BESTUFS.NET
Best Urban Freight Solutions

TREN/04/FP6TR/S07.31723/506384

BESTUFS II

Best Urban Freight Solutions II

Co-ordination Action
Priority 1.6.2 Sustainable Surface Transport

Best Practice Handbook year 1 (2005)

Theme 1: Waste transport logistics in urban areas

Due Date of deliverable: September 2005

Actual submission date : 30 September 2005

Start date of the project: Sept. 2005 Duration: 48 months

Main Authors: Heiko Abel, Raphael Karrer (RAPP Trans AG)

Revision [draft 1]

Project co-funded by the European Commission within the Sixth Framework Programme (2002-2006)		
Dissemination level		
PU	Public	**X**
PP	Restricted to other programme participants (including the Commission Services)	
RE	Restricted to a group specified by the consortium (including the Commission Services)	
CO	Confidential, only for members of the consortium (including the Commission Services)	

TABLE OF CONTENTS

FIGURES

TABLES

1 Introduction

1.1 The BESTUFS Thematic Network and need for action

Background

More than 80% of today's road freight trips in European conurbations are on distances below 80 km and can be defined as urban or urban-regional transport. The delivery and collection of goods within urban and metropolitan areas, especially in the core areas of cities with old and established centres has a major impact on the local community concerning the economic power, quality of life, accessibility and attractiveness of a city. Besides the benefits of the goods transport in urban areas like the supply function or economic importance also negative impacts appear like for example air pollution or congested roads. Taking the negative and positive impacts into consideration an efficient and environment-friendly urban transport system is essential for the economic health and the quality of life of cities.

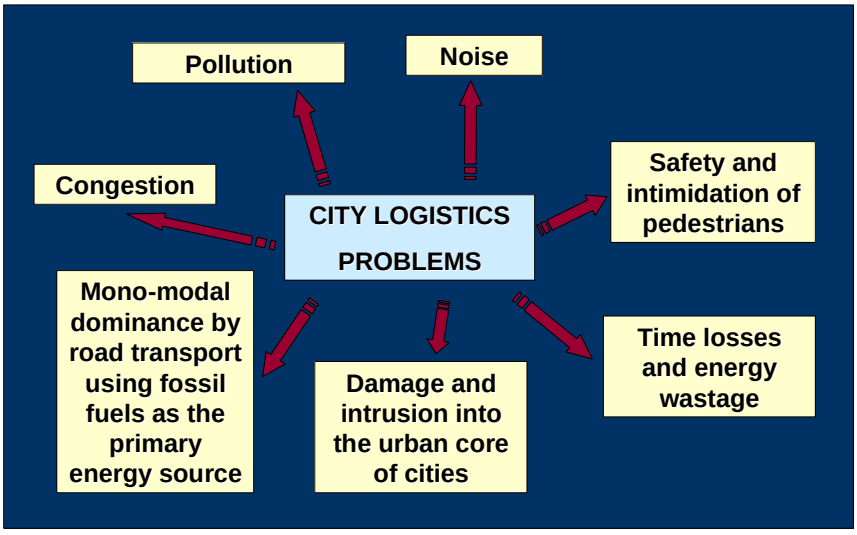


Figure 1: City Logistics Problems

Need for Action

For a future economic and environmental supply it is therefore important to assess the opportunities and chances of technical (vehicle technology, telematics applications, etc.), organisational (co-operation, etc.), operational (route planning, etc.) and political (time windows, weight limits, etc.) measures for improving the urban transport systems.

The CA BESTUFS contributes within the 6th Framework Programme to the Key Action „Sustainable Surface Transport".

The sustainable surface transport work programme addresses the following objectives:

- New technologies and concepts for all surface transport modes (road, rail and waterborne).
- Advanced design and production techniques.
- Rebalancing and integrating different transport modes.
- Increasing road, rail and waterborne safety and avoiding traffic congestion.

BESTUFS aims to maintain and expand an open European network between urban freight transport experts, user groups/associations, ongoing projects, the relevant European Commission Directorates and representatives of national, regional and local transport administrations and transport operators in order to identify, describe and disseminate best practices, success criteria and bottlenecks with respect to City Logistics. Overall, BESTUFS II will further identify the problems and the requirements of the cities as well as of all private actors involved in urban freight and will maintain the environment for establishing policy as well as research recommendations. The most relevant and helpful findings promoted in BESTUFS in form of guides for actors in medium sized cities together with national seminars organised in 22 countries will undoubtedly be suitable for many actors and many cities within Europe.

Furthermore, BESTUFS will describe the urban context and the role urban freight transport plays in a city. A group of experts will quantify freight transport related processes and measures compared to other transport modes as well as compared to different sustainability objectives. Finally, common data models and applied practical modelling tools are addressed in more detail by European experts that will consider this topic at roundtables and prepare suggestions for a European harmonisation and roadmap.

Building on the structure and experience gained from this project, BESTUFS will be augmented in three major ways: (1) a broad geographic coverage including the provision and dissemination in various languages of guides about urban freight transport best practice; (2) a quantification of the contribution of urban freight solutions to EU policy objectives; and (3) an examination of urban freight transport models and data structures.

Coordination Action

The general idea behind a “Coordination Action”, to encourage the co-operation between domain experts, research institutions and other interested groups at a European level is not new in the transport domain. The COST activities as well as the ‘concertation’ mechanism installed by the Transport Telematics Application Programme (T-TAP) in the 4th Framework Programme are previous examples. The latter focused on clustering themes and topics: Within the Program, funded projects were clustered and asked to participate in so-called ‘concertation’ meetings to discuss common ground and to derive further needed actions. The COST activities did not have a clustering component as such, but the participants did devise a sharp focus

on single themes, which in many respects can be regarded as the predecessors to the thematic network activities of the 5th FP.

BESTUFS II
Thematic Network

The EC established a thematic network (TN) on BEST Urban Freight Solutions (BESTUFS) in January 2000 with a duration of 4 years. This thematic network (TN) corresponds directly to the task 2.3.2/4 of the *Key Action*: *Sustainable Mobility and Intermodality*. The open European network has been established between urban freight transport experts, user groups/associations, ongoing projects, interested cities, the relevant European Commission Directorates and representatives of national, regional and local transport administrations.

The partners of BESTUFS aim to broaden the existing BESTUFS network to include medium sized urban areas in Europe the enlarged EU.

The work of BESTUFS takes place within the policy and regulatory framework of the Community, including the common transport policy, the development of the Trans European Transport Networks and the green paper on urban transport. It is the role of this thematic network to act as a facilitator in order to ensure that excellent strategies and best practices are not lost to the remainder of the European Community, the freight community and cities themselves. This approach allows structuring all relevant material available concerning the prioritised themes of BESTUFS and supports the analysis of the projects.

The concept of a thematic network is thereby focusing on the co-operation between experts and projects with already existing or just emerging experiences and expertises and on the collection and raw analysis of results of national and European projects - rather than starting new research activities. Within the network the following organisations and interest groups are involved: more than 20 European cities and regional administrations, interest groups like POLIS, ACEA, FTA or EVO, national networks (Association of Italian cities for sustainable mobility and transport issues, Forum for City Logistics Denmark) as well as European and International bodies (e.g. IMPACTS, Institute for City Logistics).

The following overview shows the co-ordination and organisation of the network:

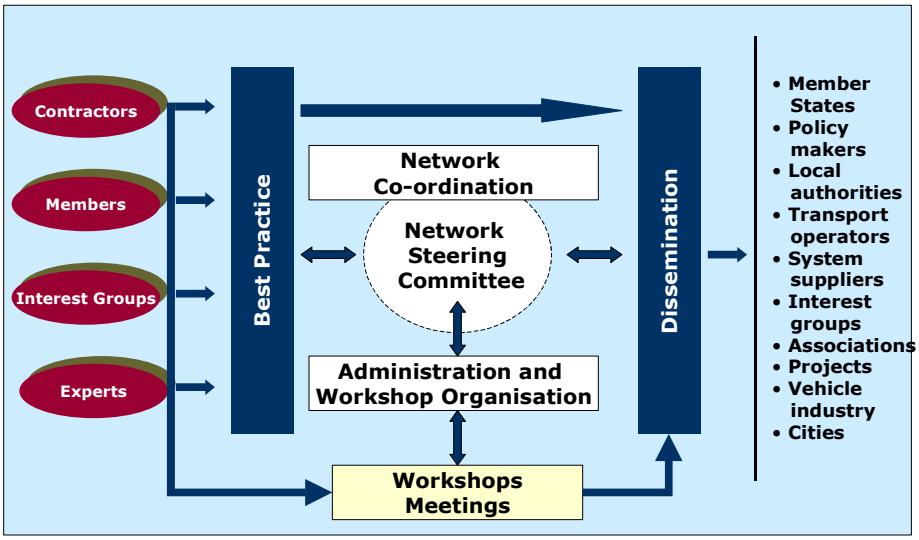


Figure 2: Co-ordination and organisation of the network

Main objectives of BESTUFS

Main objectives of BESTUFS II are:

- to strengthen and extend the existing BESTUFS European network for urban freight transport experts, user groups/associations, ongoing projects, interested cities, European Commission Directorates, system/technology providers and truck manufacturers; the network is focused on the movement of goods and commercial transport in urban areas,
- to continue the long-term and dynamic ‘concertation’ activity during the period of the 6th FP,
- to support the integration of so called “last mile” distribution processes in cities into a door-to-door supply chain approach,
- to provide a platform for the exchange of ideas and information on urban freight transport modelling and to consider harmonisation and standardisation of corresponding associated data by experts,
- to strengthen intermodal transport as interface to CLS and to provide support for promising intermodal approaches,
- to support the increased introduction and use of alternative fuels and cleaner vehicles in the domain of CLS,
- to identify needs for standardisation in CLS and to support the realisation of European wide standards (e.g. on vehicle weight and size restrictions or for regulations concerning night deliveries),
- to identify and present project results and best practice of CLS through a similar thematic structure to that used in BESTUFS,
- to widen and strengthen the relationships with both European and international networks regarding urban commercial transport,

- to strengthen both the European Community's position in this area and the European industries providing CLS,
- to widely disseminate CLS best practice in a series of guides that will be available in whole range of national languages,
- to broaden the geographic coverage and increase the awareness of urban freight transport best practice across Europe, with special emphasis on medium sized urban areas,
- to support the DG TREN policy objectives (emission reduction, energy aspects, mode shift, congestion reduction, safety, etc.) with respect to CLS and to increase the contribution of CLS to achieving transport policy objectives,
- to quantify the contribution of the potential that CLS can make to DG TREN policy objectives and to quantify the role of urban commercial transport compared with other urban transport activities in terms of sustainability,
- to support the clustering of projects at a European level and to integrate projects and clusters into the network,
- to collect, compare and summarise available experiences and results of projects and initiatives in the CLS domain from Europe and to a lesser extent internationally,
- to identify and describe best practices and success criteria within the CLS domain,
- to disseminate experiences, projects, best practices and success criteria to a broad interested audience with the aim of initiating a transfer of urban freight transport solutions,
- to establish links and cooperation with other transport and urban interest oriented networks or groups in order to share and integrate results and to avoid duplication of work,
- to strengthen links and cooperation with national CLS CA or networks in order to share and integrate results,
- to support the co-operation between actors, which are active or which are interested in the urban freight transport domain, by providing information and contacts.

BESTUFS Glossary

The BESTUFS Glossary focuses mainly on urban freight transport and tries to create a common understanding of the used terms within all BESTUFS deliverables, workshops and discussions. It is available at www.bestufs.net.

More information about the BESTUFS project

Web: www.bestufs.net
Post address: BESTUFS
Administration centre

P.O. Box 1969
2280 DZ Rijswijk
The Netherlands
E-mail: bestufs@nea.nl
Telephone No.: +31 70 3988 393
Fax No.: +31 70 3988 426

1.2 Relation to previous and running activities concerning urban freight

1.2.1 Global level

OECD Working Group on Urban Freight Logistics

The OECD (Organisation for Economic Co-operation and Development) set up a working group dealing with urban freight logistics. This working group follows the aimed targets of OECD, based on the Article 1 of the Convention signed in Paris on 14th December 1960, which came in force 30th September 1961 and promotes policies designed to achieve the highest sustainable economic growth and employment and a rising standard of living in Member countries. The Working Group on Urban Freight Logistics was set up to learn from international experiences and solutions, which have been proposed and implemented in OECD member countries with both successes and failures. In their actually report "Delivery the Goods – 21st Century Challenges to Urban Goods Transport" the OECD Working Group focuses on the delivery of consumer goods and highlights best practices in Member countries [OECD 2003].

Institute for City Logistics

In 1999 the Institute for City Logistics (ICL) at Kyoto, Japan was established. The most important objective of this Institute is to be the centre of excellence for the research and development on City Logistics and urban freight transport. ICL carries out the fundamental investigations and make it applicable to the real society. ICL also provides the platform for the exchange of knowledge, experience and information about City Logistics and urban freight transport. ICL will perform activities related to City Logistics and urban freight transport, including [Taniguchi et al 2003]:

- Organise the international conferences
- Perform investigations
- Develop software
- Provide short courses
- Issue newsletters
- Publish books and journals

1.2.2 European level

THERMIE

Within the European Community programs THERMIE (1990-1994) and JOULE-THERMIE (1995-1998) the rational use of energy in transport has been looked at. Concerning urban goods transport various measures and technologies have been investigated and assessed. For more information see www.cordis.lu under THERMIE and transport.

COST Actions

On European level the following COST Actions concerning freight transport and logistics are relevant:

- COST 310/316: Freight Transport Logistics (1989-1992)
- COST 321: Urban Goods Transport (1994 –1998)
- COST 339: Small Containers (1998 – 2001)

Especially COST 321 (http://www.cordis.lu/cost-transport/src/cost-321.htm) provided important base material, information and results as an input for the further activities in the BESTUFS TN [COST 321; 1998]. On one hand COST 321 reviewed current and potential measures promoted by public authorities and private parties, in the logistical, technical, behavioural, infrastructural and administrative field. An extensive survey was conducted, leading to a policy-relevant classification of observed and planned measures which were qualitatively assessed relating to their potential contribution to the improvement of the quality of urban goods transport. On the other hand COST 321 provided quantitative results on the impact of measures using simulation and modelling tools and also estimated effects in projects and case studies. Also some key figures relating to urban goods transport have been identified and provided for several cities.

The BESTUFS TN can be seen as a follow up and continuation of the COST 321 project.

Projects of the 4th framework programme

Within the 4th framework programme several projects are related to urban goods movements dealing with organisational, operational, technical and economical aspects.

Important projects are: DIRECT, ELCIDIS, EUROTOLL, EUROSCOPE, IDIOMA, IMAURO, LEAN, MOMENTUM, MOSAIC, MOST, PROPOLIS, PROSPECTS, REFORM and SURFF. These projects have been identified within the BESTUFS project during a clustering process considering urban goods transport themes as freight centres, traffic access restrictions etc. For more information see www.cordis.lu.

Projects of the 5th framework programme

Besides BESTUFS there are also other projects linked to urban goods transport within the 5th framework programme (1998-2002) such as EUTPII, PROGRESS, SULOGTRA, REVEAL, OSSA, MOST or CUPID (all within the sub-programme “competitive and sustainable growth”). For more information see www.cordis.lu.

CITY FREIGHT is a European research project on inter- and intra-urban freight distribution networks. It will carry out an analysis of selected freight transport systems already functioning in Europe and evaluate their socio-economic and environmental impacts in an urban context, with a common assessment methodology. CITY FREIGHT will focus on innovative and promising logistic schemes in the seven countries represented in the project consortium.

The objective is to provide guidance to interested stakeholders (government,

regional, or local authorities, network operators, shippers and consignees) on the advantages and drawbacks of some recent innovations in the field of inter- and intra-urban freight distribution systems.

Other demonstration projects concerning Clean Urban Transport started 2001 as a result of the CIVITAS Initiative (CIty-VITAlity-Sustainability; http://www.civitas-initiative.org/civitas/home.cfm), which had been launched in autumn 2000 by the European Commission as a joint Initiative between Key action Economic and Efficient Energy of the "Energy" Programme and the Key Action Sustainable Mobility and Intermodality of the "Growth" Programme). 14 EU-cities (Aalborg, Barcelona, Berlin, Bremen, Bristol, Cork, Gothenburg, Graz, Lille, Nantes, Rome, Rotterdam, Stockholm and Winchester) and five associated cities from the accession countries (Bucharest, Gdynia, Kaunas, Pécs and Prague) are participating in pilot projects combating congestion and pollution through technologies and measures that range from the introduction of new information and transport management systems to the promotion of "clean" vehicle fleets for passengers and goods.

Projects of the 6th framework programme

The 6th framework programme does also address sustainable freight transport in their topics: There will start a CA "Logistics Best Practices" with focus in logistics in general, but which will also encompasses city freight solutions.

BESTUFS Clustering report

More extensive information on complementary research activities related to the BESTUFS topic of urban freight transport can be found in the BESTUFS Clustering report (Deliverable D 4.4). The BESTUFS Clustering report relates the BESTUFS themes to the body of research activity from European and national sources by clustering relevant R&D projects around the BESTUFS key themes. It is available at www.bestufs.net.

1.2.3 National level

On national level the activities concerning urban goods transport vary largely between the European countries.

Since the beginning of 1990 especially France (COST 321, Programme national marchandise en ville) but also Spain (COST 321, initiatives of single cities), Switzerland (COST 321, DIANE 6, City of Zurich), Belgium (COST 321, urban freight transport plans), Italy (COST 321, urban freight transport plans), Denmark (COST 321, cities of Copenhagen, Aarborg, Arhus), Germany (COST 321) and the Netherlands (COST 321) are active in urban goods transport issues. However, the concerns and also the activities differ very much between the cities within a country.

1.3 Themes to be treated within BESTUFS and BESTUFS II

Identified themes within the BESTUFS

As a result of the first BESTUFS workshop on 16th/17th May 2000 in Brussels and from experiences and suggestions at further workshops the following

BESTUFS workshops

catalogue of themes has been determined to be considered with priority within the BESTUFS project (the themes in italics have - at least partly - been treated so far):

Methodology

- Models and methods to deal with the complexity of urban freight transport chains and the shared responsibilities
- Goods transport efficiency, assessment and costs
- *Statistical data, data acquisition and data analysis*

Planning and policy

- *Land use planning and business models for urban freight platforms*
- Traffic, land use, infrastructure and regulations planning and policy
- Integration of distribution centres and traffic management

Transport concepts and management

- Door to door freight transport aspects
- Improved management of the urban road space and the kerbside access
- Interfaces between public and goods transport
- *City access, parking regulations and access time regulations*
- *Road pricing, tolls and heavy vehicle fees*
- *E-commerce and distribution (home shopping)*
- *Night delivery*

Co-operation and organisation

- Co-operation of transport operators
- *Public-private-partnerships (PPP) and stimulation e.g. via freight forums*
- Win-win situations

Transportation technology

- Transport units and intermodal transfer facilities
- Innovative urban freight transport ideas (e.g. via underground systems, pipelines, etc.) and unusual transport modes (bicycles, etc.)
- *Urban rail freight*
- *Vehicle technology and functionalities (e.g. low-emission vehicles), weights and dimensions*

Supporting technology and infrastructure

- Intelligent transport systems (ITS), transport telematics applications and systems for urban goods transport
- *Enhanced signage and information systems (e.g. VMS)*
- Infrastructural solutions (e.g. to improve loading and unloading)
- Enhanced usage and maintenance of infrastructure (e.g. via a road map for transport vehicles)
- Enforcement support (e.g. by video control)

Legal issues

- Relationship and harmonisation between the urban, regional, national and European legislation

Identified themes within the BESTUFS II workshops

First three themes to be treated in the Best Practice Handbooks of BESTUFS II:

- Waste transport logistics in urban areas (Theme 1)
- Experiments and incentives in favour of environmental friendly vehicles and equipment (Theme 2)
- Enforcement

Workshops in 2005/2006

In the year 2005/2006 the following themes have been (or will be) addressed, each in a particular workshop:

- Approaches to Urban Consolidation: concepts and experiences [1st BESTUFS II workshop 13th and 14th January 2005 in London (UK)]
- Last Mile Solutions [2nd BESTUFS II workshop 21st and 22nd April 2005 in Nuremberg (Germany)]
- Urban freight transport in small and medium sized cities [forthcoming 3rd workshop 29th and 30th September in Kaposzvar (Hungary)]
- Waste transport logistics in urban areas [forthcoming 4th workshop 9th and 10th March 2006 in Zurich (Switzerland)]

1.4 Aims, contents and use of the handbook

Aims of the Best Practice Handbooks

In the field of urban goods transport, the Best Practice Handbooks aims at

- giving information and hints about innovative ongoing strategies, concepts and activities in European countries,
- providing knowledge and experiences of completed and running projects and actions
- providing contacts for further information.

Contents of this handbook

The present Best Practice Handbook (Deliverable 2.1) is related to the themes

- Waste transport logistics in urban areas (Theme 1)

consisting of

- an overview on national situations and relevant projects
- Case studies (Best Practices) and experiences
- Conclusions and recommendations

The material for this handbook has been collected and completed by the BESTUFS II contractors and subcontractors including important inputs from the involved experts and the workshops.

Use of the handbook

The main focus of this handbook is to get a European overview of solutions and existing activities related to the considered themes. The results are described as experiences rather than as a thorough scientific analysis.

Comments from readers

Remarks and input regarding this Best Practice Handbook are welcome. Please send your ideas for updates and additions to the following address:

Heiko Abel
RAPP Trans AG
Uetlibergstrasse 132
8045 Zürich, Switzerland
heiko.abel@rapp.ch
Tel.: +41 43 268 60 32
Fax: +41 43 268 60 40

Or to the BESTUFS administration centre:

BESTUFS Administration centre
P.O. Box 1969
2280 DZ Rijswijk, The Netherlands
bestufs@nea.nl
Tel.: +31 70 3988 393
Fax: +31 70 3988 426

2 Best Practices

Identification of Best Practices

In order to develop a common framework for best urban freight solutions as many as possible relevant aspects which might have an impact on urban freight transport are considered. In general, different “types” of actions, research and activities can be identified to characterise best practice solutions for urban freight transport.

A best practice solution does not necessarily focus on particular measures such as the implementation of freight centres in urban distribution traffic. Also activities without direct impact on the actors of urban transport operations such as the improvement of the data and information basis or of planning tools in urban freight transport are considered. The following “types” of action can be part of best practice solutions:

- Projects, actions and activities where goods transport changes are realised – “vertical” projects. Normally, these projects are directly related to a particular problem in urban freight transport.
- Projects, actions and activities which will not directly lead to changed urban freight transport operations but which provide tools and/or knowledge to influence and prepare decisions in urban freight traffic – “horizontal” projects. These projects are focusing on the improvement of overall planning and basic knowledge, i.e. data collection, education, planning tools etc. Usually, they are not directly related to a particular problem.

Sources of Best Practices and thematic structuring

To analyse existing and ongoing projects in the field of urban freight transport a thematic structure is applied. This approach allows to structure all relevant material available concerning the prioritised themes of the BESTUFS network and supports the analysis of the projects.

To identify best practice in urban freight transport three “sources” will be used within the BESTUFS project:

- First, a formal approach is followed by providing tools as a thematic structure, suitable attributes and parameters as well as assessment directions.
- Second, a pragmatic approach is realised in order to assess ongoing projects as well as available project results on their contents.
- Third, workshops, national seminars and conferences are organised in order to extract experiences and knowledge from experts.

The following graphic describes the action lines:

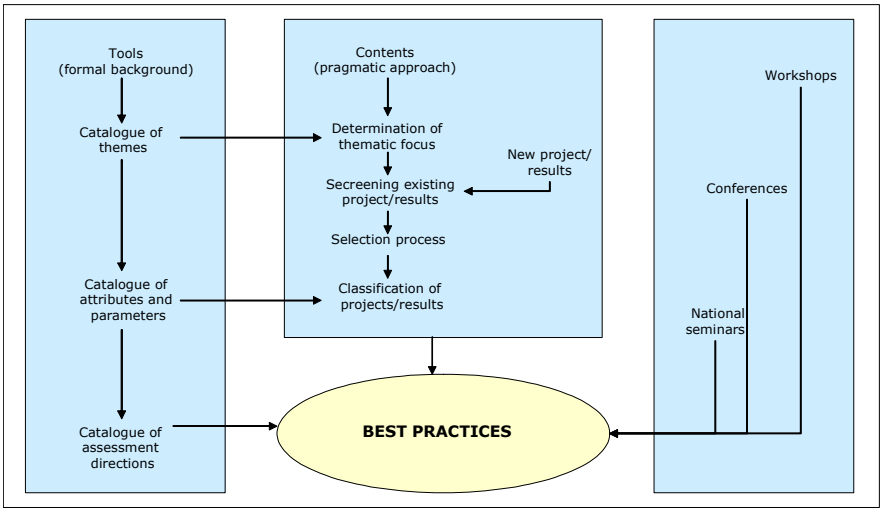


Figure 3: Sources of Best Practices and thematic structuring

BESTUFS definition of Best Practice

Best Practices are planned or implemented private only, public only or Public Private Partnership (PPP) strategies, measures or activities which have an essential contribution to urban goods transport and ideally lead to benefits for all actors involved. This can be projects, concepts or strategies. Best Practices will be identified on the fulfilment degree regarding the following requirements:

- Best Practices have to fit to a defined theme or address a relevant problem with respect to the movement of goods in urban areas (see structure of themes).
- Best Practices should be based on real experiences (real world implementations, pilot projects, concepts, strategies) or analysis in studies.
- Best Practices should have considerable and measurable positive effects (qualitative, quantitative) on relevant indicators of urban goods transport.
- In some cases it can also be important to take project activities into account which have not been successful. We can also learn from bad experiences and improve solutions by describing and analysing failure factors.

Urban freight transport and environment

Urban freight transport is an extremely important activity in the context of urban life: it is fundamental to sustaining our lifestyle and serves industrial and trade activities, which are essential to wealth generation. Efficient freight transport can play a significant role in the competitiveness of an urban area and is, in itself, an important element of the urban economy, both in terms of

the income it generates and the employment levels it supports. However, freight transport is responsible for traffic and environmental impacts in urban areas (such as contributing to congestion, pollution, noise, fossil fuel use etc.). Freight transport is, therefore, an important factor in the consideration of urban sustainability: it sustains the economic life of the city, but is also responsible for a number of social and environmental impacts. Over the past 20 years there have been significant changes and developments in the ways in which freight operations are carried out and the concerns about the negative environmental and social impacts of freight vehicle activity. First, distribution and logistics systems have changed considerably, with a significant degree of centralisation in manufacturing sites, stockholding points and retailing. Supply chain structures have also changed substantially, especially for larger companies where many have taken increasing control over the supply chain and the distribution of goods to their premises. Second, the stockholding patterns, and hence the goods delivery patterns required by manufacturers, retailers and other urban premises, have changed substantially, with a tendency towards more frequent, smaller deliveries. This move towards more frequent deliveries has resulted in a growing use of smaller freight vehicles. Third, the level of current concerns about the environmental impacts of our urban activities, and especially our urban transport systems, were not present 30 years ago. It is now widely acknowledged that new urban sustainability policies are necessary if urban areas are continuing to be desirable places to live, work and spend our leisure time. City logistics is a keyword to manage urban goods flows.

The definition of the term City Logistics

In the context of this project the term *City Logistic* is considered in its broadest sense, such that it includes not only the movement of goods in urban areas, but also activities related to other commercial transport (e.g. service technician trips). CLS are attracting ever more attention due to three primary reasons: First, current urban goods transport activities are perceived as having a negative affect on the quality of life in urban areas; Second, structural changes are taking place in urban areas in terms of planning city infrastructure and transport policy (e.g. pedestrian and parking zones), and commercial developments (e.g. shopping malls and emerging e-commerce – home delivery); Third, technological innovations (e.g. low emission vehicles, small containers, less expensive transhipment, or EDI) are swiftly entering the market and becoming competitively priced compared to the established technologies.

Projects must not only focus on urban city logistic, also regional projects that directly influences urban freight transport, e.g. the planning of an urban freight platform in the periphery, that leads to bundled transport flows and reduces vehicle-kilometres can be taken into account.

3 Waste transport logistics in urban areas

3.1 Introduction

An important aspect of urban freight transport often overlooked when considering city logistic distribution pattern, relates to the disposal of waste. To create a sustainable transport policy in cities therefore means not only dealing with distribution processes but also with waste transport issues. Economic development leads to increased production and consumption that has led to an increased production of waste worldwide. Another driving factor for waste growth is the shorter lifecycle and the packing material of products.

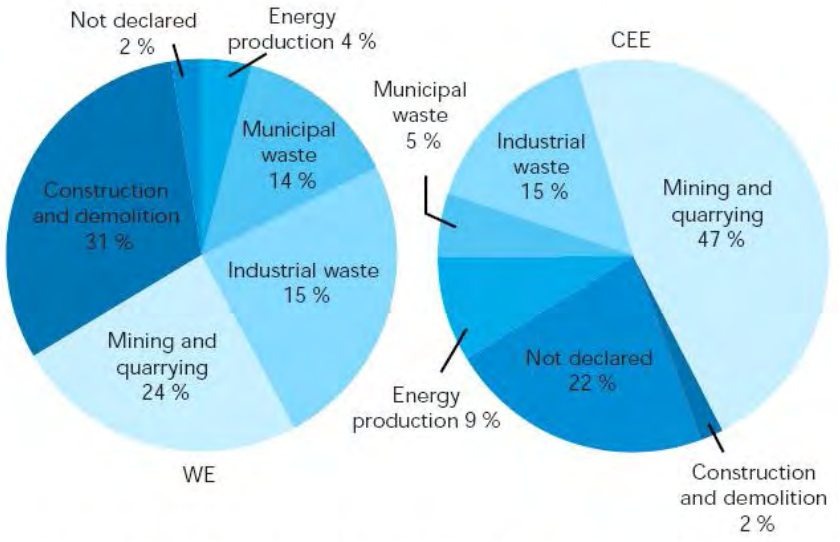
Waste problem

The consequences of these developments are especially relevant to cities and conurbations where most of the waste is generated. It is estimated that more than 3000 million tonnes of waste are generated in Europe every year. This equals 3.8 tonnes/capita in Western Europe (WE) and 4.4 tonnes in Central and Eastern Europe (CEE) (EEA: Europe's Environment – The third Assessment, Copenhagen, 2003).

Municipal waste is extensive and continues to grow. More than 306 million tonnes are estimated to be collected each year, an average of 415 kg/ capita and accounts for approximately 14 % of total waste generation in WE and 5 % in CEE. Approximately 740 million tonnes of waste are generated by the manufacturing industry in Europe every year.

The rate of recycling across Europe countries is varied, with some countries achieving much better levels than other. In relatively few WE countries, recycling of some waste streams has increased considerably during the past

decade. In the EU between 1985-90, approximately 11% of municipal waste was recycled (including composting). This increased to 21% by 1995 and 29% by 2000 (Eurostat, New Cronos Database, 2002). By comparison, in eight EU accession countries where data exist, on average only 8.6% of municipal waste was reported as being recycled during the period 1998-2001 (EEA: Europe's Environment – The third Assessment, Copenhagen, 2003).



Notes: Figure for WE does not include Belgium, Iceland, Luxemburg, Norway, Sweden, Spain, Switzerland. Figure for CEE does not include Bulgaria, Czech Republic, Estonia, Hungary, Poland, Slovak Republic and Slovenia.
Source: Eurostat, 2002a

Figure 4: Total waste generation by sector in Western Europe and Central and Eastern Europe

Market liberalisation offers also chances for intermodal solutions

In recent years a liberalisation in waste sector took place. In The Netherlands as on example the local waste processing plants or landfill areas (public owned) have been replaced by bigger regional/national operating waste processing (incineration/recycling) plants (usually private operated). The privatisation of waste sector becomes more and more important. As a result of this process the distances between the production of waste (households or companies) and the recycling/processing plants often grow. This offers new opportunities for intermodal transport solutions (barge, rail).

Waste Management and waste management plans

To deal with waste problems is assigned to waste management. "**Waste management**" shall mean the collection, transport, recovery and disposal of waste, including the supervision of such operations and after-care of disposal sites. Waste collection and waste Logistics are parts of a waste management concept. According to EU legislation (Directive 75/442/EEC), all Member States are required to produce one or more waste management plans. These must relate in particular to the type, quantity and origin of

waste; its recovery or disposal; general technical requirements; special arrangements for particular wastes; and suitable disposal sites or installations. Twelve EU countries have national waste management plans or strategies and three countries have prepared regional plans. Waste represents the loss of both material and energy resources. Because excessive waste generation is a symptom of inefficient production processes, low durability of goods and unsustainable consumption patterns, waste quantities can be considered as an indicator of how efficiently society uses raw materials. Therefore, waste management begins with preventing waste from being generated. The waste management sector, in charge of waste treatment and disposal, has become an independent economic sector, as waste management becomes an environmental problem of growing concern.

Integrated waste management calls for community awareness, waste avoidance, re-use, recycling and minimisation. Communities will become more aware of the need to avoid littering and to practice waste reduction, re-use, recycling as far as possible.

Waste disposal logistics and waste transport are part of waste management activities

Waste disposal logistics and waste transport are part of the integrated waste management and can deliver an important support to the sustainability of cities by e.g.:

- Maximisation of economical profits by reducing costs of waste disposal (effective operation of material reverse flows by e.g. fleet management or route optimisation)
- The optimised access of households and industry to waste disposal
- The minimisation of negative environmental effects (e.g. less noise and exhaust gas emissions)

To date, there have only been isolated attempts to optimise existing industrial and municipal waste disposal logistics systematically. When waste disposal logistics strategies and operations are compared, it becomes quite clear that there is a great potential for optimising waste disposal processes. Also limited competition in waste disposal can lead to inefficient and non environment-friendly waste transport. Actual developments in several countries show that there is a trend towards more competition in waste transport.

3.1.1 Definitions, classification and scope

Term waste

The term **waste** can be defined as follows: Materials that are not prime products (that is, products produced for the market) for which the generator has no further use in terms of his/her own purposes of production, transformation or consumption, and which he/she wants to dispose. Wastes

may be generated during the extraction of raw materials, the processing of raw materials into intermediate and final products, the consumption of final products, and other human activities. Residuals recycled at the place of generation are excluded.

Municipal waste and manufacturing/ industrial waste

Waste can be classified regarding the place of production (households or industry) or kind of waste. A first distinction can be made towards:

- **Municipal waste**: municipal waste means waste from households as well as commercial, industrial and institutional waste, which because of its nature and composition is similar to waste from households. In the first line it is solid waste generated by private households, but that can also include general "households" waste of industrial companies (in general garbage), that is not accounted as waste from production processes. Municipal waste includes a wide variety of materials: paper and cardboard, food, garden waste, glass, plastic, metal etc. This also includes bulky waste meaning large items of waste material such as electric appliances, furniture, large car parts, trees, etc.
- **Manufacturing/Industrial waste**: means waste materials from factories, processing plants, wholesale establishments, assembling plants or shops and garages, such as paper, cardboard, food processing wastes, cinders and ashes, lumber scraps, sawdust excelsior, shavings, floor sweepings, metal scrap and shavings, glass and other waste products. Industrial waste or manufacturing waste results directly from production processes. It often and typically contains somewhat higher levels (up to four times) of contaminants (such as heavy metals and human-made chemicals) than municipal solid waste and needs to be managed with environmental controls appropriate to the specific waste(s) being land filled.

Households waste disposal	Industrial waste disposal
Weekly or two weekly collection	Often daily collection
Unified container (boxes or bags)	Variety of container (boxes)
Short ways to the interface of the disposer	Often long ways on industrial complex
No transhipment, mostly one process of collection	Transhipment is a widespread process
Compact and dense usage of containers	Low compact and dense usage of containers

Table 1: Main differences between disposal of households and industrial disposal

Special waste products

Besides municipal, industrial/manufacturing waste other **special waste products** can be outlined:

1. **Hazardous waste:** Hazardous waste is a solid or fluid waste which because of its quantity, concentration, or characteristics may cause an increase in mortality or serious irreversible illness or pose a substantial

hazard to human health or the environment when improperly treated, stored, transported, disposed of, or otherwise managed. Hazardous waste can be for instance: medicaments, colors, waste oil, batteries. Hazardous wastes are identified and managed as a result of their being specifically placed on lists, or because they exhibit at least one of four particular characteristics (ignitability, corrosively, reactivity, or toxicity). European Council Directive 91/689/EEC (the Hazardous Waste Directive, or HWD) sets the framework within Member States of the European Community for provisions to control the movement of arisings of hazardous wastes. The aim of the HWD is to provide a precise and uniform European-wide definition of hazardous waste and to ensure the correct management and regulation of such waste. Additionally international agreements about the treatment and management of dangerous goods (hazardous waste) are of importance (e.g. ADR[1], RID[2]).

2. **Construction waste:** Rubble and other waste material arising from the construction, demolition, renovation or reconstruction of buildings or parts thereof, whether on the surface or underground. Consists mainly of building material and soil, including excavated soil. Includes waste from all origins and from all economic activity sectors.
3. **Waste water (sludge)**: The Council Directive 91/271/EEC of 21 May 1991 set rules for urban wastewater treatment. This directive concerns the collection, treatment and discharge of urban wastewater and the treatment and discharge of wastewater from certain industrial sectors.

Further special waste products: atomic waste, inherited waste, waste from electricity production etc.

Landfill

Municipal waste is often disposed of in **"landfill"**. Landfill describes the disposal of solid waste at engineered facilities in a series of compacted layers on land and the frequent daily covering of the waste with soil. Fill areas are carefully prepared to prevent nuisances or public health hazards, and clay and/or synthetic liners are used to prevent releases to ground water. If no hazardous materials are placed into the landfill, it may be possible to reclaim the site after the landfill is closed. Landfill means a waste disposal site for the deposit of the waste onto or into land (i.e. underground), including (Council Directive 1999/31/EC of 26 April 1999 on the landfill of waste):

- internal waste disposal sites (i.e. landfill where a producer of waste is carrying out its own waste disposal at the place of production), and
- a permanent site (i.e. more than one year) which is used for temporary

[1] ADR is a European agreement relating to the international carriage of dangerous goods by road.

[2] RID is a European agreement relating to the international carriage of dangerous goods by road.

storage of waste, but excluding:

- facilities where waste is unloaded in order to permit its preparation for further transport for recovery, treatment or disposal elsewhere, and
- storage of waste prior to recovery or treatment for a period less than three years as a general rule, or
- storage of waste prior to disposal for a period less than one year;

Landfill is still the predominant treatment option in most countries throughout Europe. The landfill of municipal waste has decreased from 67 % in 1995 to 57 % in 1999 in EU countries, while composting and recycling rates have increased.

Incineration plant/ incinerator

Incineration plants: Facility subject to authorisation, designed to incinerate waste. An increasing number of incinerators are now deployed in the generation of energy (electricity or thermal energy) using waste as the primary combustible material. The by-products of incineration (bottom ash and fly ash) are processed with a view to controlling the impacts of this activity both on mankind and on the environment. Bottom ash and fly ash is hazardous waste that has to be disposed specially.

Recycling

The definition of **recycling** is to pass a substance through a system that enables that substance to be reused. Waste recycling involves the collection of waste materials and the separation and clean-up of those materials. Recycling turns products that have already been used by consumers into new products and is an important step toward alleviating overtaxed natural resources and reducing the need for landfill sites. Landfills are filling quickly and communities are reluctant to house new sites for numerous reasons including leaching of toxic materials out of landfills into local water tables.

Waste Logistics

Waste Disposal Logistics (Waste Logistics) is a broad term referring to the logistics management and disposing of hazardous or non-hazardous waste from packaging and products. It includes reverse distribution which causes goods and information to flow in the opposite direction of normal logistics activities. The following processes are part of the waste disposal logistics:

- Collection
- Transportation
- Transhipment
- Storage

Reverse Logistics

While traditional logistics seeks to organise forward distribution, that is the transport, warehousing, packaging and inventory management from the producer to the consumer, environmental considerations opened up markets for recycling and disposal, and led to an entire new sub-sector:

Reverse Logistics. Reverse Logistics is different from Waste Logistics (-Management) as the latter mainly refers to collecting and processing waste (products for which there is no new use) efficiently and effectively. Reverse Logistics concentrates on those streams where there is some value to be recovered and the outcomes enter a (new) supply chain. Reverse Logistics starts with products going back in the supply chain or calling for recovery or value reclaim. In principle there is a returning party, who had the product, and a receiving party, who is trying to resell, redistribute or recover value from the product.

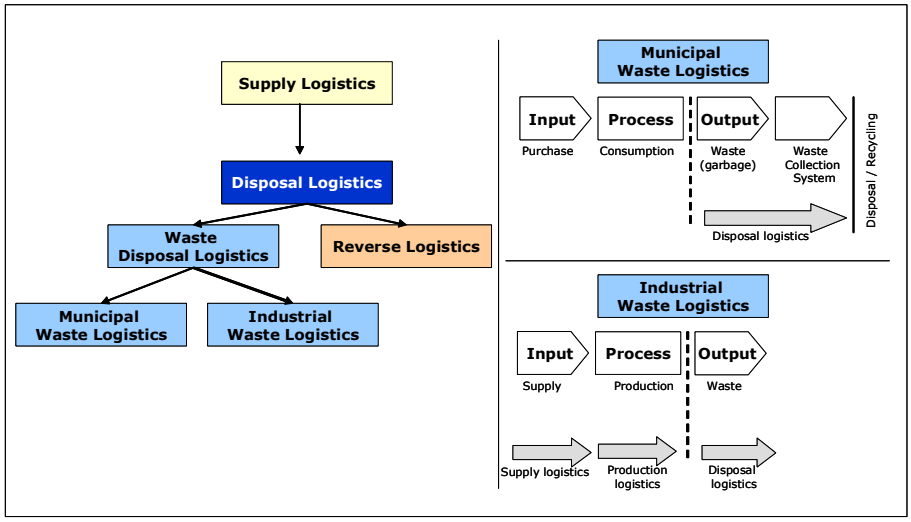


Figure 5: Waste disposal logistics

3.1.2 Waste transport in context with urban freight transport

Waste in urban areas

Within urban areas the transport of waste is a necessity, which also contributes to the overall levels of lorry traffic activity taking place. The BESTUFS project focuses good and best practice that is applied to freight transport which takes place in urban environments.. For this material collection exercise the theme is “Waste transport logistics in urban areas”.

As with other forms of road transport, the movement of waste has a number of impacts on the environments it serves:

- Noise emissions (transport of waste, transhipment of containers, short-distance starting and stopping)
- Exhaust gas emissions
- Congestion and negative economical impacts

In context with urban waste transport logistics the following issues have

assumed to be of interest:

- Integrated logistics concepts for waste (in context with an overall city logistics concept for a town)
- The planning of the disposal transport chain that helps to minimise trips and vehicle kilometres (by e.g.: route planning, bundling concepts).
- Equipment technology (vehicle and container technology) that allows a higher loading capacity and by this a reduction of round trips and the usage of less trucks
- Equipment technology (vehicle and container technology) that allows a modal shift from road to intermodal transport and by this reduces the road transport mileage within urban areas.
- New technologies that supports route planning and tour optimisation (transport telematics like route guidance and route planning software, GIS-application for the positioning of containers etc.)
- Site planning for disposal and incineration plants that supports a reduction of vehicle kilometres (Site optimisation)
- The integrated planning of supply and distribution logistics: coupling supply processes with waste disposal
- The usage of environment-friendly transport modes like inland waterways and rail transport for disposal activities.
- Management of time windows for waste disposal logistics that reduces congestion

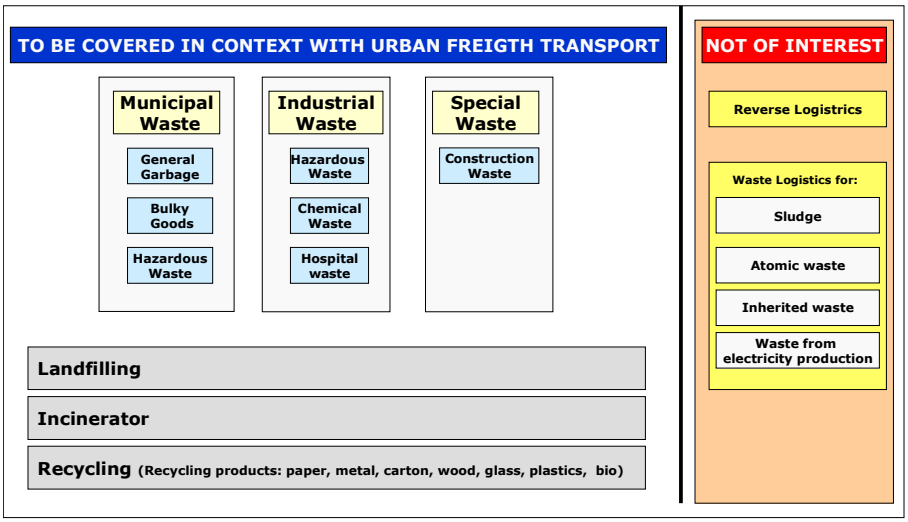


Figure 6: Theme of this material collection

3.2 Country overview

In the following we give a very brief summary on the national situation in the various countries.[3] A more detailed description of waste transport logistics activities in various countries can be found in ANNEX 1.

Framework conditions

Main general framework conditions that exist in various countries are:

- Cost situation of municipalities (more efficient waste collection and logistics): Although municipalities are public organisations and there is no need to make profits, there is a need to cut on the costs and to make the collection, transport and processing as efficient as possible for the residents. However, collection and transport of waste is only a small share in the overall cost to be paid by the residents. As seen in many cities, especially in those in the New Association Countries like for instance Slovakia, financial gaps in municipalities' households do not allow the financial support of waste transport and logistics concepts.
- Congestion situation in cities: The congestion in cities is severe. However, the collection and transport of waste often can be done outside the hours of peak traffic. Therefore, the congestion is not a very big argument to change logistic concepts for waste collection and transport.
- Privatisation of waste disposal (tendering processes, organisational issues): Privatisation can be an issue. Public waste collection organisations are replaced by private organisations. However, these private organisations have a bigger drive to optimize the logistic processes in order to be competitive in the market.
- Current waste collection system is not satisfying: Old-fashioned systems which were labour intensive, costly and noisy have gradually been replaced by modern collection systems and collection vehicles.
- Environmental situation within cities: Main issues regarding the waste collection and transport are the noise, exhaust emissions and litter. State-of-the-art vehicle and collection technologies focus on reducing these issues. For instance there are more and more underground storage systems for waste and modern collection vehicles are safe (using camera's etc.), silent and clean.
- Awareness for waste problems in general and especially waste collection and transport: Generally speaking the waste logistics in former EU 15+ are well developed and big logistic problems have been solved

[3] A more detailed report on each country's situation concerning road pricing and urban freight transport is given in Annex I.

already. Now there is attention and some awareness to make systems more sustainable, e.g. by means of modal shift or more efficient transportation by road. But there is still need to tackle the problem in the New Member States in Eastern Europe.

- Planning processes: waste management: Generally speaking, waste management is included in planning. For example at construction of new residential areas and housing projects, the collection of waste is often well addressed.
- Legal framework conditions: There are regulations and laws with respect to transportation of waste on national and European level. There is a significant difference in the type of waste, e.g. regulations for transporting hazardous waste are of course stricter. Also there is a significant difference if the transport is inside a country or crossing borders in the EU or outside the EU.

Summary of experiences

There are a lot of examples from innovative and environment-friendly waste transport and logistics concepts in urban areas. Nevertheless waste transport and logistics is often neglected and emphasis in many countries is more on an overall waste management context which sometimes includes of course logistical aspects.

Privatisation in the waste sector makes competition conditions more and more important and which leads to cost efficient approaches in the overall waste sector. This leads also to economically transport and logistics concepts. In this context often private operators seek to find cost efficient waste collection solution by using ITS, trying to integrate rail and waterborne transport in the waste disposal chain or by optimising route planning. Therefore a lot of innovative projects from private operators can be found.

But cities' authorities are also active to support directly an environment-friendly waste disposal scheme for their municipalities. There are for example projects in the Netherlands, in Germany or Switzerland that have been initiated with public support.

Motivation and approaches

There can be seen different approaches for setting up projects in the field of waste transport and logistics in urban areas. One main motivation is the reduction of negative impacts caused by waste transport like emissions (exhaust gas and noise). Especially noise is an important effect that often impact negatively quality of life. In case of night waste collection this can be of importance: on the one hand night collection can reduce congestion in the day time by using the less frequented evening and night hours. On the other hand the processes of loading and unloading combined with driving noise from stops and starts of vehicles leads to derogations of night time peace. In this case the sensed noise is higher than the real noise emissions.

Another important approach is the improvement of the cost situation in waste

collection activities. As already mentioned the ongoing privatisation in the waste sector leads to an increased cost pressure for operators. Efficient waste collection processes are one part of an cost reducing overall waste management. Private operators therefore often look toward an optimisation in waste collection processes. But sometimes municipalities describe in tenders the organisation of waste collection that has to be carried out by private operators. This can lead of course to an optimisation but often also private operators are hindered to set up an own ideal waste collection plan.

Effects of projects

Projects which are based on new technology aims often to improve capacity management of boxes and containers. An optimised loading and filling of those units leads to a better capacity usage and to a reduction of collection trips and vehicle-kilometres. Modal shift approaches uses more environment-friendly transport modes with the effect of reduction of negative emissions and congestion in urban areas. Tour optimisation and usage of ITS supports the reduction of vehicles-kilometres.

Austria: towards sustainable waste management

The objectives of waste management in Austria follow the generally accepted guiding principle of sustainable development that combines the aspects of ecology, economy and social security. Especially with regard to waste management, the re-orientation of environmental policy aims at solutions with long-lasting effectiveness, simultaneously focusing on the aspects of cost-effectiveness and the internalisation of external costs.

With respect to waste management, the ecological management of material flows means the long-term control of flows of anthropogenic materials while reducing environmental pollution to a minimum. The guidelines of waste management policy primarily include:

- the priority of waste prevention
- the recovery of unavoidable waste and
- the optimisation of final disposal.

Belgium: Waste transport logistics is and will becoming of importance

Waste transport logistics in Belgium has been in the past of medium importance but nowadays and in future waste transport is and will become of more importance. Waste collection and transportation are realised by road. The collection rounds begin early in the morning (from 6.30 am) before traffic jam but they overlap for a part with the traffic peak. The transport of collected waste occurs all the day. Due to the short distances, waste is transported by road. Waste collections and transportation to the incinerator or a grouping centre are realised by waste bins belonging to the collecting companies.

The main types of innovative logistics concepts are in the area of integrated logistics concepts, equipment technology and management of time windows. In the Liege (Walloon) region an innovative concept of waste disposal

logistics by barges has been set up successfully.

Bulgaria: towards a future oriented waste disposal system

In Bulgaria the waste areas is actually in an upheaval process. The obligations and the responsibilities of the state and local authorities in regard to the organization, permitting, financing, supervision and control of the waste management activities are regulated by the Waste Management Act (WMA). The National Waste Management Programme (NWMP) sets for the period 2003 – 2007 based on the adopted principles for waste management that are adapted to the national conditions. The main objective of the National Waste Management Programme is to contribute for sustainable development by establishment of integrated framework for waste management.

Until now the transportation of waste to the landfills is carried out by means of specialized trucks without using transfer stations. In general the landfills are located near the settlements at a distance of 3 – 7 km. The main challenge to the companies carrying out organized waste collection during the next years will be the increase of the transport distances as a result of the transition form the existing disposal system to regional disposal facilities.

The Ministry of Environment and Water developed National Waste Management Program and Handbook for determining of number and kind of necessary containers and techniques for waste collection and transporting. Also this year there is foreseen to introduce GPS system for watching of vehicles which transport the wastes in Sofia.

Czech Republic: high awareness for waste issues

Awareness of citizens and entrepreneurs on the national level is relatively high; there are strong efforts to protect the environment by proper waste management. Politicians deal with this issue by adopting and amending legislation, complying with EU legislation, and also by introducing not-so-popular charges for citizens as well as companies.

Denmark: Efficient waste collection leads to efficient waste transport logistics concepts

Since the 1980s the principles of waste management in Denmark have undergone some radical changes. Whereas previously the upgrading of the technical infrastructure of waste disposal had been the dominant theme of waste planning, the recent waste management is directed towards the minimisation of waste volumes and the assignment and utilisation of waste disposal.

Municipalities demand more efficient waste collection, which has directly influenced the establishment of waste transport logistics concepts. The privatisation has directly influenced the establishment of waste transport logistic concepts.

Estonia:

The municipal or household waste management is in responsibility of the

privatisation in waste sector has started

local municipal government. It means that there should be local waste management plans, waste management regulations and municipalities should organize - not necessarily to provide service itself - waste collections and develop as well recovery schemes in general.

In practice - during the 1990ies almost all of the former municipal waste management firms were privatised. So, the service is provided dominantly only by private companies today. Actually estimations show that nearly 25 % of household (first of all private households) are still not taking part in the 'visible collection schema' - what is a reason for littering and unlawful disposal of waste.

Finland: very innovative in waste transport logistics.

In a sparsely populated country like Finland waste management has not been a big problem. Originally all municipal waste was transported to waste landfills. In the main urban areas these landfills started to be more difficult to find and therefore transport distances got longer and the interest for transport logistics increased. In Finland the municipalities are responsible only for the management of municipal waste created by local inhabitants. They are not responsible for the management of industrial waste. The industry must either treat its waste self or buy services for its treatment. In order to organise and execute - with viable prices - waste management in compliance with latest environmental quality demands, Finnish municipalities have started regional co-operation. During the past years Intermunicipal Waste Management Organisation (IWMO) has become the most utilised form of co-operation for municipalities.

The basic waste transport logistics strategy is based in tendering processes as follows:

- urban areas are divided into contract areas, each suitable for full time work for one or two vehicles;
- every three to five years municipalities or IWMOs ask tenders from transport operators.

There are innovative waste transport logistics concepts existing (e.g. using pipeline transport) and also national research activities are supporting sustainable solutions in waste transport. Main logistics concepts focus on route and trip planning, equipment technology and ITS-usage.

France: in general waste management is of higher importance than waste logistics concepts

Congestion situation in cities is rather serious but it is not generally considered that waste collection vehicles are a very important part of the problem. In most cities, waste collection hours have been organised in order not to interfere with peak hours for passenger or freight transport. Of the 530 tons of waste produced and transported annually in France, more than 270 millions and 10.8 billions of tons-km are transported in an urban area. 3% of total urban goods movement (in vehicle-km) come from waste transport (8% if construction waste is included).

Some concepts and strategies envisioned for the future of urban waste collection and transport are based on the following principles (NOT implemented yet) :

- creating transfer centres within dense urban areas, enabling more consolidation and connection to non road based means of transport
- combining store deliveries with the pick up of cupboards/packaging during the same delivery tour (with the same vehicles)
- using radically new collection processes such as pneumatic networks or tramway/buses networks
- creating multi purpose vehicles that can handle both waste and other goods (same chassis, different containers), and could be integrated into multimodal organisations.
- on noise management : developing a concept of “chain of silence” which would include all the different segments of the waste transport and logistic chain.

Germany: high relevance and very progressive

The present concepts for waste transport logistics are grounded on the waste recycling directive (Kreislaufwirtschafts- und Abfallgesetz) which is in force since 1996. The focus of this directive is to move from a simple disposal of waste towards an avoidance and material recycling. Core of the directive is that producer and distributor of products are also responsible for its disposal. Waste in the sense of the directive is first of all to avoid and in a second step to recycle, if this is not possible it has to be combusted. According to the general framework conditions also the waste logistics concepts are adapted. While in the past waste logistics was a local issue as each city installed dumpsites close to the city area, waste management was also a local approach to and from the city. With the new recycling directive waste logistics became a national, partly international issue.

Due to the increased requirements on the handling of waste on the one side and the requirements to carry out the waste management more efficiently, high pressure is on the waste transport logistics on cost savings. Main measure for municipal as well as for private operators is to improve the cost efficiency in the field of urban collection transport by: exploiting technological innovations, strengthen organisational processes and to improve the fleet structure.

Greece: waste collection was introduced in order to deal with the traffic problems in main cities

Night - or early morning - waste collection was introduced in order to deal with the traffic problems in main cities, since congestion delayed waste collection trips and citizens were dissatisfied by the traffic problems caused by waste vehicles. Additionally time planning and time windows have been introduced. In the 1980ies standardisation of litter bins - in order to reduce waste collection time- and vehicles with compressors - to increase their

loading capacity came up.

Logistics strategies are not really an everyday practice. Mostly ad hoc interventions regarding fleet management and trip scheduling are actually used by most municipalities.

The main problem for municipalities to introduce new waste management concepts and by this waste logistics concepts are financial bottlenecks. Currently private operators are involved in waste management activities.

Hungary: towards EU-conformity in waste policy

More than 90% of communal solid waste was collected in 1999. In the framework of public services 665 landfills are operated. There is no organised waste collection in 468 communities inhabited by 4% of the population.

In accordance with the EU guidelines (EU directive no. 94/62), the Waste Management Law states in a Euro-conform way that at least 50% weight of the packaging waste has to be recovered. Within the guidelines of collection and recovery, at least 25% weight of the packaging material from the packaging waste has to be recycled; in view of all types of the packaging material, the quantity of the recycled material has to reach at least 15% of its weight. While the EU directive sets up the end of 2005 as a deadline for the achieving of the above mentioned goals, the Hungarian regulation is more stringent and its deadline is the 1st July 2005.

Ireland: congestion in Dublin makes efficient waste collection systems necessary

The past five years has seen a major shift towards the privatisation of the collection recycling of wastes including recyclable dry domestic wastes. Municipal authorities have traditionally operated in-house fleets for delivery to landfill sites in public ownership.

Congestion, particularly in Dublin, has made waste transport logistics more difficult to manage effectively. This is compounded by the increasing distances to be travelled to landfills as the older landfills near the city centre reach capacity and by the changing patterns of commercial deliveries in the city centre. The logistics strategy will see the new bring banks being placed close to areas of high density (within walking distance to minimise car borne deliveries) and domestic collections being managed in a way that will not create any additional traffic following the introduction of the brown bins.

In Dublin city centre domestic waste is collected at night together with street cleaning materials.

Italy: clean vehicles are used for waste collection

Currently, the collection of un-separated wastes, which does not includes any type of waste sorting, continues to be the main activity of waste management companies, even though the introduction of the integrated waste management system is changing the organisational and technical method of collection.

The separated waste collection systems are essentially based on the use of street skips and large-sized vehicles with rear and side loading. In some large cities (Milan), the system of door-to-door collection of sacks still remains.

The following criteria of logistic optimisation are of future importance:

- global evaluation of costs and benefits (also taking into consideration the environmental and social ones),
- definition of optimum territorial areas from the logistic standpoint,
- co-ordination of the subjects involved (public, private, individual citizens),
- optimising the single company processes (lower costs, less environmental impacts)

In Italy several innovative projects in the area of waste transport logistics have been developed from intermodal transport to the usage of environment-friendly vehicles.

Latvia: focus on implementation of EU standards

A national municipal solid waste management strategy for Latvia was finished in November 1997 with an implementation period from 1997 to 2015. The strategy includes several aspects:

- development of the legislation system incorporating institutional aspects;
- improvement of waste management, including development of new regional landfills;
- elaboration of an economical system for waste management.

The activities are strongly focussed on the implementation of EU-standards. Innovative projects in the field of urban waste transport and logistics are currently not known.

Lithuania: raising public awareness

Waste management is one of the priority environmental protection areas in Lithuania. Raising public awareness and increasing involvement in the processes of waste management takes place. At present, attention is focussed on collection of municipal waste, recycling, landfill management and development system. Introduction of the regional waste management systems and closure of old landfills presents one of the greatest challenges to municipal and county administrations.

The Netherlands: more and more intermodal waste transport were introduced

Strategies for waste logistics are aimed to make the collection and transport of waste more efficient and environmental sustainable. In stead of noisy traditional garbage collection with small buckets which were labour intensive, modern silent and clean automated collection vehicles are now used.

Instead of fixed vehicle chassis, now more and more container systems are

used that (when full) can be transferred to a special transport vehicle or other modes of transport. Furthermore, as the waste volumes and transport distances have been growing, more and more intermodal waste transport systems to the processing plants by rail or inland navigations were introduced on various origin-destinations. Motives to innovate and to improve waste logistic systems are e.g.: reducing costs for collection and transport of waste, less noise, emissions and disturbance or modal shift.

Slovakia: Currently no waste transport and logistics concepts

There are currently no waste transport logistics concepts existing. Nevertheless Slovakia has developed a waste management programme (WMP) for the next years. It was adopted in 1993 by Ministry of Environment of the Slovak Republic and has been the basic strategy for Waste Management in Slovakia. All current single waste management activities and plans are managed and originated according to with WMP of the Slovakian Republic.

Slovenia: Waste management is one of the most poorly regulated fields of environmental protection

Waste management is one of the most poorly regulated fields of environmental protection in Slovenia. The disposal of waste at local (municipal) landfills is more or less the only possible method of managing urban and most industrial waste. The separate collection of household waste is organised (only) in few municipalities.

The Waste Management Strategy of the Republic of Slovenia – Problems and Specific Issues in Approximation to the EU (adopted by the Government of the Republic of Slovenia on 1 August 1996) is an important step towards the improvement of the current state. It defines basic guidelines and objectives in the field of waste management and grades possible waste management methods. The Strategy is a constituent part of the NEAP (National Environmental Action Programme), which in its programme section merely summarises the main objectives, measures and orientations.

Spain: low importance of waste transport and logistics

The awareness for waste issues and especially waste transport and logistics is rather poor. In the last years there is a trend trying to implant automated waste collection system all around the country. First waste logistics concepts in Spain have started with night waste transport using special vehicles, because of improving the waste problem, preventing traffic congestion (night) and getting it faster.

Only the main cities have developed any initiative for the automated collection, especially in historical centres.

Switzerland: a lot of efforts for a sustainable waste management and logistics

In 1986 the Swiss waste disposal policy has publicised the first model (guidelines) for the future Swiss waste disposal system.

Since the first Swiss waste disposal model 20 years are gone and today the

logistics

success can be seen. After a first period of the establishment of a functioning disposal system and the construction of waste disposal facilities a second period of consolidation and optimisation has started. The conception of sustainability leads to a more active role of waste disposal policies.

In the last decades the waste “disposal” made a change towards waste “management”. In charge of waste collection (household waste as well as industrial waste) is the administration of a municipality. The municipalities (very often cooperating with each other, or under supervision of the canton) lay down the specific rules of how, when and where what kind of waste is collected or where it can be disposed and what fees apply. In the 1990s central aim became cutting costs for waste management as a whole, while maintaining the environmental standards.

New technologies in waste logistic include

- waste collection vehicles (systems: translift, cats, msts; use of ACTS system for vehicles and rail/road transport, IES system see project CH-1, use of balances to weigh every household’s, company’s waste amount for billing);
- new types of allocation boxes: i.e. project to install 6.5 m3 underground containers in the old town of Zurich to replace the waste allocation places on ground (bags and widely used 0,77 m3 waste containers)

United Kingdom: currently low importance, but innovative

Commercial waste was collected by commercial organisation, municipal and household waste by in house direct labour organisation within the city government. In the 1980s municipal waste was outsourced on a competitive tendering basis. Nowadays some in house operations exist but have to be market tested. Traditionally waste was shipped to landfill sites which were located as far away from the most vocal voters, irrespective of distance.

With as many as 20 per cent of local authorities unlikely to meet their controlled emissions standards, there is an increasing enthusiasm for natural gas-powered refuse collection vehicles (RCVs).

There are a lot of innovative research activities taking place like the STRAW project (Sustainable Transport Resources and Waste Project) which offers the opportunity to think strategically about the scale and location of waste management and reprocessing infrastructure, while optimising transport of materials between facilities and regions using rail, inland waterways and coastal options.

The Mayor of London and Transport for London are continuing to develop a strategic approach to the waste and waste transport sector in London. The Mayor required the development of the London Sustainable Distribution Partnership (LSDP) which has already been involved the development of several initiatives and projects.

Development of a London-wide waste land use and transport model for municipal, and commercial and industrial waste streams including the environmental impacts of waste transport: It will consider the increasing transport demand and use of vehicles and the role of different modes as greater proportions of London's waste is recycled and recovered.

3.3 Regarded case studies (project-level)

23 projects collected

23 projects from most of the participating countries have been collected. Table 2 gives an overview on all collected projects, the projects' phase, form of organisation the type of waste, spatial extension, degree of innovation and estimated relevance for BESTUFS.

ANNEX II gives a detailed and summarised description of all collected projects.

Most projects with focus on technology, modal shift solutions or overall general concepts.

The most waste transport and logistics concepts and projects that have been identified have been with focus on: technological aspects (e.g. compression and container technology, usage of pipeline systems, environment-friendly vehicle usage etc.), modal shift solutions (taking into account waterborne transport, rail transport or waste transport by tram) and overall logistical concepts that include for example re-planning of collection tours, ITS-usage or tour planning.

Best practices

For showing the experiences made in the surveyed countries selected best practices in each country have been chosen. Ideally they should show how waste transport logistics concepts in urban freight do function and about that they should give some background information why this example does function very well and what have been or are the main difficulties within this named project.

Table 2: Overview on collected projects

Country	City/Region	Name of concept	Project Phase	Form of organisation	Main type of waste	Spatial extension	Degree of innovation	Relevance for BESTUFS
AT – 01	Region of Oberösterreich, Steiermark, Vorarlberg	Potential of optimisation in waste disposal logistics	Planning and design	public	household	regional	high	High
AT – 02	Austria	CARGOtrade.net	stopped	private	household	regional	medium	high
BE – 01	Liege, Walloon region	Inland waterway urban transport of household waste	operation	public	household	regional	medium	high
BE - 02	Brussels	Future usage of inland waterway transport in household waste transport	planning and design	public	household	urban	medium	high
CH – 01	Canton Thurgau	IES Integrales Entsorgungssystem	operation	public	household	regional	high	high
CH – 02	Canton Zurich	Optimisation of Waste Logistics / Recovered Paper Logistics - Guidelines for municipalities of the Canton Zurich	planning and design	public	household	urban	low	high
CH – 03	City of Zurich	Cargotram	operation	public	household	urban	high	High
DE – 01	Ulm	Waste container management RWE Umwelt Sued	operation	private	industrial	regional	high	high
DE – 02	German cities	OPTRANS	realisation	private	household	regional	high	High
DK – 01	All municipalities in Denmark	MiljøLogistik	operation	private	industrial	regional	medium	medium
FI – 01	Helsinki Metropolitan Area	PUZER XMIT	operation	private	household and industrial	urban	high	high
FI – 02	Finland (also urban areas)	MOLOK - Smart collection system for solid waste	realisation	private	household and industrial	urban	high	high
FR – 01	Lille	Lille municipal waste waterborne transport from Lille to Blaringhem	stopped (to be re-implemented)	ppp	household	urban	medium	high
FR – 02	263 municipalities from the eastern part of the Oise Department (Oise Vallee), 60 km North of Paris	VERDI (Valorisation Et Recyclage des Déchets en Intercommunalité)	operation	ppp	household	urban	medium	high
GR – 01	Kifissia	Waste transhipment and compression	operation	public	household	urban	medium	high
GR – 02	Thessaloniki	Waste transhipment and compression	operation	public	household	urban	medium	high
IRE- 01	Dublin Area	Glass collection	operation	private	household	urban	medium	medium

Country	City/Region	Name of concept	Project Phase	Form of organisation	Main type of waste	Spatial extension	Degree of innovation	Relevance for BESTUFS
IT – 01	Rome	INTERMODAL SYSTEM, ROAD-RAILWAY FOR THE TRANSPORT OF WASTE - AMA (Environmental Municipal Company) Rome	operation	public	household	urban	medium	high
IT – 02	Rome and other Italian cities	Waste collection with environment-friendly vehicles	operation	public	household	urban	medium	high
NL – 01	Randstad Area	SHAFRA Zuid-West (Shift in waste transport modality in the Randstad area – pilot South-West)	realisation	ppp	household and industrial	regional	medium	low
NL – 02	City centre of The Hague	De Schone Stad	operation	ppp	household and industrial	urban	medium	medium
UK – 01	London	LSDP	Planning and design	public	household	urban	medium	High
UK – 02	England and Wales	STRAW	Planning and design	ppp	household	regional	medium	Medium

(marked projects are presented in detail)

Assessment of the projects

The following project descriptions show examples of planned or implemented projects and assess the experiences made. As many innovative projects are planned or set-up a selection had to be made.

Thereby, the following aspects were considered:

- Relevance for BESTUFS, innovative character and contribution to solve problems
- Success / failure analysis and real world experiences
- Balance among countries and approaches
- Availability of existing and further information.

Example 3.3.1:
IES Canton Thurgau

3.3.1 Integrales Entsorgungssystem IES im Kanton Thurgau

(Integral Waste Disposal System in the Canton Thurgau) (Switzerland) [Karrer, R. 2005]

Key words

Modal shift, rail transport, reduction of vehicle kilometres, consolidation, tour planning

Background

- The political will for an efficient, coordinated concept for waste disposal in the region, with cooperation of diverse political instances.
- New single waste incineration plant in region built in 1997 (replaced two older plants). Therefore an efficient transport and logistic concept for the in total longer transport distances of the waste to the plant became crucial.
- To ease the effects of traffic in the areas near the incineration plant, which is densely populated, also rail transport had to be considered.
- A newly built incineration plant was approved under the condition that a considerable part of the transport is carried out by rail instead of road transport. (Reduction of ton-kilometers on the road in the whole region)

Objectives

- Reduce traffic caused by waste collection and transport processes in the area and to reduce negative environmental impacts
- Save costs by reducing trips and consolidation activities

Basic approach

- The project was initiated by cooperation among 66 municipalities and the administration of the canton Thurgau. The whole waste disposal in the region was delegated to a public organisation called “Verband KVA Thurgau”. The region covers about 190’000 inhabitants
- The main aim of the waste logistic concept was an increase in efficiency in the whole waste logistic of the region including environmental concerns
- The transport concept is called “Integral disposal system” (IES) and is used for the waste collection as well as for the clustered transport to the incineration plant
- Within a radius of 10 km from the plant, the household waste collection is carried out by trucks. Further away by a truck-train combination.
- Waste collection tour: A standard ACTS container (27 m3) is used on the waste collecting tour (household waste) with a specialised truck, equipped with a compactor (translift). When full, the ACTS container is

driven to one out of 5 road-rail intersection places (CUS), where the container is transhipped onto a rail wagon, and an empty container transhipped back on the truck. 130 containers are in use in the year 2005.

Figure 7: Vehicle with container and "translift" for household waste collection

Figure 8: Transhipment of the container from truck to rail with ACTS system

- Parallel to the public waste collection tours there are 3 points (RAZ) plus the plant where private and small industrial firms can bring their bulky waste themselves. These points are equipped with a compactor. When needed a truck takes the full containers to one of the intersection places nearby for transhipment to rail.
- The third way (for small industrial companies) is to have a compactor

and a container on site. The full container is brought to a transhipment place.

- At road-rail transhipment places standard goods handling facilities, as common for the ACTS system are used. This actually only needs a rail track next to a paved area. The transhipment is done by the on the truck installed hydraulic mechanism.
- Main advantage of the concept is the separation of waste collection process and waste transport process. On the one hand the waste collection tours become more efficient (the time consuming transport to the incineration plant can be left out). On the other hand the waste transport can be carried out by rail, which is the more environment friendly means of transportation.
- Kind of waste handled: all general household waste in the region, bulky waste of households and of small industrial firms, combustible construction waste
- Used technologies are: ACTS container and transhipment system, a system called “Translift” installed on the collection vehicles to compact the waste and forward it into the container, compactor system for stationary points (RAZ) and companies
- Apart form the EIS, the project includes an optimisation of the collection tours: the number of spots on the street where household waste can be placed in advance of the collection tour was reduced, with the effect that the number of stops decreased, which makes the collection more efficient.
- The rail company charges per container (independent of the weight). Because of this and because of the generally higher efficiency of the collection tours compactors are used to fill the containers.
- The performance of the concept is well monitored in terms of performance, cost, modal share, efficiency.

Future plans development

The introduced integral disposal system has now been in operation since 1997 and will persist.

Future plans are:

- Evaluation and procurement of new trucks (replacing the one in operation now) with a higher payload to make an increase of the average container load possible (and a further increase in productivity). The trucks should come into operation in 2006.
- Verification of the collection tours to increase the efficiency
- There will not be a change in the overall concept nor in the organisation (no privatisation tendencies)

Results and experiences

Experiences and conclusions:

During introduction phase the following obstacles occurred: Need for cooperation between diverse instances; opposition from the population near the central incineration plant (concerns about air quality and traffic volumes); political opposition against increased costs for rail transport (which were actually lower); opposition from the road transport industry against modal shift to rail.

As the rail transport is charged per wagon (3 containers on 1 wagon), costs can be reduced when the filling weight is as high as possible. The average filling weight was at around 9,9 tons per container during the years 1999 to 2003. This weight is limited by the allowed maximum load of the trucks used.

Cost of collection (figures for 1997): In IES-areas (collection by truck and transport by rail) the specific cost for collection is CHF 86.74 / t plus the rail transport of CHF 27.65 / t. In areas where waste is brought to the plant directly it is CHF 90.50 / t. This meets the expectations from the project planning.

Before the introduction of the concept there were 17 vehicles for the collection in operation. Since there only 9 are needed. Reasons: Shorter transport distances from collection area to transhipment place, higher collection performance by reducing the spots where people can place their household waste and roughly twice as much load in a container than in a conventional waste vehicle.

The truck kilometres travelled during collecting tours could be reduced from 2’680 km to 2’150 per week. Overall reduction of truck kilometres of 600’000 km per year.

Overall costs for waste collection and transport could be reduced compared to the old concept (two incineration plants within the area, truck transport only)

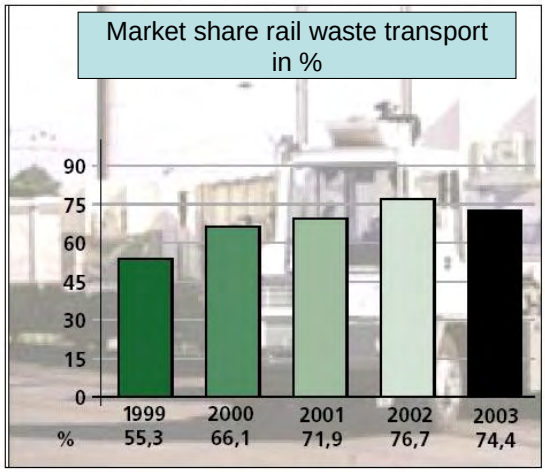


Figure 9: Percentage of tonnage delivered at plant by rail, development since 1999

Acceptance:

After a certain time population got used to the new collection regime (less spots to place waste, only on right side of the road etc.).The overall logistic concept is well accepted by staff, road transport operators, and operators of the incineration plant.

In the first year 15 companies had a waste press with a container at their site. This number was increased up to 24 in 2005.

Benefits:

For stakeholders: environment friendly concept, overall lower cost and higher efficiency

For service providers: integrated system with concerted processes in collection, transport, incineration and landfill

For the public (inhabitants): cheaper fees for waste disposal, less traffic (esp. near the incineration plant)

Success factors and failure factors:

Success factors: positive effects for all stakeholders; higher efficiency and lower costs for waste handling; less noise and air pollution

Failure factors: none

Lessons learned: Experience transferable to other projects

Road – rail integrated concepts can be successful as well as from an economically point of view but also politically and for the environment (environment, inhabitants, operators)

More information

Peter Hungerbühler, Verband KVA Thurgau, Rüteliholzstrasse 5, CH-8570 Weinfelden
Tel. +41 71 6269660
hungerbuehler@kvatg.ch

Raphael Karrer, Rapp Trans AG, Uetlibergstrasse 132 ,
CH-8045 Zürich
Tel. +41 43 2686033
raphael.karrer@rapp.ch

See also References and contact persons!

Example 3.3.2:
Inland waterway urban transport

3.3.2 Inland waterway urban transport of household waste in Liege

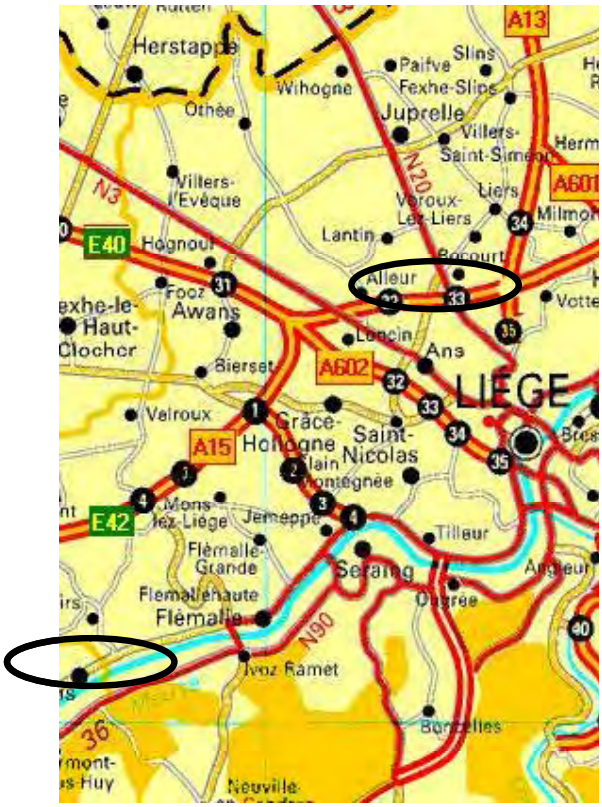
Walloon region (Belgium)
[Monami, E. 2005]

Key words

Modal shift, waterborne transport, reduction of vehicle kilometres

Background

Inland waterway transport of waste began when the incinerator was opened in 1990. Inland waterway transport of household waste was of 73.614 tons in 1996 and of 37.755 tonnes in 2001, representing approximately 27% of total wastes treated by the incinerator during the year.



In 2004, 172.500 tons of waste has been transported to the incinerator of Herstal, among which 133.000 tons arrives by lorry and 39.500 tons by barge, representing approximately 23%. Despite the strong decrease between 1996 and 2001, we may observe a slight increase of 4.6% of the volume of waste transported by barge in comparison with 2001.

Objectives

The main objective has been to reduce environmental impacts of municipal waste transport. The initiative was undertaken because it was seen to be interesting for financial and environmental reasons.

Basic approach

The incinerator managed by the Association of Municipalities for the Treatment of Waste in Liege (INTRADEL) in Herstal treats household wastes collected from 72 municipalities of the agglomeration of Liege.

Household wastes collected by about 28 municipalities, located in the southern part of Liège, are transported from a central transfer station in Ivoz-Ramet (about 20 km in the south of Liege, belonging to the municipality of Flemalle) to the incinerator by barges on the Meuse. The transfer station of Ivoz-Ramet is located on the right bank of the Meuse and is easily accessible by road. Lorries from these municipalities deliver the collected waste to the station, equipped with a covered wharf, from which a barge leaves every two days to the incinerator, which is directly connected to the Meuse.

Future plans development

A very similar project is about to be implemented in Brussels Capital Region in the next three years.

Results and experiences

Results:

The main conclusions of such a project are very positive. Inland waterway transport of waste contributes to the improvement of the quality of life in urban areas by reducing the number of back and forth movements from and to the incinerator of waste lorries circulating in the city centre of Liege.

Waste transport by barge allows avoiding the transit of 40 waste lorries a day through the city of Liege. Data concerning the number of vehicle kilometres was not available. Inland waterway transport emits 2.6 times less greenhouse gases than road transport per transported ton. Moreover conveying costs of inland waterway transport is the lowest in comparison with other transport modes.

The remaining 44 municipalities (including the municipality of Liege which provides the highest amount of waste) transport the collected waste to the incinerator by lorry. The choice of transport mode depends on the localisation of the municipality and its distance from the incinerator. The 28/44 ratio is variable in time and depends on choices made by the waste collection companies with which each municipality work.

Frequency used to be of one barge a day at the beginning of the experience, but the reduction of waste volumes has led to a reduction in frequency. Current frequency of inland waterway transport is of one barge every two days.

Benefits

For service providers: The energy consumption per transported ton of inland waterway navigation is far less important than that of other transport modes.

For the public (inhabitants): The main benefit for the inhabitants is a strong reduction of the number of lorries transiting through the city. This implies a reduction of congestion and thus less air and visual pollution.

Success and failure factors

Success factors: Each barge transporting waste from Ivoz-Ramet to the incinerator is equivalent to 40 waste collection lorries. Inland waterway transport prevents congestion and pollution that would be caused if all wastes were transported by road.

Failure factors: No specific problems have been encountered in the implementation of this initiative. The transport of waste is however dependent of the river flow. In cases of high river level and floods, especially in the winter, navigation is sometimes impossible and/or forbidden.

Lessons learned

The project is easily transferable to other cities whose layout or land planning is similar to the one of Liège. Moreover, the interested cities should be equipped with the necessary infrastructure along the riverbanks.

More information

Eric MONAMI, STRATEC
e.monami@stratec.be

See also References and contact persons!

Example 3.3.3:
PUZER XMIT

3.3.3 PUZER XMIT Pneumatic Waste Bag Transportation System (Finland)

[Himanen, V. 2005]

Key words

Pipeline transport, waste separation, reduction of collection tours, reduction of vehicle kilometres

Background

One of the major problems in waste management is access to the waste collection areas usually situated in the courtyard of every house. Also, the conditions of these areas are often unsatisfactory and smell nuisances in these areas force relatively frequent collections with relatively high costs and local disturbances.

Objectives

The objectives of this project have been in the first line to develop a product that helps to save costs in waste disposal (waste collection) and to reduce negative impacts of waste storage and positioning in the courtyard of houses.

Basic approach

In 2001 Puzair Ltd has developed pre-separated waste transport system that is actually operating in the Helsinki Metropolitan area. Apartments are equipped with two (mixed/bio) small waste bins in the kitchen closets (Also, more than two waste fractions could be used). When a waste back (decomposing one for bio waste) is full, inhabitants take it to the waste station in the basement of the house. The waste fraction is chosen by pressing a pushbutton that unlocks the lid. The system (pipeline) transports (the distance is about 200 m) the bag into the container (for that waste fraction) with compressing facilities. The containers are shared with a shopping centre nearby. Cost savings can be obtained because round trips for waste collection are diminished. Also, local nuisances caused by truck driving and waste handling in the courtyards are stopped.

- The project initiated by Puzair Ltd has been realised together with company's customers, subcontractors and EVTEK Institute of Technology. The project has been included in STREAMS Technology Programme partly financed by TEKES (the National Technology Agency of Finland)
- The system was developed first in a laboratory and in 2001 applied in practical use. The operation is monitored and improvements have been applied.

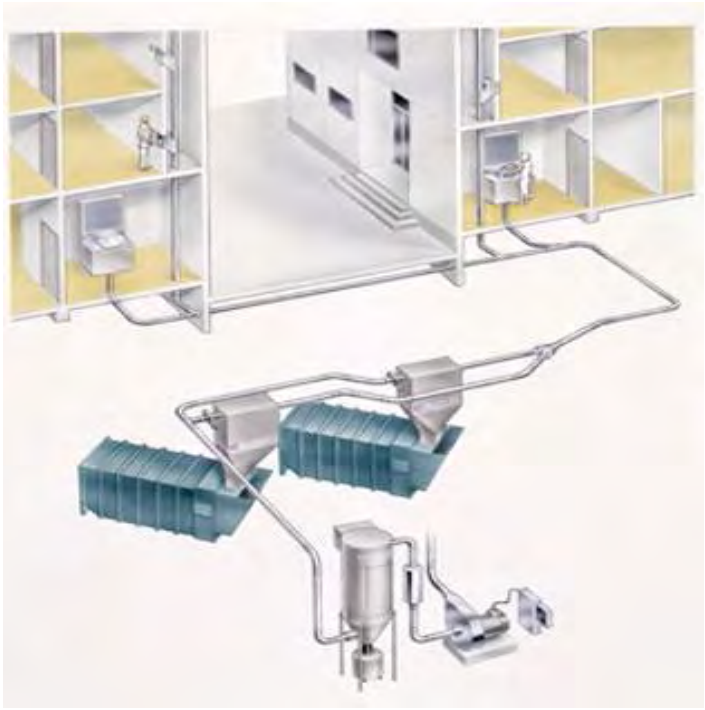


Figure 10: The PUZER XMIT-system

Future plans development

A new system is made for the new shopping centre/apartment block in Helsinki City Centre.

Results and experiences

Experiences and conclusions:

Benefits:

- The company has got a new product that it is selling worldwide.
- Collection of waste can be rationalised and therefore fewer truck trips are needed. Also working conditions for drivers are improved.
- Inhabitants are saved from nuisances caused by trucks collecting wastes from their courtyards.

Success Factors: A new and innovative approach, easy to install at the same time as a new housing block and nearby shopping centre were built.

The project is transferable to other projects.

More information

Veli, HIMANEN, JP-TRANSPLAN Ltd.
veli.himanen@relate.fi

See also: www.puzer.com and References and contact persons!

Example 3.3.4: Cargotram

3.3.4 Cargotram (Switzerland)

[Neuhold, G. 2005]

Key words

Modal shift, waterborne transport, reduction of vehicle kilometres

Background

Because of ecological reasons the Cargotram was introduced to shift waste transport from road to rail and thus to

- reduce vehicle kilometres by reduction of truck usage
- improve quality of life in the city of Zurich

The concept followed is a decentralised waste collection near to the urban population.

Objectives

ERZ (Entsorgung und Recycling Zürich) is the city refuse disposal service. In Zürich, items too bulky for the dustcart can be collected at a charge, or left for free at one of the two ERZ yards. Yet 300 tonnes of bulky waste items are dumped illegally every year. ERZ has been brainstorming on how to provide a more attractive yet inexpensive service.

Zürich has an extensive tram network serving most neighbourhoods. There are also many suitable sidings not used by regular services. ERZ approached the tram company, VBZ, with the revolutionary idea of using this infrastructure to collect bulky refuse in the neighbourhoods, so making disposal much more straightforward for residents. The idea was met with enthusiasm and Cargotram was born.

The main objective has been to reduce the negative effects from waste collection by trucks such as noise and exhaust emissions. Therefore the replacement of district collections by truck and the optimisation of the performance in waste collection processes close to the customers' home and the transport by tram to the recycling area have been aimed.

Basic approach

The Cargotram project has been introduced in 2003 and is implemented in daily business and operating. The initiator of the Cargotram has been Mr. Neuhold, CEO of "Entsorgung und Recycling Zürich" ERZ (municipal public waste disposal and recycling company Zurich). The approach has been and is to collect bulky goods of households near the tram stops and since 2005 onwards the collection of waste and electronic and electronic equipment for households and industries.

The payload is carried in two standard refuse containers. These are carried on four-wheeled flat wagons.

The Cargotram serves different tram station in the city area of Zurich. In total 9 station are actually served. A pre-condition of the system is that the concept is not hindering the public transport by tram. Therefore the positioning of Cargotram is at those stations where additional tracks are existing (turning points at the end of a tram line). The Cargotram is addressed to public transport users, residents, cyclists and pedestrians. It is not allowed for non-users of public transport to deliver bulky goods to the Cargotram. Cars and delivery vehicles will be turned away. The collection of bulky goods is taking place every four weeks per station. The opening times for the Cargotram are between 3 p.m. and 7 p.m.

Since traction vehicles and freight trailers were already existent, the project could be realised in a very efficient way. The project has been and is carried out in co-operation between the municipal ERZ and the “Verkehrsbetriebe Zürich” VBZ (public transport service of Zurich).

Figure 11: Cargotram Zurich

Future plans development

The project has proved its worth and will be continued.

Results and experiences

Experiences and conclusions:

Cargotram not only makes a contribution towards reducing congestion and pollution, it also provides a valuable service to residents. Together with exemplary public transport, attractive local amenities and the 'Mobility' car sharing pool it can be seen as part of a wider concept offering residents a higher quality of life without having to own an automobile.

The project is permanently monitored. The evaluation is with focus on:

- evaluation of tonnage
- acceptance by the local population
- development of illegal waste disposal

Benefits:

- For stakeholders the benefits are less traffic and high acceptance form the population.
- For service providers the marketing effect and image (winner of innovation award).
- For the public the comfortable disposal possibilities for bulky goods free of charge.

Success Factors: Main success factors have been the good planning and communication, the good co-operation of service providers, high acceptance.

The project is transferable to other cities.

More information

Gottfried NEUHOLD, ERZ Zurich

http://www.vbz.ch/vbz_opencms/opencms/vbz/deutsch/Dienstleistungen/Cargotram/

See also References and contact persons!

Example 3.3.5: OPTRANS

3.3.5 OPTRANS (Germany)

[Huschebeck, M.. 2005]

Key words

Tour optimisation, I+C-technologies, reduction of vehicle kilometres, reduction of noise and exhaust emissions

Background

OPTRANS deals mainly with the assessment of transport chains within waste recycling processes due to the German waste recycling directive. Based on a common method for a ecological and economic assessment of transport chains information and communication solutions were developed aiming on an optimisation of the transport flows for the recycling of plastics from private households. The main goal of OPTRANS was to evaluate how far transport demand can be reduced and alternative transport modes can be integrated in to waste transport chains.

Objectives

The OPTRANS solutions should provide an optimisation of road based transport flows and practically show the potentials to integrate alternative transport modes into these transport chains.

Basic approach

Within OPTRANS exemplary transport chain for plastic recycling packaging are regarded and evaluated. Focus was on the transport chain starting from the sorter. Hence, waste collection processes are not explicitly considered.

The survey contained the following steps

- Making goods flows and transport processes for plastic recycling transparent
- Analysing the weaknesses of waste recycling processes in the transport chains considering ecological and economic aspects
- Developing an IT approach optimising the waste recycling transport chain
- Implementing and demonstration of the IT solution
- Evaluating the project results and transferring them to other fields of waste recycling.

Following a comprehensive system evaluation a system architecture was developed distinguishing a strategic, tactical and operational planning level.

At the strategic planning level a tool was developed (TAG) planning the goods flows between the different senders and receivers of recycling material. On the basis of a daily goods flows transport orders are created that aim to achieve an optimum balance and that considers economic and

ecological aspects.

On tactical level the following processes takes place:

- The recycling material is pressed and tagged with a transponder
- The pressed material will be stored and a message is send to the strategic planning application for further planning steps
- The strategic planning application decides on the location the pressed material will be send to
- The specific information will be transferred on the transponder, which can then be send to a handheld loading it on to a truck

On operational level a tour optimisation application is used for creating optimised round trips. The possibility to employ intermodal transport modes for carrying out the operational transport process was considered in a survey.

Future plans development

In realisation - presently not known

Results and experiences

By using a IT based dispatching and tour optimisation applications about 2 Mio km could be saved per year for the demonstration partners DKR and ALBA Wertstoffmanagement. About 5% of the total km driven can be safed and about 16% of the vehicles. Both together, but also by an improved location of the recycling plants transport cost might be saved by about 12%.

On the basis of the survey carried out to assess the potential for intermodal transport about 14% of the transport operations might be changed to rail based intermodal transport chains.

More information

Marcel HUSCHEBECK, PTV Karlsruhe

See also References and contact persons!

Example 3.3.6: OPTRANS

3.3.6 Potential of optimisation in waste disposal logistics (Austria)

[Schrampf, J. 2005]

Key words

Tour optimisation, simulation model, reduction of vehicle kilometres, reduction of noise and exhaust emissions

Background

The Austrian Ministry of Transport Innovation and Technology, in the framework of "Logistik Austria Plus", set off innovative concepts and solutions for transport and logistics and funded companies and research establishments for implementing projects between 1999 and 2003. The regarded project was part of this research programme.

As waste transport logistic causes ecological and economical cost, the content of this project was the generation of a simulation model, to analyse and forecast the effects of different waste transport systems. This project is a first step towards scientific research on internal and external effects of different waste transport systems taking into account various socio-economical and socio-demographic parameter.

Objectives

The aim was to create a model simulation that allows optimising the collecting system of different kinds of household waste by considering several objectives and parameter.

Basic approach

In order to design the forecast model on a city level and set its parameters, data have been collected and analysed. Correlations between socio-economic and socio-demographic characteristics, waste quantity, kind and quantity of accumulation bins subject to disposal interval and optimal number of stops subject to disposal system have been identified.

Then, key figures of disposal routes and vehicles have been identified: number of driven kilometres, duration for collection and transport of each kind of waste subject to disposal system and different operational cycles of disposal vehicles as well as the resulting exhaust gas emissions subject to the residential area structure.

A high number of people in several cities have been surveyed in order to find out how many kilometres they drive (with their own car) subject to the characteristics of disposal system.

At least the exhaust gas emissions resulting from disposal vehicles (3 different engines: diesel, bio diesel and natural gasoline) and private cars on one hand, on the other hand the emissions resulting from the production of fuel as well as the manufacturing, maintenance and disposal of the vehicles have been evaluate in the framework of a life cycle assessment (two

methods: “Centrum voor Milieukunde Leiden and Ecoindicator 95). The costs of trucks or car drive subject to disposal system have been calculated.

By means of those identified parameters a city model has been simulated, the environmental and economical impacts shown and possible improvement discussed. With this simulation model it is possible to generate very precise waste data models without intensive field research.

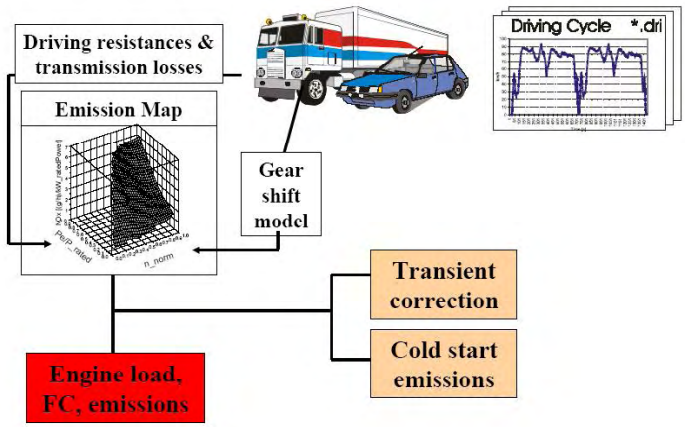


Figure 12: PHEM-project-scheme

(PHEM = Passenger car and Heavy duty vehicle Emission Model)

The simulation model has been used to compare, for a city model (this city does really exists), 8 scenarios composed of a combination of the three following waste disposal systems depending on the kind of waste:

1. collect system
2. “collect islands” (at the street corner, by shopping centres…)
3. one central collecting point in the city (e.g. rubbish dump…)

Future plans development

It is not known if the project has found further applications, but the results have been published and are available for further research activities.

Results and experiences

The project was a success, as the aim was reached: the model simulation runs properly. Moreover it was the first time that such a complete analysis of exhaust gas emissions and a forecast of waste quantity of each kind according to the residential area structure was achieved in Austria.

This project could be considered as a further step for an integrated optimisation of waste disposal logistics in Austria.

The whole content of the report and the model simulation itself can be used for further research or applications.

More information

Jürgen SCHRAMPF, ECONSULT

See also References and contact persons!

3.4 Synthesis from the case studies

Reasons for the need of waste transport logistics in urban freight transport

The amount of waste has risen over the last decades and is still going on to rise. Especially in the New Member States the problem of waste becomes of more importance because of rising waste volume. This requires efficient waste management programmes and concepts that supports a reduction, separation and recycling of waste. A lot of efforts have been spent to waste management since beginning of the 1990ies in various countries.

As seen from the material collection there is still an improvement potential, especially in the cities of the New Member States. The experiences from West European Cities can be seen as a chance to improve the situation in city freight transport and especially the waste collection. Currently also cities of the New Member States have started waste management programmes reducing the waste volume, separating waste and recycle it. They have started already and aim to start the adoption of EU-regulations by transferring EU-standards in national laws and regulations.

Waste logistics is one important part of an overall waste management activity that can support the reduction of noise and exhaust emissions especially in city areas and by this improve the quality of life in urban areas.

Currently in Germany a discussion about exhaust emissions in urban areas, especially PM 10 “Feinstaub” has started. That will also affect city logistics schemes that have recently become of less important. Also other cities will discuss this problem. Waste collection is one of the main freight transport activities within urban areas. Therefore this issue will become newly discussed and of importance.

Objectives and tasks

The objectives are varying in dependence on the initiator of projects: private or public. Whereas private companies try to optimise their waste logistics because of cost saving measures and efficiency increase, public authorities often seeks for environment-friendly measures to increase quality of life in urban areas.

Main objectives on private side are for example:

- the increase of efficiency in waste collection process and waste logistics
- the cutting of costs in the waste logistics system
- the gaining of image by initiating environment-friendly concepts
- the introduction of new technologies (selling reasons)

The main objectives from public side are:

- avoidance of negative environmental impacts

- avoidance of congestion
- also cost efficiency in waste transport

Type of projects

There is a great variety of different projects and measures dealing directly urban waste transport logistics. A lot of these projects are regional ones with direct impact on cities' freight transport like for instance the regional transport flows organised by inland navigation from the city to regional landfills or intermodal transport by rail. The connection between urban areas and regions strongly depends on the location of landfills which are mainly located outside the cities because of negative impacts and spatial needs.

But there are also projects with focus on urban waste transport and logistics. Especially those with the aim to optimise collection activities (ITS-usage, tour planning and tour optimisation).

A lot of projects are in the first line not directly addressed to environmental issues. Because of privatisation tendencies and growing competition in waste sector a lot of projects have been started to lower operational costs by optimising collection activities. But those projects support of course the reduction of negative environmental impacts. Those projects are mainly initiated by private operators (PUZER XMIT-system from Finland for example). But of course there are projects that have been started with the aim to achieve more quality of live in urban areas by reducing negative impacts (SHAFRA Zuid-West in the Netherlands).

Regarding the measures that have been initiated to optimise waste transport flows and to reduce negative effects of waste transport processes the projects have been with focus on:

- Modal shift from road transport to rail and inland waterway transport
- Tour optimisation and collection tour planning
- Integral waste transport and waste management systems
- Usage of environment-friendly vehicles
- Technologies and equipment

Many projects have been initiated within a Public Private Partnership (PPP) (like for example "De schone Stad" in the Netherlands). Because of the involvement of public authorities and private operators in the waste disposal the projects have been implemented and worked out in near co-operation. Often the public side is responsible for waste management activities but private operators are carrying out waste disposal in practice. So public authorities have outsourced those activities with help of tendering processes.

3.5 Conclusions and recommendations

3.5.1 Conclusions

Waste policy

Waste management has become and is an important issue to European countries. EU-regulations and national legislation spend a lot of efforts to reduce negative impacts from waste. They set thresholds for the share of recycling waste to all waste, they define waste operation process and more. National governments have transferred those EU-regulations and standards into national legislation. In the New EU-Member States this process of adoption of EU-regulations has already started or begins to start.

The 1990ies can be seen as the age of waste management. Most European countries at this time have developed waste management plans taking all relevant processes of waste disposal activities into account:

- Waste collection and transport / logistics
- Upgrading of technical infrastructure
- Planning of landfills and incinerators
- Recycling activities

Nowadays waste management activities are often based on the principle of sustainability and by this include:

- the priority of waste prevention and minimisation
- the recovery of unavoidable waste
- the optimisation of final disposal
- producer responsibility
- better resource efficiency
- decouple waste growth from economic growth

Importance of waste transport and logistics

Nowadays in most European countries experts consider the importance of waste transport and logistics in their country whether high nor low. However the future importance of waste transport logistics in various countries differs a lot. Whereas the importance in the old EU-Member States + Switzerland and Norway is mainly estimated to be average, in the New EU-Member States waste transport and logistics becomes more important in future. This is also a result of still missing standards in the newly associated countries. Only in Germany waste transport is seen as a high important task today and in future.

Most innovative countries

Regarding waste transport and logistics concepts the main innovative countries are: Austria, France, Germany, The Netherlands, Switzerland and United Kingdom. In Austria the government spends a lot of financial input and efforts in research projects with focus on waste transport and logistics like the research activities “Logistik Austria Plus” and Green Logistics. Projects and concepts have been introduced with focus on ITS-usage, modal shift towards rail transport or transhipment technologies.

In Germany also national research projects have been initiated like for instance the OPTRANS-project. Practical approaches have been and are usage of new vehicle and equipment technologies, intermodal transport, tour optimisation and integration of IT-systems.

Also France has spent a lot of efforts into a sustainable waste policy including waste transport solution. In France waste logistic projects with usage of inland navigation have started. Additionally the combination of store deliveries and re-transport of packaging waste are envisaged in future as well as the usage of pneumatic networks and tramways etc.

Switzerland (City of Zurich) has started waste disposal by tram. In the Netherlands the introduction of new container systems take place that show an improvement in capacity usage and by this tour and vehicle-kilometre reduction. The UK shows also high efforts in environment-friendly waste transport and logistics by using natural gas-powered vehicles or ITS usage. Also research activities with focus in urban waste transport and logistics in the London area have been started.

Experiences

As seen from the project waste transport concepts using inland waterways and railway transport can be very successful. Especially the product group “waste” seems to be affine to those modes. In the presented projects modal shift objectives have shown optimisation potential. It has been proved that economical results in form of efficiency enhancement and cost reduction but also the reduction of negative environmental effects can be reached by modal shift solutions.

The optimisation of collection tours by using ITS, tour planning software or collection time planning has also shown positive effects. But those efforts have been mainly be made because of economical reasons like for example in case of re-organisation of landfill location. For city authorities especially the transport flow optimisation has been of interest and the reduction of noise during collection processes. Often night collection has been an answer to congestion in cities. The environmental effects of waste collection measures in case of tour optimisation are relatively low.

3.5.2 Recommendations

Combination of measures and planning approach

Several measures can be taken into account for the improvement. As seen from the presented projects there are often existing single solutions but still missing integrated logistics solutions. In future it has to be taken into account to use different solutions and strategies: like for instance the combination of intermodal transport concepts and ITS-usage and environment-friendly vehicles for the waste collection. Furthermore not only the transport should be influences by new concepts and technologies but also the location of landfill facilities should be planned regarding the reduction of negative impacts (vehicle kilometres, noise and exhaust emissions etc.).

There should be a common planning approach between spatial planning and transport activities, especially waste transport. The integration of spatial planning has to consider the optimal location for landfills and incinerator. This should support a reduction of vehicles-kilometres but also the improvement of quality of life. The optimised planning of landfills and incinerators has also to take economically aspects into account.

Responsibility of city authorities

The city authorities can play an active role in waste disposal and waste transport and logistics concepts. As seen from many countries city authorities are in the first line responsible for the waste management and linked to this for waste transport and logistics. Often they have outsourced and are outsourcing their waste activities to private operators. In this case they start tendering processes where the specification for waste management and waste transport are made. In those specifications city authorities have to take the chance to define standards for collection processes and technologies that can be used. Not only the operation costs of waste disposal but also environmental aspects have to be considered. Sustainability is one of the central key words for political authorities. This means to take also social and environmental developments into account with view on future development of a city. Therefore cities should be aware to create a sustainable way also in waste management and waste transport in their cities.

Actually PM-10-discusison in Germany

The actual PM-10-discussion in Germany has shown that there is awareness for the avoidance of negative impacts of exhaust emissions from urban freight transport. In the future city logistics will get more importance. New concepts and regulations will lead to an improvement in urban freight transport. Discussions in Germany have taken also new regulations for city access into account. Those discussions will also influence waste transport and logistics.

Research activities and technical innovations

As seen from Germany and Austria national governments can influence the development of sustainable and future oriented waste management systems and waste logistics approaches. Research projects in the field of waste transport and logistics can be an important step for future projects, solutions and technologies and can support the technical and operational business application. Also other countries should think about national but also regional research activities in this field. In co-operation with private operators sustainable solution can be initiated.

REFERENCES AND CONTACT PERSONS

References			
ADEME, ECORAIL	2001	Transports des déchets, la solution ferroviaire	Paris, 2001
ADEME, VNF	2001	Transports des déchets, la solution fluviale	Paris, 2001
ADEME	2000	CEMT/OCDE, Table Ronde 116, Les Transports de déchets	OECD/CEMT, 2000
Thorel, X.	2004	La logistique de déchets urbains: quelles solutions fluviales?	Marne la Valle, 2004
Baudirektion Kanton Zürich (Department for Construction	1997	Vollzugshilfe für Gemeinden zum Ablagerungsverbot – Guidelines for municipalities	Zurich, 1997
Baudirektion Kanton Zürich (Department for Construction)	2004	Beiträge zur Abfallplanung – Zwischenbericht 2003 – Mid-term Report Waste Disposal Planning	Zurich, 2004
De Brito, M. / Dekker, R./ et al	2003	Reverse Logistics: a review of case studies	Rotterdam, 2002
EU Commission	1975	Council directive of 15th July 1975 on waste	Brussels, 1975
Federal Ministry for Education and Research	2004	OPTRANS – Optimized Transports in Waste disposal and recycling.	Karlsruhe, 2004
Federambiente (Italian Association of Public Services on Sanitation and Environment)	2004	Integrated Urban Waste management : comparative analysis of waste collection	Rome, 2004
Heimsoth, J.	2000	The optimisation of disposal logistics of industrial companies	Stuttgart, 2000
ONR (National Observatory on Waste)	2004	Annual report on waste management: potential of the integrated waste management	Rome, 2004
Rapp AG	1998	Feasibility study waste	Basel, 1998
Rapp AG	1998	Disposal logistics for Lörrach	Basel, 1998
Resource Recovery Forum	2000	Inland Waterways and the transport of waste	North Yorkshire, 2000

Stadt Zürich – Stab Verkehr	2004	Mobilitätsstrategie der Stadt Zürich – Wirtschafts- und Güterverkehr (Mobility Strategy Zurich – Urban freight transport)	Zurich, 2004
Technical University of Dresden, Institute for Logistics	2004	Logistics concept for waste disposal.	Dresden, 2004
Verband KVA Thurgau	2003	Jahres- und Managementbericht KVA Thurgau 2003	Weinfelden, 2003.
VGP Drava	1994	Inventarizacija odlagališč komunalnih odpadkov v Sloveniji (Inventory of Municipal Waste Deposits in Slovenia)	Ptuj, 1994

Persons who provided material

Austria	Jürgen SCHRAMPF ECONSULT Birostrasse 12 1230 Wien Austria Tel.: ++43 (1) 615 70 50 - 34 Fax: ++43 (1) 615 70 50 - 33 e-mail: j.schrampf@econsult.at	
Belgium	Eric MONAMI STRATEC Av. Adolphe Lacomblé 69-71 1030 Brussels Belgium Tel.: ++32 2 738 78 83 Fax: ++32 2 735 09 95 e.monami@stratec.be	
Bulgaria	Prof. Dr. Vikenti Spassov, President Bulgarian-French Association for Logistics & Management-BULFRALOG Hemus 16 BG-1111 Sofia Tel.: ++359 2 870 7084 Fax: ++359 2 9709 242 vspassov@vtu.bg	Delia Tonev BULFRALOG Hemus 16 BG-1111 Sofia, Tel.: ++3592/9709 243 Fax: ++3592/258031 tonevdh@yahoo.fr
Danmark	Lars Bentzen NTU Rørdalsvej 201, DK-9220 Aalborg Tel.: ++45 99 30 00 00 Fax: ++45 99 30 00 01 ntu-aalborg@ntu.dk	

Estonia	Peeter Eek Waste Department, Ministry of the Environment Narva mnt. 7 A, 15 172 TALLINN, Eesti / Estonia Tel.: ++ 372 6262884 Fax: ++372 6262869 e-mail: peeter.eek@envir.ee	
Finland	Veli Himanen, JP-TRANSPLAN Ltd. P.O. Box 500 FIN-01621 Vantaa Tel.: ++358 40 772 6615 Fax: ++358 9 682 6565 veli.himanen@relate.fi	
France	Laetitia DABLANC INRETS ENPC – 19, rue Alfred Nobel, Cite Descartes, Champs sur Marne, 77455 Marne la Vallee cedex, France Tel.: ++33 1 64 15 21 03 Fax: ++33 1 64 15 21 40 laetitia.dablanc@inrets.fr	Gerald LALEVEE ADEME Centre de Valbonne 500 route des Lucioles 06560 Sophia-Antipolis cedex France Tel.: ++33 4 93 95 79 00 Fax: ++33 4 93 65 31 96 gerald.lalevee@ademe.fr
Germany	Marcel HUSCHEBECK PTV AG Stumpfstrasse 1 76131 Karlsruhe Germany Tel:: +49 721 96 51 178 Fax: +49 721 96 51 696 Marcel.huschebeck@ptv.de	
Greece	Iro DIMITRIADOU Trademco S. A., 21 Kodratou Str Athens 104 36 Greece Tel. ++30 210 5279300 Fax: ++30 210 5279300 production@tredemco.gr	

Hungary	Horvath BALAZS TRANSMAN Kft. Hercegprimas u. 10 H-1051 Budapest Hungary Tel.: ++361 3531484 Fax: ++361 3110265 horvatth.balazs@transman.hu	
Italy	Giovanni RUBERTI Centro Studi sui Sisteme di Transporto (CSST) Corso Re Umberto, 30 10128 Torino Italy Tel.: +39.011.5513831 Fax: +39.011.5513821 giovanni.ruberti@csst.it	Marina DRAGONIERI Centro Studi sui Sisteme di Transporto (CSST) Corso Re Umberto, 30 10128 Torino Italy Tel.: +39.011.5513831 Fax: +39.011.5513821 marina.dragonieri@csst.it
Ireland	Hugh Finlay Dublin Institute of Technology Department of Transport Engineering Bolton Street, IRE – Dublin 1 Tel.: ++353 1 4023764 Fax: ++353 1 4023991 hugh.finlay@dit.ie	
Latvia/Lithuania	Algirdas Sakalys Transport Research Institute Vilnius Gediminas Technical University Tel.: ++370 5 2745075 Fax: ++370 5 2744981 algirs@ti.vtu.lt	
Netherlands	Ron van Duin TU Delft, Faculty of System Engineering and Policy Analysis Jaffalaan 5, Delft Netherlands Tel.: +31 (0)15 278 1142 Fax: +31 (0) 15 278 2719 j.h.r.vanduin@tbm.tudelft.nl	Martin Quispel NEA P.O. Box 1969 2280 DZ Rijswijk The Netherlands Tel.: ++31 70 3988 309 Fax: ++31 70 3988 426 mqu@nea.nl

Spain	Guillermo MONTERO PROINCA Calle Asunción 16, 3-D 41011 Sevilla Spain Tel.: ++34 954 28 60 33 Fax: ++34 954 28 53 68 gmontero@proinca.com	Gonzalo Bernal ENVAC IBERIA, S.A. Av. Innovación s/n Edificio Hercules 1 Planta – modulo 5 41020 Sevilla Spain Tel.: ++34 620 959 242 g.bernal@envac.es
Slovenia	Mr. Prof. Stane Bozicnik University of Maribor Faculty of Civil Engineering Smetanova 17 2000 Maribor SLOVENIA Tel: ++386 2 2294311 Fax: ++386 2 2524179 stane.bozicnik@uni-mb.si	
Slovakia	Peter Zitnansky VUD a.s Inland Waterway Transport Research Department Pristavna 10 821 09 Bratislava Slovak Republic Tel.: ++421 2 53631501 zitnansky@vudba.sk	
Switzerland	Heiko ABEL Rapp Trans AG Uetlibergstrasse 132 8045 Zürich Switzerland Tel.: ++41 43 26860-32 Fax: ++41 43 26860-40 heiko.abel@rapp.ch	Raphael KARRER Rapp Trans AG Uetlibergstrasse 132 8045 Zürich Switzerland Tel.: ++41 43 26860-33 Fax: ++41 43 26860-40 Raphael.karrer@rapp.ch

United Kingdom	Tom ZUNDER NewRail: University of Newcastle upon Tyne Stephenson Building Newcastle upon Tyne NE1 7RU United Kingdom Tel.: ++44 1226 379789 Fax: ++44 7092 119058 Tom.zunder@ncl.ac.uk	Stephen ANDERSON Transport Studies Group University of Westminster Luxborough Street London W1M 4UW United Kingdom Tel. ++44 (0)20 7915 5485 Fax ++44 (0)20 7911 5057 S.M.Anderson@westminster.ac.uk

ABBREVIATIONS

EU	European Union
EUR	Euro
AUS	Australia
CH	Confoederatio Helvetica
AT	Austria
e.g.	Example given
EC	European Commission
ITS	Intelligent Transport System
NL	The Netherlands
OECD	Organisation for Economic Co-operation and Development
R&D	Research and Development
TN	Thematic Network
UFS	Urban Freight Solutions
UK	United Kingdom

ANNEX

ANNEX I **General country situation**

ANNEX II **Collected case studies (projects-level)**

ANNEX I

General situation concerning waste disposal and waste logistics within countries

Country	Description
Australia	
Austria	In 1979 only 75% of the municipalities in Austria had a waste collection system, but till 1989 such a system was launched in every town. The separation of paper, metal, plastic, glass, etc. was introduced only a few years later. Waste management, as an essential part of comprehensive environmental protection, is undergoing a process of permanent evolution. The objectives of waste management in Austria follow the generally accepted guiding principle of sustainable development that combines the aspects of ecology, economy and social security. Especially with regard to waste management, the re-orientation of environmental policy aims at solutions with long-lasting effectiveness, simultaneously focusing on the aspects of cost-effectiveness and the internalisation of external costs. With respect to waste management, the ecological management of material flows means the long-term control of flows of anthropogenic materials while reducing environmental pollution to a minimum. The guidelines of waste management policy primarily include: ▪ the priority of waste prevention ▪ the recovery of unavoidable waste and ▪ the optimisation of final disposal. The Austrian Waste Management Act (AWG) entered into force on 1st of July 1990. § 1 of the Act defines the following objectives: ▪ To keep detrimental, unbeneficial or otherwise unhealthy influences on man, as well as on animals, plants, their living conditions and their natural environment as low as possible; ▪ to preserve raw material and energy resources; ▪ to keep the demand for landfill capacities as low as possible; ▪ to ensure that only such materials should remain as waste, the dumping of which does not present any potential hazard for future generations (precautionary principle). In Austria, the household wastes are disposed either by collect system or by bring systems. There two categories of bring systems: ▪ “collect islands” situated at the street corner or by a shopping centre or etc. ▪ central collecting point, e.g. nearby a recycling plant or a landfill. People are officially engaged to throw their wastes in the appropriate containers but in fact, there are hardly penalties. **Telematics applications** In some pilot projects in Tirol (a federal state of Austria) for example, the waste collecting vehicles can automatically weight the containers before emptying them. The waste containers are equipped with transponder chips, so they can be recognized by a reading-system during the emptying process. The main reason for the implementation was to optimise the charging system, in order to have cost rates that can be invoiced according to real waste amount in kg. Besides this, the possibility is given, to create data of waste amount for every household, also in temporal context. This allows for the future, to further optimise waste transport logistics, as time and amount of upcoming waste amount can be forecasted precisely. **Main Actors of waste disposal in Austria:** ▪ Federal ministries and regional authorities (County’s governments) ▪ Public Collecting/Recycling organisations, e.g.: MA 48, BAWU (see description below) ▪ Private Recycling / Treatment companies, e.g.: ARA system ▪ Freighters, e.g.: ELA

	The BAWU waste logistic system is probably one of the highest developed that can be found in Europe. It is not only covering one municipality, but a whole federal state, giving an optimised waste transport solution by rail. Formerly waste has also been transported to incineration plants throughout the country by lorries and HGV's. As federal roads directly cross smaller and medium cities and alternative motorway routes are hardly available, these lorries had to cross several cities, right through their centre. With the shift to rail transport by using efficient transhipment technology, urban waste transport traffic has been highly reduced. Although an official survey or study to measure the real impact has not been done yet, it is quite obvious that the reduction of lorry traffic has been huge. **Research activities:** The Austrian Ministry of Transport, Innovation and Technology has funded 70 research projects with € 9,1 millions between 1999 and 2003 in the framework of the "Green Logistics" programme, in collaboration with Universities, research centres, waste collection companies, freight services, consultants, IT and software companies, etc. Logistik Austria Plus focused on: ▪ optimization of intermodal logistics chain ▪ reduction of limit of profitability for combined freight services ▪ computerization of logistics chain, especially for transport of hazardous goods ▪ better operation in peripheral regions for rail transport of goods ▪ technological and organisational innovations ▪ reduction of barriers of innovation ▪ increase in transport infrastructure efficiency and in environment and social compatibility of transport of goods Furthermore there are numerous University Institutes and Research Institutions especially dealing with waste management, waste logistics and recycling. They are ambitious in cooperative research with industry and official authorities and support a number of theses and dissertation on various topics on waste management and waste transport logistics.
Belgium	**History of waste management and logistics in Belgium:** Belgium is one of the most densely populated and industrialized areas in the world. It is therefore affected by numerous pollution and waste management problems. These last years, we could observe a rising concern for environmental problems and consumer protection issues. The total environmental expenditure in Belgium (public and private sectors) is estimated to account for 1.3% of GDP divided amongst waste management, waste water treatment, air pollution control and soil remediation. The quantities of waste generated by households and companies are increasing year by year, with a lot of different types of waste produced. Sorting waste and then selective collections generate important vehicles flows. Big waste operators have developed waste management concepts including solutions for waste prevention, sorting and treatment. **General situation of waste transport logistics in Belgium today:** In Brussels, the collection and transport of waste are organised and realised by a regional public company (Agence Bruxelles Propreté or ABP) and by the some larger private companies (WATCO, BIFFA, Van Gansewinckel and Page).

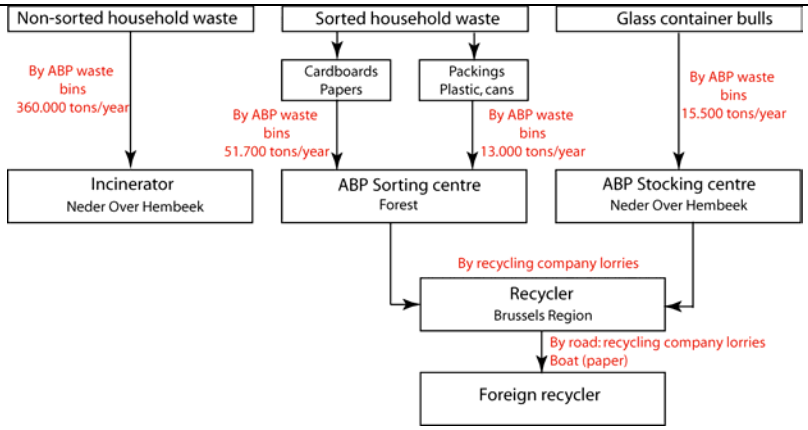


Figure 13: Waste transport in Brussels (ABP)

Due to the short distances, waste is transported by road. The collection rounds begin early in the morning (from 6.30 am) before traffic jam but they overlap for a part with the traffic peak. The transport of collected waste occurs all the day. Waste collections and transportation to the incinerator or a grouping centre are realised by waste bins belonging to the collecting companies.

Framework conditions in the Brussels region:

- Brussels Region in subdivided in three sectors. Each sector is entitled to two collecting days per week. Moreover, some areas are covered in the morning and some in the evening. An emerging problem has recently appeared. Some people, whose waste gets collected from 6 p.m., do not have the time to get back from work and put their waste bags outside. Since putting waste bags outside before the allowed time window is strictly prohibited, some people complain about the inadequacy of those collections hours. This could lead to some changes in the collecting hours. “Agence Bruxelles Propreté” envisages postponing the evening collection rounds by one or two hours, but this raises the problem of night collection.
- The waste-collecting vehicle fleets need to be as clean as possible in terms of emissions. Therefore, the ABP is submitted to some constraints of equipping their vehicles with particles filters (Order of the Government of Brussels Capital Region, dated of the third of July 2003, relative to the introduction of clean vehicles in the regional public organisms and the organisms depending on their authority and control).

Importance of waste transport logistics today:

Nowadays waste management and waste disposal logistics are of high importance in Brussels, because:

- as it became more difficult to find suitable locations for new landfills and get them accepted by surrounding populations and approved by the concerned authorities,
- as the installation of new incinerators became more contentious,
- as urban traffic was going up and started to threaten the accessibility of several city centres,
- as the sensitivity of the population to the emissions and noise produced by heavy vehicles in city centre also increased.

Bulgaria

Current situation of waste management and waste transport logistics

The main types of transport vehicles used for transportation of municipal waste to the landfills are: self-loading vehicles and container carriers. The waste transportation vehicles are often above 10 years old. During the past few years there is a tendency towards import of specialized second hand equipment from West Europe carried out by some companies.

The transportation of waste to the landfills is carried out by means of specialized trucks without using transfer stations. In general the landfills are located near the settlements at a distance of 3 – 7 km.

The main challenge to the companies carrying out organized waste collection during the next years will be the increase of the transport distances as a result of the transition form the existing disposal system to regional disposal facilities:

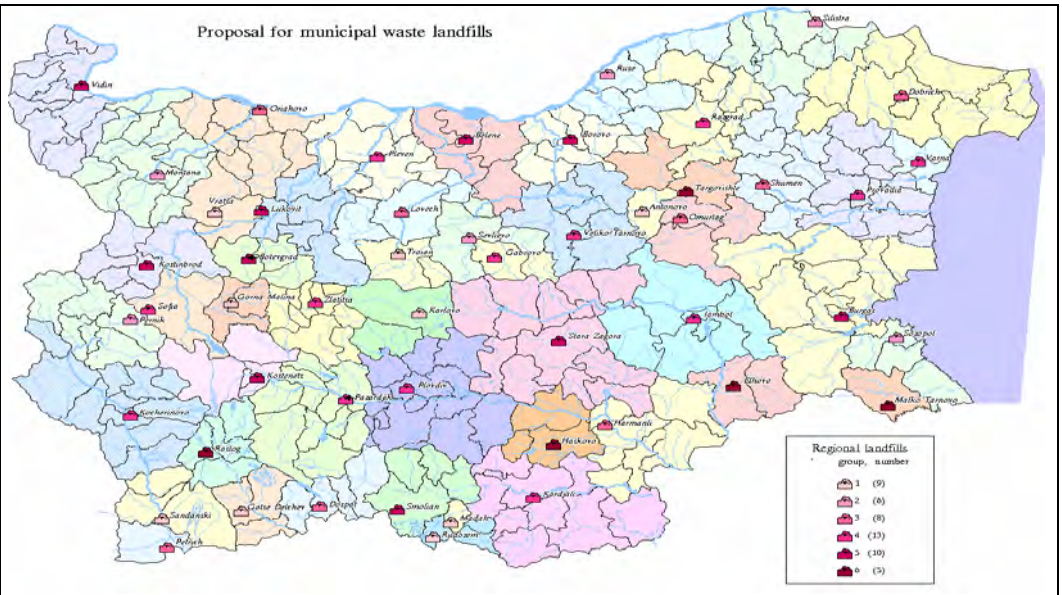


Figure 14: Municipal Waste Fills in Bulgaria (proposed)

The current transportation of industrial waste is characterized by shipment of big quantities on small distances. Basically this is due to the existence of large percentage of waste disposed by the generators in their own facilities.
This year the Ministry of Transport and Communications develops the requirements for transportation of dangerous goods including hazardous waste. Also this year there is a plan to introduce GPS system for tracking and tracing of vehicles which transport waste in Sofia.
The Ministry of Environment and Water developed a National Waste Management Program and a Handbook for determining the number and kind of necessary containers and techniques for waste collection and transporting.

Framework conditions
The obligations and the responsibilities of the state and local authorities in regard to the organization, permitting, financing, supervision and control of the waste management activities are regulated by the Waste Management Act (WMA). The mayors of municipalities organize the management of the waste generated on their territory according to the requirements of the Waste Management Act. The National Waste Management Programme (NWMP) sets for the period 2003 – 2007 based on the adopted principles for waste management that are adapted to the national conditions.
The main objective of the National Waste Management Programme is to contribute for sustainable development by establishment of integrated framework for waste management, which will lead to:

- reduction and limitation of the harmful impact upon the environment caused by the waste generated;
- better resource efficiency
- maximum producer responsibility;
- encouragement of the investments and the waste management activities.

The implementation of the NWMP will be assisted and supplemented by the realization of the following plans and programmes:

- Plan for implementation of Directive 94/62/EC on packaging and packaging waste;
- Plan for implementation of Directive 1999/31/EC on landfill of waste;
- Plan for implementation of Directive 2000/53/EC on end-of-life vehicles;
- National plan for management of sludge from waste water treatment plants;
- National plan for management of hospital waste.

Actors: Today collection and transportation of the municipal waste as well as the winter cleaning and maintenance of the streets has been carried out by three private companies: “Chistota – Sofia” SC, “WOLF”

	Ltd and “DITZ” SC upon concessionary contracts with the Sofia municipality.
Czech Republic	Awareness of citizens and entrepreneurs on the national level is relatively high, there are strong efforts to protect the environment by proper waste management. Politicians deal with this issue by adopting and amending legislation, complying with EU legislation, and also by introducing not-so-popular charges for citizens as well as companies. Bodies responsible for waste collection are: ▪ State authorities, which announce main lines of meeting appropriate legislation in the form of laws, ordinances or regulations, in compliance of which the waste collection and treatment system is carried out and controlled (Ministry of the Environment). ▪ In next stage, it is the regional authorities (regional/town/local councils) applying valid legislation to their conditions and implementing approved provisions in relation to citizens, companies and organisations. ▪ Real estate owners within both private and state sectors. Waste collection in the Czech Republic has been carried out in a well-established way: ▪ Collection in bins; ▪ Collection in containers; ▪ Collection into special vessels for dangerous waste (freight provided by trucks); ▪ Collection into vessels for scrap iron, paper, PET bottles, glass, etc. (freight provided by trucks); Recycling in the Czech Republic is carried out only to a relatively little extent, mainly in the form of the utilization of collected waste for road building materials, cement additives, other building materials additives. Implementation of drafted Waste management plans from the level of waste producers up to the level of regional and national „Plans“. Bigger attention should be paid to household waste separation, implementation of new technologies for disposing of all types of waste, utilization of special waste for the production of TAP (Technologic alternative fuels), utilization of animal and biological waste (e.g. for replacing fuels now used for cement production, hygienic disposal in special incineration plants with required high incinerating temperature).
Denmark	Since the 1980s the principles of waste management in Denmark have undergone some radical changes. Whereas previously the upgrading of the technical infrastructure of waste disposal had been the dominant theme of waste planning, the recent waste management is directed towards the minimisation of waste volumes and the assignment and utilisation of waste disposal. Until the early 1980s, waste regulation aimed at providing an optimal infrastructure for the waste volumes and their regional distribution, which meant that in the first place waste planning was concerned with determining the needed dimensions and locations for waste treatment facilities. The waste management system in Denmark is closely following the EU waste guidelines and directives. Denmark manages household, industrial and commercial waste in a comprehensive waste management system. This system covers both packaging waste and hazardous waste. The Danish EPA (The Danish Environmental Protection Agency) is the authority responsible for waste management, while the local authorities (=municipalities) have to decide on the practical implementation. The responsibility for the waste management system in Denmark lies solely with the local authorities, also the duty to assign waste treatment and disposal facilities lies with the local authorities, and waste generators are bound to use them. All the municipalities of the country are supposed to make their own plans for the development of waste minimisation and waste management. Further, private companies have been established to operate mainly within collection of household waste and industrial and commercial waste, as well as recycling. The private companies/transport operators, which win the contracts concerning the waste management in the municipalities, do not have the permission to optimise the route on own initiative. The routes are given in the invitation to the tender. Municipalities demand more efficient waste collection, which has directly influenced the establishment of waste transport logistics concepts. The privatisation has directly influenced the establishment of waste transport logistic concepts. The new Government’s waste policy for 2005-2008 is built upon three fundamental elements: ▪ We must prevent the loss of resources and environmental impact from waste. ▪ We must decouple growth in waste from economic growth. ▪ We must ensure the improved cost-effectiveness of environmental policies through improved quality in

	waste treatment, and an efficient waste management sector. The national waste management goal sets guidelines for an overall recycling level of 60-65%. However, to a wide extent it is up to the municipality to discover how to reach this target on different types of waste and to decide which waste fraction demands priority. In order to establish a comprehensive waste management, the municipalities became the authorities for all waste from all sources, including private households, institutions, industries, service trades etc. Thus the municipalities became obliged to secure capacity for the treatment of all wastes.
Estonia	The municipal or household waste management is in responsibility of the local municipal government. It means that there should be local waste management plans, waste management regulations and municipalities should organize - not necessarily to provide service itself - waste collections and develop as well recovery schemes in general. In practice - during the 1990ies almost all of the former municipal waste management firms were privatized. So, the service is provided dominantly only by private companies today. Actually estimations show that nearly 25 % of household (first of all private households) are still not taking part in the 'visible collection schema' - what is a reason for littering and unlawful disposal of waste. There are in general in all public places waste bins and containers and this service is ordered by local municipalities. By finance of local governments and waste companies there are public domain containers for separate collection - paper, plastic, class and hazardous wastes. Additionally some local governments have waste stations. Further plans are that almost every local authority has its own waste station. The new 2004 Waste act foresees so called 'waste collection organized by Local Municipality' - it means that in density populated areas the municipality defines the 'waste collection areas' each of them not more then 10000 people, organizes the tender, makes the contract with the best offer.
Finland	**General situation of waste transport logistics in Finland today:** In a sparsely populated country like Finland waste management has not been a big problem. Originally all municipal waste was transported to waste landfills. In the main urban areas these landfills started to be more difficult to find and therefore transport distances got longer and the interest for transport logistics increased. Also, the urban congestion caused by increased use of cars as well as increased population in major cities, made waste collection and transport more difficult and expensive. Also, general awareness of environmental problems has increased. In the 1980's there were over 1000 municipal waste landfills in use. In 2000 the figure had come down to 214. According to the National Waste Plan approved in Finland in 1998 the share of municipal waste recovered ought to be 70% in 2005. Only 40 per cent of municipal waste was recycled in 2000. Currently planning of increased recycling is very acute in order to reach the target of 70% in 2005 In Finland the municipalities are responsible only for the management of municipal waste. They are not responsible for the management of industrial waste. The industry must either treat its waste self or buy services for its treatment. In order to organise and execute - with viable prices - waste management in compliance with latest environmental quality demands, Finnish municipalities have started regional co-operation. During the past years Intermunicipal Waste Management Organisation (IWMO) has become the most utilised form of co-operation for municipalities. The scope of activity, size and ownership structure of these companies varies to a great extent. Some companies take care of the whole field of waste management and others only manage a limited amount of tasks. Quite often waste collection and transportation is not included directly in the scope of these companies. This task is taken care by the municipality itself or by private transportation companies. The basic waste transport logistics strategy emerging from the above development of waste management is based in tendering processes as follows: ▪ urban areas are divided into contract areas, each suitable for full time work for one or two vehicles; ▪ every three to five years municipalities or IWMOs ask tenders from transport operators. Municipalities and IWMOs plan waste collection and transport according to day-, week- and monthly schedules regarding every collection point. They provide transport companies with daily schedules. These include lists of waste types to be collected and related addresses according to routing made often by a tour planning programme like MapInfo or Maestro. In practice, drivers are free to decide the route but obliged to visit all collection points in the list. There are about 800 vehicles in Finland for waste collection and transport. About half of these compress

	collected waste in order to increase capacity, 30 % are used for the collection of liquid waste, and 20 % are used for the collection of demountable platforms. According to a current survey (Granqvist, J., I. Berg and O. Uusitalo. 2001. The development of the waste logistic. VTT Building and Transport, Research report RTE 3663/01. Espoo.) main problems regarding current waste transport logistics include: i) data gathering and information flow in the logistics chain; ii) various pitfalls like poor maintained and too narrow areas for waste collection or restrictions to collect waste during night; iii) working safety; iv) drivers' poor motivation. Automatic recognition of waste bins has been experimented but failed because of various practical problems. **Private concepts on company level:** Ecomond Ltd has developed route guidance and route planning software (Transport Control System, TCS) which link data processing in the waste management company, the transport company, and the vehicles. It provides, e.g. real time data on the waste collection. Route planning, data handling, use of staff and vehicles, and training of new drivers have become more efficient (see: www.ecomond.com). Development work has been a part of the STREAMS Technology Programme. **Research activities:** One of the five focus areas of the STREAMS Technology Programme is collection, transportation and management of waste streams. The Programme started in 2001 and is now in the final stages. The Programme is financed by Tekes (the National Technology Agency of Finland) and institutions involved include regional bodies, universities, research centres, associations, consultants, and other private companies.
France	**History of waste management and logistics:** On the government side : a law was passed in July 1992 on waste management which included specific actions regarding the optimal organisation of waste transport, based on the principle of proximity (limitation of transport distances). In 1998, the ministry of environment issued guidelines to promote "solutions for waste transport which minimise impacts and use lesser polluting modes such as rail and water". Also in 1998, a specific regulation for waste road transport has been imposed (transport operators have to be registered to a specific transport register). "Transfer centres" are being developed. They have been imagined to minimize transport flows by consolidating products to be transported in an optimized manner. On the industry side, global service providers tend to replace specialised companies: these waste logistic operators tend to "offer a global logistic service including collection, grouping, transport, etc. The service provider tends to organise all the different services needed in waste management, and to sub contract some of these activities, for example transport". **General situation of waste transport logistics in France today:** National legal framework conditions (mostly due to European initiatives and directives) have imposed innovative waste management to some local governments, others have organised clean waste transport projects by themselves, for environmental reasons. ADEME (governmental agency for the environment) is the leading actor for innovations in waste transport and logistics. The French system is based on tendering processes, with a strong municipal control over companies. 900 million tons of waste are produced in France each year (87% are construction and agriculture based), of which 530 are transported. Today, it is considered that 1/3 of total transported tons in France are waste products (but only 15% of tons-km). Average transport distance is 43 km (26 km for municipal waste). About 97% of tons are transported by road, 2% by rail and 1% par water. "Transfer stations": today there are 530 transfer stations in France (with an annual increase of about 5-6% since 1996). They have been established with the official objective to reduce waste transport costs. Compared with other countries, French transfer centres tend to be rather small and to treat only one sort of waste (generally municipal waste). Waste transport distances tend to increase, due to 3 factors : ▪ "NIMBY" behaviours oblige to treat waste further apart from residential and urban areas ▪ more recycling and more sophisticated treatment of waste (such as incineration with electricity production) mechanically generates more transport, as treatment sites are located further apart from

	cities than traditional landfills, and are less numerous. “More sophisticated waste treatment processes generate more transport”. ▪ some cities are enable to cope with the increase of municipal waste combined with the closure of old landfills or treatment sites, so they send their waste to other areas, sometimes quite far. Waste transport and management plans today have to be defined at a departmental level (there are 100 departments in France, which means waste management is rather scattered and poorly consolidated). An important effort relates to modal shift in waste transport, with some experiments in water and rail waste transport (more so for industrial waste). Regions or urban areas most concerned: Lille and Nord Pas de Calais region, Rhone river, Paris region (several projects), Lorraine and Franche-Comte. On the collection side (mostly in urban areas), an effort is put on clean technologies for waste transport vehicles. **Urban waste transport and logistics** Congestion situation in cities is rather serious but it is not generally considered that waste collection vehicles are a very important part of the problem. In most cities, waste collection hours have been organised in order not to interfere with peak hours for passenger or freight transport. Of the 530 tons of waste produced and transported annually in France, more than 270 millions and 10.8 billions of tons-km are transported in an urban area. 3% of total urban goods movement (in vehicle-km) come from waste transport (8% if construction waste is included). Some concepts and strategies envisioned for the future of urban waste collection and transport (source : ADEME) are based on the following principles (NOT implemented yet) : ▪ creating transfer centres within dense urban areas, enabling more consolidation and connection to non road based means of transport ▪ combining store deliveries with the pick up of cupboards/packaging during the same delivery tour (with the same vehicles) ▪ using radically new collection processes such as pneumatic networks or tramway/buses networks ▪ creating multi purpose vehicles that can handle both waste and other goods (same chassis, different containers), and could be integrated into multimodal organisations. ▪ on noise management : developing a concept of “chain of silence” which would include all the different segments of the waste transport and logistic chain. ITS in waste disposal transport is not very advanced in France. What is most advanced is clean urban vehicle technology. However, out of 10 000 vehicles (dump trucks) circulating within French cities to collect municipal waste, only 300 are clean: 100 CNG, 100 electric, 100 diesel with filter (ADEME, October 2003).
Germany	**History of waste management** The present concepts for waste transport logistics are grounded on the waste recycling directive (Kreislaufwirtschafts- und Abfallgesetz) which is in force since 1996. The focus of this directive is to move from a simple disposal of waste towards an avoidance and material recycling. Core of the directive is that producer and distributor of products are also responsible for its disposal. Waste in the sense of the directive is first of all to avoid and in a second step to recycle, if this is not possible it has to be combusted. According to the general framework conditions also the waste logistics concepts are adapted. While in the past waste logistics was a local issue as each city installed dumpsites close to the city area, waste management was also a local approach to and from the city. With the new recycling directive waste logistics became a national, partly international issue. With the establishment of the waste recycling directive new responsibilities are established with new players on the market. The waste recycling directive distinguishes between municipal solid waste and packaging waste. **Municipal solid waste** In general the municipality (or a public entity linked to the municipality) is responsible for the environmental friendly and harmless disposal of municipal solid waste from households. Hence the municipality organises the logistics to collect the waste and for the further processing of the disposal. Since June 2005 the disposal at dumpsites is further restricted. Waste can only be landfilled if a particular treatment took place. For most of the cities municipal solid waste will be combusted by then. With

	the introduction of market forces and the ban to landfill untreated municipal solid waste on dumpsites waste logistics become an important issue to manage urban waste transport. Municipalities established a mix of curb site collection and bring system. **Packaging waste** In 1991 the packaging regulation was established in Germany. Due to the increasing amount of packaging it was decided that the producers and retailers have to take back their packagings and to recycle it. Industry and retailer founded in 1990 the DSD company (Duales System Deutschland) being responsible for the collection, sorting, storage and transport of the packagings which are contracted out to private operators. The financing of the DSD takes place via licence fees per packaging (grüner Punkt). The collection and sorting of the packaging is carried out by the private or municipal companies locally. This process is organised by a mix of curb site collection and bring system. The processing and recycling processes are done by specialised recyclers. Depending on the type of packaging (plastics, paper etc.) different processes will be applied. Recyclers are located widespread over Germany, which means that from a (local) sorter to a recycler often distances longer than 300 km have to be driven. **Effects of waste recycling directive** According to the German waste recycling directive municipalities have to develop a waste management plan leading to many different strategies in different cities. Result from these plans is that a competition between different municipalities has been established comparing the different approaches over the price. Therefore, the waste management plans go beyond the point only to secure the disposal of waste but to develop competitive strategies. A further aspect to be considered is that many new waste combustion plants were build in the recent past. On the other side existing dumping sites having the perspectives to be closed and offer dumping capacities to all kind of customers. Both developments together kept the price for waste disposal relatively low. As the disposal of untreated waste is not possible after June 2005 there will be no further demand for dump site capacities and the prices are expected to rise. Overall, both trends – the competition on low price municipal waste disposal as well as reduced disposal capacities – places on the development of efficient transport and logistics strategies a particular focus. In 2004 the German waste market realised a turnover of 37 Bio. Euro of which the market share of municipal operators is 37%. 65% of the waste has been recycled. Due to the increased requirements on the handling of waste on the one side and the requirements to carry out the waste management more efficiently, high pressure is on the waste transport logistics on cost savings. Main measure for municipal as well as for private operators is to improve the cost efficiency in the field of urban collection transport by: exploiting technological innovations, strengthen organisational processes and to improve the fleet structure. The following describe some general trends how waste logistics adapts to the new requirements: ▪ Due to the increasing costs of specialised waste collection vehicles many cities introduced variable working time models, that increases the use of capacity of the vehicles and reducing the costs. In consequence the time frame for carrying out the collection is expanded. ▪ With new vehicle developments (e.g. the loading process is carried out by the driver from the driver cabin – no dedicated loader) personnel cost can be reduced ▪ Furthermore, swap bodies that can be transhipped for the long haul transport leg are employed in the collection process. This creates a seamless chain for bringing the waste to the further processing step. ▪ Reduction of the collection intervals per household. In most German cities waste is collected in 2 weeks intervals only. ▪ Integration of IT systems and sensors. The installation of sensors on containers (satellite supported fill level sensors) in combination with trip planning applications can reduce the cost of vehicle fleets operating in the city. Since June 2005, both, municipal solid waste as well as packaging waste has to be further treated before putting it on a dump site. If municipal waste can not be brought to a near by waste combustion plant (about 25 to 30 km) a transhipment to the long haul leg takes place. Such a transhipment process is common practice for the further processes of the packaging waste. Packaging waste will be sorted (369 sorting plants in Germany) and brought to the further processing steps. A transhipment of the collected waste in order to bring

	to the sorting plant is often necessary for packaging waste. This will then be done at a forwarder depot, locally. The transport volumes of plastics packaging waste in 2000 was about 900.000 tonnes with 56.900 trips. **Research activities** A focus on German research activities in 2001 was on Waste management initiated by the Federal Minister for Education and Research. The research programme funded innovative demonstration projects for optimising waste transport logistics. Aim was to optimise transport flows and to promote efficient and sustainable transport processes by innovative approaches. Overall 24 projects were funded focussing on: ▪ Projects for the optimisation of disposal transport processes ▪ Projects linking delivery and disposal processes ▪ Projects for the development of an information platform ▪ Projects towards planning tools for disposal processes
Greece	**History of waste management and logistics:** Night collection of waste was introduced in the 1950ies and extended in the 1970ies. Night - or early morning - waste collection was introduced in order to deal with the traffic problems in main cities, since congestion delayed waste collection trips and citizens were dissatisfied by the traffic problems caused by waste vehicles. Additionally time planning and time windows have been introduced in the 1970ies. In the 1980ies standardisation of litter bins - in order to reduce waste collection time- and vehicles with compressors - to increase their loading capacity came up. Logistics strategies are not really an everyday practice. Mostly ad hoc interventions regarding fleet management and trip scheduling are actually used by most Municipalities. Athens, Thessaloniki, Patras and other big cities were trying from 1970ies to implement time plans, clustering and routing. With the gradual improvement of fleet and fleet management they tried to serve household waste disposal keeping cost low. **General situation of waste transport logistics in Greece today:** Household waste collection and disposal, is carried out mainly by the Local Authorities. Waste management in Greece focuses on landfills and recycling. The Regional Plans for solid and liquid waste are under updating and expected to be finalised by the end of this year. Nevertheless, the main problem is the location of the landfills and the guarantee of their proper operation. Waste is transferred to landfills by collection vehicles, which cause trip delay and increase service and repair cost. Some Municipalities, trying to reduce their cost by using private companies for waste collection and disposal to the landfills. In this case, Local Authorities specify the terms of the waste disposal. Regional Plans for waste treatment deal mainly with landfill operation and not transportation problems. A relatively new strategy is the waste transhipment and compression in containers located near the depots, increasing thus the loading capacity and minimising the vehicles trips. Containers are located at sites that serve as intermediate disposal areas. When capacity is reached, waste is transported to the landfill by tractors Athens is the first in Greece city that implements a telematics system based on a GIS application to spot the exact position of each service vehicle (foreseen 2005). This evolution is important, because it will allow the service provider to be informed instantly about incidents occurring during routes –e.g. extended staying of a vehicle at a spot may imply a mechanical problem, or some difficulty in moving because of traffic conditions. The idea is to achieve a more efficient fleet management. In addition to that, litterbins will be equipped with some kind of identification with an electronic device indicating the loading factor, so that the product of each vehicle on a daily basis could be calculated. This is not directly related to transport logistics, but eventually it is estimated that a better allocation and placement of bins will come out, minimizing vehicles' trip time. It may also lead to route planning to some extent. Athens and Thessaloniki, the greatest cities in Greece, implement fleet management and first introduced the two-sized fleet (small and big vehicles) in order to serve better narrow streets or areas with little waste. By now that this practice has started to spread and those cities have proceeded to a more diverse fleet, consisting of four different sizes. This leads to an improved allocation of capacity depending on the route.

	Research activities: Research in this field is not really spread in Greece. Some interesting case studies have been investigated by students of technical institutions –mostly NTUA at Athens. The bulk of these works deals with route planning. At early 90's the Municipality of Pyrgos, a small town, conducted an assessment to identify the most suitable time window for waste disposal. Other Municipalities assign to transport planners the clustering and routing of the waste collection vehicles, within the frame of their Transport Assessment. These practices are not yet generalised to all cities.
Hungary	The decrease in generated waste (from the annual 106 million metric tons to 68.7 million metric tons in ten years) was more the consequence of economic decline than of conscious preventive measures. Nearly half of the non-hazardous waste is generated in agriculture and in the food industry and most of it is utilised. Only about 30% of non-hazardous industrial waste, however, is utilised and more than 60% is dumped. In 2001 the share of homes involved in regular waste collection was the highest in Central Hungary (95.1%), while it is the lowest in the Northern and Southern parts of the Plain (72.3%). More than 90% of communal solid waste was collected in 1999. In the framework of public services 665 landfills are operated. There is no organised waste collection in 468 communities inhabited by 4% of the population. The conditions, system and structure of the waste management and waste recovery are regulated in Hungary by the Act of Parliament XLIII relating to Waste Management which came into force on the 1st January 2001 and also by the governmental decree no. 94/2002 concerning the detailed regulations for the management of packaging and of packaging waste. This decree was accepted in 2002. The regulations, similar to the EU practice, sets out the recovery obligation from the producer of the packaging material to the user and thus creates the direct and measurable system for the collection and recovery of waste. In accordance with the EU guidelines (EU directive no. 94/62), the Waste Management Law states in a Euro-conform way that at least 50% weight of the packaging waste has to be recovered. Within the guidelines of collection and recovery, at least 25% weight of the packaging material from the packaging waste has to be recycled; in view of all types of the packaging material, the quantity of the recycled material has to reach at least 15% of its weight. While the EU directive sets up the end of 2005 as a deadline for the achieving of the above mentioned goals, the Hungarian regulation is more stringent and its deadline is the 1st July 2005. The National Development Plan strategy emphasises the importance of quality environmental protection infrastructure. Investments proposed are in line with environmental protection priorities. The Second National Environment Protection Programme for 2003-2008 (NKP II) that will be accepted in the near future. One topic of this programme is waste management and recycling. The NDP contains a number of areas that directly contribute to environmental sustainability which also includes the topic rationalising the collection and treatment of urban solid waste. There are some research projects have connections to the waste management issues but not directly with focus on waste transport and logistics in urban areas.
Ireland	Historically the management of the collection and disposal of household waste is the responsibility of the municipal and local authorities. The past five years has seen a major shift towards the privatisation of the collection recycling of wastes including recyclable dry domestic wastes. Municipal authorities have traditionally operated in-house fleets for delivery to landfill sites in public ownership. Industrial wastes are handled by commercial companies but wastes from retail shops are generally handled by the municipal authorities. **General situation of waste transport logistics in Ireland today:** According to the Environmental Protection Agency (EPA) some 3 million tonnes of municipal waste was generated in the Dublin region in 2003 comprising 1.6 million tonnes of household waste, 1.3 million tonnes of commercial waste and 72,000 tonnes of street cleansing waste. The Dublin region accounts for almost a third of all the waste generated in the country at 960,000 tonnes per annum. Construction & demolition waste is the single largest waste stream in the Dublin region and creates 4 million tonnes per annum. A new five year review and forward plan for municipal wastes was launched on the 18th April by the four municipal authorities entitled ""Draft Replacement Waste Management Plan for the Dublin Region 2005 – 2010". This evaluation and plan sets out revised strategies and targets for treating wastes. The plan foresees a further investment of €300 million over the next six years in addition to the current yearly capital investment of €30 million and current annual running costs of € 176 million.

	The actors in Greater Dublin are the four municipal authorities who oversee the collection of waste and the management of the landfill sites. The municipal authorities also contract private operators to mange and to market recyclable household waste, industrial wastes and to export hazardous wastes for treatment. The commercial operator Oxigen is contracted by the four local authorities in greater Dublin to collect recyclable domestic waste and to dispose of glass. This involves a 10 year contract (1998 – 2008) for the collection, processing and marketing of dry materials from householders. Oxigen provides all the wheel bins, lorries, employees and the weighing and identification system for the collection of dry recyclable materials. Oxigen works in partnership with Bailey's Waste Paper and others for the processing of materials and is subject to regulation by REPAK. **Waste transport logistics:** The logistics arrangements involve fleets of dedicated vehicles operating from depots located in different parts of the major cities, collecting from homes and premises and delivering to landfills. The strategy is to optimise the fleet deployment and to encourage cost efficiencies. Waste collection operations are subject to the city ordinances and directions applying to the management of road-works (- ref. "Directions for the Control & Management of Road-works in Dublin City", DCC, March 2005). The frequency of collections is kept to a minimum – once-weekly collections from homes being the norm. **Framework conditions:** Congestion, particularly in Dublin, has made waste transport logistics more difficult to manage effectively. This is compounded by the increasing distances to be travelled to landfills as the older landfills near the city centre reach capacity and by the changing patterns of commercial deliveries in the city centre. The logistics strategy will see the new bring banks being placed close to areas of high density (within walking distance to minimise car borne deliveries) and domestic collections being managed in a way that will not create any additional traffic following the introduction of the brown bins. In Dublin city centre domestic waste is collected at night together with street cleaning materials – this latter operation is particularly noisy. Day collections are made in the less congested suburbs. The four local authorities seek to optimise their logistical efficiencies and the new "pay by use" and pay by weight" regimes for householders help to achieve efficiencies in terms of minimising the need for collections on specific routes. **Research activities:** The four local authorities continue to develop better solutions for improving their logistical efficiencies. For example Dublin City Council (DCC) tracks the route yields for the collection of "grey bins" and has available to it the expertise of an in-house GIS mapping unit. Fleet deployment can be optimised accordingly. For the recyclable "green bins" the private contractor Oxigen continues to incorporate new technologies into its business model. These include GIS applications, mapping database technology, microchip tagging of bins, automatic weighing systems, database management with automatic billing services, the development of new markets for recycled waste materials. An innovative approach has been developed to manage the glass banks in order to optimise the utilisation index of the sites and the fill capacity of the different waste streams, thereby minimising the need for servicing the sites.
Italy	At the end of the 1960ies and early 1970ies, gradual conversion took place from the system of undifferentiated door-to-door garbage collection with loose sacks to the use of skips and vehicles equipped with mechanised loading systems (containers). The sizes of the skips and vehicles have gradually increased and then decreased in more recent times, with the introduction of the separated waste collection systems and of the integrated waste management systems. In addition, the growing sensitivity concerning the environment and the quality of life is obliging companies to introduce the use of low-emission vehicles. The production of total waste in Italy in 2003 is about 30,038,000 tons (about 524 kg/person/year). The trend reveals an increase (+0.6% between 2003 and 2004), even if the annual percentage of increase is falling. Separated waste collection (recycling), which has reached a percentage value of 21.5%, with substantial differences between northern (30%), central (15%) and southern (10%) Italy is continuously growing with constant annual increases of 12%. Currently, the **collection of un-separated wastes**, which does not includes any type of waste sorting,

continues to be the main activity of waste management companies, even though the introduction of the integrated waste management system is changing the organisational and technical method of collection. The separated waste collection systems are essentially based on the use of street skips and large-sized vehicles with rear and side loading. In some large cities (Milan), the system of door-to-door collection of sacks still remains, whereby common plastic bags are employed, and then left on the pavements, which are collected by hand and loaded onto large trucks. In this case, loading operation frequency is much higher.
The separated waste collection for recycling has grown over recent years as an addition to the un-separated collection and, in some cases, it has led to the transformation of the entire waste collection system. The systems of collection are different in times and ways, depending on the type of material collected, such as: paper, plastic, glass, metals and aluminium and wood. Generally they take place through side and rear loading skips, domes, bins, door-to-door sacks, multi-material skips or through disposal at collection platforms or centres, known as ecological islands.
The current trend is to use of small-sized bins, located within apartment block spaces. This makes it possible to free considerable urban spaces, but it also encourages making sure that people separate their waste correctly and prevent undesirable mixes.
In some special situations, alternative solutions to skip collection are being sought, encouraging the development of alternative services such as targeted door-to-door or collection on- call services.

Waste management operators
In all the main cities there is a company for the collection and transport of waste. They are mainly private (S.p.A.) companies whose main shareholder is the actual municipality. Such companies reach remarkable sizes (2000 employees at the AMIAT of Turin). They often sub-contract their activities, especially some particular services (like city market waste collection and cleaning) to specialised companies. Towns that do not own a waste transport company, contract-out the service to private companies. In many cases, small towns join forces to share the services offered by the same waste collection and transport company.

Logistic schemes
A typical logistic scheme, generally used for un-separated waste collection is based on the use of large sizes skips, up to 2400 – 3200 litres in capacity, and is based on the use of large-sized vehicles, with side or rear loading. The latter type of loading makes it possible to reduce the number of operators and therefore operating costs, but is not too good for urban areas where the difficult parking and traffic conditions limit the correct use of this technique. For that reason, side loading is widespread especially in urban-outskirt areas with a low concentration of houses and traffic. With large-sized skips it is possible to serve an average of 5 street numbers and 60 families and thus reduce the frequency of stops for loading.

Another logistic scheme used quite a lot in Italy, involves the use of small skips of sizes ranging from 35 to 360 litres coupled with the use of smaller rear loading vehicles. This arrangement is widespread for **separated waste collection**, but it is also used for **the un-separated waste collection**, especially within the older parts of towns where the characteristics of the streets do not allow the use of large vehicles.

The following criteria of **logistic optimisation** are spreading:

- global evaluation of costs and benefits (also taking into consideration the environmental and social ones),
- definition of optimum territorial areas from the logistic standpoint,
- co-ordination of the subjects involved (public, private, individual citizens),
- optimising the single company processes (lower costs, less environmental impacts)

Optimisation by the operators (lower costs, less environmental impacts)
Individual waste collection and disposal companies are the first to have to implement processes for the optimisation and reduction of costs in order to win contracts, which's awarding criteria, besides technical and legal specifications, is that of the lowest cost.
Many companies are equipped with map instruments and true GIS for help in planning the service. Some of them are equipped with GPS detection systems and on board computers for monitoring the service and handling events.
One of the distinctive features of waste transport in Italy is the growing diffusion of vehicles powered by

	methane gas for waste collection and transport. In the past, trial projects in the waste transport sector have been developed, with sometimes uncertain results due to unperfected technologies (vehicles were fuel powered). Today, however, we are seeing the growing popularity of more modern vehicles, with electronic injection systems and catalytic converter, type-tested as E.E.V. (Enhanced Environmental Vehicle) whose emission values are lower than those of Euro 5.
Latvia	The National Environmental Protection Plan (NEPP) for Latvia was approved by the Government in 1995. One priority has been and is the point waste management. The investment programme “500-“ covers the waste sector. A national municipal solid waste management strategy for Latvia was finished in November 1997 with an implementation period from 1997 to 2015. The strategy includes several aspects: ▪ development of the legislation system incorporating institutional aspects; ▪ improvement of waste management, including development of new regional landfills; ▪ elaboration of an economical system for waste management. The implementation of programme "500-" will achieve: ▪ a reduction of the total amount of disposed waste by re-use or recycling as secondary raw material; ▪ mitigation measures for environment and human health by a reduction in the total amount of waste and establishment of new sanitary landfills; ▪ improving the level and quality of the waste management service by introducing new waste collection systems and technologies; ▪ establishing a real market for recycling thus eliminating the use of raw materials. The main problems of the waste management are rooted in the every high number of inadequate waste dumping sites and their impact on environment. The illegal dumping of waste causes ground and fresh water pollution, soil and landscape erosion problems. At the present moment 252 dumping sites are operating in the territory of Latvia but 251 are closed (over 1998 / 2000 55 dumpsites were recultivated, totally covering 67.8 ha of land). Today in Latvia there is no centralized waste management system and service available for every individual and enterprise. The waste management services are available for around 80% of the urban and only for around 20% of the rural population. The collection and deposition of the municipal waste is carried out by the communal utilities enterprises. The private enterprises offer their service mainly in the largest towns and they service around 50% of population. The waste registration is carried out only in the dumpsites of the largest towns. Today in Latvia approximately 2,4 million m3 that equals 480 tonnes of solid waste are being deposited each year. The actual amount of waste is 40 - 50% bigger since only 50 - 60% of waste is collected. This means that approximately 600 - 700 thousand tonnes of waste are created each year, of which 30% is waste of commercial structures and institutions. At present waste sorting mainly is performed at dumping sites. Partial sorting is performed in Riga, Ventspils, Jelgava, Valmiera, Liepaja and Jurmala. Waste (metals, paper, lead accumulators, glass chippings, plastic packaging, luminescent bulbs, used tyres) processing and utilisation possibilities are insufficient although enterprises receive subsidies on a competition basis from Latvian Environmental Protection Fund for collection and utilisation of goods and remnants of products that are harmful to environment. Nature resources tax relief promotes voluntary management of used packaging in the state and herewith the amount of packaging that comes to dumping sites and landfills is decreasing. Evaluating the European Union Directive 99/31/EC on establishment of waste landfills, Latvia has made a decision: ▪ to establish 10-12 solid waste management systems that comply with environmental protection requirements, including solid waste landfills, and to close down waste dumping sites that do not comply with environmental protection requirements till 2009; ▪ to reduce pollution caused by waste dumping sites envisaging recultivation of all existing dumping sites till 2012. Today there are no innovative transport and logistics concepts in waste disposal.
Lithuania	Waste management is one of the priority environmental protection areas in Lithuania. Raising public awareness and increasing involvement in the processes of waste management takes place. At present, attention is focussed on collection of municipal waste, recycling, landfill management and development

	system. The National Strategic Waste Management Plan provides the establishment of ten regional waste management systems. Operation of the regional waste management systems should start in 2009 at the latest. The Strategic Waste Management Plan has foreseen the closure of the present landfills that do not meet the EU requirements by 2012. Introduction of the regional waste management systems and closure of old landfills presents one of the greatest challenges to municipal and county administrations. The process of implementing regional waste management system is managed by county administrations. Five inter-municipal organisations have been established in Lithuania for coordination of preparation of investment projects by municipalities.
The Netherlands	First appearance of waste transport logistic projects can be observed after 1970. Slowly the average transport distances of waste got longer. Local processing of waste or landfill in the direct area was more and more replaced by larger scale incineration and recycling plants with a bigger area to serve. Furthermore, there was more and more separation of type s of waste due to the fact that by means of new processing methodologies more materials can be recycled nowadays. However, recycling plants also have a much wider sourcing area compared to the many landfill areas that were used in the past. Moreover as consumption of goods increased and more package material was used by producers, the overall volume of waste has increased. The current production is about 4 times the production in 1950. Strategies for waste logistics are aimed to make the collection and transport of waste more efficient and environmental sustainable. In stead of noisy traditional garbage collection with small buckets which were labour intensive, modern silent and clean automated collection vehicles are now used. Instead of fixed vehicle chassis, now more and more container systems are used that (when full) can be transferred to a special transport vehicle or other modes of transport. Furthermore, as the waste volumes and transport distances have been growing, more and more intermodal waste transport systems to the processing plants by rail or inland navigations were introduced on various origin-destinations. Motives to innovate and to improve waste logistic systems are e.g.: reducing costs for collection and transport of waste, less noise, emissions and disturbance or modal shift. Currently waste collection and logistics is done by modern means and by professional organisations. Processing of waste is done on bigger distances from the origin. Therefore collected waste is transported in transferable containers to allow efficient road transport (2 or 3 ISO-20ft containers) or by barge or train. The domestic waste is under control of the municipalities. These municipalities can do the collection and transportation on their own or can outsource these activities to specialized companies. Processing plants such as incineration plants are private companies. However shareholders are usually authorities such as the main municipalities, provinces that are making use of the plants. On the other hand industrial waste is not controlled by municipalities. Contracts for the waste collection are business-to-business. There is a trend towards scale enlargement, both in the supply and demand sides. On one hand small processing companies and plants on city level are replaced by bigger companies plants that serve a bigger area (e.g. provincial level, national level or even operating cross-border). Municipalities usually co-operate with each other to bundle the activities and contracts. The awareness of waste transport logistics is there. Waste collection and transportation is rather significant in the urban areas and therefore gets some attention. However the logistic costs are not the most important aspect when decision making on the destination to bring the waste. Experiments have been with clean waste collection vehicles running on CNG. However, this has led to a widely implemented technology. Recently DIFTAR systems have been introduced in several areas in The Netherlands to reduce the amount of waste produced. At DIFTAR (Differentiated Tariffs) the weight of the waste for each household is measured when collected it. Subsequently the residents pay per kg waste that they actually put on the streets. This results in a financial incentive for the residents to reduce the amount of waste that they produce and in this way increases the awareness. Framework conditions influencing directly or indirectly the establishment of waste transport logistics concepts and strategies: ▪ Cost situation of municipalities (more efficient waste collection and logistics): Although municipalities are

	public organisations and there is no need to make profits, there is a need to cut on the costs and to make the collection, transport and processing as efficient as possible for the residents. However, collection and transport of waste is only a small share in the overall cost to be paid by the residents. ▪ Congestion situation in cities: The congestion in Dutch cities is severe. However, the collection and transport of waste often can be done outside the hours of peak traffic. Therefore, the congestion is not a very big argument to change logistic concepts for waste collection and transport. ▪ Privatisation of waste disposal (tendering processes, organisational issues): Privatisation can be an issue. Public waste collection organisations are replaced by private organisations. However, these private organisations have a bigger drive to optimize the logistic processes in order to be competitive in the market. ▪ Current waste collection system is not satisfying: Old-fashioned systems which were labour intensive, costly and noisy have gradually been replaced by modern collection systems and collection vehicles. ▪ Environmental situation within cities: Main issues regarding the waste collection and transport are the noise, exhaust emissions and litter. State-of-the-art vehicle and collection technologies focus on reducing these issues. For instance there are more and more underground storage systems for waste and modern collection vehicles are safe (using camera's etc.), silent and clean. ▪ Awareness for waste problems in general and especially waste collection and transport: Not really an issue anymore in The Netherlands. Generally speaking the waste logistics are well developed and big logistic problems have been solved already. Now there is attention and some awareness to make systems more sustainable, e.g. by means of modal shift or more efficient transportation by road. ▪ Planning processes: waste management: Generally speaking, waste management is included in planning. For example at construction of new residential areas and housing projects, the collection of waste is well addressed. ▪ Legal framework conditions: There are regulations and laws with respect to transportation of waste on national and European level. There is a significant difference in the type of waste, e.g. regulations for transporting hazardous waste are of course stricter. Also there is a significant difference if the transport is inside The Netherlands or crossing borders in the EU or outside the EU. Also in Provincial Environmental regulations attention is paid to transport of waste. If transportation of waste is in The Netherlands, the drivers of waste transport vehicles need to be able to show accompanying letters with information on the origin, type of waste, amount and destination. <u>Importance of waste collection and waste transport and logistics in the Netherlands:</u> In the past the there was no big need for waste logistic systems and schemes. The volumes were lower and the transport distances were much smaller. Waste was dumped in landfill areas near the urban area or cities or burned in local plants. Nowadays waste transportation is on much longer distances and subsequently there is a bigger need for logistic solutions. In future there will be a growth in the attention of waste transport because waste logistics will become more and more get international orientation. However, the importance will not be very high regarding urban freight, since there are no big logistic problems that are difficult to solve. On the contrary there is a growing opportunity to use intermodal transport systems instead of road transport.
Slovakia	There are currently no waste transport logistics concepts existing. One main problem is the financial situation of municipalities that allows currently no comprehensive investments. There is existing a congestion problem in some cities like for example Bratislava or Košice but financial restraint hindrances the introduction of modern and innovative transport and logistics concepts in the field of waste transport. Nevertheless Slovakia has developed a waste management programme (WMP) for the next years. It was adopted in 1993 by Ministry of Environment of the Slovak Republic and has been the basic strategy for Waste Management in Slovakia. All current single waste management activities and plans are managed and originated according to with WMP of the Slovakian Republic. According to basic principles of the Waste Management Programme of the Slovak Republic for 2000-2005 all regions, cities and relevant organizations create waste management plans. The waste management activities have been evaluated with the following results: since 1996 the following objectives have been reached: ▪ Neutralisation of improperly stored dangerous waste – partially completed ▪ Creation of containerization system for dangerous waste - partially completed ▪ Building up regional incinerators for medical waste – completed ▪ Creation of undirected collection of recycled kinds of waste - partially completed

	▪ Reduction of volumes of problematic substances in municipal waste. The waste management activities have been evaluated for the time period from 1996 until 2000. The time after has not been evaluated until now and activities are ongoing.
Slovenia	Waste management is one of the most poorly regulated fields of environmental protection in Slovenia. The accumulated waste management problems are multilayered and originate from the past social attitude towards waste and waste management; main reasons are a lack of vertical and horizontal administrative and technical co-ordination and organisation; a lack of legal regulations and economic measures; the geology and hydrology of Slovenia or the characteristic settlement pattern. None of the attempts to solve the problem of waste has produced a significant result: The disposal of waste at local (municipal) landfills is more or less the only possible method of managing urban and most industrial waste. Often the location of these landfills is inappropriate, they do not meet technical requirements (unsealed, no gas drainage, exposed to floods, close to groundwater, etc.) and are mostly full. There are between 50000 and 60000 illegal waste dumps in Slovenia. One of the consequences of inappropriate waste management is the excessive release of methane from landfills, representing approximately 5% of the overall emission of greenhouse gases in Slovenia. Many landfills operate without proper documentation or have no legal status. The separate collection of household waste is organised (only) in few municipalities. The problem of processing the separately collected waste has not been solved satisfactorily yet. Industry frequently disposes its waste together with urban waste. Some companies have their own mono-disposal sites for specific types of hazardous waste, e.g. sites for disposal of tailings, slag and cinders. The collection of certain types of urban waste, which are collected and recycled effectively in other EU countries, has not yet been organised in Slovenia, e.g. aluminium cans and PET bottles (beverage bottling), packaging styrofoam, wooden crates for fruit and vegetables, old clothes, household appliances, apparatuses containing electronic circuits, old cars, etc. **There are many projects in Slovenia, (sponsored by public funds), dealing with the waste management, but none (according to our knowledge) deals with the logistic and organisational problems of the waste transport.** The waste, also in the cities, is collected in Slovenia during the day. In the city centres the waste collection trucks cause often considerable congestion problems. The Waste Management Strategy of the Republic of Slovenia – Problems and Specific Issues in Approximation to the EU (adopted by the Government of the Republic of Slovenia on 1 August 1996) is an important step towards the improvement of the current state. It defines basic guidelines and objectives in the field of waste management and grades possible waste management methods. The Strategy is a constituent part of the NEAP (National Environmental Action Programme), which in its programme section merely summarises the main objectives, measures and orientations.
Spain	At the beginning of 1980ies in Spain the first appearance of waste transport using vehicles with rear loading and compacting technology took place. Following at the end of 1980ies bins in the streets and relating vehicles modification for the new process, catching the containers and bins and waste compacting was introduced. During the mid of 1990ies first recycling system and selective collection were initiated. Finally, at the beginning of 2000, new systems with side loading with modified vehicles have been developed and introduced. This kind of collection needs less staff for the process. In the last years there is a trend trying to implant automated waste collection system all around the country, but currently this way of collection is working only in some cities. First waste logistics concepts in Spain have started with night waste transport using special vehicles, because of improving the waste problem, preventing traffic congestion (night) and getting it faster. Two types of collection systems exist: Stationary system: it consists of a number of collection points, linked together by pipelines that transport the waste to a central collection station. When a refuse bag is deposited into an inlet, it is temporarily stored in a chute on top of a discharge valve. All the full inlets connected to the collection station are automatically emptied at regular intervals. The control system switches on the fans and a vacuum is created in the network of pipes. An air inlet valve is opened to allow transport air to enter the system. The system is ideal for separating waste for recycling, in which case there is an additional inlet and container for each category of

	refuse. When the containers are full, normal trucks collect them for emptying for further transportation to incineration facilities, composting plants or land fills. Benefits for the user are comfort and the flexible service hours. This service needs less vehicles and stuff, and the vehicles only have to get the waste containers from the central collection station avoiding to run all around the city and minimizing vehicle kilometres. Only the main cities have developed any initiative for the automated collection, especially in historical centres. First automated system was in La Villa Olímpica improving the 1992 Barcelona Olympic Games. The fifty automated systems working today are located in 15 different cities, five of them the most populated like Madrid, Barcelona, Valencia, Bilbao and Sevilla. *Mobile system*: in the mobile system, the waste is deposited in storage tanks, which are regularly emptied via special docking stations into vacuum-equipped vehicles. For those who live or work in the area, the mobile system is used in just the same way as the stationary version. The refuse bag is put into an inlet, which may be located indoors or outdoors. The bags are temporarily stored in a closed tank. The storage tanks are linked to docking points via a network of pipes. The docking points are placed so that the vehicle collecting the waste does not need to drive into yards, etc. The vacuum truck has the same function as a stationary collection centre, collecting the waste through a pipeline system. As in the stationary vacuum system, the waste is compacted and dust and odours are filtered out of the air. The mobile system is primarily recommended for small residential areas. Benefits for the user are comfort and the flexible service hours. This service also needs less vehicles and stuff but the vehicles have to cover all the different collection points and that's a failure factor comparing with stationary system. This system is only implanted in the most important cities like stationary one.
Switzerland	In 1986 the Swiss waste disposal policy has publicised the first model (guidelines) for the future Swiss waste disposal system. With respect to the environment problems at this time by non co-ordinated and uncontrolled waste disposal two main objectives have been formulated: ▪ Solving actual problems: within 10 – 15 years environment-friendly solutions should be found. ▪ Prevention: general accepted and ecological criteria for environment-friendly disposal had to be elaborated. Besides this the first waste disposal model has been the basis for a lot of regulations that still exist. In general the model has postulated the following: ▪ Waste should be avoided at its source. Possibilities can be offered by modern production processes, the development of long-living goods as well as the optimisation of packing material. ▪ The waste disposal economy protects human beings and its environment ▪ Only two materials should be produced from waste: recycling materials and those materials that will be finally stored. ▪ Pollutants and contaminants should be dissolving out of the material circuit. ▪ If possible waste material should be recycled under ecological and economical aspects. ▪ Switzerland carries out its disposal not in foreign countries. ▪ Waste disposal should be financed by waste producers and users of disposal activities. ▪ Public authorities have only a subordinated role. Since the first Swiss waste disposal model 20 years are gone and today the success can be seen. After a first period of the establishment of a functioning disposal system and the construction of waste disposal facilities a second period of consolidation and optimisation has started. The conception of sustainability leads to a more active role of waste disposal policies that should set ecological standards and framework conditions: ▪ for an economical and ecological efficient waste disposal policy ▪ for an liberalisation in waste sector ▪ for a better task share between federal authorities, cantons and municipalities ▪ for a sustainable resource policy In the last decades the waste "disposal" made a change towards waste "management". In charge of waste collection (household waste as well as industrial waste) is the administration of a municipality. The municipalities (very often cooperating with each other, or under supervision of the canton) lay down the specific rules of how, when and where what kind of waste is collected or where it can be disposed and what fees apply. In the 1990s central aim became cutting costs for waste management as a whole, while maintaining the

	environmental standards. To accomplish this, flat-rate taxes were replaced by quantity-dependent fees for waste collection and disposal. These fees usually are cost covering and also include costs for certain recycling activities that are free of charge. The costs-by-cause principle is widely spread: The fee for a waste bag depends on its volume. Parallel to these activities in most cantons and municipalities facilities and concepts for the collection of recyclable waste was built up. All recyclable materials still can be disposed free of charge. The level of the fee in most municipalities on the size of a waste bag or a waste container. As an effect of this new regime, over-all waste quantity could be reduced. Concerning household waste it has to be distinguished between the logistics of general waste and recyclable waste: General waste is being collected on tours with vehicles (either run by a private company but on behalf of a public organisation/municipality or it is conducted by a public organisation itself). Used paper and carton (municipal waste) is usually collected on two-weekly or monthly tours, similar to general waste collection. No fees apply. The same concept is widely used for bio-waste, but there are usually only sporadic collection tours. In contrast to this concept recyclable materials have to be carried to specific spots by private persons or firms. Shops, selling batteries, electronic hardware and household machinery are obliged to take these products back independently whether a new product is bought or not. The shop is responsible for the transport and the correct handling of the waste. To finance the recycling process a fee applies with every electronic or mechanic product of sold. This fee is called “vorgezogene Recyclinggebühr” (advanced recycling fee) and is paid by the customer. For glass and metals there are in most municipalities collecting points (in cities often within walking distance), where local inhabitants can dispose these garbage. Special small containers of different kinds are used to transport glass and metals to a processing plant. Recycling related concept for PET: For PET recycling, a specialised society was founded (“PET-Recycling Schweiz”) in 1990 with 90% of all beverage producers as members. A new law was introduced in this year, forcing all producers, dealers of PET products to either finance a recycling society or providing the recycling service themselves. The society is in charge of the collection logistics of empty PET bottles, as far as it is not done by supermarket chains themselves. PET products (mainly bottles) can be disposed in 47’000 boxes all over Switzerland, usually where PET bottles are sold. A specialised society is in charge of transport and processing the empty bottles (see below). Current activities are: ▪ Further optimisation of the system; collection tours ▪ Trend towards weighing of waste and charging per kg instead of per volume (bags, containers). To do this, waste collection vehicles are more and more equipped with balances. New technologies in waste logistic include ▪ waste collection vehicles (systems: translift, cats, msts; use of ACTS system for vehicles and rail/road transport, IES system see project CH-1, use of balances to weigh every household’s, company’s waste amount for billing); ▪ new types of allocation boxes: i.e. project to install 6.5 m3 underground containers in the old town of Zurich to replace the waste allocation places on ground (bags and widely used 0,77 m3 waste containers) There are some innovative and future waste disposal concepts existing that directly have impacts on urban freight transport: The Canton Thurgau as one example (➲ see also project description) has built up a sustainable way in waste disposal and waste logistics by using trains and by effective tour planning what results into a reduction of vehicle kilometres. The town Zurich for instance has set standards in form of guidelines for a future waste disposal system and additionally has incorporated the waste disposal in the overall mobility and city freight transport strategy. The municipal waste and recycling authority (ERZ = Entsorgungs- und Recycling Zürich) has equipped all its waste collection vehicles with environment-friendly EURO-Norm 3-vehicles and particles filters. The number of waste collection vehicles could be reduced by optimized tour planning and better utilisation rate so that the total driven vehicle-kilometres could be reduced. For bulky goods the ERZ Zurich has introduced a cargo tram service. Public transport users are allowed to bring their bulky goods by public transport without paying a fee to the foreseen stops of the cargo tram. The

	collection of bulky goods and the whole disposal is organised by trams equipped with two containers ➲ compare also project description.
United Kingdom	**Current situation in waste disposal management and logistics:** Commercial waste was collected by commercial organisation, municipal and household waste by in house direct labour organisation within the city government. In the 1980s municipal waste was outsourced on a competitive tendering basis. Nowadays some in house operations exist but have to be market tested. Traditionally waste was shipped to landfill sites which were located as far away from the most vocal voters, irrespective of distance. The growing complexity of materials in waste will increase the difficulty (and therefore the cost) of separating the useful from the useless, the safe from the hazardous. This will, in turn, increase the benefits to adopting waste management systems which ensure that, as far as is possible, streams of materials are separated at source. With the right incentives and information, householders will be far more effective at achieving separation, compared to expensive, centralised materials recovery facilities The developing trends in favour of decentralised local waste management facilities are likely to continue. This is partly because this will be more acceptable to a public which does not want to host processing plants for waste which is not local, but also because there are economic benefits of minimising the transport of materials and energy. The combination of small is beautiful with the proximity principle will become increasingly appealing to local authority planners, waste managers and industry alike. Further important aspects are: ▪ Producer Responsibility will become commonplace – pushing the financial liability for waste management onto supply chains ▪ Convergence in the waste sector will continue ▪ Energy from renewable sources will secure a 'green premium' in the form of renewable obligation certificates ▪ Serious blockages in the planning process could create local shortages in the geographic capability to process waste locally In the UK there is a landfill tax on all waste which is disposed of and not recycled. This amounts to about £750m p.a. and the waste industry is allowed to distribute 8.5% directly on initiatives and research. Landfill tax in 1996 was 0%, by 2005 £18/tonne. As this increases it'll make landfill uneconomic. Other options such as recycling centres, green energy centres or composting cost £40 p/tonne. Once landfill tax reaches £40/tonne then expansion will be seen in the alternatives, which it must be noted use greater square metreage. **Vehicle propulsion systems**: With as many as 20 per cent of local authorities unlikely to meet their controlled emissions standards, there is an increasing enthusiasm for natural gas-powered refuse collection vehicles (RCVs). These can reduce emissions, cut costs and are said to be half as noisy as diesel RCVs. Reading Borough Council has converted to natural gas, as have Restermel Borough Council in Cornwall (with the aid of a grant under the Government's Powershift Scheme which enables businesses to recoup up to 75 per cent of the additional cost). **ITS:** British waste collection is as sophisticated as parcel logistics using vehicle routing systems, pda, GPS tagged containers, GPS tagged vehicles, photograph lift with PDA, sent via PDA, vehicle tracking via GPS, proof of collection, etc. Bespoke routing systems are used that interactively plan the routing through the day, using satnav systems. **Framework conditions**: The UK Government has set English local authorities the challenging target of recycling or composting 25% of household waste by 2005/06. The household waste recycling rate in England is currently 13.6% - so an urgent step change in performance is needed if we are to achieve the Government's target. There are similarly challenging targets set by the devolved administrations in Scotland, Wales and Northern Ireland. Government co-operates with industry, the public sector and the wider community to bring about positive change in the management of waste in the UK by increasing recycling.

	Actors are mainly: government (DEFRA), The Environment Agency responsible for consenting and enforcement at waste recycling and disposal facilities, industry who under producer responsibility are ultimately responsible. **Research activities**: The STRAW project was funded by BIFFA from the proportion of the landfill tax that they can reallocate to research and initiatives. The Sustainable Transport Resources and Waste Project offers the opportunity to think strategically about the scale and location of waste management and reprocessing infrastructure, while optimising transport of materials between facilities and regions using rail, inland waterways and coastal options. The Mayor of London and Transport for London are continuing to develop a strategic approach to the waste and waste transport sector in London. The Mayor required the development of the London Sustainable Distribution Partnership (LSDP) which has already been involved the development of several initiatives and projects. Development of a London-wide waste land use and transport model for municipal, and commercial and industrial waste streams including the environmental impacts of waste transport: It will consider the increasing transport demand and use of vehicles and the role of different modes as greater proportions of London's waste is recycled and recovered. This model will have the ability to influence strategic and local planning through the Sub-regional Development Frameworks and Unitary Development plans, which will inform the number and type of new waste management facilities that will be required in the capital. The Greater London Authority (GLA) is undertaking further work to assess the implications of creating a strategic waste collection and disposal authority. (TfL) This builds on two previous pieces of work undertaken by the GLA and Association of London Government (ALG): ▪ a London model of municipal waste volumes and costs (GLA & ALG) ▪ identification of the potential spatial land-use requirements for waste facilities (GLA) Stage 1 of the Grand Union Canal Study was a survey to identify potential wharf sites and opportunities for waste, recyclables and construction materials. The work already undertaken in raising awareness of the potential for using the canal during the canal survey has already helped to initiate projects including the movement of 70,000 tons paper annum of cardboard from Park Royal to Maidenhead. This uses the section of canal between Park Royal and Slough where the load would be transferred to road. This equates to 8,750 lorry journeys saved (in and out) using 16 ton lorries. The return journey from Park Royal to Slough is 31 miles giving a total of 271,250 miles lorry miles saved per year. (TfL) Stage 2 of the Grand Union Canal study builds upon the first phase to identify volumes of commercial and industrial waste and other 'bulk' commodities suitable for transport along the canal and the anticipated volumes which could be transported now and in the future (using projections identified within the London Plan and other studies). For each commodity outline proposals are to be developed and costed for its movement by water. (TfL)

ANNEX II

Collected case studies (projects-level) – Waste transport logistics in urban areas[4]

Code	City/Region	Name of concept	Short description of concept
AT - 01	Austria – region of Oberösterreich, Steiermark, Voralberg	Potential of optimisation in waste disposal logistics	The Austrian Ministry of Transport Innovation and Technology, in the framework of "Logistik Austria Plus", set off innovative concepts and solutions for transport and logistics and funded companies and research establishments for implementing projects between 1999 and 2003. The regarded project was part of this research programme. As waste transport logistic causes ecological and economical cost, the content of this project was the generation of a simulation model, to analyse and forecast the effects of different waste transport systems. This project is a fist step towards scientific research on internal and external effects of different waste transport systems taking into account various socio-economical and socio-demographic parameter.
AT – 02	Austria	CARGOtrade.net	The goal was to create a cost-effective market place on the internet, where loaders of waste (ARO and ELA) bid transportation charges (mostly paper and cardboard) and freighters have the opportunity to tender (reverse auction). To finance this service, both sides would have to pay a fee for procurement of transport contract. The achievement for waste transport logistics is that due to the transparency and publicity of the platform, freighters have the possibility to substitute empty runs and optimise tours.
BE – 01	Liege, Walloon region	Inland waterway transport of household waste	The incinerator managed by the Association of Municipalities for the Treatment of Waste in Liege (INTRADEL) in Herstal treats household wastes collected from 72 municipalities of the agglomeration of Liege. Household wastes collected by about 28 municipalities, located in the southern part of Liège, are transported from a central transfer station in Ivoz-Ramet (about 20 km in the south of Liege, belonging to the municipality of Flemalle) to the incinerator by barges on the Meuse. Inland waterway transport of waste began when the incinerator was opened in 1990.The transfer station of Ivoz-Ramet is located on the right bank of the Meuse and is easily accessible by road. Lorries from these municipalities deliver the collected waste to the station, equipped with a covered wharf, from which a barge leaves every two days to the incinerator, which is directly connected to the Meuse. The main conclusions of such a project are very positive. Inland waterway transport of waste contributes to the improvement of the quality of life in urban areas by reducing the number of back and forth movements from and to the incinerator of waste lorries circulating in the city centre of Liege. Waste transport by barge allows avoiding the transit of 40 waste lorries a day through the city of Liege.
BE – 02	Brussels	Future usage of inland waterway transport in household waste	ABP (Agence Bruxelles Propreté) is a regional public organisation managing waste disposal in the city of Brussels. For the organisation of waste collection, the city is divided into several zones in which waste bins have fixed itineraries. It requires 180 lorries, operating three loadings (waste bins collect the waste until they are full, transport waste to the incinerator or to the sorting centre and come back to

[4] Marked lines are treated in detail – compare also project description

Code	City/Region	Name of concept	Short description of concept
		transport	continue the collection, that occurs three times). Waste bins always start their collection from the most distant zone of the incinerator or recycling centre. That represents three transports through Brussels for each zone, corresponding to 540 transports by road for a complete collection. The traffic generated by ABP waste collections and transportation from households to the incinerator (Neder Over Heembeek) and the sorting centre (Forest) is then estimated to 2.610 travels a week (5.220 goings and backs). "Agence Bruxelles Propreté" envisages transferring the non-sorted waste collected in the south of Brussels onto barges to the incinerator located in Neder-Over-Heembeek (North of Brussels). This measure should avoid the back and forth of waste lorries from and to the incinerator, inducing consequent savings in terms of vehicle kilometres and of the workforce. Moreover, the barges, instead of an empty return, could be filled with the sorted waste collected in the north of Brussels and bring it to the sorting station of Forest (South of Brussels). Waste would be packaged into containers in order to make the transhipment easier. The project could be in application within two or three years from now on.
CH - 01	Canton Thurgau	Integrales Entsorgungssystem IES Kanton Thurgau (Integral Waste Disposal System in the Canton Thurgau)	The political will for an efficient, coordinated concept for waste disposal in the region, with cooperation of diverse political instances has been the reason for introducing a new waste disposal concept in the Canton Thurgau. A new single waste incineration plant in region built in 1997 (replaced two older plants). Therefore an efficient transport and logistic concept for the in total longer transport distances of the waste to the plant became crucial. To ease the effects of traffic in the areas near the incineration plant, which is densely populated, also rail transport had to be considered. A newly built incineration plant was approved under the condition that a considerable part of the transport is carried out by rail instead of road transport. (Reduction of ton-kilometers on the road in the whole region).
CH - 02	Zurich	Optimisation of Waste Logistics / Recovered Paper Logistics Guidelines for municipalities of the Canton Zurich	The overall trend towards increasing efficiency in waste management in general, and in waste logistics in particular has lead to a rethinking of municipal waste logistics in Zurich. Therefore a handbook was created to assist the municipal authorities (being in charge of the waste collection on their territory) to optimise waste logistic processes in terms of cost and efficiency. One main aim has been to cut costs of waste management, while maintaining the achieved standard of environmental standard within this field. The project was initiated by the administration of the canton of Zurich, department for waste, water, energy and air (AWEL). The main aim of these guidelines is to help municipal authorities in planning of an efficient waste logistic with guidelines, benchmarking tool, recommended analysis and optimisation processes, best practice. The proposals cover logistics for general household waste and recovered paper (meant to be recycled). Four goal dimensions are defined for a successful optimisation of the waste logistics: technical feasibility, environmental and social economic efficiency. The performance of optimisation projects based on this guidelines is being monitored as far as the municipality in charge of the waste management do this in order to asses the effects of the implemented measures. Success factors: The guidelines are precise and clear and therefore are a real help for the work of municipal authorities to carry benchmark and develop measures for an increase in economic efficiency of waste logistics. Failure factors: The guidelines have a consulting character and do not automatically generate en optimisation, which still depends on the efforts and feasibility circumstances in every single municipality.
CH – 03	Zurich	Cargotram	The Cargotram project has been introduced in 2003 and is implemented in daily business and operating. The initiator of the Cargotram has been Mr. Neuhold, CEO of "Entsorgung und Recycling Zürich" ERZ (municipal public waste disposal and recycling company

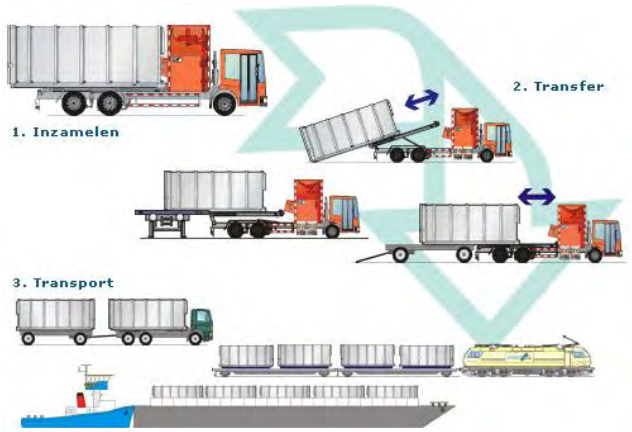
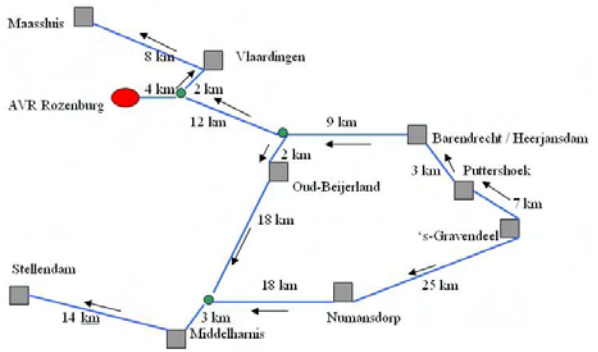
Code	City/Region	Name of concept	Short description of concept
			Zurich). The approach has been and is to collect bulky goods of households near the tram stops and since 2005 onwards the collection of waste and electronic and electronic equipment for households and industries. The payload is carried in two standard refuse containers. These are carried on four-wheeled flat wagons. The Cargotram serves different tram station in the city area of Zurich. In total 9 station are actually served. A pre-condition of the system is that the concept is not hindering the public transport by tram. Therefore the positioning of Cargotram is at those stations where additional tracks are existing (turning points at the end of a tram line). The Cargotram is addressed to public transport users, residents, cyclists and pedestrians. It is not allowed for non-users of public transport to deliver bulky goods to the Cargotram. Cars and delivery vehicles will be turned away. The collection of bulky goods is taking place every four weeks per station. The opening times for the Cargotram are between 3 p.m. and 7 p.m.
DE – 01	Ulm	Waste container management RWE Umwelt Süd	RWE Umwelt Süd is company servicing the area of Baden Württemberg and Bayern with waste logistics solutions. About 10.000 containers in this region have to be managed by different depots carrying out the delivery and pick up of these containers. In order to improve these processes a container management system has been developed since 2001 that tracks information where container are placed, when they have to be picked up or delivered and that considers technical maintenance intervals. In addition technical data on the container weight (measured by an integrated weighing machine) or on the ident code of the container are integrated. According to the requirements a management and dispatching system has been developed and installed first in a pilot demonstrator at some vehicles later at several depots. The approach focuses on connecting the driver to a central management and dispatching application. Drivers will get order and tour data while they are on the trip to pick up or deliver containers. Furthermore, drivers should have the possibility to send SMS status messages to the dispatching base. The movement of the vehicles is tracked by fleet monitoring application. The technical approach includes the equipment of GPS positioning systems on containers and vehicles. Vehicles are equipped with on board units and handheld allowing to record all relevant tour and invoicing data and has the possibility to integrate a barcode scanner. The movement of the vehicles as well as on the container locations is shown on a digital map that is part of the management and dispatching system located at the depot monitoring the entire process. The entire systems works in the way that the driver receives new orders and tour data from the dispatcher while he is on the trip via voice message or SMS. The driver is selecting the route to the next tour point. Each container will be identified via barcode scanning or transponder and weighed. These data go directly into the management system for further processing. The approach started with a simplified installation of 5 vehicles in one depot in order to collect experiences before going into an installation on a larger scale. The test trial showed that the acceptance of the systems was quite well among the different users (driver, dispatcher, management). Overall the processes in the transport chain could be accelerated leading to a higher use of capacity of the vehicles. Furthermore, the approach led to an improvement of the data quality that also contributed to a more efficient management of container handling and invoicing. Finally more transparency on the entire container handling processes could be gained leading to a much better planning basis. After the test trial 80 vehicles were equipped with the on board unit and integrated in to the dispatching system.
DE – 02	German cities	OPTRANS	OPTRANS deals mainly with the assessment of transport chains within waste recycling processes due to the German waste recycling directive. Based on a common method for a ecological and economic assessment of transport chains information and communication

Code	City/Region	Name of concept	Short description of concept
			solutions were developed aiming on an optimisation of the transport flows for the recycling of plastics from private households. The main goal of OPTRANS was to evaluate how far transport demand can be reduced and alternative transport modes can be integrated in to waste transport chains. The OPTRANS solutions should provide an optimisation of road based transport flows and practically show the potentials to integrate alternative transport modes into these transport chains.
DK – 01	All municipalities in Denmark	MiljøLogistik	Since 1990 until now an integrated logistics concept for industrial waste as initiative of private transport operators is still working. Transport operators wanted to optimise the planning of the transport chain, which helps to minimise trips and vehicle kilometres. Independent transport operators are working together based on the same concept but in different regions. Each transport operator is responsible for only one region. The concept includes internal waste management, collection, transportation and treatment.
FI – 01	Helsinki Metropolitan Area	PUZER XMIT	One of the major problems in waste management is access to the waste collection areas usually situated in the courtyard of every house. Also, the conditions of these areas are often unsatisfactory and smell nuisances in these areas force relatively frequent collections with relatively high costs and local disturbances. In 2001 Puzair Ltd has developed pre-separated waste transport system that is operating actually in the Helsinki Metropolitan Area. Apartments are equipped with two (mixed/bio) small waste bins in the kitchen closets (Also, more than two waste fractions could be used). When a waste back (decomposing one for bio waste) is full, inhabitants take it to the waste station in the basement of the house. The waste fraction is chosen by pressing a pushbutton that unlocks the lid. The system (pipeline) transports (the distance is about 200 m) the bag into the container (for that waste fraction) with compressing facilities. The containers are shared with a shopping centre nearby. Cost savings can be obtained because round trips for waste collection are diminished. Also, local nuisances caused by truck driving and waste handling in the courtyards are stopped.
FI – 02	Finland	MOLOK - Smart collection system for solid waste	In 2001 Molok Ltd has developed containers, which are 1,5 m below the surface and one meter above. These containers have reduced traffic related to waste collection to less than one-half of that required by the old system. The reasons for the reduction are: i) in deep containers new waste material compresses the old already more contaminated one and ii) at the same time cover it; iii) below surface temperature is lower and therefore comtaminating process is lower. In order to cut transport costs further, research has been directed on the ways how to get direct information on the need to empty the containers. Molok Ltd initiated the project as a part of the STREAMS Technology Programme Technology partly financed by TEKES (the National Technology Agency of Finland). VTT (a research centre in Finland) is working in the project too. When the construction of containers diminishes smell problems, the best time for collecting waste equals the time when the container is full. The problem is how to know this. The main aim is to get information: a) when every container is full or b) what are chemical or physical processes in it. The main field of interest is in household waste. The system which informs when a container is full is based on GSM-technology. Research on the chemical and physical processes of organic waste in waste containers is still on-going.

Code	City/Region	Name of concept	Short description of concept
			Further reduction in the number of waste collection trips is anticipated. The performance of the project is monitored through a test of the information system in several tens of Molok containers in Finland. Molok containers have already reduced transport costs by reducing the number of waste collection trips. The research described above may produce further savings.
FR – 01	263 municipalities from the eastern part of the Oise Department (Oise Vallee), 60 km North of Paris	VERDI (Valorisation Et Recyclage des Déchets en Intercommunalité)	The project is part of a global strategy for clean municipal waste management and transport of 263 municipalities including rail transport in their waste logistics chain. The main reason for starting this project has been the reduction of environmental impact of municipal waste transport, accompanying the development of a modern incineration and recycling site. The aim of the project is to transfer all incoming waste transport and part of the outgoing waste transport (final waste, cinders, recycled material) from road to rail. The Ecorail logistic rail operator (a subsidiary of SNCF) has been chosen to implement its “multi berces” technique (a light rail/road combined transport technique) for the transport of SMVO (a co-operation of 263 municipalities from the eastern part of the Oise department in the Oise vallee (60 km north of Paris) waste to the new incinerator and waste sorting complex. After collection of household waste (bulky and recycling waste) from each household, waste is grouped at different transfer sites connected to rail, where an Ecorail train is formed and sent daily to the incineration and recycling complex, at the south west area of the syndicate. These transport chains were previously done by road transport. Realised benefits have been rather high because of : 1. Strong media attention to the project 2. Many tons-km of road waste transport could be avoided. “It is considered that the Verdi program avoids the pollution of the equivalent of 32 500 circulating private cars annually in the area” (Verdi administration).
FR – 02	Lille	Lille municipal waste waterborne transport from Lille to Blaringhem	The main objective has been to reduce environmental impact of municipal waste transport, accompanying new incineration and treatment sites development and to Transfer all incoming waste transport and part of outgoing waste transport (final waste, cinders, recycled material) from road to water. The waste collection taking place in Lille covers household waste, mainly bulk and recycling material. Some technological investments and logistic reoargnisation had to be made (with financial and technical support of Voies Navigables de France, VNF, the public national agency for water traffic management). Waste is placed in 20’ containers « ampliroll » which are disposed by cranes on 3 barges (containing 35 TEUs each) every day. Barges navigate 60 km to Blaringhem. They are discharged the next morning by Kalmar crane with spreader (with a rotating axle). Containers are then transported by trucks on neighbouring landfill. The form of organisation of this waste transport logistics project is a Public Private Partnership. The project partners are: Port of Lille, Lille Metropolitan Authority, Voies Navigables de France (VNF, the public national agency for water traffic management). The project was considered a success and a good example of waterborne transport for waste. Very good results could be achieved by avoidance of trucks and vehicle-km. The demonstration project has helped the Lille administration go further with their global logistic reorganisation of waste management and transport, based on waterborne transport.
GR – 01	Kifissia, Attica	Waste transhipment and compression	In 2005 the municipality of Kifissia has started a new concept of waste disposal aiming to reduce vehicle kilometres and by this negative environmental impact. Additionally cost savings have also been a reason because the operation and maintenance cost of the vehicle

Code	City/Region	Name of concept	Short description of concept
			fleet is rather high, due to frequent visits to the landfill area and poor road surface quality The concepts is based on new compression technologies that allows a higher truck usage rate. The containers that compress waste are located at a site very close to the depot. The transhipment station is optimally located and is equipped with containers that compress waste. The vehicles empty their content there, instead of travelling all the way to the landfill –and wasting much time in there waiting at queue. As long as the containers are filled, special tractors take waste to the landfill site. In addition to that, many routes are performed in the night time, limiting congestion. The concept is further enhanced by the combined usage of vehicles with different capacity. Small ones are used in the city in areas with narrow roads and dense traffic. There is great potential for savings in vehicle maintenance cost. Operation cost is also going to decrease, as tractors will only make up to 1/5 of the trips made by waste disposal vehicles today
GR – 02	Thessaloniki	Waste transhipment and compression	Earlier than Kifissia (1996) the municipality of Thessaloniki has already started a concept of waste disposal aiming to reduce vehicle kilometres and by these negative environmental impacts. The transhipment station has been carefully planned. Its capacity is adequately larger than the demand on a daily basis and this safety margin is going to increase after a 4th compressor is set in operation. It is also important that the facility is utilized by increasing the number of containers available to discharge part of the waste temporarily stored (containers are used to transfer waste to the landfill with tractors). The location of the station is optimum (close to a junction connecting the city ring road with major highways), offering very good road conditions. The implementation of the project is environmentally sound, minimizing any objection that could be stated on the operation of the station (fully closed system, air filtering, dust/noise absorption). It is expected, though, to reduce trips to the landfill at least by 80%, since each container has a capacity equivalent to 4.5-5 vehicles.
IRE – 01	Dublin	Glass Collection	The private operator Oxigen has developed a sophisticated way to mange glass collections which they are contracted to do by the four municipal authorities. The number of glass bank sites in service in the Dublin region is currently 149 from which 525 tonnes were collected during the month of January 2005. An Utilisation Index is used to monitor the performance of the different sites. This index is computed from the weight of glass collected in each of the four local authority areas divided by the volume of sites in service and is a measure of how busy the sites are. The total tonnage collected during the whole of 2004 was 3345 tonnes and this will increase under the new waste management plan as additional sites come into service. A glass bank site comprises three different colour compartments for green, for clear and for brown bottles. Data is collected on the weights collected from each colour on site, the number of site visits, the colour ratios and the Fill Percentages for both the individual colour compartments and for the overall site itself. The Fill Percentage is the weight collected in the compartment divided by the available volume of the compartment based on a 1.2 tonne capacity for a 5 cubic metre container. If a Fill Percentage for a particular colour compartment is higher than those of the other colours on the same site, then that is the colour that determines the collection frequency. When one particular colour compartment is full or near full, the whole site must be serviced. The Site Percentage value is the weight for the whole site divided by the total volume of the site based on the maximum tonnage available if all colours were filled. If the Site Percentage figure is high then the site is well colour balanced and is being emptied at its optimal frequency. If the Site Percentage figure is low and yet one of the individual Fill percentages

Code	City/Region	Name of concept	Short description of concept
			is high, then that site is not well colour balanced. If the Site Percentages and the individual Fill Percentages are low, then the sit is being serviced too frequently. An analysis of the data shows that for the majority of sites, it is the clear glass compartment that fills first whist the green and brown compartments are often only half full. Oxigen are therefore considering rebalancing the size of the different colour compartments at their sites in order to optimise the space available for all colour compartments, thereby minimising the frequency of site services. A move may be made to re-order the sites with volume ratios of 3:2:1 for green: clear; and brown glass instead of the 2:1:1 ratios currently in use, in other words the capacity of the clear compartment should be doubled. This will help to optimise the Fill Percentages and to reduce the need for servicing.
IT- 01	Latium region, metropolitan area of Rome	INTERMODAL SYSTEM, ROAD-RAILWAY FOR THE TRANSPORT OF WASTE - AMA (Environmental Municipal Company) Rome	It is an intermodal road-railway system for transporting urban waste: the waste is collected through compactor lorries, which then transport it up to the railway marshalling yard. Here the waste is transferred onto a freight train, which then takes it near the dump. Through this system, the road network is used only for waste collection, while the railway is used for transporting it to the dump. The development of this system is based on the fact that in the traditional waste transport system, only 35% of the route used by the vehicles (compactor with skip-overturning system) is actually dedicated to the activity of waste collection, while the remaining 65% is necessary to reach the dumping site. The system has been introduced by AMA Spa, an Environmental Municipal Company, created in September 2000, as a stock company whose capital is entirely owned by the City Council of Rome. The adoption of this system brings several advantages: ▪ Optimisation of the collection service with recovery of productivity: the AMA vehicles dedicate the entire work-shift only to the emptying of the skips with consequent increase of the daily collection potential. ▪ Reduction of heavy traffic on the main urban thoroughfares and above all on the outer ring road. ▪ Reduction of air and noise pollution ▪ Savings as compared to the current system of waste collection and road transport. ▪ Compatibility as compared to the choices that will be implemented in the future sites of waste disposal plants, provided, of course, that they are chosen near existing railway lines. References on the Web: http://www.amaroma.it/web/web2004/home.cfm?content=servizi/gestionerifiuti http://www.amaroma.it/web/web2004/home.cfm?content=impiantitecnologie/innovazione_rifiuti
IT – 02	Rome and other Italian cities	Waste collection with environment-friendly vehicles	The sensitivity to air pollution issues within waste transporting companies is growing. Interesting examples are represented by initiatives of the (AMA) Rome waste management company, which is introducing devices and vehicles with low environmental impact, such as: ▪ vehicles equipped with ceramic catalytic silencers, ▪ “particulate trapping” devices on the exhaust, ▪ vehicles powered with low sulphur diesel fuels (less than 0.05%) in weight). ▪ electrical vehicles in the old part of towns, ▪ experimental use of bio-diesel and mineral diesel obtained from rape oil. In addition, AMA was the first in Europe to experiment the use of compacting lorries powered with methane gas obtained directly from waste disposed of at the landfill. The initiative has been realised thanks to the technical co-operation of IVECO and by CO.LA.RI., owner

Code	City/Region	Name of concept	Short description of concept
			of the Malagrotta dumping site and the methane gas production plant. For the time being, methane gas power supply concerns a small part of the vehicle fleets of the main waste transporting companies in Italy. For the future, the gradual replacement of the older and worn out vehicles assigned to waste collection with the same number of new ecological compactors is expected.
NL – 01	Randstad area	SHAFRA Zuid-West (Shift in waste transport modality in the Randstad area – pilot South-West)	The SHAFRA Zuid-West-Project was initiated 1998 and run up to 2002 by the Provincie of South-Holland in co-operation with GOVERA. The waste collection encompasses only general garbage of households and industries. The smaller waste collecting companies in the relevant municipalities wanted to realise a bigger co-operation with companies in other municipalities. Due to the co-operation there is more volume to transport and this was in favour of intermodal transport systems. The ecological reasons that are result of this concept are a decrease of exhaust gas emissions and noise emissions. The economical reasons for the introduction have been the aim to use a more efficient intermodal transport system, providing scale advantage by means of transportation by inland vessel, an economic gain was expected compared to the traditional means of waste collection and transport to the processing plant. New technologies have been studied that are based on waste collection vehicles using containers that can be changed (full ones are replaced by empty containers) and transhipped to inland barges by means of a crane on board of the vessel. Waste collection vehicles use ISO 14ft (MSTS) or ISO-20ft containers that can be transhipped. Also traditional vehicles can be used, but then the waste needs to be transhipped to ISO-20ft containers on a central location. Full and closed ISO-containers are brought to a nearby quay. Due to the fact that the ISO containers are closed they don't give much nasty smells for the direct environment. The inland navigation vessel makes a roundtrip along several transhipment locations to pick up full containers and to deliver empty ones. The following figure presents the sailing network and the locations where containers are transhipped to/from the barge.   At the end of the roundtrip the vessel goes to the processing plant where full containers are empties again. The empty containers are

Code	City/Region	Name of concept	Short description of concept
			then distributed again by the barge. The empty containers that are delivered at the quay can then be picked up by the collection vehicles and the process starts all over again. During the planning phase there have been done impact assessments and calculations on the costs, emissions, fuel consumption and road transport mileage: ▪ In total 26% cost reduction can be gained compared to the (at that time) current methods of waste logistics ▪ Fuel consumption increases with 14% ▪ Increase of production of exhaust emissions, especially with respect to particles. However production of exhaust emissions is taking place on open waters with no direct effect on people. ▪ Positive impact on saving of road transport kilometres, a saving of 80%
NL – 02	The Hague	De schone Stad	The waste logistics project is one concept within the total project "Clean City" (De Schone Stad). Because waste collection and deliveries were poorly co-ordinated, which caused congestion, noise, high emission values and unsafe situations in the city centre the project was co-ordinated. The main reason has been the increased number of non-coordinated pick-ups of several waste collection companies. The envisaged co-operation in the waste collection should lead to reduction of noise and exhaust emission. The aim was a quick and efficient waste collection which is supported by the entrepreneurs, residents and waste collection companies. This should result in a cleaner city and less disturbance for the residents and visitors. The project was started in 2002 and is still in operation. The project was initiated by the group local entrepreneurs (=shop keepers/ retailers), representatives from the residents, the former Platform Urban Distribution and the national branch organisations. After 9 months the results have been evaluated and showed some success, although still some entrepreneurs neglected the time for placing the waste outside and the waste collection companies and the cleaning service didn't always arrive in time. The set of rules has led to an improved traffic flow, reduced disturbance and a cleaner image. However, some parties don't follow the rules yet, and it seems like continued check of law abidance remains necessary.
SLO – 01	MARIBOR	Sledenje vozil- GPS – TRACKING SYSTEM - GPS	The company SNAGA has initiated a concept using technology for vehicle location, monitoring and communication that uses advanced technologies to significantly enhance the operation of the vehicle fleet by improving the quality of service, raising the efficiency and drastically lowering the operating costs of the vehicle fleet. The system utilizes the price advantages of the GPS technology to make the system suitable for the users. The reasons for the introduction have been mainly control over waste transport and can be seen as starting-point for optimisation of route planning. It was aimed to increase the efficiency in vehicle usage and by this to lower costs in the transport chain but also to reduce negative environmental impacts.
SP – 01	Barcelona	Mallorca Stationary system.	Narrow streets and historical elements make it impossible to enter Palma de Mallorcas' historical centre with conventional machinery (trucks for waste transport). Therefore a new and modern waste collection system was installed in 1999 and has been in operation since 2002. The central collection station is located 100 metres from the sea and is placed underground. The measures that have been taken into account have been: a Stationary Automated Collection System. This facility is characterized by a complex net of almost 12 km of pipes, 345 inlets and 2 separate fractions. It is equipped with one group cyclone-compactors and a diverter valve to collect two different fractions, organic waste and the rest. 345 inlets have been installed in the streets with a combination of domestic, commercial and

Code	City/Region	Name of concept	Short description of concept
			mixed inlets to give service both to the residents and to the numerous small shops and restaurants in the area. This system is based on pipeline transport and makes no road transport necessary.
UK – 01	London	London Sustainable Distribution Partnership (LSDP)	The Mayor of London and Transport for London are continuing to develop a strategic approach to the waste and waste transport sector in London. The Mayor required the development of the London Sustainable Distribution Partnership (LSDP) which has already been involved the development of several initiatives and projects. However, to make even more progress TfL is developing a freight unit and a mechanism for stakeholder engagement. To deliver an integrated view of freight, the LSDP will be redefined to include a Freight Strategy Group (FSG), four Industry Action Groups (IAG), one of which will be waste, and five Sub-regional Freight Quality Partnerships (SRFQP). **Development of a London-wide waste land use and transport model for municipal, and commercial and industrial waste streams including the environmental impacts of waste transport:** It will consider the increasing transport demand and use of vehicles and the role of different modes as greater proportions of London's waste is recycled and recovered. This model will have the ability to influence strategic and local planning through the Sub-regional Development Frameworks and Unitary Development plans, which will inform the number and type of new waste management facilities that will be required in the capital. The Greater London Authority (GLA) is undertaking further work to assess the implications of creating a strategic waste collection and disposal authority. (TfL) This builds on two previous pieces of work undertaken by the GLA and Association of London Government (ALG): ▪ a London model of municipal waste volumes and costs (GLA & ALG) ▪ identification of the potential spatial land-use requirements for waste facilities (GLA) Stage 1 of the Grand Union Canal Study was a survey to identify potential wharf sites and opportunities for waste, recyclables and construction materials. The work already undertaken in raising awareness of the potential for using the canal during the canal survey has already helped to initiate projects including the movement of 70,000 tons paper annum of cardboard from Park Royal to Maidenhead. This uses the section of canal between Park Royal and Slough where the load would be transferred to road. This equates to 8,750 lorry journeys saved (in and out) using 16 ton lorries. The return journey from Park Royal to Slough is 31 miles giving a total of 271,250 miles lorry miles saved per year. (TfL) Stage 2 of the Grand Union Canal study builds upon the first phase to identify volumes of commercial and industrial waste and other 'bulk' commodities suitable for transport along the canal and the anticipated volumes which could be transported now and in the future (using projections identified within the London Plan and other studies). For each commodity outline proposals are to be developed and costed for its movement by water. (TfL)
UK – 02	England and Wales	Sustainable Transport Resources and Waste Project, STRAW	The STRAW project was funded by BIFFA from the proportion of the landfill tax that they can reallocate to research and initiatives. It is primarily focused on looking to build sustainable multi modal reverse logistics solutions within a local and regional framework. A project to demonstrate the environmental and economic benefits to England and Wales of a multi-modal mass balance approach to the transport of waste and recyclable material. The Sustainable Transport Resources and Waste Project offers the opportunity to think strategically about the scale and location of waste management and reprocessing infrastructure, while optimising transport of materials between facilities and regions using rail,

Code	City/Region	Name of concept	Short description of concept
			inland waterways and coastal options. The project is a combination of strategic 'Blue Sky' visioning with practical assessment of intermodal transportation of waste in terms of: • What can be achieved? • How can it be achieved? • Over what time period? • At what cost? The partners are a mixture of government departments and agencies, industrial partners and sustainable technology bodies. The project will deliver the following: ▪ A review of the current waste transportation infrastructure; ▪ Identification of barriers to alternative waste transport modes; ▪ The projected waste and recyclable materials flows to 2020; ▪ Integration with other projects from the Biffaward Programme on Sustainable ▪ Resource Use; ▪ Review of current European and International Best practice; ▪ Life-Cycle Assessment of a regional Case Study to demonstrate environmental and economic benefits; ▪ Development of Best Practice guidance for Intermodal Waste Transport; and ▪ Development of Planning Guidance for Intermodal Waste Transport.