compaction and decline in organic matter content is not expected to increase in the future due to the implementation of prevention and reduction measures (such as the measures included in the national Agri-Environmental Programme; see section 4). For the same reasons, the organic carbon stock in Austrian soils is expected to remain stable on average. However, major pressures may still come from future changes in climate, land use (conversion of grassland into arable land) and crop rotation, or from increases in livestock (see sections 6.2.1 and 7.1).

Climate change and the development of the tourist sector may result in increased hydro-geological risks (see section 6.2.6).

3. POLICY INSTRUMENTS AND INTERNATIONAL COOPERATION

3.1. Environmental policy

Up to date, a comprehensive environmental law does not exist in Austria. Environmental legislation consists of a multiplicity of specific laws. In general, the principle of the comprehensive protection of the environment, that is the conservation of the natural environment as a basis for human life against harmful pressures, is applied (Constitutional Law on Comprehensive Environmental Protection, 1984). The protection of the environment includes, in particular, the application of measures for the prevention of air, water and soil pollution as well as the mitigation of noise. The transparent environmental control and the right of the public to access environmental information are regulated in the Environmental Information Law (introduced in 1993 and amended in 2005) and the Environmental Control Act (1998). According to the Environmental Control Act, the Ministry of Environment is obliged to submit an environmental control report to the parliament, every three years. This report is produced by the Umweltbundesamt (Federal Environment Agency).

Furthermore there are many laws in force which regulate specific environmental issues such as chemicals, protection against radiation, environmental liability, environmental impact assessment, contaminated sites, waste, air emissions and water. For some environmental issues such as soil or nature protection, regional laws apply as the responsibility lies at the provinces (federal states) level.

3.2. Soil policy instruments

3.2.1. Soil legislation

In Austria, soil protection is directly regulated by the following instruments:

- National Law for the Clean-up of Contaminated Sites (Altlastensanierungsgesetz) since 1989;
- Soil Protection Acts (Bodenschutzgesetze) in five out of nine federal provinces, targeted at the maintenance of productivity of agricultural soils.

National objectives and targets for soil conservation have been established in the following programmes/strategies (see section 3.2.2 for more details):

- Austrian Sustainability Strategy: Protection of Environmental Media and Climate Protection.
- Soil Protection Protocol of the Alpine Convention, entered into force in December 2002.

In the context of the current five provincial soil protection acts, the main goal is to maintain the productivity of agricultural soils. Specific objectives include, in particular, the reduction of inputs of pollutants, the prevention of soil erosion and/or soil compaction as well as the control of the application of sewage sludge and the survey and inspection of soil status.

More details can be found in the soil chapter of the SOE report of Austria (Umweltbundesamt, 2004; 2007a).

On the other hand, there are no specific regulations on soil protection at the federal level regulating for example the containment of soil erosion or the maximum input of pollutants. However, a number of regulations address soil protection indirectly. These are often an outcome of the implementation of EU policy or have been adapted to comply with EU legislation. These include:

- Klärschlamm- und Müllkompostverordnungen (Sewage Sludge and Waste Compost Ordinances) of the Federal Provinces,
- Kompostverordnung (Compost Ordinance),
- Düngemittelverordnung (Fertiliser Ordinance)
- Pflanzenschutzmittelgesetz (Pesticides Act)
- Luftreinhaltegesetz (Air Pollution Control Act)
- Wasserrechtsgesetz (Water Act)
- Province land planning acts.

For more details see Umweltbundesamt, 2004.

3.2.2. Soil policy targets

Several targets for soil conservation have been established at various administrative levels in Austria. In particular, soil protection was declared a national goal by the Federal Constitutional Law on Comprehensive Environmental Protection (Federal Legal Gazette No 491/1984).

This was recognised in the Austrian Sustainability Strategy (Schutz der Umweltmedien und Klimaschutz [Protection of Environmental Media and Climate Protection]). The goal is translated in concrete into a national system of environmental quality targets, to be evaluated through the use of indicators. These targets include, in particular:

- the prevention of further soil sealing,
- the maintenance of soil fertility through erosion protection measures and organic farming,
- the prevention of the input of toxic substances (heavy metals, organic pollutants) into the ecosystems and the food chain and

- the limitation of risks posed by landfills by means of the mandatory treatment of waste (Federal Ministry of Agriculture, Forestry, Environment and Water Management, BMLFUW, 2002).

As an example, a quantitative target has been established to reduce the increase of sealed soils to 1/10 of the rate detected in 1999 (10 ha/day) by 2010. This corresponds to a maximum amount of 1 hectare of newly sealed soil per day.

Specific targets have also been established in the framework of the Soil Protection Protocol of the Alpine Convention, which was ratified by Austria and entered into force in December 2002. In this protocol, general qualitative and quantitative targets have been established. These are related to the reduction of soil degradation, in particular by the application of soil protection measures in agricultural and commercial production activities; the sustainable management of land and soil; the containment of erosion and the limitation of soil sealing. These targets shall be reached through: a mapping of alpine areas affected by erosion; the preventive reduction of inputs into soils of pollutants deriving from air, water, waste and damaging substances; and the establishment of permanent soil monitoring sites.

Finally, although soil protection in Austria is mainly carried out at the province level, several standards have also been established at the national level[15]. These standards are not binding, but they are used as the basis for national soil assessments and rehabilitation obligations. The standards cover, for example, the procedures for the evaluation of the content in soil of certain elements, as well as trigger values for intervention and action (ÖNORMEN, i.e. Austrian standards L1075 or S2088).

3.2.3. Market based instruments

In Austria, marked-based instruments have been established in the framework of the agri-environmental programme (ÖPUL) and the national law for the remediation of contaminated sites (Altlastensanierungsgesetz). The list of instruments in force is provided in Table 2.

In particular, subsidies are available to farmers through ÖPUL for the application of explicit erosion control measures (e.g. soil cover in vineyards and orchards; conservation tillage on farmland) and for implicit measures (e.g. biological farming; cover crops; maintenance of small agricultural structures). The results of a specific survey show that farmer participation in the programme increased in the period 1998-2002. In 2002, the area with applied measures reached 150 000 ha or over one third of the area estimated to be under high risk for soil

[15] Not all provinces have established their own standards and targets. For example, in relation to provincial soil protection legislation, a soil limit value ordinance has been established only in Upper Austria. The ordnance is in force since 2006 and defines precautionary and trigger values for intervention.

erosion. It is estimated that an amount of about 143 million EUR was invested in erosion control measures in 2001 (Strauss & Klaghofer, 2006).

Public support for the management of remediation activities (monitoring, registration and clean-up of contaminated sites) is made available to local and regional authorities, private enterprises and private owners through a special fund. The fund is financed by the revenues from a tax on waste management. In 2004, the fund amounted to 70 million EUR. More details on this specific instrument are provided in Appendix 2. The total amount of funding in the period 1990 – 2006 was 875 million EUR. In 47 % of all projects, the applicant for funding was a community. The highest funding rates are provided for sites were the polluter could not be identified or made liable (including war induced contamination).

Table 2. MBI overview

Marked-based Instrument (MBI)					Soil threats covered by the MBI								Type of instrument (3)	References (4)	Sources (5)	Detailed information available (6)
Country/Region	Country code	ID	Name of instrument	Short description	1. General	2. Erosion and Hydro-geological risks	3. Decline in organic matter	4. Contamination	5. Sealing (1)	6. Compaction	7. Decline in soil biodiversity (1)	8. Salinisation (2)				
Austria	AT	1	Agro-environmental programme (ÖPUL)	Subsidies for explicit erosion control measures (e.g. soil cover in vineyards and orchards; conservation tillage on farmland) and for implicit measures (e.g. biological farming; cover crops; maintenance of small agricultural structures).		X	X						2	Olmeda-Hodge et al. (2004)	1	N
Austria	AT	2	Contaminated Sites Remediation Fund	Special fund for the recording and remediation of contaminated sites, financed by the revenues from a tax on waste management.				x					2	OECD (2005a). p.105; EEA (2000); UBA Vienna (2004)	1	Y
Austria	AT	3	Waste deposit levy	The tax covers the deposit of specific types of waste.				x					1	EEA/OECD (2006)	2	Y

Table 2. MBI overview

Marked-based Instrument (MBI)					Soil threats covered by the MBI											
Country/Region	Country code	ID	Name of instrument	Short description	1. General	2. Erosion and Hydro-geological risks	3. Decline in organic matter	4. Contamination	5. Sealing (1)	6. Compaction	7. Decline in soil biodiversity (1)	8. Salinisation (2)	Type of instrument (3)	References (4)	Sources (5)	Detailed information available (6)
Austria	AT	4	Subsidies from the Structural Funds	Funding from the Structural Funds (in particular the Regional Development Fund) are used for the clean-up of contaminated and rehabilitation of urban areas (brownfields). Planned expenditure for the rehabilitation of industrial sites in the period 2000-2006: 1.01 million EUR (EC, 2006). Rehabilitation of urban areas for EU-25: 2 billion EUR. No information is available to the EEA for the expenditure at the country level under this chapter.				x	x				2	EU Regulation 1260/1999. No information on national regulations is available to the EEA	3	N

NOTES

1) No information available
2) No information available
3) Type of instrument:
1 Taxes and charges
2 Subsidies
3 Tradable permits
4 Voluntary agreements
5 Other

4) Relevant literature referring to the specific instrument
5) Sources of the information contained in this table:
1 DGENV, 2005
2 EEA-OECD, 2006
3 EC, 2006
6) Y/N. If yes a detailed table is available for the specific instrument

3.3. International co-operation

Austria is a party to the UNCCD. It also ratified the Soil Protection Protocol of the Alpine Convention.

The Umweltbundesamt is active in international fora and initiatives in the field of soil, such as the European Soil Bureau Network and the Common Forum on Contaminated Land.

Austria is represented in the technical committee for soil quality (TC 190) of the International Organization for Standardization (ISO).

Austria participated actively in all technical working groups as part of the multi-stakeholder consultation during the development of the EU Soil Thematic Strategy.

4. SOIL MANAGEMENT, MONITORING AND ACCESS TO ENVIRONMENTAL INFORMATION

4.1. Soil management

For a description of soil management programmes (e.g. ÖPUL) see section 3.2 Marked based instruments. No other national programmes for soil protection are known.

4.2. Soil monitoring

In Austria soil surveys have been carried out for different purposes by different institutions.

Spatial soil information is available from the Forest Soil Survey and, on agricultural land, from the Soil Taxation Survey and the Soil Management Survey. Information on land consumption and soil sealing is available from CORINE land cover (1990, 2000) and the Austrian Real Estate Database (yearly updates)[16].

An Environmental Soil Survey was undertaken in the period 1989-1998 by the federal provinces, which have the main responsibility for soil management and soil protection in agricultural areas. These investigations provide point information and follow common procedures, according to the recommendations prepared by the working group "Environmental Soil Survey" of the Austrian Soil Science Society (Blum et al., 1989). The sites are situated in a basic grid of about 4 km x 4 km. In some regions, the grid was narrowed to 2.75 km x 2.75 km or even 1 x 1 km. The Forest Soil Monitoring System (FSMS) of the BFW covers the whole country, following a grid of 8.7 km x 8.7 km. In 20 of these plots, out of a total of 514 plots, an intensive monitoring is carried out as part of the level II UN-ECE forest soil monitoring programme[17].

Repeated measurements have been carried out partially in four federal provinces and in the forest sites (Biosoil project).

Beside the 20 level II plots another 18 intensive soil monitoring plots are implemented in four provinces.

In addition, three other long-term field experiments, aimed at monitoring changes in soil organic matter, are managed by AGES (Austrian Agency for Health and Food Safety).

[16] The Austrian soil monitoring programmes are described in detail in EC, 2005.
[17] See http://www.icp-forests.org/index.htm

Information on soil erosion and soil compaction is collected from test areas and maintained at the Institute for Land and Water Management (IKT) of the Federal Agency for Water Management (BAW).

Finally, according to the national law for the Clean-up of Contaminated Sites ("ALSAG"), the Umweltbundesamt (Federal Environment Agency) is keeping a record of the suspected contaminated sites as well as a register of contaminated sites.

4.3. Information, education and data access

The data from the soil monitoring programmes are stored in a soil information system, BORIS[18], maintained by the Umweltbundesamt.

Every three years the Umweltbundesamt prepares a State-of-the-Environment Report. The report provides information on the environmental situation and the performance of environmental control in Austria, including soil, and is available on line[19].

Yearly reports on the record of the potentially contaminated sites as well as a register of contaminated sites are also available on line[20] .

An additional valuable source for information and education on national soil-related activities is provided by the national soil internet platform[21] . Relevant information and publications (e.g. the DVD about soils from the provincial government of Upper Austria or the book about 'Soils in Carinthia') are available under the rubric "Produkte" (Products). The platform provides also a virtual soil trail and relevant links to other institutions, organisations or departments of federal provinces dealing with soil issues.

[18] INTERNET: http://www.umweltbundesamt.at/en/umweltschutz/boden/boris/
[19] INTERNET: http://www.umweltbundesamt.at/en/umweltkontrolle/ukb/
[20] INTERNET: http://www.umweltbundesamt.at/en/umweltschutz/altlasten/statistik/
[21] INTERNET: http://www.bodeninfo.net/

5. STATE OF THE ENVIRONMENT

"Austria is one of the leading countries in organic farming and renewables. Despite a generally high level of environmental protection and eco-efficiency, it has problems meeting agreed reduction targets for greenhouse gas and NO_X emissions. Pressure on the environment is increasing due to a continuing rise of passenger and freight transport, causing various environmental problems, including air emissions, noise and fragmentation of ecosystems and landscapes" (extract from EEA, 2005). Details on Austrian environmental performance are provided in Table 3 (selected EEA core-set indicators, published in EEA, 2005 and revised by national experts for this report).

According to the OECD:

> “Austria’s GDP increased by 27 % between 1990 and 2001. The Austrian economy, which is very open and highly dependent on foreign exchange, experienced an economic upswing in the late 1990s and a slowdown in 2001-02.
>
> Federal and provincial governments have long had ambitious environmental policies to respond to pressures on the environment from sectors such as industry, transport, agriculture and energy, as well as the reliance on the environment of the tourism and leisure industry, which generates about 18 % of GDP.
>
> Austria’s decoupling of environmental pressures from economic growth was very strong during the review period. Overall, the energy, material and pollution intensity of the economy have continued to decrease. However, progress has been elusive for municipal waste generation, certain air emissions and biodiversity conservation. As a landlocked country, Austria partly depends for its environmental quality on progress by its neighbours. Within the context of its membership of the European Union since 1995 and of its expanding relations with Central and Eastern European countries, Austria faces both further pressures on its environment and opportunities to co-operate with its close partners. Today, priority environmental issues include climate protection, nature and biodiversity conservation, waste management and water and soil management.
>
> To meet these challenges, Austria will need to: i) implement more efficient environmental policies; ii) further integrate environmental concerns into economic
>
> and sectoral policies; and iii) further strengthen its international environmental co-operation." (extract from OECD Environmental Performance Reviews: Austria, 2003)

Table 3.Environmental indicators[22]	
Environmental issue	***Description***
Greenhouse gas emissions	Because of rising emissions, in particular from the industry, road transport and energy production sectors, total 2005 greenhouse gas (GHG) emissions were 18.1 % above 1990 levels. Austria needs to reduce emissions if its Kyoto Protocol target of 13 % below 1990 levels is to be met by the 2008–2012 commitment period. In particular, between 1990 and 2005, GHG emissions have shown an increase of 10.9 % from industry, an increase of 91.6 % from transport (though a considerable amount is due to 'fuel tourism' caused by low fuel taxes and thus prices in Austria) and an increase of 16 % from energy production sector. In 2005, the Austrian government launched a broad consultation process re-evaluating the national climate strategy with a view to taking appropriate measures. Data source: Austria Annual Greenhouse Gas Inventory 1990-2005; Submission under the decision 280/2004/EC (15 January 2007)
Energy consumption	Total energy consumption increased by 9.8 % between 2002 and 2005. In 2005, gross energy consumption amounted to 1.441 PJ. Fossil fuel sources contribute approximately 77-78 % of the total energy demand. Additional measures to abate increasing energy consumption are needed.
Renewable electricity	Production of renewable energy is increasing, mainly as a result of the Ökostrom law (target: additional 10 % of renewable energy in electricity production in 2010 based on delivery of electricity from the distribution grid to the end consumers). In 2005, Austria generated 59 % of its electricity production from hydropower (including large hydropower plants). However, the use of renewable energy sources (Biofuels Directive) in the transport sector, which is expected to increase substantially until the year 2008, is also relevant even though it is not included in this specific indicator. Between 2002 and 2005 the production of electricity from new renewable energy sources has increased from 0.4 TWh to 2.2 TWh corresponding to a share of 0.8 to about 4.2 % based on delivery of electricity from the distribution grid. For 2007 the Austrian E-Control projects an increase of this share to 8.8 %.
Emissions of acidifying substances	Compliance with the ceilings of the EU National Emission Ceilings Directive for SO_2 and NH_3 will be achieved; high reductions, in particular in SO_2, have already been accomplished. The major challenge is NO_X, in particular emissions from the transport sector. Some reasons for higher NO_X emissions are: 'fuel tourism' (fuel prices in Austria are lower than in some neighbouring countries); high share of transit traffic and diesel vehicles (with higher specific emissions than petrol cars); higher real-life emissions of vehicles than during test cycles. Additional ambitious measures in main source sectors are currently being discussed.
Emissions of ozone precursors	Compliance with the ceiling of the National Emission Ceilings Directive for NMVOC (non-methane volatile organic compounds) is likely to be achieved. For NO_X see comments above under 'emissions of acidifying substances'.
Freight transport demand	Pressure on the environment is increasing due to a continuing rise of both passenger and freight transport, causing various environmental problems, including air emissions as well as noise

[22] NB: These indicators were published in part C on the report “The European Environment. State and outlook 2005” (EEA, 2005). An update is foreseen for the next edition of the report, to be published in 2010.

Table 3.Environmental indicators[22]	
Environmental issue	***Description***
	and fragmentation of ecosystems and landscapes. Freight transport has grown steadily in recent years in particular since the second half of the nineties. The freight transport demand increased by 58 % between 1990 and 2005, approximately two-thirds of this transport is road transport (road freight transport on national territory, fuel tourism excluded). Increasing contributions of fuel tourism and transit traffic have further contributed to increasing emissions, as shown in the national inventory. A recent study indicates that up to one-third of the motor fuels sold in Austria is not consumed in Austria. With the implementation of the biofuels directive into national law a slowdown in the growth of national GHG emissions by the Austrian transport sector is expected.
Share of organic farming	The share of organic farming area in Austria increased once more from 9.6 % in 2003 to 11 % in 2005 (this latest figure refers to the total agricultural area). This progress is particularly due to a considerable increase in organic arable farming. The total area of certified and supported organic farms (without alpine pastures and alpine meadows, according to the IACS, the integrated assessment and controlling system) amounts to 360.369 ha as of 2005 (source: BMLFUW, 2006).
Municipal waste	The high figures (ca. 600 kg/capita) are not only the result of the generated waste quantities but also of a comprehensive waste collection system which covers all households in Austria, and of high waste quantities collected from communal services. Nearly half of the increase between 1995 and 2001 is caused by an improvement in data collection. During the same period, the percentage for recycling and composting of municipal waste increased from 51 % to 63 %, while the share of waste going to landfills dropped from 46 % to 33 %.
Use of freshwater resources	Between 3 505 and 3 850 million m^3 water are abstracted from freshwater sources every year. From 1985 to 2002 the situation was more or less stable regarding total water abstraction. Variability from year to year can mainly be explained by variations in hydropower generation which are compensated by electricity production from caloric power plants, thus leading to variations in water abstraction used for cooling. However, since 1985, water abstraction for industrial production purposes has decreased from 43 % to 32 % of the total amount, whereas water abstraction for cooling purposes for production of electricity has increased from 32 % to 48 %. Irrigation plays a negligible role in Austria: less than 2 % of the water abstracted is used for irrigation purposes. The present per capita abstraction of freshwater is about 470 m^3 (including cooling-water used for the production of electricity). Since important efforts have already been taken in the past to increase efficiency and to reduce losses, no major further reductions can be expected in the near future.

6. ECONOMY AND SOCIETY[23]

6.1. A snapshot of the country socio-economic development

6.1.1. Social background

In Austria, population density amounts to approximately 98 inhabitants per km^2 on average. This is relatively small in comparison with other Western European countries. However, population density reaches 260 inhabitants per km^2 in residential areas.

As far as consumption patterns are concerned, private households in Austria spend on average 2 540 euro per month. Inflation-adjusted household expenses decreased by around 6 percent between 2000 and 2005. The sectors living and energy account for the largest portion of household with around 22 %, these two categories remained unchanged as compared to the last survey. The second largest expenditure category is traffic with 16 % followed by food costs with 13 %. The categories clothing, shoes and housing equipment declined. There are marked differences between expenditures of households living in cities and in the countryside. In areas with medium population density households spend about 2 640 EUR per month, while higher per-capita expenditures are found in densely urbanised areas. Taking the GDP per capita as a wealth measure, Austria was at 8th place in 2006, well above the EEA 32 and EU-27 average values.

A review of European socio-economic datasets done by country's experts is provided in Appendix 4.

6.1.2. Historical economic background

In Austria, industry has a smaller importance in the economy as compared to other countries. After World War II, Austria succeeded to convert a substantial part of its war industry into civilian production. Within this process the majority of enterprises was put under state control. Since 1993, a large part of the state-controlled industry was dissolved resulting in a strong decrease of persons employed, a deep restructuring and the partial privatisation of these industries. At the end of the 1990s, the first positive effects of this structural adjustment became visible: employment stabilised again; under pressure of globalisation, a substantial part of the Austrian industries showed an upward trend of their profits. The operational structure of Austrian industrial enterprises is relatively small: 18 % of the total workforce was active in enterprises with up to 19 co workers, 24 % was allotted to enterprises with 20-99 persons employed and 58 % to enterprises with 100 and more persons employed. The Austrian industry has experienced a strong structural change during the past two decades:

[23] This section was developed by Austria.

Traditional heavy industry (i.e. industry under state control) strongly decreased by the middle of the 1990s. Production has fewer persons employed, has moved abroad or cannot compete with the foreign manufactured products due to the higher costs. Work-force costs in the Austrian industry are relatively high in international comparison; while average labour costs per hour follow the European Union average.

The restructuring, and in particular the decline of the heavy industry in the 1990s, did not have observable effects on environmental pressures. In fact, despite the decrease of the overall production, its share in overall emissions is still considerable as of today.

6.1.3. Current economy

Services and a highly-developed industry dominate the Austrian economy, with the primary sector of agriculture and forestry accounting for only 1.7 % of the GDP. Although the tertiary sector has the largest portion of the GDP (67.7 % in 2006), the contribution of the secondary sector is still important (30.6 %). The most important industrial branches are metal production, -processing and steel construction, mechanical engineering, production of food, semi-luxury and luxury foodstuffs, chemical industry and car & car parts. Austria is particularly renowned internationally for electronic technology, in particular custom-made electronics products, such as chipsets and integrated circuits (development of chips for airbags, ABS braking systems, components for Airbus aircraft and for super-high-speed trains, etc.). Austrian industry is characterized by the high portion of small and medium-sized enterprises (SMEs), with only 167 enterprises employing more than 1,000 persons.

6.2. Economic statistics by sector

A country review of European socio-economic datasets is provided in Appendix 4.

6.2.1. Agriculture

In Austria 3.26 million hectares of land or 40 % of total area are used for agriculture (Farm structure survey 2003). 1.38 million hectares of which are arable land and 1.81 million hectares are permanent grassland, the rest are used as vineyards, orchards and other purposes (house gardens, tree nurseries etc.).

Agriculture and forestry (including fisheries) added share to the GDP was nearly 1.7 % in 2005 (BMLFUW, 2006). If the upstream and downstream activities of agriculture (e.g. seed production, processing of agricultural products) are taken into account, agriculture represents a significantly larger share of the GDP.

The farmed area per holding has been rising steadily since 1970. The average farm size is about 18.4 hectares agricultural area and 34.0 hectares of cultivated area (2003).

The main crops, in terms of sown area and yield, are wheat, corn, barley and sugar beets. Austria is almost self-sufficient in wheat (152 %), barley (98 %), corn (86 %), sugar (135 %) and a number of other items. The self-sufficiency degree for beef is 147 %, for pig meat 102 % and for poultry meat 73 % (2004).

Austria is still one of the leading countries in the EU in terms of the share of organic farming. It also has the highest percentage of farms that participate in the Programme for Rural Development, promoting environmental measures in agriculture. Mountain farms play an important role in Austria. About 39 % of all farms and forest enterprises are classified mountain farms, and mountain regions account for some 70 % of total land area. Within the mountain regions, many of the ecologically valuable areas with high biodiversity have resulted from agricultural activities.

Austrian agriculture is characterised by a steady decline in the number of farms (-12 % from 1999 to 2003). This reduction concerned primarily part-time farms, whereas the number of full-time farms remained stable. The number of cattle and pigs in Austria has slightly declined during the last ten years (cattle in 11.8 %, pigs in 12.4 %), but the average number of animals per holding has continued to increase (1989: 18 head of cattle per holding; 2005: 24 head of cattle per holding; 1989: 25 pigs per holding, 2005: 58 pigs per holding), although this is below EU-15 averages. This may increase the risk for nutrient surpluses in the farm area.

6.2.2. Transport

Austria has a dense transportation network. The Federal Railway Administration controls some 90 % of the Austrian 6,095 km of railways in 2002. Of the 5 564 km of standard-gauge track, 3 521 km are electrified; 94 km of the 479 km of narrow-gauge track are electrified.

In 2002, paved highways totalled 133 361 km, including 1 613 km of expressways. In 2000, there were 4 097 145 passenger cars, and 779 651 trucks, buses, and taxis.

Austria has 358 km of inland waterways, over 80 % of which are navigable by engine-powered vessels.

In 2001, airports amounted to an estimated 55, of which 24 had paved runways. Of the six major airports in Austria—Schwechat (near Vienna), Graz, Innsbruck, Klagenfurt, Linz, and Salzburg—Schwechat is by far the most important. (Encyclopedia of the nations (2007): http://www.nationsencyclopedia.com/Europe/Austria-TRANSPORTATION.html). The number of passengers in Air traffic between 1990 and 2005 increased by a factor 2.7.

In 2005 about 26 % of total passenger transport demand was fulfilled by public transport and about 61 % by passenger cars. The passenger transport demand increased by 21 % between 1990 and 2005. Including passenger kilometres from fuel tourism, the increase of passenger transport demand increased by about 53 %. Fuel prices in Austria are lower than the

European average, leading to a certain amount of fuel tourism – a share of the fuel sold in Austria has not been used in Austria. As sold fuel has to be used for the inventory, an increase of 53 % for the passenger transport demand is shown in the inventory. At the same time, there is also an increasing trend of the total vehicle stock, especially a considerable increase of diesel cars.

6.2.3. Energy

In 2005, the Austrian gross energy consumption amounted to 1,440 PJ and has increased between 2002 and 2005 by about 3.3 % per year. The main energy sources are oil and oil derivates (41.9 %), followed by natural gas (24.3 %), renewable energy sources (21.4 %) and coal (11.8 %). The final energy input amounts to 1,105 PJ and has increased between 2002 and 2005 by about 3.1 % per annum. With regard to final energy consumption in 2005 major sectors were transport (31.1 %), industry (27.6 %), households (25.8 %) and private and public services (13.2 %). Between 2002 and 2005 the largest increase in final energy consumption was observed in the transport sector (4.5 % p.a.) followed by industry (2.8 % p.a.) and households (2.7 % p.a.)

Electricity production is dominated by hydropower (2005: 39 TWh), however electricity production by thermal power plants has increased within the last years from 18.5 TWh in 2002 to 23 TWh in 2005. In 2005, electricity production from renewable energy sources (wind and biomass) was about 4 TWh.

6.2.4. Industry

According to Statistik Austria, the industry sector (not including the building industry) covered 5 998 companies with a total transaction volume of 142.9 billion € in 2005. Main industrial sectors are energy supply (109 companies, 12.1 % of the total transaction volume of industry), machine construction (492 companies, 9.8 %), production of motor vehicles and automotive supply industry (83 companies, 9.7 %), food industry (1,172 companies, 8.3 %), metal production (95 companies, 8.1 %), metal products (910 companies, 6.4 %), chemical industry (111 companies, 5.4 %), coke oven and refinery (4 companies, 4.4 %), communication engineering (43 companies, 4.3 %). The building industry covered 4 281 companies with a total transaction volume of 21.1 billion €. In the period 2000-2005, high growth rates could be observed in the motor vehicles and automotive supply industry (+38.1 %), the metal products industry (+36.6 %), the machine construction (+ 33 %), the chemical industry (+30.7 %), the energy supply (+ 29.3 %) and the metal production (+22.1 %).

6.2.5. Trade

Austria is well-known as a small open economy[24]. Austrian foreign trade is traditionally European-centred. The main causes are, on the one hand that Austria is an inland and never was a colonial power and on the other hand in the relatively high portion of raw materials, semi manufactured and supplying products for the European industry with high transport cost intensity. Additional reasons are the Austrian export structure and the lack of domestic branded/high quality articles. In Austrian export trade and industry a continuous structural change to technologically high-quality manufactured products took place in the last decades. In 1977, the portion of raw material-dependent goods still amounted to 14 % of the exports; in 1992 it was reduced to only 8 %. In relation to the trade partners in Eastern Europe and the OPEC countries, Austria is a provider of finished goods, thus has a certain "competitive weakness" as compared to other industrial nations. Due to its geographical position, trade with eastern EU-countries has an enormous role for Austrian foreign trade. As compared to the old EU-15, Austria displays the highest share of trade with the new member countries.

6.2.6. Tourism

The tourism and leisure industry plays a vital role in the national economy. In 2005, the total foreign currency earnings from tourism amounted to approximately 15.7 billion €. Tourism accounts for approximately 16.3 % of the GDP, according to the direct and indirect aggregate value added, generated in 2005 (Tourism Satellite Account – TSA) and employs some 750 000 people. In terms of the per capita income in foreign currency from tourism, Austria is on second place worldwide with 1 825 € in 2004.

The number of beds and the number of overnight stays are the most important statistical indicators to measure the performance of tourism: in 2005, approximately 1.081 million guest beds were registered. In the same year, the number of overnight stays amounted to 119.2 million. Visitors from abroad accounted for about 87.7 million and domestic guests for about 31.5 million. Foreign visitors represented 73.6 % of the total overnight stays in 2005. Austria is among the top tourist destinations.

Another important statistical indicator is the number of arrivals: in 2005 they amounted to 29.3 million (resulting in a plus of 3.1 % compared to 2004 or 874 303 more than the previous year). The guests stayed an average period of 4.06 days, which resulted in a 30.3 % occupancy rate of guest beds.

Austria now offers 900 indoor swimming-pools, 22 000 km of prepared alpine ski-slopes, 16 000 km of cross-country ski trails, 69 wild-life parks - to mention only a few examples.

[24] A small open economy is an economy that participates in international trade, but is small enough compared to its trading partners that its policies do not alter world prices, interest rates, or incomes.

Negative consequences on the environment are the increase of risk for soil erosion and landslides as well as land consumption for leisure infrastructure and the disturbance of the landscape as well as wild life due to fragmentation. On the other wild-life parks can help to protect the biodiversity.

6.2.7. Waste

According to the Federal Waste Management Plan of 2006, the total volume of waste amounts to approx. 54 million tonnes in 2004, excavated soil and construction & demolition waste representing some 53 % of total waste volume. The latter figure includes the waste produced during the remediation of contaminated sites of national priority, amounting to approximately 1 million tonnes per year or 2 % of the total annual amount of waste produced, in the period 1990-2006 (see also Appendix 1)[25]. About 65 % of the total waste volume was collected for the purpose of conditioning and recovery, 12 % was incinerated and 23 % was treated by other methods (e.g. landfilled). Waste generated by households and similar establishments increased by more than 10 % in 5 years and amounted to 3.4 million tonnes in 2004. About 35 % of the waste generated by households was collected separately in order to be submitted to recycling. Another 16 %, corresponding to bio waste, was collected separately and recycled through composting or anaerobic treatment in biogas plants. Due to the coming into operation of additional waste incineration plants during the last years, there was an increase in the amount of the waste categories "slag and ash, flue ash and dust from waste incineration and furnaces", amounting to 1.57 million tonnes in 2004. Accordingly, the amount of landfilled waste is decreasing.

6.2.8. Mining

After a period of post-war expansion, mineral production has stagnated in recent decades, and metals mining continues to decline, because of high operating costs, increased foreign competition, low ore grades, and environmental problems. All the metal mines in the country were closed, except an iron ore operation at Erzberg (producing 1.8 million tons of iron ore and concentrate in 2000) and a tungsten operation at Mittersill, which was the West's largest underground tungsten mine. Most of the growth in the mineral resources area was in the production of industrial minerals, the area in which future mining activities will most likely be concentrated, mostly for domestic consumption.

Austria produces 2.5 % of the world's graphite, ranking 10th in the world, and is one of the world's largest sources of high-grade graphite. In 2000, estimated output was 12 000 tons, down from 30 000 in 1996. The country produces 1.6 % of the world's talc, ranking ninth, with a reported output in 2000 of 133 060 tons of crude talc and soapstone. The country's only

[25] Source: 2006 Federal Waste Management Plan. These figures do not take into account the remediation of small sites for which data are not available.

producer of talc, Luzenac Naintsch AG, operated three mines, in Styria, and produced a range of talc, chlorite talc, dolomite talc, and chlorite-mica-quartz ores.

Other minerals, with 2000 output in tons, include: limestone and marble, 23 824 000; dolomite, 7 152 000, for the domestic cement industry, along with calcite and limestone; gypsum and anhydrite, 946 000; brine salt, 400 000 (salt mines are owned by the government, with plans to privatize the operations); tungsten, 1 600; pumice (trass), 3 961; and crude kaolin, 119 000, down from 298 000 in 1998. Gold production in 2000 was 100 kg. Crude magnesite production was reported at 726 000 tons in 2000.

Lignite production has been declining since 1963, when output was 6 053 000 tons, reaching 1 110 000 tons in 1996. Production of bituminous coal declined steadily after World War II, and in 1968 ceased altogether. The government introduced a new privatization plan in 2000, having completed a 10-year privatization program in 1997.

In 2007, mining sites account for an area of 114 km² or about 0.14 % of the total Austrian territory (Umweltbundesamt, 2007. http://www.umweltbundesamt.at/fileadmin/site/umweltthemen/raumplanung/2_flaechenverbrauch/flaechenverbrauch_2007_tabelle_infobox.gif)[26].

Other sectors: Military is a small sector in Austria.

[26] Information provided by national experts, source: Encyclopedia of the nations (2007): http://www.nationsencyclopedia.com/Europe/Austria-MINING.html

7. LAND USE

7.1. Land use changes

Austria is to a large extent covered by forest and natural vegetation (55 % of total area). However, in recent years, the proportion of artificial areas has increased (source: EEA, 2006ab). Overall, the settlement area per capita in Austria has more than doubled in the period 1950-1995, increasing from 200 m^2 to over 400 m^2 per inhabitant. The trend seems to have accelerated in recent years (Umweltbundesamt, 2004). On the other hand, according to the EEA land accounts, built-up areas have increased of 3 % in Austria in the period 1985-2000 (EEA, 2006ab)[27]. The increase in artificial areas has occurred mainly at the expenses of arable land and pastures. Table 4 summarises the main land cover changes. More details can be found in EEA, 2006ab.

The expansion of built-up areas in Austria is caused by a combination of demographic, socio-economic and general economic factors. The stirring prices of houses in urban areas and a growing vocation for living in the countryside have led to the urbanisation of rural areas or sub-urbanisation, characterised by more extensive building typologies and increased needs in transport infrastructures. On the other hand, the economic structural changes that have occurred since the 1970s, with a growing preponderance of the service sector over the manufacture sector and the consequent shifting of jobs, have resulted in an increase of the area per workplace.

This has been accompanied by the establishment of new multinational companies, which have special demands concerning the size of their premises and the connection to

[27] According to the Umweltbundesamt, there has been a growth of the settlement area per capita of 25 % in the period 1995-2001. This correspond to a 23 % increase of the total area used for settlement and transport purposes, against a population rise of less than 1.5 % in the same period (Umweltbundesamt, 2004). National figures are in contrast with EEA land accounts (artificial areas increased on 3 % in the period 1985-2000 as shown in Table 4). This is due to several reasons, including the specific CLC methodology, which does not take into account land use changes less than 5 ha and area smaller than 25 ha (see note in Table 4); and the revision of the Austrian real estate database, which overestimates changes in built-up area for the period 1995-2001. To this respect, the Austrian Eionet National Reference Centre informed that a complete revision of the real estate database was carried out at the end of the 1990s due to the implementation of the mountain farm cadastre. This led to a large and abrupt increase of built-up areas in the database, as the built-up area data were not regularly updated before 1995. As a consequence, the statistical figures referring to the period 1995-1999 are not fully reliable and a large part of the 23 % increase in built-up areas in the period 1995-2001 is a statistical artefact. However, it is not possible to give better estimates for this period. More reliable estimates can only be given from 2001 onwards.

international transport routes, as well as the relocation of companies from urban to suburban areas.

Societal changes resulted, *inter alia*, in the increase of the average size of accommodation and the number of single households. For example, the average usable floor area of newly established private homes increased from 108 to 123 m^2 in the period 1980-2001, while the unitary usable floor area (38 m^2 per inhabitant in 2001) increased of 15 % in the period 1991-2001 (Umweltbundesamt, 2004).

Table 4. Relevant statistics 1990-2000 by land cover class in ha

Corine land cover types	**Land cover flows**					
	Total land cover, 1990[28] (ha)	Total Consumption of 1990 land cover (ha)	Total Formation of 2000 land cover (ha)	Net Formation of Land Cover (formation-consumption)	Net formation as % of initial year	Total land cover, 2000 (ha)
1 Artificial areas	340 169	2 217	12 629	10 412	3.1	350 581
2A Arable land & permanent crops	1 176 629	7 088	475	-6 613	-0.6	1 170 016
2B Pastures & mosaics	1 578 181	6 344	1 855	-4 489	-0.3	1 573 692
3A Forested land	3 762 872	9 707	9 991	284	0.0	3 763 156
3B Semi-natural vegetation	818 810	695	733	38	0.0	818 848
3C Open spaces/ bare soils	621 313	10 532	10 365	-167	0.0	621 146
4 Wetlands	25 220	30	0	-30	-0.1	25 190
5 Water bodies	67 179	31	596	565	0.8	67 744
Total (ha)	8 390 373	36 644	36 644	0	0.0	8 390 373

Note

Comments on the results of CLC Changes 1990 – 2000 provided by the Austrian National Reference Centre. Due to the methodology which does not consider small areas (below 25 ha), only 0.5 % of the country was identified as change area. It is important to document the reference period for the change statistics, to be able to compare the change figures with other countries. To be consistent in terms of time, a comparison between countries should not be made on the basis of total change figures, but on the basis of annual average figures. In Austria, in a 15-year period (the CLC1990 data were derived from satellite images taken in 1985) a change of 0.5 % of total area. This leads to a 0.03 % of yearly change rate.

The main changes occurred due to the melting of glaciers, amounting to 10,000 ha (almost 1/3 of all changes) and the establishment of golf courses, with almost 5,000 ha. Urban growth is in comparison a minor change (3,300 ha). However it must be taken into account that especially the increase of urban areas takes place in Austria in smaller units than the minimum detectable unit of 5 ha for changes. Almost no unique enlargement of

[28] Land cover changes in Austria refer to the period 1985-2000 (as CLC1990 Austria data refer to 1985).

the built-up area in Austria reaches an area threshold of 5 ha. Therefore the growth of settlements is systematically underestimated in CORINE Land Cover data. In addition many settlement areas in Austria have sizes around 25 ha. Especially in the rural areas (e.g. the Weinviertel) this threshold is very common. As the interpretation of settlement areas in CORINE Land Cover allows the interpreter to place a buffer of up to 300 m around villages, this buffer was frequently used to integrate small villages, that may have accurately been measured only e.g. 23.8 ha or 24.3 ha, in the CORINE Land cover database with an area above 25ha. This revision of the database has been carried out in the CLC 1990 data already. Therefore small changes can also not be detected in the CLC 2000 database.

The melting of glaciers has led to an increase of landslides, increase of soil erosion, changes in run-off patterns.

Source: EEA, 2006bc

7.2. Land ownership

The revision of the Water Act in 1990 establishes that a buyer of land that is registered to be potentially contaminated is liable for the potential remediation in case the land will be declared as contaminated. The 1989 Law for the Clean-up of Contaminated Sites establishes that, in case the owner is not known, the remediation of contaminated sites has to be funded by the state (federal funds).

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APPENDIX 1. Soil contamination from local sources

In Austria, it is estimated that potentially polluting activities have occurred at 80 000 sites and investigation is in progress to establish whether remediation is required. Following a European trend, more is being learned on the size of the problem but the speed of the clean-up is considerably slow. In particular, investigations carried out up to 2005 identified about 2 000 potentially contaminated sites, while 2 500 sites are expected to be contaminated and in need to be remediated. In contrast, only 70 heavily contaminated sites have been cleaned up in the past two decades. In all these sites, the contamination is a legacy of the past. Information on new contamination[29] is not available. However, new contamination is not expected due to the introduction of legislative and regulatory frameworks for the prevention of contamination and the implementation of pollution prevention measures at operating sites.

Industrial production and commercial services (44 % of all investigated sites); municipal waste treatment and disposal (27 %); industrial waste treatment and disposal (15 %); and storage (14 %) are reported to be the most important localised sources. At industrial and commercial sites, the metal working industry (23 % of all investigated sites); gasoline and car service stations (20 %); commercial services (16 %); and the oil industry (10 %) are the most frequent sources of soil and groundwater contamination.

National reports indicate that heavy metals, polycyclic aromatic hydrocarbons, cyanides and mineral oil are the most frequent soil contaminants at investigated sites. Other contaminants include phenols. These estimates are based on the frequency with which a specific contaminant is reported to be the most important in the investigated sites.

A considerable amount of private and public money has already been spent on remediation activities. However, this is relatively small compared to the total estimated costs. Annual expenditure on the management of contaminated sites is less than 2 % of the estimated overall costs. Although Austria has legislative instruments which apply the "polluter-pays" principle to the management of contaminated sites, a considerable share of the remediation expenditure (65 %) comes from public budgets. This may reflect the scarce availability of information on the costs borne by the private sector.

Annual national expenditure for the management of contaminated sites is 67 million EUR or 8.2 EUR per capita. This corresponds to the 0.3 per mille of the national Gross Domestic Product. The largest portion of expenditure is employed for remediation measures (75 % of the total expenditures) and site investigations (13 % of total expenditures).

[29] This is, contamination occurring after the establishment of the national inventory in 1989.

The degree and extent of the contamination, environmental standards, local site conditions and applied technologies are the main cost components. The link between environmental merit and invested budgets is highly dependent on national regulations and the way they are implemented. Remediation costs are highly related to the different clean-up targets and local site conditions. In Austria, an analysis of typical investigation and remediation costs shows that:

- unitary costs (per site) for the investigation of a (potentially) contaminated site are generally comprised between 50 000 and 500 000 EUR;
- unitary costs for the application of risk-reduction measures exceed 500 000 EUR in more than 20 % of the cases, with peaks of over 5 million EUR per site in 2 % of the sites.

These costs are considerably higher than the average costs in other European countries. This is the consequence of the highly conservative measures applied in Austria, which aim at the removal of the sources of contamination, rather than at the restoration of the site for less sensitive uses, reflecting national priorities.

A national inventory or register of contaminated sites has been established since 1989. The national inventory only includes sites of historical contamination[30]. Potentially polluting activities (abandoned and in operation), potentially contaminated sites and contaminated sites are registered. The inventory includes industrial, commercial and waste disposal sites. Pipelines, airports, nuclear operations, accidents and military sites are not registered in Austria. For each site, the register provides information on the exact location, site characteristics, local conditions, environmental impacts (in terms of risks to environmental media) and progress in the management of the site. Groundwater is reported to be by far the most important media investigated. Investigations of soil, surface water, sediments, waste, soil gas and indoor air are also carried out in case of specific site conditions.

Several techniques are available for the reduction of the risks related to soil contamination. *Ex situ* (off-site) techniques are applied in 95 % of the remediations. A significantly high percentage of the most-frequently applied techniques (about 40 %) can be defined as traditional. These include the so-called "dig and dump" techniques and the containment of the contaminated area. This reflects the fact that contaminated soil is frequently treated as waste to be disposed of rather than a valuable resource to be cleaned and reused. In the period 1990-2006, the remediation of national priority sites (funded by the Ministry of Environment) produced about 17 million tonnes of excavated soil which was treated as waste. This corresponds to 1 million tonnes per year or about 2 % of the total amount of waste generated in 2004 (source: 2006 Federal Waste Management Plan). These figures do not take into account the remediation of small sites for which data are not available.

[30] Contamination which occurred before 1989.

The protection of groundwater resources is the most important motive for the application of risk-reduction measures. The protection of the ecosystems and the protection of the soil per se are not considered a priority for remediation. This is due to the severity of groundwater quality regulations, as in Austria the totality of drinking water supplies come from groundwater sources, and to the lack of specific regulations covering the soil media.

APPENDIX 2. Market Based Instruments fact sheets

Table A2.1 MBI fact sheet AT02

Country/Region	Austria
Country code	AT
ID	2
Name of instrument	Contaminated Sites Remediation Fund
Short description	In Austria, public funding for the recording and remediation of contaminated sites made available from a special fund, which is financed by the revenues from a tax on waste management.
Year of introduction	1989
Date last revision	NA
Type of instrument (1)	2
Level of application	Federal
Institution(s) responsible for implementation	Overall responsibility lies with the Federal Ministry for Agriculture, Forestry, Environment and Water ('Lebensministerium'). The finance corporation Österreichische Kommunalkreditbank AG decides upon applications for public funding for the clean-contaminated sites.
Website	http://www.umweltbundesamt.at/
References (2)	EEA (2000), Management of contaminated sites in Western Europe. European Environment Agency Topic Report no. 13/1999. EEA, Copenhagen
Contact -- name	Martin Schamann
Contact -- phone / fax	0043 1 31304 5921 / 0043 1 31304 5911
Contact – email	martin.schamann@umweltbundesamt.at
Contact -- organisation	Umweltbundesamt
Objectives	To stimulate the remediation of contaminated sites in a cost-effective way.
Target group / sector addressed	Owners and (potential) users of contaminated sites; in particular landfills and former industrial sites.
Eligible objects / activities	Contaminated sites and their remediation.
Eligible subjects	Beneficiaries include municipalities, private enterprises, private owners and the provinces.
Conditions	Contaminated sites are designated on the basis of the results of a risk assessment. Urgency of remediation is expressed in three priority classes. Only sites that were contaminated before 1989 are taken into consideration.
Yearly revenue (million EUR)	70
Reference year (3)	2004
Source of funding	The Fund for the Remediation of Contaminated Sites is fed by the revenues from an earmarked tax on the landfilling and export of waste (AT03).
Relationship with other instruments	In addition to the Remediation Fund, private parties and the provinces (Länder) also contribute to the recording and remediation of contaminated sites.
Evidence on effectiveness and possible side effects	Between 1989 and 2005, 2,000 sites in Austria were designated as contaminated sites (i.e., sites that, according to the results of a risk assessment, have been found to pose a considerable risk to human health or the environment). This is estimated to be about 80 % of the total number of contaminated sites. Remediation was completed for about 3.5 % of these designated sites. It was not until secured funds were available that several of the larger contaminated sites were cleaned up and a systematic recording system was established. Nevertheless, with the means currently available and with the current methodology, it will not be possible for all relevant sites to be recorded, assessed and cleaned up within the next few decades.

Table A2.1 MBI fact sheet AT02	
Costs of and possible problems with implementation	NA
Stakeholders' opinions	NA
Relevant legislation	Altlastensanierungsgesetz 1989 (as amended); Umweltförderungsgesetz 1993 and Förderungsrichtlinien 2002.
Sources (4)	DGENV, 2005
Detailed description	NA
Comments	

NOTES

NA *Information not available*
NN *Field not applicable*
(1) *Type of instrument:*
1 *Taxes and charges*
2 *Subsidies*
3 *Tradable permits*
4 *Voluntary agreements*
5 *Other*
(2) *Level of application:*
Federal, regional, local
(3) *Relevant literature referring to the specific instrument*
(4) *Reference year for the revenue*
(5) *Sources of the information contained in this table:*
1 *DGENV, 2005*
2 *EEA-OECD, 2006.*

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APPENDIX 3. Country review of European datasets related to soil threats

For this appendix, the national experts were asked to comment (1) on the results of the different assessments and datasets as well as (2) to provide references on national data sources for these topics if available.

Erosion

PESERA (Pan European Soil Erosion Assessment) data are available at the JRC web site:

http://eusoils.jrc.ec.europa.eu/ESDB_Archive/pesera/pesera_data.html

1) The results given in the maps are not really representing the national estimations of soil erosion risk. In the PESERA results a higher “soil erosion risk” is identified for the Austrian Federal Provinces of Carinthia and Burgenland. This result does not reflect the actual situation in Austria. The calculations based on the PESERA model are considered too rough to suit the small-structured conditions in Austria. This maybe is mainly due to the rough resolution of input data used.

2) Significantly more exact results for soil erosion were calculated for Austria (Van Camp et al. 2004; Strauss & Klaghofer, 2006)

Soil organic matter

OCTOP data are available at the JRC site:

http://eusoils.jrc.ec.europa.eu/ESDB_Archive/octop/octop_data.html

1) The general picture of the OCTOP map seems to be OK, but the area with OC content of 1-2 % seems to be too large. It should amount only one quarter of arable land (approx. 350 000 ha). Furthermore the area between Upper and Lower Austria bordering to Czech Republic is unrealistic homogenous (only the OC class 6.0 to 12.5 %). Of course, it has to be stated that the OCTOP map is produced using pedo-transfer functions.

2) National map on content of topsoil organic carbon content based on soil inventory results (real measurements) is included in the national SOE report (Umweltbundesamt, 2004); https://secure.umweltbundesamt.at/boris/cgi-bin/p07/frameset.pl

Hydro-geological risks

Data on natural and technological accidents are available at the EM-DAT web site (1):

http://www.em-dat.net/

1) The database seems to cover the most severe disasters in Austria.

2) Digitaler Wildbach- und Lawinenkataster der WLV (Forsttechnischer Dienst für Wildbach- und Lawinenverbauung); GEORIOS - GIS gestütztes Datenbankmanagement zur Dokumentation von Massenbewegungen in Österreich – GBA (Geologische Bundesanstalt), both good at local level (< 1:50 000), but no national coverage)

Earthquake map HORA at BMLFUW covering Austria

APPENDIX 4. Country review of European socio-economic datasets

For this appendix, the national experts were asked to comment on the different statistics and datasets at European level listed below.

Agriculture

Relevant statistics 1990-2006, source ESTAT, OECD, FAO

Agriculture statistics available at the EEA data service: http://dataservice.eea.europa.eu/dataservice/available2.asp?type=findkeyword&theme=Soil%20country%20profiles%20

Data sources are OK. Definition of utilised agricultural area should be the same in every country to make figures comparable. E.g. inclusion or exclusion of Austrian alpine pastures and alpine meadows makes a big difference for Austrian figures on the area of organic farming or UAA.

Transport

Relevant statistics 1990-2006, source ESTAT, OECD, FAO

Transport statistics available at the EEA data service (1):

http://countries.eea.europa.eu/SERIS

The link was updated, transport information available through the EEA dataservice is old, for more detailed information see Umweltbundesamt, 2007a.

Energy

Relevant statistics 1990-2006, source ESTAT, OECD, FAO

Energy statistics available at the EEA data service (1):

http://dataservice.eea.europa.eu/dataservice/available2.asp?type=findkeyword&theme=Soil%20country%20profiles%20-%20Energy

Energy statistics of Statistik Austria should be used as a source of disaggregated data. Data on energy statistics are regularly submitted by Statistik Austria to the International Energy Agency.

Industry

Relevant statistics 1990-2006, source ESTAT, OECD, FAO

Industry statistics available at the EEA data service (1):

http://dataservice.eea.europa.eu/dataservice/available2.asp?type=findkeyword&theme=Soil%20country%20profiles%20-%20Industry

For disaggregated data and some categories (trade, industry) the data provided by Statistik Austria should be used.

Trade

For disaggregated data and some categories (trade, industry) the data by Statistik Austria should be used.

Tourism

Relevant statistics 1990-2006, source ESTAT, OECD, FAO

Tourism statistics available at the EEA data service (1):

http://dataservice.eea.europa.eu/dataservice/available2.asp?type=findkeyword&theme=Soil%20country%20profiles%20-%20Tourism

The data of Austria are outdated (latest data are from 1994). More recent national data (2005) can be accessed by internet at http://wko.at/bstf/down/tizinternetversion.pdf (in German), http://portal.wko.at/wk/dok_detail_file.wk?angid=1&docid=242179&dstid=252&stid=130142 (Summary in English)

Waste

Relevant statistics 1990-2006, source ESTAT, OECD, FAO

Waste statistics available at the EEA data service (1):

http://dataservice.eea.europa.eu/dataservice/available2.asp?type=findkeyword&theme=Soil%20country%20profiles%20-%20Waste

The link shows "no results found". Austria submits waste data for the OECD/Eurostat Joint Questionnaire, has submitted waste statistics according to EU-Waste Statistics Regulation and submits the Federal Waste Management Plan to the European Commission.

Social statistics

Relevant statistics 1990-2006, source ESTAT, OECD, FAO

Social statistics available at the EEA data service (1):

http://dataservice.eea.europa.eu/dataservice/available2.asp?type=findkeyword&theme=Soil%20country%20profiles%20-%20Social%20statistics

Population density statistics [1]

Population density statistics available at the EEA data service [1] [2]:

http://dataservice.eea.europa.eu/dataservice/available2.asp?type=findkeyword&theme=Soil%20country%20profiles%20-%20Population%20density

Other socio-economic data

Two important sources are should be used: for disaggregated data (i.e. household data) the data by Statistik Austria should be used. For GDP data (and respective subcategories) the AMECO database of the European commission should be used (http://ec.europa.eu/economy_finance/db_indicators/db_indicators8646_en.htm)

European Commission

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Abstract

The ‘Soil Country Analyses’ series is the outcome of a collaboration between the European Environment Agency (EEA), the EIONET countries and the European Soil Data Centre from the IES-JRC.

In order to overcome the general scarceness of information on soil at European scale and to include socioeconomic aspects in the assessment of soil in Europe, the EEA initiated in 2007 the preparation of the soil country analyses, by putting together available information on the different soil aspects. This information was loaded into a customised questionnaire for each country. The countries were then asked to review the information and provide additional data where possible.

The country reports presented here are the final outcome of this process. The reports offer an overview of the status of soil resources at the national level and touch on the aspects presented in the Soil Thematic Strategy. These include the main soil threats, the different soil policy instruments (also economic instruments) in force, and the specific soil management programmes and monitoring activities implemented or planned in each country.

The mission of the JRC is to provide customer-driven scientific and technical support for the conception, development, implementation and monitoring of EU policies. As a service of the European Commission, the JRC functions as a reference centre of science and technology for the Union. Close to the policy-making process, it serves the common interest of the Member States, while being independent of special interests, whether private or national.

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