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Final Report

Compost production and use in the EU

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GLOSSARY OF TERMS AND ABBREVIATIONS

ABP / ABPR	Animal By-Products / Regulation. ABP as defined by the Animal By-Products Regulation (EC) no. 1774/2002
Anaerobic digestion (AD)	Fermentation process of organic feedstocks under anaerobic conditions with the objective to produce a methane-rich gas as renewable energy resource, liquid or solid digestion residues (digestate) can be used as organic soil amendment. Solid digestate can be composted together with structure material or other organic feedstocks and used like compost.
Bark compost	Compost produced from bark; usually not mixed with other organic residues but with additives as a nitrogen source
Biomix compost	Biowaste, green waste, sewage sludge (quite common system in Italy where sewage sludge is co-composted with source separated bio and green waste)
Biowaste	Mixture of kitchen and garden waste from source separated collection of organic household waste. This is the material commonly collected in the commingled collection scheme for food and garden waste (brown bin, biobin system)
Biowaste compost (BWC)	Compost produced from biowaste
Compost classes	Compost classified according to quality levels. In many cases the classification refers to heavy metal concentration classes which are related to specific use restrictions.
Compost products	Composts fit for use
Compost specification	Information which specifies compost properties for an application
Compost types	Composts made from specified categories of source materials
d.m.	**D**ry **m**atter
f.m.	**F**resh **m**atter
Garden waste	Organic waste from private gardens
Green waste	Organic waste from gardens and parks
GWC	**G**reen **w**aste **c**ompost; compost produced from green waste
HACCP	**H**azard **a**nalysis and **c**ritical **c**ontrol **p**oint; system of risk management and risk analysis (originally developed in food processing) of the proposed site and process. It realtes mainly to hygienic aspects. The elements of the process which are the critical points that control these risks must be identified and control measures must be applied to stop them from being a problem. This mist be included in a plan that is constantly re-evaluated to ensure its functioning.
Heavy metals	Even if chemically not fully correct we use heavy metals for the potential toxic elements Cd, Cr, Cu, Hg, Ni, Pb and Zn
Manure compost	Compost from solid stable manure or from dewatered (separated) slurry
MBT	**M**echanical **b**iological **t**reatment of mixed or residual waste with the main purpose of biological stabilisation of the organic biodegradable municipal waste fraction in order to gurantee requirede stability criteria for the safe and environmentally sound disposal on landfills
MWC	**M**ixed **w**aste **c**ompost; unless otherwise specified, this refers to compost derived from refuse, or from a biodegradable fraction which is separated from the refuse following its collection within the residual waste stream
MS	**M**ember **S**tates of the European Union
MSW	**M**unicipal **s**olid **w**aste
n.d.	**N**o **d**ata available
OM	Organic matter
OP	**O**rganic **p**ollutants; will be used throughout this report to refer to chemicals such as dioxins, polychlorinated biphenols (PCBs), absorbable organic halogens (AOX) and other organic chemical contaminants such as phthalates.
PTEs	**P**otential **t**oxic **e**lements (mainly used synonymously with heavy metals)

Proximity principle	Advocates that waste should be disposed of (or otherwise managed) close to the point at which it is generated, thus aiming to achieve responsible self-sufficiency at a regional/or subregional level
QAO (Quality Assurance Organisation)	Organisation carrying out the external independent quality assurance scheme for composting plants. In most of the cases this includes the awarding of a quality label for the certified compost products
QAS (Quality Assurance System)	External independent quality assurance scheme for composting plants. This includes the approval of plant operation (*process management*) as well as product certification according to existing compost standards.
QM (quality management)	Management required for the entire process of compost production. It starts from the receipt control of delivered feedstock materials and ends with final product storage and dispatch of compost to the customer. QM systems comprise a traceable documentation system to be checked by external QSO or the competent authority if it is part of the licensing and compost related legislation.
Residual waste	This is the waste which is collected from households, commerce and industry which has not been separated at source.
SOM	**S**oil **o**rganic **m**atter
SSC	**S**ewage **s**ludge **c**ompost; compost produced from dewatered municipal sewage sludge irrespective of the proportion of sludge used in the initial mixture of raw compost
Stability / maturity	There is no accepted definition but this refers to measures of the completeness or relative stage of the composting/decomposition process (the question is: to what extent has the material been biologically stabilised by the process? How much biological activity is still present?).
VFG	**V**egetable, **F**ruit and **G**arden waste (in Dutch: GFT). It has special significance in Flanders and The Netherlands where those municipalities designated as GFT regions are obliged to separately collect 'GFT' waste.

Used Acronyms for EU Member States

AT	Austria	FI	Finland	MT	Malta
BE	Belgium	FR	France	NL	Netherlands
BG	Bulgaria	GR	Greece	PL	Poland
CY	Cyprus	HU	Hungary	PT	Portugal
CZ	Czech Republic	IE	Ireland	RO	Romania
DE	Germany	IT	Italy	SE	Sweden
DK	Denmark	LT	Lithuania	SI	Slovenia
EE	Estonia	LU	Luxembourg	SK	Slovakia
ES	Spain	LV	Latvia	UK	United Kingdom

EXTENDED SUMMARY

Objectives

The study is intended as an input to the end of waste compost case study in order to obtain background information about the material flows of the most important types of organic residues and wastes which are used for the production of compost, the various areas of compost application and markets and the regulatory frame work in place in EU27.

Task 1: Identify compost classes

Where Member States have established regulations for the production and use of compost, the identification of one or more materials, use or quality related compost types and classes can be found. We have to distinguish between precautionary criteria which are intended to protect the environment and the consumer from any not acceptable negative impact from using the compost and those which relate to certain use aspects in specific application areas. While the first ones are typically found in statutory frame work legislation the latter ones are rather elements of voluntary standards and market related quality assurance schemes.

Precautionary compost classes
The most common classification relates to maximum concentration levels of the *seven classical* heavy metals (Cd, Cr, Cu, Hg, Ni, Pb and Zn).
Where more than one heavy metal related class are laid down they are mostly linked to specific application areas such as agriculture and food production (e.g. class 1) or landscaping and land reclamation (e.g. a lower class 2). Further precautionary parameters with limit values are impurities (physical constraints such as visible particles of metals, plastics and glass) and pathogenic indicator organisms such as *Salmonella ssp., E. coli, Enterococcae etc.*. Both are in principle part of existing compost standards and regulations.
Organic pollutants are only part of compost criteria where sludge or mixed waste is ruled in as potential source material (FR [where compost can be produced from mixed waste], DK [where compost and sludge is subject of one unique regulation], AT [for the compost type *waste compost* from MSW only]

Identification of the input materials that may be used to produce compost
Another important aspect is the definition of input materials which may be used for the production and marketing of compost. Those *positive lists* may also be classified as precautionary tool in order to exclude potentially polluted materials from being re-distributed to the environment. As a consequence, legislation and standards link certain compost designations to the category of input materials used (e.g. the term *quality compost* is restricted for compost produced from a specified positive list of *'clean'* source separated waste materials, whereas compost from mixed municipal solid waste (MWC) must be named *waste compost* or *stabilised biowaste* or similar) and/or specified areas of application which are considered to show different levels of sensitivity (food – non food).
However, input material classification is defined as *compost type*, where 9 types could be identified: *biowaste compost* (source separated collection of organic household waste), *green waste compost, VFG compost* (vegetable fruit and garden waste without meat)*, biomix compost* (including sewage sludge)*, bark compost, manure compost, sludge compost, MSW compost or stabilised biowaste* (produced in MBT plants from mixed residual household waste).

In general we find rather a *more or less extensive* positive list than a list with material exclusions. The most prominent waste groups excluded from compost production are

- Municipal Sewage sludge: BE/Fl, DE, FR, LU, NL, SE, UK
- Mixed (not source separated) MSW: BE/Flanders, DE, FI, LU, NL, UK

In some cases, where stabilised biowaste or MSW-compost is not excluded in principle, its use is restricted to limited applications such as landfill coverage or brown fields and similar (e.g. AT, CZ, IT).
We find the following schemes of ruling in input materials for compost production:

- Distinct positive list within statutory regulations: AT, BE, CZ (draft compost ordinance) DE, ES, HU, IT, LT, SI (incl. MWC).
- No general list but licensing rules: CZ (current status), DK, FI,, FR, IE, LU, SK
- Voluntary principles or lists within *quality* protocols and standards: NL, SE, UK
- No regulatory definitions or positive lists: BG, CY, EE, LV, MT, PL, PT, RO

Irrespective of the regulatory background a comprehensive list of allowed input materials comprised from national rules results in an extensive number of materials.
During the exercise of requesting the MS experts to indicate waste materials allowed in their countries, it became evident how important it is to have a precise qualitative description of the individual type and origin of material for a common understanding and interpretation.
Therefore, on EU level, it would be recommendable to widen the *European Waste Catalogue* with these further necessary specifications.

Another important aspect is the differentiation of materials with respect to Animal by Products as defined under Category 2 and 3 of the Animal By-Products regulation (EC) no. 1774/2002. This is important because additional process and even final product criteria may apply based on national implementation rules for the treatment of ABP in composting plants.

Use types classify composts for certain areas of application in dependence on defined quality parameters. In the case of compost for biological agriculture or compost restricted to the use in common agriculture this is linked to quality classes (heavy metal limits). It was interesting to see that the classification *fresh* and *mature* compost is of minor importance and only in DE, FI, LU (which has adopted the German RAL-System) and IE (only one general requirement for compost) we found voluntary classification systems.
As an indirect parameter to assess the maturity and sufficient stabilisation plant response or germination tests are used.

The limit values and their impact on compost production
In the context of standards setting for *products from waste* which are reintroduced in natural systems, precautionary aspects are handled on the highest regulatory level within national (or sometimes provincial) legislation by means of setting limit values (quality criteria) for potential contaminants and pollutants.
It is clear that the level setting of those thresholds has a major impact on the type (input material) and quantity of compost which would comply with the defined quality class.
In addition to the absolute limit setting statistical variability of compost sampling and analyses must be taken into account. This relates to seasonal variations as well as the material specific variation within a sampled batch and the inter-laboratory variance stemming from sample taking down to sample preparation and parameter detection.
Therefore Member States with advanced compost legislation and standards always have included a system of *tolerances* or data interpretation (mainly for heavy metals).
However, a reliable estimation to what extent a certain limit setting would affect the compost market could only be done in the case of heavy metal classes mainly for biowaste and green waste compost based on some national data sets available.
It is remarkable that heavy metal limit concentrations for compost from source separated biowaste and green waste are at similar levels in existing national standards. This indicates the close link of material (compost type) related qualities and the level of limit setting.

In order to estimate the relation of factual compost qualities and potential limit concentrations three representative threshold values for heavy metals [strict (low)/organic farming; moderate

(medium)/typical setting for biowaste compost; relaxed (high)/French compost standard which includes MWC] were taken as a reference.

mg kg^{-1} d.m.	Cd	Cr	Cu	Hg	Ni	Pb	Zn
Level 1 – low	0.7	70	70	0.4	25	45	200
Level 2 – medium	1.3	100	110	1.0	40	130	400
Level 3 – high	3.0	120	300	2.0	60	180	600

The distribution of heavy metal concentrations from national investigations show very similar patterns for biowaste and green waste composts respectively. In contrast to former investigations, today this is also valid for Spain (Catalonia) and France. However, Cu, Pb and Zn as typical anthropogenic elements seem to be elevated in less advanced countries in biowaste management and composting. Further systematic (country specific) differentiation is evident for Ni, an indicator for geogenic/pedogenic variations.

National evaluations of biowaste compost data sets from DE, AT, NL, ES/Catalonia showed that 45, 39, 13 and 12 % respectively of analysed compost samples would meet the organic farming limit values whereas a level 2 limit (moderate or medium) would in the case of DE, AT and NL include 93 to 96% of all analysed samples. This would be only 59% for the Catalonian composts (though this can be taken only as a rough empirical and not statistically approved indication, since only 17 composts have been analysed). However, it is interesting, that for green waste compost the evaluation for DE, NL and AT gave a very consistent result of about 60% of composts meeting the very low limits for organic farming and nearly 100% would comply with moderate typical limit values for biowaste compost.
Sewage sludge and mixed waste compost show considerable higher metal concentration. Only 8% of 186 German SSC and 15% of 96 French MWC samples meet the medium requirements. Due to the very high Cu and Zn values 49% of the SSW do not even meet the highest limit scenario taken from the French compost standard, whereas 74% of the French MWC still comply with this standard.
The only comparison available for fresh and mature compost (DE) showed no difference as far as the compliance with the assumed limit classes is concerned.

Environmental impact – potential accumulation of heavy metals in soils
This has been assessed by computing accumulation scenarios for the 3 limit concentration levels as well 75 percentile level of German biowaste/green waste composts as well as sewage sludge composts and of mixed waste compost from France..
From this it can be concluded:

- Setting limits in accordance with the French standard for mixed waste compost (level3) would unnecessarily attract source materials which would result in considerable higher impacts on soil. Specifically, this is the case for Cd, Cu, Hg and Zn.
- The scenarios comparing the 75 percentile of BWC/GWC with SSC and MWC indicate that
  - BWC results for all elements in the lowest accumulation rate; the critical soil threshold values for loamy soils taken from the German Soil Protection Ordinance would not bee reached even after a long period of 150 years.
  - In the case of SSW and MWC the most significant accumulation would occur for Cu, Pb and Zn if compared to BWC/GWC.

Further precautionary parameters
Impurities: Impurities or any inert non organic contraries may be found in composts from biodegradable municipal waste. Today it is a common exercise that impurities are limited in compost regulations.
Either this is done by setting a general maximum concentration of the sum of plastics, metals and glass above a certain particle size (mainly > 2 to 5 mm) or this is differentiated for these 3 fractions. In some cases we also find an individual limit for films and other plastic materials. A common standard which has been proven to be a reliable figure in quality managed biowaste composting is < 0.5 % d.m. total impurities in the 2 mm fraction of final compost products. The maximum amount of stones with a diameter of > 5 mm is also regulated in some of the existing standards.

Even if modern separation technologies are applied in mixed waste composting systems resulting compost show significant higher total impurity contents (mean of French mixed waste composts: 1.44 % d.m.) than biowaste composts from source separation schemes (mean of German BWC: 0.2 % d.m.).

Process and health related requirements

From the very beginning of the implementation of compost standards hygienic aspects have been addressed in order to *"guarantee a safe product"* and to prevent the spreading of human, animal and plant diseases. As a result provisions for the exclusion of potential pathogenic microorganisms within process and quality requirements are established on two levels:

- direct methods by setting minimum requirements for pathogenic indicator organisms in the final product
- indirect methods by documentation and recording of the process showing compliance with required process parameters (HACCP concepts, temperature regime, black and white zone separation, hygienisation/sanitisation in closed reactors etc.).

On a European level today, the key reference is the Animal By-Products Regulation (EC) nr. 1774/2001 which provides detailed hygienisation rules for composting and biogas plants which treat animal by-products as defined in the regulation. Therefore, national rules on process parameters for hygienisation as well as final product control have to be seen on the background of the EU ABP Regulation. National flexibility is mainly limited to non ABP (non meat) processing, category 3 catering waste, manure and to a limited extent former foodstuff.

What is new and still little developed is the use of validated processes and composting systems based on paragraph 13 of Annex VI ABPR. The validation system opens the possibility for MS authorities to approve any process which meets the minimum pathogen reduction as required by that Annex.

However, for an *end of waste* regulation for compost on EU level it would seem a major challenge to overcome the individual and considerably varying process requirements for biowaste (catering waste) composting as implemented by MS.

This includes a range of varying requirements for closed reactor or open windrow systems, time temperature regimes including max. particle size as well as final product control or other HACCP concepts. A broad and flexible regime for hygienisation (temperatures between 55 and 65 °C; several time spans depending on the temperature achieved; the number of mechanical agitations depending on the overall composting system) would be – in principle – a possible solution. However, it might be questionable if countries with very strict rules would accept compost products from other MS with more relaxed requirements.

Not all national regulations and quality standards include requirements for the maximum *number of germinating weeds and plant propagules.* But this has been seen as an important quality parameter at least in areas like horticulture, private gardening, compost produced as a constituent in growing media and potting soils. We find upper limits of 0 to 3 germinating plants per litre of compost.

The status of the compost: waste or product

The possibility for compost produced from waste and within the waste regime to be marketed and used under the product regime is mainly rolled out under either the fertiliser or the waste legislation. Frequently, we find simple fertiliser registration schemes in countries where no specific biowaste/compost regulations exist. But it can also be the case in advanced countries like the NL. Remarkably, a distinct *end of waste* legislation under the waste act exists only in one MS (AT).

Often it is not easy to distinguish between voluntary and obligatory standards since we find rules that say *if compost is to be marketed as product certain criteria have to be fulfilled, otherwise the compost can also be used under the waste regime*. So the producer has the choice whether he wants to register the compost under a product or fertiliser regime or not and no clear obligation is provided. This becomes evident where one country can be found with more than one solution as shown in the following overview on available options.

Compost may become a PRODUCT	
Specific compost regulation within waste & environmental legislation with **extensive QM and external approval scheme** for compost	AT
Compost related regulation within the waste and environmental legislation or based on standards but with **simple registration scheme**	LT, FR, SK
Regulation within the waste and environmental legislation rolled out by the way of the **licensing procedure**	IE, LU (+ obligatory QAS); UK (only with voluntary QAS)
(Simple) **fertiliser registration** within the fertiliser legislation	CZ, ES, FI, GR, HU, IT, LV, NL, PL, PT, SI
Compost remains WASTE	
Specific compost standards available Compost derived from source-segregated or 'residual waste' animal by-products that does not meet 'product' requirements, but is spread on land (ABP and waste management licensing regulations apply).	BE/Fl (+ obligatory QAS), DE (+ voluntary QAS) UK
No specific compost legislation Compost derived from source-segregated, non-ABP biowaste that does not meet 'product' requirements or 'Compost-Like-Output' from Mechanical and Biological Treatment of residual waste that is disposed of (not spread on land).	BG, CY, CZ, DK, EE, HU, MT, PL, RO, SE UK

As far as *end of waste* compost registration and certification schemes are concerned we may distinguish 4 typical options:

- (1) simple fertiliser registration without external inspection and sample taking
  ➔ CZ, DK, ES, FR, HU, IE, LV, NL, PL
- (2) registration under fertiliser or waste regime involving external inspection of documentation and process management by accredited laboratory (third party inspection but no full QAS)
  ➔ ES, SK
- (3) *End of Waste* regulation involving a full scale third party QAS. Compost ceases to be a waste when the external inspection of the composting process and final product investigation allows for product certification by an acknowledged certification body (QAO)
  ➔ AT, BE, DE (in Germany quality certified compost remains still in the waste regime but is handled and traded like a freely marketable product)
- (4) Similar to regime (3) but extensive documentation on purchase contract down to dispatch as well as proper application has to be provided in the case of agriculture and land grown horticulture
  UK (Compost Quality Protocol – England and Wales)

Legal provisions applying to the USE of compost

Utilisation restrictions exist for different end-use applications. Direct regulations like dosage restrictions (admitted quantity of compost per ha) are to be distinguished from indirect regulations such as *Good Agricultural practice (GAP)* protocols and the so called *Cross Compliance* requirements in agriculture. The latter refer mainly to qualified fertilising to be executed in a way that considers the nutrients in soil and in compost, and the up-take by the plant.

The ranges of restrictions for the amount of compost (on dry matter basis per ha) or plant nutrients to be applied are summarised here:

quantity of compost*	agriculture / regular	3 t (pasture land) – 15 t (arable land) ha^{-1}
	non food / regular	6.6 t – 15 t ha^{-1}
	non food / once	100 t – 400 t ha^{-1}
quantity of N	agriculture / regular	150 kg – 250 kg ha^{-1}
quantity of P_2O_5	agriculture / regular	22 kg – 80 kg ha^{-1}
	set aside land	20 kg ha^{-1}

* in most cases quantity differentiation is depending on quality class obtained.

As a general rule today, for regular compost application in agriculture the quantitative limitation is ruled by the nitrogen and phosphorous supply. To some extent also the organic matter substitution potential is considered. Therefore the most common quantities discussed lie between 6 and 10 t d.m. per ha and year. In land reclamation measures single restoration uses are granted in quantities between 100 and 400 t d.m..

Direct load restrictions for heavy metals on soils mainly stem from regulations on the use of sewage sludge in agriculture. Also fertiliser application rules (*fertiliser ordinances*) include dosage limits for heavy metals. With the exception of BE/Fl and FR, those rules are commonly not provided in specific compost regulations.

Quality assurance as an instrument of product standardisation and specification
Quality assurance is an established and successful tool to guarantee compost quality and to open markets in Europe. Therefore quality assurance organisation which provide compost with a certificate or quality label have been established in the following 10 Member States: AT (2 organisations), BE/Fl (obligatory for all composting plants), DE, CZ (starting phase), ES (registered trademark in Andalusia), HU, IT, LU (obligatory for all composting plants), LV (in the starting phase based on the EU ECO-label), NL (2 organisations), SE (incorporates the only national compost quality standard), UK (PAS 100 + Quality Compost Protocol/QCP).

In AT, DE, BE, NL, LU and Norway QAS are embedded in national regulations, though to varying statutory extent.

European quality assurance schemes comprise the following elements:

- Raw material/feedstock type and quality
- Limits for harmful substances/PTEs
- Hygiene requirements (pasteurisation)
- Quality criteria for the valuables (e.g. organic matter)
- External monitoring of the product and the production
- In-house control at the site for all batches (temperature, pH, salt)
- Quality label or a certificate for the product
- Annual quality certificate for the site and its successful operations
- Product specifications for different application areas
- Recommendations for use and application information
- Production control and process management
- Education and qualification of the operators
- Partnering with controlling authorities
- Facilitating production, quality and end-use related research
- Promotion of quality standard, compost image and use
- Marketing (Belgium), Marketing tools (all countries)

Quality assured composts are accepted as “products” only if product standards coincide with the ideas of the relevant parties and the needs of the market.

- **Quality assurance** is a good basis for sales consulting, for public relations work, and for fostering a positive image.
- The **quality label** makes possible the establishment of a branded “quality-tested compost” and a positive image for compost.
- **Regular analyses** during compost production act to guarantee a quality-controlled product.
- **Standardised analyses** carried out in accordance with specified methods enable an objective assessment of the compost quality.

- The **analysis results** form a basis for the product declaration and the application recommendations.

The net result is a compost product of continuously high and defined comparable quality which is therefore marketable and saleable on a large scale.

Task 2: Quantity, uses, import and export of compost

Amount of compost produced
Due to the lack of consistent data reporting and collection systems, reliable numbers on biowaste and green waste collection and potential as well as compost production are in some cases not easy to assess. However extrapolation from well documented national experience can be taken as a trustable basis.
In many cases a differentiation between biowaste and green waste is not possible since collection systems for those fractions vary a lot on national and regional level respectively. Specifically for the quantity of sewage sludge treated via composting only very poor data seem to exist.
Since the collected data have been compared to former investigations and are being corrected based on realistic potentials of an overall capture of 150 kg per inhabitant and year of biowaste and green waste the final estimation may give a good basis for further considerations on the importance of organic waste recycling in Europe. This figure was used where no reliable national assessments were provided.
The collectable amount of compostable biowaste and green waste in EU 27 is estimated with 80.1 Mt whereof 29.5 % or 23.6 Mt are currently separately collected. The proportion of which is composted or (pre-)treated in biogas plants cannot be given, but the composted part can be estimated with at least 95 %. This results in 10.5 Mt production of bio and green waste compost

	Total	Biowaste compost		Green waste compost		Sewage sludge compost		Mixed waste compost	
EU27	**13.2 Mt**	**4.8 Mt**	**36%**	**5.7 Mt**	**43%**	**1.4 Mt**	**10.4%**	**1.4 Mt**	**10.3%**

Only from biowaste and green waste composting a total compost potential of 35 to 40 Mt of compost can be achieved. Including compost produced from sewage sludge the total estimate is 45 Mt
Based on the very unsure and controversially debated strategies for the management, treatment and use of municipal sewage sludge only a roughly estimated scenario for sludge composting can be provided on European scale. If 15 % of the total municipal sludge production (approximately 5.3 Mt fresh matter sludge) would be considered for being composted together with the same amount of bulking agents and green waste this would result in ca. 5 Mt of compost.

Market shares and developments
Data on compost market sectors could be gained from 12 countries. Those MS represent approximately 80 % of the EU compost production and therefore show realistic trends. The average distribution of the market shares is:

- Agriculture – more than 50% with increasing tendencies,
- landscaping – up to 20 %,
- growing media production (blends) and manufactured soil – around 20 %
- the private consumer market with hobby gardening and wholesales – up to 20 %

Countries with mainly mixed waste compost production and little developed markets strongly rely on agriculture (ES, FR) or on land restoration/landfill covers (FI, IE, PL). In Poland, the low quality produced leads to 100% use in land restoration/landfill covers.
The compost application sector and the volume sold in the sectors depend only to a certain extent on type of source material, compost class and quality respectively. Application areas like agriculture just require standard quality, landscaping or even the growing media sector need upgraded and more specialised products (with quality specifications in plant response, salt content, pH, particle size among others), but compost type is of minor relevance as long as the plant performance is positive.

At least in countries with an advanced biowaste and compost business the market seems to be stable, though with a slight trend towards substrates and ready made prodcuts for landscaping and potting soil.
As far as compost types from the different input categories are concerned the following general trends may be concluded:
1) Countries with well established biowaste recycling are still faced with increasing amounts of green waste from private and public estates. Part of it – besides the use for energy recovery from biomass – will still go into composting;
2) Sewage sludge is expected to be an increasing source for composting where direct use in agriculture and incineration are not the preferred options;
3) Manure composting including separated (dewatered) slurry might be developed as an alternative treatment in areas with considerable excess of livestock (as a measure for organic sorption of organic nitrogen).

Market prices for composts in the different market sectors
Starting from a low value output of waste treatment activity in the 1970ies and 80ies, during the last 20 years, compost has been established as a fully acknowledged humus product in the key sectors agriculture, horticulture, landscaping, hobby gardening and land restoration. However prices are closely linked to the value perception of the professional and non professional customers. Traditionally in agriculture prices from 0 to 2 €/t are charged. But in some areas or even by individual composting plants with professional marketing and spreading service prices go up to 14 € per ton. Highest prices may be gained for low quantities of packed compost or compost blends at levels up to 150 to 300 € per tonne.

Task 3: Use of alternative materials to compost

Agricultural residues
Agricultural residues like manure or straw show less efficiency when it comes to the real benefits for the soil with respect to stable humus production and availability of nutrients.
Under the term of HUMUS MANAGEMENT (includes organic matter needs of soils, biodiversity, physical soil improvement etc.) the specific performance in humus reproduction of compost becomes more and more acknowledged and accepted in agriculture. Compost provides for an essential higher reproduction potential compared with slurry digestion residues, manure, straw or green manure. Rising mineral fertiliser prices gave high attraction by farmers to the amount of nutrients and fertilising values of compost which sums up e.g. in Germany to 8.10 €/t compost or 320 €/ha. In this respect the fertiliser substitution potential of compost amounts from 8 to 10 % which is mainly related to the limited world-wide phosphate resource.

Sewage sludge
Around 3.62 million t d.m. of treated sludge from municipal waste water treatment plants in Europe can be seen as an alternative product to compost. This is above all the case for 1.46 million t d.m. of composted sludge which is mainly used for landscaping/land restoration purposes. Remarkably, sewage sludge achieves only 10 to 20% of the humus value compared to compost.

Peat and bark
In the growing media sector compost is used beneficially as an alternative to peat on account of its nutrition and biological (disease suppressing) properties. Another factor is the savings in CO_2 release by protecting European bogs. The international Peat Society quantifies the alternative use of compost in growing media in 2005 with 0.95 million m³ and the use of bark with 2.05 million m³

Further alternative material potentials
Essential organic material flow outside the typical municipal waste area exists which represents an additional alternative. The projection for the EU27 results in a magnitude of bewteen 1,6 and 2.5 billions tonnes annually with residues from the food sector, forestry residues, residues from agro-industry (incl. straw and animal excrements) and some food and beverage residues. The suitability of

treating those materials in an aerobic composting process depends on the composition, degradability, water or nutrient content (C/N-ratio). So not for each of the materials composting is first choice.

Task 4: Production and Market potentials of compost

There is enough market for the up-to-date around 23.6 Mt composted residues from kitchens, gardens and parks in Europe. The market potential shows at the minimum double the size than the maximum European compost production potential of 40 Mt. The agricultural sector alone would be large enough in nearly all MS to take up the entire compost production. On a European level only around 3 % of the arable land is needed annually to apply all composts.
Even the non agricultural sector (e.g. landscaping, hobby gardens, growing media with peat replacement) shows already a sufficient market potential e.g. in Germany.
Market problems in some countries are caused mainly by low compost qualities and the lack of experience and knowledge about compost and the potential customers. End-of-waste standards can act in this respect beneficially by rising the awareness of the importance of the compost quality in the waste sector as a precondition for successful application and marketing.
Strategies and tools to exploit the market potential completely are given on the one hand with high qualities from separate collection and a quality assurance. The demonstration of the soil related benefits of compost (humus management) and the development of specialised compost products and blends have proven to be successful strategy on the other hand.

Task 5: Identify import and export potentials of compost

End-of-waste standards are intended to open the European markets for compost. However on account of weight and the resulting transport costs the import and export potential for compost is quite limited. Besides the cross border activities related to local markets in the direct catchment area of compost plants close to borders no continuous commercial cross border compost material flow was detectable. Only shortage of national agricultural markets due to fertiliser legislations or strong manure competition (e.g. in Belgium and the Netherlands) lead to considerable export efforts.. Considering these limitations we can expect a maximum import and export potential of **1.8 million t of bio- and green waste annually.**

OBJECTIVE AND TASK OF THIS STUDY

Background

This report has been prepared by ORBIT e.V. including its branch organisation the European Compost Network ECN and a group of European experts which are members of ECN.

The study is issued in the context of the European Commission's Waste Management Policy (Thematic Strategy on the Prevention and Recycling of Waste, Proposal for a Revision of the Waste Framework Directive; COM, 2005a[FA1]; COM, 2005b[FA2]) in order to support the Commission's DG Joint Research Centre JRC in the development of *end of waste* concepts. The Institute for Prospective Technological Studies (IPTS) of JRC is working in a research project to look at the science based methodology that could be used to determine end of waste criteria e.g. for the case study of compost.

The introduction of *end of waste* provisions were initiated in order to

- improve environmental performance of recycled products as economic operators seek to attain the level required for their recycled product no longer to be considered a waste;
- create greater legal certainty and predictability for purchasers and sellers of recycled products or materials;
- achieve regulatory simplification for low-risk wastes used as secondary materials;
- facilitate the establishment of markets in and between the Member States;
- to promote the traceable quality assurance and certification systems which lead to a common level playing field for compost production and marketing in all EU Member States.

The Commission has proposed to set environmental criteria at a high level to reduce environmental risk. However, one very important pre-requisite is the existence of a viable market for the recycled products.

Objectives

The study is intended as an input to the end of waste compost case study in order to obtain background information about

- the material flows of the most important types of organic residues and wastes which are used for the production of compost,
- the various areas of compost application
- the compost markets and
- the regulatory frame work in place in EU27.

Methodology and limitations

Main sources for the qualitative and quantitative estimations were data collections and statistics on national and EU wide level. Our national partners of the European Compost Network, national and European organisations in the area involved as well as colleagues from national Ministries of Environment and Environment Agencies have been contacted via a questionnaire (see acknowledgements and Annex 6). Important sources of information were earlier studies carried out by or with participation of the authors such as a study on behalf the UK Waste & Resources Action Programme (WRAP) by Hogg et al. (2002) which compared compost standards in the EU, North America and Austrialasia and a European survey on the legal basis for the separate collection and composting of organic waste (Amlinger, 1999)

The Questionnaire

Main tools for the collection of the quantitative and qualitative data about European organic material streams for the report was a 15-page questionnaire which was sent mainly to the Country Representatives (CR) of the European Compost Network/ECN. Contacting the CRs made it possible to have only one main contact with a national background per country and execute some pressure on

timely and sufficient response to the questionnaire. Otherwise for example the organic waste part, the sludge information and the compost use and sanitisation issue would have required to contact different Ministries (e.g. Environmental and Agricultural Ministry) and officials from abroad.

The questionnaire's structure followed the Report's tasks and included the following main parts:

Part 1: Legal background on organic waste, compost classes & related legislation, standards and protocols.

Part 2: Input materials types for composting and corresponding legislation incl. the Animal-By-products Regulation EC 1774

Part 3: Accompanying national legislation for compost production incl. provision for the definition as waste or product

Part 4: Legislation and standards for compost use, specific application rules und restrictions

Part 5: Compost types and quality classes, the portions used in the various application sectors connected with different sales prices including im- and exports of compost.

Part 6: Materials flows data of the most important streams of organic residues

Feedback

The extensive questionnaire created sufficient feedback and information from the advanced countries with a developed compost industry. On account of their starting situation in biological waste treatment most of the new Member States were not fully aware of the issue of standardisation, compost types and classes, application restrictions and markets. So half of the questionnaire was of no or of minor relevance for them. Here the size and number of questions led to complaints and to the fact that they got a reduced version of the questionnaire which fit to the national situation.

In order to support the contacted experts, ECN provided an individual set of information of most countries from studies and reports collected in the ECN office - e.g. the results of a similar questionnaire of the International Solid Waste Association ISWA, the country files from the WARP quality assurance report or studies e.g. contracted by the German EPA about Poland and Bulgaria.

All the supporting activities created a good response besides the countries Malta and Cyprus which didn't reply to the questionnaire despite numerous phone calls. The responsible waste management contact person changed continuously. Additional contacts with consultants confirmed that nearly no organic waste treatment activities exist in these 2 Member States. This and the fact of the very small country size and waste arising led finally to a stop of the information gathering efforts.

The questionnaire showed insufficient feedback information on compost import and export. These were subject to the treatment plants and to a certain extent confidential. Here the questionnaire had to be supplemented be telephone interviews with plant managers directly:

Quality of responses

Here the following main problems occurred which required additional interviews by phone:

- Despite examples in the questionnaire misunderstandings occurred about the English definitions of terms like biowaste or mixed waste. So a lot of verification and control was necessary to guarantee the necessary comparability of information
- The availability of quantitative data on organic waste streams, compost qualities and use was very poor because of missing organised continuous data collection. The compost market situation depends on existence of specialised research projects (UK, IE, FR, ES ..) normally done only every few years. Continuous market surveys exist only in countries with established quality assurance schemes where annual reporting to a central office is requested.
- The Feedback came in partly by documents in national languages which required extra translation work.
- Biological waste treatment provisions are embedded in the national waste policy and waste management situation and all of them differ. So it was quite a challenge to summarize 27 countries.

Quality assurance of the results
The essentials of the questionnaire where collected in tables which where sent to the experts for a final revision and verification before they were used for the report.

Some principle limitations
In line with previous experience with these types of investigations the authors must admit that the quality of data and information collected suffers from the fact that systematic statistics on material flows in many sectors are missing. Also there is a lack of common definitions or understanding of terms (e.g. biowaste – just to name the most prominent example).
As a result it was not possible to achieve consistent data even on the two most important waste streams *biowaste* (source separated organic waste from households and similar installations) and *green waste* (garden and park waste) and its treatment.
Therefore it has to be taken into account that a considerable set of data is based on personal estimations of the experts involved as well as extrapolations from national data where reliable experience exists.
Due to the fact that compost markets in relation to compost types and classes show a very diffuse performance in the different MS a quantitative relation between quality classes, compost types and use types respectively is hardly possible. Consequently an assessment of the potential impact of certain compost class definitions (criteria, limits) on EU level on specific market sectors or even differentiated for several compost types cannot be carried out in a distinct manner.

The tasks of the study

The key tasks of the study are listed below:

Task 1: Identify compost classes Inventory of the relevant compost classes according to the legislation in place in the Member States and according to the other relevant standards and certification schemes in use.	
Task 1.1.	Denomination of the compost classes.
Task 1.2.	Identification description of the reference legislation, standards, protocols
Task 1.3.	Certification schemes or similar, as well as of the geographical validity and use
Task 1.4.	Identification of the types of uses for which the compost class is considered to be fit for use
Task 1.5.a	Identification of the input materials that may be used to produce compost
Task 1.5.b	Description of the technical, health, environment and other criteria or parameter that specify the compost class, the composting process
Task 1.6.	The limit values for these parameters
Task 1.7.	Characterisation of required quality assurance provisions
Task 1.8.	Clarification of the status of the compost from a waste legislation point of view, reflecting in particular also the differences across the Member States
Task 1.9.	Identification and brief description of other legal provisions applying to compost (e.g. process or operational requirements).
Task 1.10	Legal provisions applying to the USE of compost in the different countries
Task 2: Quantify the production, import, uses and export of compost	
Task 2.1.	Amount of compost produced
Task 2.2.	Amount of compost imported, preferably quantified separately per country of origin
Task 2.3.	Amounts of compost used according to use, type and sector
Task 2.4.	Amount of compost exported, preferably quantified separately per destination country
Task 2.5.	Amounts of the different input materials used to produce the different compost classes
Task 2.6.	The study shall provide also information on the prices in € of the different types of composts for the different uses.
Task 2.7.	In addition to the data for the reference year, trends (e.g strong increase in production or use in recent years) should be systematically identified and reported.

Task 3: Identify and quantify the use of alternative materials to compost Identifying which other materials are used to fulfil the functions of compost in the different uses. To what extent compost and the alternative materials can substitute each other. This should take into account the technical suitability of the materials as well as the relative prices. Furthermore the task includes quantifying the amounts of the alternative materials that are used for the same purpose as compost (kg per year, for each Member State and type of use).	
Task 4: Estimate and assess production and market potentials of compost	
Task 4.1	The production potentials for the different compost types (kg per year) considering the availability of the input materials and the alternative treatments (such as landfill, incineration or anaerobic treatment) of the input materials.
Task 4.2	The market potentials for compost in the different uses (kg year). The estimates should show separately the potentials for substituting alternative materials and the market potentials due to increased demands.
Task 4.3	Ten years prognosis: The main critical factors for exploiting the market potentials shall be assessed as well as realistic time expectations. The time horizon for this task shall be the coming ten years.
Task 5: Identify import and export potentials of compost Import and export potentials of compost shall be estimated for each Member State and the different compost classes (kg per year). The estimations shall take into account, among other things, imbalances of the production and market potentials (Task 4), similarities of compost classes from the different Member States, proximity and the price/transport cost relation.	

1 Task 1 – Compost quality classes

Before going into the question of compost classes and how they are rolled out in the regulatory framework of MS we here outline the logic of compost types and classifications:

Table 1: Categories of compost types and classes

Compost type The compost type is defined by the main type, origin and characteristic of *source material* used for the production of the compost.	
Biowaste compost	Compost from kitchen and garden waste from source separated collection of organic household waste. This is the material commonly collected in the commingled collection scheme for food and garden waste (brown bin, biobin system)
Green waste compost	Compost produced from garden and park waste
VFG compost	Compost vegetable fruit and garden waste. This type of compost has been established in NL and BE/Fl based on the collection scheme for organic household waste where the collection of meat is excluded.
Biomix compost	Biowaste, green waste, sewage sludge (quite common system in Italy where sewage sludge is co-composted with source separated bio and green waste)
Bark compost	Compost produced from bark; usually not mixed with other organic residues but with additives as a nitrogen source
Manure compost	Compost from solid stable manure or from dewatered (separated) slurry
Sewage sludge compost	Compost produced from dewatered municipal sewage sludge together with bulking material
Mixed waste compost	Compost produced from mixed municipal solid waste (no source separation of the organic waste fraction)
Stabilised Biowaste	Biologically stabilised (composted) organic fraction from mechanical biological treatment of residual waste
Compost classes Compost classes mark certain quality levels as regards the concentration of contaminants (heavy metals, impurities); these criteria often are relevant for specified applications.	
Heavy metal class	Limit values for heavy metal may mark a compost class restricted for a certain land use or to be marketed at all.
Impurities	Marking the contents of admissible inert extraneous materials (contraries) like plastics, metals and glass. There might be a 2 class system distinguishing between composts for food production/pasture land and non food areas
Use types **The use types classify composts for certain areas of application in dependence on defined quality parameters. In some cases this might also be linked to quality classes**	
Compost for biological agriculture	This use type is characterised by two criteria: • For the use of the *compost type BIOWASTE COMPOST* from source separated organic household waste limit values for heavy metals have to be respected [Reg. (EC) 2092/91] There are no such quality criteria for other compost types like green waste compost. • Any compost produced from municipal sewage sludge is forbidden in biological agriculture
Compost for food production	Restriction of certain heavy metal or impurities related *compost classes* (e.g. class '2' or 'B') for the use in agricultural or horticultural food and feeding stuff production
Substrate Compost	Compost providing specific performance characteristics such as particle size, salt content, stability, plant response, nutrient availability etc. in order to be successfully used as constituent in growing media and potting soils.

Mulch compost	Compost of generally coarse structure (higher portions of wood chips with a maximum particle size > up to ca. 35 mm) and with less demands regarding maturity
Mature compost	Fully humified compost, generally utilised and recommended in all – also sensitive – applications; Identification is done by test methods testing the plant response or measuring the biological activity of the compost (e.g. *oxygen consumption, CO_2 evolution, self heating test)*
Fresh compost	Half matured compost but having passed thermal sanitisation (thermophile phase) with still a relatively high biological activity to be used in less sensitive applications like arable land

1.1 Task 1.1 & task 1.2: Denomination of the compost classes & identification description of the reference legislation, standards, protocols

Where Member States have established regulations for the production and use of compost, the identification of one or more material, use or quality related compost types and classes can be found. We have to distinguish between precautionary criteria which are intended to protect the environment and the consumer from any negative impact from using the compost and those which relate to certain use aspects in specific application areas. While the first ones are typically found in statutory frame work legislation the latter ones are rather elements of voluntary standards and market related quality assurance schemes

The most common classification relates to maximum concentration levels of the *seven classical* heavy metals (Cd, Cr, Cu, Hg, Ni, Pb and Zn).

Where more than one heavy metal related class are laid down they are mostly linked to specific application areas such as agriculture and food production (e.g. class 1) or landscaping and land reclamation (e.g. a lower class 2). Further precautionary parameters with limit values are impurities (physical constraints such as visible particles of metals, plastics and glass) and pathogenic indicator organisms such as *Salmonella ssp., E. coli, Enterococcae etc.*. Both are in principle part of existing compost standards and regulations.

Organic pollutants are only part of compost criteria where sludge or mixed waste is ruled in as potential source material (FR [where compost can be produced from mixed waste], DK [where compost and sludge is subject of one unique regulation], AT [for the compost type *waste compost* from MSW only]

Task 1.1 and task 1.2 have been integrated in Table 3. In the field *Description of classes* also some indications for task 1.4 (describing use types or use restrictions of the compost class) is allocated too. Further it is shown if the classification system is rolled out within a statutory or a voluntary regime.

Table 2 gives a summarising survey of the main compost classifications as established in EU MS.

Table 2: Summary table with compost classification types and number of classes adopted in national compost standards and legislation

	Number of classes or categories			
Criterion	**1**	**2**	**3**	**4**
Heavy metals	**BE, DK, FR, GR, HU, LT, NL, PL, SE, UK**	**DE, SK**	**AT, CZ, ES, IE, SI**	**LV**
Input materials	**UK**: Quality compost from source separated organic waste	**BE**: VFG compost; GWC **IT**: GWC; Mixed Compost (may include sewage sludge) **FI**: GWC; compost from digestate		**AT**: (1) source separated org. waste (2) sewage sludge (3) bark (4) mixed municipal solid waste
Application types			SI: (1) Agriculture – no restrictions (2) Agriculture with restrictions (3) Agriculture excluded	**AT**: (1) agriculture (2) landscaping (3) landfill coverage (4) bagged compost **CZ**: ?? **DE**: (1) compost for Agric./landscaping (2) substrate compost (3) mulch compost
Stability		**DE:** (1) mature compost (2) fresh compost **IE** requirement within licensing **LU** (1) mature compost (2) fresh compost		

Table 3: Number of classes in compost standards, description

	Type of Classification	Number of Classes	Designation		Description of Classes	Reference legislation or standard	
			Original	English [P] = Product [W] = Waste		Reference standard	statutory voluntary [S]; [V]
AT	**Precaution** ***heavy metals***	3	Qualitätsklasse A	Class A+ [P]	Top quality; limit values taken from Council Regulation (EEC) No.2092/91 on biological agriculture	Kompost-Verordnung /Austrian Compost Ordinance = Ordinance on quality requirements for composts from waste which includes quality requirements for composts from waste, type and origin of source materials, labelling and placing on the market of compost, and the definition when compost ceases to be waste (End-of-waste Regulation) Quality classes definition as pre-requisite to declare compost products for the use in destined market sector	**S**
			Qualitätsklasse A	Class A [P]	"Quality compost"- suitable for use in agriculture, horticulture, hobby gardening.		**S**
			Qualitätsklasse B	Class B [P]	Minimum quality for "compost" to be declared as product; restricted use in non-agricultural areas (land reclamation, landscaping, biofilter etc)		**S**
BE/*Flanders*	**Precaution** ***heavy metals***	1	-	Legislation [W]	Valid for all applications including digestion residuals and manure	Flemish Regulation on Waste Prevention and Management VLAREA	**S**
	Input material	2 each with or without VLACO QAS	Groencompost	Green compost [W]	Compost from source-separated garden waste	VLACO Quality assurance system	**S**
			Groencompost met VLACO-label	Green compost with VLACO label [W]	Compost from source-separated garden waste with the voluntary VLACO quality label	dto	**V**
			GFT compost	VFG-compost [W]	Compost from source-separated biowaste without meat (Vegetable, Fruit and Garden Waste)	dto	**S**
			GFT compost met VLACO-label	VFG-compost with VLACO label [**W**]	Compost from source-separated biowaste without meat VGF with the voluntary VLACO quality label	dto	**V**

	Type of Classification	Number of Classes	Designation		Description of Classes	Reference legislation or standard	
			Original	**English [P] = Product [W] = Waste**		**Reference standard**	**statutory voluntary [S]; [V]**
					Further product types are specified under the VLACO flag made from aerobically composted digestion residuals and manure	dto	**S**
BE/*Brussels*	Compost type	1			Source separated biowaste and green waste.		**n.d.**
BE/*Wallonia*	??						
BG	No standard					Law for Waste Management *Prom. SG. 86/30 Sep 2003* and the Supplementing Ordinance No. 8 only general provisions	
CY	No standard	---	---	---	---	---	---
CZ	**Application**		Kompost na zemědělskou půdu	Group 1 Agricultural compost [**P**]	The only compost class which is of relevance at the moment. because compost only has to be registered for this group. The input material and use is not restricted to agriculture. Quality requirements correspond to Class 1 of the Czech Standards Institute but with less quality parameter compared to the waste composts.	Act on fertilisers 156/1998 Sb. by the Public Ministry of Agriculture	**S**
	Precaution *heavy metals, PTE…*		"Rekultivační compost":	Group 2 Waste composts:	Differentiation by PTEs, heavy metals, not degradable parts and the application area.	Act On waste 185/2001 Sb.	**S**
	and application	3	*I. třída*	*Class 1 - best quality* [**P**]	To be used for sport and recreation facilities, living areas, public greens. Not in areas where children might play. No reference to agriculture/food production area applications.	Act on waste - Draft Biowaste ordinance* *** expected to be in force in 2008**	**S**
			II. třída	*Class 2 - 2nd best quality* [**P**]	For city greens, parks, forest parks, restoration of industrial zones. No reference to agriculture/food production area applications.	Act on waste - Draft Biowaste ordinance*	**S**
			III. třída	*Class 3 3rd best quality* [**P**]	Lowest biowaste quality acceptable for restoration, on landfills and for finishing landfills and for biofilters. Sometimes in mixtures with sludge	Act on waste - Draft Biowaste ordinance* Ordinance on surface waste utilization 294/2005 Sb.	**S**
	Application	1	Stabilizovaný odpad	Group 3 [**W**] Stabilised waste	Stabilised organic material suitable to be incorporated into landfills	Act on Waste	**S**

	Type of Classification	Number of Classes	Designation		Description of Classes	Reference legislation or standard	
			Original	English [P] = Product [W] = Waste		Reference standard	statutory voluntary [S]; [V]
DE	**Precaution** ***heavy metals***	2	Klasse 1	Class 1 [**W**]	Heavy metal limit value class I: max. application: 30t d.m./ha*y	Biowaste Ordinance	**S**
			Klasse 2	Class 2 [**W**]	Heavy metal limit value class II: max. application: 20t d.m./ha*y		**S**
	Application ***use type***	4	Frischkompost	Fresh compost [**W**]	Food & non food application mainly in agriculture; decomposition degree II & III (of V)	Quality Standard RAL GZ 251 within the Quality Assurance	**V**
			Fertigkompost	Mature compost [**W**]	Food & non food; decomposition degree IV & V (of V)	System of the German Bundesgüte-gemeinschaft Kompost e.V. BGK	**V**
			Substratkompost	Substrate compost [**W**]	Constituent for growing media; decomposition degree V (+ further criteria: limited content of soluble plant nutrients and salt);	dto	**V**
			Mulchkompost	Mulch compost [**W**]	Low portion of fine particles for soil coverage; decomposition degree: no requirements but after hygienisation;	dto; the QAS for mulch compost was adjusted in 2006. Two additional standards exist for liquid and solid digestion residuals	**V**
DK	**Precaution** ***heavy metals***	1	Kompost	Compost [**W**]	In Denmark there are no 'classes' – only the product standard 'compost', which should meet the requirements of the statutory order. For compost of garden and park wastes there are no requirements	Stat. Order 1650 of 13.12.06 on the use of waste (and sludge) for agriculture	**S**
EE	No classes	---	---	---	---	---	---
ES	**Precaution** ***heavy metals***	3	Class A	Class A [**P**]	In Spain no compost can be sold without having it registered in the "Official Register on Fertilisers Products". Once a product is included in the Register it can be sold. The registration period is 10 years (!!!) Three classes of compost in function of heavy metal content exist with connected application limits according to the quality of compost. Class A compost which is very near to Ecolabel requirements	Real Decreto 824/2005, de 8 de julio, sobre productos fertilizantes.(in english: Real Decree 824/2005 on Fertiliser Products)	**S**
			Class B	Class B [**P**]	Class B compost which can be used for compost produced from clean organic wastes (included biowaste from separate collection)	dto	**S**

	Type of Classification	Number of Classes	Designation		Description of Classes	Reference legislation or standard	
			Original	**English [P] = Product [W] = Waste**		**Reference standard**	**statutory voluntary [S]; [V]**
			Class C	Class C **[P]**	Class C compost which should be reserved for not so clean organic wastes (included the considered "compost" or "stabilised organic waste" obtained from composting of residual waste or rest waste due to the fact that in most Spanish regions no separate collection of biowaste exists)	dto	**S**
FI	**Input material and Application**	4	Maanparannus-komposti	Soil improvement compost **[P]**	The classes differ in the types of allowed source materials, maturity and organic matter content	Fertiliser regulation 12/07	S
			Tuore komposti	Fresh compost **[P]**	Low maturity compost for agriculture	dto	**S**
			Maanparannusmädäte	Digestion rest for soil improvement **[P]**	Compost which uses digestion residuals as input material	dto	**S**
			Kasvijätekompo sti	Green waste compost **[P]**	Compost made from garden waste	dto	**V**
FR	**Precaution** ***heavy metals***	1	Amendements organiques et supports de culture	Organic soil improvers - Organic amendments and supports of culture **[P]**	The standard seeks to fix designations, definitions and specifications, labelling, contents to declare and dose limits for use of organic soil improvers with and without fertiliser. Compost sale requires certification according to the standard. No 3rd party inspection and sample taking.	Standard NFU 44051 "Organic soil improvers - Organic amendments and supports of culture"	**S**
GR	**Precaution**	1	---	[P]	Standards for mixed waste compost with criteria for heavy metals, impurities, pathogen indicators; At the moment MWC from MBT plants only. No specific use restrictions	Solid Waste Management Act 114218/1997 Hellenic Ministerial Decision	**S**
HU	**Precaution** ***heavy metals***	1	Komposztok	Compost **[P]**	Only 1 compost class. Physical, chemical and biological quality parameters for final compost	Statutory rule No. 36/2006 (V.18.) about licensing, storing, marketing and application of yield increasing products (including composts)	**S**

	Type of Classification	Number of Classes	Designation		Description of Classes	Reference legislation or standard	
			Original	**English [P] = Product [W] = Waste**		**Reference standard**	**statutory voluntary [S]; [V]**
IE	**Precaution** ***heavy metals***	3	Class 1	Class 1 **[P]**	The basis for the standard development is the Working Paper 2nd Draft of the EU Biowaste Directive	EPA licensing for each plant according to National Waste Management Act	**S**
			Class 2	Class 2 **[P]**	It distinguishes separately collected biowaste in environmental quality classes 1 or 2.	Proposal for new standard exists	**S**
			Stabilised biowaste	Stabilised biowaste **[W]**	Stabilised biowaste' is resulting from the mechanical/ biological treatment of unsorted waste or residual municipal waste and also source separated BWC or GWC if it would not meet the Class 1 or Class 2 requirements	In force probably 2008	**S**
	Stability	1	Compost	Compost **[P]**	AT4 is ≤10mg/O_2/g dry matter or Dynamic Respiration Index is ≤1,000mgO2/kg volatile solids/h. Oxygen uptake rate ≤ 150 mg O2/kg volatile solids per hour (OxiTop© Method)	Draft EPA/ license Individual license	
IT	**Input material and control type**	2 ("mixed" and green compost)	Ammendante Compostato Verde	Green compost **[P]**	Compost produced from green waste only. Standards refer to physical-chemical parameters (pH 6-8.5, Moisture content<50%, Organic Nitrogen >80% total N, Humic and Fulvic Acids > 2%, C/N<25), heavy metal contents (Pb, Cd, Ni, Zn, Cu, Hg, CrVI), impurities and microbiological contamination. The product has no market and application restrictions	National Law on Fertilisers D.lgs. 217/06 which do not require any monitoring.	**S**
			Ammendante Compostato Verde con Marchio Qualità CIC	Green compost with CIC Quality label **[P]**	As above but samplings are made by certificated personnel from the Italian Composting Association (CIC).	Quality label ensures fulfilment of statutory standards (assessment of compliance is usually an issue due to the rather poor performance of controlling authorities.	**V**
			Ammendante Compostato Misto	Mixed Compost **[P]**	Compost produced with different source segregated organic waste (green waste, kitchen waste, sludge, etc). Parameters are the same as for green compost, with different requirements for organic carbon (25%d.m.), humic and fulvic acids (7% d.m.). The product has no market and application restrictions	National law on fertilisers (D.lgs. 217/06). Defines legislation standards for fertilisers quality. No monitoring scheme/protocols.	**S**
			Ammendante Compostato Misto con Marchio Qualità CIC	Mixed Compost with CIC Quality label **[P]**	As above but samplings are made by certificated personnel from the Italian Composting Association (CIC).	Quality label ensures fulfilment of statutory standards (assessment of compliance is usually an issue due to the rather poor performance of controlling authorities.	

	Type of Classification	Number of Classes	Designation		Description of Classes	Reference legislation or standard	
			Original	**English [P] = Product [W] = Waste**		**Reference standard**	**statutory voluntary [S]; [V]**
	Input material	**1**	n.d.	Mixed Waste Compost [**W**]	The use of MWC based on this old national decree is not considered to be used anymore but the decree is still in force. Application is limited to brown fields, street construction and landfill restoration	DPR 915/82 - DCI 27/7/84	**V**
LT	**Precaution** ***heavy metals***	1		**[P]**	Compost must be accompanied with a certificate of its quality and properties.	Requirements for the composting of biowaste, approved by the Ministry of environment 25th Jan. 2007, No. D1-57	**S**
LU	**Application** ***use type***	4	Frischkompost	Fresh compost **[P]**	Food and non food application mainly in agriculture; decomposition degree I & II (of V)	Only individual licensing of plants which requires a quality assurance system like the one in Germany. .	**S**
			Fertigkompost	Mature compost **[P]**	Food and non food application; decomposition degree IV & V (of V)	Quality Standard RAL GZ 251 within the Quality Assurance	**S**
			Substratkompost	Substrate compost **[P]**	Constituent for growing media; decomposition degree V (+ further criteria: limited content of soluble plant nutrients and salt);	System of the German Bundesgüte-gemeinschaft Kompost e.V. BGK	**S**
			Mulchkompost	Mulch compost **[P]**	Low portion of fine particles for soil coverage; decomposition degree: no requirements but after hygienisation;	dto	**S**
LV	**Precaution** ***heavy metals*** **Application as fertiliser** ***nutrients***	1		**[P]**	Compost from green and kitchen waste has to be certified as organic fertiliser Total N, total P (P_2O_5), total K (K_2O), humidity, organic matter, pH There are no direct legislation demands to compost production from bio waste and its usage. There are indirect rules for the treatment of sludge and their compost[1] (including methods of taking the examples and providing of the analyses from sludge and its compost) or registration and sale of organic fertilisers[2] (including methods of taking the examples and providing the analyses of organic	Cabinet Regulation No. 530 " Regulations on identification, quality, conformity and sale of fertilisers" 25.06.2006	**n.d.**

[1] Cabinet Regulation No. 362 **"Regulations on utilisation, monitoring and control of sewage sludge and its compost"** 02.05.2005
[2] Cabinet Regulation No. 530 " **Regulations on identification, quality, conformity and sale of fertilisers**" 25.06.2006
[3] Cabinet Regulation No. 820 " The methodology for taking and preparing of control copies from fertiliser materials" 03.10..2006.
[4] Regulations on the receiving EC eco labeling on substrates, http://www.meteo.lv/public/ekomarkejums.html

	Type of Classification	Number of Classes	Designation		Description of Classes	Reference legislation or standard	
			Original	English [P] = Product [W] = Waste		Reference standard	statutory voluntary [S]; [V]
					fertilisers[3]). As a recommendation 2005 the Ministry of Environment published the requirements to receive the 'EC eco label' for growing media produced from biodegradable waste[4]		
	Precaution ***heavy metals***	5		Class 1 to 4 **[W]**	Classes are related to the concentration of heavy metals – Cd, Cr, Cu, Hg, Ni, Pb, Zn - Class 1-4 – can be used in agriculture Class 5 can be disposed of	Cabinet Regulation No. 362 "Regulations on utilisation, monitoring and control of sewage sludge and its compost" 02.05.2005	**n.d.**
MT	No standard	---	---	---	---	---	
NL	**Application n*utrient content N, P_2O_5***	1	Compost	Compost **[P]**	After 10 years of experiences the Dutch Government decided that not the quality (heavy metals) but the nutrients are the primary problem with compost. No longer is the applied amount of compost but the nutrient load limited. All compost which is applied for crop-growing in soils must be independently certified with a very strict threshold for glass. Because the sales area of compost is not predictable while the production more or less of all biowaste composts will be certified in future. Certification is operated by independent institutes/ auditors in cooperation with the Dutch Waste Management Association DWMA/VA. for biowaste and the BVOR Dutch Association of Compost Plants for green waste.	New fertiliser regulation after 01/2008 which covers all fertiliser material for agricultural soil. There is a new less strict threshold for heavy metals which must be kept, but no analysis on heavy metals is required.	**S**
PL	**Precaution** ***heavy metals***	1		**[W]**	Composts which want to be sold as organic fertilisers must be approved/licensed by the Ministry of Agriculture and Rural Development. Licensing includes requirements for heavy metals, organic matter (40 %!). Licensing request depends on source material and intended application e.g. food production	The National Law on Fertilisers and Fertilization. 26.07.2000. Dz. U. Nr 89, poz. 991	**S**
PT	No classes			**[P]**	Only product registration and declaration of precaution and product properties every 5 years.	Registration is obligatory for placing the compost product on the market	**S**
RO	**---**	---	---	---	---	---	**---**

	Type of Classification	Number of Classes	Designation		Description of Classes	Reference legislation or standard	
			Original	**English [P] = Product [W] = Waste**		**Reference standard**	**statutory voluntary [S]; [V]**
SE	**Input material**	1	Certifiering av kompost och biogödsel	QAS for compost and digestate **[W]**	Voluntary quality assurance system for compost and digestion products is operated by the Swedish Waste Management Association Avfall Sverige together with Swedish Standardisation Institute SP	Swedish Standardisation Institute SP certification SPCR 120 and SPCR 152	**V**
SI	**Application** ***heavy metals***	3	Kompost 1. razreda	Class I **[P]**	The decree shows limit values in 3 classes for heavy metals for the use of compost, sewage sludge and fertilisers. Class I can be used without any restrictions besides the consideration of the Instructions for implementing good farming practices (OJ RS 34/009	Decree on input of dangerous substances and plant nutrients into the soil (OJ RS 68/96 and 35/01)	**S**
			Kompost 2. razreda	Class II **[P]**	Class II can be spread with a special permission with a limited application rate considering the heavy metal content and load besides the consideration of the instructions for implementing good farming practices (OJ RS 34/00)	dto	**S**
			Kompost za nekmetijsko rabo	Class III **[W]**	Class III is not suitable for agriculture	dto	**S**
		Lower than Class III [**Waste**]			If compost does not meet Class III it can be applied as WASTE respecting certain criteria (risk assessment)		
SK	**Application**	2	Kompost I. triedy	1st. class compost [**P**]	The quality criteria are set for humidity, contain of combustible substances, total nitrogen, C/N ratio, pH level, indecomposable additions, whole homogeneity. Also are monitored the highest levels of present elements in 1st. class compost. Such compost has to be registered and after it may be marketed according to Act on fertilisers. Can be applied on agricultural soil in compliance with good agricultural practice	Slovak technical standard No. 46 57 35 – Industry composts	**S**
			Kompost II. triedy	2nd. class compost [**W**]	The quality criteria are set for humidity, contain of combustible substances, total nitrogen, C/N ratio, pH level, indecomposable additions, whole homogeneity. Also are monitored the highest levels of present elements in 2nd class compost. 2nd class compost can not be registered as fertiliser. Can be used in landscaping, private gardens etc.	dto	**S**

	Type of Classification	Number of Classes	Designation		Description of Classes	Reference legislation or standard	
			Original	**English [P] = Product [W] = Waste**		**Reference standard**	**statutory voluntary [S]; [V]**
UK	**Input material**	1	Compost from source-segregated biodegradable waste, also defined as a Quality Compost	Compost from source-segregated biodegradable waste, also defined as a Quality Compost [P]	**BSI PAS 100:2005** specifies the minimum requirements for the process of composting, the selection of materials from which compost is made, minimum compost quality, how compost is labelled and requires that it is traceable. It also requires Hazard Analysis and Critical Control Point assessment and the implementation of a compost Quality Management System and compost labelling and marking.	PAS 100:2005 The British Standards Institution's '*Publicly Available Specification for Composted Materials'*	**V**
		1	Quality Compost	Quality Compost [P]	The **Quality Compost Protocol (QCP)** defines the point at which compost may become a product, by setting the criteria for production of quality compost from source-segregated biodegradable waste. Quality compost will be normally regarded as having ceased to be a waste when dispatched to the customer. In order to comply with the QCP, a number of criteria must be met, including that: • The compost is made from source-segregated input waste listed in appendix B of the Protocol. • The compost meets the requirements of one of the approved standards (PAS 100:2005) listed in Appendix A of the Protocol. • The compost is destined for appropriate use in one of the markets designated by the Protocol (agriculture & soil-grown (field) horticulture, land restoration, soft landscape operations and amateur horticulture). • Each compost delivery is accompanied by the *compost certification code* and a declaration that the compost was produced in conformance with the Quality Protocol. The compost producer provides the compost recipient with a Contract of Supply for each consignment of compost, and keeps a copy of each contract.	Quality Compost Protocol (QCP) '*Quality Protocol Compost: quality protocol for the production and use of quality compost from source-segregated biodegradable waste'.*	**V**

1.2 Task 1.5.a – Regulations and standards on Input materials for composting

In most countries where compost regulations are available the waste materials allowed for the production and use of compost are defined

In general we find rather a *more or less extensive POSITIVE LIST* than a list with material exclusions. The most prominent waste groups excluded from compost production are

- Municipal Sewage sludge: BE/Fl, DE, FR, LU, NL, SE, UK[5]
- Mixed (not source separated) MSW: BE/Flanders, DE, FI, LU, NL, UK[5]

FR has two different standards for waste compost and sewage sludge respectively. LU would allow the use of sewage sludge only if it is not mixed with source separated organic household waste (biowaste). In other cases where the result of aerobic rotting of the organic fraction of residual waste would be allowed for the production of *waste compost (MWC)* its application is restricted to surface reclamation of landfill sites, biofilters or similar technical applications (e.g. AT, CZ, IT).
An overview with the principle systematic of how input materials for compost production are ruled in national standards and regulations is shown in Table 4.

1.2.1 The rationale of a positive list

The main rationale for establishing standards for input materials by the means of a positive list is quite obvious: in trusting the basic quality of e.g. source separated organic materials it can be expected that the compost derived thereof may achieve the desired quality at a constant high level in terms of potential contaminants. Therefore the predictability of the production over time deserves a higher level of confidence by all addressees, the compost producer, the responsible authorities and the public in their responsibility for environment and health protection and the potential compost customers.

Further, a *positive list* follows an important principle of recycling: searching for the best treatment and recycling option for each individual waste stream. The logic behind could be phrased as follows:
"What would be metabolised into humus if exposed to an incidental transformation process in nature should be directed towards 'HUMIFICATION' if it occurs as specified waste material."

Excluding *negative lists* by trying to define what cannot be used might bear the risk of creating loopholes. On the other hand, if rolled out in ordinances or regulations, any of those lists tend to be rather inflexible following the common procedures of amending legislation. Even if a further suitable waste type has been identified it could take months or years of additional negotiations for a new version of an ordinance. (Example from Germany: during the preparation of the biowaste ordinance, the lawmakers neglected to include biodegradable plastics in the positive list which already at an early stage was used as collection tool for kitchen waste).

An alternative and more flexible solution might be to lay down a statutory list of suitable waste groups and to establish a standing committee (e.g. within the standards organisation) which checks specific raw materials on their suitability for the production of high quality composts.
Another scheme can be reasonable in BE/Flanders: here some materials are in principle allowed but need individual approval on a case by case level.
An important aspect is that – independent of the general list of allowed source materials and wastes – the authorities (municipalities, waste management associations) who are responsible for the set-up of the collection scheme may decide on what is collected with the collection services (*bio bin / brown bin*) and what not. As a result for instance in Austria and Germany in some regions *meat* is excluded and in other areas not.

[5] Only if the compost producer applies for PAS 100 (BSI, 2005) and/or Compost Quality Protocol Scheme (Environment Agency, 2007)

It is important to note that the scope of standards (in terms of what is, or is not included) also influences the way in which standards are set. Strictly speaking, the standards may be non-comparable for this reason alone. For example, in different countries, sludge may be treated within the compost standards (e.g. Austria, Italy) or it may be treated under separate legislation (e.g. Flanders, Sweden, Luxembourg, Germany, France, UK).

Table 5 lists all waste materials that have been found in national standards and regulations for the production of compost. This is independent from the question if compost is treated under the waste or product regime.

1.2.2 Positive list and European Waste Catalogue

Most countries rely fully on the European Waste Catalogue and provide – in some cases – additional specifications or requirements.

Austria has decided to establish an independent list and coding of materials in order to guarantee a distinct designation and interpretation of waste types. It has been judged that the logic of the EWC on its own does not provide this necessary information in order to prevent undesirable polluted materials from being used. Examples are

- 19 05 99 Wastes not otherwise specified
- 19 06 03 Liquor from anaerobic treatment of municipal waste
- 02 01 03 Plant-tissue waste
- 02 03 04 Materials not suitable for consumption or processing

It seems that also on a European level it would be wise to add to the EWC codes a precise qualitative description of the individual type and origin of material when being included in a positive list. This would be of crucial importance to create a higher chance of common interpretation in all Member States of the specific waste types which are included and which not.

The specific national requirements for the individual wastes are included in footnotes to Table 5. From this it can already be concluded that the Member States have identified the need of further specification in terms of clarification for the practical implementation in licensing and day to day operation in the plants. It is obvious that a binding positive list must be accompanied by a consistent and traceable receipt control (compliance approval upon receiving the waste) and documentation system, which can be inspected by the competent authority.
The list should not be read as a proposal for a positive list as part of a European *end of waste* regulation. But it might be used as a guiding document for preparing a list of applicable source materials for quality compost production.

In total we found 11 countries with positive lists as part of statutory regulations and 3 countries with voluntary standards for input materials.

The survey here is structured as follows:

Table 4	General overview on the systematic of how Member States established specific requirements for input materials in composting • General description of how input materials for compost production are defined. • Indication if the requirements have a statutory or voluntary status
Table 5	Comparative list of waste materials allowed for the production of compost in EU Member States • Detailed list with input materials as found in national regulations. • This list contains 4 categories of waste. In addition for category 1 and 2 we distinguished between typical origins. **1. Waste for biological treatment from <u>exclusively vegetable origin</u> (NO animal by products or meat)** ▪ Organic vegetable waste from garden & parks and other greens ▪ Vegetable waste, from the preparation and consumption of food, luxury food & beverages ▪ Organic residues from commercial, agricultural and industrial production, processing and marketing of agricultural and forestry products – purely of vegetable origin ▪ Other organic residues – purely of vegetable origin ▪ Digestion residues from anaerobic digestion of waste materials – pure vegetable origin **2. Waste for biological treatment <u>with parts of animal origin</u>** ▪ Animal waste, especially waste from the preparation of foodstuffs ▪ Organic residues from commercial, agricultural and industrial production, processing and marketing of agricultural and forestry products – with parts of animal origin ▪ Digestion residues from anaerobic treatment of waste materials which may contain parts of animal origin **3. Further waste for biological treatment [these wastes might need <u>additional approval of origin and involved processes</u>]** **4. Additives for composting [added in minor quantities (up to 10 – 15 % at maximum) in order to improve the composting process, humification and maturation]**

Table 4: General overview on the systematic of how Member States established specific requirements for input materials in composting

	Statutory Voluntary [S] / [V]	Main principles how materials for composting are ruled [Types of wastes etc]	Input Materials specifically excluded?
AT	**S**	• Statutory End of Waste – Compost Ordinance; Waste management plan 2006; • 5 categories of waste materials, detailed specification and denomination with waste codes independent from the European Waste Catalogue. These categories differentiate between pure plant tissue waste and waste which can contain animal by-products according to the EU ABP Regulation o high quality materials of plant tissue origin only (including source separated garden und park waste) o high quality materials including parts of animal origin (Cat. 3 ABP, manure, paunch waste); including source separated organic house hold and catering waste o Materials with eventual need of specific quality controls due to potential contamination again differentiated for plant tissue materials and ABP o Mineral additives such as stone dust, wood ash, dredged soil, lime stone ; limited to 10 respectively 15 % (dredged soil)	NO
BE *Flanders*	**S**	VLAREA (Flemish Regulation on Waste Prevention and Management) Source separated biowaste and green waste. Some additional types of organic waste according to case by case licensing. No generally applicable written standards as to the latter.	Sewage Sludge Mixed MSW
Walloonia	**n.d.**[6]	Source separated biowaste and green waste.	NO
Brussels	**n.d.**	Source separated biowaste and green waste.	NO
BG	**---**	No regulation or standard	---
CY	**---**	No regulation or standard	---
CZ	**[S]** *draft Biowaste Ordinance (2008)*	There are no materials in- or excluded by legislation. The fertiliser law included some thresholds for input materials in general. In the new draft Biowaste Ordinance the waste materials are ruled. There are specific heavy metal content limits for sewage sludge. Each catalogue number has certain requirements. Ministry of Environment intends to prepare legislation with obligation for separate collection. At the moment there are only large voluntary projects e.g. in Prague.	NO
DE	**S**	Ordinance on Biowaste (BioAbfV): Here only waste materials are ruled, which may be used for the production of compost.	Sewage Sludge[7] Mixed MSW
	S	Fertiliser Ordinance (DüMV) includes an extensive positive list of source materials which goes far beyond the positive list of the *Biowaste*	NO

[6] n.d. … no data available

[7] Compost can be produced also from sewage sludge, but this is regulated in the German Sewage Sludge Ordinance and is excluded from the Biowaste Ordinance as well as the Fertiliser Ordinance.

	Statutory Voluntary [S] / [V]	Main principles how materials for composting are ruled [Types of wastes etc]	Input Materials specifically excluded?
		Ordinance. Compost can be used as *organic soil improver* or *organic fertiliser*, if the used source materials comply with this ordinance. Any material which is listed in the Fertiliser Ordinance and has achieved the waste status but is not found in the Biowaste Ordinance cannot be used for the production of compost.	
	V	RAL GZ 251: Positive list of the quality assurance scheme based on RAL GZ 251 includes all materials as listed in the Biowaste Ordinance and the Fertiliser Ordinance.	NO
DK	**S**	Waste separated at source, including composted waste, from private households, institutions and private enterprises together with sewage sludge . Garden waste can be treated and used without any restrictions. In principle raw materials should meet the requirements of the stat. order on heavy metals and organic compounds before processing. For compost the authority agrees to analyse also the final product. But the principle is: if input material complies with the limit values of the stat. order the final product may not be analysed anymore!	NO
EE	**---**	No regulation or standard	---
ES	**S**	Statutory legislation Real Decree 824/2005 on Fertiliser Products . For the elaboration of Fertiliser Products of Group 2 [Organic Fertiliser], 3 [Organic-mineral Fertiliser] and 6 [Organic Amendment] of Annex I, only allowed is the use of raw materials from organic (animal or vegetal) source, included clearly in the list of biodegradable organic waste of Annex IV (taken in part of European waste list (Decision 2001/118/CE 16 January 2001, transposed by Spanish Order MAM/304/2002, 8 February.[8]	NO
FI	**–**	NO common regulation for input materials; indicated materials in the positive list below refer to licensing practice in Finland; General strategy: source separation of organic household waste, garden and park waste, catering waste and residues from food production and processing.	Mixed MSW
FR	**[S]**	NF U44-051: Compost Standard: No definite positive list; all types of compostable waste including mixed municipal waste is allowed with the exception of sewage sludge; pre-requisite for compost use and marketing as product ["STATUTORY PRODUCT STANDARD"]	Sewage sludge
	[S]	NF U44-095: Sewage sludge/Biosolids compost = product; pre-requisite for compost use and marketing as product ["STATUTORY PRODUCT STANDARD"]	---
GR	**---**	Only mixed waste composting ; No regulation; nearly no composting plants; permits for input materials decided by the Prefecture authority, on the basis of the Environmental Impact Assessment of the facility	NO
HU	**S**	Statutory rule Nr. 23/2003. (XII. 29.) about the treatment of biowaste and technical requirements of composting with a positive list. The list contains 6 main categories of waste materials and detailed specification and denomination and waste codes ruled by the Hungarian Statutory Rule Nr. 16/2001. (VII.18.) about the list of the wastes based on the European Waste Catalogue codes (EWC).	Mixed MSW Sewage sludge

[8] Spain: In addition to this, Article 17 [Use of wastes] sets that the use as an ingredient of any material included in the European List of Wastes, as mentioned in Commission Decision 2001/118/CE, 16 January 2001, which modifies the Decision 2000/532/CE by which refers to the list of wastes, will be submitted to the competent authority of the region where the waste is produced and, if necessary, where the waste is recovered.

	Statutory Voluntary [S] / [V]	Main principles how materials for composting are ruled [Types of wastes etc]	Input Materials specifically excluded?
IE	**---**	NO; There is no list of acceptable material in legislation in Ireland or in a QAS.	NO
IT	**S**	Fertiliser Law (L. 748/84, no Decree 217/06) A positive list is given; it basically includes source separated food waste, garden waste from private and public gardens, slurries and manure from husbandry, sewage sludge, agro-industrial by-products, wood and textile (untreated) residues from food processing etc. All indicated wastes in the positive list below refer to EWC codes explicitly reported in a Technical Regulation on simplified authorisation Procedures for waste recovery. This is independent from the question if compost might be considered as a product but superintend composting plants licensing. Other biodegradable types of waste must be approved on a case-by-case basis.	Mixed MSW
LT	**---**	Environmental Requirements for Composting of biowaste, approved by the Ministry of the Environment on 25 January 2007, No. D1-57 allows the use of biowaste, green waste, agricultural and forestry waste and mixed waste to be composted. It even allows compost organic waste from industrial source (exception waste is specific in 13 para of the requirement) and products from restaurants, canteens etc. as long as the Animal by-Products Regulation is met.	NO
LU		Allowed input materials are defined within the individual plant license. Organic residues from households, gardens and parks together with industrial organic residues	Animal carcasses, slaughterhouse wastes, sewage sludge, waste from animal breeding e.g. animal manure; potato peelings from commercial sources
LV	**---**	No regulation or standard	---
MT	**---**	No regulation or standard	---
NL	**S**	EU waste catalogue; Within the KIWA certificate as well as in the VA Certificate there are no specific rules for input materials. The producer of the compost is responsible for the quality of the process and the end product. Both process and end product are regulated by law. In the Netherlands it is not allowed to accept manure or sludge in a facility to produce compost. The product of this mixture of manure or sludge with compost remains manure or sludge. Vegetables, fruits and garden waste (VFG) from households together industrial organic residues - a small positive list exists	Potato peelings from commercial sources Mixed MSW Animal Manure Sewage sludge
PL	**S**	There is no positive list of materials for composting. Laws on waste materials and fertilisers allow the use of sewage sludge and mixed waste for compost and the production of organic fertilisers if the final product meets the heavy metal standards. The use of waste from animal origin must be approved by the Veterinary	Industrial organic waste excluded for the production of organic

	Statutory Voluntary [S] / [V]	Main principles how materials for composting are ruled [Types of wastes etc]	Input Materials specifically excluded?
		Institute.	fertilisers
PT	**---**	No regulation or standard	---
RO	**---**	No regulation or standard	---
SE	**V**	Voluntary Quality Assurance System: SPCR[9] 152: Certification rules for compost from biowaste; SPCR 120: Certification rules for compost from biowaste Source separated material from gardens, households, restaurants, food processing, agriculture and forestry Otherwise the allowed input materials are defined in the individual permits of each composting plant	Sludge
SI	**S**	Regulation about the Treatment of Biowaste to Compost (Feb. 2004) It includes an input material list which contains mixed waste and sludge. It allows ABRP only after a corresponding treatment required by ABPR 1774 and an evaluation by a Veterinarian	NO
SK	**V**	No specific regulation and positive list; but traditionally there exists a basic rule what is licensed case by case.	NO
UK	**V**	BSI PAS 100 (Standard): No positive list; but requires the biowaste to be source-segregated and that the compost producer only accepts it if the Hazard Analysis and Critical Control Point assessment finds that an effective Critical Control Point exists for each hazard.	Treated wood Non compostable packaging and plastics
	V	EA-WRAP Quality Compost Protocol: Appendix B provides a list of acceptable biowaste types for the production of quality composts. Full compliance with the Quality Compost Protocol is the pre-requisite that certified compost can be marketed as a product (the positive list is currently more restrictive than the theoretical range of biowaste types that a BSI PAS 100 compost producer could accept.)	Sewage sludge Treated wood Japanese knotweed[10] Non compostable packaging and plastics

[9] SPCR: Swedish National Testing & Research Institute

[10] This exclusion is in the Composting Association's Compost Certification Scheme guidance documents. Under the Wildlife and Countryside Act 1982, it is illegal to permit the spread of Japanese Knotweed. Pieces of rhizome as small as 0.7 grammes can regrow! Likely unacceptable risk that part of the Japanese Knotweed rhizome may be inadequately decomposed by the end of composting, and thus become established in any locations where the compost is spread.

Table 5: Comparative list of waste materials allowed for the production of compost in EU Member States independent of waste or non-waste regime

[AT] Countries in […] indicate that the use of this waste as input material for composting is connected with certain restrictions for marketing and use or that specific quality requirements must be met. See also footnotes.

	Type of waste material	Further specifications	EWC Code	Corresponding EWC waste type	Input materials accepted by MS
1	Waste for biological treatment from exclusively vegetable origin (*NO Animal By Products or meat*)				
1.1	Organic vegetable waste from garden & parks and other greens				
1.1.01	Mixtures from organic wastes according to 1.1	corresponds to VFG = vegetable, fruit & garden waste; source separated	n.s.	n.s.	AT, BE, BG, CZ, DE, FR, HU, IE, NL, PL, SE, UK
1.1.02	Grass cuttings, hay, leaves,	Only slightly contaminated cuttings (not along highly frequented streets and highways	20 02 01	Compostable waste	AT, BE, BG, CZ, DE, ES, FI, FR, HU, IE, IT, LT, LU, LV, NL, PL, SE, SK, UK
1.1.03	Leaves,	Only slightly contaminated (not along highly frequented streets and highways	20 02 01	Compostable waste	AT, BE, BG, CZ, DE, ES, FI, FR, HU, IE, IT, LU, LV, NL, PL, SE, SK, UK
1.1.04	Vegetable waste, flower waste, windfalls	Also cut flowers from florist markets and households	20 02 01 02 01 03	Compostable waste Waste from vegetable tissue	AT, BE, BG, CZ, DE, ES, FI, FR, HU, IE, IT, LU, LV, NL, PL, SE, SK, UK
1.1.05	Bark	Only bark not treated with lindane	03 01 01[11] 03 03 01	Bark and cork waste Waste from wood preparation and the production of cellulose, paper and cardboard	AT, BE, BG, CZ, DE, ES, FI, FR, HU, IE, IT, LT,LU, NL, PL, SE, SK, UK
1.1.06	Wood , not specified	Only untreated wood;	03 01 05	Saw dust, wood shavings, cuttings, wood, chipboard, veneer with the exception of those which belongs to 03 01 04	AT, BE, BG, CZ, DE, ES, FI, FR, HU, IE, [IT][12], LT, PL, SE, SK, UK
1.1.07	Wood, tree and bush cuttings	Complete or shreddered	20 01 38 20 02 01	Wood with the exception of those which belong to 20 01 37 Biodegradable waste	AT, BE, BG, CZ, DE, ES, FI, FR, HU, IE, [IT] [13], LT, LU, NL, PL, SE, SK, UK
1.1.08	Wood, from the processing of untreated wood	Only untreated wood	03 01 05	Saw dust, wood shavings, cuttings, wood, chipboard, veneer with the exception of those which belong to 03 01 04	AT, BE, BG, CZ, DE, ES, FI, FR, HU, IE, [IT][13], LT, LU, NL, PL, SE, SK, UK
1.1.09	Cemetery waste – source separated		20 02 01	Biodegradable waste	AT, BE, BG, CZ, DE, ES, FI, FR, HU, IE, IT, LU, NL, PL, SE, SK, UK
1.2	Vegetable waste, from the preparation and consumption of food, luxury food & beverages				
1.2.01	Cereals, fruit & vegetables		20 02 01 02 01 03	Compostable waste Waste from vegetable tissue	AT, BE, BG, CZ, DE, ES, FI, FR, HU, IE, IT, LU, NL, PL, SE, SK, UK
1.2.02	Tea leaves, coffee grounds		20 02 01 02 01 03	Compostable waste Waste from vegetable tissue	AT, BE, BG, CZ, DE, ES, FI, FR, HU, IE, IT, LU, NL, PL, SE, SK, UK
1.2.03	Dough, yeast		20 02 01 02 01 03	Compostable waste Waste from vegetable tissue	AT, BE, BG, CZ, DE, ES, FI, FR, HU, IE, IT, LU, NL, PL, SE, SK, UK
1.2.04	Residues from spices and herbs		20 02 01 02 01 03	Compostable waste Waste from vegetable tissue	AT, BE, BG, CZ, DE, ES, FI, FR, HU, IE, IT, LU, NL, PL, SE, SK, UK
1.2.05	Wooden oversize fraction from screening compost for		n.s.	n.s.	AT, BE, BG, CZ, DE, ES[14], FI, FR, HU, IE, IT, LU, NL,

[11] Waste from wood processing and the production of plates and furniture

[12] To be specifically approved for each plant

[13] To be specifically approved for each plant

	Type of waste material	Further specifications	EWC Code	Corresponding EWC waste type	Input materials accepted by MS
	reuse in composting				PL, SE, UK
1.2.06	Former foodstuff	Of vegetable origin only	02 01 03 02 03 04[15]	Waste from vegetable tissue Materials not suitable for consumption or processing	AT, BE, BG, CZ, DE, ES, FI, FR, HU, IE, IT, LU, NL, PL, SE, UK
1.2.07	Vegetable catering waste and used cooking oil	Of vegetable origin only (plant tissue) source separated from central as well as household kitchens as well as catering services	02 01 03 02 03 04[16]	Waste from vegetable tissue Materials not suitable for consumption or processing	AT, BE, BG, CZ, DE, ES, FI, FR, HU, IE, IT, LU, NL, PL, SE, UK
1.3	Organic residues from commercial, agricultural and industrial production, processing and marketing of agricultural and forestry products – purely of vegetable origin				
1.3.01	Harvest residues, hay and silage		02 01 03[17]	Plant-tissue waste	AT, BE, BG, CZ, DE, ES, FI, FR, HU, IE, IT, LT, LU, NL, PL, SE, SK, UK
1.3.02	Bark		02 01 03[17]	Plant-tissue waste	AT, BE, BG, CZ, DE, ES, FI, FR, HU, IE, IT, LU, NL, PL, SE, SK, UK
1.3.03	Grain/Cereal dust		02 01 03[17]	Plant-tissue waste	AT, BE, BG, CZ, DE, ES, FI, FR, HU, IE, IT, LU, NL, PL, SE, SK, UK
1.3.04	Straw		02 01 03[17]	Plant-tissue waste	AT, BE, BG, CZ, DE, ES, FI, FR, HU, IE, IT, LU, NL, PL, SE, SK, UK
1.3.05	Vines		02 03 04	Materials not suitable for consumption or processing	AT, BE, BG, CZ, DE, ES, FI, FR, HU, IE, IT, LU, NL, PL, SE, SK, UK
1.3.06	Tobacco waste		02 03 04	Materials not suitable for consumption or processing	AT, BE, BG, CZ, DE, ES, FI, FR, HU, IE, IT, LU, NL, PL, SE, SK, UK
1.3.07	Beet chips, tails		02 01 03[17] 02 03 04	Plant-tissue waste Materials not suitable for consumption or processing	AT, BE, BG, CZ, DE, ES, FI, FR, HU, IE, IT, LU, NL, PL, SE, SK, UK
1.3.08	Residues from canned and deep freeze food processing		02 03 04	Materials not suitable for consumption or processing	AT, BE, BG, CZ, DE, ES, FI, FR, HU, IE, IT, LU, NL, PL, SE, SK, UK
1.3.09	Residues from fruit juice and jam production		02 03 04	Materials not suitable for consumption or processing	AT, BE, BG, CZ, DE, ES, FI, FR, HU, IE, IT, LU, NL, PL, SE, SK, UK
1.3.11	Residues from starch production		02 03 04	Materials not suitable for consumption or processing	AT, BE, BG, CZ, DE, ES, FI, FR, HU, IE, IT, LU, NL, PL, SE, SK, UK
1.3.12	Vinasse, molasse residues		02 03 04	Materials not suitable for consumption or processing	AT, BE, BG, CZ, DE, ES, FI, FR, HU, IE, IT, LU, NL, PL, SE, SK, UK
1.3.13	Feed and feed residues not fit for use	Of vegetable origin only	02 01 03[17]	Plant-tissue waste	AT, BE, BG, CZ, DE, ES, FI, FR, HU, IE, IT, LU, NL, PL, SE, SK, UK
1.3.14	Residues of tea and coffee production		02 03 04	Materials not suitable for consumption or processing	AT, BE, BG, CZ, DE, ES, FI, FR, HU, IE, IT, LU, NL, PL, SE, SK, UK
1.3.15	Marc, seeds, shells, grist, press-cake	e.g. from oil mills, spent barley, draff of hop; marc of medicinal plants, copra, only materials which have not been treated with organic extraction agents	02 03 01	Sludge from washing, cleaning, peeling, centrifuging and segregation processes	AT, BE, BG, CZ, DE, ES, FI, FR, HU, IE, IT, LT, LU, NL, PL, SE, UK[18]
1.3.16	Crushed grain or process		02 03 01	Sludge from washing,	AT, BE, BG, CZ, DE, ES, FI,

[14] Not considered because it not appears in European waste list, but presumably it would not be of any problem to include it

[15] Waste from the preparation and processing of fruit, vegetables, grain, cooking oil, cacao, coffee, tea and tobacco, from canned food production, yeast production and preparation of molasses

[16] Waste from the preparation and processing of fruit, vegetables, grain, cooking oil, cacao, coffee, tea and tobacco, from canned food production, yeast production and preparation of molasses

[17] 02 01: Waste form agriculture, horticulture, fish farming, forestry, hunting and fishing

[18] allowed in PAS 100 (BSI, 2005) but not yet in Quality Compost Protocol (Environment Agency, 2007)

	Type of waste material	Further specifications	EWC Code	Corresponding EWC waste type	Input materials accepted by MS
	residues			cleaning, peeling, centrifuging and segregation processes	FR, HU, IE, IT, LT, LU, NL, PL, SE, UK[18]
1.3.17	Fruit, cereal and potato draff	From breweries and distilleries	02 03 01	Sludge from washing, cleaning, peeling, centrifuging and segregation processes	AT, BE, BG, CZ, DE, ES, FI, FR, IE, IT, LT, LU, NL, PL, SE, SK, UK[18]
1.3.18	Filtration ditomite		n.s.	n.s.	AT, PL
1.3.19	Uncontaminated sludge or residues of press filters from separately collected process water of the food, beverage, tobacco and animal feed industry	From vegetable, fruit and plant tissue processing only		Sludge from washing, cleaning, peeling, centrifuging and segregation processes	AT, PL, UK[18]
1.3.20	Eventually slightly polluted sludge from the food and fodder industry exclusively of vegetable origin		02 03 01 02 03 05	Sludge from washing, cleaning, peeling, centrifuging and segregation processes Sludge from company owned waste treatment	AT, BE, BG, CZ, DE, ES, HU, IE, IT, NL, PL, [SE], UK[18]
1.3.21	Eventually slightly polluted pressfilter, extraction and oil seed residues from the food and fodder industry exclusively of vegetable origin		02 03 04	Materials not suitable for consumption or processing	AT, BE, BG, CZ, DE, ES, FR, HU, IE, IT, NL, PL, [SE], UK[28]
1.3.22	Wastes from the production of alcoholic and non-alcoholic beverages (except coffee, tea and cocoa'		02 07 01	Wastes from washing, cleaning and mechanical reduction of raw materials	CZ, ES, PL, UK,
1.3.23			02 07 02	Wastes from spirits distillation	CZ, ES, PL, UK
1.3.24			02 07 04	Materials unsuitable for consumption or processing	CZ, ES, PL, UK
1.3.25			02 07 99	Wastes not otherwise specified	UK
1.3.26	Spoilt seeds		02 01 03	Plant-tissue waste	AT, BE[19], BG, CZ, DE, ES, FI, FR, HU, IE?, IT, LU, NL, PL, SE, UK
1.3.27	Wood, tree and bush cuttings	Complete or shreddered	20 01 38 20 02 01	Wood with the exception of those which belong to 20 01 37 Biodegradable waste	AT, BE, BG, CZ, DE, ES, FI, FR, HU, IE, [IT][20], LU, NL, SE, SK, UK
1.3.28	Wood, from the processing of untreated wood	Only untreated wood	03 01 05	Saw dust, wood shavings, cuttings, wood, chipboard, veneer with the exception of those which belong to 03 01 04	AT, BE, BG, CZ, DE, ES, FI, FR, HU, IE, [IT][13], LU, NL, PL, SE, SK, UK
1.3.29	Wood – sawdust	Only untreated wood	03 01 05	Saw dust, wood shavings, cuttings, wood, chipboard, veneer with the exception of those which belong to 03 01 04	AT, BE, BG, CZ, DE, ES, FI, FR, HU, IE, [IT][13], LU, NL, PL, SE, SK, UK
1.4	Other Organic residues – purely of vegetable origin				
1.4.01	Sub-aqua plants; sea weed		02 01 03	Plant-tissue waste	AT, BE[19], BG, CZ, DE, ES, FI, FR, HU, IE?, IT, LT, LU, NL, PL, SE, UK
1.4.02	Micelles from antibiotics production		16 03 06	Organic waste with the exception of those listed under 16 03 05	AT, BE[21], CZ, DE, NL, PL, SE,
1.4.03	Biodegradable packaging and bioplastics		07 02 13, 15 01 02, 15 01 05	waste plastic plastic packaging composite packaging	AT[22], BG, DE, ES, FI, FR, HU, IE, IT, LT, LU, NL, PL, SE, UK[23]

[19] approved on case by case basis

[20] To be specifically approved for each plant

[21] in accordance with the regulation on GMOs (genetically modified organisms)

[22] non bio-based source materials max. 5%; conventional plastic polymers are excluded.

[23] Compostable packaging:

,Allowed only if independently certified in compliance with one or more of the following:

- BS EN 13432 Packaging - requirements for packaging recoverable through composting and biodegradation.

	Type of waste material	Further specifications	EWC Code	Corresponding EWC waste type	Input materials accepted by MS
1.4.04	Wastes from packaging; absorbents, filter materials, wiping cloths and protective clothing'		15 01 01 15 01 03	paper and cardboard packaging wooden packaging	AT[24], CZ, UK[25]
1.4.05			15 01 09	textile packaging	AT, UK[26]
1.4.06	Municipal Wastes (household waste and similar commercial, industrial and institutional waste) including separately collected fractions'		20 01 01	Paper and cardboard	AT[24], CZ, UK[25]
1.4.07			20 01 99	Other fractions not otherwise specified	UK
1.4.08	Cooking oil and fats, grease trap residues of vegetable origin		02 03 04 20 01 25	Materials unsuitable for consumption or processing Edible oil and fat	AT, [BE][27], CZ, DE, ES, FI, FR, HU, IE, IT, NL, PL, SE, UK[28]
1.4.09	Silage leachate water		02 01 99	Waste not further specified	AT, BE, FR, [IT][12], NL, PL, SE,
1.4.10	Waste from forestry		02 01 07	Waste from forestry	AT, CZ, LU, PL, UK
1.4.11	Fibre rejects	Waste from pulp, paper and cardboard production and processing	03 03 10	Fibre rejects	ES, CZ, PL, UK,
1.4.12	Waste bark and wood	Waste from pulp, paper and cardboard production and processing	03 03 01	Waste bark and wood	ES, CZ, PL, UK
1.4.13	Organic matter from natural products	Wastes from the textile industry	04 02 10	Organic matter from natural products	CZ, ES, UK
1.4.14	Wood	Wastes from construction and demolition wastes	17 02 01	Wood	CZ, UK[29]
1.4.15	Off-specification compost	Only if the compost is derived from input types allowed by this Quality Protocol. This category includes oversize material resulting from screening such compost.	19 05 03	Off-specification compost	CZ, UK
1.4.16	liquor/leachate from a composting process	From vegetable waste treatment only	19 05 99	liquor/leachate from a composting process	CZ, PL, UK
1.5	Digestion residues from anaerobic digestion of waste materials – pure vegetable origin				
1.5.01	Digestion residues from the anaerobic treatment of the waste classes 1.1 and 1.2		19 06 06	Digestion residues/-sludge from the anaerobic treatment of animal and vegetable waste	AT, BE, BG, CZ, DE, ES[30], FI, FR, HU, IE, IT, LT, NL, PL, SE, UK
1.5.02	Liquor from anaerobic treatment of municipal waste		19 06 03	Liquor from anaerobic treatment of municipal waste	CZ, ES, UK
1.5.03	Liquor from anaerobic treatment of vegetable waste		19 06 05	Liquor from anaerobic treatment of animal and vegetable waste	CZ, ES, PL, UK
1.5.04	Sludge from cooking fat and oil production, solely vegetable origin	Also centrifugal sludge	02 03 04	Materials unsuitable for consumption or processing (?)	AT, CZ, PL, ES, UK
1.5.05	Glycerine phase	E.g. from rape seed and waste cooking oil esterification (rape seed oil methylester - RME, waste	n.s.	n.s.	AT

- EN 13432 or EN 14995 in national standard form in any other EU Member State with independent compliance verification by a nationally recognised competent authority or certification body,
- German standard DIN V54900 Testing of the compostability of plastics,
- American standard ASTM D6400 Standard specifications for compostable plastics,
- Any variation upon the standards referred to above for ‚home compostable' packaging agreed between the regulator, WRAP, the Composting Association, the organization is responsible for standards and the certification bodies associated with them.'

[24] Only paper which has been in contact with food and foodstuff (e.g. food packaging)
[25] Not allowed if any non-biodegradable coating or preserving substance is present
[26] Allowed only if entirely natural fibres
[27] Separately collected; in practice not destined for composting
[28] if no chemical agents added and no toxin residues
[29] Not allowed if any non-biodegradable coating or preserving substance is present.
[30] Except for constraints reflected in 1774/2002 regulation

	Type of waste material	Further specifications	EWC Code	Corresponding EWC waste type	Input materials accepted by MS
		cooking fat methylester)			
1.5.06	Distillation residues from production of rape seed oil methyl ester		02 03 04	Materials unsuitable for consumption or processing (?)	AT, CZ, LV, PL, UK
2	Waste for biological treatment with parts of animal origin				
2.1	Animal waste, especially waste from the preparation of foodstuffs				
2.1.01	Kitchen and food waste from private households with animal residues	Catering waste from source separated organic household waste	20 01 08	Biologically degradable catering waste (To be utilised only if compatible with the provisions of the Animal By-products regulation)	AT, BE[31], CZ, DE, ES, FI, FR, HU, IE, IT, LT, LU, NL, PL[32], SE, UK[33]
2.1.02	Kitchen and food waste from central kitchens and catering services with animal residues		20 01 08	Biologically degradable catering waste (To be utilised only if compatible with the provisions of the Animal By-products regulation)	AT, BE[31], CZ, DE, ES, FI, FR, HU, IE, IT, LT, LU, NL, PL[32], SE, UK[33]
2.1.03	Former foodstuffs of animal origin		020202 020304	Animal tissue waste Materials unsuitable for consumption or processing	AT, BE[31], DE, ES(?), FI, FR, HU, IE, IT[34], LU, LV, PL[32], SE, UK[35]
2.1.04	Eggshells		020202 020304	Animal tissue waste Materials unsuitable for consumption or processing	AT, BE[31], DE, ES, FI, FR, HU, IT[34], LU, PL[32], SE, UK[35]
2.2	Organic residues from commercial, agricultural and industrial production, processing and marketing of agricultural and forestry products – with parts of animal origin				
2.2.01	Sludge from the food and fodder industry with parts of animal origin		02 02 03	Materials unsuitable for consumption or processing (?)	AT, BE[31], BG, CZ[34], DE, ES[30], FR, HU, IT[34], NL, PL[32], SE, UK
2.2.02	Press-filter, extraction and oil seed residues from the food and fodder industry with parts of animal origin		02 02 03	Materials unsuitable for consumption or processing (?)	AT, BE[31], CZ[34], DE, ES[30], FR, HU, IT[34], NL, SE, UK
2.2.03	Spoilt feeding stuff of animal origin from fodder producing industry		02 02 03	Materials unsuitable for consumption or processing (?)	AT, BE[31], BG, CZ[34], DE, ES(?), FR, HU, IT[34], NL, PL[32], SE, UK
2.2.04	Residues from horn, hoof, hair, wool, feathers		02 02 02	Animal tissue waste	AT, BE[31], DE, ES[34], FR, HU, IT[34], NL, PL[32], SE, UK
2.2.05	Sludge and press-filter residues from slaughter houses and fattening industries		02 02 02	Animal tissue waste	AT, BE[31], DE, ES[34], FR, HU, IT[34], PL[32], SE, UK[18]
2.2.06	Paunch waste	Belongs to ABPR Cat. 2 Material	02 02 02	Animal tissue waste	AT, BE[31], DE, ES[34], FR, IE, IT[34], NL, PL[32], SE, UK
2.2.07	Solid and liquid manure	Belongs to ABPR Cat. 2 Material	02 01 06	Animal faeces, urine and manure	AT, BE[31], BG, CZ[34], DE, ES(?), FI, FR, HU, IE, IT[34], LU, LV, PL[32], SE, UK[36]
2.2.08	Gelatine waste		02 02 03	Material unsuitable for consumption or processing	AT, BE[31], BG, CZ[34], DE, ES[34], FR, IT[34], PL[32], SE, UK

[31] Only with individual approval

[32] Organic fertilisers produced using animal wastes by composting or more preferentially biogas method, can get approval but they have to be assessed by veterinary institute.

[33] Only if composted in accordance with national rules at a facility registered by the Animal Health vets

[34] If approved by veterinary service, according to EU regulation on ABP 1774/2002

[35] Only if composted in accordance with 'national rules' requirements at a facility registered by the Animal Health vets.

[36] Slurry and used animal bedding of the following types are allowed; straw, shredded paper; paper pulp; sawdust; wood shavings and chipped wood.

	Type of waste material	Further specifications	EWC Code	Corresponding EWC waste type	Input materials accepted by MS
			02 02 09	Waste not otherwise specified	ES[34], FR, IT[34], PL[32], SE, UK
2.2.09	Wastes from aerobic treatment of solid wastes'	Only allowed if compost was derived from input materials specified in this list	19 05 03	Off-specification compost	CZ[34], UK[36]
2.2.10	Wastes from aerobic treatment of solid wastes'	liquor/leachate from compost processing	19 05 99	Wastes not otherwise specified	UK[37]
2.3	Digestion residues from anaerobic treatment of waste materials which may contain parts of animal origin				
2.3.01	Digestion residue of anaerobic digestion of materials of waste group 2 rendered fat and cooking oil of animal origin		19 06 06	Digestion residues/-sludge from the anaerobic treatment of animal and vegetable waste	AT, BE[31], BG, CZ[34], DE, ES[34], FI, FR, HU, IT[34], PL[32], SE, UK
2.3.02	Digestion residue of anaerobic digestion of dairy residues	e.g. whey, cheese residues and dairy sludge	19 06 06	Digestion residues/-sludge from the anaerobic treatment of animal and vegetable waste	AT, BE[31], BG, CZ[34], DE, ES[34], FI, FR, HU, IE, PL[32], SE, UK
2.3.03	Digestion residue of anaerobic digestion of raw milk	Material acc. to Art. 6 (1g) of Regulation 1774/2002/EC	19 06 06	Digestion residues/-sludge from the anaerobic treatment of animal and vegetable waste	AT, BE[31], BG, CZ[34], DE, ES[34], FI, FR, HU, IE, PL[32], SE, UK
2.3.04	Digestion residue of anaerobic digestion of slaughter house waste and by-products		19 06 06	Digestion residues/-sludge from the anaerobic treatment of animal and vegetable waste	AT, BE[31], CZ[34], DE, ES[34], FR, HU, PL[32], SE, UK
2.3.05	Digestion residue of anaerobic digestion of skins, hides and furs		19 06 06	Digestion residues/-sludge from the anaerobic treatment of animal and vegetable waste	AT, BE[31], CZ[34], DE, ES[34], HU, PL[32], SE, UK
2.3.06	Wastes from anaerobic treatment of wastes	Only allowed if compost was derived from input materials specified in this list	19 06 03	Liquor from anaerobic treatment of municipal waste	ES[34], UK
2.3.07	Wastes from anaerobic treatment of wastes		19 06 05	Liquor from anaerobic treatment of animal and vegetable waste	CZ[34], ES[34], UK
2.3.08	Wastes from the preparation and processing of meat, fish and other foods of animal origin		02 02 02	Animal tissue waste	ES[34], PL[32], UK[38]
2.3.09	Wastes from the preparation and processing of meat, fish and other foods of animal origin		02 02 03	Material unsuitable for consumption or processing	CZ[34], ES[34], PL[32], UK[39]
2.3.10	Wastes from the preparation and processing of meat, fish and other foods of animal origin		02 02 09	Wastes not otherwise specified	UK[40]
2.3.11	Wastes from the dairy products industry		02 05 01	Materials unsuitable for consumption or processing	CZ[34], ES[34], PL[32], UK[41]
2.3.12	Wastes from the baking and confectionery industry		02 06 01	Materials unsuitable for consumption or processing	CZ[34], UK[42]
3	Further waste for biological treatment with *[these wastes might need additional approval of origin and involved processes]*				
3.01	Municipal sewage sludge	Sludge which is used for compost production must be acknowledged for the direct use in agriculture	19 08 05	Sludge from treatment of urban waste water	[AT], BG, CZ, ES[30], FI, FR, HU, IE, IT[43], LT, LU[44], LV,

[37] Liquor/leachate from a process operated according to 'PAS 100 only' or 'PAS 100 and Quality Compost Protocol' requirements (includes restrictions in input material types and sources)..
[38] EWC code 02 02 02 may include animal blood
[39] May include gut contents, shells and shell-fish wastes.
[40] Allowed only if animal manure, slurry or bedding of types which are listed in the UK Quality protocol
[41] May include raw milk.
[42] May consist of, or include former foodstuffs [Category 3 animal by-products],
[43] Sewage sludge is allowed if it complies with Italian enforcement of the European Directive (EC) n° 278/86
[44] Only sewage sludge not mixed with kitchen waste

	Type of waste material	Further specifications	EWC Code	Corresponding EWC waste type	Input materials accepted by MS
					SK, PL, [SE][45], [UK][46]
3.02	Wastes from the leather and fur industry'		04 01 01	Fleshings and lime split wastes [leather shavings]	CZ, ES, UK
3.03	Municipal solid waste – not source separated				[AT][47], BG, ES, FR, HU, [IE][48], LT, PL, [SE][45],
4	Additives for composting *[added in minor quantities (up to 10 – 15 % at maximum) in order to improve the composting process, humification and maturation]*				
4.01	Rock dust		01 03 08 01 04 09	Dusty and powdery waste except those belonging to 01 03 07 Waste from sand and clay	AT[49], HU, NL, PL[32], SE?
4.02	Lime stone dust		02 04 02	Calcium carbonate sludge not according to specification	AT[49], BG, DE, FI, FR, HU, LV, NL, SK, PL[32], SE,
4.03	Bentonite		---	---	AT[49], DE, HU, PL[32], SE?,
4.04	Ash from combustion of plant tissue (e.g. wood, straw)		10 01 01	Bottom ash, slag and boiler dust (excluding boiler dust mentioned in 10 01 04)	AT[50], BG, DE, FI, HU, PL[32], SE?,
4.05	Excavated soil	Not contaminated	17 05 04	Soil and stones other than those mentioned in 17 05 03	AT[49 50], HU, SK PL[32], SE?, UK[51]
4.06	Washing soil from sugar beet and potato processing		02 04 01	Soil from cleaning and washing beet	AT[49 50], CZ, DE, PL[32], UK[18]

n.s. ... not specified

[45] Not allowed within the QAS Certification scheme of SPRC 152 (compost) and SPCE 120 (digestate); Otherwise this might be used.

[46] BSI PAS 100, but only if HACCP assessment indicates acceptable risk and compost sample test results show sufficient quality → Not allowed under CQP.

[47] Compost from mixed MSW is restricted to the use in reclamation of landfill sites and may only be delivered directly to the landfill.

[48] Not for quality compost. But there are dedicated facilities which process mixed waste which is used in landfills

[49] Sum of all mineral additives for the process optimisation max 10% (m/m); dredged soil: max 15% (m/m)

[50] Limit values for heavy metals must be respected

[51] Allowed only if Hazard Analysis and Critical Control Point (HACCP) assessment determines that adequate pollutant risk control is feasible.

1.3 Task 1.5.b & 1.6 – Aspects of health and environmental protection – PRECAUTIONARY STANDARDS and limit values

1.3.1 Introduction

The term *precautionary* in this context is linked to a principle philosophy of setting standards for activities which might bear the potential risk of a negative environmental or health impact.
A precautionary approach in elaborating quality criteria for a product or for its use basically intends to preserve the subject of protection in its status of health or environmental quality or – if to the overall benefit of the system a certain impact would be accepted – to assess the effect with the aim not to endanger the functioning of all living entities and environmental compartments involved.
Therefore, in the context of standards setting for *products from waste* which are reintroduced in natural systems, these precautionary aspects are handled on the highest regulatory level within national (or sometimes provincial) legislation.
We might distinguish between strict precautionary criteria which are clearly linked to environmental and health protection (Table 6) and those which rather address a minimum quality as related to its beneficial application and use (Table 7).
While the first group is primarily found in the context of *statutory legislation,* for the second group this is not always the case. Rather those *soft parameters* are important elements in voluntary or market specific standards in order to prevent misuse with potentially unwanted effects.
As a general tendency it can be said that in countries with well established source separation and composting traditions and markets even some of those soft criteria are found in statutory regulations.

In this section we have included also aspects of *Task 1.5. – Description of the technical, health, environment and other criteria or parameter that specify the compost class or the composting process.*

Table 6: Quality criteria associated with threshold or limit values in order to prevent negative impacts to the environment and health

Criterion/Parameter	General justification
Criteria strictly related to health and environment protection • *These criteria can be found in nearly all statutory compost regulations*	
POSITIVE LIST of allowed input materials (with or without additional quality criteria)	• This is intended to guaranty a systematic high level of quality by introducing only *clean* and well traceable mono waste streams. • Therefore it is widely accepted that final product control can be minimised with respect of the number of parameters (pollutants) to be analysed and frequency of investigations.
HEAVY METALS	• Limit values for heavy metals are – in the frame work of a precautionary concept – set in order to guarantee the multifunctional use and functioning of soil within a *good practice* application regime
IMPURITIES	• This parameter includes traditionally the sum of undesirable extraneous waste fractions which may accompany organic waste collected from households or industries by the way of wrong sorting at the source. • Impurities include *plastics, metals and glass;* in some cases also *stones* • Two aspects of precaution are addressed: ▪ Prevent any injury by sharp particles (glass, metals) ▪ Provide an optically clean product (no plastics) • As a rule, in the case of organic waste collection from households specific separation technologies must be applied during compost processing • In well established source separation systems the proportion of impurities in the collected source materials (*brown bin*) ranks between 0.5 and 2.0 % (w/w).
PROCESS REQUIREMENTS – Time-temperature regime	• Together with the testing of the final product on indicator pathogens this is the key requirement to provide a *save* product. • This indirect method provides by means of temperature measurements and its documentation one of the most important *critical control points*

Criterion/Parameter	General justification
	for a sufficient reduction of potentially present pathogens during the decomposition process. • It is established in all compost related regulations in place. • In Germany these process requirements have been established for a number of open and in Vessel *Validated Composting Systems and Protocols*. One of validated composting systems must be adopted when applying for a permit.
PATHOGENS in final product	• Indicator pathogens such as *Salmonella ssp., E.coli, Enterococae, Clostridium sp., Listeria sp. Etc.* are use in order to certify a product as *safe* with respect of not endangering the spreading of human or animal diseases.

Table 7: Quality criteria associated with threshold or limit values in order to guarantee a minimum use performance and to prevent any deception of and misuse by the user or customer

Criteria related mainly to the usability of the compost and to the preventing of any deception of the customer • *These criteria include threshold or limit values but* o *they may apply only for selected area of applications and uses (e.g. potting soil etc)* o *they are in many cases a matter of product specification in voluntary standards and part of the product declaration for defined uses*	
WEEDS	• Compost used in private gardening in green houses or as potting soil constituent needs to be free of germinating seeds or plant propagules • Therefore limit values have been set between 1 and 3 germinating weeds per litre of compost
PLANT RESPONSE (bio-assay)	• Plants response, germination or phytotox tests are a wide spread praxis in compost quality testing in order to prevent composts with any plant growth inhibiting factors from entering the market • Often the requirement for testing the plant growth is restricted to the more sensitive uses like horticulture, constituents of growing media or for the use in potting soil. • The test in some cases (DE) involves a nitrogen fixation test
Minimum ORGANIC MATTER content	• Typical minimum concentrations required are 15 or 20 % organic matter. • This is rather a product related criterion in order to draw the boundary between *compost* and a *top soil* or *compost/soil blends;* • Dilution of compost with mineral components (e.g. sand, soil) should be prevented.
SALINITY / el. conductivity	• A limit value for electrical conductivity or salt content is only very scarcely realised (AT) in order to prevent the labelling marketing of compost for salt sensitive plants and application (private gardening, substrates, potting soil) • Otherwise salinity is a matter of declaration combined with recommendations for the proper use
STABILITY	• Stability comprises a minimum level of decomposition, mineralisation and humification of the compost produced. • Two aspects are of primary importance here o To prevent averse ongoing biological processes when bagged composts are stored (formation of ammoniac, mould and odour etc.) o To prevent *low grade* processing such as dry stabilisation or uncontrolled processes which do not meet the minimum BAT or good practice requirements

Different countries have developed their precautionary standards for compost products to different levels. In some cases quality assurance systems – sometimes accomplished with additional *standards* – exist which will typically be voluntary in nature (e.g. UK, SE, AT, in preparation or initiatives also in IE, IT, CZ). Very often we find an integration of both, legislation with minimum standards for the production and marketing of compost supplemented by voluntary QA systems as well as standards. The latter are mainly related to requirements for specific applications like the use of compost as constituent in soil improver or in manufactured soils and growing media.
It is notable that:

1.) Those countries where separate collection is furthest advanced, and where compost production (as a percentage of total potential) is highest, have statutory quality standards for the production and marketing of compost in place (AT, BE/Fl, DE, DK, IT, LU, NL); but it is also the case for ES)

2.) Those countries with standards which are 'high but voluntary' include the UK and SE, IE (as part of the licensing, draft standard in preparation), CZ, HU. The market in these countries requires rules and regulations for compost and digestion residues. Rather than waiting until statutory standards define processes, qualities and monitoring systems, these countries have started their own development towards a sustainable solution.

1.3.2 HEAVY METALS – procedures for standard setting

Countries which start to establish organic waste recycling with a view to producing quality compost concentrate, in the first phase, on separate collection and composting processes. Legal regulations are usually set up for harmful elements in the compost, limit values for heavy metals being the most obvious example. In others, there has been an attempt to develop a precautionary standard based upon a desire to prevent the build up of potential toxic elements (PTE) in soil. This is linked to ideas of soil multi-functionality, in which the intention is to ensure that all possible functions or uses of a soil are preserved.
It is obvious that aiming to provide a soil improver the two aspects, the justified beneficial effect as well as the soil protection are the key factors driving the concept. From this we have to evaluate what technology we have available in order to comply with these aims.
Here some brief remarks about the available concepts of standard setting excerpted from Amlinger et al. (2004).

Three basic options are available in order to determine "safe" limit values for potential toxic elements (PTEs). They vary according to the viewpoint adopted:

1.) Risk based assessment such as the No Observable Adverse Effect Levels (NOAEL) concept

2.) Mass balance or No Net Accumulation (NNA) in relation to the concentration of contaminants in the soil (precautionary approach)

    There are two options for a NNA concept:

    i. Limiting **PTE or organic pollutants (OP) concentrations** in fertilisers and soil amendments to the same level found as soil background concentrations ("*same to same*" or "*similar to similar*" concept)

    ii. Limiting the **PTE/OP load** so that it matches the amount of tolerable exports from soil via harvested crops, leaching or erosion ("*import = export*" concept)

3.) Between those two polarities manifold hybrid systems and indicators such as the assessment of predicted environmental concentration (PEC) in comparison with the predicted no effect concentration (PNEC) are discussed.

What is commonly agreed is that any concept should provide long-term safe food and feedstuff production, the protection of the water resources and the biodiversity in the soils.
The debate on how far precaution must involve the soil itself and its basic functions (transformation, buffer, filter, biodiversity, genetic heritage and as a result productivity) is still going on and is mirrored by the different approaches.
The main difference may be summarised by quoting the Cornell study (Harrison at al., 1997[FA3]):

"For example, some people place faith in technological solutions and our ability to calculate impacts and risks. Others are more sceptical, believing that history shows that there have been numerous failures of technology resulting in unanticipated environmental and health damage. These are fairly fundamental differences in worldview, leading some to favour precaution while others are willing to proceed until harm is shown to occur.
There is no such thing as "safe". Rather, the question is: "What is an acceptable risk, and to whom?"

A strategy that simply aims for a reduction of inputs following a no net accumulation scenario (input = estimated output) might result in a decline of SOM or nutrient status in the soil below a desirable level according to good agricultural practice (GAP) and sustainable productivity objectives.
On the other hand, a pure risk based approach could result in accumulation (up to a specified level) but this might not be acceptable by neither sustainability nor general political means in order to preserve soil as a multifunctional resource for future generations.
Figure 1 illustrates the huge variations in limiting soil concentrations for Cd and Zn in sewage sludge resulting from these two different – precautionary and risk based – approaches

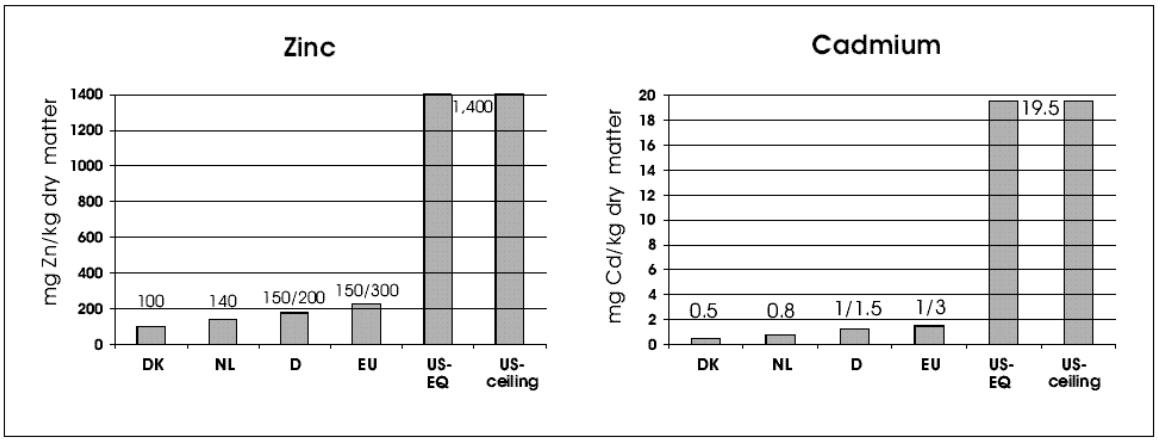


Figure 1: European and US allowable Zn and Cd soil concentrations for sites suitable for sludge application (Harrison at al., 1997[FA4])

A detailed and critical review on concepts for defining heavy metal limit values for the use of compost mainly in agriculture and food production is discussed in Amlinger et al. (2004)

The level of limit should be related to products which are capable of being produced from the materials derived from large scale source separation projects and to quality levels which can realistically be achieved in continuous, regular production in composting plants. Pilot scale projects are not suitable for the definition of standards.

Consequently the level of heavy metals admissible for organic waste composts and the yearly load per area unit is correlated with the status of implementation of source separated collection of organic wastes.

The following summarises the range of national heavy metal and arsenic limit values by comparing minimum, maximum and mean limits of regulations for organic waste compost and those for mixed waste compost. The bottom line (min/max) shows the factor between lowest and highest limit values found. This indicates the still considerable differences between the extremes.

Table 8: Maximum, minimum and mean limit values of PTEs for composts in Europe

Limit values for Compost from source separation (BWC & GWC)									
	Cd	Cr	CrVI	Cu	Hg	Ni	Pb	Zn	As
	mg/kg d.m.								
min	0.7	50	0	25	0.2	10	45	75	5
max	3	250	3	600 (1,000)*	3	100	280	1,500 (4,000)*	50
mean	**1.4**	**93**	**0.9**	**143 (184)***	**1.0**	**47**	**121**	**416 (587)***	**23**
max/min	*4.3*	*5.0*		*24.0*	*15.0*	*10.0*	*6.2*	*20.0*	*10.0*
Limit values for Composts from MSW									
	mg/kg d.m.								
min	3	250	0	450	3	100	200	1,000	10
max	20	1,000	10	1,000	16	300	800	4,000	25
mean	**8.0**	**473**	**6.7**	**625**	**7.1**	**168**	**456**	**2,000**	**17**
max/min	*6.7*	*4.0*		*2.2*	*5.3*	*3.0*	*4.0*	*4.0*	*2.5*

* Limits for Cu=1,000 and Zn=4,000 mg kg^{-1}d.m. are stemming from the Danish *Statutory Order on Application of Waste Products for Agricultural Purposes* where sewage sludge is covered as well as compost. This explains the extremely high thresholds.

1.3.3 The issue of variability – can we trust analytical results?

Sampling and analytical methods for trace elements in compost have a strong impact on the reliability over time of threshold concentrations. Above all, the sampling method must be considered a most important factor. Sampling from bulk, non-homogenous materials (heaps) may contribute to the variance of analytical results by > 1000% whereas today's validation of laboratory analytical methods lead to negligible standard errors of < 5 – 10% depending on the absolute level of the parameter concerned. For example, this has been demonstrated by a study on the spatial variability of compost quality in Germany (Breuer et al., 1997) as well as in inter-laboratory trials.

Table 9: Spatial variability [coefficient of variation/CV] of heavy metal contents within a sampled compost heap Breuer et al. (1997[FA5])

		Cd	Cr	Cu	Hg	Ni	Pb	Zn
		Range of coefficient of variation [%]						
BWC	4 windrows	11.8 - 93.4	6.5 - 13.4	6.2 - 18.4	17.3 - 20.4	4.8 - 11.8	8.2 - 17.9	3.3 - 7.4
GC	2 windrows	14.0 - 102	6.2 - 10.2	12.9 - 18.7	16.6 - 23.3	3.6 - 8.3	47.7 - 73.3	3.8 - 12.2
Mean value		29.1	11.1	17.5	17.7	9.6	19.8	6.4

* 20 independent samples have been taken from each of 4 biowaste compost piles and of 2 green waste compost piles and have been analysed individually. The figures in the table comprise the minimum and maximum *coefficient of variation (CV)* as compared to the result of the mixed, combined sample. It shows a maximum relative deviation for Cd (± 93.4 and 102 %). The value given in the bottom line represents the mean CV as found in these 6 compost heaps.

Another investigation evaluated the variability of the analytical results in composts. In this case three independent samples were taken from each of two BWC and two GWC. From this it was concluded that an unavoidable deviation of independent sampling of ± 30% (Cd, Co, Cr, Cu, Hg, Mn, Mo, Ni, Zn) and of ± 40% (Pb) even if done by the same person has to be accounted (Zethner et al., 2000[DFA6]).

Therefore sample taking has been addressed prominently as part of compost standards and also within European standardisation work (CEN)[52]

1.3.4 Sampling of compost for qualitative analyses and compliance testing

All sampling schemes adopted by national standards aim at gaining a laboratory sample which represents the entire sampled lot on the one hand, and the compost type produced on the other hand. The latter originates from the general strategy that not every single compost batch produced has to be analysed. This is based on the confidence in a continuous production regime as far as source materials (compost type) and process management (composting technique) are concerned. Therefore the number of analyses to be made follows random sampling systems in most cases in dependence of the total throughput of the entire composting plant. As a matter of course the random sampling scheme has to be applied separately for each substantially specifiable type of compost (e.g. biowaste compost, green waste compost, sludge compost, bark compost, stabilised MBT material etc.).
As far as available from national standards the key elements of the sampling systems for composts are described in Table 10 and Table 11.

Table 10: Frequency of sampling related to the yearly materials throughput or compost produced mainly carried out within external quality schemes

Quantitative classes of composting plants	Number of external quality inspections (sampling)	Remarks
AUSTRIA – Compost Ordinance		
Volume of produced compost y^{-1}		***Minimum quantity of sampled lot***
< 50 m³	1 single approval	5 m³
>50–300 m³	1 every 3 years	20 m³
>300–1,000 m³	1 every 2 years	50 m³
>1,000–2,000 m³	1 per year	100 m³
>2,000–4,000 m³	2 per year	150 m³
above 4,000 m³	Additional: 1 inspection for every 4,000 m³; 12 per year at maximum	150 m³
Compost from MSW	1 each 500 m³ produced MWC	200 m³
BELGIUM - VLACO		
Treatment capacity per year		
< 20,000 t	8 per year	
> 20,000 t	12 per year	
DENMARK – Statutory Order		
Treatment capacity per year		
All input capacities	4 per year or every 2,000 m³ compost	
FRANCE – Project proposal for a standard		
Treatment capacity per year		
All input capacities	Every lot minimum: 2 per year	
GERMANY – RAL GZ 251		
Treatment capacity per year	***Maintenance monitoring***	***1st year recognition phase***
≤ 8,000 t	4 per year	≤ 2,000 t 4 per year
> 8,000 t	one analysis per 2,000 t input	> 2,000 t 6 per year
	up to a maximum of 12 analyses per year	> 6,001 t 8 per year
		> 12,001 t 12 per year
LUXEMBURG – Interim Guideline and RAL GZ 251 (from DE)		
Treatment capacity per year	***Internal control***	***External control***
> 20,000 t *heavy metals*	12 per year	4 per year

[52] EN 12079 Soil Improver and growing media – Sampling and project HORIZONTAL – standards for soil, sludge and treated biowaste: WI CSS99031, -58, -57, -32, -59, -60 and 34 technical reports http://www.ecn.nl/horizontal/phase2/sampling/. See Annex 2.

Quantitative classes of composting plants	Number of external quality inspections (sampling)		Remarks
PAH, PCB	4 per year		4 per year
PCDD/F	2 per year		4 per year
The NETHERLANDS – Internal Quality Control (IKB) of KIWA			
Treatment capacity per year	***Internal control***		***External KIWA control***
All input capacities	6* - 12 per year (1 per 4 weeks)		8 per year
SWEDEN			
Biological treatment per year	***Internal control***		***External control***
	Qualification year	***Maintenance monitoring***	
≤ 5,000 t	2 per year	1 per year	1 per year
> 5,000 t	4 per year	2 per year	1 per year
> 10,000 t	8 per year	4 per year	2 per year
SWITZERLAND – Instructions and recommendations of the FAC**			
Treatment capacity per year	***Internal control***		***Reduced sample numbers***
< 100 t	voluntary		If the results of individual investigations over a longer period do not exceed 50 % of the limit values, the sampling frequency can be reduced in agreement with the FAC
100 – 500 t	1 per year		
500 – 1,000 t	2 per year		
> 1,000 t	4 per year		
UNITED KINGDOM – PAS 100			
Independent from feedstock treated per year	***Maintenance monitoring***		***Validation***
	1 per 5,000 m³ or 1 per 12 months, whichever occurs sooner		3 consecutive batches
Working Document, 2nd Draft " Biological treatment of biowaste"			
Treatment capacity per year	***Internal control***		***Reduced sample numbers***
> 500 – 1,000t	2 per year		When within a period of 2 years results are constantly below 75 % of threshold values the competent authority may on a case-by-case basis allow a reduction of the sampling frequency
1,000 – 10,000 t	At intervals of at least every 1,000 t treated biowaste produced or every 3 months, whichever comes first		
> 10,000 t	12 per year		

* Hotsma (2002[FA7]); ** Swiss Research Institute for Agro-Chemistry

The sampling of materials with low homogeneity is crucial in terms of reducing the total error as related to the analytical results. Special care must be exercised at the individual steps of the entire sampling procedure. Some main principles are summarised from the European standard for the sampling of soil improvers and growing media (EN 12579) as well as the Austrian, German and Swiss guidelines.

Basic requirements for the taking of representative samples

- The sample portion must be in the same condition with regard to the preparation (sieving, removal of impurities etc.) as the associated compost batch, which is intended to be marketed.
- The final, combined sample must represent the whole of the material of the sample portion. The sampling points must be designated at random.
- Compost monitoring must be performed with batches, which are representative of the annual compost production. If the consignment does not appear to be from the same batch (lot) or consists of different materials (products), then the material(s) must be sampled separately.
- Sampling may be preferably undertaken during loading or discharge, if it is done in a way that the combined sample represents the entire lot.

Sampling Equipment and Sample Containers

- These have to be
  - clean
  - made of non-contaminating material (carbon steel or another unalloyed type of steel); materials like zinc coated steel, copper or stainless steel are not suitable.
- Sampling drills can only be used in case of favourable properties of the compost (not too dry, not too bulky).
- Drills have to be suitable for the material to be tested:
  - Inner diameter minimum 2.5-times the maximum particle size of the compost (CH)
  - Inner diameter minimum 10 cm and sufficiently wide jaws (e.g. single Edelmann auger, sand type, ∅ 10 cm of the firm Eijkelkamp).
  - Extracted Material should have 1 m minimum length

Beside the detailed description of taking and preparing of incremental samples, combined samples and final or laboratory samples respectively, a *comprehensive documentation* of the sampling is an important tool for the traceability of analytical results. Therefore sampling records where all single steps including a drawing of the location of sampled batch and distribution of incremental samples is an obligatory ingredient of standards.

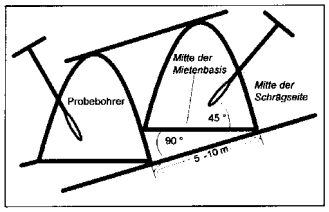
This is of special importance if investigations are carried out via regular random sampling of single lots, which have to represent comparable compost materials within a defined time or throughput related frame.

Table 11 outlines the key requirements of sampling procedures of *EN 12579 'Soil Improver and Growing Media – Sampling'*, as well as the *Austrian Compost Ordinance*, the German *RAL GZ 215, the* Swiss *'Instructions and Requirements Compost',* The Netherlands and Italy (Regione Piemonte).

Table 11: Schemes for sample taking for composts

Limitations of the size of a sample portion	
EN 12579	A sampled portion shall be not more than 5,000 m^3 (bulk) or 10,000 packages (packaged material) of the same material from the same consignment.
Netherlands	A sampled portion shall be not more than 5,000 m^3
Number of final samples	
EN 12579	One portion each for the supplier and buyer (receiver) or enforcement officer; one portion for an independent tester if a dispute on the analysis arises.
Netherlands	Nine individual random incremental samples constitute the 9 final (laboratory) samples, sent to the laboratory.
Number of sampling points or incremental samples	
EN 12579	One incremental sample from each sampling point. $n_{sp} = 0,5(V^{1/2})$ rounded up to the nearest whole number where V is the nominal quantity of the sampled portion in cubic metres with a minimum $n_{sp} = 12$ and a maximum $n_{sp} = 30$.
Austria	With shovel: Depending on the total volume of the sample portion m^3 of compost batch investigated: <100 | ≥100 | ≥200 | ≥400 | ≥800 Minimum number of sampling points: 4 | 5 | 6 | 7 | 8 A larger number of sampling points is permitted. With drill: no requirements, depends on the total cubature of the sample portion

<table>
<tr><td>Germany</td><td colspan="4">From heaps or stocks with shovel:<table>
<tr><td></td><td>≤ 500 m³</td><td>> 500 m³</td><td>Quantity / sample point</td></tr>
<tr><td>With shovel</td><td>≥ 2</td><td>≥ 4</td><td>30 – 40 l</td></tr>
<tr><td>With drill</td><td>≥ 10</td><td>≥ 15</td><td>≥ 6 l</td></tr>
<tr><td>During loading</td><td colspan="3">≥ 10 times from the outlet of the conveyer evenly distributed over the entire lot</td></tr>
<tr><td></td><td colspan="3">Number of single packages</td></tr>
<tr><td>Packaged material [≤ 2l or 2 kg/pack.]</td><td>n ≤ 4</td><td>n = 5 - 16</td><td>n > 400</td></tr>
<tr><td>Nr of sampled pack.</td><td>all</td><td>$\sqrt{n}$</td><td>≥ 20</td></tr>
</table></td></tr>
<tr><td>Italy (Regione Piemonte*)</td><td colspan="4">Seven incremental samples per 200 m³</td></tr>
<tr><td>Netherlands</td><td colspan="4">Nine individual random incremental samples constitute the 9 final (laboratory) samples, sent to the laboratory.</td></tr>
<tr><td>Switzerland</td><td colspan="4"><table>
<tr><td>From heaps or stocks:</td><td>< 300 m³</td><td>> 300 m³</td><td>< 15 m³ / 30 m³</td></tr>
<tr><td></td><td>1 per 15 m³</td><td>15 total</td><td rowspan="2">3</td></tr>
<tr><td>Sieved compost</td><td>1 per 30 m³</td><td>10 total</td></tr>
</table>
<table>
<tr><td rowspan="2">During loading or discharge</td><td rowspan="2">from sieve or reactor output</td><td colspan="2">when loading</td></tr>
<tr><td>from heap</td><td>from stored compost</td></tr>
<tr><td>Unsieved compost</td><td>1 per 15 m³</td><td>1 per 15 m³</td><td>1 per 15 m³</td></tr>
<tr><td>Sieved compost</td><td>1 per 15 m³</td><td>---</td><td>1 per 30 m³</td></tr>
</table></td></tr>
<tr><td colspan="5">Distribution of sampling points</td></tr>
<tr><td>EN 12579</td><td colspan="4">Bulk: Visually divide the sampled portion into the same number of equal portions as the number of sampling points;
Packaged: Each sampling point shall be in a different randomly selected package.</td></tr>
<tr><td>Austria</td><td colspan="4">Distributed evenly over the total volume of the sample the making of the cuts in the sample must be adapted according to the profile of the pile) (slope, cone, trapezium, sheet).</td></tr>
<tr><td>Germany</td><td colspan="4">Distributed randomly over the lot</td></tr>
<tr><td colspan="5">Volume / mass of incremental samples</td></tr>
<tr><td>EN 12579</td><td colspan="4">at least 0.5 l</td></tr>
<tr><td>Austria</td><td colspan="4">With shovel: at least 20 l disregarding at least the top 10 cm
With drill: no requirements; quantity of final sample → at least 30 l.</td></tr>
<tr><td>Germany</td><td colspan="4">Each sample has to be of approx. equal weight or volume
particle size < 20 mm → 2 l
particle size > 20 mm → 3 l</td></tr>
<tr><td>Italy (Regione Piemonte*)</td><td colspan="4">1.5 – 2 kg</td></tr>
<tr><td>Netherlands</td><td colspan="4">at least 1 kg</td></tr>
<tr><td>Switzerland</td><td colspan="4">at least 3 1; all samples have to have the same size.</td></tr>
<tr><td colspan="5">Taking the samples</td></tr>
<tr><td>EN 12579</td><td colspan="4">Bulk: Incremental samples shall be taken from throughout the depth of the material, ignoring material nearer than 5 cm to any surface;
Packaged: Randomly take incremental samples from throughout the package.</td></tr>
</table>

Austria	With shovel: extracted from places distributed over the cut surface disregarding at least the top 10 cm; To create a parallel sample, the appropriate sample quantity for the individual sample can be extracted per cut in each case from the opposite cut surface.
Netherlands	Method 1: From 9 evenly distributed stratums after making a bore hole in advance the samples are taken from approximately 1 m depth. Method 2: Two cross-sections of appr. 2 m are made with a loader. From each cross-section 5 and 4 increments respectively of 1 kg each are taken and constitute the 9 final samples.
Switzerland	Uniform spacing of 5 - 10 m along the pile By opening of the pile cross-section an extraction of 5-6 samples uniformly distributed over the entire cross-section is to be performed by shovel. 
Preparing the final sample	
EN 12579	Combine the incremental samples to form a combined sample. Reduce the combined sample by coning or quartering or with an apparatus for sample division. Prepare the laboratory sample according to EN 13040.
Austria	Reduce the combined sample by coning or quartering or with an apparatus for sample division.
Netherlands	The 9 random incremental samples constitute 9 separate final (laboratory) samples, sent to the laboratory.
Germany	Samples are mixed and transferred to the plastic foil. Clods are to be crushed separately and subsequently reintroduced to the sample. The foil is to be lifted at the corners in such a manner that the compost will roll to the opposite end and is mixed several times until the sample appears to be homogenous. Spread on the foil and 8 sectors are marked by drawing diagonals. Then 2 opposite sectors are removed. This process is repeated until the final sample required for shipping of approx. 20 litres remains.
Quantity of final sample	
EN 12579	5 l → chemical analysis 5 l → physical analysis 5 l → bio assay 15 l → bulk density according to EN 12580
Austria	15 l → chemical, physical analysis, bio assay 1 l → microbiological test (pathogens)
Germany	20 l → all parameters
Italy (Regione Piemonte*)	3 kg
Netherlands	1 kg → all parameters
Switzerland	1 l → chemical, physical analysis 4 l → bio assay, impurities

* DiVaPRA Universitá di Torino, IPLA,ARPA Piemonte, 1998. Metodi di analisi dei compost. Regione Piemonte - Assessorato all'Ambiente, Torino. Cfr Regione Piemonte, Metodi di analisi dei compost, 1998

It is evident that standardised sampling schemes (frequency and method of sampling depending on type of product and capacity of yearly compost production) and analytical methods including tolerances are key elements for the implementation of compost quality requirements .
In general two steps have to be considered when discussing concepts of analytical tolerances for elements that establish quality classes or limit values:

- Rules for the regular quality approval by the compost producer
  - Repeatability, standard deviation and tolerances of repeated measurements for analytical results for a specified batch within a defined sampling scheme.
  - within a certain set of consecutive measurements (e.g. tolerance of 25 % of a single batch when the mean value of the last 4 tests meets the limit value).
  - Reproducibility, standard deviation and tolerances of analytical results produced by different laboratories
- Rules for compliance tests carried out on behalf of the responsible authority, when taking samples of composts at the market place

From a number of ring tests (*ILT - inter-laboratory trials)* for composts it becomes evident that coefficients of variation (CV) achieved between laboratories [this is identical with the reproducibility between different laboratories] in general increase at low absolute concentration of measured elements (Figure 2 and Figure 3).

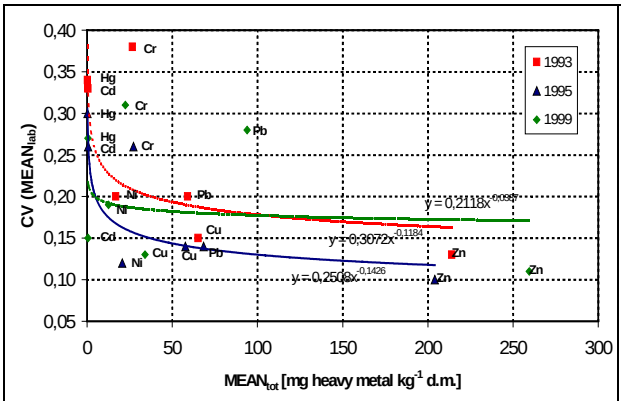


Figure 2. Coefficient of Variation of laboratory mean values [CV(MEANlab)] between participating laboratories of fresh samples vs. concentration levels of heavy metals; German inter-laboratory trials 1993/95/99

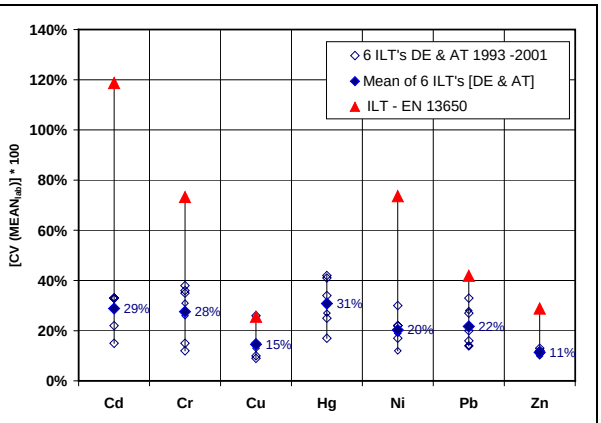


Figure 3: Coefficient of Variation of laboratory mean values [CV(MEANlab)] between participating laboratories of 6 German and Austrian inter-laboratory trials 1993 - 2001 and in the CEN TC 223 ILT for the European standard EN 13650: Soil improvers and growing media. Extraction of aqua regia soluble elements

Based on these results it becomes evident that besides the consideration of material linked and seasonal variability the *reproducibility factor* (= *coefficient of variation*) between the results of different laboratory must be considered

Table 12 gives an orientation about the mean coefficients of variation resulting from the inhomogeneity of a sampled compost batch and the investigated inter-laboratory trials.

Table 12: Mean coefficients of variation resulting from the two main factors of variability: the inhomogeneity of a sampled compost batch and the deviation between individual laboratories.

	Cd	Cr	Cu	Hg	Ni	Pb	Zn
	coefficient of variation [CV %]						
Mean CV compost heap	29.1	11.1	17.5	17.7	9.6	19.8	6.4
Mean inter-lab CV	29	28	15	31	20	22	11
Sum of mean CVs compost heap and between laboratories	**58.1**	**39.1**	**32.5**	**48.7**	**29.6**	**41.8**	**17.4**

These figures can be used as orientation for introducing a tolerance in the following way :

1.) To allow for a tolerance if a compost product is sampled and analysed by the competent authority in the frame work of a control inspection (here Amlinger et al.,2004, recommend a 50 % tolerance which means that a compost would still be considered to comply with the set requirements even if a measured value would exceed the limit value up to 50%).

2.) To allow for a tolerance for a single batch analyses if the sliding mean value of e.g. 4 preceding measuremts is below the set limit value (e.g. this tolerance is 25 % following the German Biowaste Ordinance).

In fact, some national regulations have established such systems of tolerances or admissible deviations to existing limit values for compost. These systems refer to the specific structure and low homogeneity of compost batches or the random (and not batch wise) sampling requirements.

Systems for admissible tolerances as used in national regulations are summarised in Table 13:

Table 13: Systems of tolerated deviations of limit values for composts

[I] Product / batch / sample related tolerance *[independent of analytical tolerances of repeated analyses from one laboratory sample]*					
Sample taken on behalf of:	**Tolerance / admissible deviation refer to**	**Compost type**	**Tolerance factor**	**Specification under which condition a deviation or tolerance to a measured value is allowed**	**Country**
Producer	Any sample taken	any	+ 43 %	Control sample may exceed any limit value for any batch analysed not allowed since 1-1-2008	NL
			+100 %	To be authorised on a case by case basis by the responsible body for a period of max. 6 months "StoV," from 09.06.86	CH
			+50 %	Draft revision of the "StoV" from 01.05.02; See above	
	Single batch among a series of batches	any	+ 25 %	Value may not exceed limits in the sliding average of the last four tests … and if none of the results of an analysis exceed the limit value by more than 25%.	DE
		any	+ 50 %	75% of 5 samples must be below the limit value; one result may exceed the limit value by max. 50%.	DK*
	Any sample	any	+ 20%	Each value measured may not exceed limit value by more than 20 %	IE
	4 independent samples of 1 batch	MSWC MBTC	+ 30 %	3 of 4 obligatory independent samples of 1 batch have to meet the limit values. 1 sample may exceed the limit by 30 %	AT
		any	+ 20 %	Samples taken within 12 months: 2 or 4 — Max. No. of samples exceeding any limit: 1 Samples taken within 12 months: 12 — Max. No. of samples exceeding any limit: 3	DG Env. WD 2nd draft
Control authority	Sample from a single declared batch	any	+ 50 % resp. + 30 %	Analytical value of the controlled batch may exceed the limit value by max. 50 % (Cd, Cr, cu, Hg, Ni, Pb) resp. 30 % (Zn, organic pollutants)	AT

[II] Limits for repeatability[53]
[tolerances /max. deviations for repeated measurements from one or more samples for the determination of the concentration of PTEs or organic pollutants in ONE compost batch]

Tolerance / admissible deviation refer to	Specification of system	Country
Independent random samples of one single batch *[any heavy metals and organic pollutants]*	• Maximum 6 repeated independent samples from one batch • Exclusion of max. 2 outliers (extreme values) • Max. deviation of individual result from mean value: + 30 %	AT
Repeatability[53] limit for repeated measurements of one laboratory sample	Repeatability[53] limit [% of mean value; at p=95%] Cd: 28 % | Cr: 22.4 % | Cu: 22.4 % | Hg: 36.4 % | Ni: 19.6 % | Pb: 28 % | Zn: 28 %	DE
Repeatability[53] limit for repeated measurements of one laboratory sample	Repeatability[53] limit [% of mean value; at p=95%] Cd: 19.75 % | Cr: 21.55 % | Cu: 11.61 % | Hg: --- | Ni: 14.51 % | Pb: 17.94 % | Zn: 8.92 %	WD 2nd draft EN 13650
Repeatability[53] for repeated measurements of one laboratory sample for PAH	Repeatability[53] [% of mean value] for PAH sample 1 | sample 2 | sample 3 Mean value [mg kg^{-1}]: 13 | 62 | 2 090 Repeatability [%]: 18.3 % | 11.9 % | 10.7 %	WD 2nd draft & ISO 13877

* In DK tests for cadmium, mercury, lead, nickel, chromium, zinc and copper can be omitted if the waste producer documents that these metals are either not present or only in negligible quantities in the waste. In the case of cadmium, mercury, lead and nickel tests can also be related to concentrations per kilogram of phosphorous.

1.3.5 The impact of decomposition state on measured values

The question here is to what extent the decomposition or stabilisation rate would influence the measured value of a mineral compound like heavy metals and if it would be justified to standardise limit values and analytical results at a certain organic matter level?

Mineral components are – due to the decomposition and volatilisation of the organic fraction – accumulating relative to the total dry matter during the ongoing composting process. Hence, it is likely that a very well matured compost would show considerable higher metal concentration than the same compost batch if sampled at a very early stage of composting. This *concentration factor* can be levelled by relating the analysed result to a certain organic matter content. For example, the concentration factor of a mineral element in *"compost"* with 60% OM would be 1.75 if related to the basis of 30 % OM, or 2.0 if related to 20% OM.

Here some potential benefits and constraints of introducing an *organic matter standardisation factor* for heavy metal limit values:

[53] Repeatability limit: critical difference between analytical results from 2 or more repeated measurements which is tolerated at a given probability p = 95%.. These factors are calculated from the standard deviations of repeated measurements in German inter-laboratory trials and give the precision of an analytical method. The repeatability limit is derived by multiplying the standard deviation with the factor $1.96 * \sqrt{2}$.

Constraints:

- The standardisation factor used may cause market problems if very strict limit values are set e.g. close to the median or even 75th percentile level of the compost type concerned. For instance, compost having a Zn concentration of 180 mg kg^{-1} at its original 40% OM level would exceed a threshold value of 200 mg kg^{-1} d.m. if standardised to an OM content of 30 % and consequently kicking it of the market or the option to use it in organic farming (Annex IIA EC Reg. 2092/91/EC).
- Green waste compost or bark compost which tend to have a higher organic matter content due to the high amount of ligneous constituents in the raw material would also be affected to a higher extent than biowaste composts.
- In order to prevent any risk of exceeding a set of limit values, producers might be encouraged to add mineral additives to an unnecessary high extent with the aim to achieve a low OM concentration

Positive aspects:

- Without a standardisation factor, if low grade source materials are used or any contamination could be expected sampling and analyses at an early stage of composting could be misused in order to comply with the set quality criteria.
- This might create market distortion because of a missing common level of accurate product definition.

The consequences of the use of an *organic matter standardisation factor* is shown in Table 14 and Figure 4.

Table 14: Relative and absolute increase of concentration values if the measured concentration is standardised to a 30 % OM level assuming different actual levels of OM in compost

		Element at original OM concentration [mg kg^{-1} d.m.]					
		0.5	20	40	80	160	240
Original OM *[% d.m.]*	**Relative increase**	***Element standardised to a 30 % OM Basis [mg kg^{-1} d.m.]***					
35	8 %	0.54	22	43	86	172	258
40	17 %	0.58	23	47	93	187	280
45	27 %	0.64	25	51	102	204	305
50	40 %	0.70	28	56	112	224	252
55	56 %	0.78	31	62	124	249	280
60	75 %	0.88	35	70	140	280	315

The calculation of the metal concentration standardised to a defined OM content is done with the following formula:

$$HM_S = HM_A \times \frac{100 - OM_S}{100 - OM_A}$$

HM_S heavy metal concentration at standardised OM content [mg/kg d.m.]
HM_A heavy metal concentration as analysed in original sample [mg/kg d.m.]
OM_S standardised organic matter content [% d.m.]
OM_A analysed organic matter content in original sample [% d.m.]

Figure 4 shows an example for the theoretical increase of an analytical value (here 200 mg/kg d.m.). If the original OM content was 60 % d.m. the value standardised to 30% OM would be 350 mg/kg d.m.. In contrast, if the original OM content is 15 % d.m. the standardisation would result in a decrease of the standardised concentration to 165 mg/kg d.m.

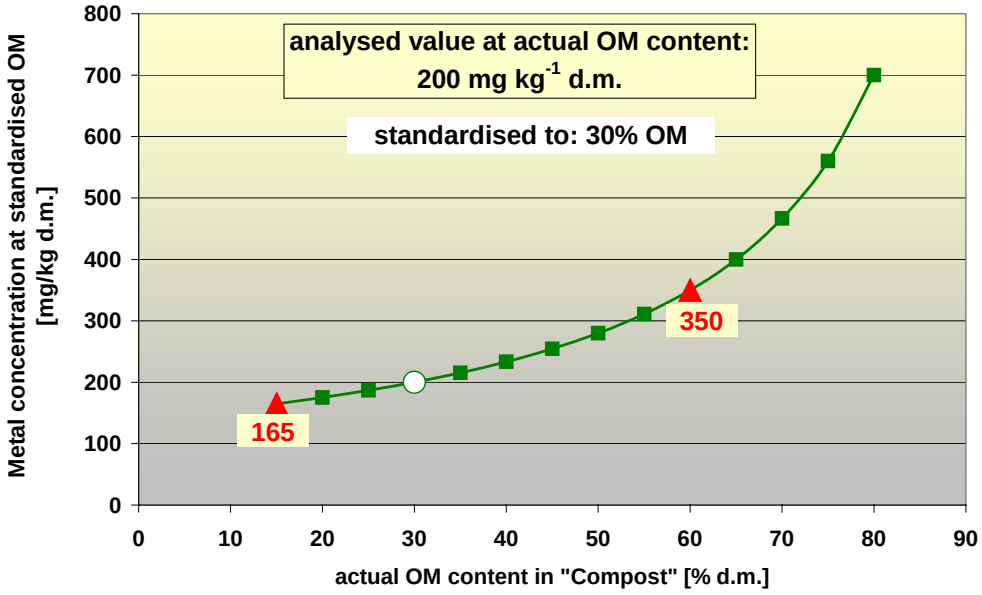


Figure 4: **Example for the mathematical increase or decrease of metal concentration related to a standard organic matter content (30 % OM) with varying actual OM levels if the concentration in the original sample is analysed with 200 mg/kg d.m.**

Table 15 lists heavy metal limit values of statutory and voluntary standards in EU Member States .

Table 15: Heavy metal limits in European compost standards

Country	Regulation	Type of standard	Cd	Crtot	CrVI	Cu	Hg	Ni	Pb	Zn	As
			mg/kg d.m.								
AT	Compost Ord.:Class A+ (organic farming)	statutory ordinance	0.7	70	-	70	0.4	25	45	200	-
	Compost Ord.:Class A (agriculture; hobby gardening)		1	70	-	150	0,7	60	120	500	-
	Compost Ord.: Class B (landscaping; reclam.) limit value (guide value)*		3	250	-	500 (400)	3	100	200	1,800 (1,200)	-
BE	Royal Decree, 07.01.1998	statutory decree	1.5	70	-	90	1	20	120	300	-
BG	No regulation	-	-	-	-	-	-	-	-	-	-
CY	No regulation	-	-	-	-	-	-	-	-	-	-
CZ	Use for agricultural land (Group one)	statutory	2	100	-	100	1	50	100	300	10
	Landscaping, reclamation (draft Biowaste ordinance) (group two)	statutory Class 1	2	100	-	170	1	65	200	500	10
		Class 2	3	250	-	400	1.5	100	300	1200	20
		Class 3	4	300	-	500	2	120	400	1500	30
DE	Quality assurance RAL GZ - compost / digestate products	voluntary QAS	1.5	100	-	100	1	50	150	400	-
	Bio waste ordinance	statutory decree (Class I)	1	70	-	70	0.7	35	100	300	-
		(Class II)	1.5	100	-	100	1	50	150	400	-
DK	Statutory Order Nr.1650; Compost after 13 Dec. 2006	statutory decree	0.8	-	-	1,000	0.8	30	120/60 for priv. gardens	4,000	25
EE	Env. Ministry Re. (2002.30.12; m° 87) Sludge regulation	statutory	-	1000	-	1000	16	300	750	2500	-

Country	Regulation	Type of standard	Cd	Crtot	CrVI	Cu	Hg	Ni	Pb	Zn	As
			mg/kg d.m.								
ES	Real decree 824/2005 on fertilisers										
	Class A	statutory	0.7	70	0	70	0.4	25	45	200	-
	Class B		2	250	0	300	1.5	90	150	500	-
	Class C		3	300	0	400	2.5	100	200	1000	-
FI	Fertiliser Regulation (12/07)	statutory decree	1.5	300	-	600	1	100	150	1,500	25
FR	NFU 44 051	standard	3	120		300	2	60	180	600	
GR	KYA 114218, Hellenic Government Gazette, 1016/B/17- 11-97 [Specifications framework and general programmes for solid waste management]	statutory decree	10	510	10	500	5	200	500	2,000	15
HU	Statutory rule 36/2006 (V.18)	Statutory Co: 50; Se: 5	2	100	-	100	1	50	100	--	10
IE	Licensing of treatment plants (EPA)										
	stabilised MBT compost compost not meeting class I or II	statutory	5	600	-	600	5	150	500	1500	-
	(Compost – Class I)	statutory	0.7	100	-	100	0.5	50	100	200	-
	(Compost – Class II)	statutory	1.5	150	-	150	1	75	150	400	-
IT	Law on fertilisers (L 748/84; and: 03/98 and 217/06) for BWC/GC/SSC	statutory decree	1.5	-	0.5	230	1.5	100	140	500	-
Luxembourg	Licensing for plants		1.5	100	-	100	1	50	150	400	-
LT	Regulation on sewage sludge Categ. I (LAND 20/2005)	statutory	1.5	140		75	1	50	140	300	-
LV	Regulation on licensing of waste treatment plants (n° 413/23.5.2006) – no specific compost regulation	statutory =threshold between waste/product	3			600	2	100	150	1,500	50

Country	Regulation	Type of standard	Cd	Crtot	CrVI	Cu	Hg	Ni	Pb	Zn	As
			mg/kg d.m.								
Netherlands	*BOOM Compost*	terminated with 31/12/2007	*1*	*50*	-	*60*	*0.3*	*20*	*100*	*200*	*15*
	BOOM very clean Compost		*0.7*	*50*	-	*25*	*0.2*	*10*	*65*	*75*	*5*
	Amended National Fertiliser Act from 2008	statutory	1	50		90	0.3	20	100	290	15
PL	Organic fertilisers	statutory	3	100		400	2	30	100	1500	-
PT	Standard for compost is in preparation	-	-	-	-	-	-	-	-	-	-
Sweden	Guideline values of QAS	voluntary	1	100	-	100	1	50	100	300	
SI	3 classes of heavy metals were not delivered	statutory	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
SK	Industrial Standard STN 46 5735 Cl. 1	voluntary (Mo: 5)	2	100		100	1	50	100	300	10
	Cl. 2	voluntary(Mo: 20)	4	300		400	1.5	70	300	600	20
UK	UKROFS fertil.org.farming, 'Composted household waste'	statutory (EC Reg. 2092/91)	0.7	70	0	70	0.4	25	45	200	-
	Standard: PAS 100	voluntary	1.5	100	-	200	1	50	200	400	-
EU ECO Label	COM Decision (EC) n° 64/2007 eco-label to growing media COM Decision (EC) n° 799/2006 eco-label to soil improvers	voluntary [Mo: 2; As: 10; Se: 1.5; F: 200 [only if materials of industrial processes are included]	1	100	-	100	1	50	100	300	10
EC Reg. n° 2092/91	Required for compost from source separated Biowaste only	statutory	0.7	70	-	70	0.4	25	45	200	-

1.3.6 Austria – an example for comprehensive and precautionary standards setting by integrating types of input materials, heavy metal classes, product designation and declaration as well as dedicated areas of application

The presumably most sophisticated model was implemented in the Austrian Compost Ordinance. We summarise the classification system here as an example how compost classes (heavy metal limits) are linked with source materials, compost designation and the declaration for admissible areas of application.
The 3 classes are defined with respect to heavy metal concentrations:

- ***Class A+*** (top quality; limit values taken from Council Regulation (EEC) No. 2092/91 on organic farming)
- ***Class A*** (high quality; minimum requirement for the declaration *'Quality Compost'* and the use in agriculture)
- ***Class B*** (minimum quality; suitable for non-agricultural use)

Table 16: Maximum heavy metals concentration for composts and sewage sludge as input material according to the *Austrian Compost Ordinance*

mg/kg d.m.	Cd	Cr_{tot}	Cu	Hg	Ni	Pb	Zn
COMPOST							
class A+ → *org. farming*	0.7	70	70	0.4	25	45	200
class.A → *agriculture*	1	70	150	0.7	60	120	500
class.B → *land reclamation*.	3	250	400/ 500*	3	100	200	1,200/ 1,800 *
SEWAGE SLUDGE							
for '*quality sludge compost*	2.0	70	300	2.0	60	100	1,200
for *'compost'*	3.0	300	500	5.0	100	200	2,000

* guide / limit value for Cu and Zn; if the guide value in the compost is exceeded the concentration has to be indicated in the labelling

In order to mark composts processed from high quality source materials, the ordinance allows the following terms in the declaration or labelling sheet:

- ***'Quality Compost'***, suitable for use according to ***Council Regulation (EEC) No. 2092/91 'on organic production of agricultural products*** and indications referring thereto on agricultural products and foodstuffs (compost must be at least class A+ quality and produced from source segregated organic waste)
- ***'Quality Compost'*** (compost of at least class A quality, produced from source segregated organic waste)
- ***'Quality Sewage Sludge Compost'*** (compost of at least class A quality, produced from high quality sewage sludge)
- ***'Compost'*** (compost which at least meets class B and does not include mixed residual waste as input material)
- ***'Bark Compost'*** (produced exclusively from bark)
- ***'Waste Compost'*** (Compost derived from non-hazardous household waste and similar commercial waste → mixed municipal solid waste**.** The areas in which MWC may be used are restricted (landfill surface cover or biofilter). MWC cannot be marketed freely but must be transferred from the producer directly to the final user)

The admissible compost *designation in the labelling* and the area where the compost may be applied also depends on the *category of input materials* used as well as on the applicable *quality class* (heavy metals). The basic system is shown in Table 17.

Table 17: System of compost denomination, quality classes, input category and area of application

Category of Input material		Quality Class (heavy metal class) A+	A	B
Only Category 1 *'Biowaste'*	*Designation*	Quality Compost *"suitable for organic farming acc. To 2092/91 EEC"*	Quality Compost	Compost
	*Application area***	any	agriculture ~~*organic farming*~~°	landscaping ~~*agriculture*~~°
Category 1 and 2 *(incl. sewage sludge)*	*Designation*	Compost or Quality - Sewage Sludge-Compost *	Compost or Quality - Sewage Sludge-Compost *	Compost
	*Application area***	agriculture ~~*organic farming*~~°	agriculture ~~*organic farming*~~°	landscaping ~~*agriculture*~~°
Only Category 3 *MSW Compost*	*Designation*	MSW Compost	MSW Compost	MSW Compost
	*Application area***	reclamation of landfill sites; biofilter; ~~*agriculture*~~		
Only Bark	*Designation*	Bark Compost	Bark Compost	Bark Compost
	*Application area***	any	agriculture ~~*organic farming*~~°	landscaping ~~*agriculture*~~°

* The designation QUALITY-SEWAGE SLUDGE COMPOST is allowed, if heavy metal limits for high quality sludge are met

** only those application areas are indicated which require the highest degree of quality

° crossed out applications are not permitted to be used for the indicated compost qualities

Moreover the general *application areas (agriculture, landscaping, reclamation on landfill sites, biofilter and constituents in growing media and manufactured soils)* are split into several *application cases* for which specific restrictions for the use may apply
All other material is classified as waste and remains waste whatever is done with it (and it is subject to landfill taxes etc.).

1.3.7 Consequences of qualitative standards setting for the compost production

An important task is to evaluate what effects the setting of a quality criterion for compost to cease to be waste would have. How would certain limits relate to the reality of compost quality currently produced? It has to be weighed if an environmentally motivated quality criterion is proportionate with respect to what best practice management systems may achieve.

In relation to heavy metals, we assumed three scenarios of limit values:

1. Level 1 (low limit): the limit values established in the framework of the Regulation (EC) n° 2092/91 for the use of compost from source separated organic household waste in organic farming
2. Level 2 (medium limit): This level is derived from a study by Amlinger et al. (2004) on behalf of the EU Commission and is based on a scientific and statistical concept combining the variability and statistical implications of compost production from source separated organic waste in Europe and the heavy metal limits defined in the framework of the EU ECO label for soil improver and growing media.
3. Level 3 (high limit): This is identical with the French standard for the marketing of compost which is orientated also at concentration levels which can be achieved via composting of mixed residual waste without source separation (NF U44-051; AFNOR, 2006[FA8]).

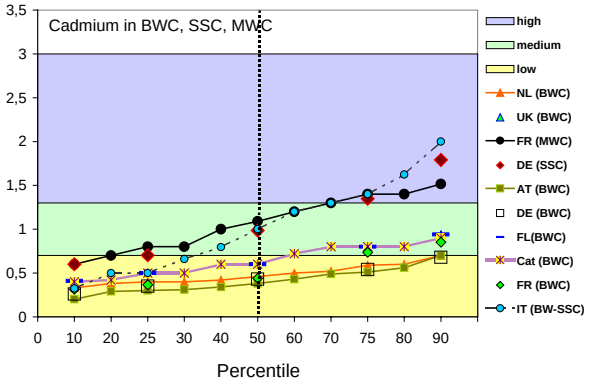
Table 18: Very strict (level 1 – low), moderate (level 2 – medium) and relaxed/soft (level 3 – high) potential limits for heavy metals used in this study for the evaluation of the impact of limit setting on compost production, marketing and use

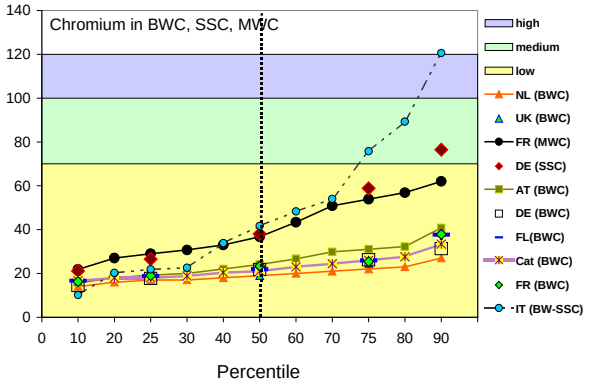
	Cd	Cr	Cu	Hg	Ni	Pb	Zn
	mg/kg d.m.						
Level 1 – low	0.7	70	70	0.4	25	45	200
Level 2 – medium	1.3	100	110	1.0	40	130	400
Level 3 – high	3.0	120	300	2.0	60	180	600

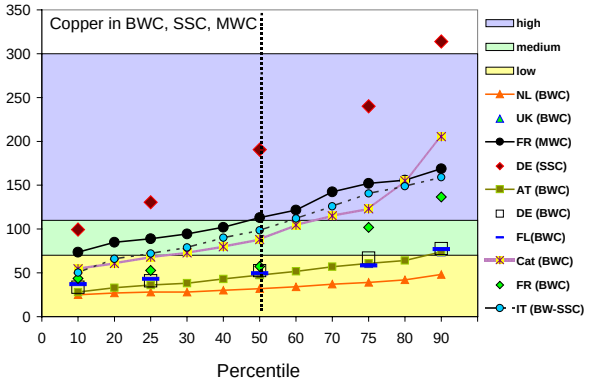
In the following Figure 5 we compares the percentile distribution of national datasets for BWC, SSC and MWC (left column) with those of GWC (right column).
In the case no better investigations were available we used the data which have already been used by Amlinger et al. (2004): AT, NL, IT. For the other countries more recent data from 2005 and 2006 could be provided by the national experts.

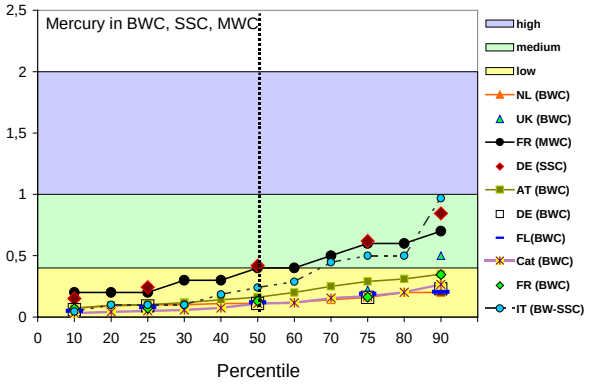
Evaluation of data sets from national investigations

Biowaste (BWC), sewage sludge (SSC) & mixed waste (MWC) compost

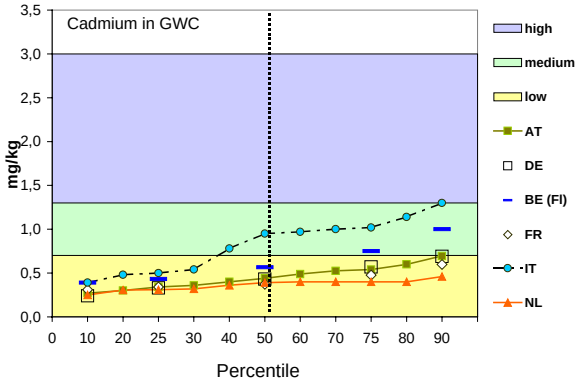


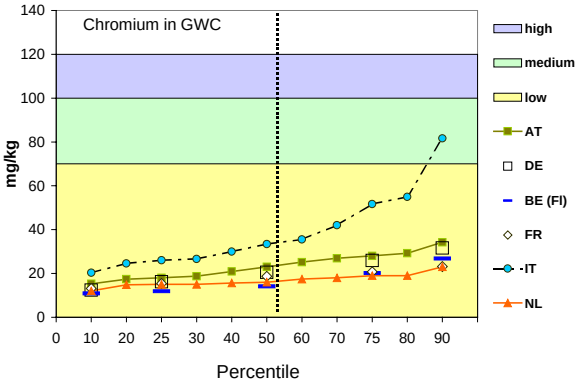


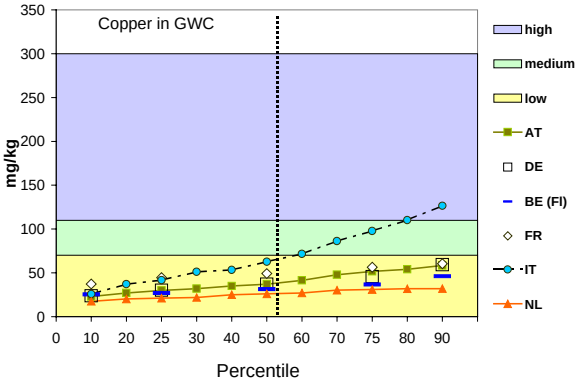


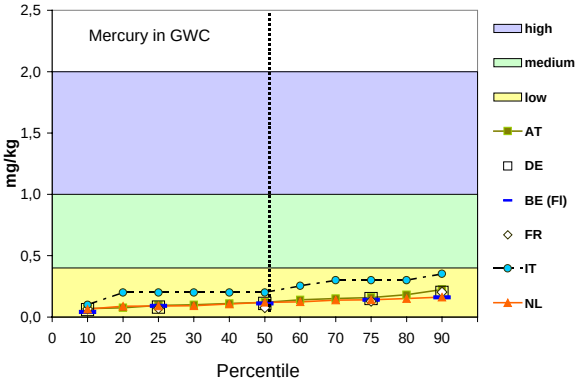


Green waste compost (GWC)









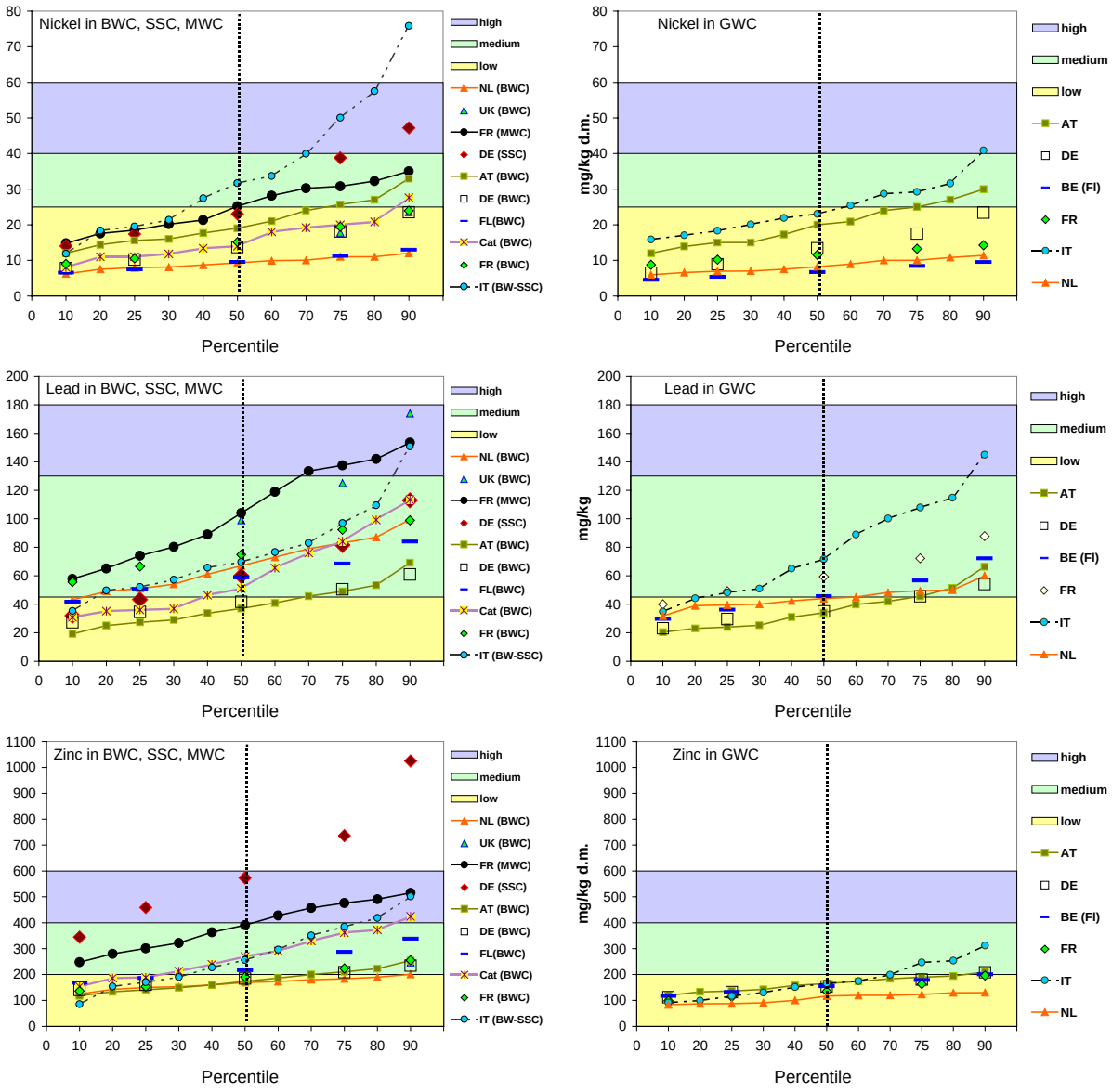


Figure 5: **Distribution of heavy metal concentrations in BWC, SSC, MWC (left) and GWC (right) from several national investigations and data sets in relation to the assumed three levels of heavy metal limits**

From this evaluation it can be concluded:

- BWC and GWC show a similar distribution pattern for the individual elements.
- Countries with advanced source separation and composting systems show a very similar level and distribution of heavy metals in both BWC and GWC.
- The differentiation between countries, which are in the starting phase and those with fully established source separation as identified in earlier publications (Amlinger et al., 2004) is less significant with more recent data. However, Cu, Pb and Zn as typical anthropogenic elements seem to be elevated in less advanced countries in biowaste management and composting.
- Further systematic (country specific) differentiation is evident for Ni, an indicator for geogenic/pedogenic variations.
- In the case of IT, it is not always clear if the compost includes a certain percentage of municipal sludge which might be the reason for the higher concentrations. In Italy both, biowaste and sludge compost are classified as *"mixed compost"* and therefore these two compost types cannot be further distinguished.

- The pre-evaluation of a new French investigation on compost quality was provided by ADEME (Feix, 2007; personal communication) and shows well comparable data now to other countries for biowaste and green waste composts
- The data of 189 German SSC show – with the exception of Pb – constantly higher concentrations. This is exceptionally true for Cu and Zn
- Also the metal concentration of the French MWC (Coppin, 2008; personal communication) is higher than for biowaste compost throughout the data distribution

1.3.8 How many composts would be excluded from the *product regime* if strict, moderate or loose limits would be set?

As mentioned, the level of concentration limits for heavy metals might have a critical impact on compost production and market. To guarantee a minimum level of environmental protection if compost are marketed as a product is the one and predominantly discussed issue to be respected. On the other hand a strict limitation below what can be produced by means of source separation and good quality management would cut off the intended benefits of organic waste (organic matter) recycling to soil.

Therefore a careful look has to be done on the impact of those limit concentrations on the potential compost production.
As an example we show the effect of extremely strict limits following a stringent concept of *no net accumulation* (Amlinger et al., 2004; see also chapter 1.3.2). This has been discussed in Germany several years ago and is demonstrated in Table 19.

Table 19: Calculated limit values for composts following Bannick et al. (2002[FA9]) in comparison to existing qualities in Europe and statistically *"warranted"* mean value and individual concentrations on facility level

	for soil type:	Cd	Cr	Cu	Hg	Ni	Pb	Zn
		mg/kg d.m.						
***"No net accumulation"* limits**	clay	1.63	107	70	1.10	76	108	261
	loam/silt	1.10	64	49	0.56	55	76	207
	sand	0.46	32	27	0.14	17	44	111
BWC low (1)		0.50	23	45	0.14	14	50	183
BWC high (2)		0.87	39.9	74	0.30	27	88	276
Warranty values **Means** on plant scale (*)		1.1	70	110	0,5	60	120	380
Warranty values **single samples** on plant scale (*)		1.8	100	180	1.1	80	190	530

(1) Average of mean or median values from European compost surveys (biowaste composts; Amlinger et al., 2004)

(2) Average of 90th percentile values from European compost surveys (biowaste composts; Amlinger et al., 2004)

(*) Warranty values: Concentration levels which can be warranted on the basis of 376 investigated composting facilities in the average of 4 subsequent measurements at a precision of $p < 0.05$ (Reinhold, 2003[FA10])

Reinhold (2003) estimated that in Germany only 10 %, 42 % and 62 % out of 376 composting plants are able to guarantee to comply with the limit values for sand, loam and clay soils respectively which are shown in Table 19. This would have caused a severe damage to the compost recycling and market but still missinga robust scientific justification.

From some exemplary national data sets we have calculated the proportion of compost samples which would fit into each of the assumed scenarios of *quality classes*. The German composts are taken from compost plants which participate in the German quality assurance scheme of the *Bundesgütegemeinschaft Kompost e.V.* (BGK e.V./Thelen-Jüngling, 2007; personal communication).

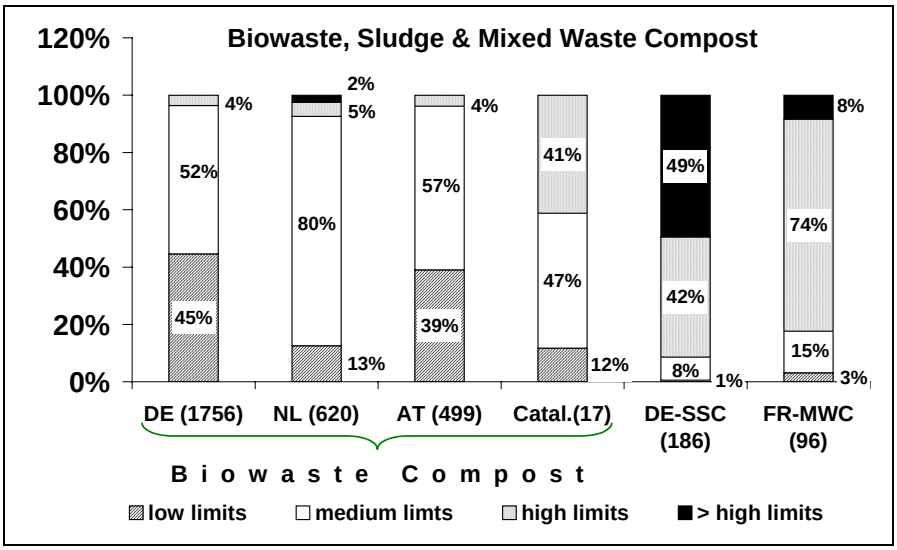


Figure 6: Percentage of BIOWASTE, SEWAGE SLUDGE (SSC) and MIXED WASTE (MWC) compost samples from DE, NL, AT, Catalonia (Catal.) and FR data sets within the assumed three limit concentration levels (*low, medium, high*)

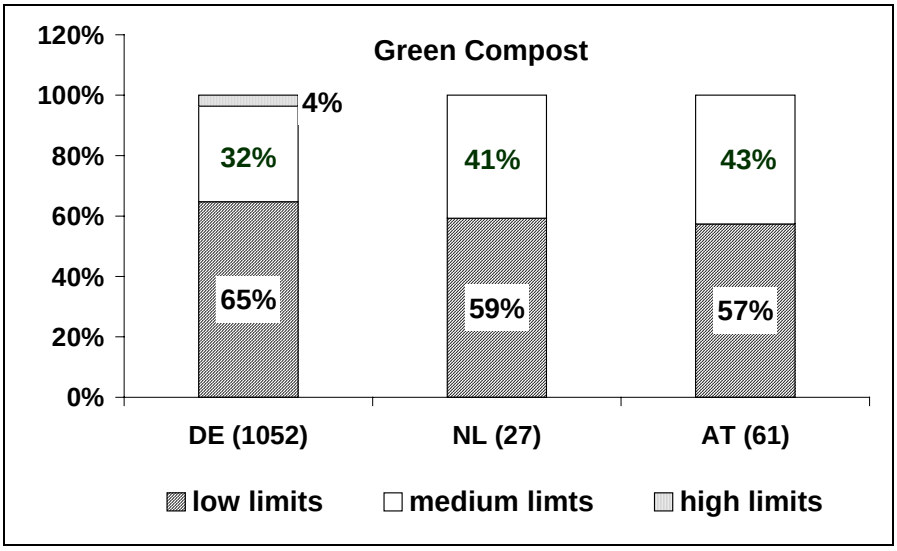


Figure 7: Percentage of GREEN WASTE compost samples from DE, NL and AT data sets within the three assumed limit concentration levels (*low, medium, high*)

From this it can be seen that even when source separation systems are similarly established at a high level of good management, national variations may occur due to background concentrations of individual metals. National evaluations of biowaste compost data sets from DE, AT, NL, ES/Catalonia showed that 45, 39, 13 and 12 % respectively of analysed compost samples would meet the organic farming limit values whereas a level 2 limit (moderate or medium) would in the case of DE, AT and NL include 93 to 96 % of all analysed samples. This would be only 59 % for the Catalonian composts (though this can be taken only as a rough empirical and not statistically approved indication, since only 17 composts have been analysed). However, it is interesting, that for green waste compost the evaluation for DE, NL and AT gave a very consistent result of about 60 % of composts meeting the very low limits for organic farming (though for GWC not heavy metal limits are defined at EU level) and nearly 100 % would comply with moderate typical limit values for biowaste compost.
It was interesting to see that the 660 NL composts analysed 2005 in German laboratories following the German QAS gave similar results than German composts, hence with a lower proportion in the highest

quality class, whereas former Dutch datasets provided for the study of Amlinger et al. (2004) and used in Figure 5 showed for some elements consistent lower concentrations. We assumed differences in the analytical procedure. Hence, this could not be verified yet.

In any case this supports the importance of European unique standards for analytical methods as intended with the project Horizontal (see Annex 2).

The only comparison available for *fresh* and *mature compost* (DE) showed no difference as far as the compliance with the assumed limit classes is concerned. The 2,734 investigated composts are taken from compost plants which participate in the German quality assurance scheme of the *Bundesgütegemeinschaft Kompost e.V.*.

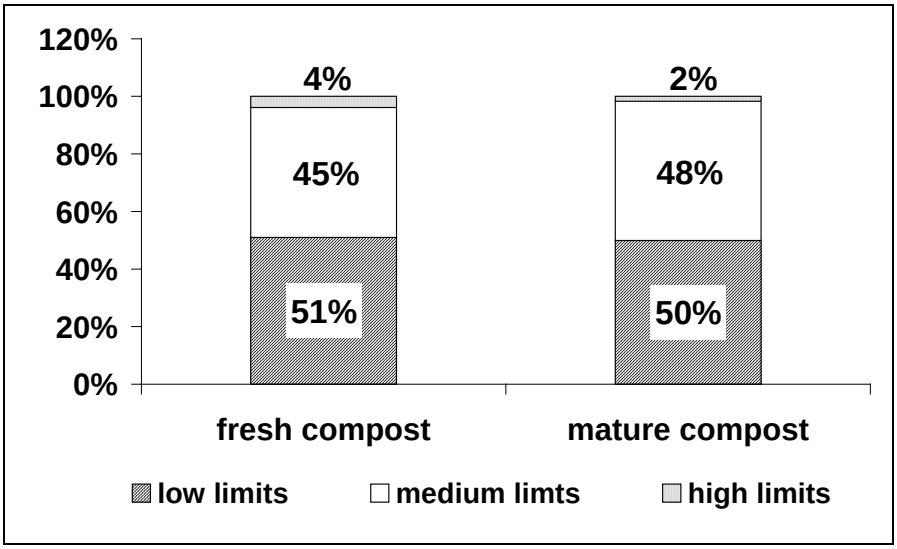


Figure 8: Percentage of *fresh (n=779)* and *mature (n=1955)* compost samples from DE, data sets fulfilling the three limit concentration levels (*low, medium, high*)

Finally these results must be seen also from the perspective of long term soil protection. Therefore we calculated the potential accumulation of heavy metals in soils where compost is spread over a long period of time.

1.3.9 Effect of continuous compost application on the heavy metal status of the soil

Long term accumulation scenarios were first published by Amlinger et al. (2004) in a study for the EU Commission. Here the task was to elaborate a scientific concept for introducing quality criteria for potential pollutants for waste derived fertilisers and soil amendments. Here we use the same basic assumptions but we show the accumulation scenario for only one soil type (*loamy soil*).
In the graphs of Figure 9 we assume for all composts applied every year a metal concentration exactly at the three assumed limit concentrations (level 1, 2 and 3) as proposed for the scenarios in Table 18.
Further, in order to draw a more realistic picture we compared the accumulation occurring from the use of BWC and GWC with the metal concentration at the 75 percentile level of 2,801 German compost samples analysed in 2005 with 75 percentiles of SSC (BGK e.V./Thelen-Jüngling, 2007; personal communication) and of MWC (French data; Coppin, 2008; personal communication) see Figure 10).

It can be concluded:

- Setting limits in accordance with the French standard for mixed waste compost (level3) would unnecessarily attract source materials which would result in considerable higher impacts on soil. Specifically, this is the case for Cd, Cu, Hg and Zn.
- The scenarios comparing the 75 percentile of BWC/GWC with SSC and MWC indicate that
  - BWC results for all elements in the lowest accumulation rate ; the critical soil threshold values for loamy soils taken from the German Soil Protection Ordinance would not bee reached even after a long period of 150 years.
  - In the case of SSW and MWC the most significant accumulation would occur for Cu, Pb and Zn if compared to BWC/GWC.

Table 20: Assumption used in accumulation scenarios for heavy metals

			Cd	Cr	Cu	Hg	Ni	Pb	Zn
Atmospheric deposition	(1)	g/ha*y	2.315	15.2	87.45	0	44.9	59	332.6
Export									
Export via leaching	(2)	g/ha*y	- 0.28	- 9.2	- 8	- 0.28	- 17.8	- 0.56	- 38
Export via harvest	(3)	g/ha*y	- 0.67	- 5.27	- 33.92	---	- 10.29	- 5.92	- 172.9
Total export		g/ha*y	- 0.95	- 14.47	- 41.92	- 0.28	- 28.09	- 6.48	- 210.9
Precautionary soil threshold concentration for the multifunctional use of LOAMY SOILS									
Loamy soils ; pH > 6	(4)	mg/kg d.m.	1	60	40	0.5	50	70	150
Background value soil as base line for the accumulation of PTEs in the soil									
	(5)	mg/kg d.m.	0.27	22.45	16.2	0.06	22.53	24.83	61.57
Heavy metal concentration in compost									
Level 1 (low limit value)	(6)	mg/kg d.m.	0.7	70	70	0.4	25	45	200
Level 2 (medium limit value)	(6)	mg/kg d.m.	1.3	100	110	1.0	40	130	400
Level 3 (high limit value)	(6)	mg/kg d.m.	3.0	120	300	2.0	60	180	600
75 percentile bio/green waste composts (DE)	(7)	mg/kg d.m.	0.52	26	59	0.16	17.6	50	204
95 percentile bio/green waste composts (DE)	(7)	mg/kg d.m.	0.89	40	89	0.27	29	78	280
Quantity of compost per ha and year applied									
P_2O_5 concentration in compost: 0.65 % d.m.					max. **60 kg P_2O5 /ha*y**			**→ 9.2 t d.m. compost /ha**	
Soil depths and density		soil density: 1,5 g cm^{-3}						30 cm **→ 4,500 t /ha**	
Time frame for the accumulation model								**150 years**	

(1) taken from the latest investigations on the atmospheric deposition of PTEs in the east and south part of Austria from 10 locations (Böhm & Roth, 2000[FA11] and 2001[FA12])

(2) average total export of heavy metals via leachate water (at a percolation rate of 200 mm) taken from figures in Germany (Bannick et al., 2001[FA13]):

Concentration in the leachate water *[µg l^{-1}]*	Cd	Cr	Cu	Hg	Ni	Pb	Zn
	0.14	4.6	4	0.14	8.9	0.28	19

(3) average export of heavy metals via harvest (cereals, maize, sugar beet, potatoes) (Bannick et al., 2001[FA14])

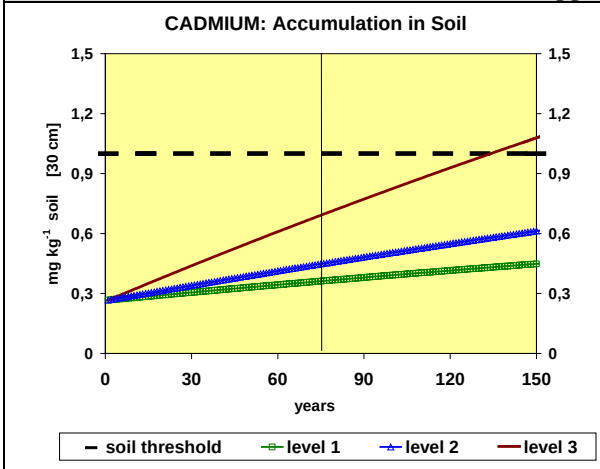
(4) BBSchV, 1999[FA15]: The German Soil Protection Ordinance defines *precautionary thresholds* as concentration level below which no specific restriction for the input of contaminants are considered and a negative impact to groundwater, plant or soil biota is not expected. If those values are exceeded yearly metal loads to the soil must be respected.

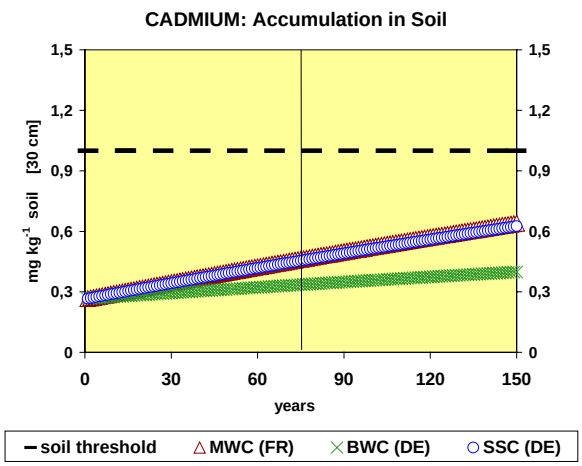
(5) mean values of background soil concentrations in clay soils of the national surveys from DK, FR and DE; see: "Trace elements and organic matter content of European soils" are available on the web page http://europa.eu.int/comm/environment/waste/sludge/index.htm

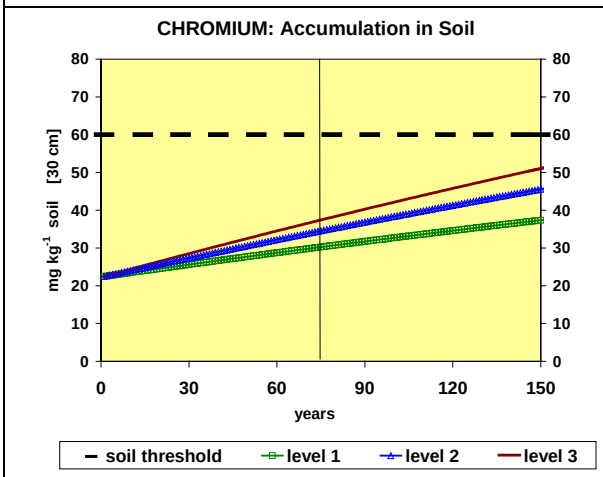
(6) assumed limit values for the scenarios (see Table 20).

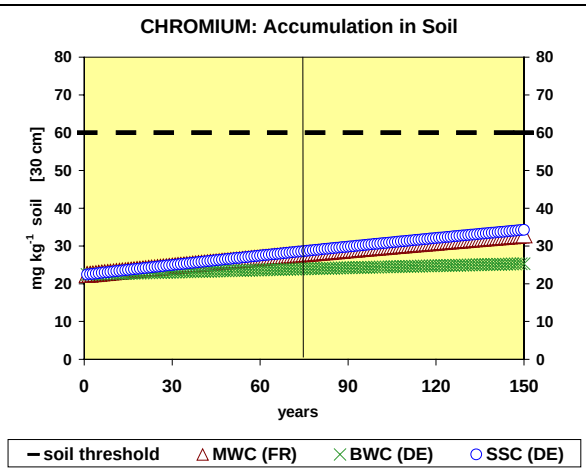
(7) the data have been provided by the German Quality Assurance Association Compost are based on the Compost analyses of 2,801 samples representing ca. 2.9 Mt of biowaste and green waste compost

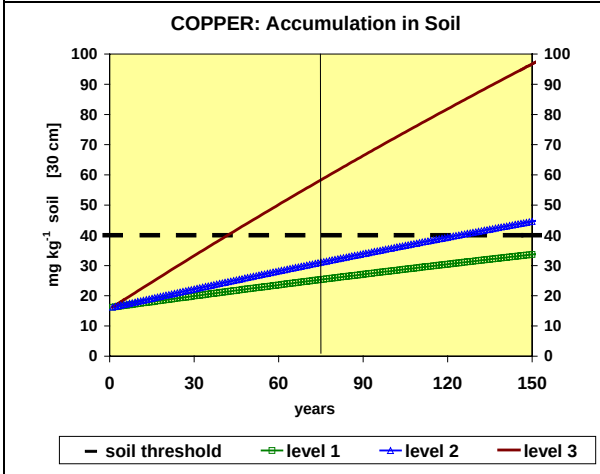
All scenarios: 9.2 t d.m. application of compost per ha & year











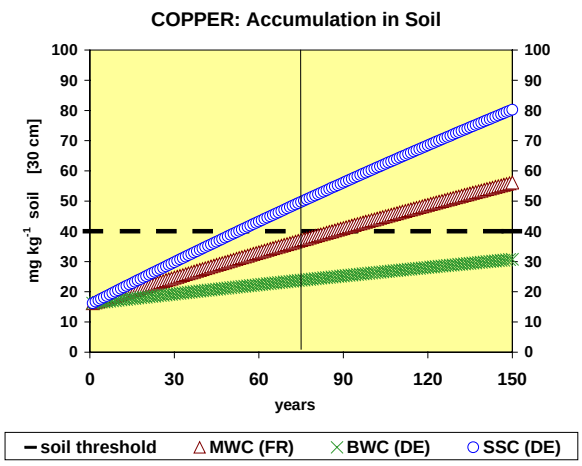


Figure 9: Accumulation of heavy metals in soil assuming the continuous application of composts with metal concentrations at 3 limit scenarios

Figure 10: Accumulation of heavy metals in soil assuming the continuous application of composts with metal concentrations at the 75 percentile of German biowaste and green waste composts (BWC), sewage sludge composts (SSC) and mixed waste composts from France (MWC)

All scenarios: 9.2 t d.m. application of compost per ha & year	

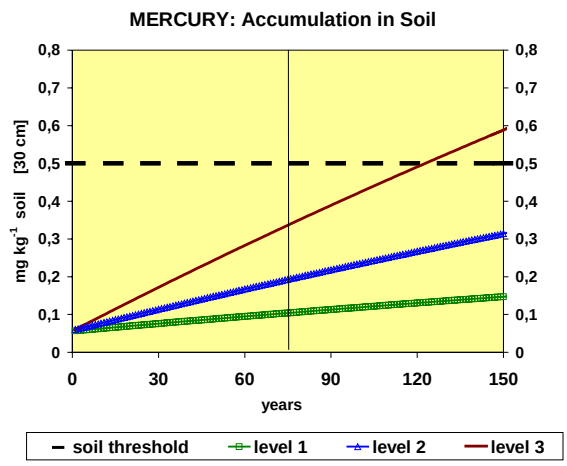
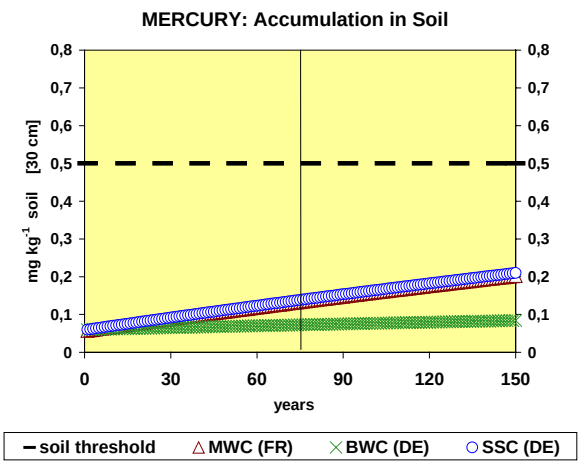
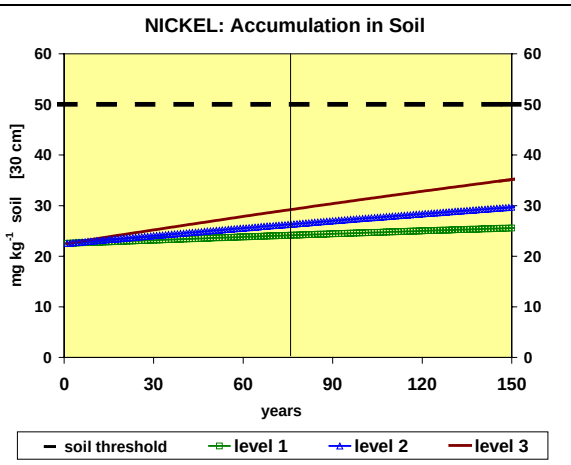
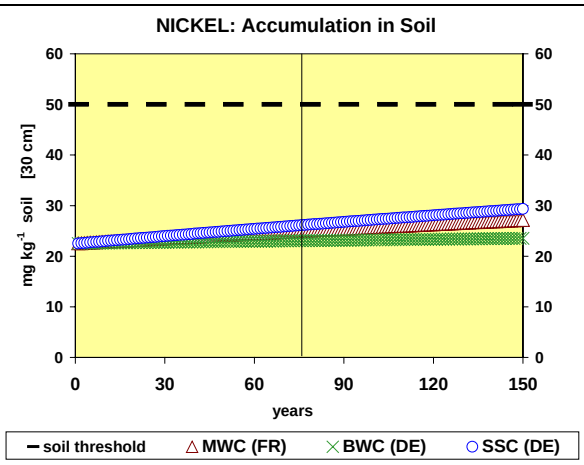
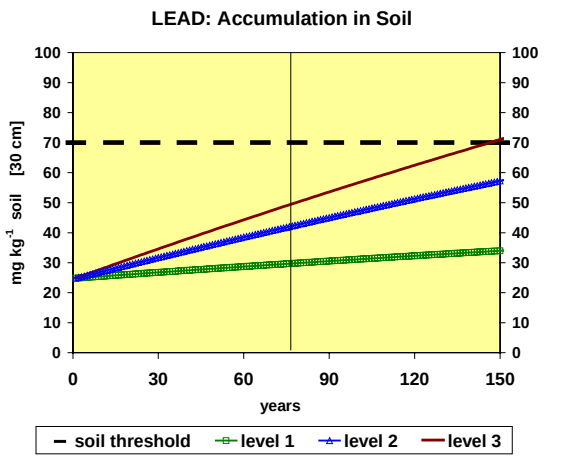
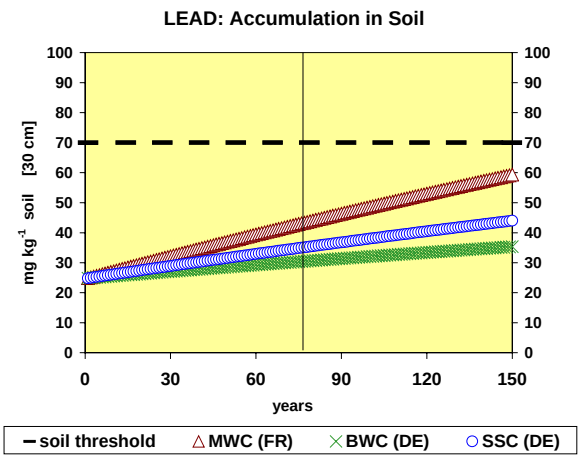

	
	
	

Figure 9 (cont.): Accumulation of heavy metals in soil assuming the continuous application of composts with metal concentrations at 3 limit scenarios	**Figure 10 (cont.): Accumulation of heavy metals in soil assuming the continuous application of composts with metal concentrations at the 75 percentile of German biowaste and green waste composts (BWC), sewage sludge composts (SSC) and mixed waste composts from France (MWC)**

All scenarios: 9.2 t d.m. application of compost per ha & year	

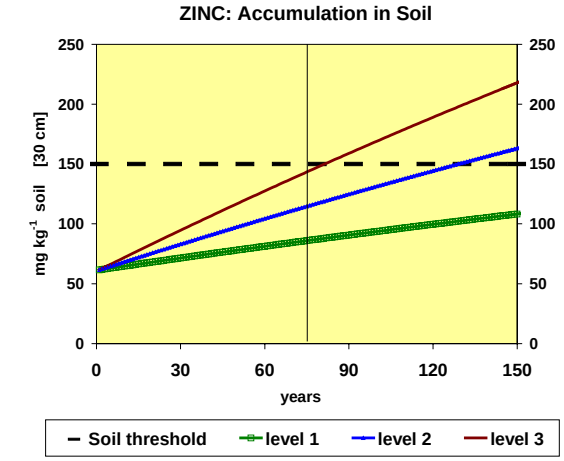
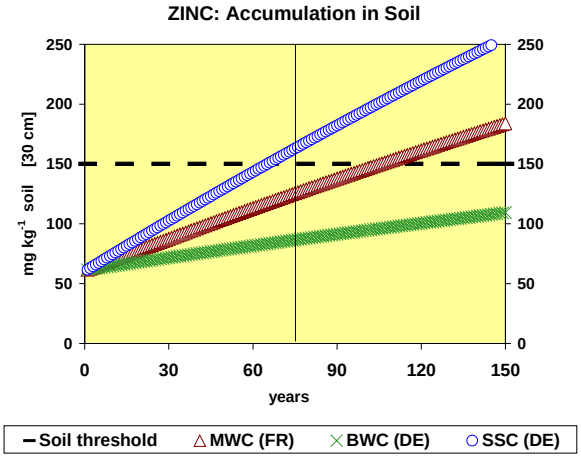

	

Figure 9 (cont.): Accumulation of heavy metals in soil assuming the continuous application of composts with metal concentrations at 3 limit scenarios	**Figure 10 (cont.): Accumulation of heavy metals in soil assuming the continuous application of composts with metal concentrations at the 75 percentile of German biowaste and green waste composts (BWC), sewage sludge composts (SSC) and mixed waste composts from France (MWC)**

1.3.10 Impurities

Impurities or any inert non organic contraries may be found in composts from biodegradable municipal waste. The better the performance of separate collection from households or small enterprises the higher the purity. From many experiences it is known that rather the collection system (door to door collection vs. road containers; 120 to 240 l wheel bins vs. 7 to 30 l buckets or bio-based, biodegradable bags for food waste) than the population density might be crucial to the amount of plastics, metals and glass. Other important factors are:

- pre-screening and other separation technologies at the composting plant
- final screening of the compost in combination with wind-sifting and magnetic separator

Plastics, metals and glass are the three fractions which are considered in existing regulations and standards.
In green waste or even in compost from sewage sludge or agro-industrial residues this issue is irrelevant.
Where mixed waste is the source for composting it is likely that additional technical efforts are necessary to achieve comparable results to compost from source separation.
Recently provided data (16 values from 3 modern mixed waste composting plants in France gave the following result (Coppin, 2008; personal communication):

[% d.m.]	MIN	MEAN	MAX
Plastics > 5 mm:	0	0.34	0.56
Glass & Metals > 2 mm:	0.30	1.25	2.83
Sum of impurities:	0.52	1.44	3.39

In contrast, in 1,756 German biowaste composts total impurities > 2mm range between 0.01 % (5 percentile) to 0.52 % (95 percentile) with a mean value of 0.2 % (BGK e.V., Thelen-Jüngling, 2007; personal communication). Assuming a limit value for total impurities of 0.5 % d.m. – which is typically found in many compost regulations – MWC even from recent processing technologies would not be accepted.
It has to be noted that the used methods for the identification of impurities is a wet screening procedure using a bleaching agent. With this method it is likely to produce higher figures than with the dry screening system as it is used in Germany. But even then (the wet bleaching systems identifies mainly a higher percentage of light plastics) this presumably would not change too much in the total mass related result.

Today it is common that impurities are limited in compost standards. Either this is done by setting a maximum concentration of the sum of plastics, metals and glass particles with a particle size > 2 to 5 mm or we find more complex regulations which specific limitations for these 3 fractions and even more than one particle size (e.g. 2 and 20 mm fraction for plastic constituents). In some cases we also find an individual limit for films and other (hard) plastic materials.
Table 21 shows maximum amounts of impurities as defined in regulations and guidelines of some European countries. On EU level a CEN standard for the identification of impurities has been drafted within the project Horizontal (see Annex 2). Here the two alternative methods, dry and wet screening with bleaching will be included.

Table 21 Limitations for the content of *impurities* in compost in national compost regulations and standards

Country		Impurities	∅ Mesh size	Limit values % d.m. (m/m)
AT	*Compost ordinance*	Total; agriculture	2 mm	≤ 0.5 %
		Total; land reclamation	> 2 mm	< 1 %
		Total; technical use	> 2 mm	< 2 %
		Plastics; agriculture	> 2 mm	< 0.2 %
		Plastics; land reclamation	> 2 mm	< 0.4 %
		Plastics; technical use	> 2 mm	< 1 %
		Plastics; agric. excl. arable land	> 20 mm	< 0.02 %
		Plastics; technical use	> 20 mm	< 0.2 %
		Metals; agriculture	---	< 0.2 %
BE	*Royal Decree for fertilisers, soil improvers and substrates*	Total	> 2 mm	< 0.5 %
		Stones	> 5 mm	< 2 %
CZ	*Act on fertilisers*	Total, agriculture	> 2 mm	< 2%
	Biowaste ordinance	Total, land reclamation	> 2 mm	< 2 %
DE	*Bio waste ordinance*	Glass, plastics, metal	> 2 mm	< 0.5 %
		Stones	> 5 mm	< 5 %
ES		Total impurities (glass, metals, plastic)	> 2 mm	< 3 %
FI	*Fertil. legislation*	Total	---	< 0.5 %
FR	*NFU 44-051*	Plastic films	> 5 mm	< 0.3 %
		Other plastics	> 5 mm	< 0.8 %
		Metals	> 2 mm	< 2.0 %
HU		No restrictions	---	---
IE	*EPA waste license*	Total; compost class 1 & 2	> 2 mm	≤ 0.5 %
		Total; low grade compost/MBT	> 2 mm	≤ 3 %
		Stones	> 5 mm	≤ 5 %
IT	*DPR 915/82*	Total	---	≤ 3
		Glass	---	≤ 3
			---	≤ 1
		Metals	---	≤ 0.5
	Fertil. law	Plastics	< 3.33 mm	< 0.45 %.
		Plastics	> 3.33 < 10 mm	< 0.05 %.
		Other inert material	< 3.33 mm	< 0.9 %
LV	*Cabinet Regulation No. 530 , 25.06.2006*	Total (glass, metal, plastics)	> 4 mm	< 0.5 %
NL	*BOOM KIWA-QAS*	Total	> 2 mm	< 0.5 %
		Glass	> 2 mm	< 0.2 %
		Glass	> 16 mm	0
		Stones	> 5 mm	< 2 %
UK	*PAS 100 voluntary. standard*	Total	> 2 mm	< 0.5 %
		Herein included plastic		< 0.25 %
		Stones: other than '*mulch'*	> 4 mm	< 8 %
		Stones: in *'mulch compost'*	> 4 mm	< 16 %

1.3.11 Process and health related requirements

From the very beginning of the implementation of compost standards hygienic aspects have been addressed in order to *"guarantee a safe product"* and to prevent the spreading of human, animal and plant diseases. This issue has been discussed even controversially since a *common opinion* about a scientifically accepted risk assessment is not easy to achieve.

Beginning with the mad cow disease, foot and mouth disease and swine fever crises in UK and Ireland the question about the health and safety status of composts produced from the so-called *animal by-products* has become even more virulent.

Provisions for the exclusion of potential pathogenic microorganisms within process and quality requirements are established on two levels:

- direct methods by setting minimum requirements for pathogenic indicator organisms in the final product
- indirect methods by documentation and recording of the process showing compliance with required process parameters (HACCP concepts, temperature regime, black and white zone separation, hygienisation/sanitisation in closed reactors etc.).

On the European level today, the key reference is the Animal By-Products Regulation (EC) n° 1774/2001 (ABPR) providing detailed hygienisation rules for composting and biogas plants which treat animal by-products as defined in the regulation.

Table 22 shows national regulations with respect to indirect and direct methods as compared to the requirements of the Decision of EC ECO-label and the ABPR.

Here we also integrated the requirements and limit values for germinating weeds and plant propagules.

In chapter 1.3.12 follows a brief summary of the provision for composting plants as laid down in the ABPR indicating some of the consequences for its national implementation.

Table 22 Provisions for the exclusion of pathogens and germinating weeds and plant propagules in several European countries

	Indirect TIME- TEMPERATURE Regime				Direct methods		
	°C	% H_2O	part. size mm	time	Application area	pathogens / weeds	product (P)/ approval of technology (AT)
ABP Regulation *2001/1774/EC*	70		12	1h	Cat. 3 material	*Escherichia coli OR Enterococcae* *Salomonella*	**Process validation**: < 1000 / g in 4 of 5 samples *1000-5000* / g in 1 of 5 samples **Final Compost:** absent in 5 of 5 samples
EC/ 'eco-label' *2006/799/EC 2007/64/EC*					soil improver growing media	*Salmonella sp.* *E. coli*[54] *Helminth Ova*[54] **weeds/propagules**	absent in 25 g < 1000 MPN *(most probable number)*/g absent in 1.5 g germinated plants: ≤ 2 plants /l
AT *Statutory 'Guidline – State ipf the Art of Composting'*	55 – 65			10 d	land reclam. agriculture flexible time/temp. regimes are described at min. 55°C 1 to 5 turnings during a 10 – 14 days thermophilic process sacked, sport/ play ground technical use horticulture/ substrates	*Salmonella sp.* *Salmonella sp.* *E. coli* *Salmonella sp.* *E. coli,* *Camylobacter,* *Listeria sp.* --- **weeds/propagules**	absent absent if positive result recommendation for the safe use absent absent absent absent no requirements germination ≤ 3 plants /l
BE *VLACO*	60 55			4 d 12 d		*process control* **weeds**	Time, temp relation absent
CZ *Biowaste ordinance*	55 65			21 d 5 d		*Salmonella spp.* *E. coli* *Enterococcae*	Absent < 10^3 CFU / g < 10^3 CFU / g
DE *Biowaste ordinance*	55 60 [1)] 65 [2)]	40 40 40		14 d 7 d 7 d		*Salmonella senft.* *Plasmodoph. Brass.* *Nicotiana virus 1* *Tomato seeds* *Salmonella senft.* **weeds/propagules**	**Process validation** [3)]: absent infection index: ≤ 0.5 guide value bio-test: ≤ 8 /plant germination rate /sample: ≤ 2% **Compost production**: absent in 50 g sample germination ≤ 2 plants/l
DK	55			14 d	Controlled sanitised compost	*Salmonella sp.* *E. coli,* *Enterococcae*	absent < 100 CFU /g FM < 100 CFU /g FM
ES						*Salmonella sp.* *E. coli*	absent in 25 g < 1000 MPN *(most probable number)*/g
FI						No harmful micro-organisms to such an extent that it may endanger man, animals or the environment.	
FR	60			4 d	Gardening/ retailer	*Salmonella sp.* *Helminth Ova*	absent in 1 g absent in 1 g

[54] For those products whose organic content is not exclusively derived from green, garden and park waste

	Indirect TIME- TEMPERATURE Regime				Direct methods		
	°C	% H_2O	part. size mm	time	Application area	pathogens / weeds	product (P)/ approval of technology (AT)
					Other uses	*Salmonella sp.* *Helminth Ova*	absent in 25 g absent in 1.5 g
IE *Green waste*	---	---	---	---	Individual license! 2004	*Salmonella sp.* *Faecal colimforms*	absent (≤ 3 MPN/4g) ≤ 1.0 x 10^3 MPN/g
catering waste	60		400	2 x 2 d	Individual license! 2007	*Salmonella sp.* *Faecal colimforms*	absent (≤ 3 MPN/4g) ≤ 1.0 x 10^3 MPN/g
Cat3 ABP	70		12	1 h			
IT	55			3 d			
Fertil. law						*Salmonella sp.* *Enterobacteriaceae* *Fecal Streptococcus* *Nematodes* *Trematodes* *Cestodes*	absent in 25 g sample ≤ 1.0 x 10^3 CFU/g ≤ 1.0 x 10^3 MPN/g absent in 50 g sample absent in 50 g sample absent in 50 g sample
LV *Cabinet Regulation No. 530 25.06.2006*					fertilisers	*Salmonella sp.* *E. coli*	absent in 25 g sample < 2500 CFU /g
The Netherlands	55			4 d		*Eelworms*	Absent
BRL K256/02						*Rhizomania virus*	absent
						Plasmodoph. Brass.	absent
						weeds	germinating plants: ≤ 2 plants/l
PL					All applications	*Ascaris* *Trichuris* *Toxocara* *Salmonella sp.*	Absent absent absent absent
UK	65	50		7 d[4)]	All applications	*Salmonella ssp.*	Absent in 25 g
PAS 100 voluntary standard	min. 2 turnings					*E. coli*	< 1000 CFU *(colony forming units)*/g
						weeds/propagules	germinating weedplants: 0/l

[1)] in vessel composting [2)] open windrow composting [3)] 2 approvals (1 in winter) for windrow composting
[4)] not necessarily consecutive days

1.3.12 The Animal By-Products Regulation – a short summary of its requirements relevant for compost production

Only the following animal by-products may be transformed in a biogas or composting plant:

(a) category 2 material, when using processing method 1 in a Category 2 processing plant;

(b) manure and digestive tract content;

(c) category 3 material.

Cat. 3- materials comprise:

- animal parts fit for human consumption (not intended for human consumption because of commercial reasons)
- animal parts rejected as unfit for human consumption (without any signs of transmissible diseases) and derive from carcasses fit for human consumption
- blood, hides and skins, hooves, feathers, wool, horns, hair and fur (without any signs of diseases communicable through them)
- former foodstuff and waste from the food industry containing animal products
- raw milk
- shells, hatchery by-products and cracked egg by-products
- fish or other sea animals (except sea mammals)
- fresh fish by-products derived from the food industry
- catering waste (not from international transport)

The hygienisation requirements are laid down in Annex VI which was amended with Regulation (EC) n°. 208/2006.
First we give a brief description of the principle requirements for composting of Cat. 3 materials. Then we focus on the possible exemptions for ***Catering Waste***

The general requirements are:

- Animal by-products referred to in paragraph 4 of Annex VI of the ABPR must be transformed as soon as possible after arrival. They must be stored properly until treated.
- Containers, receptacles and vehicles used for transporting untreated material must be cleaned in a designated area. This area must be situated or designed to prevent risk of contamination of treated products.
- Preventive measures against birds, rodents, insects or other vermin must be taken systematically. A documented pest-control programme must be used for that purpose.
- Cleaning procedures must be documented and established for all parts of the premises. suitable equipment and cleaning agents must be provided for cleaning.
- Hygiene control must include regular inspections of the environment and equipment. Inspection schedules and results must be documented.
- Installations and equipment must be kept in a good state of repair and measuring equipment must be calibrated at regular intervals.
- Digestion residues and compost must be handled and stored at the biogas respective composting plant in such way as to prevent recontamination.

Regulation (EC) n°. 208/2006 introduced two important amendments:

- the process validation as alternative treatment to a fixed time-temperature regime
- new indicator organisms for the approval of the hygienisation process and the final product.

Paragraph 13 reads:

Category 3 material used as raw material in a composting plant must be submitted to the following minimum requirements:

- ⇒ *maximum particle size before entering the composting reactor: 12 mm;*
- ⇒ *minimum temperature in all material in the reactor: 70 °C; and*
- ⇒ *minimum time in the reactor at 70 °C (all material): 60 minutes.*

In addition to the time-temperature regime of 70 °C for 1 hour at a particle size of 12 mm a **process validation system** to be conducted by Member States was introduced **as an alternative**. The authorisation of other standardised process parameters is bound to the applicant's demonstration that such parameters ensure minimising of biological risks.
The validation shall follow a standard procedure. The core element of the validation is the measuring of the reduction of viability/infectivity of endogenous indicator organisms during the process or of well-characterised test organism or virus, during exposure, introduced in a suitable test body into the starting material.

During **validation** the intended process must achieve a reduction of

- 5 log10 of Enterococcus faecalis *or* Salmonella Senftenberg (775W, H2S negative); *and*
- infectivity titre of thermo resistant viruses such as parvovirus by at least 3 log10, *whenever they are identified as a relevant hazard*;

A complete *control and monitoring programme* in order to approve the functioning of the process must be provided. This has to include continuous monitoring and *supervision of relevant process parameters*. Records must be made available to the competent authority on request.
This validation system establishes the long ago demanded flexibility for the approval of well experienced composting systems.

Paragraph [15] contains the **final product control**: This is divided into two measurements:

(i) representative sampling *during or immediately after processing* in order to monitor the proper functioning of the *hygienisation process* and
(ii) representative sampling *during or on withdrawal from storage* in order to approve the overall hygiene status of the product.

Indicator organisms have been changed based on extensive expert consultation:

- as **indicators for the hygienisation process** *Escherichia coli* **or** *Enterococcae* are used. In 4 of 5 samples maximum number of bacteria in 1 g is 1000; in 1 sample the bacteria number can be between 1000 and 5000.
- the **hygiene status of the product** is tested with *Salmonella* which must be absent in 25 g.

Finally it says: *"Digestion residues or compost, which does not comply with the requirements set out in this chapter shall be re-processed, in the case of Salmonella handled or disposed of in accordance with the instructions of the competent authority"*.
It is left to the competent authority to decide, what it would consider as representative samples. Therefore Member States have to identify a sampling scheme mainly considering total throughput and maximum time span between two sampling dates.

Exemptions and possible options for catering waste

The definition of catering waste is as follows (Annex I par. 15):

> ***„'catering waste' means all waste food including used cooking oil originating in restaurants, catering facilities and kitchens, including central kitchens and household kitchens"***

It can be generally determined that "*catering waste*" is exempted from the special requirements for collection, transportation and storage as well as from the requirements for composting and biogas plants of Annex VI by the stipulations of article 6(2)(g) and article 7(1) respectively. This covers **any**

catering waste stemming from separate collection of organic waste from households and central kitchens.
Thus **catering waste may be processed in accordance with national law** until the Commission determines harmonised measures following the comitology procedure of Art. 33(2) ABPR.
Following the wording of par. (14) of chapter II C in Annex VI **this also applies when catering waste is processed together with manure, digestion tract content, milk or colostrum**.

> *As an example, in Austria it is recommended to process kitchen waste with a high water content stemming from central kitchens and restaurants preferably via anaerobic digestion. Nevertheless, if this is of ecological advantage (i.e. reduced transport in rural areas) it is possible to treat catering waste from restaurants also in composting plants. Additional treatment requirements for composting plants are required if catering waste from central kitchens is processed.*
> *The demand of paragraph 15 of Annex VI (EC) Regulation 208/2006 to achieve an equivalent reduction of pathogens as if the treatment requirements of Annex VI are followed is considered to be met if the national rules are applied. This of course has to be adopted by the competent authority.*[55]

So far the commission did not propose harmonised process requirements for the treatment of *catering waste* in compost and biogas plants. This means that the state of the art of hygienisation and end product requirements can still be regulated by Member States.

In April 2004 the Commission published the *"Guidance on applying the new Animal By-Products Regulation (EC) No 1774/2002"* where it clarifies that the regulation abstains from a detailed provision for catering waste in favour of foreseen environmental legislation (*provision for biowaste*) or national rules.

A problem occurs from the fact that composting is a continuous process of decomposition and humus synthesis. Also with respect to inhomogeneous constitution of a relatively fresh compost material after some days or weeks of thermophilic composting, it is hardly reliable to take representative samples in that intermediate stage (this is required by par. 15 of Annex VI).

Furthermore, even the maturation of compost contributes considerably to hygienisation effects by changing the trophic composition for the microbial community and by a continuous degradation of microbial biomass. Therefore – at least in composting – all samples should be taken after final turning or screening when the compost is prepared for storage or further use! Based on the basic process characterisation this would still fulfil the set requirements for both measurements.

Many other Member States up to now misinterpreted the possibility to introduce more relaxed rules for composting of catering waste at least from source separated organic household waste and have taken over the full set of requirements of Annex VI of the ABPR in national licensing and plant approvals.

However it has to be remarked that Annex VI, even now, **does not affect the exemption for national regulation on category 3 catering waste in Art. 6(2)(g)**. Here Member States may still apply national rules independent from licensing procedures following Art. 15 and subsequent treatment and hygienisation requirements of Annex VI!

For an *end of waste* regulation for compost on EU level it would seem a major challenge to overcome the individual and considerably varying process requirements for biowaste (catering waste) composting as implemented by MS.

[55] In Austria the general requirements for process monitoring and product requirements are laid down in the *Compost Ordinance* (FLG I no. 292/2001) and process requirements have been defined in this *"Guideline – State of the Art of Composting"* which has been upgraded as obligatory state of the art in the *Federal Waste Management Plan 2006.*

This includes a range of varying requirements for closed reactor or open windrow systems, time temperature regimes including max. particle size as well as final product control or other HACCP concepts. A broad and flexible regime for hygienisation (temperatures between 55 and 65 °C; several time spans depending on the temperature achieved; the number of mechanical agitations depending on the overall composting system) would be – in principle – a possible solution. However, it might be questionable if countries with very strict rules would accept compost products from other MS with more relaxed requirements.

In Annex 3 we collected the implemented national ABPR hygienisation rules and process requirements in composting plants for the following ABP:

- catering waste from house holds
- Catering waste from central kitchens
- Former foodstuff
- All other Cat. 3 material
- Manure

In our questionnaire we asked for information on

- Diverting National regulation or full implementation of Annex VI ABPR
- Time/temp. regime
- Max. Particle size
- Closed reactor or open windrows
- Final product testing
- Waiting period for grazing/harvesting of feedingstuff

Complete information we received from: AT, BE/Fl, CZ, DE, HU, IE, NL, SE, UK.
Even from this it became evident that the national implementation of process requirements for the treatment of catering waste in composting plants differs considerably. Validated processes as foreseen in Annex VI ABPR hardly exist by now.

1.4 Task 1.7 – Compost Quality Assurance Schemes

1.4.1 Introduction

What makes a product a product? This question develops to the main focus of the recycling industry after it has learned to collect and to treat a waste stream successfully. The close connection to the waste with its often very suspicious images and potentially harmful ingredients makes it obvious that it can not be the recycling industry alone which defines the product property and thus makes a "product" out of treated waste. Possible harmful effects on the environment and humans require precaution and an effective monitoring of the waste.

At this point standardisation and certification comes into the play. A range of different levels and types of standards can meet the needs of the monitoring governmental waste bodies and in addition guarantee the requirements of the industry, the market and the consumers. It is obvious that only the product property of organic waste will be accepted by the market and thus leads to the sustainable solution.

1.4.2 Standardisation as a precondition for the product property

No market is 'free' in the sense often implied by liberal commentators. All markets are structured by norms and rules of both formal and informal types. As mentioned above, our increasingly national and international transactions need to be supported by systems of standards. The compost world is no different. There is a need, on the one hand, for regulators to exercise their duty to show caution through applying standards to protect human health and the environment when it comes to treatment and application of organic waste. On the other hand, transactions in the compost market require standardised products to reduce transaction costs and improve consumer confidence.

The set of standards can be summarized in a way that the statutory standards act as a kind of platform, just fulfilling the precautionary requirements resulting from the waste origin and giving the product a legal framework. On that platform the industry can act and fulfil voluntarily the expected standards of the consumers and the market.

Figure 11: The set of standards for organic waste recycling – from collected organic residues to marketed products (Hogg et al., 2002)

a) Statutory standards

The key reason for making standards statutory is related to the fact that compost is often derived from waste materials. In this context the Austrian Waste Management act requires that: *"hazardous, negative or other effects that impair the general well-being of man, animals, vegetation, their basis of existence and their natural environment, shall be kept as low as possible."*

Statutory standards therefore mainly comprise precautionary requirements (e.g. related to sanitisation, harmful substances, and impurities) and should cover all monitoring aspects related to the waste property of compost. It is important to recognise that because of the (typically) legal status of these definitions, these requirements do not, and cannot be changed easily in short time periods.

These standards can either establish a basic platform or they can be an extensive framework where source separation, collection, treatment, analysing, monitoring and application requirements are laid down, as is the case in Germany and Austria. In these countries the statutory standard covers the whole biological waste management cycle apart from marketing. One has to point out that the new legal compost standards in those two countries are set on the basis of the experiences of voluntary quality assurance scheme which was (and still is) in place for more than ten years.

This discussion raises questions concerning what the basic minimum requirements might be for statutory standards. Probably (and this is reflected in experience), these should establish limit values on hazardous substances (to be set by the Authorities tasked with health and environmental issues, in most cases, the Environment Ministries, possibly in agreement with the Ministries of Health). The minimum would appear to be coverage of heavy metals, organic pollutants (as deemed necessary), and pathogens.

A reasonable set reflects the statutory standards proposal in the Working Paper for a European Biowaste Directive (2001) which lists in the annexes the following criteria:

- Suitable raw materials (positive list)
- Hygiene requirements
- Quality classes based on heavy metal contents
- Compost application recommendations for each of the two classes (e.g. class 2 -> 30 t/ha and y)
- Frequency and type of analysis

These limit values should, in any case, clearly define when compost is to be considered as a product, and can therefore be marketed and used with no restrictions and no need for waste licensing. The implication of this distinction is that, of course, if outputs from a facility fail to meet these specified limit values, it should still be considered as a waste, deemed suitable for applications only under restrictions, permitting procedures, and so forth.

b) Complementary statutory standards

Statutory compost-specific standards do not stand alone. Further legal regulations influence biological waste management indirectly and amount to the creation of a complementary statutory standard. The relevant statutory legal instruments typically include:

- Waste laws - These may establish requirements in respect of source segregation and collection of the recyclables
- Site design and licensing regulations – These regulate siting, emissions, site management and occupational health issues; and
- Fertiliser, soil protection and water laws - these are responsible for application restrictions/maximum dose rates, and licensing of composts. Fertiliser and fertilising regulation offer show their real complementary property in many European countries where the "waste aspects" respectively the supply chain of organic waste is regulated in biowaste ordinances

where as the "application part" has to correspond to fertilising regulations. This avoids tricky differing "double regulation" about suitable compost application.

- Environmental regulations that govern the operation of organics processing facilities (emissions ...)

c) Voluntary quality assurance schemes QAS - the connecting link

The voluntary standards should take as their foundation the precautionary criteria of the (usually) statutory standards and define the product and sales aspects. They should effectively broaden the range of statutory criteria and requirements to the extent to which consumers are / will be satisfied. Quality assurance scheme (= independent external monitoring of the compost quality) have established themselves as suitable voluntary standard means. An important characteristic of voluntary standards is that they are much more flexible, this being a positive precondition in situations where a compost market is going to be built up.

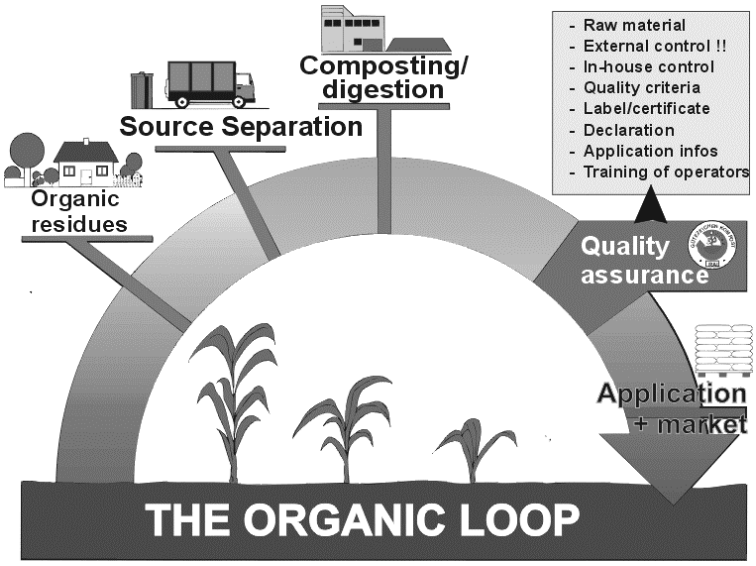


Figure 12: Quality assurance schemes QAS are essential parts of the organic loop, as essential as the technology or the market

The European quality assurance schemes have, as their main elements:

(1) Quality assurance as an instrument of product standardisation

Quality assured composts are accepted as "products" only if product standards coincide with the ideas of the relevant parties.

- **Quality assurance** is a good basis for sales consulting, for public relations work, and for fostering a positive image.
- The **quality label** makes possible the establishment of a branded "quality-tested compost" and a positive image for compost.
- **Regular analyses** during compost production act to guarantee a quality-controlled product.
- **Standardised analyses** carried out in accordance with specified methods enable an objective assessment of the compost quality.
- The **investigation results** form a basis for the product declaration and the application recommendations.
- A continuous tracking of batches enables **traceability** of products back to input supply, ensuring that checks on inputs become possible in instances (which are rare *because* of the quality control) of sub-standard products reaching the market.

The net result is a compost product of continuously high and defined comparable quality which is therefore marketable and saleable on a large scale.

(2) Quality assurance as an instrument of product specification

When the quality is stipulated and designed for a product, both precautionary and beneficial aspects have to be considered. A special emphasis has to be directed towards the adjustment of product-related requirements together with the associations and organisations concerned. Both quality assurance and the standards provide no direct influence on the domain of compost application.

Recommendations for application have to be established in co-operation with acknowledged experts in the various areas of application who ideally define a product specification as basis for product application from their particular (expert) point of view

Those specific application ranges may incorporate internal standards too (e.g compost mixtures for roof greening mixtures, for tobacco or asparagus) which have to be fulfilled. Considerable attention is often given to the areas where there is likely to be both high demand for the quality of compost and humus products, and considerable marketing potential.

With the combination of statutory standards and voluntary quality assurance schemes both the precautionary and beneficial aspects of compost application can be maintained. This type of market-oriented compost product qualification promotes the development and growth of outlets for the material. This is critical in developing the treatment of biodegradable waste through composting and digestion.

No successful voluntary standard is truly voluntary. Market forces and the way in which standards function are likely to require a statutory or quasi-statutory status. The reference to national standards and a certification system or international quality management schemes like ISO 9000 are examples for that.

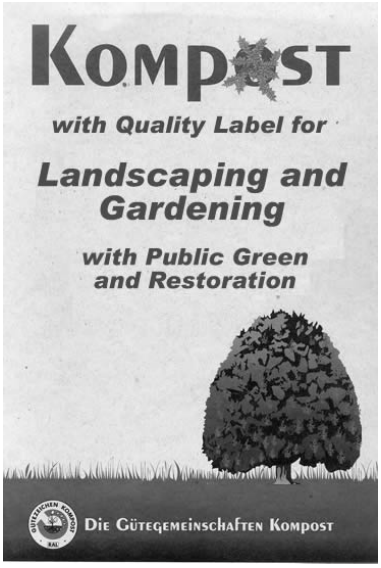


Figure 13: German compost specifications for landscaping

Participation in quality assurance schemes is, for all the countries, a voluntary act. However, once the quality standard is in force, the market begins to demand these qualities and the composting facility is likely to react as a result. Compost markets tend to be segmented with different products used in different applications. Unsurprisingly, in all countries, only the very best qualities are asked for first. In markets in surplus, this is especially true. Therefore composts without quality assurance or a certificate are likely to have, in future, only more local markets around the composting facility (where the site manager him/herself underpins the quality and gives confidence to customers) or in restoration projects.

d) Marketing and market standards

Compost is in a quite competitive situation on the market of soil improvers and organic fertilisers with peat and bark based products. The latter have long years of experience on the market, have learned their market lessons quite well and developed the necessary tools and equipment. If compost wants to compete in this game, it has to follow the same rules and to fulfil the existing standards of these markets and for the marketing when it comes to quality, branch specific technical guidelines, advertisement, design, packaging, Public Relation and sales promotion.

Figure 14: This compost (FLORATOP -Brand) presentation in a super-market can really compete with bark and peat pro-ducts

1.4.3 The quality assurance concept – key elements of quality assurance schemes

It is a matter of fact for the around 700 large European manufacturer of quality assured composts that the quality assurance process only labels high-quality products from which no waste-specific impacts for the public welfare are proceeding and the quality and effectiveness can be compared with products from primary raw materials.

This quality assurance processes comprise the following elements:

- Raw material/feedstock type and quality
- Limits for harmful substances/PTEs
- Hygiene requirements (sanitisation)
- Quality criteria for the valuables (e.g. Organic matter)
- External monitoring of the product and the production
- In-house control at the site for all batches (temperature, pH, salt)
- Quality label or a certificate for the product
- Annual quality certificate for the site and its successful operations
- Product specifications for different application areas
- Recommendations for use and application information

As a follow up of the BSE and foot and mouth diseases in UK the process and the production in the compost operation got more attention in Europe. National regulations and the European Animal By-Products regulation require effectiveness in pathogen reduction of the compost and anaerobic digestion processes for recycled organics in Europe. The decrease of tipping and gate fees in the last years leads to less careful operation and management in the facilities.

So two additional elements became part of the set of standards became part of the QAS schemes:

- Production control
- Education and qualification of the operators

The figure below summarises the 4 sector concept for a quality assurance:

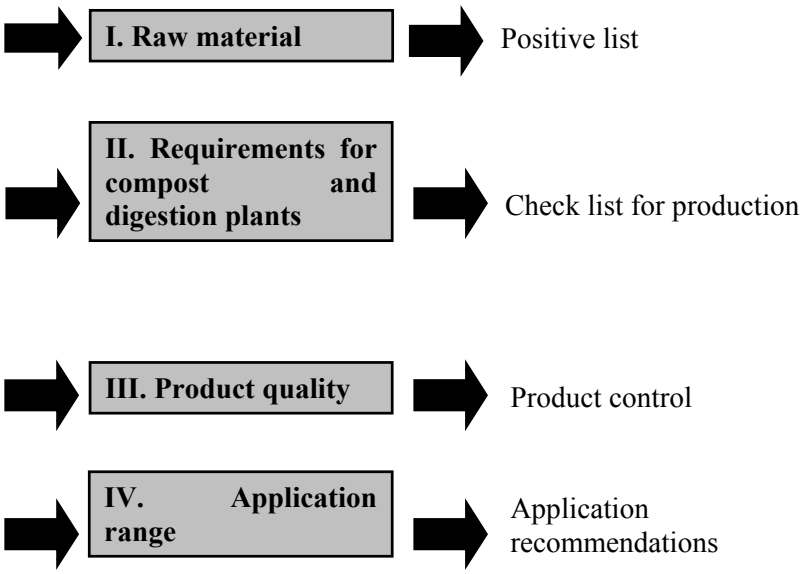


Figure 15: The concept for Quality Assurance for compost

Following the target to establish compost as a product it is the main obligation of the industry to build up such quality assurance scheme and to transform them to an independent body which must guarantee:

- Standardised products
- Defined high qualities
- Specifications for use
- Monitoring by an independent organisation

Independency is guaranteed by external sampling, approved labs and a quality committee within the quality assurance organisation which consists on independent researchers and experts and which exclude the compost producers side.

In addition, most countries, in the context of the development of systems for composting, have in place quality assurance schemes which either stand freely, or are supportive of the existing statutory standards and are mostly connected to national certification schemes (Germany, Austria, Netherlands, Sweden, UK) in order to get national acceptance and public awareness. These schemes have a variety of objectives, but they aim to ensure production of quality products to specific standards, and to facilitate marketing though use of quality symbols, and through ensuring that products are tailored to specific end-uses (through discussions with potential end-users).

Discussions about the legal status of composts suitable to specifications as "products" or as "wastes for recycling" are still running in many European countries and lately at the European Commission with the End-of-Waste concept in the revision of the Waste Framework Directive. It is one of the main points of discussion in the concepts for the development of a European Biowaste Legislation. From the experts point of view - not followed by the all legislators - source separated organics which have been and supervised by a quality assurances scheme could be also looked upon as a product. Quality assured composts fulfil by far the legal precautionary and product requirements, so they can be sold without any limitations. This is reflected by the market and by legislation in some countries like Austria and the Netherlands.

Table 23: Status of quality assurance schemes in EU Member States

Country (Quality label)	Status of quality assurance activities and certification/quality assurance organisation
AT	Fully established quality assurance system based on Austrian Standards ÖNORM S2206 Part 1 and 2 and Technical Report ONR 192206 published by the Austrian ÖNORM Standardisation Institute. Up to now two non-profit associations have adopted these standards for granting a compliance certification with the QAS: • the Compost Quality Society of Austria KGVÖ (Kompostgüteverband Österreich) • the Compost & Biogas Association – Austria (ARGE Kompost & Biogas – Österreich) The certification schemes comprise both, operational process and quality management and final product approval. Thereby the most important references are the requirements set by the Austrian Compost Ordinance which provides for a comprehensive documentation and monitoring programme. Compost can get product status if it meets one of the 3 classes based on precautionary requirements (class A+ (top quality for organic farming), class A "Quality compost"(suitable for use in agriculture, horticulture, hobby gardening and Class B (minimum quality for "compost" restricted use in non-agricultural areas)
	Under the roof of **Compost Quality Society of Austria (KGVÖ)** large scale compost producers supplemented by experts, grant an additional quality seal for the marketing of high quality composts on the basis of the officially acknowledged quality assurance system. External labs collect the samples and analyses. Evaluation of the results, documentation and granting of the label is carried out by an independent quality committee with expert members of the KGVÖ. (16 members - 300.000 t capacity)
	Compost & Biogas Association Austria (ARGE Kompost & Biogas) was founded to establish the decentralised composting of separately collected biowaste in cooperation with agriculture (on-farm composting). Nowadays the association has grown to a full-scale quality assurance organisation on the basis of the common Austrian standards. ARGE uses external auditors for sample taking, plant inspection, evaluation, documentation and certification of the plants. (370 members - 300.000 t capacity)
BE	Fully established statutory quality assurance system for compost in the Flanders region operated by the non-profit **Flemish compost organisation VLACO vzw** with its members from municipalities, government and composting plants. (Around 40 green and biowaste plants with 840.000 t of capacity). Based on the Flemish Regulation on Waste Prevention and Management VLAREA act VLACO vzw show a very unique but effective integrated approach and a broad range of tasks. The organisation executes: 1. Waste prevention and home composting programmes 2. Consultation and advice for process management incl. co-composting and co-digestion 3. Sampling, organisation of the analysis and evaluation of the results 4. Organisation of field trials and development of application information 5. Marketing and Public Relation for organic waste recycling and first of all for the compost So by means of this integrated approach the whole organic loop from source material to the use of the final product is in one hand. Nevertheless some modifications are made lately in order to include elements of ISO 9000 and the Total Quality Management TQM the quality assurance of anaerobic digestion residuals and of manure into the system. Not only the end-product is controlled but the whole process is followed up. In TQM the input (the bio or green waste), the process and the output are monitored and analysed. The reason to put standards on the input is that this allows no dilution. Depending on source materials and product characteristics up to 15 different products can be certified (statutory) and labelled (voluntarily) by VLACO vzw.
CZ	Voluntary quality assurance scheme proposed by the regional **Environmental and Agricultural Agency ZERA** is in preparation for a quality assurance scheme for 2008 after new biowaste ordinance is in force. Main task is to create a compost market by certifying compost products and organise a practical inspection and control of compost. The certification scheme is based on requirements of the Czech institute of accreditation in the agreement with international norm CSN EN ISO/ IEC 45011:1998.
DE	Fully established voluntary quality assurance system for compost and anaerobic digestion residuals in which the **Compost Quality Assurance Organisation (Bundesgütegemeinschaft Kompost BGK)** organisation is the carrier of the RAL compost quality label. It is recognised by RAL, the German Institute for Quality Assurance and Certification, as being the organisation to handle monitoring and controlling of the quality of compost in Germany. The BGK was founded as a non-profit organisation in order to monitor the quality of compost. Through consistent quality control and support of the compost producers in the marketing and application sectors, the organisation promotes composting as a key element of modern recycling management. 425 composting and 67 digestion plants with 5.9 mio t capacity plants take part in the quality assurance system and have applied for the RAL quality label. Besides the central office, a quality committee works as the main supervision and

Country (Quality label)	Status of quality assurance activities and certification/quality assurance organisation
	expert body in the quality assurance system. In addition BGK runs a database with all indicators of the composting plants and analyses results of the products. Meanwhile it includes more than 35.000 data sets. The BGK has defined a general product criteria quality standard (the RAL quality label GZ 251 for fresh and mature compost as well as for compost for potting soil compost and for different types of digestion residuals RAL GZ 245 (new since 2007 RAL GZ 246 for digestion products residuals from treatment renewable resources (e.g. energy crops)) and established a nationwide system for external monitoring of plants and of compost and digestion products. The quality assurance system comprises the following elements: Definition of suitable input in accordance with biowaste and fertiliser regulation. • Operation control by plant visits of independent quality managers. ▪ External and internal monitoring ▪ Quality criteria and quality label do demonstrate the product quality; ▪ Compulsory declaration and information on correct application; ▪ Documentation for the competent authorities. The successful work is respected by the authorities in Germany by exempting member plants from some control requirements which are subject to the waste legislation. By means of that procedure quality assured compost show a "quasi" product status in Germany.
DK	A quality assurance system for compost (quality criteria, standardised product definition, analysing methods) is prepared by **DAKOFA (Danish Association on waste management)** but is not applied. No further progress expected for the moment because separate collection of kitchen waste will not increase before the present legal background. Green waste collection and composting is very well diffused but not subject to any waste and quality standards regulation in Denmark.
ES	Draft statutory Spanish standard on compost legislation, laying down standardised, nationwide rules concerning the production, marketing and labelling of compost as a product prepared by the Ministry of Environment. A lot of studies confirmed for Spain the need to improve the compost quality in order to open up markets. This was in the outcome of a LIFE Project too deemed to investigate the production and use of quality compost in Andalusia. Based on the results the **Andalusia´s Regional Ministry of Environment** has designed and registered a trademark *"Environmental Accreditation of Compost"* that allows - on a voluntary basis - companies producing compost to show its quality**.** The Order 20/07/07 Environmental Accreditation of Compost Quality. BOJA nº 156 8/8/2007 explains how to get and use it .Compost should fulfil some limits according to the Real Decret 824/2005, 8/7/05, about fertilisers. It is the Andalusia´s Regional Ministry of Environment who will control the label use and define accredited laboratories to analyse compost samples. There is no independent sample taking.
HU	Voluntary Hungarian Compost Quality Assurance System is prepared (but not implemented) by the **Hungarian Compost Association** and waiting for the revision of the existing regulations which are intended for sewage sludge and fertilisers and are not applicable for composting. The Hungarian Compost Association has completed in 2006 the framework of the assurance system (similar to the German BGK and Austrian KGVÖ examples) and is now waiting for the new Hungarian Statutory rule about production, nominating, marketing and quality assurance for composts. <u>Basic elements of the future Compost Quality Assurance Systems (implementation in 2009) are:</u> 1. Raw material list (permissive list) 2. Compost Classes The ordinance will define three different quality classes for compost based on the contaminant content. Will also define ways of utilisation. The classes (similar to the Austrian ones) will be: Class A - top quality (suitable for organic farming use) Class B - high quality (suitable for agricultural use) Class C - minimum quality (not suitable for agricultural use) 3. Quality control End-product controlling and process controlling. Independent sample taking and analysis is intended.
IE	A first draft for a voluntary compost quality standard was presented in Ireland (2007). This task and the follow up establishment of a quality assurance system are elements of the national Market Development Plan - intended to create market for recyclables - have recently started. The **Irish Composting Association CRE supports** is involved in these developments.

Country (Quality label)	Status of quality assurance activities and certification/quality assurance organisation
IT	Voluntary quality assurance on operated by the **Italian Compost Association CIC,** the Italian National Association for the compost industry. It started as certification system for compost products in order to show compliance with the national fertiliser regulation and the statutory quality standards for green and mixed compost are laid down there. No monitoring of the standard is proposed. Basically, the quality label ensures fulfilment of statutory standards (assessment of compliance is usually an issue due to the rather poor performance of controlling authorities, hence CIC aims to reinforce the "declaration of compliance").Within the scheme samplings are made by certificated personnel from the Italian Composting Association (CIC) and analyzed at a single accredited laboratory. Now the scheme turns step by step into a quality assurance system e.g. with preparation of certifying the entire production process and above all (as requested by consumers) the traceability of compost. The CIC Quality Label is considering this to be a very important initiative for the industry because it provides an independent element of security upon which consumers and operators can make their choices. Currently, the quantities of compost that can be certified amount to approx. 250.000 ton/anno, che rappresentono circa il 20% della produzione Italiana.250,000 tons /y, which represents approximately 20% of the Italian production. I campioni sono analizzati presso un unico laboratorio accreditato per le analisi di AMMENDANTI ORGANICI e SUBSTRATI per il Marchio Europeo Ecolabel.
LU	Statutory system which relies on the German Quality Assurance System and on the German Organisation **(Bundesgütegemeinschaft Kompost e.V. BGK).** The request to execute a "quality assurance system like the one of BGK or similar" is part of the licensing procedure for every composting plant. Missing alternatives have established the BGK system in Luxembourg as the one and only. All independent sampling, control functions and documentation functions will be executed by the BGK representatives. (5 compost plants with around 50.000 t/y total capacity are part of the scheme)
LV	On the starting stage (from Nov. 2006), quality assurance organization Environmental Agency
NL	After 10 years of experiences the Dutch Government decided that not the quality but the nutrients are the primary precautionary problems with compost. Less strict heavy metal thresholds and no obligations for control any more is one result. In addition no longer is the applied amount of compost but the nutrient load limited. All compost which is used for crops which grow in the soil must be independently certified with a very strict threshold for glass. Because the sales area of compost is not predictable while the production, more or less all biowaste composts, will be certified in future and compost certification will become quasi statutory. For vegetable, fruit and garden VFG waste the certification is operated by independent institutes/auditors with independent sample takers in cooperation with the Dutch Waste Management Association DWMA/VA. The around 20 VA members treat 1.5 mio VFG waste from separate collection. This new scheme will replace the former costly KEUR certification system operated by the Dutch certification system KIWA. The BVOR Dutch Association of Compost Plants manages the certification system in both the green waste and VFG sectors which doesn't require external sampling but independent institutes/auditors for the evaluation of the process and the analysis results. 50 green waste composting plants with 1.8 mio tons of capacity are member of the BVOR.
PL	Quality Assurance refers only to the final product. The Ministry of Agriculture and Rural Development gives the certificate of organic fertiliser based on its chemical properties and pathogen status after the compost receives a positive expertise from the designated institution (depending on planned application area).
SE	Voluntary quality assurance system for compost and digestion products is operated by the **Swedish Waste Management Association Avfall Sverige** together with Swedish Standardisation Institute SP. For the moment Sweden has no statutory standard, but the necessity of standards is seen clearly by involved parties and the government. Producers and users are of the opinion that sustainable recycling of organic wastes demands clear regulations regarding what is suitable to be recycled and how it should be managed and controlled. A well-founded quality assurance programme definitely increases sustainable recycling of organic wastes. The regulations for the voluntary Swedish certification of compost and digestion residues are based on purely source-separated organic waste, with special emphasis on the acceptability of raw materials for input, the suppliers, the collection and transportation, the intake, treatment processes, and the end product, together with the declaration of the products and recommendations for use. 6 digestion and 1 composting plant are included in the certification system and have applied for the certificate.

Country (Quality label)	Status of quality assurance activities and certification/quality assurance organisation
UK	Voluntary standard BSI PAS 100 and the supplementing Quality Compost Protocol (QCP) set criteria for the production and minimum quality of quality composts. The **UK Composting Association** owns a certification scheme aligned to BSI PAS 100, which has been upgraded to incorporate the additional requirements of the QCP. Composting plants and compost particle size grades that meet all the requirements can get their composts certified and use the Composting Association's quality mark. Around 150 composting producers are under assessment, treating more than 2 mio t of source segregated bio and green waste, and 40 % of the compost they produce is already certified.

In Annex 1 QA schemes and organisations are presented in detail of AT, BE/Fl, DE, HU, NL and SE. In addition the concept for a European Quality Assurance and Certification System proposed by the European Compost Network, ECN/ORBIT e.V. is summarised in section 7 of Annex 1.

1.4.4 Costs of quality assurance of compost in compost plants

A. Costs of quality assurance in compost plants

Quality assurance as an important tool to demonstrate the compost quality and to open markets is accepted by the compost plants. Nevertheless the level of costs for monitoring is a continuous source of complaints by the plants at the quality assurance organisations. So all efforts by the QAS organisations have to be made to cut down the cost level as much as possible especially in the starting situation in a country where the scheme costs have to be carried only by few plants and the market doesn't ask for quality assured compost because it is not established on the market yet.

The figures in the following table show survey of the charges for per t input in countries where quality assurance is accepted and widely diffused. The costs reflect the EXTERNAL expenses in the renewal procedure of certificates or quality labels during the continuous operation of the plants. In the first application and validation period (first one to two years) costs are essentially higher on account of a first evaluation of the plants and the higher frequency of tests.

The burden for the small plants (< 5000 t) amounts to a critical level if one compares the quality assurance charges with average sales prices for compost of 3 to 6 €/t. The expenses here sum up between 6.60 € (500 t capacity plant in Austria) and 1.20 € as a European average for 5000 t plans for the tonne compost sold (2 t of input material decompose to around 1 t of compost). One has to keep in mind that additional marketing and sales

efforts are needed and that the necessary management and operation man power in the plants for QAS lead to further sources of expenses. The cost aspect of quality assurance might become more critical in future if additional costly monitoring requirement for compost products will result from Chemical Registration Regulation REACH.

Only limited possibilities for cost reduction for small plants exist because the statutory quality requirements and the basic fees for certification can't be modified just on account of the size of the plant. A reduced annual test frequency on account of a lower throughput meets the need of the smaller plants and is established in most QA-schemes. Exemptions are Italy which used the companies overall turnover as reference and the Netherlands. Here in 2008 a common flexible element in other non-waste QA-schemes is introduced. The more the average analysis result is below the quality standard, the lower the test frequency will be (between 2 and 6 for heavy metals and 2 and 12 times for impurities).

Table 24: Cost of compost quality assurance in selected European countries

Quality assurance costs per t input and year in € (excl. VAT)										
Through-put /y (t)	**AT[1] (ARGE) Agricult. plants**	**AT[2] (KGVÖ) industrial plants**	**GE[3] (BGK)**	**IT [4] (CIC)**	**NL [5] (BVOR) (Green C. plants)**	**NL [6] (VA) (VFG plants)**	**SE[7] (SP)**	**UK[8] (TCA) Use in Agric. +Horticulture**	**UK[9] (TCA) Other uses**	**EU Mean value**
500	2.15	3.36	-	-	-	-				
1,000	0.94	1.80	-	-	-	-				
2,000	0.97	1.32	0.82	-	1.62	1.87	1.21	1.13	1.10	**1.26**
5,000	0.63	0.67	0.52	0.48	0.76	0.86	0.48	0.45	0.44	**0.59**
10,000	0.44	0.58	0.34	0.46	0.53	0.58	0.29	0.28	0.27	**0.42**
20,000	0.26	0.44	0.31	0.45	0.39	0.43	0.15	0.23	0.22	**0.32**
50,000	0.17	0.36	0.19	0.43	0.21	0.22	0.06	0.20	0.19	**0.23**

Sources: Personal information from:

[1] KGVÖ Compost Quality Society of Austria - operates mainly biowaste treatment plants. Costs including membership fees, laboratory costs and external sampling.

[2] ARGE Compost & Biogas Association Austria - decentralised composting of separately collected biowaste in cooperation with agriculture. Costs including membership fees, laboratory costs and external sampling.

[3] BGK German Compost Quality Assurance Organisation - incl. membership fees, laboratory costs and external sampling

[4] CIC Italian Compost Association CIC - incl. company fee according to turnover plus external sampling and lab costs

[5] BVOR Dutch Association of Compost Plants - costs at green waste plants which include membership fees, laboratory costs and the costs for yearly audits by external organisations - no external sampling

[6] VA Dutch Waste Management Association - costs at biowaste (VFG) plants including membership fees, laboratory and external sampling costs, and the costs for yearly audits by external organisations. The expenses are slightly higher compared to BVOR because of additional analysis of sanitisation parameter and the external sampling.

[7] SP Swedish Standardisation Institute execute the QAS scheme - costs include membership fees, laboratory costs, and costs for yearly audits by SP - sampling is done by the plants besides the yearly audit.

[8] TCA The UK Compost Association certification for compost in agriculture and horticulture - total costs associated with certification scheme fees for all parameter and lab testing. Costs associated with testing the compost are higher compared to other application areas, as the compost producer is required to test parameters like total nutrients, water soluble nutrients and pH in addition sampling is done by the plants.

For compost used in agriculture and field horticulture, the UK Quality Compost Protocol has introduced for the land manager/farmer the requirement to **test the soil which** compost is applied to. The costs associated with soil testing are not incorporated here because it is mostly not the compost producer, but the farmer or land manager who pays for.

[9] TCA The UK Compost Association certification for compost used outside agriculture and horticulture - total costs associated with certification scheme fees and lab testing. Sampling is done by the plants.

B. Additional quality assurance requirements for compost customers in UK

In order to allow the production of compost which is no longer classed as waste the UK Environment Agency published in 2007 a Compost Quality Protocol as a supplement to the Quality Standard PAS 100 and the corresponding quality assurance. The system is intended - similar to the End-of-Waste Concept - to give evidence that the compost will actually be used for a recognised purpose and on compliance with environmental and health protection rules.

This voluntary protocol requires further costly efforts - not by the composting plant but from the compost customer - with additional application advice for land managers and farmers and with reporting at official institution about the use of the composts. If the compost application is intended to be used in a so-called Nitrate Vulnerable Zones NVZ additional soil tests are requested. The UK Nitrate Directive defines Nitrate Vulnerable Zones NVZ as areas which drain into surface or groundwater with higher nitrate concentrations respectively costal waters which are eutrophic. It is expected that e.g. in England 80 % of the arable land belongs to NVZs.

Those costs are carried by the compost customer. The following table shows the additional further costs upon the farmer/land manager related to soil testing and the time spent from an adviser qualified to advise the land manager on compost application plan (according to NVZ rules, Cross Compliance and Fertilizer Recommendations RB209 etc. The land manager usually pays for the adviser.

In total costs of 0.19 €/t result from the application of the quality protocol and have to be paid by the land managers or farmers. It can be expected that these expenses will be incorporated in lower sales prices at the compost plants.

Table 25: Quality assurance costs for compost customers following the UK Quality Protocol

Plant through-put (t/y)	Tonnes/year of compost produced[1)]	Soil which compost is applied to (ha)[2)]	Minimum number of soil samples to test[3)]	Soil testing cost[4)] (€)	FACTS advisor time/ daily rate (€)	Total cost of FACTS advisor (€)[5)]	Total cost per t (€)
2,000	1,000	44	1	86.13	663	291	0.19
5,000	2,500	110	2	215.33	663	727	0.19
10,000	5,000	219	4	430.66	663	1,455	0.19
15,000	7,500	329	7	645.99	663	2,182	0.19
20,000	10,000	439	9	861.32	663	2,910	0.19
50,000	25,000	1,096	22	2,153.29	663	7,275	0.19

Source: calculation provided by TCA UK Compost Association (02/2008)

1) Assuming 50% of weight loss during composting process

2) Assuming an application rate of 22.8 tonnes/ha according to Nitrate Vulnerable Zones NVZ rules. The Nitrate Directive defines NVZ zones as areas which drain into surface or groundwater with nitrate concentrations greater than 50mg/l or fresh respectively costal waters which are eutrophic. Here the organic manure applications are limited to 170 kg/ha of total nitrogen each year averaged over the area of the farm.

3) The Quality Compost Protocol requires to test one soil sample per 50 hectares

4) Unit cost per soil sample = £ 74 = € 98.19

5) According to the Quality Compost Protocol, the land manager should take advise from an adviser qualified under the Fertiliser Advisers Certification and Training Scheme (FACTS)

1.5 Task 1.3 and 1.8 – Product or Waste – Compost certification and national provisions for marketing and use of compost under the waste or product regime

1.5.1 Basic systematic of compost registration and certification

In principle we find three options of regimes under which compost is certified or registered to be marketed or used in the different applications. These are:

- the fertiliser regime pursuant to fertiliser legislation with and without specific compost provisions
- the waste legislation with specific compost or biowaste ordinances or simply under the waste treatment licensing procedure
- the soil protection provisions which establish certain minimum requirements for waste derived materials, sludge and compost to be spread on land

Another category outside statutory legislation are standards or voluntary agreements based on criteria which are implemented by quality assurance schemes (see 1.4).

Voluntary or Statutory?

Whether a national provision which establishes certain criteria under which compost may cease to be a waste and enters the product regime rolls out a voluntary or statutory procedure respectively is not easy to judge.

Statutory provisions:
The following schemes can be found as statutory provisions:

1. there is a national legislation which sets criteria under which compost produced from organic waste materials may be freely marketed as product
2. as an exemption, the possibility to sell or use compost also under the waste regime might still be possible, if one or more product criteria are not met. In this case dispatch, transport, storage and application of compost are governed by *waste regulatory controls (strictly speaking, this includes individual permits for each consignment to be used on a certain plot)*
3. finally the national compost legislation (independent from the fact if it is ruled under the environmental/waste or fertiliser regime) sets distinct quality and use criteria but compost remains to be a waste.

A typical, though not compost specific, legislation are ***fertiliser regulations***. In many countries composts may be registered as *organic fertiliser* or *organic soil amendment* according to national fertiliser definitions. The registration in many cases is a VOLUNTARY act, but the only possibility to market compost as a product (typical examples we find in IT, CZ, ES, FI, HU, NL, SI)

Specific End-of-Waste regulations for compost (rolled out under the national waste legislation) are only found in AT.

Voluntary schemes:
Voluntary schemes which provide for the possibility to certify the waste derived compost as product represent in itself not a reliable option following the logic of waste legislation. However a situation might be justified to be described as *voluntary* where compost is generally marketed and used as waste governed by the waste legislation but certain exemptions for products can be authorised if the compost is certified pursuant to a voluntary certification and quality standard or quality assurance system. These schemes are found in DE, FR, SK, UK.
Sometimes this leads more to a convention rather than a clear legal product definition as for instance is the case in DE where compost in principle remains a waste but if certified under the voluntary RAL quality labelling and external quality assurance scheme far reaching relaxations are applied as far as *waste regulatory controls* are concerned. Thus compost is accepted and traded *quasi like a product*.

In Table 26 we allocated compost registration and certification schemes under the *waste* or the *product* regime respectively as it is rolled out in EU MS.
It is remarkable that only 1 country (AT) have enacted a distinct compost *end of waste* regulation but compost can be sold and used as a product in 16 MS, of which the majority is ruled under the fertiliser registration regime.
Remarkably DE is the only country which has addressed biowaste and compost in a specific environmental regulation including strict quality criteria but left compost entirely in the waste regime.
Where MS are listed more than once several option may apply or no clear judgement was possible based on the available information.

Table 26: Compost registration or certification for marketing and use under national PRODUCT or WASTE regimes

Compost may become a PRODUCT	
Specific compost regulation within waste & environmental legislation with **extensive QM and external approval scheme** for compost	AT
Compost related regulation within the waste and environmental legislation or based on standards but with **simple registration scheme**	LT, FR, SK
Regulation within the waste and environmental legislation rolled out by the way of the **licensing procedure**	IE, LU (+ obligatory QAS); UK (only with voluntary QAS) [56]
(Simple) **fertiliser registration** within the fertiliser legislation	CZ, ES, FI, GR, HU, IT, LV, NL, PL, PT, SI
Compost remains WASTE	
Waste – but **specific compost standards** available Compost derived from source-segregated or 'residual waste' animal by-products that does not meet 'product' requirements, but is spread on land (ABP and waste management licensing regulations apply).	BE/Fl (+ obligatory QAS), DE (+ voluntary QAS) UK
Waste – **no specific compost legislation** Compost derived from source-segregated, non-ABP biowaste that does not meet 'product' requirements or 'Compost-Like-Output' from Mechanical and Biological Treatment of residual waste that is disposed of (not spread on land).	BG, CY, CZ, DK, EE, HU, MT, PL, RO, SE UK

1.5.2 Examples and flowcharts for typical compost registration or certification schemes

1) Simple registration systems WITHOUT third party inspection

From the standpoint of simplicity (or in contrast complexity) we find simple registration under the fertiliser regime. These are typically implemented in countries without any consistent biowaste collection and recycling systems. Consequently specific compost legislation and certification systems are missing. The main focus of registration lies on the final compost quality and declaration as e.g *organic fertiliser* or *organic soil amendment* etc..

[56] In England and Wales this means independent certification to PAS 100 and the QCP (Environment Agency, 2007). In Scotland and Northern Ireland this means certification to PAS 100 (BSI, 2005 or an equivalent standard) and meeting the other requirements summarised in table 10.

The sampling is done by the compost producer himself. External quality control may occur not on a regular basis by the authority responsible for the fertiliser registration. Usually, once registered as organic fertiliser to be used in agriculture, the compost can be traded like a product though no clear *end of waste* provision was enacted.

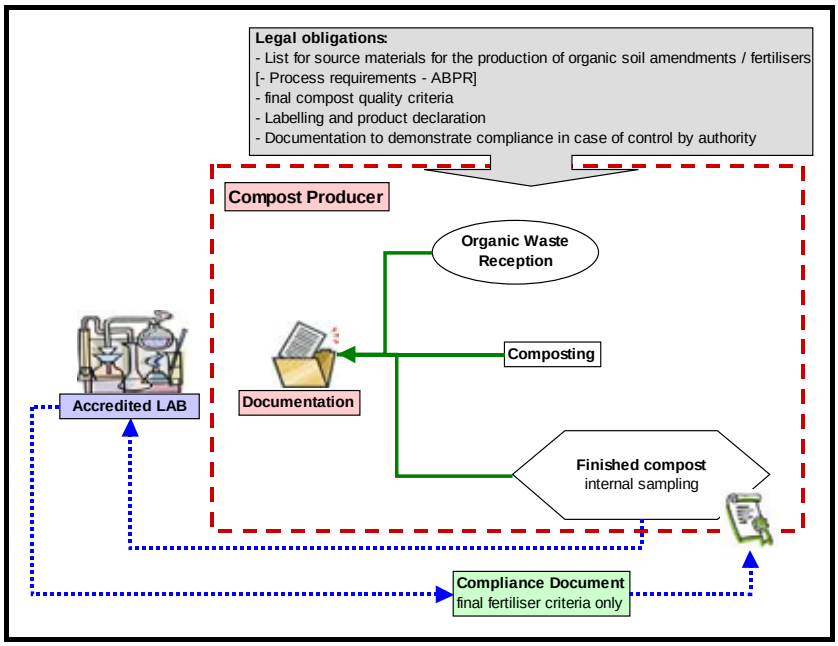


Figure 16: Simple registration regime e.g. with a national fertiliser ordinance without regular 3rd party approval of compost production and documentation

Member States for which this regime applies:
CZ, DK, ES, FR, HU, IE, LV, NL, PL

2) Simple registration systems WITH third party inspection

A further option includes the external inspection of documentation and process management including the used input materials. Based on this the acknowledged laboratory does not only produce a simple analytical report but certifies the compliance with all further regulatory requirements.

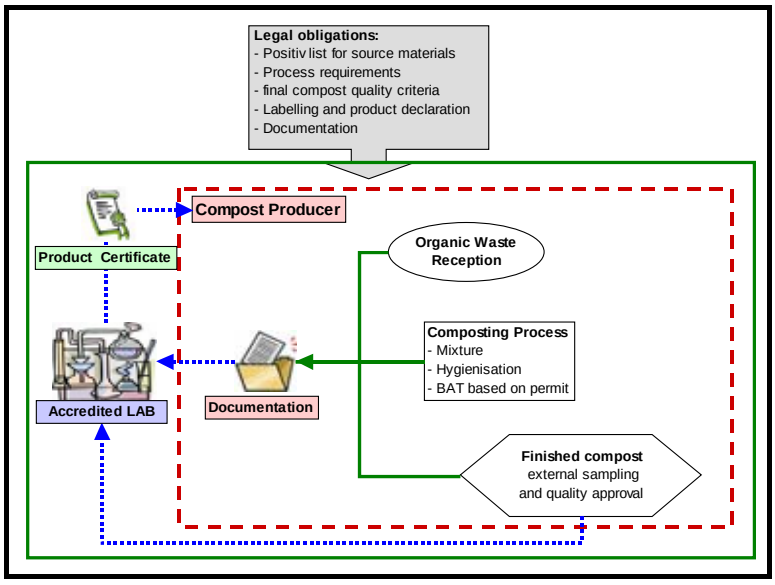


Figure 17: Registration and certification of the entire production and monitoring process in accordance with existing regulations and standards

Member States for which this regime applies: ES, SK

3) Third party certification under specific END of WASTE compost legislation

The next step shows a full scale product certification regime under a specific END of WASTE compost regulation. It is drawn from the Austrian system as laid down in the Austrian compost ordinance. However, this scheme is in line with the certification systems e.g. in DE, BE/Fl, NL, SE, LU, HU (in preparation) even if in DE this certificate and the entire QA-System does not release the compost into the product regime. But in practice also the certified composts in DE contracted and approved by the German QAO are sold and used equivalent to a product since no further waste control mechanisms are required by national or provincial authorities.
The membership in a quality assurance organisation is in most cases voluntary. In BE/Fl the entire external certification and QAS is executed by a semi-public organisation and is an obligation for all compost producers.
The following map shows two categories of countries where QAS is built upon a voluntary system or it is embedded (more or less as a statutory element) in the national regulatory framework.

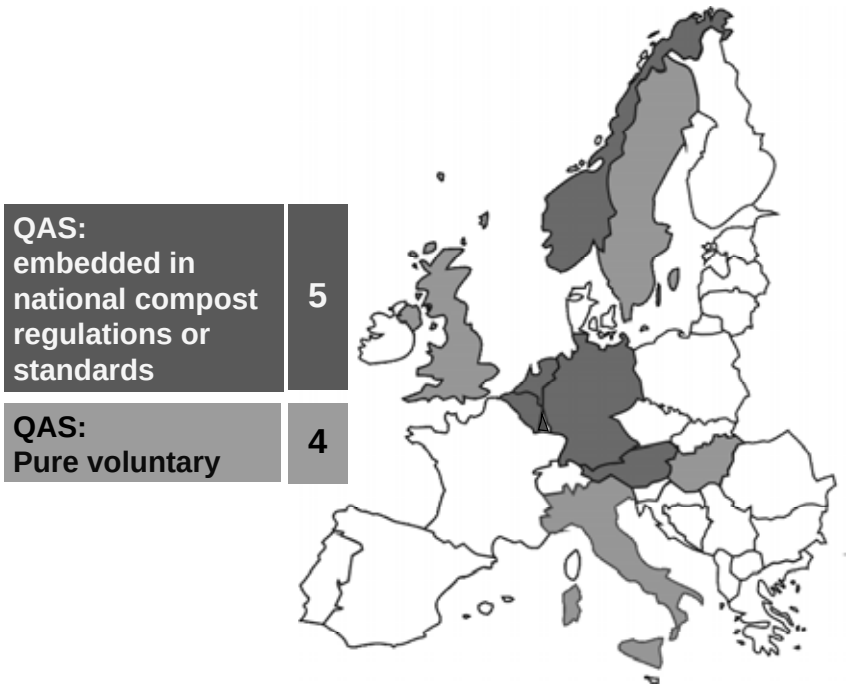


Figure 18: QAS – Quality assurance and certification schemes for compost in relation to national compost legislation

It includes the following elements:

- Compost producer is responsible for the compliance with all requirements for input materials, process management and documentation, external quality approval and product declaration
- Compost producer must have a contract with an authorised laboratory
- The sample taking is done by the authorised laboratory or a contracted partner of the laboratory
- The authorised laboratory and/or the QA-Organisation inspect and approve the documentation necessary to certify the produced compost and the required QM and process management in compliance with all legislative provisions

- Based on the analytical and the on-site inspection report the QAO awards a product and plant operation certificate including (in most cases) the allowance for the use of a quality label
- Where this is foreseen in the legislation, the compost obtains the product status from the moment a compost batch is declared according to the certificate provided by the external Laboratory or QAO.
- Based on the certified product labelling and declaration including recommendations for the proper use in the foreseen applications and market sectors, the correct application in line with all further soil and environment related rules is entirely in the responsibility of the user.
- After declaration, the compost remains product as long as it is used in compliance with existing regulations. At least the professional user must be aware: if he would apply the compost in access of allowed quantities or ignoring legal application restrictions for certain quality classes he might fall back into waste legislation followed by strict control mechanisms and fines due to *illegal disposal of goods on soil.*

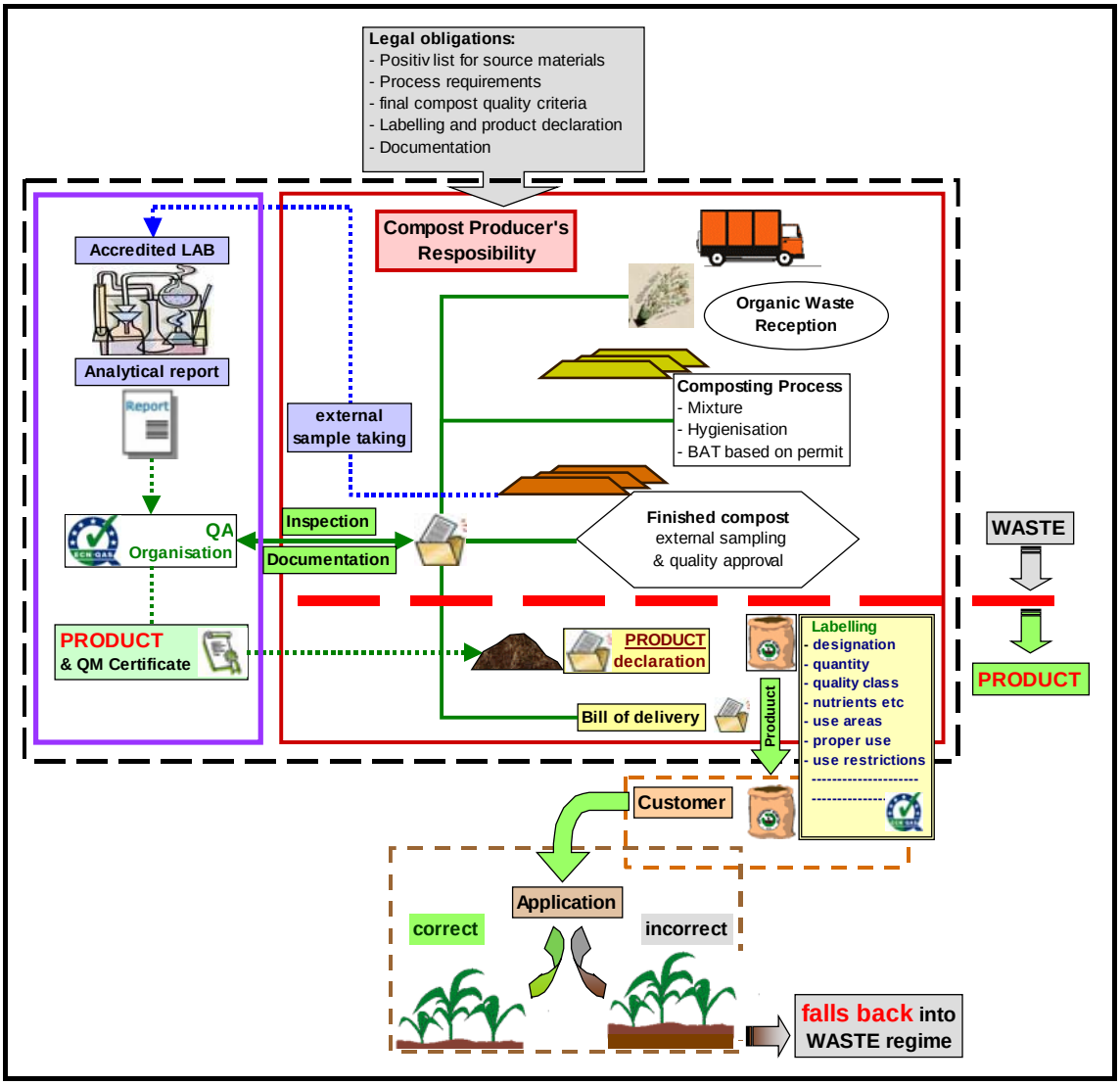


Figure 19: Product certification scheme including documentation, external inspection and sample taking based on comprehensive End of Waste legislation for compost (example: AT, BE)

Member States for which this regime applies:
AT, BE, DE

4) Third party certification under specific compost standards including the APPROVAL OF CORRECT APPLICATION

Finally in UK the national *Quality Protocol* issued by the Environment Agency and the Waste & Resources and action Programme (Environment Agency, 2007) has established a quality assurance scheme which is based on comprehensive HACCP (hazard analysis and critical control point) programme. This has to be carried out by the compost producer accomplished by extensive documentation and record keeping. In this respect the concept is similar to the above described one. The crucial point is the moment in the entire recycling process when the produced compost ceases to be a waste. Here a comprehensive documentation of compost use at least in agriculture and soil-grown horticulture must be kept by the land manager and made available to the compost producer and the certification body. Missing this the compost remains waste. This system is of course not easy to understand if one considers that the QAS itself together with the set quality standards should guarantee an equivalent and certified substitute for primary products on the market (like an organic fertiliser or soil improver as registered under the fertiliser law). If this could not be guaranteed because additional risks were identified for waste derived composts the entire *end of waste* concept should be questioned. It is interesting that the UK is the only country in the entire EU where this concept has been adopted.

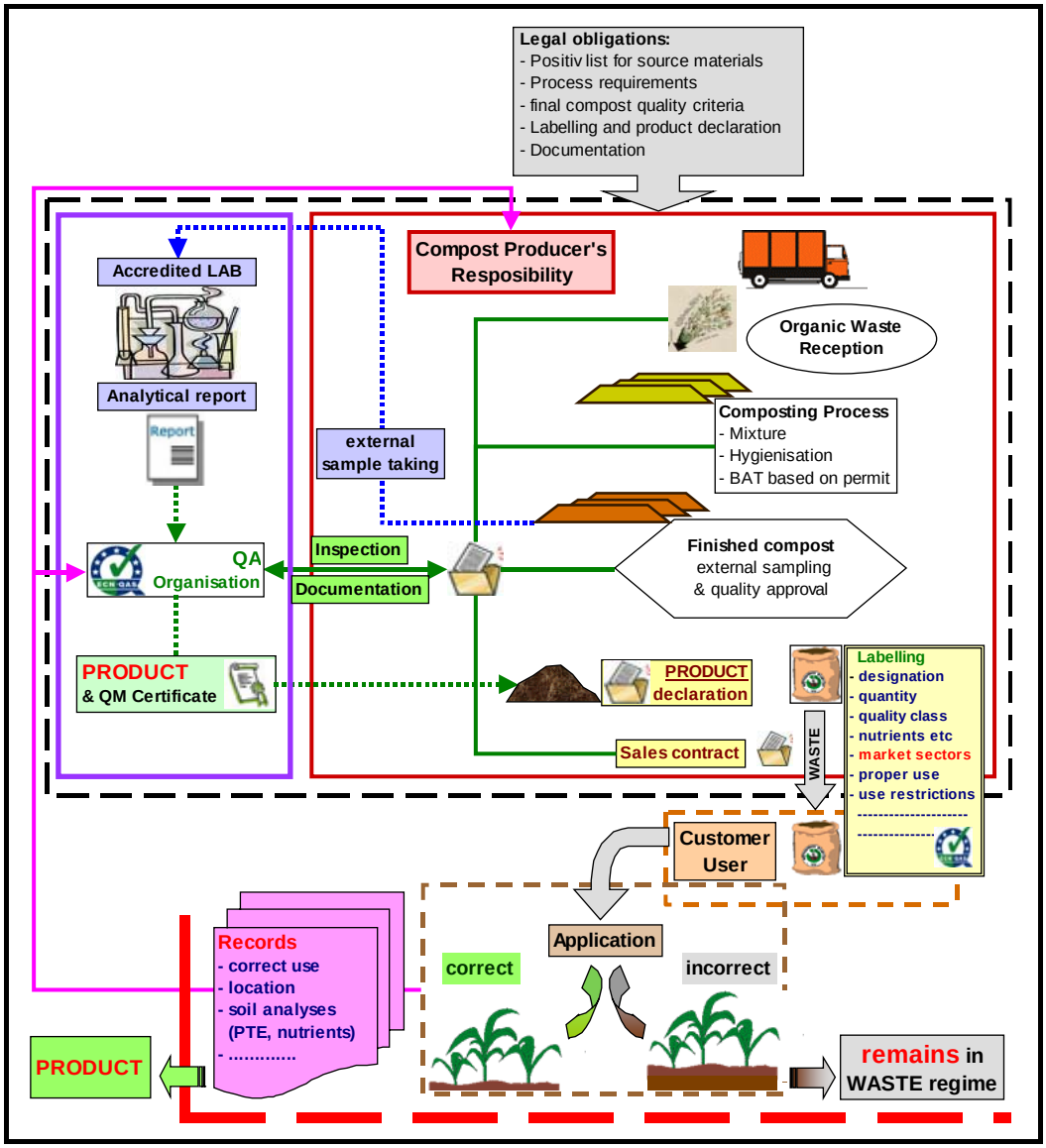


Figure 20: **Compost certification scheme including full scale documentation, external inspection and sample taking but also strict elements application approval usually implemented in Quality Protocols (example: Quality Compost Protocol in England and Wales)**

Member States for which this regime applies: UK (England & Wales)

In Table 27 we have listed the legislative framework which establishes compost produced from waste as a product or a waste material. Included is a short description of what criteria have to be approved in order to certify or register compost as a product or to be marketed even within the waste regime.

1.5.3 Some principle remarks on the strategic concept of where the compost ceases to be a waste

One of the primary arguments for any recycling activity (independent of the waste or product status of the final outlet) is the existence of a market or the likely hood that a market (a customer) can be established. In the case of compost this was questioned sometimes in the past where waste-derived compost was rather a by product of waste reduction activities than a distinct processing of specified raw materials in order to create a high quality product (growing media, organic soil amendment).
Today the proof if there is a market for compost, substituting a primary (alternative) product like peat based growing media, sewage sludge, manure etc. should be sufficiently obtained by the general argument of experience.

- Only 3 % of arable land would be needed to take up all compost potentially produced from source separated organic waste (see chapter 4.2.9)
- In average up to 30 % peat could be replaced by well matured compost products.
- Successful marketing following regional branding concepts and whereever quality compost has been communicated as a high value product in the specific sectors, this always resulted in a demand that exceeds the possible supply.

Therefore, with the exception of the UK, in countries where specific product regulations have been implemented, the product status is achieved after certification and declaration of a compost batch, which has been produced in compliance with the set criteria and standards.
This is also true in the case of Germany where compost stays within the waste regime but it can be marketed equivalent to a product if an external QAS is carried out.
Another example are national fertiliser regimes. Here sometimes very simple compliance tests without any external process verification are rolled out within the fertiliser registration scheme. Once approved as *organic fertiliser,* the compost can be freely marketed as product.

The idea to establish the ending (ceasing) of the waste property by the time of individual sale (sales contract to one of the specified/certified applications) or delivery of the compost to the customer or even after approval that the compost has been used for the recognized purpose, would counteract the free movement of goods. In fact to create a *product* aims at being marketed for a defined use und consequently needs to meet obligatory quality and labelling criteria.
The objective of the creation of an EoW provision is the equal treatment and trading of the secondary product with the primary product for which it serves as a full valid substitute since the same qualitative requirements apply.
The shift of the point in time when the compost ceases to be a waste to the moment of its use in accordance with all applicable regulations would require a consistent control system in order to approve the correct application. This concept is common in many waste recycling areas such as the use of sewage sludge in agriculture.

If this strategy would be considered also for an EoW definition it would revoke the entire process of compost production with the intention to achieve a product for the market equivalent to alternatives like manure or peat based products. Also these *'primary'* products do not need a confirmation of the fit-for-purpose-product-status in each individual act of sales or application.

Rather it is the responsibility of the user (customer) to use the product in line with the delivered information (obligatory labelling including recommendations for the proper use) and relevant regulations (good agricultural practice, water acts, soil protection regulations, fertiliser laws etc.).

Therefore examples of national EoW regulations for compost reasonably followed the path of comprehensive information of the customer. The responsibility of the compost producer ends – after correct processing pursuant to the regulatory EoW obligations – with providing comprehensive information how the compost must be used in order not to contravene corresponding regulations and provisions.

Following the Austrian Compost Ordinance (which was one of the first EoW legislations for biowaste and other source separated organic waste streams in Europe) the correctly produced, marketed and delivered *'product COMPOST'* remains its product status from the moment of declaration as long as the customer (user) follows the specific use restrictions indicated in the labelling or as provided by other national or provincial legislation. If he misuses the compost – e.g. by exceeding the maximum quantities per area unit – the *product* would backslide into the *waste regime* with all involved consequences (control mechanisms, eventual disposal costs etc.) But the logic is, that this responsibility has to be taken by the user and *not* by the producer.

However, in order to make this system work more effectively, the producer must provide all necessary information which allows a correct application in each of the possible use areas. This includes mainly product declaration, quality parameters, value giving properties, restrictions and recommendations for the application. It should therefore be indicated that in order to stay within the product regime the *professional user* must be able to show evidence about a correct application.
In addition the customers (name and address) with type of compost and quantity dispatched must be recorded.

The general fear that organic waste might be processed on stock and find its way to black dumping since the process costs were already covered by the gate fee addresses presumably a marginal and an abstract problem. This scenario seems unlikely, since compost production today would include costly quality management and external QAS which aim at the production of a marketable product.

Therefore an effective tool to prevent individual waste treatment companies from circumventing the successful application as intended by the EoW rules is the obligatory implementation of external quality assurance and approval systems. Those systems, if applied to the entire compost industry would equalize the market as well as the proper enforcement of all provisions set.

Table 27: Criteria and national regulations which define whether a compost produced from waste may be marketed as product or is still within the waste regime

	Statutory Voluntary [S] / [V]	Compost = PRODUCT or WASTE	Legal basis or Standard	Main criteria for 1) compost ceasing to be waste and/or 2) placing on the market and use of compost even under the WASTE regime
AT	**S**	**PRODUCT**	Compost Ordinance BGBl. I 291/2001	• Central registration of compost plant • Positive list of input materials • Comprehensive documentation of o Waste reception o Process management and material movement o Compost quality criteria o Product designation, declaration, labelling and selling of compost • External sampling and product certification by acknowledged institute If all criteria are met and approved by the external certification system all types of compost can be marketed as PRODUCT.
BE *Flanders*	**S**	**WASTE (secondary material)**	VLAREA Flemish Regulation on waste prevention and management (B.S. 1998-04-16)	Total quality control of the VLACO-certificate includes: • Input criteria, • Process parameters, • Standards for end-product • Correct use Compost remains WASTE in any case. User certificate by OVAM is necessary only for the application of sewage sludge compost
BG	**---**	**---**	---	---
CY	**---**	**---**	---	---
CZ	**S**	**PRODUCT**	Act on fertilisers 156/1998 Sb. by the Public Ministry of Agriculture ČSN 46 5735 Průmyslové komposty Czech Compost Standard	Fertiliser Registration System; Central Institute for Supervising and Testing in Agriculture, the Czech Environmental Inspectorate One Compost Class; Quality requirements correspond to Class 1 of the Czech Compost Standard but with less quality parameter compared to the waste composts. The use is not restricted to agriculture. Compost has only to be registered for this group and the inspection/control of samples is done by the Control and Test Institute for Agriculture which is the Central Institute for Supervising and Testing in Agriculture.
	S	**PRODUCT**	Biowaste ordinance (In preparation)	All 3 Classes foreseen in the new draft Compost Ordinance are defined as END of WASTE criteria
DE				

	Statutory Voluntary [S] / [V]	Compost = PRODUCT or WASTE	Legal basis or Standard	Main criteria for 1) compost ceasing to be waste and/or 2) placing on the market and use of compost even under the WASTE regime
	S	**WASTE**	Fertiliser Ordinance (26. November 2003) Closed Loop Management and Waste Act (KrW-/AbfG); Biowaste Ordinance (BioAbfV, 1998)	Compost also from source separated organic waste is seen as WASTE due to its waste properties and its potential to pose negative impacts to the environment. (risk of contamination) • Positive list for input materials • Hygienically harmless • Limit value for heavy metals • Requirements for environmentally sound application • Soil investigation • Official control of application by the waste authority • Documented evidence of approved utilisation All classes and types of compost, which are produced from defined source materials under the Biowaste Ordinance remain WASTE
	V	**WASTE-product (!)**	RAL Gütesicherung RALGZ 251	When participating in a voluntary QA scheme relaxations are applied with respect to the regular control and approval protocols under the waste regime. Though, legally spoken compost remains WASTE quality assured and labelled compost can be extensively treated and handled like a product. The relaxations are: • No soil investigation • No official control of application by the waste authority • No documented evidence of approved utilisation In principle all classes and types of compost, which are produced from defined source materials under the Biowaste Ordinance remain WASTE, but in practice, if certified under QAS of the RALGZ 251 compost can be marketed and used quasi like a PRODUCT.
DK	**S**	**WASTE**	Stat. Order 1650 of 13.12.06 on the use of waste (and sludge) for agriculture	The use of compost based on waste is under strict regulation (maximum of 30 kg P/year/ha etc. and the concentration of heavy metals in the soil were applied must not exceed certain levels. For this reason the authorities want to know exactly where the compost ends up which is only possible if handled as waste and not as a product (for free distribution). Garden and Park waste compost is exempted from this waste regulation and is therefore handled like a product.
EE	**S**	**WASTE**	Environmental Ministry regulations 2002.30.12 nr. 78 and in Environmental Ministry regulation 2002.01.01 nr. 269.	Heavy metal limits in compost (sludge compost) No specific regulation on compost from biowaste and green waste
ES	**S**	**PRODUCT**	Real Decree 824/2005 on Fertilisers Products	• Input-List [Annex IV of Decree on Fertilisers Products] • Documentation [Article 16] o Declaration of raw materials and proportion o Description of process o Certification to declare the fulfilment of all requirements o Declaration and labelling: nutrient content and other technical requirements (limitation of impurities,

	Statutory Voluntary [S] / [V]	Compost = PRODUCT or WASTE	Legal basis or Standard	Main criteria for 1) compost ceasing to be waste and/or 2) placing on the market and use of compost even under the WASTE regime
				size of particles, limitation for microorganisms, maximum content on heavy metals, limitation of use, use recommendations, etc.) • External quality approval by acknowledged *laboratory* • Quality parameter for final compost [Annex V of Decree on Fertilisers Products] o Heavy metal content o Nitrogen % o Water content o Granulometry o Maximum microorganisms content (sanitation)
FI	**S**	**WASTE** **PRODUCT**	Jätelaki (waste law) Fertiliser regulation 12/07	WASTE status changes to PRODUCT if compost fulfils the criteria of fertiliser regulation and is spread to land or mixed into substrate. But there is no external approval or inspection scheme. Samples can be taken by compost producer!
FR	**V**	**PRODUCT**	NFU 44051 Standard	Mixed waste compost – no positive list! 4 Product types • "Organic soil improvers - Organic amendments and supports of culture" • "Organic soil improvers - Composts containing substances essential to agriculture, stemming from water treatment (sludge compost)" • "Organic amendments with fertiliser" • "supports of culture" Further following quality criteria: • Limit values for: trace metal concentrations and loads (g/ha*y), impurities, pathogens, organic micro-pollutants • Labelling requirements There is no regular external approval or inspection scheme. Samples can be taken by compost producer. However, there exists a legal inspection by the competent authority based on the IPPC procedure which in FR is also applied to composting facilities. Compost which is not produced according to the standard is WASTE and has to follow a spreading plan and may apply for a temporary product authorisation. By this way the standard can easily be by-passed.
GR	**S**	**PRODUCT**	Common Ministerial Decision 114218, 1016/B/17- 11-97. Fertiliser law (Law 2326/27-6-1995, regulating the types of licenses for selling fertilisers).	Compost is considered as product and may be sold, provided it complies with the restrictions of the frame-work of Specifications and General Programs for Solid Waste Management. No sampling protocol and analysis obligations/ organisations are defined. Composts produced from materials of agricultural origin (olive-mill press cake, fruit stones, tree trimmings, manures etc) are considered products and sold under the fertilisers law
HU	**S**	**PRODUCT**	36/2006 (V.18.) Statutory rule about licensing, storing, marketing and application of fertiliser products	Composts are in waste status as long as they are not licensed under the Statutory rule Nr. 36/2006 (V.18.). After the licensing composts may become a PRODUCT.

	Statutory Voluntary [S] / [V]	Compost = PRODUCT or WASTE	Legal basis or Standard	Main criteria for 1) compost ceasing to be waste and/or 2) placing on the market and use of compost even under the WASTE regime
				To achieve the product status needs to be in accordance with the Statutory rule Nr. 36/2006 (V.18.). Criteria: • Input-List, • External quality approval by acknowledged laboratories, • physical, chemical and biological quality parameter for final compost.
IE	**–**	**PRODUCT**	EPA Waste license	Product status is based on individual waste license; compliance with all operational and product requirements laid down in the consent document must be shown by producer. There is NO legal standard or QAS or quality protocol in Ireland at the moment which will say when waste becomes a product.
IT	**S**	**PRODUCT**	L. 748/84 (law on fertilisers); D.M. 05/02/98 (Technical Regulation on simplified authorization procedures for waste recovery)	Criteria for product status are based on National Law on Fertilisers, which comprises: • Qualitative input list (source segregated organic waste • Quality parameters for final compost • Criteria for product labelling Compost from MBT/mixed waste composting plants may still be used under the old Decree DPR 915/82 - DCI 27/7/84 as WASTE for restricted applications (brown fields, landfill reclamation etc).
LT	**S**	**PRODUCT**	Decree of the Ministry for Environment (D1-57/Jan 2007)	According to environmental requirements for composting of biowaste the compost producer must provide a certificate on the compost quality • Compost sampling is done by the PRODUCER (!) • NO external approval or plant inspection
LU	**S**	**PRODUCT**	Waste licence	The Product Status is achieved only when a QAS is applied. QAS is an obligatory element of the waste licensing of composting plants. The further criteria are: • Positive list for input materials • Hygienically harmless (Process requirements and indicator pathogens) • Limit value for heavy metals • Requirements for environmentally sound application (labelling
LV	**S**	**PRODUCT**	Licensing as organic fertiliser (Cabinet Regulation No. 530 " Regulations on identification, quality, conformity and sale of fertilisers" 25.06.2006)	Quality of the compost, its composition. The Product Status is achieved only when it is registered and tested by certificated laboratory. The further criteria are: • Hygienically harmless • Limit value for pollutants
MT	**---**	**WASTE**	---	NO provisions for compost
NL	**S**	**PRODUCT**	Decree of the quality and use of organic fertilisers other than manure. (1991)	One or more organic components, but no animal manure, broken down by micro-organisms into such a stable end product that the composting process is slowed down considerably. • key criteria o The composting process (hygienisation)and its documentation

	Statutory Voluntary [S] / [V]	Compost = PRODUCT or WASTE	Legal basis or Standard	Main criteria for 1) compost ceasing to be waste and/or 2) placing on the market and use of compost even under the WASTE regime
				o stability (no value) and o the absence of animal manure. o heavy metal limits o minimum organic matter content o declaration & labelling
PL	**S**	**WASTE**	Fertiliser law	Ministerial Approval by Min. of Agriculture and Rural Development Criteria: • Limit values for heavy metals (3 classes; also coarse and fine compost) • Test on Pathogens
PT	**V**	**PRODUCT**	NP 1048 – Standard for fertilisers Portaria 672002 pg 436	Compost is interpreted as organic soil amendment *"Correctivo organico"* There are no specific regulations available.
RO	**---**	**---**	---	NO provisions for compost
SE	**V**	**WASTE**	Private QAS and SPRC 152 (compost standard)	Waste Criteria: definition according to European court of justice. The compost standard is managed by the Swedish Standardisation Institute SP)
SI	**S**	**PRODUCT**	Decree on the input of dangerous substances in fertilisers into soil (1996 as amended in 2001)	If compost meets the requirements of this fertiliser ordinance compost is a PRODUCT. If limit values are not met the compost can be used as WASTE provided a risk assessment is carried out by an accredited laboratory. Criteria: • Limit values for heavy metals (3 classes) and AOX, PCBs • Maximum levels for glass, plastics, metals
SK	**V**	**PRODUCT**	• Act No. 223/2001 Col. on waste as amended • Slovak technical standard (STS) 46 57 35 Industry composts • Act No. 136/2000 Col. on fertilisers • Act No. 264/1999 Col. about technical requests for products • Regulation of the Government No. 400/1999 Col. which lays down details about technically requirements for products	After biowaste has gone through recovering process it is considered as compost, but such product can not be marketed Compost may be marketed in case it is certified by an authorised person according to Act No. 264/1999 Col. Key criteria for the PRODUCT status: • Quality parameter for final compost – STS 46 57 35 • Process parameter (sanitisation) – STS 46 57 35§ • Quality approval by acknowledged laboratory or quality assurance organisation – Act No. 264/1999 Col.
UK	**V**	**WASTE**	Waste Management Licensing Regulations	England, Wales, Scotland and Northern Ireland: Compost must be sold/supplied in accordance with the Waste Management Licensing Regulation rules for storing and spreading of compost on land (these rules apply whether

	Statutory Voluntary [S] / [V]	Compost = PRODUCT or WASTE	Legal basis or Standard	Main criteria for 1) compost ceasing to be waste and/or 2) placing on the market and use of compost even under the WASTE regime
			Animal By-Products Regulations	or not the compost is derived from any animal by-products). There are not any quality criteria / classes but in the application form and evidence (test results for the waste) sent to the regulator, 'agricultural benefit' or 'ecological improvement' must be justified. The regulator makes an evaluation taking account of the characteristics of the soil / land that is intended to receive the waste, the intended application rate and any other relevant issues. England, Wales, Scotland and Northern Ireland: Compost derived in whole or in part from animal by-products must be placed on the market and used in accordance with the animal by-products regulations.
	V	**PRODUCT**	BSI PAS 100:2005 BSI PAS 100:2005 + Quality Compost Protocol	Scotland: requires certification to PAS 100 (or an equivalent standard), that the compost has certainty of market, is used without further recovery, is not be subjected to a disposal activity and is not be mixed with other wastes, materials, composts, products or additives. Northern Ireland: similar position as Scotland's. England & Wales: both, the Standard and the Protocol have to be fulfilled to sell/supply/use "Quality Compost" as a PRODUCT. Key criteria: • Positive list of allowed input types and source types • QM system including HACCP assessment; standard process including hygienisation • Full documentation and record keeping • Contract of supply per consignment • External quality approval • Soil testing on key parameters • Records of compost spreading by land manager who receives the compost (agriculture and land based horticulture • N.B.: In each country of the UK, if compost 'product' is derived in whole, or in part from animal by-products, placed on the market, stored, used and recorded as required by the Animal By-Products Regulations.

1.6 Task 1.10 – Standards on compost application

The regulations and standards for compost use vary considerably across countries. There are countries where compost use is included in a dense net of regulations on national and/or provincial level (DE, AT, NL), and then there are countries where compost can be used without any legal directions (SE, EE, PT). These differences are partly a consequence of the history of these countries and partly relate to the stage of development with respect to organic waste treatment.

Coherent approaches to policy, standards, quality assurance and market development have tended to produce positive outcomes. In other words, the concept what type of compost, which quality class may be used for what purpose or might be restricted to another one must follow a transparent and easily understandable concept.

Utilisation restrictions exist for different end-use applications. Direct regulations like dosage restrictions (admitted quantity of compost per ha) are to be distinguished from indirect regulations such as *Good Agricultural practice (GAP)* protocols and *Cross Compliance* requirements in agricultural application. The latter refer mainly to qualified fertilising to be executed in a way that considers the nutrients in soil and in compost, and the up-take by the plant).

The basic restrictions in the EU countries usually concern the permissible quantity of compost (stated in tonnes dry matter) at a maximum heavy metal content (*compost class*) which can be spread annually, or over 2 to 5 years. Table 28 provides an indication of the nature of the restrictions applied:
So we may distinguish between the following systems of application rules:

- direct load limitation (g/ha*y), in most cases calculated on a basis of 2 to 10 years
- restriction of the admissible dosage of dry matter compost per ha and year and
- restriction according to a maximum nutrient supply (phosphorus or nitrogen) of the agricultural crops

The described restrictions mostly focus on continuous application as occurs in agriculture. In most of the non food applications - e.g. landscaping, one of the main markets - compost is applied once or infrequently. Here larger amounts (e.g 200 t dm in 10 years) must be used to achieve the desired application effects. Until now only the Austrian Compost Ordinance considers this aspect.
In general it can be ascertained that with today's quality composts the factor which limits application rates is not only (or not even) the heavy metal limits, but more likely, the nutrient contents, and especially phosphorus and nitrogen. Note that it is important to understand the differences between compost products and mineral fertilisers in terms of the way in which the applied nitrogen is made available to plants. Although this depends upon a number of factors (climate, rainfall, etc.), it is accepted that nitrogen in compost is less readily available than nitrogen from mineral fertilisers. For this reason, specifically in BE/Fl and NL but also in other countries, for example, discussions have been ongoing concerning revisions of the law which implements the Nitrate Directive to take account of the fact that the nitrogen content of compost is not so available to be leached into groundwater as nitrate in mineral fertilisers.

In addition, a tendency can be detected for compost application to be included in fertiliser management systems. Regarding compost application, Germany refers to the need to follow “best fertilising expert practise”, whilst in the Netherlands, the Mineral Accounting System MINAS (obligatory since 2001 for all farmers with more than 0.5 livestock units) requires farmers to account for the mineral balances when nutrients are applied in any form.
Germany has conducted an intensive debate about how to account for the beneficial effects of a positive humus balance within agricultural subsidising programmes. In this context humus balance calculation models have been provided and acknowledged.

However, the application of compost has to respect environmental parameters. For this reason, as well as ensuring product specifications for specific end uses, the ability of the receiving medium to absorb compost applications must be carefully considered. The efforts to generate quality composts with low PTE concentrations are intended to ensure environmental protection. Loading limits are the direct counterpart of the precautionary product standards for compost, but these have to take into account not

just heavy metals, but nutrient content (in field applications, not least since such issues are covered by legal commitments in European countries).

Table 28: Regulatory systems of restrictions for the use of composts

	Regulation	Requirements or restriction for the use of compost
AT	Compost ordinance	• Agriculture: 8 t d.m. /ha*y on a 5 year basis • Land reclamation: 400 or 200 t d.m. /ha*y within 10 years depending on quality class • Non food regular application: 20 or 40 t d.m. /ha*y within 3 years dep. on quality class • El. Conductivity > 3 mS/cm: excluded from marketing in bags and for private gardening
	Water Act	• Specific application requirements pursuant to the Action Programme following the EU Nitrate Directive (e.g. limitation to 210 or 170 kg total N per hectare an year)
BE *Flanders*	Royal decree for fertilisers, soil improvers and substrates Fertiliser Regulation (nitrate directive) VLAREA waste regulation	• An accompanying document with user information is obligatory. • Fertiliser Regulation limits N and P, partly more compost use possible because of beneficial soil effects compared to manure. • VLAREA require VLACO Certificate for use and limits max. level of pollutants and show conditions for max application rates
BG	No data available	n.d.
CY	No data available	n.d.
CZ	Biowaste Ordinance, Waste Act (2008)	• According to the coming Biowaste Ordinance (2008) for the first class there are restrictions according to ordinance on hygienic requirements for sport areas, the 2nd best can be used with 200 t d.m/ha. in 10 years.
	Fertiliser law	• Fertiliser law requires application according good practice.
DE	Biowaste Ordinance (BioAbfV 1998) Soil Protection Ordinance (BbodSchV 1999) Fertiliser Ordinance (DÜMV, 2003)	• The Biowaste Ordinance regulates agricultural use with compost Class I 20 t d.m. in 3 years, Class II 30 t d.m. in 3 years. • Soil Protection Ordinance for non agricultural areas between 10 and 65 t d.m. compost depending on use. • Fertilising with compost according to good practice
DK	Stat. Order 1650 0f 13.12.06 of the use of waste (and sludge) in agriculture	• 7 t d.m. /ha*y on a 10 year basis • restriction of nitrogen to 170 kg /ha*y • restriction of phosphorus to 30 kg /ha*y average over 3 years • The levels for heavy metals and organic compounds are restricted in the INPUT material for the composting process
EE	No compost restrictions	Only restrictions for the use of stabilized sludge "sludge compost"
ES	Real Decree 824/2005 on Fertiliser Products	• Class C compost (mixed waste compost) 5t d.m./ha*y
FI	Fertilising regulation 12/07 Lannoiteasetus	• maximal Cd load/ha 6 g during 4 years (crop growing area), 15 g during 10 years (landscape gardening), 60 g during 40 years (forestry); • soluble phosphorus load per 5 years 400 kg (farming), 600 (horticulture) and 750 (landscape gardening); soluble nitrogen load during 5 years in landscape gardening max. 1250 kg.
FR	Organic soil improvers - Organic amendments and supports of culture NFU 44-051	From the moment a compost answers the standard NFU 44-051 there is no rule for the use. In the standard, flows in heavy metals, and elements are restricted to the maximum loading limits: • **Per year g/ha:** As 270, Cd 45, Cr 1,800, Cu 3,000, Hg 30, Ni 900, Pb 2,700, Se 180, Zn 6,000 • **Over 10 years g/ha:** As 900, Cd 150, Cr 6,000, Cu 10,000, Hg 100, Ni 3,000, Pb 9,000, Se 600, Zn 30,000 • Application should follow of good agrarian practices, and agronomical needs which are taken into account for the use of composts.
GR	Common National Ministerial Decision 114218/1997 Hellenic	Upper limits for amounts of heavy metals disposed of annually in agricultural land Cd 0,15, Cu 12, Ni 3, Pb 15, Zn 30, Cr 5, Hg 0,1, kg/ha/y

	Regulation	Requirements or restriction for the use of compost
	Ministerial Decision	
HU	49/2001 Statuory Rule about the protection of the waters and groundwaters being affected by agricultural activities 10/2000. (VI. 2.) KöM-EüM-FVM-KHVM - Water protection rule	• Compost application on agricultural land is limited by the amount of nutrient with 170 kg/ha Nitrogen. • Dosage levels depending on background contamination and nutrient content level in the soil laid down in the National Statutory Rule about the threshold values for the protection of the ground- and subsurface waters and soils.
IE	Statutory Instruments SI No. 378/2006 Good agricultural practice for protection of waters: Statutory instrument 612 of 2006	• IE Nitrate regulation: Compost has to be included in the Nutrient Management Plan. Availabilty of nutrients calculated like cattle manure. • There are specific waiting periods to consider for animal access to land fertilised with biowaste compost based on the Animal-By-Product Regulations. o Catering waste: 21 d for ruminant animals; 60 d for pigs; o former foodstuff & fish waste compost: 3 years (under revision)
IT	National law on fertilisers L. 748/84 (revised in 2006 with the new law on fertilisers, D.lgs. 217/06) Regional provisions	• Compost has to be considered a product to be used according only to Good Agricultural Practice as long as it meets the standards. No restriction is set on loads for unit area • Some regions have codified approaches for low grade materials applications and landfill reclamation, building on the old regulation on "mixed MSW compost" (DCI 27/7/84)
LT	Environmental Requirements for Composting of biowaste, approved by the Ministry of the Environment on 25 January 2007, No. D1-57 Standards for sewage sludge use for fertilising and redevelopment LAND 20-2005 (Gaz., 2005, No. 142-5135)	• When compost used for improve the quality of the soil, the annual quantity of the heavy metals can not exceed norms according LAND 20-2005. • Compost application in agriculture and or soil reclamation purposes, is restricted by contamination with pathogenic microorganisms, organic micropollutants and heavy metals (according to LAND 20-2005) • Compost application on agricultural land is limited by the amount of nutrient with 170 kg/ha Nitrogen and 40 kg/ha Phosphorous per year
LU	EU Nitrate Directive	• no specific regulations; advise (voluntary): 15 t d.m. /ha *y • Only record keeping about the compost use and send to the Ministry
LV	No regulations	only for sewage sludge compost
MT	No data available	
NL	New national fertiliser regulation after 01/2008	• Compost has to meet the national standard (heavy metals) • In the new fertiliser legislation limitations for application are only based on the nutrient content for agriculture max. 80 kg P_2O_5 /ha*y and 120 to 250 kg N /ha*y depending on the crop consumption • For some crops which grow in the soil (e.g. potatoes) compost needs certification and a low glass content < 0.2 %
PL	The National Law on Fertilisers and Fertilization. 26.07.2000. Dz. U. Nr 89, poz. 991	There are limits specified in regulations for amounts of composts applied to soil. There are no limits for nitrogen but only for manures. Composts shall be applied according to good agricultural practice
PT	No regulations available	---
RO	No data available	n.d.
SE	The Swedish Board of Agriculture: SJV 1998:915 (sewage sludge regulation)	• fixed maximum heavy metal load Maximum heavy metal load (g/ha*y): Pb 25; Cd 0.75; Cu 300; Cr 40; Hg 1.5; Ni 25; Zn 600
	Nitrate directive	Agriculture: nitrogen: 150 kg/ha*y and phosphorus: 22 – 35 kg/ha*y

	Regulation	Requirements or restriction for the use of compost
SI	Decree on input of dangerous substances and plant nutrients into the soil (OJ RS 68/96 and 35/01) Instructions for implementing good farming practices (OJ RS 34/00).	• Class I (low heavy metal content) can be used without any restrictions Class II (medium heavy metal content)can be spread with a special permission with a limited application rate considering the heavy metal content and load after an evaluation and risk assessment by the lab • How many nutrients e.g. Nitrogen and Phosphorous can be spread in Agriculture
SK	Act No. 220/2004 Col. on protection and using of agricultural soils	• Lays down limit concentrations of risk elements in agricultural soils
	Ministry of Agriculture Decree No. 26/2000, on fertilisers.	• Lays down fertiliser types, max. concentration of risk elements in organic fertilisers, substrates and commercial fertilisers, storage and take-off conditions, and methods of fertiliser testing
UK	Each country of the UK has different requirements Here is an example of parts of the regulations applicable for England and Wales	• **Use in agriculture and applications to soil other than land restoration:** A Waste Management Licence Exemption, Paragraph 7A, must be obtained by the land owner/manager before accepting and storing then spreading compost. The compost must be made from source segregated biowaste. Per Paragraph 7A exemption: • 'Benefit to agriculture' or 'ecological improvement' must be demonstrated, which is done by spreading compost as per Nitrate Vulnerable Zone regulations if within a NVZ, and following the Codes of Good Agricultural Practice for the Protection of Soils and Water. Given the typical total nitrogen content of ‚Green compost', the application rate would be approximately; • 30 - 35 fresh tonnes per hectare per year where a field NVZ limit of 250 kg total nitrogen per hectare applies, • 30 fresh tonnes per hectare per year if ‚Not NVZ' but as per good agricultural practice, or • 60 – 70 fresh tonnes per hectare once per two years if ‚Not NVZ' but as per good agricultural practice.
		• voluntary Code of Good Agricultural Practice for the Protection: limitation of nitrogen of 250 kg /ha/y (for all types of 'organic manure' used, including composts); compost can also be applied at a rate of 500 kg/ha once per two years

The ranges of restrictions for the amount of compost (on dry matter basis per ha) or plant nutrients to be applied can be summarised as follows:

• quantity of compost*	agriculture / regular	3 t (pasture land) – 15 t (arable land)/ ha^{-1}
	non food / regular	6.6 t – 15 t/ha
	non food / once	100 t – 400 t/ha
• quantity of N	agriculture / regular	150 kg – 250 kg/ha
• quantity of P_2O_5	agriculture / regular	22 kg – 80 kg/ha
	set aside land	20 kg/ha

* in most cases quantity differentiation is depending on quality class obtained.

In many cases we also find a reference to the Nitrates Directive or national water protection legislation leading to maximum application regimes for nitrogen or forbidding the application of compost during the winter season.

Following the ongoing discussion of the use of compost in the frame of *good agricultural practice* one can realise a clear trend towards a system that ensures a balanced nutrition of the plants. This clearly focuses on the *wanted* or *beneficial effect* of compost, more than a ban of related to heavy metal loads would.

It is evident that this approach has to be based on the site and use specific demands ruled by crop rotation, nutrient status, susceptibility to leaching of nutrients and mineralisation potential.

However, many of the maximum loads of PTEs to the soil defined in European standards and regulations are stemming from traditional sewage sludge regulations or are calculated from quantitative compost limitations multiplied by heavy metal threshold values. Only in BE and FR maximum metal loads on soil are laid down in compost standards.

Table 29: Admissible maximum dosage of heavy metals to the soil in national legislation and standards *[g/ha* y]*

Country		Cd	Cr_{tot}	Cr^{VI}	Cu	Hg	Ni	Pb	Zn	As	Se
		[g/ha y]*									
EC	**'sewage sludge'** [1] 10 y basis	150	3,000	-	12,000	100	3,000	15,000	30,000	-	-
AT	sewage sludge [2]	20	1,250	-	1,250	20	250	1,000	5,000	-	-
	Fertiliser. Ord. 2 years basis	5	300	-	350	5	200	300	1,500	-	-
BE	VLAREA (comp.) yearly	12	500	-	750	10	100	600	1,800	300	-
CY	no data available	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
CZ	sewage sludge yearly *max. 5 t d.m./3y in agriculture*	5	200		500	4	100	200	2,500	30	
DE [1]	sewage sludge	16	1,500	-	1300	13	300	1,500	4,100	-	-
DK	7 t d.m. basis / calculated	5.6	700		7,000	5.6	210	840	28,000	-	-
	related to 30 kg P_2O_5/ha / calculated	3	-	-	-	6	75	300	-	-	-
EE	no data available	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
ES	Decr. 877/1991 (SS) 10 years basis	150	4,500		12,000	100	3,000	15,000	30,000	-	-
FI	sewage sludge	3	300		600	2	150	150	1,500	-	-
	Goal for 1998	1.5				1	100				
FR	NF U 44 51 (comp.) 10 years basis	15	600		1,000	10	300	900	3,000	90	60
	NF U 44 51 (comp.) yearly	45	1,800		3,000	30	900	2,700	6,000	270	180
GR	no data available	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
HU	sewage sludge (under Nr. 50/2001.)	150	10,000	-	10,000	100	2,000	10,000	30,000	500	1,000
IE	SI 148/1998 [use of sewage sludge in agriculture]	10	1000	-	1000	10	300	750	2500	-	-
IT	DCI 27/07/84 - MWC from mixed waste	15	2,000	15	3,000	15	1,000	500	10,000	100	-
LT	no data available	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
LU	no regulation	-	-	-	-	-	-	-	-	-	-
LV	sewage sludge	30	600		1,000	8	250	300	5,000		
MT	no data available	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
NL	no regulation	-	-	-	-	-	-	-	-	-	-
PL	sewage sludge	20	1,000		1,600	10	200	1,000	5,000	-	-
PT [1]	sewage sludge /10 y basis	150	4,500		12,000	100	3,000	15,000	30,000	-	-
RO	no data available	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
SE	SNFS 1992:2 (sewage sludge)	0.75	40		300	1.5	25	25	600	-	-
SI	no regulation	-	-	-	-	-	-	-	-	-	-
SK	no regulation	-	-	-	-	-	-	-	-	-	-
UK	Sludge (use in agriculture) Regulations [3] sewage sludge average annual loading over 10 years	150	?	-	7,500	100	3,000	15,000	15,000	-	-

[1] Directive 86/276/EEC; average within 10 years [2] Sew. Sludge Ordinance, Lower Austria (Class III)
[3] S(UiA)regulations: Statutory Instrument 1989 No. 1263, The Sludge (Use in Agriculture) Regulations 1989
The QCP (England and Wales) sets maximum allowable concentrations for PTEs in soils that receive Quality Composts, as specified in the Sludge (Use in Agriculture) Code; these are more stringent than the soil PTE maximum allowable concentrations allowed in the regulations.
SS … sewage sludge

When viewing the admissible loads of PTEs in European legislation the local value of soil protection policy as well as the starting point of the standard set can be identified. When originating from sewage

sludge regulations, where the maximum amount of sludge for the use in agriculture is low (1.5 – 3 t d.m. /ha*y) in some cases maximum PTE loads are extremely low (SE and FI). In addition analytical methods used for the extraction of metals in the substrate also have to be regarded. The restrictive limitation of total amounts of compost to be applied on land again determines the resulting metal load on the basis of maximum PTE concentrations in the product.
Even if one looks only on standards for biowaste and green waste composts the variation is enormous. The maximum value ranges from the 3.3-fold (As) to the 50-fold (Cr) of the minimum values for admissible PTE loads (see Table 30).
The very high figures for Cu and Zn (1,000 and 4,000 mg/kg d.m. respectively) in Denmark mark the low consistency when comparing with the relative moderate numbers of the other metals. This makes it obvious that *traditional* rules originating from MSW and sludge standards show noticeable higher levels.

Table 30: Minimum, maximum and mean admitted yearly loads of PTEs in European soil protection, compost and sewage sludge regulations

Compost from source separation (BWC & GC)									
	Cd	**Cr**	**CrVI**	**Cu**	**Hg**	**Ni**	**Pb**	**Zn**	**As**
	*g/ha*yr*								
min	0.8	40		300	1.5	25	25	600	90
max	15.0	2,000		7,000	15.0	1,000	1,001	28,000	300
mean	**8.2**	**609**	**15**	**1,643**	**7.1**	**293**	**617**	**5,524**	**151**
max/min	*20*	*50*		*23*	*10*	*40*	*40*	*47*	*3.3*
MSW / MBT Composts / sewage sludge (BWC & GC)									
	*g/ha*yr*								
min	12	933		2,000	9	450	1334	6665	
max	150	4,500		50,000	100	3,000	15,000	60,000	
mean	**69**	**2,320**		**16,467**	**48**	**1,583**	**6947**	**27,734**	**375**
max/min	*12.5*	*4.8*		*25*	*10.7*	*6.7*	*11.2*	*9*	

2 Task 2 – Quantitative assessment of compost production and use

2.1 Task 2.1 – Compost production and potentials in the EU

Recent years have seen a phenomenal increase in biological waste treatment in Europe. Looking ahead, we must assume that at least 30 % of urban waste and a large proportion of industrial waste - approximately 40 % of the total municipal waste production in Europe could be treated biologically via composting and anaerobic digestion.

The collected and treated amounts of organic material differ much in EU countries. Around 29.5 % or 23.6 million tons of the estimated total recoverable potential of the 80 million t organic waste fractions is currently separated at the source and treated predominantly through composting (Table 31, Figure 21). This results in a compost production of around 10.5 million tons in Europe. In addition some MS produce a certain amount of compost from sewage sludge and mixed waste, estimated with 1.4 million tons of compost production each (Table 32, Figure 22).

The realistically collectable potential was estimated on the basis of 150 kg/Inh*y. This includes not only source separated kitchen and garden waste from households but also other important sources like park and garden waste from public estates and industrial waste from food industries and similar. This figure seems to be realistic under the assumption that separate collection and composting schemes are implemented following the example of some European countries with well established and integrated biowaste management systems (e.g. AT, DE, NL, SE, BE/Fl and some regions of IT and ES/Catalonia).
The current figure for the specific biowaste and green waste collection can be estimated with ca. 50 kg/Inh*y. It is not possible to provide a differentiation between biowaste and green waste since these data are not available in a consistent format on national scale. From advanced situations on regional level we may achieve up to 180 kg/Inh*y of source separated organic waste going to biological treatment (AT, NL). Considering also alternative treatment options like biomass combustion and including the organic residues which are home composted, the overall potential of organic residues might be in the order of 250 kg/Inh*y.
But this theoretical amount (124 Mt for EU27) would lead to an overestimation if used for the future assessment of *compost markets*.

Some European Member States focus mainly on green waste composting (CZ, DK, FR, SE) whereas food waste is still part of the residual waste collection scheme (*grey bin)* or is being channelled towards anaerobic digestion. IT and Catalonia (ES) have developed a successful collection scheme for food waste by separating the collection system for kitchen waste and garden waste respectively. This is extremely important especially in warmer (Mediterranean) climates where a flexible and more frequent collection of kitchen waste is demanded than for garden waste. In addition food waste can be collected with small receptacles (like 10 to 35 l buckets and certified biodegradable bags) throughout the year independent from the seasonal volume fluctuation of garden waste.

Due to the fact that the organic waste streams from garden and parks are collected and treated in manifold variations and a consistent data collection on national level does not exist a robust estimation of the future potential of the proportion to be allocated to compost production is difficult.

A similar weak leg in searching for reliable data concerns the potential quantity of municipal sewage sludge which is currently or in future likely to be used for compost production. ‘Composting’ very often is a path for municipal sludge to escape the regular waste or sludge control regime (e.g. of national sewage sludge regulations) and therefore no systematic data collection is in place.

Though promoted by individual companies (mainly in FR, ES, PT), composting of mixed municipal solid waste (MSW) is in all countries with a long tradition and experience in compost production and marketing no longer defined as *state-of-the-art*.

Only from Biowaste and Green waste composting a total compost potential of 35 to 40 Mt of compost can be achieved. Including compost produced from sewage sludge the total estimate is 45 Mt

Table 31: Amount of separately collected and composted biowaste and green waste in EU27 [* 1,000 t]

MS		Potential quantities			Separately collected [without home composting] (3)			Separately Collected Biowaste [% of total potential; (8/5)]
	Total MSW (1)	Bio-waste	Green waste	Total (2)	Biowaste	Green waste	Total	
1	2	3	4	5	6	7	8	9
AT	3,419	750	950	1,700	546	950	1,496	88%
BE	4,847	n.d.	n.d.	2,573	n.d.	n.d.	885	34%
BG*	3,593	n.d.	n.d.	1,164	0	0	0	0%
CY*	554	n.d.	n.d.	112	0	0	0	0%
CZ	3979	1354	180	1534	10	123	133	9%
DE	37,266	8,000	8,000	16,000	4,084	4,254	8,338	52%
DK	3,988	433	750	1,183	38	737	775	66%
EE	556	195	130	325	0	0	0	0%
ES*	25,694	n.d.	n.d.	6,456	n.d.	n.d.	308	5%
FI*	2,451	n.d.	n.d.	785	350	100	450	57%
FR*	46,000	n.d.	n.d.	9,378	300	2,400	2,700	29%
GR*	4,854	n.d.	n.d.	1,662	0	2	2	0%
HU*	4,446	n.d.	n.d.	1,515	n.d.	n.d.	127	8%
IE*	3,041	n.d.	n.d.	616	52	71	123	20%
IT	31,687	n.d.	n.d.	8,700	2,050	380	2,430	28%
LT*	1,295	n.d.	n.d.	514	0	0	0	0%
LU*	321	n.d.	n.d.	68	n.d.	n.d.	52	76%
LV*	715	n.d.	n.d.	346	0	0	0	0%
MT*	246	n.d.	n.d.	60	0	0	0	0%
NL*	10,900	n.d.	n.d.	2,446	1,656	1,700	3,356	137%
PL*	9,353	n.d.	n.d.	5,726	n.d.	n.d.	70	1%
PT	4,696	n.d.	n.d.	1,579	24	10	34	2%
RO*	8,274	n.d.	n.d.	3,249	0	0	0	0%
SE*	4,343	n.d.	n.d.	1,352	125	250	375	28%
SI*	845	n.d.	n.d.	300	0	0	0	0%
SK*	1,558	n.d.	n.d.	808	5	68	73	9%
UK*	35,075	n.d.	n.d.	9,009	n.d.	n.d.	1,872	21%
EU27	**257,947**			**80,101**			**23,598**	**29.5%**

(1) Source: Eurostat website (http://epp.eurostat.ec.europa.eu)

(2) In most cases individual estimations by national experts were missing. For all MS marked with an '*' the realistic potential of biowaste and green waste collection is based on the assumption of 150 kg/Inh*y

(3) The estimation of currently collected biowaste and green waste has been provided by national experts contacted during the elaboration of this study (see acknowledgments). The reference year was 2005

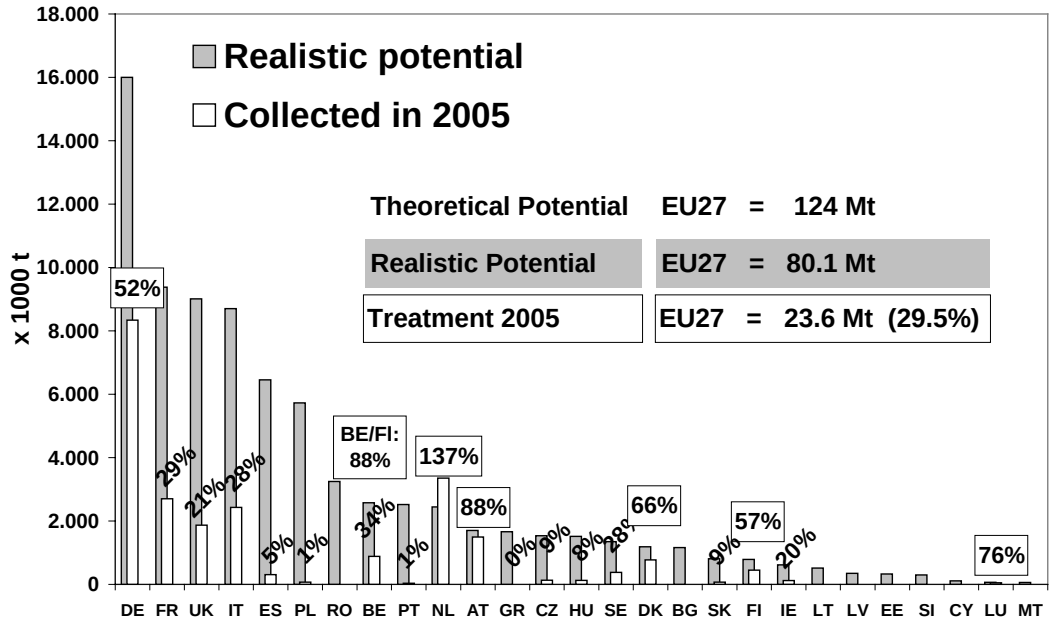


Figure 21: Collected and potential amount of source separated biowaste and green waste per year in EU27

The percentage indicates the collected proportion of biowaste and green waste relatively to the estimated realistic potential. Where no data could be provided by MS experts this was calculated on the basis of 150 kg/Inh*y organic waste collection. The highlighted figures show the most successful countries (AT, DE, DK, FI, LU and NL). It is noteworthy that this 'success' in DK, FI and NL is to a great extent based on an extensive garden waste collection and composting.

Remarkably, NL with 200 kg/Inh*y bio and green waste collection has already exceeded the mean potential estimated with 150 kg/Inh*y. This leads to 137% (!) collected vs. potential.

Table 32: Compost produced in EU Member States (tons)

	Year	Total	Biowaste compost		Green waste compost	%	Sewage sludge compost	%	Mixed waste compost	%
1	2	3	4	5	6	7	8	9	10	11
AT*	2005	**416,000**	218,400	34%	380,000	60%	32,000	5%	4,000	1%
BE/Fl	2005	**342,000**	103,000	30%	239,000	70%	0	0%	0	0%
BG		**0**	0		0		0		0	
CY		**0**	0		0		0		0	
CZ*	2006	**77,600**	4,000	5%	21,600	28%	52,000	67%	0	0%
DE	2005	**2,966,935**	2,089,139	70%	848,486	29%	29,310	1%	0	0%
DK*	2005	**350,000**	15,200	4%	294,800	84%	40,000	11%	0	0%
EE		**0**	0		0		0		0	
ES	2005	**855,000**	35,000	4%	0	0%	180,000	21%	640,000	75%
FI	2005	**180,000**	150,000	83%		0%	30,000	17%		0%
FR	2005	**2,490,000**	170,000	7%	920,000	37%	800,000	32%	600,000	24%
GR*	2005	**8,840**	0	0%	840	10%	0	0%	8,000	90%
HU	2005	**50,800**	20,000	39%	30,800	61%	0	0%	0	0%
IE	2006	**100,500**	25,000	25%	34,000	34%	17,000	17%	24,500	24%
IT	2005	**1,200,000**	850,000	71%	180,000	15%	170,000	14%	0	0%
LT		**0**	0		0		0		0	
LU*	2005	**20,677**	20,677	100%	0	0%	0	0%	0	0%
LV		**0**	0		0		0		0	
MT		**0**	0		0		0		0	
NL	2005	**1,654,000**	719,000	43%	935,000	57%	0	0%	0	0%
PL		**0**	0		0		0		0	
PT	2005	**29,501**	2,086	7%	1,730	6%	2,500	8%	23,185	79%
RO		**0**	0		0		0		0	
SE*	2005	**154,800**	38,800	25%	100,000	65%	0	0%	16,000	10%
SI		**0**	0		0		0		0	
SK*	2005	**32,938**	1,836	6%	27,102	82%	4,000	12%	0	0%
UK	2005/06	**2,036,000**	316,000	16%	1,660,000	82%	15,000	1%	45,000	2%
EU27		**13,183,991**	**4,778,139**	**36%**	**5,673,358**	**43%**	**1,371,810**	**10%**	**1,360,685**	**10%**
Bio and Green Waste Compost			**10,451,496**			**79%**				

* For MS with '*' individual estimations by national experts were missing. Here the amount of produced compost was achieved by multiplying the collection and treatment figures by the decomposition factor 0.4. This represent an average compost output of 40% of the composted source material. All other data have been provided by MS experts (see acknowledgements and Annex 6).

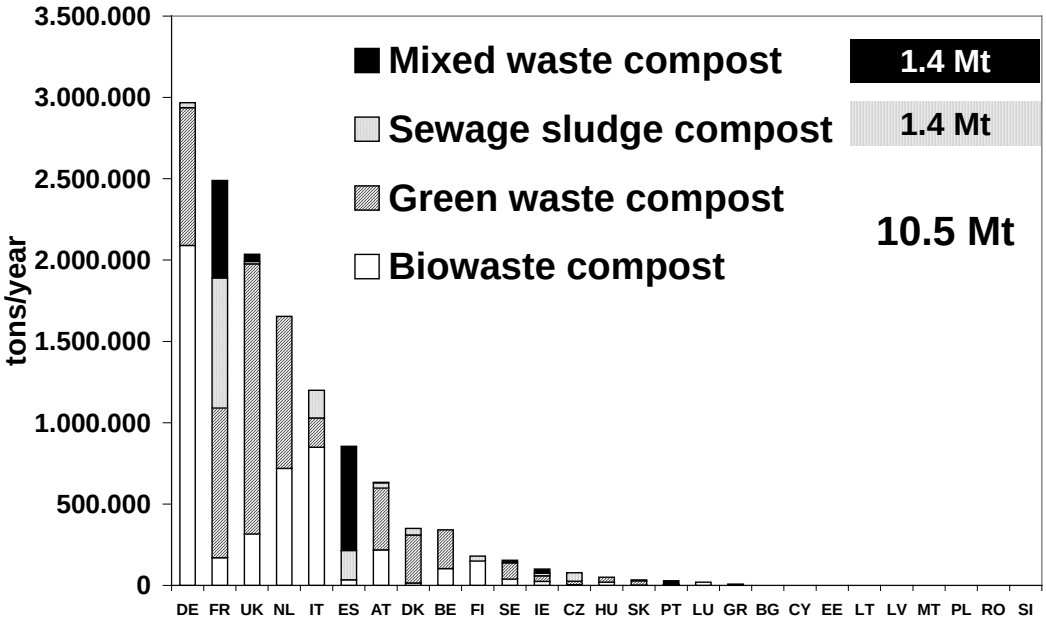


Figure 22: Compost produced in EU27 – differentiated for compost types – biowaste / green waste / sewage sludge / mixed waste compost

2.2 Task 2.7 – Market development trends

From the questionnaire and subsequent personal communication only limited information could be gained about realistic trends for the production of the different compost types. This is mainly caused by the fact that clear strategies or infrastructure are missing which would constitute a trustworthy driver for the development of a certain treatment option.
As far as compost types from the different input categories are concerned the general trends may be concluded:

1. Countries with established biowaste recycling are still faced with increasing amounts of green waste from private and public estates. Part of it – besides energy from biomass recovery – will still go into composting.
2. Sewage sludge is expected to be an increasing source for composting where direct use in agriculture and incineration is not the preferred options,
3. Manure composting including separated slurry might be developed as an alternative treatment in areas with considerable excess of livestock (as a measure for organic sorption of organic nitrogen).

See also some further considerations in Task 4.3

Table 33: Estimated trends in compost production for the main compost types

Country	Biowaste Compost	Green Waste Compost	Mix of Bio/Green Compost	Sludge Compost	Manure Compost	Municipal Solid Waste Compost
AT	=	+	n.d.	+	n.d.	n.d.
BE/FL 2006 *	–	=	n.d.	n.d.	++	n.d.
DE 2005	=	=	=	+	n.d.	n.d.
DK 2005	–	+	n.d.	n.d.	n.d.	n.d.
ES 2005	=	+	=	=	n.d.	=
FI 2005	–	–	n.d.	n.d.	n.d.	n.d.
FR 2005	–	–	n.d.	+/-	=	=
GR 2005	=	–	=	n.d.	n.d.	n.d.
HU 2005	+	++	++	++	+	+
IE 2006	+	+	+	++	=/+	+[2)]
IT 2005	–	–	n.d.	+/-	n.d.	n.d.
LV 2006	+	n.d.	n.d.	+	n.d.	n.d.
NL 2005	=	=	n.d.	n.d.	n.d.	n.d.
PL	+	+	+	+	n.d.	+
SE 2005	–[1)]	=	n.d.	n.d.	–	–
UK 2005	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
UK 2006 3)	++	n.d.	++	+	+	+

Forecast abbr.: ++ strong; + moderate increase; = stable; – moderate decrease; – – strong decrease

[1)] Increase in anaerobic digestion instead

[2)] MBT/Landfill

[3)] In the UK a category for composting animal by-products (catering waste, former foodstuffs or other category 2 & ABP materials) with green wastes is missing. This will be a key growth sector rather than 'Biowaste compost' in the UK in 2006

2.3 Task 2.3 - Amounts of compost used according to use type and sector

Table 34 shows the few available data about the distribution of use sectors of compost in the reference year 2005. In order to get data about a wider range of countries the survey was enlarged to all feedbacks of the Questionnaire and now comprises the period between 2003 and 2006. Data come from periodically executed national survey (mostly every 2 to 3 years) and as a continuous yearly data flow from the compost organisations where the members are requested to send data annually in a comparable way in the frame of the quality assurance.

The use sector and the volume sold in the sector depend only to a certain extent on the source material type, compost class and quality. Application areas like agriculture just require standard quality, landscaping or even the growing media sector need upgraded and more specialised product. Here further requirements of the customers have to be met and it is up to the marketing strategy of the compost plant to decide to enter into this market segment. So the sales volumes and market sectors are a matter of the market development and market maturity, too.

The vast majority of composting plants are not actively marketing their products on the same level compared with, for example, companies marketing mineral fertilisers, bark or peat products. Marketing in and for the landscaping and horticultural sectors (incl. private gardens) depends upon knowledge of plant growing and the related technical language, as well as of the needs of the different sectors. Declaration, advertisement and marketing must be comparable with the appearance of competing products.

Another effect on the sales distribution results from the national environmental and fertilising policy. The manure policy in Belgium makes it very difficult to sell compost to farmers (only 11% agriculture) since years. In the Netherlands, however, with the same animal husbandry and nutrient situation and problems most of the kitchen/bio-waste compost is used in agriculture (75 %) and the new fertiliser legislation after 2008 might increase the portion.

No further differentiation could be made because the available national statistics on the use of compost just show very general relative figures about the compost markets:

- Agriculture counts for more than 50% with increasing tendencies,
- landscaping up to 20 %,
- growing media production by blends and soil mixing around 20 %
- the private consumer market with hobby gardening and wholesales for another 20 %

So more than 50 % of the compost goes to mass markets which requires standard quantities. 20 to 30 % of the market volumes are used in higher specialised market areas which require an upgrade and mixing of the compost in order to meet the specific requirements of the customers.

Countries with mainly mixed waste compost production and not big highly developed markets strongly rely on agriculture (ES, FR) or on land restoration/landfill covers (FI, IE, PL). In Poland the low quality produced leads to 100% use for land restoration/landfill covers.

Table 34: Compost market shares of various sectors in major European composting countries (%)

EU Market shares 2003-2006	AT	BE/Fl	DE	ES[1)]	FI	FR[2)]	HU	IE	IT	NL bio-waste	NL[1)] green waste	PL[2)]	SE	UK	Mean EU
Sector	**2003**	2005	2005	**2006**	2005	2005	2005	**2006**	**2003**	2005	2005	2005	2005	2005	%
Agriculture	40.0	1.0	53.4	88.0	20.0	71.0	55.0	37.0	51.0	74.8	44.4	-	-	30.0	**48.0**
Horticulture & green house production	10.0	1.0	3.9	8.0	-	25.0	15.0	3.0	-	-	15.5	-	5.0	13.0	**11.3**
Landscaping	15.0	22.0	15.9	4.0	20.0	-	10.0	6.0	6.0	3.6	12.3	-	20.0	14.0	**12.4**
Blends	15.0	6.0	13.6	-	10.0	-	-	16.0		15.0	5.1	-		2.0	**10.3**
Soil mixing companies	2.0	21.0	-	-	-	-	-	-	-	-	9.4	-	10.0	-	**10.6**
Wholesalers	-	9.0	-	-	-	-	-	-	-	-	5.2	-	15.0	-	**9.7**
Hobby gardening	15.0	20.0	11.9	-	-	4.0	5.0	-	27.0	1.1	2.3	-	10.0	25.0	**11.0**
Land resto-ration and landfill cover	2.0	1.0	-	-	50.0	-	15.0	38	2.0	-	-	100.0	40.0	16.0	**26.4**
Export	1.0	7.0	-	-	-	-	-	-	-	5.5	5.0	-	-	-	**4.6**
Others	-	2.0	1.3	-	-	-	-	-	-	-	0.8	-	-	-	**1.4**

1) Green waste compost 2) Mainly mixed waste compost

Table 35 includes the very few data sets about the compost use in two subsequent years. The market situation in countries with developed markets (BE, DE, NL) is relatively stable. Changes in the fertiliser legislation in 2006 caused the decrease of the portion in agriculture in the Netherlands.

Table 35: Sectoral compost market development in selected European countries (%)

Developments in countries (%)	BE		DE		FR		NL Biowaste		NL Greenw.		UK	
	2005	2006	2005	2006	2003	2005	2005	2006	2005	2006	2005	2006
Agriculture	11.0	8.0	53.4	53.5	58.0	71.0	74.8	68.5	44.4	28.8	30.0	48.0
Change (%)	-3.0		+0.1		+13.0		-6.3		-15.6		+18.0	
Horticulture & green house production	1.0	1.0	3.9	4.1	-	25.0	-	-	15,5	19,3	13,0	4,0
Change (%)	0		+0.2		-		-		+3.8		-9.0	
Landscaping	22.0	20.0	15.9	15.3	5.0		3.6	4.2	12.3	15.5	17.0	10.0
Change (%)	-2.0		-0.6		-		+0.6		+3.2		-7.0	
Blends	6.0	8.0	13.6	13.9	-	-	15.0	15.8	5.1	10.3	1.4	2,0
Change (%)	+2.0		+0.3		-		+0.8		+5.2		+0.6	
Soil mixing companies	21.0	26.0	-	-	-	-	-	-	9.4	16.3	-	-
Change (%)	+5.0		-		-		-		+6.9		-	
Wholesalers	9.0	9.0	-	-	-	-	-	-	5.2		-	11,0
Change (%)	0		-		-		-		-		-	
Private /Hobby gardening	20.0	20.0	11.9	11.7	5.0	4.0	1.1	3.4	2.3	2.8	25.0	9,0
Change (%)	0		-0.2		-1.0		+2.3		+0.5		-16.0	
Land restoration, landfills cover	1.0	1.0	-	-	10.0		-	-	-	-	16.0	18,0
Change (%)	0		-		-		-		-		+2.0	
Export	7.0	6.0	-	-	-	-	5.5	8.3	5.0	2.1	-	-
Change (%)	-1.0		-		-		+2.8		-2.9		-	
Others	2.0	1.0	1.3	1.5	-	-	-	-	0.8	5.0	-	7.2
Change (%)	-1.0		+0.2		-		-		+4.2		-	

2.4 Task 2.5 Amounts of input materials used to produce the different compost classes

As mentioned in the Inception Report input material data are collected in a very general way from the compost plants. With the exemption of BE/Fl and DK, no real control of the input quality takes place besides the typical visual inspection at the delivery point on impurity quantities.
With the exception of sewage sludge (which limits the use of compost sometimes to certain applications e.g. organic farming, contracted vegetable production) and municipal solid waste MSW (which lead to systematic lower qualities) compost is used quite independently from the source materials.

The available European figures about the total compost production (Task 2.1) reflect the general input material situation. This doesn't allow a correlation with the output in classes because the data are not collected in a corresponding way in and from the plants. Only the countries with extensive quality assurance schemes (AT, BE/FL, NL, UK) show data compositions which allow a correlation between input material and output classes. Besides Austria all these countries define only one quality class, so there is no real quality conclusion possible.

2.5 Task 2.6 Compost prices achieved in the different market sectors

Contrary to a lot of other products the compost price doesn't reflect the real value (see table below) and the production costs. In the compost industry the sentence is well known that the money is earned at the gate (gate fee) or at the weigh bridge (accepted tons of waste). This is true for all European Countries. 95 % of the plants relay on the gate fee. Only very few companies have developed their local market so well that compost sales contribute really to the companies' economical success. So in most cases only a small pressure exists to enter into the revenue oriented high price markets which requires additional efforts and competence in market and product development and marketing.

So prices differ severely within the European Countries and depend mainly on the marketing strategy of the plants. For example a large number of plants (mainly municipality owned) have no intention to make profit but to have a good acceptance of separate collection, composting and compost. They reward the citizen for his ecologically sound behaviour by giving away the compost for free which disturbs the market in the whole area. This makes it very difficult to get reasonable price information from the countries. The first feed back from the German BGK on prices was "around 5 Euro" which is the mean value of all the prices recorded from the compost plants of the last survey. Detailed evaluations lead to a price ranges of 0 to 29 €/t in most of the application ranges. A similar feedback came from Belgium.

This underlines that the specific situation of the plant, the local market and the marketing strategy is more decisive for the price level for compost than the quality in details. Nevertheless all the considerations are only valid if there is a basic standard compost quality which is accepted by the market. End-of-waste standards can help in this respect.

Even with sales prices things start to change in the mature markets. The idea is more and more accepted that compost must have a value to be considered as valuable recycling product. Municipalities can get more external help for a qualified product development and marketing. This in line with the good experiences of the customers with compost, more information and public relation about the compost use leads to an increase of the value of compost in the customers mind.

This even affects agriculture as one of the main markets with very low revenue. More and more farmers see the full compost benefit and value and start to pay a real price.

The national situation in agriculture becomes very difficult when there is a strong competition with manure and manure sales is subsidized. This is the case in NL and BE where on account of the huge animal husbandry a surplus in manure arises and subsidies of up to 30 € per tonne of manure to consumers are paid. This and a restrictive application regulation make it difficult to sell compost to

agriculture in those countries. In order to support the perceived VALUE of compost by a positive price - this corresponds to the compost image - the strategy is quite common to request a comparatively low unit price of 1 to 2 €/t to be paid by the farmer and in exchange to offer the delivery of the compost for free.

However, this situation should not be misused to conclude that compost in principle is '*waste and has no market'*. The agricultural outlet is needed to secure the total market and to get the whole recycling loop running. Meanwhile in mature composting situations like Germany the composting plants start to go more and more for revenue markets outside agriculture by developing growing media, mixtures and locally specialised products for the individual customers.

Table 36: Investigated national average market prices in the different sectors (€/t per t f.m.)

Sector	BE/Fl	CZ	DE	Fi	ES	GR	HU	IE	IT	NL-bio	NL green	SE	SI	UK	EU Mean
Agriculture (food)	1.1		14.0	0.0	27.0*	-	15.0	-	3.0	-4.0	2.0	0.0	-	2.9	**6.1**
vineyards, orchards	1.1	-	-	-	-	-	-	-	12.0	-	-	-	-	2.9	**5.3**
0rganic farming	1.1	-	-	-	-	42.0	-	-	-	-	-	-	-	2.9	**15.3**
Horticulture & green house production	1.1	-	15.0	-	-	42.0	-	-	-	-	-	-	-	2.9	**15.3**
Landscaping	2.5	4.5	15.0	2.0	-	-	18.0	-	25	4.0	-	-	-	6.5	**9.7**
Blends	1.1[2)]	-	-	2.0	-	-	-		-	3.5	-	-	-	2.9	**2.4**
Blends (bagged[1)])	-	-	-	-	-	-	-	90.0	200.0	-	-	-	-	-	**(145)**
Soil mixing companies	1.1	-	-	2.0	-	-	-	-	-	-	-	-	-	6.5	**3.2**
Wholesalers	1.1	-	-	-	-	-	-	-	-	-	-	-	12.0	-	**6,6**
Wholesalers (bagged[1)])	-	-	160.0	-	-	-	-	-	-	-	-	-	-	-	**(160)**
Hobby gardening	7.2	4.5	-	10.0	-	-	20.0	-	13.0	0.3	-	-	21.0	20	**12.0**
Hobby garde-ning (bagged[1)])	-	-	-	-	-	300.0	-	-	-	-	-	-	-	-	**(300)**
Mulch	-	-	-	-	-	-	-	-	-	-	-	-	-	3.6	**3.6**
Land restoration, landfill covers	1.1	-	-	0.7	-	0.0	-	-	-	-	-	-	-	0.7	**0.6**

[1)] High prices because sold in small bags (5 to 20 litres) [2)] Price for compost when sold to the substrate producer!

The table above shows similar results like a survey done in year 2000 by Carlsbæk (see figure below). We have the mass market for compost which accepts large quantities with low or standard qualities at the agriculture and land restoration/landfill cover sector with prices up to 6 €/t. Vine and fruit cultivation are on the same level. Organic farming pays better prices.

Soil manufacturing companies and blenders are interested to get cheap raw material and are therefore not willing to pay high prices, so sales prices range between 2.4 and 3.2 €/t.

Landscaping and horticulture require medium efforts in product development and marketing and reflect the price sector from 10 to 15 €/t. Hobby gardening prices are on a similar level.

Relatively high prices between 90 and 300 €/t follow from situations where the compost is sold in small bags e.g. as blends, to hobby gardeners or to wholesalers. Bulky delivery to wholesaler, however, leads to only 6.6 €/t.

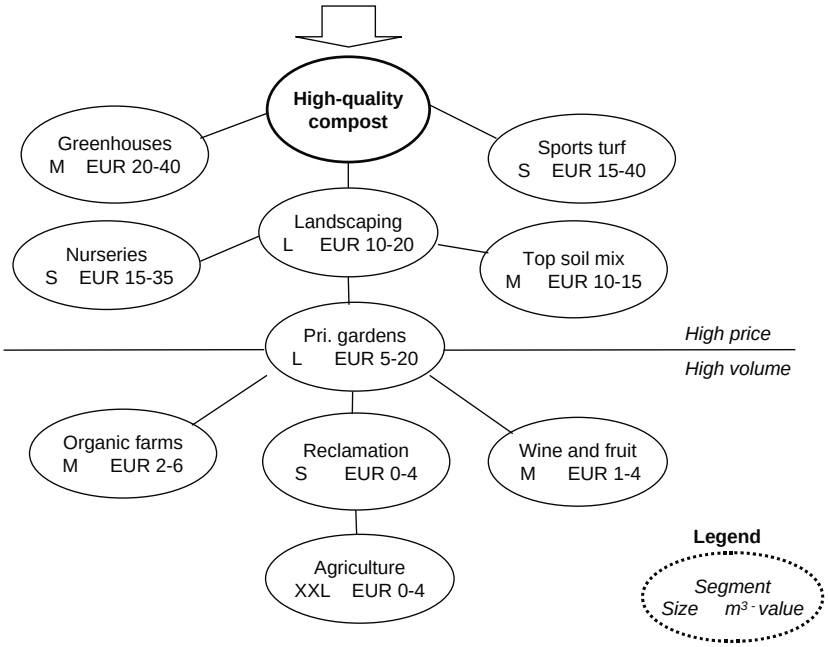


Figure 23: Compost marketing hierarchy indicating the relative size of the market segment
small to extra-extra-large, as well as the known price range for compost product within the market segment, EUR/m^3 product. The prices are actual prices for ready to use products with compost, or pure composts, when the products are sold by the producer to the wholesaler or to the end user. (idea: Tyler, 1996; modified for European conditions).
Sources: M. Carlsbæk in Amlinger, F., 2000: Composting in Europe: Where Do We Go? Paper for the International Forum on Recycling, Madrid, 14 November 2000.

2.5.1 Fertiliser and Humus Value of Compost for Agriculture in Germany

Leifert and Schneider (2007[jb16]) evaluated the fertiliser and humus value based on German market process as follows:

a) Fertiliser value of compost

Based on the fertiliser prices published on April 10, 2007 by the Chamber of Agriculture NRW (North-Rhine-Westphalia) a current calculation on the fertiliser value has been achieved for compost which is used in practice, rich in nutrients and well structured. A fresh compost (produced from kitchen and garden wastes), declared as organic NPK fertiliser 1.40(N) - 0.60(P) - 1.02(K) has a nutrient value of 8.49 €/t (Agricultural Chamber NRW, 2007[jb17]) fresh matter. The fertiliser value of a well structured compost (organic PK fertiliser 0.43-0.22) has to be calculated with 3.93 €/t fresh matter. The nitrogen content is calculated basically on the basis of the available contents. The contents of phosphorous and potassium are calculated at 100 % on recommendation of the agricultural consultants.

b) Humus value of compost

Principally with compost a stable organic mass is applied on the soil, comparable with decomposed manure it shows a defined humus content. With an average compost application ca. 2,800 kg humus-C/ha is incorporated within a 3 year crop rotation. The monetary assessment of the humus-C-fraction applied with compost can be realised by comparing with the humus supply achieved via "green manuring with *Phacelia* or *Sinapis arvensis* and/or straw sale.

The substituted costs for green manuring by applying compost are in the range of 3.28 €/t fresh matter, respectively 148 €/ha. An additional revenue could be achieved when the straw would be sold directly at field, this value is calculated with 45 €/ha respectively 1 €/t.

In total it can be said that the real value of compost **(min. 7.10 €/t - max. 12.72 €/t fresh matter)** is often underestimated in agricultural practice. On account of the increasing demand for qualitative high-class and quality assured compost it can be said that agriculture knows about the cost-saving multi-functional fertiliser compost. With further increasing prices for mineral fertilisers compost will become a valuable product for agriculture.

3 Task 3: Quantitative assessment of alternative materials

3.1 Task 3.1 – Agricultural residues as alternative material

Most of the alternative agricultural residues are second choice when it comes to the real benefits for the soil with respect to stable humus production and availability of nutrients. Under the term of HUMUSMANAGEMENT (includes organic matter needs of soils, biodiversity…) the specific performance in humus reproduction of compost becomes more and more accepted.
This is reflected e.g. by the fact that in two regions in Italy farmers may get subsidies by the government if they use certified compost.
Another example is NL and BE: here for the use of compost certain exemptions of the very strict nutrient management regulation are accepted due to the acknowledged nitrogen binding capacity of the compost organic matter pool.

Thus the substitution potential of compost to agricultural residues should not only be compared on account of the nutrient content or unspecified organic matter but on the benefits of the humus complexes provided with compost.

In soils only the portion of organic matter counts for the humus reproduction which stays in the medium-term in the soils (Humus-C; stable humus) (Kehres, 2007)[jb18].

Agricultural residues - first of all straw and manure - can create a similar benefit like compost by fertilising the soil and delivering organic matter for soil improvement. Essential differences are given to which extent compost and agricultural residues fulfil these functions.

3.1.1 Biowaste as a source for humus

Organic matter contained in compost is comparably stable. Compost contains high portions of so-called "humus-C". That is the portion of carbon that contributes to humus reproduction. This „humus-C"-fraction in compost accounts for 51 % of the total organic carbon and is therewith higher than in any other humus fertiliser. Compared with compost, straw and liquid manure contain 21 % carbon resistant to degradation, and green fertilisers just 14 %. The good reputation of compost as an effective humus fertiliser and as the "the gardener's gold" is based on this context.

Table 37: The value of organic material types matter for humus reproduction (Kehres 2008)[b19]

Biomass for humus reproduction	Humus-C rate - Total carbon
Compost	51 %
Straw	21 %
Liquid manure	21 %
Green fertilisation	14 %

Considering the amounts of Humus-C, which are applied on areas in usual amounts according to good expert practice, the differences are becoming more evident:

- With liquid manure (from pigs) only 100 kg humus-C/ha are applied.
- Straw with 600 kg lies distinctly higher. Straw contributes to humus reproduction only if it stays on the area and is not removed for other purposes.
- Green fertilising brings a lot of organic matter into the soil. This organic matter type, however, is relatively quickly decomposed. As "nutrient-humus" is this good for micro-organisms. The humus reproduction effects with ca. 500 kg humus-C/ha are relatively modest.

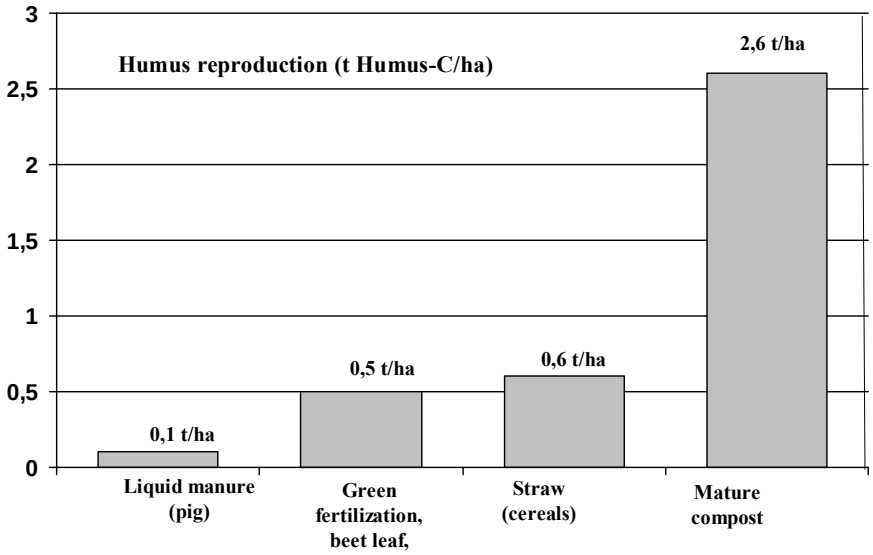


Figure 24: The efficiency of organic fertilisers for the humus structure (Kehres 2008)

With compost and its high contents of organic matter resistant to degradation more than 2,500 kg Humus-C/ha are applied. The effectiveness on the humus reproduction is by factor 4 higher than with straw and by factor 20 higher than with liquid manure.

This context is of high relevance if one knows that the agricultural cultivation (arable farming without animal breeding) is often connected with considerable losses of humus-C in the soils.

Those cultures which are cultivated for the production of biomass for energy recovery (e.g. maize, cereal silage and silage from whole plants) show deficiencies in the humus balance of -400 to 800 kg humus-C/ha and more. If these losses are not balanced with the cultivation of humus-building cultures in crop rotation or through straw fertilising or through organic fertilisers like digestion residuals or compost, the content of organic matter in the soil will gradually decrease accompanied with a following loss of soil fertility.

Before this background it is important to recognise the importance of biomass for the soil in the long run and the importance of a balanced humus content during biomass production. While it is obvious that the demand of biomass is necessary for human nutrition or for animal feeding stuff and everybody is talking about the utilisation of biomass for energy production, the fundamental demand of soils for biomass should not be ignored in the present biomass euphoria.

3.1.2 Biowaste as a source for plant nutrients

Plant nutrients contained in biowaste can substitute to some extent mineral fertilisers (and thus mineral raw materials sources). The substitution potential for phosphate is 28,000 t respectively 10 % of the phosphate of the mineral fertilisers applied in Germany. With potassium 9 % (43,000 t) and with lime fertilisers 8 % (175,000 t) can be substituted.

The predominant part of nitrogen is bound in the organic matter. However, it can be assumed that for plant nutrition up to 30 % of the total amount of a mineral fertiliser-equivalent can be credited. The nitrogen content in the atmosphere is satisfactorily available, but its utilisation as a fertiliser is very energy-consuming. The production of 1 kg nitrogen as fertiliser requires at least 40 MJ that corresponds to a calorific value of 1 kg oil. If 30 % of the nitrogen contained in compost can be used approximately 13,500 t nitrogen can be saved as mineral fertiliser and an energy potential of 540 TJ.

Table 38: Potential of fertiliser substitution of compost in Germany (Kehres 2008)

	Nutrients[1)] Mineral fertiliser	Nutrients[2)] Compost	Substitution Potential
Phosphate fertiliser	280,000 t	28,000 t	10 %
Potassium fertiliser	490,000 t	43.000 t	9 %
Lime fertiliser	2,100,000 t	175,000 t	8 %
1) Plant nutrients of amounts of mineral fertilisers sold in Germany 2) Plant nutrients per annum in composts from separate collection of biowaste			
Nitrogen		13,500 t	540 TJ

High attention must be given to phosphate. Phosphate, the world-wide resources of which are only available for another around 90 years, is of elementary importance concerning recycling and thus the protection of the few still available resources of raw materials. Contrary to the "alternative energies" plant nutrients have no "alternative nutrients". Nutrients cannot be replaced. In the long run their "closed loop management" is inevitable. No alternatives are available.

This actual situation becomes clear if one knows that the production of biomass depends directly on the availability of water and plant nutrients. In the long run phosphate will be the limiting factor on account of its decreasing availability (besides water) for the total biomass production inclusive nutrient and feeding stuff production.

3.1.3 The monetary value of the compost substitution

While the quantities of composts offered on the market remain static in between the demand for compost increases steadily in Germany (Kehres 2008).

In all the sales segments composts are sold with profit in Germany. Revenues outside agriculture with ca. 6 to 10 €/t and even more are higher than in agriculture (0.5 to 2 €/t). The lower prices in agriculture depend on higher costs for transports and spreading compared with mineral fertilising. If these costs are considered in the calculation the price is comparable with the value of the plant nutrients in compost.

From 2005 to 2007 the monetary value of nutrients contained in composts and digestion products increased by approximately 50 %. The value for compost rose from 5.30 €/t f.m. to 8.10 €. Per hectar the value for the farmer increased from 212 € on 320 €.

A value portion for the micro-nutrients also contained in fertilisers and the organic matter is not considered hereby. The value for organic matter is assumed to rise distinctly in future accompanied by the increasing cultivation of renewable raw materials/energy crops and thus the demand on humus reproduction of the soil.

The extent of replacement or a substitution potential of agricultural residues by compost can't be quantified. With between 1.5 and 2 billion tons agricultural residues a year there is enough potential and - given by the positive properties of compost - a real benefit in using compost instead. This is reflected by the European agricultural market share for compost which amounts up to 50 % in average und up to 80 % in countries like Spain or the Netherlands.

3.2 Task 3.2 – Sewage sludge production and treatment in the EU

The following table shows the results of the 4th Report of European Commission for the Sewage Sludge Directive about the sewage sludge volume which was generated in 2003 in the EU Member States. Figures from some member states are missing. Noticeable is that the highest amount of sewage sludge is generated in Germany (DE) (about 2.17 million t/d.m.) followed from Great Britain (UK), Spain (ES), France (FR) and Italy (IT). All the other member states show distinctly lower volumes.

Table 39: Sewage sludge production in the EU in t d.m. in 2003/2004 [if not indicated otherwise: Schmelz, 2007[jb20]]

EU-Member State	Sludge production in t d.m. (2003/2004)
AT	115,448
BE	99,592
CZ	211,000
DE	2 172,196
DK	140,021
ES	1,012,157
FI	161,500
FR	910,255
GR	79,757
HU	52,553
IE	42,147
IT	905,336
LV(2004)[1)]	36,164
NL	550,000
PL [2)]	446,537
PT	408,710
SE	220,000
SK	54,940
SL	9,400
UK	1,360,366

[1)] Source: R. Bendere (LASA, personal communication); 2,888 t dm of sewage sludge has been composted
[2)] Polish Ministry of Environment web page.

In order to demonstrate the periodical development of the sewage sludge amounts in the individual member states, the sewage sludges generated in the years 1999 and 2003 were compared. This proved that those member states with a very intensive connection of the population to the public waste water treatment produce a relatively constant amount of sewage sludge or show even slightly decrease (e.g. Germany, Denmark, Sweden, The Netherlands). Nearly all the other member states had an increasing sewage sludge generation in 1999 compared with 2003 what seems to be subject to an extension of waste water purification in these states.

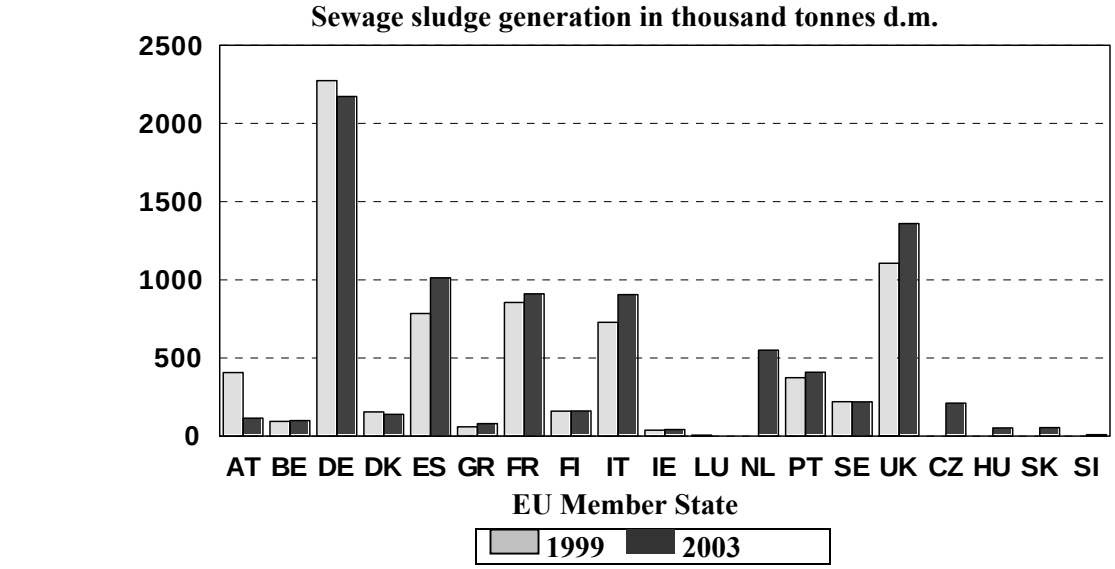


Figure 25: Potential sewage sludge in the EU in the years 1999 and 2003

Figure 26 resulted from the assessment of sewage sludge disposal in the individual member states of the EU from different sources [Schmelz, 2007; Wieland, 2003[jb21]]. The portions of the individual disposal ways from earlier (e.g. from the year 2000) or also later years (e.g. from the year 2005) had to be transferred on the sewage sludge amount of the baseline year 2003.

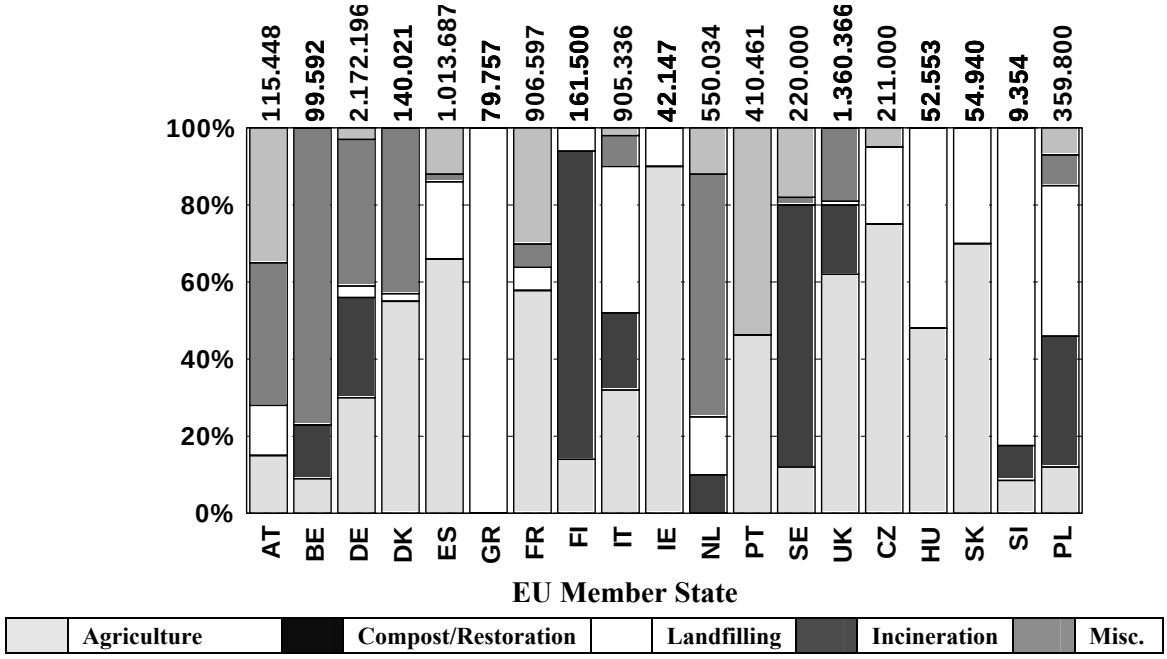
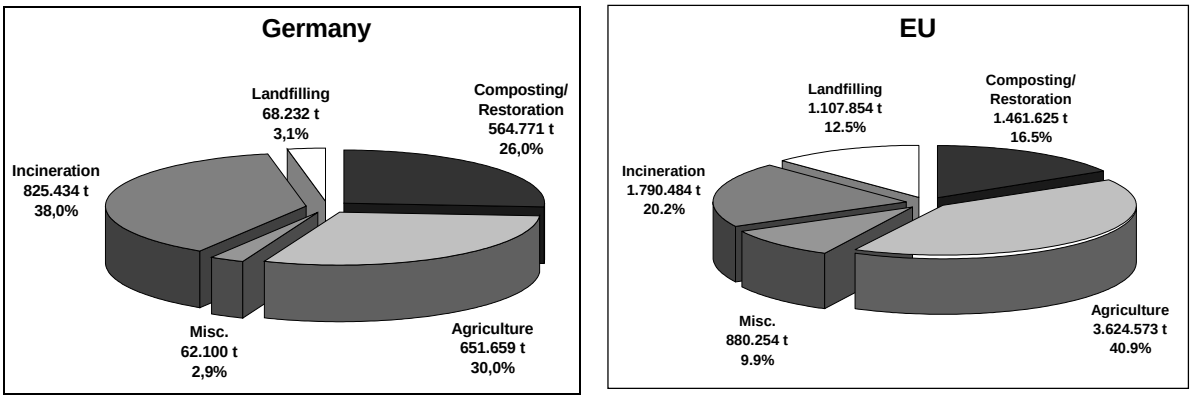


Figure 26: Sewage sludge amount and disposal in the EU

The predominant disposal ways in the individual member states show great differences. Whereas in Greece (GR) e.g. the totally generated sewage sludge is landfilled the sewage sludge from Great Britain (UK) is directed into intensive material recovery in agriculture or in landscaping. If the total amount of sewage sludge generated in the EU is classified in the different disposal ways a yield of material recovery of nearly 60 % is given. This corresponds to the material recovery portion in Germany, as the following figure proves.



100% = 2,172,196 t d.m. **100 % = 8,864,790 t d.m**

Figure 27: Sewage sludge generation and disposal in the EU and in Germany (Schmelz 2007)

3.62 million t d.m. of treated sludge from municipal waste water treatment can be seen as an alternative product to compost used in agriculture. In addition this is the case for 1.46 million t d.m. of sludge which is at least partly composted (exact figures on this proportion are missing) and mainly used for landscaping/land restoration purposes.

Based on the very unsure and controversially debated strategies for the management, and treatment and use of municipal sewage sludge no realistic scenario for sludge composting can be established on European scale. However if one would consider 15 % of the total municipal sludge production for composting - this would be approximately 5.3 million t fresh matter sludge. After composting together with the same amount of bulking agents and green waste this would lead to ca. 4 to 5 million t of sludge compost.

3.3 Task 3.3 – Consumption of peat and bark

The total European peat and bark production doesn't reflect the replacement potential for compost. Both materials are used to a very large scale in areas and kinds where there is no full substitution possible. Relevant for the compost however is the growing media sector where compost can, is and will be used beneficially on account of its properties and for the environment by saving the bogs in Europe. In order to quantify this potential for the report we use a study published in 2007 by the IPS International Peat Society which reflects the situation in the reference year 2005.

The Commission II of IPS conducted a survey "Growing Medium Constituents used in the EU" (Schmilewski, 2007[jb22]) attempting to collect as reliable data as possible on the amounts of growing media constituents used in major growing media producer countries in the EU. This survey for the year 2005 asked for amounts of organic, composted, mineral and synthetic constituents. Furthermore, the questionnaire required a split between professional and retail markets for all constituents used. Data sources are either from official national statistics, expert estimates based on related statistics or straight forward production expert estimations.

The received data show that there is an increase in the use of composted organic material in some countries, in particular for the hobby sector. Synthetic materials are of no importance in EU growing media sector. Due to the specific properties of mineral materials, these are often applied in professional media.

The availability and price of organic materials other than peat, i. e. bark or coir, often determines wether a material is used as a constituent or not. Bog peat is still the overall predominant growing medium constituent in the EU. This is also true for member states without domestic peat production. Peat-free growing media are highly esteemed by some stakeholder and user groups but still play an overall inferior role in industrial production of growing media.

Table 40: Amounts of composted materials (in m³ in 1000 t according to EN 12580) used for the production of growing media in major producer countries in the EU (Pro = professional market; Hob = hobby market).

	Composted or aged bark		Composted bio-degradable waste (mainly green waste)		Composted bark with wood[1]; composted woodwaste[2]		Other composted materials (synthetics, fibres…)	
Country:	Pro.	Hob.	Pro.	Hob.	Pro.	Hob.	Pro.	Hob.
AT	15	45	3	27	0	0	0	0
BE	30	25	5	25	0	0	0	0
DK	0	0	0	10	0	0	0	0
FI	0	1	0	50	0	0	0	0
FR	223	590	1	56	0	0	37	104
DE	20	25	100	150	0	0	0	0
IE	1	5	0	80	0	0	0	0
IT	0	0	20	247	0	0	0	0
NL	20	15	28	35	0	0	0	0
PO	0	0	0	0	0	0	0	0
ES	0	0	0	0	50	500	0	0
SE	8	15	2	5	0	0	0	25
UK	121	260	2	90	13	67	0	0
Total	438	981	161	775	63	567	37	129

[1]Data for Spain; [2]Data for UK

Alternative use of compost in growing media in 2005 - 0.95 million m³
Use of bark in growing media (incl. wooden materials) 2.05 million m³

3.4 Further material types as potential input for composting

The study required in its scope the quantitative and qualitative estimations of organic material flows in Europe. Some qualitative and quantitative assessments where made in the table above for the municipal solid waste sector, bio- and green waste, sewage sludge, agricultural residues and peat.

In order to complete the entire picture or the organic material flow outside the typical municipal waste area corresponding questions were included in the questionnaires which were sent to the Member States. Only in very few cases we got data because most of these materials are not subject to typical waste statistics. The results were not sufficient, comparable and consistent in order to allow a European survey.

As an alternative based on a consistent evaluation of the entire organic waste stream of one country (here Germany; Ottow & Bidlingmaier, 1997[b23]) a projection for the EU27 was made in order to show the magnitude of organic material flows including the sector food and forestry residues, agro industry materials and food and beverage residues. A total potential for the EU27 could be calculated with 2,345 million t.

In principal all the organic material listed in the table below can be composted, sometimes a pre-treatment is necessary. The suitability of treating those materials in an aerobic composting process depends on the composition, degradability, water or nutrient content (C/N-ratio). So not for each of the materials composting is first choice. E.g. most of the food and vegetable residues are very wet which recommends anaerobic digestion. For bark and wood energy generation might be the preferred option. The very differing properties even within one considered sub-waste streams (e.g. market wastes) makes it impossible to evaluate their contribution to a compost production in Europe.

Table 41: Amount of organic residues in Germany which not belong to household waste and EU27 projection

	DE 1993[1)] (61 mio inh.)	DE 1993	EU 27 projection
Waste type and origin	**Quantity t/f.m.**	**(t/f.m. per inh)**	**Quantity t/f.m. x 485 mio inh.**
1. Food residues			**Total 41 mio. t**
Food preparation	3,921,000	0.064	12,000,000
From markets	2,164,000	0.035	17,200,000
Catering waste	731,000	0.012	5,800,000
Spoilt food residues	679,000	0.011	5,400,000
Food product residues	103,000	0.002	0,800,000
2. Forestry residues			**Total 90 mio, t**
Bark	1,300,000	0.021	10,400,000
Wood residues	10,000,000	0.136	79,400,000
3. Agro industries			**Total 2,182 mio t**
Animal husbandry excrements	220,000,000	3.606	1,749,200,000
Husbandry excrements which are a real surplus	1,500,000	0.025	(12,100,000)
Straw in total	25,000,000	0.409	198,400,000
Straw residues (real surplus production)	10,000,000	0.163	(79,400,000)
Sugar beet and potato haulm	28,000,000	0.459	222,600,000
Residues of growing of beans, peas, flax and vegetables	1,500,000	0.025	12,100,000
4. Food & beverage industry			**Total 122 mio t**
Breweries and malt houses	2,035,000	0.034	16,300,000
Wineries	310,000	0.005	2,500,000
Fruit and vegetable production industry	252,000	0.004	1,900,000
Potato industry incl. starch	60,000	0.001	485,000
Sugar beet residues and soils	3,120,000	0.051	24,800,000
Slaughterhouse residues	1,375,000	0.023	10,900,000
Meat production	226,000	0.003	1,800,000
Whey	8,000,000	0.131	63,600,000
Total for the EU27			**2,345 mio t**

1) Ottow & Bidlingmaier (1997)

An extrapolation of the German organic waste and residues potential for the EU27 might obtain misleading results. Therefore an additional evaluation was made on the basis of another detailed and comprehensive study about the energy potential from biomass in the EU27 which considers similar streams of waste and residuals like the German based prognosis (Thrän et al., 2007[b24]). Unfortunately the whole study shows only energy potentials and does not refer to the volumes of material streams which nevertheless are the basis of the energy potential calculation. The consultancy which executed the study refused to provide the database of the materials stream volumes but delivered the calculation model for the different streams for the transformation from mass to the energy potentials. These energy figures are used to recalculate the size of the different material streams and the total volume per country. All calculation models, the assumptions and restrictions for the evaluation for the different streams of waste and residues made in the biomass study can be found in the Annex 4 of this report.

The biomass study used the year 2000 as a baseline and calculated the potentials in addition for the years 2010 and 2020. Because there has been no significant difference over the 20 years' period, the year 2020 is used for the calculations in the following tables.

Table 42: Potential of different organic residues and waste streams in EU27 for 2020 (Thrän, 2007)

Annual potential of the different material streams	Quantity t f.m.
Herbaceous residues, by-products and waste	**Total 59.54 mio t**
Cereal straw	34,030,000
Maize straw	15,700,000
Rapeseed straw	3,800,000
Sunflower straw	4,130,000
Other straw (beans, peas)	1,880,000
Excrements and litter	**Total 1,229.23 mio t**
Excrements from animals	1,201,010,000
Litter (bedding of animals)	28,220,000
Other harvest residues	**Total 61.85 mio t**
Beet leaf	44,680,000
Potato leaf	17,170,000
Commercial and industrial waste	**Total 14.83 mio t**
Brewing residues	3,860,000
Grape pressing	730,000
Sugar production	610,000
Slaughterhouse by-products	2,600,000
Waste water from the milk processing industry	7,030,000
Sewage sludge	**Total 2.44 mio t**
Organic municipal waste	**Total 69.54 mio t**
Total EU27 and all waste streams	**1,437 mio t**

The assumptions and considerations for the different streams are made from the energy perspective and don't always reflect the entire aspects for the quantification of the waste and residues volume. For example the small sludge quantity (2.44 million t) included only the part of the sludge which was sent for incineration. For the other waste streams the assumptions fit into the concept of this compost study and deliver for comparable materials streams the same order of magnitude like the Germany based prognosis. E.g. around 70 million t for organic waste compared to a potential of 80 million t in this study, surplus straw amounts in the EU27 survey up to 60 million t compared to 70 million tons in the Germany based figures. Because animal husbandry is not common on the same level in Europe like in Germany, the amount of animal excrements in the EU27 calculation with 1,200 million t might fit better than the German based value of 1,700 million t.

The essential stream of wooden material and some other smaller ones are only included in the Germany based survey. So the full overall potential of the organic waste and residues stream in the EU27 will be higher than shown in the table before and might amount up to a range between 1,600 and 2.000 million t annually. Thus the Germany based prognosis of 2,400 million t for EU 27 might be too high.

The following table shows the prognosis for the different Member States. Most of the volumes will be generated in the EU15. Because of the number of inhabitants Germany, France, Italy, Spain, UK and Poland these countries show the highest potentials with organic municipal waste and commercial waste. Most of the straw potential arises in the territorial states Germany and France.

Table 43: Country specific potential of organic residues and waste in EU for 2020 (Thrän, 2007)

Member State	National organic waste and residues potential for EU27 in million t f.m. per y						
	Total	**Excrements & Litter**	**Other harvest residues**	**Commercial & industrial waste**	**Sewage sludge**	**Organic municipal waste**	**Straw**
AT	**29.35**	26.04	1.14	0.45	0.12	0.53	1.07
BE	**48.35**	43.73	2.56	0.64	0.04	0.84	0.55
BG	**11.90**	9.07	0.10	0.06	0.00	1.33	1.34
CY	**1.98**	1.73	0.03	0.00	0.00	0.19	0.02
CZ	**27.21**	22.27	1.36	0.81	0.03	1.38	1.37
DE	**213.43**	180.81	10.81	2.85	0.48	10.05	8.43
DK	**51.22**	47.04	1.40	0.42	0.05	0.70	1.62
EE	**3.06**	2.65	0.06	0.00	0.00	0.23	0.11
ES	**129.41**	111.35	3.18	0.97	0.24	9.23	4.44
FI	**14.00**	11.46	0.58	0.25	0.01	1.00	0.69
FR	**247.71**	209.39	11.52	2.14	0.30	9.73	14.63
GR	**12.09**	8.31	1.07	0.13	0.02	1.54	1.02
HU	**27.65**	21.50	1.07	0.09	0.03	1.63	3.33
IE	**63.37**	61.15	0.62	0.46	0.01	0.78	0.35
IT	**102.89**	82.66	4.45	1.20	0.34	9.66	4.59
LT	**10.89**	9.43	0.62	0.00	0.00	0.43	0.42
LU	**4.63**	4.54	0.00	0.00	0.00	0.08	0.01
LV	**4.55**	3.92	0.36	0.00	0.00	0.11	0.16
MT	**0.54**	0.46	0.00	0.00	0.00	0.08	0.00
NL	**77.31**	70.23	3.63	1.30	0.24	1.57	0.34
PL	**111.60**	92.34	9.12	0.92	0.15	4.89	4.18
PT	**22.06**	19.47	0.39	0.13	0.00	1.70	0.38
RO	**49.51**	41.34	1.20	0.13	0.00	2.65	4.19
SE	**22.86**	18.81	1.10	0.36	0.05	1.52	1.02
SI	**6.04**	5.20	0.13	0.30	0.00	0.30	0.11
SK	**11.41**	9.89	0.49	0.00	0.02	0.35	0.66
UK	**132.44**	114.46	4.87	1.23	0.34	7.05	4.49

4 Task 4 – Markets

4.1 Task 4.1 Production potentials

In the task 2.1 we used the more realistic approach of estimating the collection potential for organic waste. Only very few national forecast figures are available about the intended composting treatment capacity and even those rely on possible capture rates for the organic waste and the necessary national diversion rate in order to meet the Landfill Directive. Lately more and more mechanical biological treatment alternatives are in discussion.
Nevertheless, in the following section we provide some information on alternative treatment options for organic waste which, in principle, would be suitable for composting.

4.1.1 European Situation and background

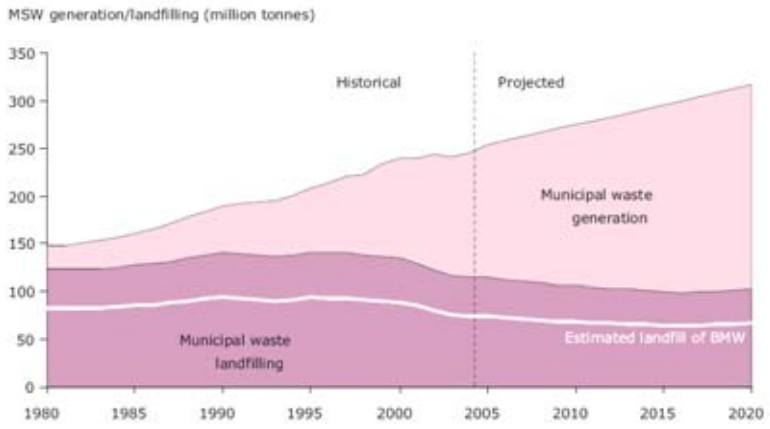
A huge pressure in most of the Member States to develop policies, concepts and treatment options for organic waste by the EU Landfill Directive exists in Europe because of the diversion targets for biodegradable municipal solid waste. On the basis of biodegradable municipal waste generated in 1995 biodegradable municipal waste BMW going to landfill must be reduced to:

- 16 July 2006 75 %
- 16 July 2009 50 %
- 16 July 2016 35 %.

A derogation of not more than four years for each of the above targets (i.e. 2010, 2013 and 2020) is available for Member States which in 1995 landfilled more than 80% of their collected municipal waste.

These target can be met by separate collection and composting/anaerobic digestion or by partly alternative treatments like mixed waste composting, mechanical biological treatment MBT or/and incineration. Landfilling of organic waste is no longer acceptable. A recent EEA survey (EEA, 2007) [b25] about the effects and implementation status of the EU Landfill Directive clearly reflect the position of the EU policy makers: "In municipal waste management, landfilling of untreated waste it generally the worst option for the environment because of its emissions of methane, its long-term emissions on to soils and groundwater as was well as the loss of resources it entails."

According to the survey the development of landfilling of MSW will be totally decoupled in future from the strong increase of MSW generation projected with a 25 % increase from 2005 to 2020 in the EU25. Meeting the diversion targets and rates of the EU Landfill Directive in the EU25 has to lead to a constant development of the biodegradable municipal solid waste amount which can be landfilled after 2005 on a level of between 60 and 70 million t annually.



Note: Figures from 1980–2004 are data from Eurostat. Figures from 2005–2020 are projections.

Source: ETC/RWM (2007).

Figure 28: Projected generation and landfilling of municipal waste in the EU-25

Because of the increase of the 25 % MSW generation will probably include an increase of biodegradable municipal waste (BMW) amounts on the same level until 2020 additional efforts for BMW diversion and treatment will be required. The necessary capacities are already insufficient now therefore the study concluded that *"based on the current policies it is estimated that based on the current policies the EU 25 will not meet them (= the targets). Thus, more efforts are required if targets have to be met."*

In most of the Member States it is still unclear if or to which extent organic waste is really recycled by means of separate collection and subsequent composting or anaerobic digestion. Until 2007 most of the MS which have a long way to go for meeting the BMW diversion targets have just some implemented very general concepts in their national waste management plans for the coming years not followed until now by "the required efforts" in practice (e.g. BMW waste legislation, pilot projects for collection and treatment, strategies…) and the national BMW management programmes including the necessary budget.

A good example about efforts needed to establish national biowaste management are the activities of the Waste Resource and Action Programme WRAP in UK which is intended to promote recycling and to create markets for recycled products. After 7 years of activities on a national level and with a large budget it can be stated that now most of the necessary biowaste management tools are in place when it comes to research, pilot schemes, pilot treatment plants, standards, awareness campaigns, substantial information and education of the involved parities.

So it is more likely that BMW landfilling will rise in future and follow the prognosis in the EU study of a 25% increase of the MSW generation until 2020 to large extent. As an alternative mechanical biological treatment might increase because it is easier and faster to implement compared to incineration and will show a better public acceptance. Compared to real recycling by separate collection and composting, MBT is not the preferred option because the stabilised organic fraction has to be landfilled anyhow and a lot of the benefits of compost are then landfilled, too. Nevertheless MBT allows shifting to the treatment of separately collected biodegradable waste at a later stage because it used similar composting and digestion technologies.

Table 44: Common organic waste treatment options in the EU Member States

Organic waste treatment options	Bio and green waste composting B/GWC	Anaerobic digestion AD	Mixed municipal solid waste composting MSWC	Mechan. biological treatment MBT	Landfilling LAND	Incine-ration INCIN
AT	**x**	**x**	**-**	**x**	**-**	**x**
BE	**x**	**-**	**-**	**-**	**-**	**x**
CY	**-**	**-**	**-**	**-**	**x**	**-**
CZ	**x**	**-**	**-**	**-**	**x**	**x**
DE	**x**	**x**	**-**	**x**	**-**	**x**
DK	**x** GWC	**-**	**-**	**-**	**-**	**x**
EE	**x**	**-**	**-**	**-**	**x**	**-**
ES	**x**	**x**	**x**	**-**	**x**	**x**
FI	**x**	**x**	**-**	**x**	**x**	**-**
FR	**x**	**-**	**x**	**-**	**x**	**x**
GR	**-**	**-**	**-**	**x**	**x**	**-**
HU	**x**	**-**	**-**	**x**	**x**	**-**
IR	**x**	**x**	**-**	**x**	**x**	**-**
IT	**x**	**-**	**-**	**x**	**-**	**x**
LT	**x**	**x**	**-**	**x**	**x**	**-**
LU	**x**	**x**	**-**	**-**	**x**	**-**
LV	**-**	**-**	**-**	**-**	**x**	**-**
MT	**-**	**-**	**-**	**-**	**x**	**-**
NL	**x**	**-**	**-**	**-**	**-**	**x**
PL	**x**	**-**	**x**	**x**	**x**	**-**
PT	**x**	**x**	**x**	**x**	**x**	**x**
SE	**x**	**x**	**-**	**-**	**-**	**x**
SI	**x**	**-**	**-**	**x**	**x**	**-**
SK	**x**	**-**	**-**	**-**	**x**	**-**
UK	**x**	**x**	**-**	**x**	**x**	**-**
Number of MS	**21**	**10**	**4**	**12**	**18**	**11**

It is quite interesting to see in the table that the advanced Member States in Central Europe more or less use all treatment and recycling options. Their advanced status in waste management allows a waste stream specific approach even for the biodegradable waste which includes optimised treatment and recycling.

The new Member States and large part of Southern Europe doesn't show enough treatment or recycling capacities for the moment. Here strategic decisions have to be made which set the frame and boundaries for waste management for the next years. Supplementing guidance for these Member States by a European Biowaste Strategy or Biowaste Directive would be very beneficial in steering developments to successful solutions which are common practice in the advanced countries. This will make it easier for the starting countries to meet the Commission's target for resource management and the intended European Recycling Society.

4.1.2 Organic material recovery solutions in the Member States

The EEA survey is supplemented by a set of 25 factsheets[b26] (EEA 2007a) for the 25 countries which contain information about national waste legislation, policies, waste management and tools implemented or planned to manage municipal waste including the biodegradable portions. Below a country specific survey about the Member States' instruments which are intended to manage biodegradable waste.

Alternative treatments to separate collection and composting are depending on national policies which can change within a short period of time as demonstrated in Portugal and Ireland recently when the national biodegradable waste strategy after new political majorities shifted from ambitious separate collection and composting targets to a mechanical biological treatment based strategy.

OPTIONS	B/GWC	AD	MSWC	MBT	LAND	INCIN
AT	**x**	**x**	**-**	**x**	**-**	**x**

Biological waste treatment

Country wide statutory separate collection of bio- and green waste and the necessary composting capacity exist.

Landfilling and mechanical biological treatment

Austria has realised a national ban on landfilling of untreated and biodegradable waste in 2004 and meets the targets of the EU landfill directive. MBT plants with 0.5 million tons of treatment capacity stabilise the organic part of the residual MSW (after separate collection of bio-waste) so it meets the Austrian acceptance and storage criteria for landfills.

Incineration

Incineration is well established in Austria but besides sewage sludge not for organic waste.

OPTIONS	B/GWC	AD	MSWC	MBT	LAND	INCIN
BE	**x**	**-**	**-**	**-**	**-**	**x**

The Waste Management System in Belgium is assigned to the 3 regions. Each region has its own waste management legislation and policy. No information from the Brussels region is available.

Biological waste treatment

Separate collection of bio- and green waste and the necessary composting capacity exist in Flanders supplemented by a waste prevention programme which reduces the waste amount for landfilling and incineration.

Landfilling and mechanical biological treatment

Landfilling of waste is intended to be reduced to the maximum level by waste prevention, recycling and mechanical biological treatment in Flanders. Only waste which can't be recycled or incinerated should be landfilled. Flanders meets already the reduction targets of the landfill directive after a ban on landfilling of organic waste in 2005. Wallonia follows Flanders in principle with a certain delay.

Incineration

Incineration is well established in Flanders and Wallonia.

OPTIONS	B/GWC	AD	MSWC	MBT	LAND	INCIN
CY	**-**	**-**	**-**	**-**	**x**	**-**

Biological waste treatment

In order to meet the EU diversion targets biological waste treatment capacities have to be built.

Landfilling

The full implementation of the landfill directive is planned for the year 2009. It requires a number of up to 100 existing landfill sites to be closed and replaced by 4 non-hazardous waste treatment and disposal centres plus 1 hazardous waste treatment centre. It also requires the establishment of a separate collection system for recyclable (packaging) waste and the promotion of composting of biodegradable waste.

Incineration

No essential capacities recorded

OPTIONS	B/GWC	AD	MSWC	MBT	LAND	INCIN
CZ	**x**	**-**	**-**	**-**	**x**	**x**

Biological waste treatment

The National Waste Management Plan 2002 -2013 in the Czech Republic includes challenging targets for separate collection and composting of biowaste in its Implementation Programme for biodegradable waste.

Landfilling

An implementation plan of the Landfill Directive has been prepared already in the year 2000 to meet all the nine key requirements of the EU landfill directive.

Incineration

Incineration capacity is part of the Czech waste management.

OPTIONS	B/GWC	AD	MSWC	MBT	LAND	INCIN
DE	**x**	**x**	**-**	**x**	**-**	**x**

Biological waste treatment

Country wide separate collection of bio- and green waste and the necessary composting and anaerobic digestion capacity of around 12 million t annually exist.

Landfilling and mechanical biological treatment

Germany has realised a national ban on landfilling of untreated and biodegradable waste by June 2007 and surpassed the targets of the EU landfill directive already. Around 50 MBT plants with 5.5 million tons of treatment capacity stabilise the organic part of the residual MSW (after separate collection of bio-waste) so it meets the German acceptance and storage criteria for landfills.

Incineration

Incineration is well established in Germany but besides sewage sludge not for organic waste. Additional capacity is under construction especially designed for the high calorific fraction from MBT.

OPTIONS	B/GWC	AD	MSWC	MBT	LAND	INCIN
DK	**x** GWC	**-**	**-**	**-**	**-**	**x**

Biological waste treatment

Collection and composting of green waste is well developed and diffused in Denmark. Bio-waste composting stays more or less on a pilot scale.

Landfilling

The number of landfill facilities in Denmark is expected to be reduced further. The requirements laid down in the Statutory Order on Landfill Facilities are expected to lead to the closure of 40-60 landfill facilities (out of the approx. 150 existing facilities) before 2009.

Incineration

Denmark largely relies on waste incineration. The general strategy is a ban on landfilling of waste that can be incinerated (is suitable for incineration).

OPTIONS	B/GWC	AD	MSWC	MBT	LAND	INCIN
EE	**x**	**-**	**-**	**-**	**-**	**-**

Biological waste treatment

The Estonian National Waste Plan suggests the collecting garden waste in cities and enhancing home composting in rural areas.

Landfilling

For biodegradable municipal waste, the Estonian National Waste Plan gives a general priority to separate bio-waste from mixed MSW before landfilling. The plan proposes to increase bio-waste recovery from 20.000 t in 2000 to 290.000 to 350.000 t in the year 2020 and to decrease landfilling of biodegradable waste from 390.000 to 450.000 t in 2000 to 40.000 t in 2020. This shift of capacities requires essential alternative treatment by composting or mechanical biological treatment.

Incineration

No essential capacities recorded.

OPTIONS	B/GWC	AD	MSWC	MBT	LAND	INCIN
ES	**x**	**x**	**x**	**-**	**x**	**x**

Biological waste treatment

The National Waste Management Plan NWMP 2000-2006 indicates a general target for BMW (mixed biological municipal solid waste including food and garden waste and paper) recycling by treating a minimum 40% by 2001 and 50% by 2006 of the total arising by composting and AD. The Plan intends to enhance energetically valorisation by means of anaerobic digestion of 2% of BMW by 2001 and 5% by 2006.

The National Plan on Waste states a general target for green waste to be separately collected and recycled: 50% by 2002 and 80% by 2006. Food waste should be separately colleted starting from big producers (restaurants, canteens, etc). All municipalities > 5000 should introduce separate collection. Source separation of biowaste (mainly food waste) is only implemented mandatory in Catalonia.

Landfilling
All uncontrolled landfills should to be closed by 2006 according to the 2000 National Waste Management Plan. By 2006 all landfill sites will be managed according to the requirements of the EU Directive, estimating that 33.1% of MSW will be eliminated via landfilling.
Incineration
The National Waste Management Plan from 2000 foresees to incinerate 9% of MSW by 2001 and 17.7% by 2006.

OPTIONS	B/GWC	AD	MSWC	MBT	LAND	INCIN
FI	**x**	**x**	**-**	**x**	**x**	**-**

Biological waste treatment
A most important policy document in relation to biodegradable waste management is the National Strategy on Reduction of Disposal of Biodegradable Waste on landfills according to the EU landfill directive requirements. This strategy also provides means and assistance in order to reach the objectives set out in the landfill directive. Scenarios of the strategy give statistics and forecasts for biodegradable waste production and treatment for the years 1994, 2000, 2006 and 2012.
The strategy contains an assessment of present biodegradable waste quantities and a forecast and various technological (incl. composting, digestion, mechanical biological treatment) and infrastructural scenarios including waste prevention.
Landfilling
The Finish waste management strategy in the past was already quite effective in reduction efficiency for biodegradable waste on landfills with less than 50 % of the volume than 10 years before.
Incineration
No essential capacities recorded.

OPTIONS	B/GWC	AD	MSWC	MBT	LAND	INCIN
FR	**x**	**-**	**x**	**-**	**x**	**x**

Biological waste treatment and mechanical biological treatment MBT
Composting of selected biodegradable MSW is increasing but is still not consolidated (141,000 t in 2002). MSW mixed bio-composting (called raw waste composting) is expected to increase essentially due to advanced technology screening and new lower national thresholds for the compost quality.
In the last years the collection of green waste has strongly progressed through the setting up of collection points. Also, the French agency ADEME has supported numerous composting projects.
The biological pre-treatment of waste is not widespread in France, but the experiences of the existing sites are followed with interest.
Landfilling
Today waste landfilling still represents the most applied management options for MSW in France: 42% of MSW are sent to landfills in 2002. From 2009 all landfills shall comply with the EU landfill directive requirements and diversion requirements.
France already largely respects the targets of 2006 and 2009 set by EU Directive on landfills. However, the estimated amount of biodegradable municipal waste going to landfill in 2016 is 40% of the total amount produced in 1995 but 35% is required by the EU Landfill directive for 2016. In accordance with this requirement the waste management plans have been revised with a stronger orientation towards recycling.
Incineration
There are approximately 130 incinerators at present in France. Some waste management plans foresee the construction of new incineration plants, some of which are already under construction. It is estimated that the amount of waste going to incineration will increase by 1- 2% in the next years. The capacity allows the biodegradable waste can be incinerated to a certain extent.

OPTIONS	B/GWC	AD	MSWC	MBT	LAND	INCIN
GR	**-**	**-**	**-**	**x**	**x**	**-**

Biodegradable waste treatment
Legislation JMD 50910 repeats the dual commitment of the Greek government to close down all illegal landfills by the end of 2008 and to reduce the biodegradable municipal waste to 65% by 2020. Intermediate targets are: 25% (2010) and 50% (2013). The targets will be achieved through the

operation of recycling and composting facilities in almost all regions of the country as well as through the full operation of the separate collection systems for selected waste streams.
At the moment, there are no facilities processing source separated organic waste, although it would be fairly easy to do so with at least the green wastes, as they are collected separately anyway and some municipalities have thought of doing so.

Mechanical biological treatment MBT

Various regional waste management plans foresee the construction of MBT plants as the main tool to meet the Landfill Directive targets. At present 3 such plants are in operation. Obviously, while the option to revise the waste management plans to include other options such as thermal treatment or source separation is always open, but conditions for any of these options do not seem to be mature yet.

Landfilling

Until the early 1990s, the use of uncontrolled dumps was the "traditional" method of solid waste disposal. Since then, the overall situation has dramatically improved: There are 45 sanitary landfills constructed in Greece (41 already operational) whereas 47 more sites are under construction including the expansion of existing ones. Last data for the year 2003 reports that 1032 dumping sites, mainly small, were still operating in various municipalities of the country. It is expected that by the end of 2008, uncontrolled waste dumping will cease to exist.

Incineration is not well diffused in Greece

OPTIONS	B/GWC	AD	MSWC	MBT	LAND	INCIN
HU	**x**	**-**	**-**	**x**	**x**	**-**

The National Waste Management Plan (NWMP) valid from 2003 till 2008 prescribes the general tasks of waste management in Hungary. Main goals and targets:

Biological waste treatment

50% reduction of landfilled quantity of biodegradable waste of the volume generated in 1995 till 2007
The National Bio-waste Programme (BIO-P, 2005-2008) has the following preferences to reduce BMW: recycling (paper), composting, anaerobic digestion (biogas generation), MBT, thermal utilisation.
The needed capacity building until 2008 is 460.000 t/y composting and 100.000 t/y MBT (HU[57])

Landfilling

Revision and liquidation of the old landfill sites till 2009. At the end of 2008 approximately half of all waste not including biomass must be recovered or used in power engineering

Incineration

The old waste incinerators will be renovated or closed till 2005 (accomplished).

OPTIONS	B/GWC	AD	MSWC	MBT	LAND	INCIN
IR	**x**	**x**	**-**	**x**	**x**	**-**

The Irish waste management policy includes the meaningful strategy for a dramatic reduction in reliance on landfilling, in favour of an integrated waste management approach which utilises a range of waste treatment options to deliver effective and efficient waste services and ambitious recycling and recovery targets. Alternative waste treatment options like composting, digestion, MBT or incineration more or less doesn't exist.

National Strategy on Biodegradable Waste (2004) sets the following targets for 2013:

- Diversion of 50% of overall household waste away from landfill
- A minimum 65% reduction in Biodegradable Municipal Waste (BMW) sent to landfill
- Developing biological treatment capacity (composting, MBT or AD) of up to 300,000 t/y
- Recycling of 35% of municipal waste
- Rationalisation of municipal waste landfills to a network of 20 state-of-the art sites
- Reduction of methane emissions from landfill by 80%

[57] STRATEGIC EVALUATION ON ENVIRONMENT AND RISK PREVENTION UNDER STRUCTURAL AND COHESION FUNDS FOR THE PERIOD 2007-2013 - Contract No. 2005.CE.16.0.AT.016. "**National Evaluation Report for Hungary - Main Report"** Directorate General Regional Policy. A report submitted by GHK Brussels, Nov. 2006, p. 217. http://ec.europa.eu/regional_policy/sources/docgener/evaluation/pdf/strategic_environ.pdf (download 15 Oct. 2007)

OPTIONS	B/GWC	AD	MSWC	MBT	LAND	INCIN
IT	**x**	**-**	**-**	**x**	**-**	**x**

Integrated biodegradable waste management with composting, MBT and incineration

Italy has established well up-to-date waste management options in an integrated way according to the specific properties of the different material flows using separate collection and recycling and the treatment options incineration (incl. energy recovery), mechanical biological treatment (12 million t annual capacity - to segregate the high calorific faction and to stabilise the organic part before landfilling) and composting of source separated bio- and green waste (2.8 million t/y).

Landfilling and biological mechanical treatment MBT

In Italy the implementation of the Landfill Directive has been carried out with a big effort from all the actors involved, and it is showing promising results. It includes very strict limits as regards organic matter (TOC) and the calorific value of the waste to be landfilled. So pre-treatment of the waste by means mechanical biological treatment to allow to stabilisation or energy recovery is necessary.

Coherently with decree 36/03 the Regions shall plan a strategy in order to decrease the amount of biodegradable waste going to landfills. Before 27 March 2008 biodegradable municipal waste must be reduced to less than 173 kg per inhabitant per year, before 27 March 2011 to less than 115 kg and before 27 March 2018 to be reduced to less than 81 kg per inhabitant per year

The waste management strategy identifies the following instruments to be implemented in order to achieve the targets:

- economic instruments to discourage landfill disposal
- separate collection of organic, wooden and textiles fractions
- mechanical/biological treatment
- biological treatment
- incineration with energy recovery
- ban on landfilling of certain waste streams

OPTIONS	B/GWC	AD	MSWC	MBT	LAND	INCIN
LT	**x**	**x**	**-**	**x**	**x**	**-**

Biological waste treatment

The development of the overall waste management system in Lithuania from 2006 aimes at meeting the targets of diverting biodegradable waste from landfills set in the landfill directive. It is assumed that set targets will be met by increasing the efficiency of separate collection of biodegradable waste and recyclables and implementation of facilities for treatment and recovery of biodegradable waste, i.e. composting.

In regional waste management projects currently under implementation, construction of green waste composting facilities is foreseen in most of the municipalities. However, in order to meet the stringent requirements of the Landfill Directive it is also envisaged that in future some form of additional waste treatment will be required, i.e. incineration (with energy recovery), mechanical-biological treatment, anaerobic digestion, etc.

In Lithuania many waste management companies have started composting activities due to a ban on the disposal in landfills of biodegradable waste from gardens, parks and greeneries,.

Landfilling

The lack of environmentally safe waste disposal sites is a key problem of waste management in Lithuania. Special efforts have to be invested into the development of new landfills which meet all environmental requirements included in EC Directive 1999/31/EC. Lithuania has indicated that no landfilling will take place in non-complying landfills after 16 July, 2009.

Incineration

There are no waste incinerators in Lithuania designed specifically for the combustion of waste.

OPTIONS	B/GWC	AD	MSWC	MBT	LAND	INCIN
LU	**x**	**x**	**-**	**-**	**x**	**-**

National and local Waste Management Plans from 2005 includes the following quantitative objectives (% by weight) should be attained for domestic waste, bulky waste and similar wastes (reference year: 1999):

- organic wastes: rate of recycling of 75 %
- rate of recycling of 45 %
- other recoverable wastes: rate of recycling of 45 %

No further detailed information on landfilling and incineration is available.

OPTIONS	B/GWC	AD	MSWC	MBT	LAND	INCIN
LV	**x**	**-**	**-**	**-**	**x**	**x**

Biological waste treatment

No biological treatment besides pilot projects

Landfilling

Latvia relies on landfilling

Incineration

No incineration capacity for MSW.

OPTIONS	B/GWC	AD	MSWC	MBT	LAND	INCIN
MT	**-**	**-**	**-**	**-**	**x**	**-**

Biological waste treatment

No biological treatment, only one pilot project on composting. Activities for separate collection and composting were intended for 2006 with no real progress until now.

Landfilling

Malta relies on landfilling

Incineration

No incineration capacity for MSW.

OPTIONS	B/GWC	AD	MSWC	MBT	LAND	INCIN
NL	**x**	**-**	**-**	**-**	**-**	**x**

The Ministry of Environment has issued a National Waste Management Plan for the period 2002 to 2012 with the essential provision to promote waste recovery, particularly by encouraging waste separation at source and subsequent separation of waste streams. Waste separation allows for product reuse, material reuse and use as fuel. The level of waste recovery must accordingly increase from 81% in 2000 to 86% in 2012.

Biological waste treatment

The Netherlands show with 3.3 million tons/year the highest recovery rate for source separated bio- and green waste in Europe.

Landfilling

Landfilling of the surplus combustible waste, as currently happens, must be finished within five years. The Waste (Landfill Ban) Decree came into force in 1995 and prohibits landfilling of waste if there is a possibility for reusing, recycling or incinerating the waste. According to the Waste Management Plan the quantity of waste to be disposed of in 2012 should be limited to a maximum (rounded) of 9.5 million tons - mainly non combustible waste, incineration residues and sewage sludge.

Incineration

Incineration should optimise use of the energy content of waste that cannot be reused by high energy efficiency waste incineration plants.

OPTIONS	B/GWC	AD	MSWC	MBT	LAND	INCIN
PL	**x**	**-**	**x**	**x**	**x**	**-**

Biological waste treatment

Biological waste should be collected separately by a 2 bins system mainly in the cities. Before July 2013 not less than 1.7 million tons/year, before 2020 not less than 2.2 million tons capacity should be installed which means the construction of 50 composting plants between 10.000 t and 50.000 t capacity.

In practice today there is only mixed waste composting with low qualities mainly used as landfill cover.

Referring to garden waste n the National Waste Management Programme it is implied that 35% of this waste category will undergo the process of composting in 2006, and 50% in 2010.

Landfilling

Poland has been granted a transition until 2012 for the implementation of the Landfill Directive. According to the Treaty of Accession, intermediate targets until 2012 were set out for each year, how much waste may be deposited in landfills.

Incineration

No essential capacities recorded

OPTIONS	B/GWC	AD	MSWC	MBT	LAND	INCIN
PT	**x**	**x**	**x**	**x**	**x**	**x**

Biological waste treatment

In order to reduce biological waste going to landfills the 2003 National Portuguese Strategy promotes separate collection and composting or anaerobic digestion. An increased capacity from 285.000 t for organic waste in 2005 up to 861.000 t in 2016 should be constructed with 10 large and several small organic waste treatment plants.

Landfilling

In 2003 the National Strategy for the reduction of biodegradable urban waste from landfills came into force in order to meet the EU Landfill Directive requirements. Additional recycling and incineration capacities should help to fulfil the diversion targets. After the latest election mechanical biological treatment is prioritised instead of recycling via composting or digestion of separately collected organic waste.

Incineration

A third incineration plant and extension of the existing incinerators is intended.

OPTIONS	B/GWC	AD	MSWC	MBT	LAND	INCIN
SE	**x**	**x**	**-**	**-**	**-**	**x**

Biological waste treatment

- • 2010 at least 50% of household waste is recycled, incl. biological treatment
- • 2010 at least 35% of food waste from households, restaurants, institutions and shops is recycled through separate collection and biological treatment.
- • 2010 food waste from food industry is recycled through biological treatment.
- Biological treatment will be mainly - besides green waste composting - based on anaerobic digestion.

Landfilling

Ban on combustible waste 1 January 2002 and on compostable waste: 1 January 2005

Inadequate statistics on how much combustible and organic waste is landfilled make it difficult to assess the need for increased capacity to comply with the prohibitions.

No essential activities on mechanical biological treatment MBT

Waste incineration is well accepted and diffused

OPTIONS	B/GWC	AD	MSWC	MBT	LAND	INCIN
SI	**x**	**-**	**-**	**x**	**x**	**-**

Based on the criteria of the Waste Framework Directive and Directive on Landfill of Waste, combined with other Directives in municipal waste sector, the Cohesion Fund priority projects in waste sector were identified on the basis of the National Waste Management Strategy and the Action Plan of Municipal Waste Management 2000 to 2006, and are focused on the construction of new infrastructure facilities in the scope of regional waste management centres.
Implementation of legislation on incineration, and biowaste collection started in 2001 but with nearly no real transformation in treatment plants especially for bio and green waste.

Biological waste treatment

The Slovenian Report about the needs for the next Cohesion Funds (SI [1)]) period estimate in figure 9.13 for 2013 the need of 270.000 t of MBT treatment and 147.000 t composting capacity for separately collected bio-waste.

No references to landfills and incineration capacities are given.

SI [1)] STRATEGIC EVALUATION ON ENVIRONMENT AND RISK PREVENTION UNDER STRUCTURAL AND COHESION FUNDS FOR THE PERIOD 2007-2013 - Contract No. 2005.CE.16.0.AT.016. "**National Evaluation Report for Slovenia - Main Report"** Directorate General Regional Policy. A report submitted by GHK Brussels, Nov. 2006 http://ec.europa.eu/regional_policy/sources/docgener/evaluation/pdf/strategic_environ.pdf (download 15 Oct. 2007)

OPTIONS	B/GWC	AD	MSWC	MBT	LAND	INCIN
SK	**x**	**-**	**-**	**-**	**x**	**-**

Waste Act No. 223/2001 Coll. regulates the whole waste management. The waste management plan WMP SR for 2006-2010 was approved by the Government in 2006. Municipalities prepare waste management plans and are responsible for all waste generated within.

Biological waste treatment

Article 18 (3m) of Act No 223/2001 does not allow to landfill green waste and also entails an obligation of separate collection of biodegradable municipal wastes to municipalities. The WMP defines the target for 2010 as decrease of biodegradable municipal waste landfilling on 20% of 2005. The municipalities are responsible for recovery of green waste. Usually they operate (or co-operate with agricultural farms) composting or biogas plant.

Landfilling and incineration

Targets for 2010 for waste management for non hazardous wastes are the following 70% recovery, 0 % incineration and 19 % landfilling.
The Slovak Report about the needs for the next Cohesion Funds period estimates until 2013 the need of 400 to 900 small municipal compost plants and 6 to 10 large ones. [58]

OPTIONS	B/GWC	AD	MSWC	MBT	LAND	INCIN
UK	**x**	**x**	**-**	**x**	**x**	**-**

Biological waste treatment

The UK Government and the National Assembly have set challenging targets to increase the recycling of municipal waste: To recycle or compost at least 25% of household waste by 2005, at least 30% of household waste by 2010 and at least 33% of household waste by 2015. No further provisions are made to which extent alternative treatments like MBT or AD are part of the strategy.
Green waste composting is well developed and diffused in UK. AD shows growing interest.
Regions in UK have different specific targets recycling and treatment target exceeding the national requirements

Landfilling: Landfilling allowances can be traded within the municipalities by the LATS Landfill Allowance and Trading Scheme.

Incineration:

Incentives exist to shift waste treatment from incineration, which is not very well diffused in UK.

[58] STRATEGIC EVALUATION ON ENVIRONMENT AND RISK PREVENTION UNDER STRUCTURAL AND COHESION FUNDS FOR THE PERIOD 2007-2013 - Contract No. 2005.CE.16.0.AT.016. "**National Evaluation Report for Slovakia - Main Report"** Directorate General Regional Policy. A report submitted by GHK Brussels, Nov. 2006 http://ec.europa.eu/regional_policy/sources/docgener/evaluation/pdf/strategic_environ.pdf (download 15 Oct. 2007)

4.2 Task 4.2 – Compost Market potentials

The results of German compost market research states clearly what compost customers - first of all the commercial ones expect: "A uniform, high quality product that is independently monitored and accompanied by product use specifications and application information". A set of quality standards and product specifications monitored by an independent quality assurance scheme for compost from separate collection exactly meets these consumer requests. Around 700 composting facilities in Europe with 9 million tons treatment capacity have already recognised the market advantages of quality assurance schemes and manage meanwhile the quality and monitoring requirements quite well. All these facilities show success on the market and the demand of their customers exceeding their supply continuously.

These activities and a reasonable price comply with the agricultural mass market's needs. In order to exploit this potential fully and to stimulate this market the benefits of compost for the soil (soil fertility, organic matter content, improved workability…) have to be demonstrated and communicated more intensively. The term "humus management" summarize this soil related benefits quite well and in an understandable way for farmers. Increasing prices for mineral fertilisers and the last dry summers where the water holding capacity really improved the growth of crops, created a value for money for the farmers. These obvious benefits led and will lead to an increasing demand from the agriculture.

Nevertheless more and more compost plants are looking for alternative outlets with better revenues than they can get from agriculture and try to enter the high price professional markets of landscaping, horticulture, growing media and potting soils. The necessary upgrading of the pure the compost by mixtures and the manufacturing of tailor made products fit for purpose require expert know how and product development. More and more of the experienced compost plants develop concepts, tools, skills, assortments and the necessary marketing to enter these professional outlets. For all these activities the image of compost and confidence in the quality is decisive. Quality and quality assurance are the preconditions.

Successful conquests of the hobby gardening market has to follow regional branding concepts "From the region for the region" in order to help private customers to understand the closing of the organic loop. The message "what I collect separately in the kitchen is available at a later stage as high quality compost for the gardens" is a unique selling proposition. It allows compost to compete even with the peat and bark products offered on the market. So, wherever quality compost has been communicated as a high value regional product in the specific sectors, this always resulted in a demand that exceeds the possible supply.

These key factors for the development of the compost market and the stimulation of the potential reflect the experiences of the compost organisations and could be found in various market analyses.

Besides Ireland and Spain no detailed national market surveys with reference to the assumption for the calculations exist. Therefore ECN contracted a consultancy with a detailed market research and estimation for the whole plant cultivation sector - which means all the major compost outlets excluded agriculture and forestry.

A similar market analysis was made available for the UK by the Waste Resource and Action Programme WRAP in 2008 (Wallace, 2008[b27]). The assumption made and the results for the different sectors in both national market surveys (DE and UK) can be used as an orientation for European countries for their market potential of the plant cultivation sector.

Below the results of some small country specific market potential evaluations. The very rough general evaluations of the market lead to the same conclusion: The market potential shows at the minimum double the size than the maximum compost production in the countries will be. So there is enough market for compost in Europe.

4.2.1 The Netherlands

The Netherlands show a worst case scenario in Europe when it comes to the potential use of compost: The most densely populated country combined with one of the highest separate collection rates of kitchen and garden waste (ca. 190 kg inh/y) combined with very large excesses of animal manure on the one hand and a very restrictive nutrient/fertilising legislation (compost application rate limited until 31st of Dec. 2007 only 6 t dry matter/ha and y) on the other hand. If compost finds its market in the Netherlands a successful use should be possible in every other European country, too. Based on the calculation below and his personal experience the representative of the biggest Dutch compost sales company Brethouwer (2007[jb28]) estimates that there is enough market potential for compost in the Netherlands. This assessment was confirmed by representatives of the two Dutch compost organisations which treat 3.3 million t annually. Dutch compost export activities to Germany are mainly done by 5 plants which are located very close to the German border.

Maximum rough calculation:
Using the whole compost production in the Netherlands of 1.5 million t/a requires - if we consider the very low legal application limit of 10 t f.m./ha *y compost - just 7.5 % of the arable crop production land of 1.1 mio ha in the Netherlands. In reality it is only 60 % of the compost which goes to the agricultural market, so only 4.5 % of the arable land is needed.

4.2.2 United Kingdom

A "Regional Compost Market Assessment" study (Wallace, 2008) in the UK confirms that the compost market growth will meet the necessary capacity development in the UK which is expected to double until 2012 in order to meet the national organic waste treatment targets. The market potential will exceed after 2015 the intended treatment capacity to be installed.

Similar to Germany and the Netherlands the agricultural market shows the biggest share and is expected to grow from 47 % to 60 % of the total production (3 million t by 2020) and another significant increase is seen in the growing media and landscaping sector. Problems are expected to occur locally with London's compost produced from food waste.

Table 45: Assessment of compost market development in UK in million t/y (Wallace, 2008

	Research Baseline	Potential growth [t compost/y]			
Sector	**2005/06**	**2010**	**2012**	**2015**	**2020**
Agriculture	1,032	1,903	2,159	2,488	3,021
Growing media	39	92	183	272	368
Retail soil improvers	257	328	362	419	535
Landscaping	212	271	298	345	441
Golf courses	3	3	4	4	6
Sports turf	28	35	39	45	57
Landfill uses	227	232	232	232	232
Regeneration	142	210	210	210	210
Other	165	0	0	0	0
Total	2,105	3,074	3,487	4,015	4,869
Treatment capacity development in UK	**3,400**	**-**	**6,600[1)]**	**-**	

1) A 50 % volume loss during decomposition has to be considered - 6.6 million t capacity allows to produce 3.3 million t of compost which fits to the market potential of 2012.

4.2.3 Spain

A study of the Spanish Ministry of Environment (MoE, Spain, no year[b29]) came to the conclusion that the market need doubles the supply of all compostable residues (mixed MSW, sludge, farming residues).

a) Potential compost production

Organic fraction of mixed municipal solid waste (F.O. RSU)	1.07 million t
Processed sludge	0.62 million t
Residues from farms/food residues, farming industry	1.79 million t
Total	**3.48 million t**

b) Potential demand and the ratio offer to demand

Estimation of a medium-sized demand in the areas of agriculture, horticulture and green areas and other ranges combined with infrastructural projects with establishing arable land were portioned among autonomous regions. It is observed that the total market, with a restrictive assumption, achieves **7.34 million t.**

As a second point resulting from the analysis proves that the offer and demand shows a heavy deficit in the regions, what signifies the great potential of the market and the necessary utilisation of all organic residues for composting. The regions in the North (Asturia, Cantabria, Galicia and Pais Vascos) are the ones having a high potential offer what is explained by the smaller incorporation of organic matter. The deficit arises mainly in Andalusia, Castilla-La Mancha, Valencia, Cataluna, Extremadura, Madrid and Murcia.

4.2.4 Italy

Calculation for the market assessment from Italian experts confirm the evaluations for other countries that there is more than enough market potential for all the national current and potential compost production.

Table 46: Compost market potential on Italy (Favonio, 2007)[b30]

Potential on farmlands	
Arable land	16,000,000 ha
Portion of arable land suitable for compost application	30%
Application rate (f.m.)	15 t/ha
Total potential for farmland	**72,000,000 t**
Thereof: - organic farming	10,00,000 t
- rice crops	1,650,000 t
- vineyards	16,540,000 t
Potential for growing media	
At a 30 % peat replacement rate	403,200 t
Potential in the landscaping sector	
	672,000 t
Compost production	
Compost production in 2005	1,200,000 t
Production potential for Italy (56 million inhabitants, capture of org. waste 150 kg inh./y, average production rate of plants 35 %)	**2,940,000 t**

4.2.5 Ireland

The following has been ascertained in the market study (van der Werf et al., 2000) [jb31]for Ireland and the production of compost from putrescible biological municipal waste PBMW:

- up to 334,000 t of PBMW compost will be produced annually by 2016 (based on 3% growth);
- estimates of potential annual outlets for PBMW compost are 447,750 t (see following table).
- annual organic amendment (e.g. peat, bark, etc.) production is 535,000 t which results in an additional outlet by replacing peat between 10 and 20 %

Table 47: Estimates of potential annual outlets for Putrescible Biological Municipal Waste PBMW compost.

Sector	Estimated potential outlets (t)	Rationale
Horticulture	55,000	• 20 % of existing horticultural peat and bark compost usage • No allowance made for usage on road verges
Agriculture	250,000	
Conventional		• PBMW compost best used on crop land • There is an estimated 400,500 ha of crop land • Assumes 12,500 ha (~3%) of crop land available annually and is applied with 20 t/ha PBMW compost as is (i.e. weight includes moisture).
Organic	64,000	• Presently 32,000 ha in production • Assumes 10% of land in organic production available annually and is applied with 20 t/ha PBMW compost (as is)
Land remediation		
Contaminated lands	No estimate made	• Need to refine estimate of hectarage requiring remediation • Need to refine targets (i.e. timing) for land remediation
Bogland restoration	20,000	• At least 50,000 ha bogland requiring restoration
Forestry	40,000	• Assumes 10% of land in forestry production available annually and is applied with 20 t/ha PBMW compost (as is)
Other		
Export	18,750	• Assumes 5% of annual 375,000 t of horticultural peat exported annually
Total	**447,750**	

4.2.6 Hungary

The Hungarian Compost Association reported about the potential for compost in Hungary in an article (Bagi and Alexa, 2002)[jb32]:
In Hungary with its long agricultural tradition crop cultivation (51 % of the country's total area) plays an important economical role. The political situation in the former regime and the changes in the last 15 years lead to shortcomings in fertiliser management and to soils very poor in organic matter. This leads to a tremendous need for high quality organic fertilisers in Hungary. The difficult economical situation in agriculture led to strong decrease of the production of animal manure from animal husbandry (see table below). Still 5 million ha are used for plant cultivation but up-do-date with a lack of provision of nutrients and organic matter from animal manure. Facing the deficit the production of compost is not only a matter of waste management but decisive for a sustainable soil management in Hungary.

The compost production in Hungary doesn't show the necessary volume which fit for meeting the huge demand of agriculture. Even if, all biodegradable organic waste (3.5 million tons) would be composted the resulting 2 million t of compost would never meet the need to improve the 5 million ha arable land. Besides agriculture an additional potential exists in horticulture, landscaping and land restoration.

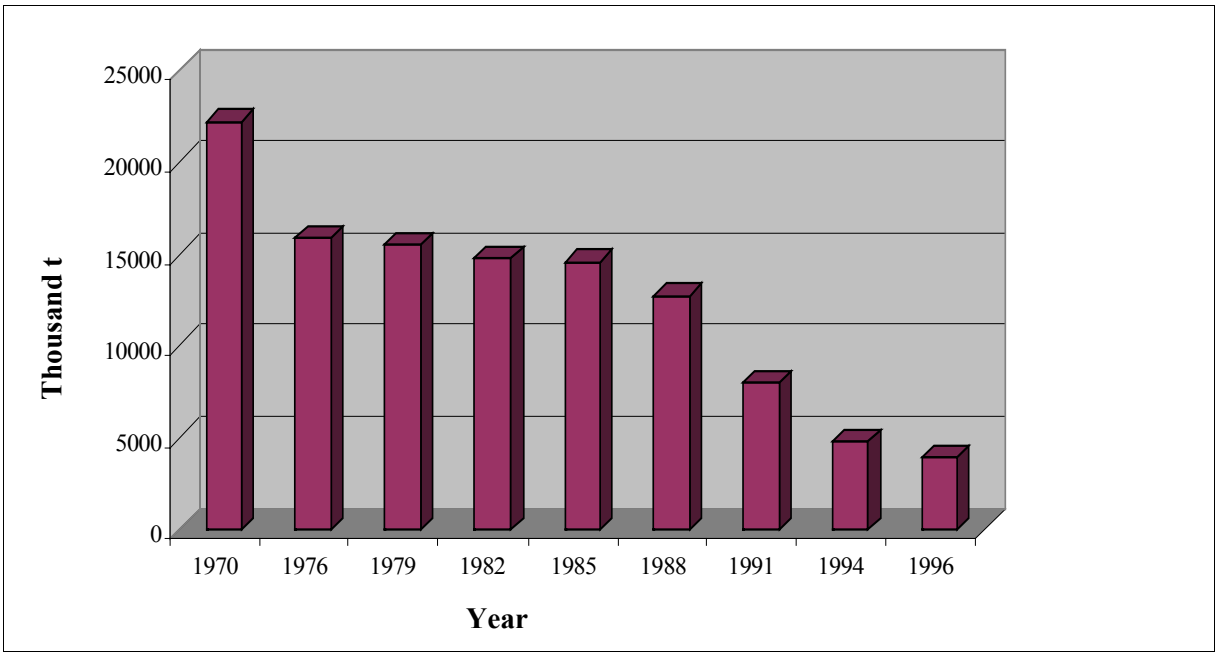


Figure 29: Development of the production of animal manure from animal husbandry

4.2.7 Bulgaria

Part of the targets of a study (Wiegel, 2005)[jb33] for the German EPA in 2005 was to provide information on the situation of the agricultural sector in Bulgaria as a basis to estimate the possible application of compost, derived from municipal waste or from sewage sludge.

The authors concluded for Bulgaria "This rough calculation shows that application area is not the restrictive factor for the use of compost and sludge." Even if we double the amount of compost and sludge, and even if we find that only half of the agricultural land has applicable conditions, the covered surface is still below 10 %."

Table 48: Substituting effects of compost/sludge and application area (Wiegel, 2005)

Parameter	Compost		Sewage sludge		Average fertiliser use kg/ha/y
	% in d.m.	kg/ha * y[1)]	% in d.m.	kg/ha * y[2)]	
Dry mass	100.0%	5,000	100.0%	2,500	--
N	1.0%	50	3.0%	75	100
P_2O_5	0.8%	40	2.0%	50	85
K_2O	1.2%	60	0.6%	15	90
					Sum
Applied dry mass t/y		250,000	-	40,000	290,000
Application area ha		50,000	-	16,000	66,000
Total agricultural area ha		2,900,000	-	2,900,000	2,900,000
Part compost/sludge area		**1.7%**	-	**0.6%**	**2.3%**

1) application of 5 t/ha/y dry matter d.m. 2) application of 2.5 t/ha/y d.m

To answer the question, of how much of agricultural land is needed, the authors assumed, that roughly 50% of organic waste (after composting) and sewage sludge will be applied - in total 290.000 tons/year dry mass. Following the concerned application rate of 5.0 resp. 2.5 tons per hectare and year they came to a total covered area of 660 km^2.

Related to the total agricultural area of 29 000 km^2 this is a share of 2.3%.

4.2.8 Germany

A. Potential in Agriculture
The German Compost quality assurance organisation BGK calculates the market potential in agriculture:

- German annual compost production 2006: 3,850,000 t compost[59]
- Arable land for plant production 2006: 9,186,000 ha[60]

If an average amount of 10 t compost /ha *y is applied this would need 385,000 ha which means only 4.2 % of the available area for plant cultivation in agriculture.

If we would apply the same 10 t to the whole agricultural area this would require annually 21,874,285t of compost.

B. Potential in plant cultivation sector
Table 49 shows the result of a market research which we contracted to get reliable, sound up-to-date data of a national market. The results found by Gottschall et. al.(2007)[jb34] are very promising for compost. All assumption made are very conservative. The plant cultivation sector which includes horticulture, hobby gardening, parts of landscaping, restoration/brownfields and public greens (**potential 3.5 - 7.6 million t)** can use the total amount of the German compost **(3.85 million t)** which is annually product. Only 20 % of the potential in the sector **(0.7 – 1.5 million m^3)** is currently used.

[59] Quelle: Daten zur Umwelt veröffentlicht unter http://www.env-it.de/umweltdaten/public
[60] Quelle: Agrarbericht 2007. Bundesministerium für Ernährung, Landwirtschaft und Verbraucherschutz veröffentlicht unter www.bmelv.de

4.2.9 Agricultural compost potential in Europe

A rough calculation with assumptions similar to the one above for Germany leads to the conclusion that the agricultural sector alone shows enough volume for the whole compost production potential which we assume for Europe (80 million t raw materaial). Only 3.2 % of the available arable land for plant cultivation is needed in the EU27.

Table 49: Survey on the compost potential in agriculture in Europe

Present situation in EU	**Amount**
Amount collected bio and green waste	23,600,000 t
Amount of compost produced in EU27	11,800,000 t
Arable land for plant production in EU27 :	123,391,000 ha[61]
A typical application rate of 10 t compost per year needs	1,800,000 ha
Portion of the total available area for plant production	**1.5 %**
Estimation for the full potential of bio- and greenwaste	**Amount**
Potential for collected bio and green waste	80,000,000 t
Amount of compost produced in EU27	40,000,000 t
Arable land for plant production in EU27	123.391.000 ha
A typical application rate of 10 t compost per year needs	4.000.000 ha
Max. portion of the total available area for plant production	**3.2 %**

4.2.10 Example for an in depth market investigation – case study of Germany

The assessment of the German market potential for products on compost basis in non-agro and forestry sectors (e.g. landscaping, growing media, manufactured soils, ornamental horticulture, hobby gardening and land restoration) was just carried out for the purpose of this study (Gottschall, R. Bieker, M. Löbig, A. 2007).

The main marketing potentials for compost can be distinguished between:

1. Areas where compost acts as partial substitute for other materials (above all peat - in the following named as "substitution potential") and
2. Areas where compost acts as an additive which leads to a new product or product qualities which are asked for without simultaneously displacing other raw material to a larger extent, are (summarized in the following under "supplementary and innovation potential". (see Figure 30)).

The first category are growing media for hobby gardening and the cultivation substrates for horticulture. The second category consists of vegetation layer materials (keyword "top soil substitute"), partially of mulch products and of special substrates for horticulture and landscaping (including public green and restoration) and hobby gardening.

[61] Quelle: Eurostat. Statistik kurz gefasst. Landwirtschaft und Fischerei 86/2007. Europäische Gemeinschaften 2007

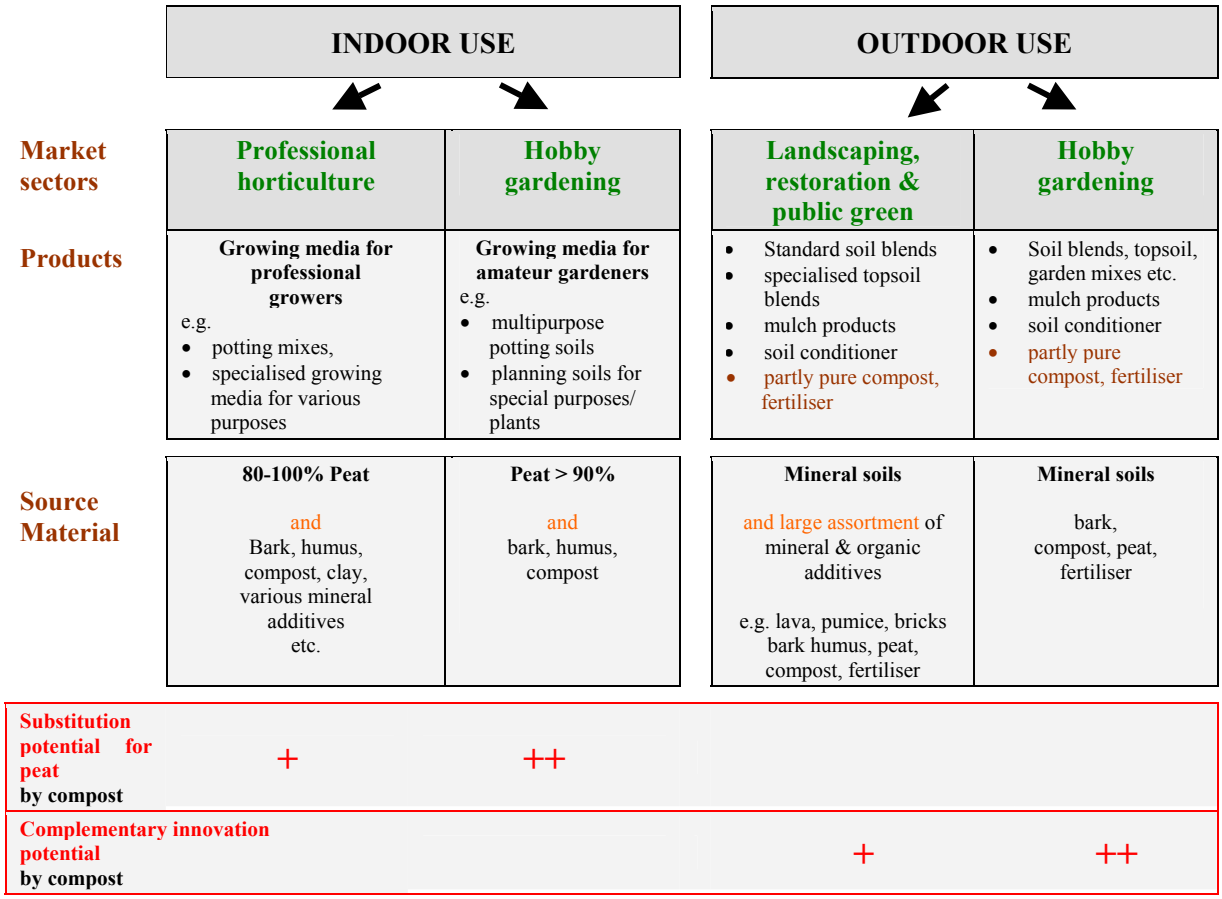


Figure 30: Relevant markets for humus products including compost (without agriculture and forestry)

An assessment of the market potentials in correspondence to compost products used in individual sales areas is presented in the following:

Table 50: Potentials of compost markets with regard to vegetation layers, growing media and culture substrates

Use sector	Total volume of product (million m³/y)	Compost application potential (million m³/y)	With X% compost portion (average)	Assumed actually realised potential of compost
OUT DOOR AREAS				
• Restoration layers 1 (landfills)	ca. 6	0.3 – 1.5	5 - 25	− − (10%?)
• Restoration layers 2 (mining areas & brown fields	ca. 6	0.3 – 1.5	5 - 25	− − (10%?)
• Other rootable soil layers	1.5 - 3.5	0.4 - 0.9	25	**0** / + (25 - 50 %)
• Landscaping-special substrate 1 (roof garden)	1	0.1	10	+ / ++ (50 - 70 %)
• Landscaping-special substrate 2 (noise barriers, lawn grating bricks, crushed stone sub.)	n.d.[1)]	n.d. [1)]	25	n.d.
• Mulch material	1.7	0.26	15	− − (10 %?)
POTTING MIXES				
• Garden soils (amateur/hobby gardeners)	ca. 2.5 - 3	1 - 1.5	40 - 50	− (10 - 15 %)
• Growing media (professional horticulture)	ca. 5.5 -6	1.1 - 1.8	20 - 30	− − (5 - 10 %)
Sum per year	**ca. 24.2 - 27.2 + ?**	**ca. 3.5 - 7.6- +?** [1)2)]	--	**ca. 20 % (0.7 - 1.5 mio m³)**

− − = very small; − = small, 0 = medium, + = high, ++ = very high

1) This part of the landscaping sector stands for an additional potential for compost. There are no data available for exact quantification. 2) German annual compost production is 4 million t annually.

Table 50 shows the results and assessment of the market research in the non agro and forestry sector. It becomes obvious that the evaluated market sectors of the hobby and professional gardening, landscaping and restoration show interesting sectors with essential potentials which is exploited at the moment by only up to around 20 %. Compost acts here as a substitute (mainly for peat) or as an additive in specialised mixtures the production of which requires more efforts and know-how but creates better sales revenues compared to e.g., the agricultural mass market.

The total potential of the sector amounts to between 3.5 and 7.6 million t annually. This figure has to be seen before the background that the total compost production in Germany reaches 4 million t. So just this sector alone shows the same size than the total German compost production which underlines that there is a sufficient market potential in Germany.

Restoration layers 1: layers for landfill coverage

At present approximately 300 landfills are in a closure phase [issued by the Federal Environmental Ministry/Umweltministerium, 2004[b35]]. Following the legal standards (Landfill Ordinance) and also from practical reasons these landfills have to be redeveloped after the final close-down of the landfill operation. Following the Landfill Utilisation Ordinance a surface sealing has to be built up - according to the risk potential and required protection that is composed of the compounds: compensation layer, sealing layer, dewatering layer and restoration layer. A possible utilisation for compost products can be seen here as top layers for restoration.

The restoration layer is the upper element of the surface sealing system of landfills and serves besides the protection capacity for the surface sealing - as location for later cultivation. The thickness depends on the vegetation rooting depths and the material properties and shall have a depth of at least 1 m.

A demand of 300.000 m^3 soil material for the restoration layer of a landfill able to be cultivated is necessary for a medium-sized landfill of ca. 30 ha [SCHULTE, 2007][b36]. At a volume of approximately 300 closed-down landfills in Germany [issued by the Federal Environmental Ministry/Umweltministerium, 2004] this amounts to ca. 90 million m^3, required for final restoration layers all over Germany.

Dependent on the quality (humus, nutrient content and harmful matter) of the used compost and before the background of the standards of the Federal Soil Protection Ordinance a compost portion of minimal 5% and maximal 25% can be assumed for the restoration of these vegetation layers. This corresponds to a potential magnitude of totally 4.5 to 22.5 million m^3 compost.

These magnitudes can be deduced from the (not legally binding) implementation of §12 of the Soil Protection Ordinance of the LAGA Boden, where among others, dependant on the humus content of the soil material used for the production of rootable topsoil layers a maximum thickness of the top soil layers is stipulated. Following from this a maximum layer thickness of the topsoil layers of 1 m should not be surpassed at the utilisation of soil material with humus contents of 1-2 %. The establishing of special locations rich in humus (> 4% Humus) must be avoided.

That means, the portion of compost used for the production of rootable soil layers depends on several frame conditions:

1. the portion of organic matter in the soil material, that shall be foreseen for the production of restoration layers and
2. the portion of organic matter in the individual compost.

If subsoils with a very low humus portion and composts with comparable low contents of organic matter are used a compost portion of up to 25% in the mixture can be realised. On the contrary, however, if composts with a comparable high portion of organic matter and eventually also a soil material with considerable humus content are used, the maximum possible compost portion must be below 10% to even 5%.

A period of 15 years must be realistically determined for the close-down of landfills according to SCHULTE [2007]. This period arises from the legal standards for the restoration layer to be incorporated prior to the sealing systems, which are presently revised [SCHULTE, 2007].

Considering this period a marketing potential of 0.3 to 1.5 million m^3 of compost can be calculated per annum (∅ 0.9 mill. m^3 compost/y). Which compost volumes are already used could not be found out. It has to be said that the above mentioned potentials are not only open for bio composts but also for sewage sludge composts.

Restoration layers 2: vegetation layers for areas following mining and brown fields

In Germany **restoration areas** - besides the above mentioned landfill locations - can be found in the following sectors:

- brown coal mining
- hard coal mining
- potassium and salt mining
- stone and earth mining

- brown fields

These devastated locations must be developed into sustainably useable infrastructures through remedial actions subsequent to their mining and industrial use. The task of restoration and renaturation is among others to reproduce rootable soils, which as fast as possible guarantee the natural soil functions and fulfil the demands for usage by the human society (HÜTTL [b37]et al., 2004).
Regarding the subsequent utilisation these areas are predominantly renaturated for agriculture, forestry or as water body (for recreation and/or nature protection). A use of vegetation layers on compost basis can only be realised for areas with a later agricultural or forestry farming, as the restoration target for areas which are reserved for nature protection usually stipulates to establish locations poor in nutrients.

As forestry is still afflicted in Germany with many reservations against the use of compost on forest soils, only areas are mentioned in the potential assessment which can be restorated for agriculture.

Of the areas (ca. 168,500 ha) used with brown coal mining up to now over ca. 111,400 ha were renaturated, ca 20% of it (about 33,000 ha) for agriculture and ca. 30 % forestry (ca. 51,500 ha) [DEBRIV[b38], 2007].

The areas of stone coal mining and the uranium mining (meanwhile closed-down) are other sectors for the application of compost for restoration. The area volume in Germany, however, is compared with the devastated areas of brown coal mining very small and declining [HÜTTL et al., 2004].

Industrial dumps, on which devastated areas are present, cover an area of totally ca. 40,000 ha in Germany [SMITSCH et al., 2000, in: HÜTTL et al., 2004]. The use of a vegetation layer on compost basis can be reasonable here, too. It is not known which areas amount annually for restoration. The same is valid for measures of abandoned polluted areas to be restored.
A reliable assessment of areas in Germany which shall be restored annually can't be made on account of missing reliable data. The marketing potentials for vegetation layers on compost basis are therefore assessed following the utilisation potential for "sewage sludge used area portions" by HAUBOLD-ROSAR[b39] [2006] for:

- brown coal mining: ca. 500 ha/y
- stone coal & stones and earth mining: ca. 200 ha/y
- brown fields: ca. 500 ha/y

A total area of 1.200 ha/a can be calculated from this, on which rootable soil layers can be produced in the run of remediation measures. With an assumed thickness of this „culture layer“ of 0.5 m for agricultural utilisation (accord. to the State of Thuringia guidelines for potassium salt dumps and implementation for the realisation of § 12 of the soil protection ordinance) a volume of totally ca. 6 million m^3 turns out. Depending on the available compost and before the background of the Soil Protection Ordinance 5-25% of compost can be used what corresponds to a compost volume of 1.5 million m^3 per year.

A product volume of ca.12 million m^3 arises together with the demand on vegetation layers in the course of landfill restoration with a compost portion of ca. 0.6 - 3.0 million m^3 per year

Other rootable soil layers (landscaping, hobby gardening)

This very important sector for compost sales covers the total range of soil mixtures asked for in landscaping and hobby gardening, which usually are described as “top soil”, “mixture of top soil”, “garden soil” etc. All of them have a top soil substitute in common - like the “restoration soils” - as rootable soil layers serving for vegetation.

Official data collection is not available for the presently marketed volumes of these products. In order to asses these data material one falls back on practice experiences of the Floratop® regional soil system. Messrs. Humus & Erden Kontor GmbH works with this system together with ca. 50 composting plants - distributed over the Federal territory in ca. 20 regions and cities (with totally ca. 5 million inhabitants).

On these composting plants and at the partly connected earth works a broad product line of different vegetation layers, garden soils, growing media and mulch products are produced and marketed via regional sales network to the landscaping and hobby gardening sector. Based on years of experience the upper limits of possible regional marketing volumes become clear and on the other hand also the possible progress rates for the regional earth work partners. This procedure extrapolates a volume potential for Germany (82 million inhabitants) of 1.5 - 3.5 million t per year .

The regional impact on the compost demand is obvious - especially at sites situated at the border of areas with high population density, large construction activities or population with high purchasing power.

With a conservatively assessed average compost portion of 25 % vol. in mixtures for the hobby gardening and landscaping sector, extrapolated onto the Germany, an annual compost volume between 400,000 to ca. 900,000 m^3 would be possible. If the average compost portion would be increased to 35 % vol. the amount could be ca. 1.2 million m^3. According to projects in practice the compost portions in these products are varying between ca. 20 to partly 60 % vol.

A statistical data is not available for the magnitude of the totally realised compost portion. Experts assess a possible volume of 30 - 50% (FISCHER, 2007; own estimations).

Special substrate for horticulture and landscaping

Regarding the amount of usable compost portions for plant cultivation in special substrates for horticulture and landscaping one has to distinguish between:

a) Special substrates for the roof gardens with very low compost volumes these often being suitable as "extensive substrate" for plants with a low nutrient demand. Subsequently the substrates themselves must contain a small amount of nutrients.

b) Special substrates for noise barriers, lawn grating bricks, rock substrates with which higher compost portions can also be realised.

Intensive researches proved that neither in literature nor in trade associations information exist for these products regarding the annual demand/consumption. Therefore the expert assessment of PROF. FISCHER [2007[b40]], the former director of the institute for soil science and plant nutrition for horticulture of the advanced technical college of Weihenstephan (today Institute for Horticulture) was used to evaluate the annual consumption of substrates for roof gardens with around. 1 million m^3. With an average portion of 10% of compost this corresponds to a compost potential of 100,000 m^3. Possibly realised is already 70% of it.

For substrates for roof gardens (group a) the potential amounts up to 100,000 m^3. Possibly realised is already 70% of it.

For the group b) of special substrates for noise barriers, lawn grating bricks, rock substrates no assessment can be predicted on account of a missing data basis.

Mulch material

Compost for mulch purposes plays for the moment just a secondary role Germany. This leads to the fact that the RAL-Quality Label as a quality assured product for mulch composts has been withdrawn by the Compost Quality Assurance Organisation BGK. In our opinion there are still chances in this area for an additive of coarse-grained screening residues of compost which is saleable according to our experiences.

Little but insecure data are available for the amount and marketing of bark. Following GABSDIL [b41][2005] the volume of barks arising in lumber industry (0.482 million t (absolutely dry) 70 % are externally utilised, the rest nearly completely energetically utilised. His questioning of bark-utilising works proved that 75 % bark mulch, 9 % bark humus, 11 % bark growing media and 55 % others are produced. On the assumption that in the long run an average of 15 % compost of the above mentioned total amount could be used means ca. 0.36 million t of bark mulch. With a water content of ca. 45 % in the saleable product and a bulk weight of ca. 300 kg/m^3 (verbal information of bark contractors on 10/26/2007) a volume of bark mulch resulted of ca. 1.7 million t.

On the assumption that this total amount of mulch material will result on an average of 15 % useable compost a sales potential of 0.35 million m^3 compost for mulch products will be achieved. The figures published by the Compost Quality Assurance Organisation BGK referring to the produced quantities of mulch compost suggest a realised potential that might be under 10 %, if not under 5 %.

Growing Media for Amateur Gardeners and Professional Growers

Now we are coming to the area where compost can substitute peat. The data of the Federal Statistical Office are the basis of an assessment of the possible substitution potential.

According to the data of the Federal Statistical Office ca. 8 - 9 million m^3 peat are used in Germany. [Federal Statistical Office, 2006[b42]]. Ca. 2/3 occur in growing media for hobby gardeners [FALKENBERG, 2006[b43]]. The assumption that growing media for the hobby gardening depending on the individual nutrient contents of ca. 25 - 60 % (after pre-selection ∅ 40 - 50 Vol.-%) compost can be used and in the range of growing media for the professional growers on account of the high standards only 10 - 40 % (after pre-selection 20 - 30 Vol-%) a compost potential can be calculated of 1.0 - 1.5 million m^3 in hobby gardening and 1.1 - 1.8 million m^3 for the professional gardeners.

Practice proves that these figures fit to the experience of several compost producers who are marketing several hundred thousands m^3 of growing media with a compost portion of 50 % all over the Federal Republic of Germany.

If these potentials are compared with the compost quantities of growing media for amateur gardeners and growing media for professional gardeners used today with the potentials acquired by SCHMILEWSKI [2007] less than 10 % of the potential is exploited.

Following the inquiries of the German Compost Quality Assurance Organisation in 2006 ca. 73,000 t substrate compost and ca. 305,000 t mature compost went to the manufacturers of growing media. This contradicts in a certain way the acquired values of SCHMILEWSKI (2007) as the quantities of the BGK are distinctly higher after being converted by means of the bulk density (factor 1.6 to 1.8) with ca. 550,000 - 650,000 m^3.

4.2.11 European standards by trade related organisations and branch standards

Compost has to correspond to all relevant specification and standards of trade and branch organisations and the declaration (resulting e.g. from quality assurance) has to include the relevant information in order to allow a qualified application in the different sectors - here mainly landscaping and growing media. If end-of-waste is intended as a fit for purpose standard for compost this type of additional regulations have to be taken in account. Here a short survey;

Additional international specifications

A) Phytosanitary standard by the international plant protection organisation EPPO
EPPO is an intergovernmental organization responsible for European cooperation in plant protection in the European and Mediterranean region. Under the International Plant Protection Convention (IPPC), EPPO is the regional plant protection organization (RPPO) for Europe.
In September 2007 the EPPO Standards PM3 - Phytosanitary Procedures: Guidelines for the management of plant health risks of biowaste of plant origin (revision PM 3/66) was accepted which includes recommendations for phytosanitary procedures in order to avoid the introduction and spreading of pests that damage cultivated and wild plants, in natural and agricultural ecosystems.

B) RHP-Compost as constituent in potting soils and substrates
There is a product certification scheme for "RHP compost" with the RHP quality mark. RHP-compost is in this respect a constituent that is used for the composition of substrates and potting soil in Europe, with an application portion limited to 10-20%. It specifies RHP compost for horticulture and for the consumer sector with a broad range of process and product specific requirements.

German legal and technical regulations, quality requirements and application information affecting the use and application of compost (national example - similar list exist in AT, NL ..)

On a national level in Germany the quality, use and application of compost is accompanied by numerous legislation, standards and technical guidelines which affect the production, the product and the markets. Producer of compost must be aware of the requirement in order to meet the customers' demands. The following list summarizes German examples, similar collections exist e.g. in NL and AT. An extended detailed list for Germany can be found in Annex 5.

A) Legislation
Examples are the German Closed Loop Management and Waste Law for the promotion of environmentally friendly disposal of wastes, the Federal Law on Soil Protection, Biowaste Ordinance, Landfill Ordinance and the Fertiliser Ordinance.

B) German Branch Technical Guidelines DIN (Standards)
Relevant here are national standards which in detail give technical guidance for landscaping and the use of organic soil improvers. e.g. DIN 18 915 "Vegetation Technology in Landscaping, Land Cultivation" or the CEN (German DIN EN) 12 580 "Soil Improving Means and Growing Media".

C) Additional Specifications of the FLL - Research Society for Development of Landscapes and Landscaping e.V., Bonn.
Besides the detailed recommendation and specification for the work with and the use of growing media, potting soils and soil improvers from the landscaping branch, other organisation exit which publish exact descriptions of the application e.g. the FLL-Recommendations for the Planning, Construction and Maintenance of Outdoor Riding Rings Issue 2007. FLL or FLL-Quality Requirements and Recommendations for the Application of Organic Mulch Material and Composts in Landscaping, Issue 1994.

D) Quality Standards and Application Recommendations

Finally the compost industry developed and published application recommendations based on their quality standards mostly together with customer branch organisations e.g. from the agricultural, the growing media producers or for the landscaping sector. This guarantees the necessary acceptance of the application guidelines by the compost customers. Examples are Quality Standards for Growing Media. Quality Assurance RAL-Quality Label 252, Issue 2006 or

ZVG and BGK - Recommendations for Compost Application. Soil Improvement for the Cultivation of Planting Areas, 2002, BGK German Compost Quality Assurance Organisation e.V., Cologne, ZVG German Horticulture Association e.V., Bonn. or
ZVG and BGK - Recommendations for Compost Application. in the House and Family Garden, 2002, BGK German Compost Quality Assurance Organisation e.V., Cologne & ZVG German Horticulture Association e.V., Bonn.

4.3 Task 4.3 – Prognosis and effects of EU Policy on the organic waste stream

Any prognosis on the volume and the development of the organic waste and residual streams for the next years will be quite difficult to make. Although there is evidence that a growing number of countries/regions are including composting as a cornerstone of advanced waste management systems, the situation on organic waste in Europe is rather insecure. Both for the chances and for the risks of composting/anaerobic digestion due to the numerous European provisions/legislations under progress or those which are currently in first stages of implementation in the Member States. As a matter of fact effects of different legislation are partly contrasting.

Examples are:

- The **EU Landfill Directive,** which currently is the primary driver for initiatives on biodegradable waste. Its implementation at a national level often includes also separate collection of organic waste, and composting/AD as its primary destination[62]. Anyway, no general provision is included for the destination of biodegradables, hence the way composting and anaerobic digestion shall be combined with incineration and MBT will be a matter of local strategies, and they factually vary widely from country to country.
- The **Waste Framework Directive** that establishes the waste hierarchy in its ongoing revision should strengthen the current hierarchical approach, putting recycling at a higher level than recovery. Also, a discussion is open on the establishment of possible EU-wide recycling targets, according to a proposal approved by the EP in the Plenary Vote (1st reading) in February 2007. The higher the potential target, the more important composting/AD in future waste management strategies will be, given organics still represent the biggest fraction in MSW in most areas of Europe.
- The related possibility to have a **Biowaste Directive** (or biowaste strategy) based on the ongoing extended impact assessment; however, a "biowaste initiative" is being developed by the EC, including e.g. the possible approval of end-of-waste standards. Such standards may increase confidence in purchase and application of compost, but depending on their final definition may also pose control constraints and/or difficulties for compliance (REACH).
- The **EU Soil strategy,** which shows 2 potentially contrasting drivers: on the one hand, compost is identified as a tool to fight the decline of organic matter in soils (identified as one of the "soil threats"); on the other hand, the need to prevent contamination calls for an increased awareness for high-quality standards. This may anyway be quite easily and reasonably addressed through source separation of compostable waste. In any case, the draft Soil Framework Directive does not include any concrete incentive or driver for the use of compost or any other soil improver.
- The **European Climate Change Programme** , which is considering the sue of compost as a tool to reduce Greenhouse gases, thereby fighting climate change, through a set of possible mechanisms: Carbon sequestration in soils, improved workability and reduced use of fossil fuels, replacement of peat and mineral fertilisers, reduced release of Nitrous Oxide relative to mineral fertilisers, etc.
- The **EU sewage sludge directive** is also set to be revised (although it does not seem to be on the agenda of the day, despite the many "Institutional Commitments" and calls by the EP and the Council on the EC to provide). A reasonable approach was included in a previous Draft (2001), that was considering the implementation of "Pollution prevention programmes" as a key tool to ensure ever-improving quality of sludge as a feedstock for production of soil improvers. This may affect future compostability of sludge, unless a more "radical" approach, mimicking the Swiss one (with a ban on application of sludge) will be chosen.

[62] See "Report from the commission to the council and the European Parliament on the national strategies for the reduction of Biodegradable waste going to landfills pursuant to article 5(1) of directive 1999/31/ec on the landfill of waste" {com(2005) 105 final}

- The **Animal By-Products Regulation** 1774/02, its past and foreseen revisions, provide for complementary sanitary provisions for production/application of compost made of animal waste (including food waste). Although a reasonable approach has been developed in last years, which acknowledges the nature of food waste as "low risk" waste, the nature of detailed and specific sanitary provisions may still influence (rather negatively) the practicability of composting/AD initiatives in many ways
- Plans are underway to consider the possible inclusion of composting in the **IPPC Directive** (BREF for composting and anaerobic digestion of separately collected organic waste is in discussion, a Draft Factsheet is available). Even if BAT following the BREF requirements applies only to larger plants with > 50 t per day throughput, also smaller plants would inevitably become affected in the mid-term, in so far as licensing authorities would take the BREF as reference for all plants. A binding BAT would impose a disproportionate burden upon composting and therefore constitute a significant handicap for the implementation of cost effective and environmentally sound systems in many Member States where biowaste treatment is still in its infancy. This development will affect especially those countries which require decentralized small scale low-tec solutions (often in conjunction with agriculture) on account of the rural settlement structure like most of the new Member States, Scandinavia, Ireland and parts of UK, Germany, Austria, Central Spain etc.
- The **EU Nitrate Directive** imposes limits on N loads on farmlands. This in general may be a limiting factor use of soil improvers, but may also trigger a greater application of compost as a replacement of mineral fertilisers, given the lower N availability and the fact that compost is a slow-release source of N. Some EU Member States have already enforced related provisions that recognise such an important feature of compost, thereby driving a higher application of it instead of liquid slurries or mineral fertilisers. Some Italian Regions even have considered benefits on lower N availability and leaching when establishing some subsidies for the use of compost in the frame of Rural Development Plans in past years.
- EU Policy for Renewable Energy and Directive on **Renewable Energy Sources RES** 2001/77may also establish competing trends for anaerobic digestion or direct thermal exploration of biomass. As a matter of act, some Countries have established important drivers for anaerobic digestion (e.g. Italy, UK) but also subsidies for incineration (particularly high e.g. in Italy) that may hamper the growth of composting.
- **Common Agricultural Policy (CAP)** and its system of European Union agricultural subsidies and programmes require that farmland maintained in 'Good Agricultural Condition' and that particular land management activities considered to benefit the environment. Some countries have included the principles of "humus/organic matter management" in these requirements and check it in the frame of the cross compliance obligations. This might include the use of more compost by the farmers.

5 Task 5 – Import/Export and potentials

5.1 Import/export situations

For the study we contacted compost experts and plants in all European Countries with essential compost production. The following main reasons for export and import of compost became obvious due to the feed backs:

1. Close border activities
The contacted plants described the typical catchment area of a home market with a circle of around 50 km and justified this with a distance which a large truck (25 tons capacity) can make within an hour for the costs of 50 to 60 €. These transport costs and the other marketing expenses are still covered by the prices in the mass markets of around 5 €/t (125 € per truck). All contacted plants close to borders (less than 50 km) underline the importance of this home market. They appreciate an end-of-waste standard because of the occurring constraints with selling compost over the border.

2. Export need:
Shortage in national demand because of extensive competition of other cheap organic materials mainly manure is for the moment the main driver for export activities like the situation in Belgium and the Netherlands show.

3. Import demand:
Real import demand could not be detected in the research. Shortage in organic source materials and the need for the improvement of soils effect the compost market at the moment only locally. The value of compost doesn't allow the transport to the area where the main need exists especially to the Mediterranean countries.

As a summary it can be stated that the import and export potential for compost is quite limited. Besides the cross border activities related to home markets of compost plants no continued commercial cross border compost material flow was detectable.

The main continuous import and export activities and potentials are connected to the growing media sector. Admixture of compost in various products based on green waste are a common business especially for the large international peat, soil and bark producing and dealing companies. However, in the blends compost is no longer subject to waste legislation and to the end-of-waste discussion.

5.2 Future potential for ex- and import

To estimate a future maximum potential for European cross border compost business we would recommend using the examples of the Netherlands and Belgium as a benchmark. As an average they exported 4.5 % of the annual production in 2005 and 2006. In other countries the same national market shortage due to the nutrient legislation is not given so the pressure to export doesn't exist in the same way. Nevertheless nearly all the exporting plants in Belgium and the Netherlands are located very close to the border and have part of the "home market" on the other side. This reason might have the same level of relevance.

Considering a future compost market in Europe we expect more mature markets which lead to higher compost qualities and more compost mix products for special application. The resulting higher prices allow longer transport distances and thus more cross border business.

A further outcome of the end-of-waste discussion is already visible. The awareness of the importance of the quality of compost products has already risen on a European level. It will increase further after establishment of European end-of-waste standards and should develop the cross border compost business further.

So it is justified to use the Dutch and Belgium export quota (average 4.5%) for an estimation of a European export and import potential. Considering the production potential in Europe of 39.5 million t of bio- and green waste compost we can expect a maximum import and export potential of **1.777 million t.**

5.3 Current outline of import and export activities for compost in selected Member States

Table 51: Report from the Countries about ex- and import activities and volumes

Member State	Reported activities
AT **3,000 to 5,000 t** **1,000 to 5,000 t**	One plant in 3 km distance from the Swiss border exports pure compost and compost mixes to a landscaping and wholesaler enterprises. Requirements for export is a product certification and the documentation according to the Austrian compost ordinance. No further requirements. A second very large plant in less than 50 km distance to the German border export various mixtures with up to 20 % mature compost portion with out any compost related requirements. Source of information: Austrian Compost Society KGVÖ ARGE Kompost & Biogas, Austria Phone calls with 5 large Austrian plants close to border
BE/Fl **24,000 t in 2005** **20,000 t in 2006** **Green compost**	6 plants export quantities between 1000 and 3000 tonnes. 4 plants export smaller quantities - all is green waste compost. Most of the plants are situated near the border. The very strict manure legislation allows only small quantities to be used in agriculture. With application rates similar to other countries the Belgium market would be big enough according to VLACO vzw. Precondition for export is a certification according the VLACO standard. No additional requirements have to be fulfilled by the plants for the 20 % of the compost which goes to the Netherlands. The other 80 % which are exported to France have to meet the French NF U 44051 compost product standard which means that the Belgium plants send compost sample for analysis and certification to French labs . For transport of compost in Flanders or export the manure policy also obliged some administrative paper work (transport documents). Flanders can export compost to France and the Netherlands but not to the Wallonie. Source of information: Flemish Compost Organisation VLACO VZW
DE	Export from Germany is limited because it requires extra efforts for notification on account of the waste status of compost. In addition the German market shows enough volume and acceptance in Germany for the national compost use. So detected export trials are based on situations where plants are located very close to the border (less than 50 km) and therefore part of the "home market" would be on the other side of the border. No further official export activities detectable to one of the other neighbour countries of Germany. The only cross border activities are related to a huge soil and growing media manufacturing company in the Eifel which just provides mixing and bagging services for German plants. **France:** Export of compost from the Saar Region to France was tried several times but the necessary paperwork for notification of compost as a waste was too complex and time consuming for the smaller compost plants which are located very close to the border. French authorities in that area are very careful and restrictive on account of bad experiences with German waste compost import in the beginning of the 90ties. The plants

	in that area would welcome an EU end-of-waste regulation.
300 t/y annually	One plant exports around 300 t annually to one of the famous French vine regions without further declaration. Cheap transport because empty French trucks use the material as return freight. **No import** form France detectable because of low compost production and lower quality if made from mixed waste compost compared to the German RAL quality.
500 t ?	**Export to Switzerland.** Until now just an inquiry for mature compost for one landscaping project at a German compost plant in 2 km distance to the border. The delivery would require German RAL standard and an up-to-date health certificate according which means analysis by the customs for pathogens. The certificate would be valid for 4 weeks. Source of information: German Compost Quality Association which provides services compost plants in NL, BE, LU, CH 4 Regional advisors for compost plants Verband der Humus- und Erdenwirtschaft VHE NRW Phone calls with 18 plants close to borders to DK, NL, BE, FR, CH, AT and PL
DK **up to 500 t** **2006 Export 1,000 t to Norway**	Only small quantities as a test to Sweden (Solum Group) No extra paperwork needed besides bill of delivery because exported as product. One Danish plant (Solum Group, Kopenhagen) with subsidiary in Norway exported around 1000 t green waste compost for large construction projects like a football stadium. Cheap transport by ship. To export compost outside the EU, the company orders a so called "health certificate" from the Plante Directorate (Division of the Ministry) which confirms that microbial samples e.g. on salmonella have been taken (by the Plante Directorate 7 years ago) and that everything is okay. In Norway the subsidiary has an import permission for compost and so the "bill of loading" from the ship was enough paper work. Source of information: Solum Group, Copenhagen (producer of compost and specialised blends)
ES	No import or export activities to France are recorded at the Agencia de Residus in Catalonia. The chances for exporting or importing the low compost qualities made from mixed waste compost are seen as quite low because of the low price of the material. This doesn't allow any far distance transport. Good qualities made from separately collected biowaste find a good market in Catalonia, so there is no export necessary. The same reasons might be valid why there is no compost im- and export detectable with Portugal. In addition there are only four Spanish plants located in an acceptable distance to the Portuguese border (in Andalusia, Extremadura, Leon, Galicia) in a reasonable distance. Huge demand in Spain for all types of composts exists according to the survey of the Ministry of Environment. Source of information: Ministry of Environment Agencia de Residus de Catalunya Ategrus (Study 2007 about the Spanish situation when it comes to biological treatment)
FR	No information in France available about import and export activities Source of information: Ministry of Environment Emails with Plants near the Italian and Spanish border
GR	No import Trials are under way to export sea weed compost to Denmark without positive results until know Source of information: University of Athens, Waste department Kompost Hellas

HU	No export because of huge national demand in agriculture Feasibility study of the Hungarian Compost Association came to the conclusion that import of compost from Austria is too expensive. Source of information: Hungarian Compost Association
IE **? tons to UK** Plant owner gave no volume information	Export of peat reduced products with green compost additions from one plant to a UK DIT store as growing media mainly for hobby gardening, Source of information: Irish Compost Association CRE Bord na Mona (Supplier of peat based products e.g. or growing media)
IT	Imports are only known as growing media constituent No export because only small plants along the Northern Border and high transport costs expected because of the Alps Source of information: Italian Compost Association CIC which called some plants
LU	No export and import activities recorded Source of information: Ministry of Environment Consultancy IGLUX
NL **in 2006** **51,000 t biowaste compost** **20,000 t green waste compost** **in 2005** **92,000 t** **in total**	The Netherlands are the biggest exporter of compost in Europe mainly on account of their well developed separate collection (190 kg /Inh*y) and the troublesome situation with too much nutrient in the soil which led to a very restrictive nutrient policy with draw backs for compost compared to manure and mineral fertilisers. Another reason is the location of 5 of the 6 exporting plants very close to the German border in a region with mainly crop cultivations. This makes the German "home market" on the other side of the border very interesting. The remaining plant is probably the biggest European plant (400,000 t capacity) in the centre of the Netherlands with excellent traffic connections even by train and contracts with national "soil dealers" in Germany e.g **Strahmann GmbH** Bahnhofstr. 28, D-49406 Drentwede, Tel. (+49 4246) 9311-0 Fax (+49 4246) 9311-99 mail: kontakt@strahmann.de, www.strahmann.de - provides agricultural services incl. selling, storage and spreading fertilisers) and as contractor: International Transport Service Karl-Heinz Küppers, TSK Transportservice **Karl-Heinz Küppers GmbH**, Hühr 16, D-41334 Nettetal, Tel. +49 2153 71955, Web: www.tsk-kueppers.de The plants exporting biowaste compost (vegetable, fruit and garden compost) are all members of the German Quality Assurance Schemes and their production is awarded with the RAL quality label. By means of this control the state governments close to the Netherlands exempted those plants from additional obligations. The two other green waste composting plants close to the German border export the compost as growing media mixtures to wholesalers in Germany which doesn't require and additional compost related documentation. Source of information BVOR Dutch green composting plants association DWMA Dutch waste management organisation - Compost division Phone calls with 3 of the plants
PT	No export could be identified from the usual information sources.. No import could be identified from the usual information sources.. Source of information: New University of Lisbon Institute of Waste and National Institute of Statistics.
SE	No activities, neither with Norway nor with Sweden Source of information: Waste Management Association Avfall Sverige, biological waste treatment division Phone call with 3 waste management companies in South near Denmark
UK	Estimate there has been limited import and export of bagged growing media for amateur and professional use (containing a % of composted garden/green biowaste) and a little export of soil improving composts to some EC Member States and non-EC countries.

	Industry surveys to date have not captured such information. Source of information: UK Composting Association
Rest of MS	No import and export activities detectable, no essential compost production, very low price level on the market, mostly very low qualities, benefits of good quality compost mostly not well known

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