Best Practice Handbook Year (2005)

Theme 1: Waste transport and logistics in urban areas
Theme 2: Experiments and incentives for environment-friendly vehicles

Public

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1 Introduction

1.1 The BESTUFS Thematic Network and need for action

More than 80% of today’s road freight trips in European conurbations are of 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 in terms of the supply of goods or economic importance there are also negative impacts appear such as 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

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 thematic network 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 II is a project that is relevant to all of these objectives, even though it is submitted to the City Logistics call under the fourth objective, “Increasing road, rail and waterborne safety and avoiding traffic congestion”.

BESTUFS II is a follow-up initiative of the thematic network BESTUFS and 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 II 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 II 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 the BESTUFS project the follow-up initiative of BESTUFS II 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.

The general idea behind a “Coordination Action”, to encourage the cooperation 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.

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 II aim to broaden the existing BESTUFS network to include medium sized urban areas in Europe including those in the New Member States.

The work of BESTUFS II-network 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 the BESTUFS II-network 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:
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.

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
1.2 Relation to previous and running activities concerning urban freight

1.2.1 Global level

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].

The Institute for City Logistics (ICL) was established at Kyoto, Japan in 1999. 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 makes 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 performs activities related to City Logistics and urban freight transport, including [Taniguchi et al 2003]:

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

1.2.2 European level

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

- COST 355: Changing behaviour towards a more sustainable transport system (2004 on)

COST 321 especially provided important base material, information and results as an input for the further activities in the BESTUF$S$ 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 BESTUF$S$ TN can be seen as a follow up and continuation of the COST 321 project.

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 BESTUF$S$ project during a clustering process considering urban goods transport themes as freight centres, traffic access restrictions etc. For more information see www.cordis.lu.

Besides BESTUF$S$ 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.
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.

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

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

At a 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, Aalborg, Arhus), Germany (COST 321) and the Netherlands (COST 321) have been active in urban goods transport issues. However, the concerns and also the activities differ very much between the cities within a country.
In introduction

Identified themes within the BESTUFS workshops

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

Identified themes within the BESTUFS II workshops

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

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

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.

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

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

each topic 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:

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2 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.

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**

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 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.

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.

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).
In recent years a liberalisation in waste sector took place. In The Netherlands, for 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 has become increasingly 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 is used to deal with waste problems. “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 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 reflows 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

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.

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

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

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

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).
   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. ADR¹, RID²).

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.


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

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 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

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.
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 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.

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 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 logistics which causes goods and information to flow in the opposite direction to normal logistics activities. The following processes are part of the waste disposal logistics:

- Collection
- Transportation
- Transhipment
- Storage

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

Within urban areas the transport of waste is a necessity, which also contributes to the overall levels of lorry traffic activity taking place. The BESTUF 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 environment 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
Waste transport logistics in urban areas

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

The 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. 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 important reason 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.

- Waste collection system is not working satisfactorily: 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 of waste problems in general and especially waste collection and transport: Generally speaking the waste logistics in former EU 15+ are well developed and big logistics 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. But there is still need to tackle the problem in the New Member States in Eastern Europe.

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3 A more detailed report on each country’s situation concerning road pricing and urban freight transport is given in Annex I.
- Planning processes/waste management: Generally speaking, waste management is included in planning. For example, in the 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.

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 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.

Several different approaches have been taken in 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). Noise is another important effect that often impacts negatively on the quality of life. In the 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 busy evening and night hours. On the other hand the processes of loading and unloading combined with driving noise from vehicle stops and starts leads to night-time disturbance. In this case the perceived noise is higher than the actual 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 for optimisation in waste
collection processes. But sometimes municipalities describe the organisation of waste collection that has to be carried out by private operators in tender documents. 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 often aim 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 use 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

In Bulgaria the waste areas is actually in an upheaval process. The
future oriented waste disposal system

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: privatisation in waste sector has started

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.

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.

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.

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.

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.

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.

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.

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.

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.

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 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)

Commercial waste was traditionally collected by commercial organisations, while municipal and household waste was collected by in-house direct labour organisations within the city government. In the 1980s municipal waste was outsourced on a competitive tendering basis. Nowadays some in-house operations still exist but have to be market tested. Traditionally waste has been shipped to landfill sites which were sometimes located substantial distances from the urban area in which the waste was collected.

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.

Use of alternatively-fulled vehicles and ITS systems have been used by some waste companies to help reduce environmental impacts and at the same time reduce vehicle operating costs.

3.3 Regarded case studies (project-level)

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 of the waste transport and logistics concepts and projects that have been identified have a 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.

To illustrate the experiences in the countries surveyed, several best practice examples in each country have been selected. Ideally they should show how waste transport logistics concepts in urban freight function, and provide some background information about 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

<table>
<thead>
<tr>
<th>Country</th>
<th>City/Region</th>
<th>Name of concept</th>
<th>Project Phase</th>
<th>Form of organisation</th>
<th>Main type of waste</th>
<th>Spatial extension</th>
<th>Degree of innovation</th>
<th>Relevance for BESTUFS</th>
</tr>
</thead>
<tbody>
<tr>
<td>AT – 01</td>
<td>Region of Oberösterreich, Steiermark, Vorarlberg</td>
<td>Potential of optimisation in waste disposal logistics</td>
<td>Planning and design</td>
<td>public</td>
<td>household</td>
<td>regional</td>
<td>high</td>
<td>High</td>
</tr>
<tr>
<td>AT – 02</td>
<td>Austria</td>
<td>CARGOtrade.net</td>
<td>stopped</td>
<td>private</td>
<td>household</td>
<td>regional</td>
<td>medium</td>
<td>high</td>
</tr>
<tr>
<td>BE – 01</td>
<td>Liege, Walloon region</td>
<td>Inland waterway urban transport of household waste</td>
<td>operation</td>
<td>public</td>
<td>household</td>
<td>regional</td>
<td>medium</td>
<td>high</td>
</tr>
<tr>
<td>BE – 02</td>
<td>Brussels</td>
<td>Future usage of inland waterway transport in household waste transport</td>
<td>planning and design</td>
<td>public</td>
<td>household</td>
<td>urban</td>
<td>medium</td>
<td>high</td>
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<td>CH – 01</td>
<td>Canton Thurgau</td>
<td>IES Integrales Entsorgungssystem</td>
<td>operation</td>
<td>public</td>
<td>household</td>
<td>regional</td>
<td>high</td>
<td>high</td>
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<tr>
<td>CH – 02</td>
<td>Canton Zurich</td>
<td>Optimisation of Waste Logistics / Recovered Paper Logistics - Guidelines for municipalities of the Canton Zurich</td>
<td>planning and design</td>
<td>public</td>
<td>household</td>
<td>urban</td>
<td>low</td>
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<tr>
<td>CH – 03</td>
<td>City of Zurich</td>
<td>Cargotram</td>
<td>operation</td>
<td>public</td>
<td>household</td>
<td>urban</td>
<td>high</td>
<td>High</td>
</tr>
<tr>
<td>DE – 01</td>
<td>Ulm</td>
<td>Waste container management RWE Umwelt Sued</td>
<td>operation</td>
<td>private</td>
<td>industrial</td>
<td>regional</td>
<td>high</td>
<td>high</td>
</tr>
<tr>
<td>DE – 02</td>
<td>German cities</td>
<td>OPTRANS</td>
<td>realisation</td>
<td>private</td>
<td>household</td>
<td>regional</td>
<td>high</td>
<td>High</td>
</tr>
<tr>
<td>DK – 01</td>
<td>All municipalities in Denmark</td>
<td>MiljoLogistik</td>
<td>operation</td>
<td>private</td>
<td>industrial</td>
<td>regional</td>
<td>medium</td>
<td>medium</td>
</tr>
<tr>
<td>FI – 01</td>
<td>Helsinki Metropolitan Area</td>
<td>PUZER XMIT</td>
<td>operation</td>
<td>private</td>
<td>household and industrial</td>
<td>urban</td>
<td>high</td>
<td>high</td>
</tr>
<tr>
<td>FI – 02</td>
<td>Finland (also urban areas)</td>
<td>MOLOK - Smart collection system for solid waste</td>
<td>realisation</td>
<td>private</td>
<td>household and industrial</td>
<td>urban</td>
<td>high</td>
<td>high</td>
</tr>
<tr>
<td>FR – 01</td>
<td>Lille</td>
<td>Lille municipal waste waterborne transport from Lille to Blaringhem</td>
<td>stopped (to be re-implemented)</td>
<td>ppp</td>
<td>household</td>
<td>urban</td>
<td>medium</td>
<td>high</td>
</tr>
<tr>
<td>FR – 02</td>
<td>263 municipalities from the eastern part of the Oise Department (Oise Vallee), 60 km North of Paris</td>
<td>VERDI (Valorisation Et Recyclage des Déchets en Intercommunauté)</td>
<td>operation</td>
<td>ppp</td>
<td>household</td>
<td>urban</td>
<td>medium</td>
<td>high</td>
</tr>
<tr>
<td>GR – 01</td>
<td>Kifissia</td>
<td>Waste transhipment and compresion</td>
<td>operation</td>
<td>public</td>
<td>household</td>
<td>urban</td>
<td>medium</td>
<td>high</td>
</tr>
<tr>
<td>GR – 02</td>
<td>Thessaloniki</td>
<td>Waste transhipment and compresion</td>
<td>operation</td>
<td>public</td>
<td>household</td>
<td>urban</td>
<td>medium</td>
<td>high</td>
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<tr>
<td>IRE- 01</td>
<td>Dublin Area</td>
<td>Glass collection</td>
<td>operation</td>
<td>private</td>
<td>household</td>
<td>urban</td>
<td>medium</td>
<td>medium</td>
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<tr>
<td>Country</td>
<td>City/Region</td>
<td>Name of concept</td>
<td>Project Phase</td>
<td>Form of organisation</td>
<td>Main type of waste</td>
<td>Spatial extension</td>
<td>Degree of innovation</td>
<td>Relevance for BESTUFS</td>
</tr>
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<tr>
<td>IT – 01</td>
<td>Rome</td>
<td>INTERMODAL SYSTEM, ROAD-RAILWAY FOR THE TRANSPORT OF WASTE – AMA (Environmental Municipal Company) Rome</td>
<td>operation</td>
<td>public</td>
<td>household</td>
<td>urban</td>
<td>medium</td>
<td>high</td>
</tr>
<tr>
<td>IT – 02</td>
<td>Rome and other Italian cities</td>
<td>Waste collection with environment-friendly vehicles</td>
<td>operation</td>
<td>public</td>
<td>household</td>
<td>urban</td>
<td>medium</td>
<td>high</td>
</tr>
<tr>
<td>NL – 01</td>
<td>Randstad Area</td>
<td>SHAFFRA Zuid-West (Shift in waste transport modality in the Randstad area – pilot South-West)</td>
<td>realisation</td>
<td>ppp</td>
<td>household and industrial</td>
<td>regional</td>
<td>medium</td>
<td>low</td>
</tr>
<tr>
<td>NL – 02</td>
<td>City centre of The Hague</td>
<td>De Schone Stad</td>
<td>operation</td>
<td>ppp</td>
<td>household and industrial</td>
<td>urban</td>
<td>medium</td>
<td>medium</td>
</tr>
<tr>
<td>UK – 01</td>
<td>London</td>
<td>LSDP</td>
<td>Planning and design</td>
<td>public</td>
<td>household</td>
<td>urban</td>
<td>medium</td>
<td>High</td>
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<tr>
<td>UK – 02</td>
<td>England and Wales</td>
<td>STRAW</td>
<td>Planning and design</td>
<td>ppp</td>
<td>household</td>
<td>regional</td>
<td>medium</td>
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</table>

(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 BESTUF, 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: 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
A 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 from 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)
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)

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Example 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.
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.

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

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 if 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

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See also References and contact persons!
Example 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

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

The project has proved its worth and will be continued.

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

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

See also References and contact persons!
Example 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 - actually 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

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See also References and contact persons!
Example 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…)

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

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

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See also References and contact persons!
3.4 Synthesis from the case studies

The amount of waste generated in the EU has risen over recent decades and is likely to continue rising. Especially in the New Member States the problem of waste is likely to become ever more important 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 the importance of this issue will increase.

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).

Many projects are in the first instance not directly concerned with 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 management has become an important issue in European countries. EU-regulations and national legislation spend a lot of efforts to reduce negative impacts from waste. They set thresholds for the proportion of waste to be recycled, they define waste operation processes 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 1990s 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

Nowadays in most European countries experts consider waste transport and logistics in their country to be important, but views vary about whether it is of high, average or low importance. However the future importance of waste transport logistics in various countries is likely to differ substantially. 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 will become more important in future. This is also a result of the current lack of standards in the newly associated countries. Only in Germany is waste transport seen as a task of high importance today and in the future.
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.

As seen from the project waste transport concepts using inland waterways and railway transport can be very successful. “Waste” products seem to be very suited to these modes. In the projects presented, 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

Several measures can be taken into account for the improvement of waste transport and logistics. As seen from the projects presented there are often existing single solutions but integrated logistics solutions are rather lacking. In future, the use of different solutions and strategies has to be taken into account, like for instance the combination of intermodal transport concepts and ITS-usage and environment-friendly vehicles for the waste collection. Furthermore, in addition to transport being influenced by new concepts and technologies, the location of landfill facilities should also 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.

The city authorities can play an active role in waste disposal and waste transport and logistics concepts. As seen in many countries, city authorities are in the first instance responsible for waste management, and therefore 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 opportunity 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 also taking social and environmental developments into account with a view on the future development of a city. Therefore cities should also be aware of creating a sustainable approach in waste management and waste transport in their cities.

The PM-10-discussion in Germany has shown that there is awareness of the avoidance of negative impacts of exhaust emissions from urban freight transport. In future, city logistics will become more important. New concepts and regulations will lead to an improvement in urban freight transport. Discussions in Germany have also taken new regulations for city access into account. Those discussions will also influence waste transport and logistics.
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.
4 Experiments and incentives in favour of environment-friendly vehicles and equipment

4.1 Introduction

Most European cities are confronted with problems regarding air- and noise-pollution and congestion caused by motorised road traffic. The development of urban logistics in the past decades even worsened that situation, due to increasing delivery activities in city centres. The nuisance caused by urban freight transport and the environmental problems are growing and becoming less and less acceptable. Shops and businesses suffer from the poor accessibility of the city, residents and shoppers experience the negative effects of the pollution caused by vehicles. The economic and environmental viability of cities are negatively affected by this present organisation of urban goods distribution.

Motorised traffic is the main source of air pollution in most European cities. The impact on energy-use and environment is significant. Road transport contributes considerably to continuing air quality problems. These problems include premature mortality, aggravation of respiratory and cardiovascular disease, aggravation of existing asthma, acute respiratory symptoms, chronic bronchitis, and decreased lung function. Numerous studies also link exhaust gases to increased incidence of lung cancer.

Another problem caused by road transport is noise which is especially a problem in urban areas. Noise will become increasingly dominant in the future. The sensibility regarding noise is continually rising. In case of urban freight transport noise is not only caused by driving activities but also from loading and unloading processes.

The high increase in fuel prices during the last months and the current dependence on oil makes a rethinking in the fuel usage strategy necessary. The pressure on prices has also started a debate not only now but also in former times to think about alternative sources for energy. The recent increase in energy prices has made clear that alternative solutions are asked more and more in future times. But not only technological developments in the propulsion technologies are asked but also the development of the filling station infrastructure for the alternative fuel supply.

Furthermore new logistics concepts that focus on the reduction of fuel consumption by using alternatives modes or by the organisation of more efficient logistics concepts by increasing the loading factor for examples will play a major important role in the future.
The Commission, in its Green Paper on the security of energy supply and in the White Paper on a common transport policy, suggests a target of 20% use of alternative fuels in road transport by 2020. Alternative fuels, on the whole, should provide:

- Improvement in security of energy supply, i.e. by source diversification and oil substitution
- Reduction of greenhouse gas emissions on the grounds of climate change concerns
- Reduction of other exhaust gas emissions (NOx, HCs)

In the Commission Communication on alternative fuels this suggestion was further developed, identifying three main candidates, focussing on alternative fuels that would have a market potential of substituting at least 5% of conventional motor fuels by 2020, in order to ensure a reasonable perspective for infrastructure and product development:

- Biofuels
- Natural gas
- Hydrogen

LPG (Liquefied Petroleum Gas) has also been considered beneficial.

Currently obstacles are given to use environment-friendly vehicles in city distribution and in general.

Transport companies have often the same arguments against the usage of environment-friendly vehicles:

- Vehicles with alternative propulsion systems are often too expensive and the international competition puts them under cost pressure.
- The benefits of using environment-friendly vehicles are not primary obvious.
- The reliability is often not proofed.
- Losses in loading capacity have to take into account (hybrid propulsion) or the maximum total driving distance with one tank filling is less than compared with traditional vehicles (electro and gas propulsion).

It is still a long way to convince companies and private persons of the viability of alternative propulsion vehicles. A further main problem is the density of the filling-station net. Most cities in Europe have quite a low dense net of alternative refilling possibilities. The acceptance of using alternative vehicle concepts may have a broader penetration if a high density can be guaranteed. And here is exactly the problem what is also called ‘penguin-effect’: because of uncertainties about market development, future
technology standards and praxis suitability of alternative propulsion systems no one (vehicle manufacturer, consumer, operators of secondary infrastructure) takes the initiative for a consequent introduction of alternative propulsion systems (RAPP, 1998). Therefore often public authorities are asked to promote the penetration of alternative propulsion system technologies by incentive or regulatory measures.

4.1.1 Definitions, classification and scope

Environment-friendly vehicles can be characterised by different indicators. The classification depends not only on the propulsion system, which is of course the main important factor to minimise negative impacts of road transport. There are more environment-friendly technologies that are suitable to reduce noise, pollution and congestion. The following aspects may be of importance for the classification of an environment-friendly vehicle and vehicle technology:

- **Alternative propulsion systems**: new ways in alternative propulsion systems are nothing new. There are a lot of future technologies that uses alternative fuels like LPG, CNG, Bio-Fuels or Hydrogen-based-Technology. As reaction to the future short run of oil resources new sources will gain more and more importance. Renewable energy is a keyword for future sustainable mobility. New future-oriented propulsion technologies and fuels already exist and have delivered evidence that they can be operated environment-friendly and economically efficient, but a market penetration has not taken place.

- **Classical propulsion technologies leading to a reduction of fuel consumption and exhaust gas emission**: There are a lot of discussions, whether alternative fuels will be the panacea against conventional fuels or not. In the automobile industry exists meanwhile a lot of car concepts that have very low fuel consumption (the 3-litre car) and less emissions (like for example the new diesel-technology developed by French car manufacturers). The energy balance in comparison between alternative and conventional propulsion systems from the extraction to the production and emission of exhaust gas is a point often discussed and yet not finally answered. In context with this best practice theme also low-consumption and low-emission cars will be considered as environment-friendly vehicle concepts. In context with freight transport the classification of vehicles regarding EURO-Norm-emission standards (EURO I – IV) can be of relevance. Besides the EURO-classification also other graduations regarding the environment-friendliness can be made depending on the classification scheme and objective.

- **Vehicle technologies that support noise reduction**: Not only exhaust gas
emission, but also noise emission can impact negatively the quality of life in urban areas and environment. Besides technologies that reduce exhaust gas emissions, technologies that reduce noise emissions are of interest too. Especially electric vehicles are suitable to reduce noise emission and besides no exhaust gas emissions are given (Zero-Emission-Vehicles). But also automatically loading ramps can reduce noise caused by loading and unloading processes. Another measures in car technology that supports the reduction of noise are shielded engines.

- **Environment-friendly vehicle and loading equipment** can also contribute to lower emissions and fuel consumption by improving the loading capacity usage. A better usage of loading space can reduce vehicle mileage and can by this have positive impacts on the urban environment. Technical equipment that can be of relevance are container technology, trailer design or hold design.

**Weight and truck size** can also effect exhaust gas and noise emission in freight transport. Changing the gross vehicle weights (GVW) of heavy duty trucks impacts not only the size of engine required to pull the truck but also the emissions associated with that truck. Allowing heavier trucks means more freight can be carried per trip thus reducing the number of truck-trips necessary to carry a given amount of freight. In addition, as the weight of the trucks increases the emissions per truck mile travelled tend to increase but as the total number of trips decreases, the total emissions of pollutants (carbon monoxide (CO), NOx, particulates, etc) into the environment decreases. With increased weight also come increased emissions on a per trip basis. The emission rate for heavy duty diesel engines tends to follow more directly the horsepower requirements of the engine as opposed to the load being pulled.

**Alternative motor fuels** have the technical potential to gain significant market share within the next decades, even exceeding the 20% substitution target suggested by the Commission for 2020. Despite the fact that the present generation of electric vehicles is still not perfectly developed, they proved to be more energy efficient than ICE (Internal Combustion Engine) vehicles. This is partially due to their ability in using regenerated energy from braking, but also the much higher energy-efficiency of the electric engine plays an important role, as well as the complete absence of energy use during stops. Operating hybrid and electric vehicles in urban distribution has to be combined with a urban distribution centre based approach. For battery electric vehicles, an urban distribution centre near the city-centre with ‘home-recharging’ equipment is necessary. For hybrid electric vehicles, the urban distribution centre may be located further away from the city, but at a reasonable distance (ELCIDIS, 1998-2002, Brussels). Electric vehicles offer a clean and energy-efficient alternative to vehicles with an internal combustion engine. In congested urban traffic, the varying demand for power can be met more energy-efficiently by an electric motor. Battery electric vehicles have a range of around 80 km, making them very suitable for trips...
within urban areas. These vehicles are particularly suitable for use in urban distribution activities, where vehicles only run daily routes and can be recharged overnight. In general, urban distribution vehicles cover a daily distance of also around 80 km, meaning that the range of electric vehicles is sufficient for the delivery of parcels and packages in urban areas. Besides that, urban distribution vehicles make up to more than a hundred stops a day, for such use an electric motor provides the power for stop-and-go traffic much more efficiently than an internal combustion engine. Due to the large battery weight, there are no electric vehicles with a payload of more than 1500 kg on the market. For companies planning to use clean urban distribution vehicles with a payload of over 1500 kg, hybrid electric vehicles are an alternative. Hybrid electric vehicles are equipped with an internal combustion engine and an electric motor, enabling them to drive in the electric mode over short distances, in particular suitable for city centres. In this respect, they are able to combine the advantages of local clean transport with a high(er) payload and a large range.

**Internal Combustion Engine (ICE):** The common internal combustion car engine is extremely inefficient in its use of energy. Only 13% of the energy produced by the engine is used in forward motion - 62% of the energy is wasted because the engine has to be powerful enough to cope with maximum demand even though this is required for only a very small proportion of the vehicle's operating time (www.ecologicalhomes.com).

**Alternative-Fuel Vehicles (AFVs)** are as defined by the Energy Policy Act, any dedicated, flexible-fueled, or dual-fueled vehicle designed to operate on at least one alternative fuel.

**LPG (Liquefied Petroleum Gas)** is an established alternative motor vehicle fuel with scope for additional market share, possibly up to 5% by 2010. LPG, however, may compete with CNG for additional market share unless targeted to different segments. The potential of LPG for improving security of energy supply and reducing greenhouse gas emissions should be assessed under the same conditions as the other recognised alternative fuels, including the perspective of future market and technology developments.

**CNG (Compressed Natural Gas):** Natural gas as a motor vehicle fuel has a clear CO2 advantage over gasoline and is comparable to diesel today. In future, the advantage of natural gas vehicles is expected to surpass diesel. With 2010 technology, natural gas vehicles are projected to have 16% lower CO2 emissions compared with gasoline vehicles and 13% lower CO2 emissions compared with diesel vehicles. The inherently lower greenhouse gas intensity of natural gas vehicles could be further exploited by optimised engine technology and new concepts for heavy-duty engines. Natural gas vehicles today have advantages for local air quality, comparable to projected future improvements of emissions of diesel vehicles, in particular as regards particulate emissions. A main driving force for the large-scale introduction of natural gas as motor fuel is concern for the security of supply for the transport sector currently solely dependent on oil products. The potential in
market share of natural gas as a motor fuel would not be limited by primary supply to the 10% envisaged in the Alternative Fuels Communication for 2020. The potential market share of natural gas as a motor fuel is not limited by primary supply. A share of 10% in road transport by 2020 would only represent about 5% of the total gas demand in the EU expected by that time.

Expansion of the re-fuelling infrastructure and of captive fleets from ongoing programmes should minimise costs in the transition period. Natural gas could gain a broader market share if supported by long-term tax and excise duty advantages, providing stable conditions until a broad market has developed. Mature vehicle technology is available, but diversity of products and services still need to be improved. Further efforts in research and development should support additional improvements in the technology.

In the early stages, fleet and local markets, such as urban transport, offer the potential for high utilisation of refuelling stations, providing the revenue to sustain further investment and expansion of the network. To the extent that natural gas substitutes diesel, this also relieves the refinery balance in Europe, already stretched by a surplus production of gasoline relative to diesel (AFCG, 2003).

**Bio-fuel-technology (Biomass-to-Liquid (BTL))** offers a low-CO2 emission fuel due to the biological origin of the carbon in the gas. Raw materials can either be waste (animal manure, waste water treatment sludge, etc.) or energy crops turned into methane rather than into other fuels. Production cost of biogas depends on circumstances, but is normally higher than natural gas. Biogas qualifies to meet requirements under the biofuels directive (targeting 2% market share by 2005, increasing to 5.75% by 2010). The technical feasibility of using biogas has been demonstrated in Sweden, where 4000 vehicles (as of the end of 2003) operate on biogas.

**Electric vehicles:** Electric vehicles provide both positive effects: less pollution and low noise emission. This power for electric propulsion technology is generated by batteries.

**Hybrid-electric-vehicles technology (HEV)** combines an IC engine and an electric motor with battery as torque generators. Throughout the motored vehicle evolution, there have always been concept and prototype cars combining the advantages of two different propulsion systems, which include a second power source and energy storage device to supplement the fuel tank. The co-axial adjustment of electric machine and ICE allows a vehicle drive by both, separately or in combination. High efficiency can be realized with split HEV, a concept which combines the serial and the parallel system. The ICE power can be used for both, vehicle and electric alternator drive. The potential for fuel saving is given by start-stop functionality, optimized engine operation, brake energy recovery and electric drive. There are several motivations for hybrid electric vehicles, but the main drivers are given by environmental aspects, especially fuel consumption and CO2-reduction.
**Hydrogen-based (fuel cell) technology**: Hydrogen is a potential future main energy carrier. Due to its broad feedstock flexibility it could considerably broaden the energy supply base of the transport sector. Hydrogen offers the long-term potential for full reliance on renewables. Hydrogen does not exist in free form but only chemically bound in molecules such as water or hydrocarbons. Energy input serves to split these compound molecules and produce pure hydrogen molecules. Energy is then released again in chemical reactions of hydrogen with oxygen to water. This energy conversion process through production and re-combination of hydrogen molecules is conceptually analogous to electricity production from primary energy sources and subsequent consumption in electrical applications, with the electrons being the energy carrier there. Hydrogen can readily be produced in industrial scale either from fossil energy resources, such as natural gas through reforming and coal through gasification, or with electricity through electrolysis of water. The key factors in all these processes are cost of the energy input and the efficiency of energy conversion. Hydrogen production from biomass gasification could offer the most efficient pathway from renewable resources. Other ways of producing hydrogen, such as bio production by algae and bacteria and high-temperature direct water splitting in solar thermal plants or co-production power plants are still in early stages of research. The choice of production pathways will be essential to minimise GHG emissions and energy use (AFCG, 2003).

The main drawback for Hydrogen powered cars at the moment is the expensive and energy intensive process involved in creating the liquid Hydrogen. In addition, existing gas stations will need to be fitted with liquid Hydrogen pumps & storage vessels what leads to high investment costs.

**Fuel cell electrics** are vehicles that use an electric motor like a battery electric, but instead of batteries, power is provided by a fuel cell. A fuel cell is an electro-chemical device that produces electricity from the chemical interaction of hydrogen and oxygen. Hydrogen gas and oxygen gas (from ambient air) are brought together after traversing a membrane. The by-products of the reaction are electricity, pure water, and heat. Performance characteristics are similar to those of electric vehicles. Experts worldwide view fuel cells as the best eventual replacement for the ICE!

**Advantages of Hydrogen Fuel Cell Cars:**
- zero-emissions when hydrogen is used as the fuel
- quiet; low operating costs (similar to EV's);
- extreme efficient (90% compared to 30% for gas engines), although under load the efficiency decreases to 40 - 50%.

**Disadvantages of Hydrogen Fuel Cell Cars:**
- relatively new technology - not yet consumer available
Experiments and incentives in favour of environment-friendly vehicles and equipment

- Storage methods (see below) still being developed, although high pressure CNG cylinders are long tested and proven extremely safe and reliable, as well as inexpensive;
- Refuelling infrastructure not yet in place

**EURO-Norm**: The EURO-Norm describes the emission standards for vehicles set by the European Union. Motor vehicle emissions are regulated by Directive 70/220/EEC (passenger cars, light vehicles) and 88/77/EC (heavy vehicles). Amendments to those directives tightened the EURO limit values stepwise. Since the early 1990s, the EURO emission standards for passenger cars and other vehicles have initiated a significant reduction in air pollution per driven kilometre. The European Commission will propose a new emission standard in Spring 2005. It is likely to enter into force in 2010. The agreement on a standard is important for the EU Member States to create an incentive for clean vehicles, i.e. through differentiated vehicle taxation or road tolls.

### 4.1.2 General framework conditions

The European Union but also national authorities are aiming to increase the share of environment-friendly vehicles. This is also the result of global activities to reduce greenhouse gas emissions. As mentioned the Commission, in its Green Paper on the security of energy supply and in the White Paper on a common transport policy, suggests a target of 20% use of alternative fuels in road transport by 2020.

With particular regard to the objectives of the Kyoto Protocol, various transport strategies geared towards the reduction of greenhouse gases have been drafted. The Community strategy to reduce CO2 emissions from passenger cars was created in 1995 in order to reduce emissions of CO2 within the transport sector (European Commission, 1995). By implementing various measures, the CO2 strategy hopes to reduce CO2 emissions to 120 g/km by 2005 (by 2010 at the latest). In a bid to ensure that the objectives of the CO2 strategy are achieved, voluntary agreements have been made with car manufacturers aimed at reducing CO2 emissions from new cars to an average 140 g/km by 2008 or 2009 (depending on the respective association of manufacturers). One of the targets set in the EU Transport White Paper (EC, 2001) is the gradual reduction of the transport sector’s dependence on oil, thereby contributing to the achievement of the objectives of the Kyoto Protocol. The EU Directive on the promotion of the use of bio-fuels or other renewable fuels for transport of 8 May 2003 was introduced to promote and ensure the use of bio-fuels in the transport sector.

EU Directive 2001/81/EC on National Emission Ceilings (NEC Directive) for certain atmospheric pollutants is also of major significance. The Directive
sets a target of 103 000 tonnes for national emissions of nitrogen oxide (NOx) by 2010. Total emissions in 2001 came to around 199 400 tonnes, of which around 134 000 tonnes were accounted for by the transport sector. Whether this objective can be achieved is thus very much dependent on the reduction of NOx emissions in the transport sector.

The European Bio-fuel Directive (Directive 2003/30/EC), which came into force at the beginning of May 2003, sets out the provisions for the promotion of the use of bio-fuels or other renewable fuels for transport. The full implementation of the EU bio-fuels Directive (5.75%) could reduce greenhouse gas emissions by up to 1.0 million t CO2 equivalent per year. This would correspond to approximately 5% of the current greenhouse gas emissions from the transport sector.

Analyses show that in order to be able to transpose the bio-fuels Directive in the transport sector, it will be necessary to blend higher proportions of bio-fuels (than planned in the “National indicative targets for the minimum proportion of bio-fuels and other renewable fuels”) or market them in a pure form. A higher blending rate would require the construction of a separate infrastructure. For higher blending rates or as unmixed bio-fuel, bio-diesel is a good solution because ethanol (from 10% blending) requires engine technology to be adapted, whereas bio-diesel can be used in existing fleets. The best place to use fuels with high blending rates or unmixed bio-fuels is in vehicle fleets. An analysis shows that both in road transport and in the off-road sector, there is a considerable potential for using bio-diesel.

4.2 Country overview

In the following we give a very brief summary on the national situation in the various countries. A more detailed description the theme experiments and incentives in favour of EFV and equipment in various countries can be found in ANNEX 1.

During the 1990s Germany, the Netherlands and Switzerland among other countries carried out a number of pilot projects concerning alternative models for distribution in city centres - known as city logistics. In the late 1990ies also the usage of EFV has been considered to be implemented in the city distribution concepts. Today the usage of EFV or other innovative concepts with the objective to reduce negative environmental effects from urban freight transport are especially known in Western European countries. Those countries have supported environmental projects and concepts. The primary objective is to create transport solutions to the benefit of the city environment in terms of road safety, air and noise pollution, accessibility, energy consumption, safety and the visual environment. The supports and
incentives have been on the one hand financial sponsoring of concepts but also the investment in research projects and often an informal PPP, creating dialog between municipal authorities, transport business and shop owners in the city. Together those parties have set up some interesting projects.

The main general framework conditions that exist in various countries are based on the general EU objectives. To reach the sustainable and environmental objectives of the EU the Member countries have in parallel addressed those objectives to their national legacy. Most countries have adopted EU-regulations and have adjusted their laws or defined new ones that meet the required thresholds and objectives of a common European environment-friendly policy.

But it has also to be mentioned that none of these regulations addresses directly the topic environmental standards in urban freight transport. The activities that have been initiated in urban freight transport with focus on EFV-usage in city logistics are of course a result of the EU and national legislation what can not be neglected. In most countries a lot of efforts have been spent on the development of environment-friendly vehicle concepts and technology, but not directly with focus on urban freight transport.

Nevertheless those research and project initiatives will influence in future also the urban freight domain. For example general development and operation of EFV (for example in public transport or for private usage) also support the build up of a filling station net that of course is also usable for freight transport.

The current discussion of PM-10 has also started a new debate of the usage of more environment-friendly vehicles in some countries. In Germany a fruitful dialog has started.

In eastern European countries there are no trials, demonstration projects or concepts with focus on the usage of EFV or new technologies in urban freight transport. This is mostly reasoned by financial budgets that are often smaller compared to Western European countries. Nevertheless most countries have adopted and translated EU regulations in national laws. Those environmental standards are often directly transferred in environmental programmes and initiatives. Also tax reduction for the usage of alternative fuels is known, but as already mentioned no usage of EFV in urban freight transport activities is known. In some countries (cities) there are EFV used in public transportation. Municipalities have supported the usage of alternative fuels in public transportation. Also in case of private car usage alternative fuels become more of interest.

The usage of EFVs in urban freight transport has mostly been addressed in Western European countries. In countries like the Netherlands, Germany,
Denmark, the UK, Finland and others the national and municipal authorities have started to support the usage of environment-friendly vehicles in urban freight distribution. Political authorities have recognised that a need of EFV and environment-friendly technologies can deliver a contribution to a better quality of live also in urban freight transport.

The main efforts for reducing environmental impacts by urban freight transport are based on the strategy of sustainability. Nearly all countries have started programmes and projects to reach sustainable objectives according to the Kyoto Protocol. This is valid for Western European countries but also for Eastern European countries.

A further motivation for the set up of distribution concepts with EFV are living conditions in inner urban areas. Because of increase in road transport in all European cities the impacts have grown dramatically. Exhaust emissions but also noise emissions reduce the quality of live in urban areas. Municipalities became and become aware of those problems and started to reduce those impacts by new logistics concepts also taking into account the usage of EFV (e.g. Osaka (JP) or Copenhagen (DK)).

For private operators the costs are a main argument for the usage of EFV. If operators take part in new city logistics concepts that are often realised as trials or if they aim to carry out the distribution by EFV they want in the first line benefit from economical profits. Only if the cost situation can be improved the usage of EFV is an opportunity for them. Another argument for using of EFV of course can also be marketing effects: if it is made public that an operator uses EFV it can of course gain higher sales effects. It can beyond show that an operator is involved in future-oriented research concepts, that he acts innovative and sustainable and cares for his and others environment.

National but also municipal authorities have initiated research programmes and projects to encourage the use of EFV in the field of urban freight transport and logistics. In France the National Program on Goods in Cities (Programme National Marchandises en Ville) has developed and promoted research projects in co-operation with transport operators, the electricity (EDF Electricite de France) and gas (GDF Gaz de France) supplier. Within the program “Cleaner Vehicles” the national government has given financial support for research activities. Switzerland has taken part in the EU research project IDIOMA which has been financed by the Swiss Federal Office for Research and Education (SBF).

Most national research activities are not with direct focus on the usage of EFV within urban freight transport and logistics but more general with focus on propulsion and vehicle technologies. E.g. in Austria a lot of research activities have been carried out in connection with EFV but more with focus on technology. In Ireland the “Sustainable Energy Ireland” has funded research activities with focus on renewable energy like recovering of bio-
fuels.

Also in those countries where car manufacturer are located like France or Germany the private automotive industry is developing research projects with focus on environment-friendly vehicle technologies, but also on a more general level (private car usage).

Incentives

The promotion and usage of EFV in urban freight transport (but not only with focus on urban freight) is fostered by several incentives municipalities and national political authorities have used and uses:

The support measures that have been mainly used are:

- Informal PPP: creating a dialog and setting up a common concept. Within those dialog the municipal authorities, transport operators and/or shop owners came together to set up a sustainable solution to a more environment-friendly form of urban freight transport like for example the following concepts:
  - The PIEK- and DEMO-programme (NL)
  - OPTRANS research project (DE)
  - Environmental zone scheme (DK)

- Tax reduction for the usage of alternative fuels (mineral oil tax) or for the usage of EFV (vehicle tax)

- Private concepts of logistics operators are also known that have initiated the usage of EFV in their city distribution. Often those concepts are also part of research projects co-funded by public authorities, but not always:
  - Hermes Versand Service (DE)
  - La Petite Reine (FR)

- Tax reduction for the usage of modern filter technology

- Permissions for access to special areas like shopping areas, business districts etc. for vehicles with lower emissions (city access schemes) like
  - the Danish trial in Copenhagen

- Road pricing schemes that takes into account the emission category of heavy goods vehicles (EURO-norm) like
  - The London Congestion Charge
  - the Heavy Vehicle Fee (LSVA) in Switzerland

- Funding of innovative research projects and trials in the field of urban freight transport by using EFV
  - Programme National Marchandises en Ville (France)
  - “Green truck experiment” under financial support of the
Main problems and failure factors

One failure factor for the set up of environment-friendly distribution and logistics concepts in urban areas are higher investment and maintenance costs caused by the usage of EFV (like the concept of the city of Malaga/Spain). Especially for countries and municipalities where the financial budgets are narrow there is often no possibility to fund innovative environment-friendly projects with focus on EFV in city distribution. In Bulgaria for example the barriers to the introduction of cleaner vehicles and alternative fuels are high capital and life-time costs and a lack of refuelling infrastructure.

The network of filling stations for alternative propelled vehicles is in most countries one of the main problem. This problem can also be described with the “hen–egg-problem”: if the infrastructure is not given the sale and promotion of EFV is quite difficult. On the other hand if there is no demand for EFV because of higher costs or other barriers an infrastructure net of filling stations will not be build up.

A special problem in case of electric vehicles is the short mileage provided by one charging battery and the weight of those batteries.

In the following a **general short overview** about the situation in different countries is given:

Austria: much efforts, but not with focus on urban freight transport

There have always been efforts to further develop alternative fuel systems, which was driven by the automotive companies and supported by the state. But there is no special focus on urban freight transport. The more general aim is to increase the number of alternative powered vehicles; especially in individual transport and public transport (e.g. bus fleets). The project “Clean City Traffic Austria” has shown that alternative concepts (in this case NGV-usage) can lead to lower operational yearly costs, less emissions and a higher distance reach.

Belgium: no focus on urban freight transport

Belgium shows a high interest to support alternative fuel vehicles and set up a strategy for complying with the international standards set out in Kyoto. Tax incentives and promotion activities like a «CO2 guide» support the usage of EFV. Nevertheless the focus of the Belgian policy is on private passenger car usage and public passenger transportation. Trials, projects and demonstration projects in the field of urban freight transport are missing.

Czech Republic: no incentive programme exist

In general, Czech public authorities support environment-friendly vehicle usage, proclaiming programs and adopting measures. In fact, financial
support is addressed to the public passenger transport, it means to bus operators. The Czech government adopted “Assistance program for alternative fuels in transport – Natural gas” in May 2005. The goal is to substitute 20-23% of conventional fuels with alternative fuels by year 2020.

Up to now no incentive programmes for the usage of environment-friendly vehicles exist.

Bulgaria: No incentive activities

There were on freight specific activities concerning EFV identified. Main focus of activities in Bulgaria is on the development of public passenger transport network and the vehicles used in this system. However Bulgarian universities and manufacturers take part in research and development of hybrid compulsion, filter systems etc. that can also be applied in freight vehicles.

Denmark: Incentives for EFV as 'side effects' of city logistic experiments

During the 1990s Denmark mainly carried out theoretical analyses and research projects concerning city logistics. Exploration of solutions and testing of alternative models in city distribution led three Danish municipalities - Aalborg, Aarhus and Copenhagen - to prepare a joint programme for the development of goods transport in city areas. The 3 experiments undertaken in these cities follow distinct approaches, all of them focused on general city centre delivery schemes (loading zones, lorry capacity utilisation etc.). Only the Copenhagen city access certificates model privileges electric and hybrid vehicles. For deliveries in the city centre with such vehicles the obligation to fulfil minimum vehicle age, capacity usage etc. is inapplicable.

Estonia: no projects in urban freight transport

The Estonian Environmental Strategy, elaborated in 1996, identifies the principal environmental problems in Estonia, establishes short-term and long-term objectives and activities to tackle these problems and proposes economic and institutional reforms in environmental management. The Strategy declares that in the near future, the quality of air in the towns and the health of people will highly depend on the number of vehicles, regulation of traffic and the quality of fuel. Within the urban freight domain no projects and concepts in favour of EFV do exist.

Finland: low importance because of low environmental problems

The awareness for environment-friendly vehicles is still low. Low level of air pollution together with modest congestion has not given impetus for major actions. However, in the future increasing oil prices may increase the interest. The development of alternative fuels has been more complicated and no commercial activities in urban freight transport exist. However, various research projects on alternative fuels have been carried out.
The freight sector, so far, is the least concerned with EFVs (with the exception of La Poste). There are very few EFVs in circulation today. But compared to other countries many trials and projects have been carried out and the political authorities support measures and concepts of EFV in urban freight transport.

In the recent past, the main incentive for developing environmentally freight vehicles has been the ELCIDIS European program, which has helped La Rochelle in developing a large scale experiment (this project and its results are detailed as one of the projects presented in the last section) and the National Program on Goods in Cities (Programme National Marchandises en Ville), which has cooperated with operators and with Electricite de France and Gaz de France to develop some experiments of electric and CNG delivery vehicles in French cities.

Alternatively propelled vehicles will become of more importance in the future as administrations have to take care and guarantee high air quality standards in the future. In Germany a lot of efforts have been made to support the usage of alternative fuels. The current discussion is about the reduction of PM-10 within the inner-urban areas which has also started a new debate on city-logistics and also on the usage of environment-friendly alternatives in city areas. Also the increase in fuel prices has started a new discussion to use environment-friendly vehicles, but not only with focus on urban freight but more in general.

There are no projects in the field of urban freight transport. The only measure promoting urban freight transport by using EFV is an access restriction measure. In order to reduce SMOG, light trucks and vans using diesel are forbidden to enter the cities of Athens and Thessalonica.

The current plans for environment-friendly vehicles do not focus on freight transport. The general plans concern the production of bio fuels in Greece and the elimination of taxes for the environment-friendly fuels and vehicles. These measures are expected to affect freight transport too.

In Hungary the awareness to reduce environmental pollution is very high. The regulations set by the national policy are in accordance with the EU legislation and political authorities have set targets to support a reduction of pollution. Also research activities within the field of vehicle technology have been carried out. But nevertheless the usage of EFV in the field of urban freight transport is not known.

While there is recently a welcome awareness at political level of the need to encourage EFVs, the activities on the ground are still on a pilot scale. It is

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<th>Country</th>
<th>Summary</th>
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<tr>
<td>France</td>
<td>A lot of efforts and support</td>
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<tr>
<td>Germany</td>
<td>EFV will gain more importance in future</td>
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<tr>
<td>Greece</td>
<td>EFV only in public transport</td>
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<tr>
<td>Hungary</td>
<td>No usage of EFV in urban freight transport</td>
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<tr>
<td>Ireland</td>
<td>A lot of efforts in bio-fuel-</td>
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hoped that the Irish Bio-fuels programme will grow substantially and that excise relief will be more widely available to encourage a major expansion of the supply. Significant excise and tax incentives would be needed to encourage the Irish market for LPG and for CNG because the price differentials with conventional fuels are too low.

Experiments and incentives in favour of environment-friendly vehicles and equipment in Italy were definitely not diffused till 1990. Nowadays at national and local level some steps have been done, and the trend is in the direction of a growing interest.

Official Lithuanian bodies are aware of the call for action. Only a programme for fostering bio fuels is foreseen. The statute agreed on foresees supporting measures (of financial nature) for producers and users of bio fuels. It is a result of the treaty of Lithuania’s accession to the EU, where it was agreed to increase the share of bio fuels to 5.75% by 2010. So far, hardly any freight vehicles are equipped with bio fuel compulsion. Just minimal EU standards (EURO 1 to 3) take effect besides this program. There are no other measures, programmes or experiments in favour of environment-friendly goods vehicles.

Many municipalities are increasingly confronted with bad environmental conditions due to high exhaust gas and noise emissions, even in less densely populated areas that have not been considered problem areas before.

At national level policies have been defined to develop and stimulate cleaner and safer vehicles. The noise emissions are treated in the PIEK (Eng: PEAK, means peak noise levels, in contrast to continuous noise levels) programme. The DEMO project was targeted at removing barriers that includes the market introduction of cleaner and more efficient vehicles. The program contains vehicle concepts, knowledge transfer projects and the platform Cleaner Vehicles.

Based on the success of PEAK and DEMO the awareness for these kinds of initiatives has grown.

Today the use of EFV in urban freight transport is not very widespread. Main EFVs are used in the field of public transport or private car usage.

There are given approaches and policy actions to foster the usage of alternative fuels but still starting. There is an existing filling station network for LPG and CNG: LPG fuel is used mainly by passenger cars, whereas
CNG is typical for bus transport, especially for urban bus transport in bigger cities. The CNG filling stations network includes 6 distributing places/stations (Bratislava, Nitra, Zvolen, Poprad, Košice, Michalovce).

Examples for the usage of alternative fuels in freight transport are not known so far in Slovakia.

Slovenia: no EFV-usage in freight transport

Slovenia has not as many problems with congestion as other cities in Europe and also quality of air is less critical. Therefore EFV are not so widespread until now, but research activities have started especially with focus on equipment and technology. In the area of urban freight transport no examples of the usage of EFV are known, most examples are in the field of public transport (electric busses).

South-Africa: a policy towards EFV

The South-African policy has recognised the problem of energy consumptions and environmental impacts from transport industry. Several energy programmes and initiatives have been started. But currently there is no focus on urban freight transport. The energy and transport strategy has more a general approach to all vehicles.

Spain: nearly no EFV-usage in freight transport

There are a lot of efforts to reduce negative impacts from transport in urban areas, but most projects regarding the usage of EFV are focussed on public transport. There is only one project that tried to improve the environmental situation with in the city of Malaga by using EFV but this project failed because of higher costs for transport operators by using EFV.

UK: key incentives and programmes for EFV

The UK Government has been supporting the development and use of environmentally friendly vehicles for many years. It has had grant programmes in place for more than decade to provide support to the developers of demonstration models of clean, low carbon vehicles and technologies and to assist vehicle operators in purchasing emission reduction equipment and new electric, hybrid and gas powered vehicles.

4.3 Regarded case studies (project-level)

28 projects from have been collected that have been assessed as valuable to show the usage of EFV and innovative other technologies in urban freight transport. ANNEX II gives a detailed and summarised description of all collected projects.
The projects differ in respect to their objectives, financial support and technologies.

The focus of projects has been mainly on distribution and logistics concepts in combination with the usage of EFV. Main objectives behind those projects are environmental reasons (quality of live in urban areas) or/and the delivery situation within the cities that encourage political authorities as well as private parties to start rethinking the logistics strategy.

EFV can not seen as an alone standing solution but the combination of reorganisation of logistics concepts and the usage of alternative propelled vehicles have been initiated. Examples for municipal logistics concepts with public support of EFV have been for example:

- City gods (Copenhagen), effective freight transport in Aalborg and Aarhus (all projects DK - 01/02/03)
- EL CIDIS in La Rochelle (FR - 01)
- CUDE project Malaga (ES - 01)
- Distribution concept in Osaka (JP - 01)

Most projects have been built up in PPP. Municipalities and private transport operators as well as private shop owners have started to optimise city logistics concepts.

Besides a voluntary intention to improve the delivery and environmental situation also projects forced by new regulations setting more narrow emission limits have been set up. In the Dutch PIEK-programme (NL – 01) new stricter noise emission standards have forced shops and the transport sector to come up with innovative measures. Given the products currently used, industry and commerce cannot comply with stricter standards.

Besides EFV in combination with logistics concepts also EFV trials and projects of private transport operators for their optimisation of costs situation in distribution processes for vehicles fleets have been carried out. In addition to marketing effects mainly cost reasons have been the starting point for usage of EFV:

- Joynson Bruvers Ltd Oxfordshire (UK - 01)
- Hermes Versand Service (DE - 01)
- TNT (DE - 02)
- Chronopost (FR - 03)

Mainly large CEP-operators are active in the field of EFV usage for their distribution processes. This is also reasoned by the distance of their deliveries. Because of short distance deliveries in their core market (urban areas) the usage of environment-friendly vehicles makes sense. If a filling station net of alternative fuels exists it is first build up in those urban areas. In rural areas the infrastructure is mostly poor. Taking these facts into
account the private CEP-operators make a clear calculation of their operating costs by using EFVs.

DHL Express (Germany) has just (November 2005) started to operate with 170 delivery vehicles on basis on CNG. Reasons for their engagement have been the improvement of costs situation but also to meet the emission standards. As incentive the reduced mineral oil tax tariff has been one reason for the introduction. Furthermore upcoming discussions about the reduction of PM-10-particles in German cities by access restrictions and driving bans have been another reason. The vehicles will be used in Stuttgart, Berlin, Munich, Bremen and Düsseldorf.

Against the experience DHL Germany has made in most cases the usage of CNG has lead to higher costs (experience from the German CIVITAS projects and French experience). Only the demonstration project in Austria (AT – 01) has shown that for example in case of using NGVs the yearly costs are lower compared to diesel or petrol.

Most of the projects with EFV in context with urban freight transport are co-funded by public authorities. But there are also private initiatives existing. A lot of project initiating concepts in urban freight transport by using EFV have been set up in connection with national and municipal programmes. The main aim, in case of municipalities, is to improve the environmental situation and delivery situation in the city area. Most projects that have been set up are PPP with transport companies and shop owners. The role of the municipality has been often the initiator of such projects. Besides this financial support and a moderation role within the planning process are of course a major role municipalities have taken or take over.

There are also national programmes that have supported the usage of EFV within the urban freight delivery process. The long-term PIEK-programme has been started by the Dutch government. 10 projects have been set up since 1999 in order to bring about the necessary technical adjustments, by tackling the source, the materials used when loading and unloading goods and the points of loading. Also the DEMO programme has been initiated by the National Ministries. The Austrian Government has for example initiated a programme to fund projects that contribute to a cleaner, safer and more environment-friendly environment.

Often the national support programmes are not with direct focus on urban freight. But incentives like tax reduction for alternative fuels and propulsion systems, the initiation of new emission standards leads to innovative projects also in the field of urban freight transport (see also the example of DHL Express Germany).

The different projects, concepts, trials and demonstration projects have shown that various alternative propulsion systems are thinkable: electric
Experiments and incentives in favour of environment-friendly vehicles and equipment

**freight transport**

propulsion, usage of NGV, bio-fuels etc. But none of those concepts are really promising and successful with a few exempts. Main problems are:

- higher costs
- high maintenance efforts
- missing reliability
- missing filling station (or loading station) density.

Taking as example electric vehicles the main problem in urban freight transport is the distance reach. In dependence on the vehicle-kilometres driven per day electric vehicles are limited in their action radius. Also technical problems in battery technology are given (see Hermes Versand Service DE – 01).

The Austrian experience with NGVs has shown that they fit the costs (in comparison to diesel or petrol driven vehicles), show lower emissions and have a high distance reach. But in other cases (TNT trial Germany DE – 02) higher costs have been recognized. Also the maintenance effort for CNG vehicles has been a problem (see experiences in France). Experiences from the French “Monoprix-test” have calculated 20% higher costs in case of CNG-vehicles usage against diesel vehicles (FR – 04).

Despite all the negative experiences there are also positive ones like the Austrian project or the German DHL Express experiences.

**Other vehicle technologies**

There are only a few examples where except propulsion technologies other vehicle technologies are used to reduce negative environmental impacts. In Switzerland new loading technologies have been developed within the EU-project IDIOMA. Within the EU-project IDIOMA a combibox-system for intermodal transport has been developed and tested with the aim to reduce vehicle mileage and to improve the overall capacity usage in pre- and end-haulage. The assessment has shown that environmental benefits such as CO2 reduction and energy efficiency could be improved but on the other hand transport cost and time reduction and optimisation in capacity usage could not be reached. Nevertheless the trial has shown that environmental benefits could also be used by innovative loading technology. If cost and operation could be improved those technology would have a real chance to be introduced.

The Dutch PIEK-programme also has developed noise reducing technologies with simple measure like loading and roll-container technology (design of wheels and ramp design).

**Traffic planning measures to support the usage of more EFV**

The municipalities can also take responsibilities to encourage private transport operators to use more EFV by traffic planning measures. Examples are:
- zone management
- access restrictions to special urban areas (like inner city areas) or
- road pricing schemes

Vehicles with low emissions can benefit for example by a better access or reduced payment in case of road pricing. That means not that only vehicles on basis of alternative fuels will have advantages. Also vehicles with higher EURO-Norm standards or a better capacity usage receive advantages. Examples of traffic planning measures where more EFV have an advantage are:

- the project City Gods in Denmark, where an optimised capacity usage allows a better access to the city centre
- the London congestion charge, where drivers (also trucks) of alternative fuel vehicles and electrically propelled vehicles are exempted from charging.

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 incentives, trials and demonstration projects in urban freight transport and logistics do function. Those projects furthermore should give some background information why those examples do function very well and what have been or are the main difficulties within this named project.

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 4.3.1: Clean City Traffic (Austria)

[Schrampf, J., 2005]

Key words

NGV, city distribution, emission reduction

Background

Clean city traffic is a field trial of ecological and economical efficiency of NGVs in parcel distribution.

Objectives

Main objectives have been: ecological (reduction of noise and exhaust emission) and economical reasons (current cost situation unsatisfying).

Basic approach

The project started in 2004. The study was made in collaboration with the project “clean city traffic”, sponsored by ÖAMTC Akademie, General Motors Austria, DHL Express and OMV Gas.

For the first time on board emission measurement on comparable vans from the type Opel Combo were made by the technical university on Vienna. A realistic trip of the parcels delivering company DHL was fixed and comparable vans with Diesel, Gasoline and Natural Gas engines were measured during the trip on board.

Results and experiences

Figure 14: Comparison CO2 emissions
Experiments and incentives in favour of environment-friendly vehicles and equipment

Figure 15: Distance that can be driven with 10 EUR costs

![Distance chart]

Figure 16: Cost analysis

(Basis: Euro per year / 4 years / 40,000 km per year):

![Cost analysis chart]

Future plans development

Opel announced to continue and extend its supply of natural gas vehicles to Germany and Austria while OMV promised to continue to build up the natural gas fuelling station grid in Austria. Viennese gas distributing company Wiengas offered to give support for building private fuelling stations for big...
Experiments and incentives in favour of environment-friendly vehicles and equipment

commercial and industrial fleet-owners.

More information

Jürgen Schrampf, ECONSULT

See also References and contact persons!
Example 4.3.2: PIEK

Example 4.3.2: PIEK-programme (The Netherlands)

[Schoemaker, J., 2005]

Key words
noise emission reduction

Background

Many municipalities are increasingly confronted with bad environmental conditions due to high exhaust gas and noise emissions, even in less densely populated areas that have not been considered problem areas before.

According to the law implemented in 1998 the PIEK-programme has been initiated. At the end of 1998 the renewed “Decree Retail Trade Environmental Protection” came into effect. This Dutch decree sets down that the noise emission level must remain within the noise emission standard. It stipulates that the noise emission generated when loading and unloading goods, in particular with trucks, between 19:00 and 07:00 must comply with strict peak noise standards. The PIEK/PEAK programme is currently focussed on subsidising acquisition of “quiet” vehicles and equipment. This subsidy program is valid for the period 2004 – 2008 and is meant to reduce the disturbance for inhabitants.

Objectives

Main objectives have been: ecological (reduction of noise emission) and economical reasons (current cost situation unsatisfying). In the following the main aims are listed:

<table>
<thead>
<tr>
<th>Key aim</th>
<th>Scheduling sub-project</th>
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<tr>
<td>1 Transfer of knowledge</td>
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<tr>
<td>2 ‘Quiet’ behaviour</td>
<td></td>
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<tr>
<td>3 Optimum loading/unloading location</td>
<td>Drawing up guidelines</td>
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<td></td>
<td>Retrofitting measures</td>
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<td></td>
<td>New buildings</td>
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<tr>
<td>4 ‘Quiet’ vehicle &lt; 7.5 tonnes</td>
<td>Engine plus intake and exhaust</td>
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<td>Transmission and Differential</td>
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<td>Brakes</td>
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<td>Warning signal</td>
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<td>Tailift (incl. low floor)</td>
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<td>Body</td>
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<td>Doors</td>
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<td>Transport locking</td>
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<td>5 ‘Quiet’ vehicle &gt; 7.5 tonnes</td>
<td>Engine plus intake and exhaust</td>
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<td>Transmission and Differential</td>
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<td>Warning signal</td>
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<td>Body</td>
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<td>Doors</td>
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<td></td>
<td>Transport locking</td>
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<tr>
<td>6 Transport refrigeration systems</td>
<td>Generator refrigeration + eutectic refrigeration</td>
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</table>
The noise emissions are treated in the PIEK (Eng: PEAK, means peak noise levels, in contrast to continuous noise levels) programme. Given the products currently used, industry and commerce cannot comply with the stricter standards. These noise emission standards are forcing shops and the transport sector to come up with innovative measures. At the same time, however, it must be possible to implement these innovations both technically and economically within a few years. The Ministry of Housing, Spatial Planning and Environment, the Ministry for Economic Affairs and the Ministry for Transport, Public Works and Water Management introduced a long-term PIEK (peak noise) programme in 1999 in order to bring about the necessary technical adjustments, by tackling the source, the materials used when loading and unloading goods and the loading-unloading locations. With the exception of the truck and the shopping trolley, all solutions meet the 60 dB(A) requirement. Trucks and shopping trolleys meet the 65 dB(A) requirement.

The long-term PIEK programme comprises the following 10 main projects:

- Transfer of knowledge to relevant companies;
- Encouraging quiet behaviour;
- Optimal loading and unloading locations;
- Low-noise distribution vehicles up to 7.5 tons;

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<tr>
<th>Experiments and incentives in favour of environment-friendly vehicles and equipment</th>
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<tr>
<td>Liquid air conditioning</td>
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<td>Hydraulic transport refrigeration</td>
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<tr>
<td>Gas engine with optimal suspension, enclosure, intake and exhaust</td>
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<tr>
<td>7 On-board forklift</td>
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<tr>
<td>Rubber buffers on stop points</td>
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<tr>
<td>Lower RPM (with larger engine)</td>
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<tr>
<td>Gradual starting/stoppage of forks</td>
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<tr>
<td>Disconnecting engine from bodywork</td>
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<tr>
<td>Electric propulsion</td>
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<tr>
<td>Spring elements on freight truck or on forks of on-board forklift</td>
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<tr>
<td>8a Hand pallet trucks</td>
</tr>
<tr>
<td>Flat road surface</td>
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<tr>
<td>Absorbent coating on underside of fork plates</td>
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<tr>
<td>Fork wheel bearings without play</td>
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<tr>
<td>Soft wheels</td>
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<tr>
<td>Rubber buffers on stop points</td>
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<tr>
<td>8b Rolling containers</td>
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<td>Rubber wheels instead of plastic</td>
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<tr>
<td>Sandwich wheels instead of hard plastic</td>
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<tr>
<td>Rubber tyre instead of plastic</td>
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<td>Sprung fork or wheels</td>
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<tr>
<td>Wheel and fork bearings without play</td>
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<tr>
<td>Eliminating gate clearance</td>
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<tr>
<td>Behaviour</td>
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<td>9 Shopping trolleys</td>
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<tr>
<td>Soft wheels</td>
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<td>Rubber buffers on stop points</td>
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<td>Flat road surface</td>
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<td>Sprung fork or wheels</td>
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<td>Building prototype</td>
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<td>Eliminating gate clearance</td>
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<tr>
<td>10 Electric drive</td>
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<tr>
<td>Hybrid drive</td>
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</tbody>
</table>
- Low-noise distribution vehicles over 7.5 tons;
- Low-noise refrigerated transport installations;
- Low-noise portable forklift trucks;
- Noise reduction in roll containers, pallet trucks, hand pallet trucks;
- Noise reduction in shopping trolleys;
- Electric propulsion or a combination of electric and diesel or gas propulsion.

The PIEK MAP (Multi-Annual Program) has resulted in many innovations. Solutions that can meet the PIEK standard of 60 dB(A) have been found for all components that were too noisy. Exceptions are the shopping trolley and heavy truck. These can meet 65 dB(A).

- The PIEK Multi-Annual Programme has shown that meeting the standards of the Detam order in council is technically possible. It can be concluded that the PIEK MAP has largely fulfilled expectations in terms of developing new ‘quiet’ products;
- In addition to developing ‘quiet’ products, the goal is also to achieve the introduction of these products to market. In late 2004, there are some fifty ‘quiet’ products available on the market. The conclusion here as well is that the PIEK MAP has met expectations;
- In addition to the technical feasibility of ‘quiet’ products (PIEK MAP), the government has made an effort to encourage purchases of ‘quiet’ products in the near future. To do this, the PIEK grant programme was begun in 2004. Its available budget was exhausted in 2004, which constitutes a success. This means a good follow-up to the PIEK MAP has been achieved – ensuring that the results achieved will not go to waste but actually make their way to the market;
- To support the market introduction process, the business world also introduced a PIEK mark in 2004. The PIEK mark is a product certificate that can be requested by manufacturers of ‘quiet’ products. In the future, the PIEK mark will contribute to the recognition of ‘quiet’ products, which in turn is expected to contribute to the demand for and use of such products (www.piek-keur.nl)

The main benefits are:
- Possibility to meet the decree for transport operators and shop owners
- New market for producers of logistic means
- Night distribution without noise problems

The success factors have been mainly: close co-operation between government, transport operators, shop owners and producers of technical
Experiments and incentives in favour of environment-friendly vehicles and equipment

solutions.

Future plans development

The project will continue till 2008.

More information

Jarl Schoemaker, NEA

See also References and contact persons!
Example 4.3.3: Hermes Versand Service (Germany)

[Huschebeck, M., 2005]

Key words

noise emission reduction, CNG, electric vehicles, hydrogen technology

Background

Since 1995 Hermes is testing the capabilities of alternative propelled vehicles within its fleet. Within the period 1995 to 2001 several technologies were tested:

- From 1995 to 1997 a trial with electronic vehicles was made
- From 1995 up to now CNG propelled vehicles have been tested
- From 1999 to 2001 tests with hydrogen propelled vans were made

Within regular delivery trips environmentally friendly vehicles were employed. The vehicles are mostly standard vans refitted with alternative propulsions. The CNG vans were refitted diesel vans (bivalent technology). The hydrogen propelled vehicle was a refitted Mercedes Sprinter. In a second trial using hydrogen the first fuel cell propelled van (based on Mercedes Sprinter) was used.

Objectives

Main objectives have been: ecological (reduction of noise emission) and economical reasons (current cost situation unsatisfying). Within different German cities (Hamburg, Hannover, Berlin, Lüneburg, Bremen, Augsburg, Stuttgart) alternative propelled vehicles have been tested.

Results and experiences

The trials carried out with electronic propelled vehicles showed great technical problems leading to high maintenance effort and the low capabilities if the batteries. An accompanying vehicle had to be employed for securing the delivery. Furthermore, the range of operation was to low for further continuation.

To the beginning of the trials at Hermes with CNG propelled vehicles larger costs are recognised, this was due to the reason that to that time the refitting of the vehicles to CNG propulsion was expensive (about 7.500 Euro per vehicle) and additional public funding was not available. In addition accompanying vehicles had to be employed to guarantee the delivery. After the trials a continuation was hampered as no leasing contracts were possible for CNG vehicles. Furthermore, the range of operation was to low (150 km compared to 400 km with a conventional van). Positive results could be achieved in terms of reducing CO2 emissions by 10%. Hermes considers CNG only as intermediate technology towards hydrogen and fuel cell propulsion.

Experiences with the hydrogen fuel were made in 1999, however due to
technological problems the trial was stopped. The second trial using Mercedes fuel cell car started in 2001. The vehicle proved its technical feasibility in daily distribution environment. Over one year of testing about 16,000 km could be carried out. The range of operation was sufficient for urban delivery trips (about 150 km). Barrier are still the high investment costs for fuel as well as for the propulsion technology (tipple of the vehicle investment cost and double of the fuel costs compared to diesel propelled vehicles). Environmental advantages could be achieved in terms of CO2 emissions (almost zero), noise and energy efficiency.

Future plans development

The trial with electronic propelled vehicles was stopped in 1997 due to technical reason. No further applications are planned.

For carrying out the CNG trials Hermes purchased 15 vehicles. Due to the positive results from these trials a further operation is in consideration (Hermes is favouring a leasing of the vehicles).

More information

Marcel Huschebeck, PTV

See also References and contact persons!
**Example 4.3.4:** Elcidis

| **Example 4.3.4: Logistics and services terminal** (City of La Rochelle, France) |
| [Dablanc L., 2005] |

**Key words**

Logistic platform, city distribution, electric vehicle, Public-Private-Partnership

**Background**

Air quality impacts as well as noise emissions due to deliveries in the city centre. Congestion due to deliveries.

**Objectives**

Reduce congestion in the city centre, make the circulation of buses and pedestrians easier.

Enhance air quality and reduce noise in city centre.

Provide new services for retailers and inhabitants (home deliveries).

**Figure 17:** Electric delivery vehicle

**Basic approach**

From the Elcidis terminal (located close to the city centre), 6 electric vans and one electric small truck are used to deliver the goods to the historic centre of La Rochelle. No deliveries can be made in La Rochelle city centre with trucks (above 3.5 tons) after 7:30 in the morning. These deliveries have to be subcontracted to the Elcidis terminal operator.

The project works well, with continuous subsidies from the city of La Rochelle. The vehicles have proven technically successful. On an organisational point of view, the vehicles used (small vans) have proven too limited in capacity. This has been a major drawback of the system, inducing additional costs.

**Financial solution**

The Elcidis transport operator (transports Genty) has been given the electric vehicles and they have received an operating subsidy. This subsidy has...
Experiments and incentives in favour of environment-friendly vehicles and equipment

helped them keep the charge which is imposed on the Elcidis terminal users to a minimum.

Transports Genty have also been given access to the terminal at no charge (the rent is paid by the City of La Rochelle).

Development of the project in La Rochelle has always been a goal (development of traffic, development of revenues, development of services provided). Deliveries of refrigerated goods, deliveries of large volume parcels and home deliveries have been recently added to the range of services provided by Elcidis.

Further applications were expected in a few other French cities. However, because of the operational costs involved, no other city so far has developed a project based on Elcidis concepts.

The range of services given through the Elcidis terminal is expected to grow, including a development of home deliveries.

One of the objectives of the city of La Rochelle is to stop giving financial subsidies to operate the Elcidis system. It is expected that by 2006, the terminal will be self operated (with no subsidies).

A detailed assessment of environmental benefits and losses due to the introduction of the Elcidis distribution centre project has been made by ADEME in 2003, using 2002 data. It is shown on the last page. NB. It should be noted, first, that gains and losses brought by the Elcidis system regard a very small percentage of total traffic (400 parcel deliveries are made daily in La Rochelle with Elcidis, representing a small share of the total freight activity of the city centre). Therefore, the huge percentages of gains and losses shown on the table represent only a small gain or loss in absolute terms.

On the whole, this study indicates that:

1. Electric vehicles have brought a huge benefit regarding exhaust gas emissions, noise emissions and CO2 emissions.

2. It has increased urban congestion and visual impacts, due to the very small loading capacity (3 m3) of the vehicles used.

The conclusion drawn by PSA Citroen (which has provided the vehicles) is the following: « Despite the true interest demonstrated for the electric vehicles, the question of large scale production of these vehicles remains. The cost of batteries and a limited autonomy (80 km) are first in cause. Furthermore, the EU directive on Out of Use Vehicles will forbid, by the end of 2005, all trace of cadmium in vehicles. When enforced, this directive would prevent the use of all nickel-cadmium batteries».

Realised and perceived benefit:
For stakeholders

Retailers have been extremely favourable to Elcidis electric vehicles. Transport operators using Elcidis have been satisfied. However, transport operators not using Elcidis perceive it as too costly. The city of La Rochelle wishes to stop giving subsidies to the operation of Elcidis in the coming months.

For service providers

Elcidis operator (Transports Genty) has applied (successfully) to a second bid to operate the centre, after the first 3 years of experiment. This demonstrates that they have been satisfied with the experiment. The Elcidis project has given them the opportunity to use (at no charge) a well located transhipment facility. The experiment has given them an image of a clean urban freight operator. Financial benefits are not clear yet.

For the public (inhabitants)

Inhabitants are either favourable or indifferent to Elcidis. The experiment is rather well known among inhabitants.

Success factors:

Technical success (the electric vehicles run well and are well accepted by the drivers)

Approval of the public (retailers, inhabitants).

Failure factors:

Cost of the vehicles.

Limited capacity of the vans and difficulty in finding larger vans or small trucks running on electric power. From an administrative point of view, it has been difficult to register the FAAM 3.5 t vehicle. Elcidis managers have had to overcome a very suspicious French central administration before being given approval for using this truck in the city centre.

Lessons learned: Experience transferable to other projects

The experiment is transferable to other sites, but at a cost (in La Rochelle, the city’s financial support is still very high).

Another lesson is the loading capacity of the vehicles. Any experiment similar to Elcidis should be using a truck able to carry at least one pallet. The Elcidis experiment has suffered extremely from the insufficient capacity of the vans initially used (Citroen Berlingo).

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Experiments and incentives in favour of environment-friendly vehicles and equipment

Example 4.3.5: IDIOMA (Zurich, Switzerland)

Innovative Distribution with Intermodal Freight Operation in Metropolitan Areas, Combbox-System

[Abel, H., 2005]

Key words

Transhipment technology, intermodal transport, loading unit technology, vehicle technology

Background

Switzerland has a long tradition in intermodal transport; it is an important part of Swiss freight transport policy both on national and on regional level. Within IDIOMA, this intermodal experience has been demonstrated in three tasks in the Zurich region. One task has been the Innovative Combbox-system for intermodal logistic.

In the Zurich area – as in other metropolitan areas – the consignment sizes decrease and the delivery frequency increase. Therefore the urban and regional goods transport increase referring to number of trips, mileage, vehicle requirement etc. A forecast from the Canton of Zurich for the next 30 years expects an increase in goods transport of 120% (in tons, especially external transport from and to the Zurich area). Transport is dominated by road goods transport. The share of intermodal transport compared to road and rail transport is still low.

The following particular site problems referring to intermodal transport are to be tackled on the validation site Zurich:

- The costs of the pre- and end-haulage legs of the intermodal transport chain are high compared to the costs of the whole transport chain.
- The pick-up and delivery transports cause high costs compared to the transported load.
- The decreasing consignment sizes reduce the possibilities using intermodal transport chains because there is a lack of small-load-unit-systems for less-than-truck-loads.
- The running concentration of terminals for intermodal transport leads to longer distances in pre- and end-haulage.
- The conventional terminal infrastructure (cranes etc.) is often too expensive for small and medium terminals and leads to high costs per load unit.
- The transhipment costs in terminals with small and medium quantities using conventional technologies are high.
- Roll-off-containers have been used in the last years in Switzerland especially for bulk goods (e.g. construction materials, waste, agricultural products, etc.) for short and medium distances. The system reached a remarkable market share but is today limited to bulk goods.

Therefore innovative intermodal concepts are needed to improve the
efficiency of the intermodal transport chain relating to pick-up and delivery transport and the sustainability of goods transport. In Switzerland this is especially valid for intermodal transport over short and medium distances and transhipment points with small quantities.

Objectives

Within the EU-project IDIOMA a combibox-system for intermodal transport has been developed and tested with the aim to reduce vehicle mileage and to improve the overall capacity usage in pre- and end-haulage.

The general objectives over all tasks of the IDIOMA-project have been:

- To demonstrate and to analyse the technical and operational feasibility of the systems / concepts used
- To analyse and assess the benefits and costs of the systems / concepts under different conditions and over the whole transport chain
- To recognise barriers for the use (e.g. handling etc.), to make adjustments and to propose improvements
- To estimate and assess the ecological and economical effects (incl. economical feasibility) for different conditions and compared with other solutions
- To define favourable preconditions and supporting measures for the breakthrough.

Basic approach

The Subproject 1 (Innovative Combibox-System for intermodal logistics) is linked to combined transport and to pick-up and delivery transport.

Combibox-System (incl. all elements)

Within this project the use of small container system (including telematics application) for consumer goods within the transport chain (between
Rothenburg and Zurich, 60km) of the PISTOR-company was demonstrated. The CombiBox-System is based on the following components: the CombiBox (small container unit for 4 Euro-pallets, with or without cooling system), a special distribution vehicle, a tracking and tracing system, a swap body (for 4 small containers) and the horizontal transshipment equipment.

<table>
<thead>
<tr>
<th>Elements of the transport chain</th>
<th>Current situation</th>
<th>Planned features of the demonstrator</th>
</tr>
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<tbody>
<tr>
<td>Distribution platform Winterthur</td>
<td>Storage, commissioning in roll-boxes, tour planning, loading and unloading of vehicles at the ramp</td>
<td>demo case: barcode on roll-boxes, scanning of the provided and loaded roll-boxes, load the roll-boxes in the combiboxes, transshipment with horizontal transshipment equipment</td>
</tr>
<tr>
<td>Road transport</td>
<td>From the distribution platform to the pick-up and delivery area, by truck or by truck &amp; trailer</td>
<td>Swap body with 4 (truck only) or 8 boxes (incl. trailer)</td>
</tr>
<tr>
<td>Pre-endhaulage between distribution platform and terminal (case 2b)</td>
<td>-</td>
<td>Pre- and endhaulage by truck with swap bodies (4 boxes)</td>
</tr>
<tr>
<td>Rail transport</td>
<td>-</td>
<td>Rail transport from distribution platform USEGO or a terminal nearby to a terminal in Basel (swap bodies with 4 combiboxes or rail wagon with 6 to 10 combiboxes)</td>
</tr>
<tr>
<td>Transhipment point Zürich (trailer)</td>
<td>Uncouple the trailer from the truck, unload trailer and reload truck</td>
<td></td>
</tr>
<tr>
<td>Transhipment point Zürich (boxes)</td>
<td>-</td>
<td>Transhipment of boxes from truck (incl. trailer) to city lorry and reverse by horizontal transshipment technology (or forklift)</td>
</tr>
<tr>
<td>Terminal Zürich</td>
<td>-</td>
<td>Transhipment of boxes from rail wagon to city lorry and reverse by horizontal transshipment technology (or forklift), transhipment of swap bodies</td>
</tr>
<tr>
<td>Pick-up &amp; delivery area Zürich</td>
<td>Transport from shop to shop by truck</td>
<td>Transport to one shop or from shop to shop by city lorry</td>
</tr>
<tr>
<td>Stop at client</td>
<td>unload/load roll boxes using a lifting platform</td>
<td>put down / take up combiboxes depending on, exchange combiboxes, unload/load roll-boxes out of/n in combiboxes (flows and conditions), scanning of the barcode of the delivered roll-boxes</td>
</tr>
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</table>

Description of elements of the transport chain task “Innovative CombiBox-System for intermodal logistics”

Two demonstration cases have been tested: Transport by truck from Rothenburg to Zurich and final distribution in Zurich city by small lorries and the second case using rail in main-haul.

For demonstration two transhipment equipments are necessary (one at the distribution platform, one at the transhipment point in Zurich).

- The operator that have developed and tested the CombiBox-system has decided not to continue this loading technology. But there is a basic interest if framework conditions with regards to functionality can be improved.
- The system developer of the CombiBox-system has started work on the improvement of the system.
- A lot of haulier are thinking about the insert of small box solutions with corresponding small vehicles

Results and experiences

The pre-demonstration phase has shown that the project realisation has last longer than expected because of several reasons:

- The necessary equipment had to be developed new
- The daily business of the transport operator had not be disturbed

Future plans development
It was difficult to find a transhipment area
A lot of road haulier are sceptic against innovations

Experiences in the demonstration phase have been mainly:
All partners have made high efforts to carry out a successful project
The final phase of test has been characterised by most efforts: check of
starting availability of all project and equipment components
Small boxes and container equipment has special requirements to
infrastructure. The existing infrastructure has been not optimal.
Therefore a compromise has been made.

The transhipment point in Zurich city has been not optimal.
An increase in transport efficiency could not be reached by this project,
especially an increase in capacity usage.

Also in case of transport costs and transport time benefits could not be
achieved. Transport costs of the demonstration case 1 (using Combibox-
system in traditional road transport) have been about 17-25% higher and in
the second case using intermodal transport 28% to 35% higher.

The expectations regarding the energy consumptions and environmental
impacts have been fulfilled, especially the indicator emissions per capita and
resource and energy savings.

The Combibox-System used in the pure road transport chain compared
to conventional road transport lead to a decrease of road mileage of
about 25%, a decrease of 20 to 30% concerning the emissions (Except
CO: increase of 250%) and a decrease in energy consumption of 26%.
That means that the external costs (emission and accidents) have been
reduced by 17%.

If the Combibox-System is used in intermodal transport chains there is a
decrease of road mileage of about 65%, a decrease of 22 to 55% concerning
Nox, HC, CO2, but no change concerning particles and CO
(increase of 220%). The energy consumption decreased by 39% and
external costs could be reduced by 31%.

More information
Heiko Abel, Rapp Trans AG
See also References and contact persons!
4.4 Conclusions and recommendations

4.4.1 Conclusions

There is a great difference between Western European countries and Eastern European countries. In Western Europe a lot of trials, experiments and demonstration projects with usage of EFV in urban freight transport are shown. Public authorities have spent resources and financial support to encourage innovative freight transport concepts and logistics concepts in urban areas by insert EFV or new vehicle technologies. In Eastern Europe most countries are aware of the problems they are faced with and they adopt standards and regulations determined by the European Commission. They also follow a sustainable policy and support the usage of alternative fuels but measures are not focussed on urban freight transport. A lot of Eastern European countries have set up environmental and sustainable programmes and policy concepts that also include the support of alternative fuel usage and cleaner vehicle usage. Incentives are often tax reduction for the usage of more environment-friendly alternative fuels. But direct concepts in urban freight transport are often not developed because of given financial restriction by municipal authorities and low financial budgets by transport operators forces responsible market actors and political authorities to save financial resources. But there are also some minor activities in the field of public transportation. A lot of municipalities in Eastern Europe have started to use alternative fuel driven bus fleets (e.g. the public transport company of Ljubljana) because most of the bus services are not privatised the municipality can directly decide to change fleets. In case of private operators the decision is depending on the good will of the private operator what is especially given in the field of urban freight transport where mostly private operators carry out freight transport.

Eastern European countries are also active in the field of research. Universities but also private companies spend financial and personnel resources in the development of sustainable transport solutions but mainly on a more general basis and not with focus on urban freight transport.

There are only a few concepts where private transport operators are willing to change their fleets towards EFV. Most projects are supported by public financial budgets. Private operators only change their fleets and operating concepts if:

- there is a clear financial benefit for them,
- there is a satisfying filling station net in the operation area and
- there probably is a marketing effect and image benefit.
Environment-friendly behaviour is of course in mind of transport operators. They no environmental benefits by using alternative propelled vehicle fleets. An environmental engagement is only given if the return on investment is given for the company.

As seen from the projects mainly large CEP services like DHL Express, TNT or Hermes have changed their fleets. They are to a high degree active in urban distribution and delivery collection. The drop points are very narrow so that savings by usage of CNG or bio-fuels are more effective because the stop and go-process in the inner city area is leading to the most consume of traditional fuel driven fleets. Additionally in large fleets cost savings and economies of scale are given. Also the filling station infrastructure is more given in urban areas compared to rural areas.

The role of public authorities

The material collection has shown that a lot of municipal and national activities have started to encourage the use of EFV in urban freight transport. National programmes like the PIEK-programme or the French “National Programme on Goods in Cities” have evidenced that national programmes and support measures can lead to successful results.

The role of incentives and restrictions

Stricter emission standards and regulations leads often to a rethinking of the operation strategy. Combined with tax reduction operators can be encourage to change operation strategy. Financial incentives often lead to a successful change. As seen in Germany DHL Express has started to change their fleet towards alternative fuel usage. Stricter standards and tax reduction has led to this decision in DHL’s transport strategy.

Environmental benefits

Nearly all projects with respect to the usage of EFV in urban freight transport have shown high ecological benefits. In various projects an assessment regarding the emissions and environmental impacts has been carried out. The Austrian project “Clean city traffic” or the French project assessment have evidenced that EFV contributes to lower environmental impacts. Achievements that often could be reached are the reduction of CO2-emissions, lower noise emissions and improved energy efficiency.

Failure factors

The main failure factors that have been assessed are:

- higher operational costs by usage of EFV
- an insufficient filling station (loading station) infrastructure
- reliability problems and defects and
- high maintenance efforts.
### Success factors

The success often depends on framework conditions like:

- emission and environmental regulations and standards
- incentives like tax reduction (fuel price development)
- filling station net
- individual transport strategy and deployment of vehicles

A combination of incentives and restriction in case of Germany for example has shown that a rethinking has started. Only if cost situation of the usage of EFV gets better in comparison to traditional fuel technologies a success can be reached.

Also public funds and support measures can help to foster and promote EFV. In case of the French and Dutch programmes success has been evidenced.
4.4.2 Recommendations

The role of public authorities

It is important that national authorities take over a leading role in supporting EFV and the usage of alternative fuels. Also financial incentives can lead to an engagement of private operators as seen in many examples. But it has also to be mentioned that national and municipal authorities should in the first line work as “kick-off”. The private industry should not only be pushed by financial support but should invest in from own interest. Promoting projects and initiatives can contribute to a more public PR of innovative projects that should encourage private parties in rethinking their transport strategy with EFV.

Combination of measures

There should be introduced political measures, programmes and concepts that are not only with focus on restriction. A selected portfolio of measures that show restrictions but also incentives should be selected. Restrictions (emission standards) can of course force private transport operators to think about a renewal of their vehicle fleet. If they are burdened by higher costs or access restriction in case they can not fit the given standards and limits this will probably lead to the usage of more EFV but on the other hand higher operation costs of transport operators can lead to higher prices on consumer site. Incentives (tax reduction) can encourage the usage of EFV as seen in several examples. A good combination of restrictions and incentives can be very successful.

Also traffic planning measures can be compromising. Exemptions from road pricing or guaranteed city access in case of lower emissions (better EURO-norm, alternative fuels or electric vehicles for example) or better capacity usage can support the usage of more EFV or new vehicle technologies.

The need of national and municipal programs

Broad programs that are aiming to support the usage of more environment-friendly vehicles should be further developed on EU or national wide basis. The Dutch PIEK program but also the French program has shown that a general “umbrella-program” can support measures on a municipality as well as national level. It is very important to enclose also the New Member Countries in EU projects with focus on EFV and especially with focus on the usage of EFV in urban freight transport. Because of restricted financial municipal and national budgets EU funds should support with focus on the New Member Countries.
Efficient focus

Financial support should be especially given where success on a broader basis is given. Of course smaller projects with few vehicles can also be successful and have an initiation character and can promote and encourage the usage of EFV. But in the first line operators with big vehicle fleet should be focussed on. They cause a high number of vehicle-kilometres. Especially the large CEP-services or recycling and waste disposal companies. If those companies can be encouraged to renew their fleet and if maybe funds would be available the negative impacts can be reduced more efficient than compared to small projects. About this a signal can be set and the public interest and promotion effect on trials, demonstrators and projects on a broader basis with transport operators that operate bigger fleets can be reached.

Kind of alternative vehicles that should be supported

As seen from the projects most compromising success has been reached by the usage of CNG (DHL Express Germany, the Austrian project “Clean City Traffic”). Most problems that have been recognised appear in case of using electric vehicles. Therefore it should be checked before for which reasons and under which circumstances EFV-projects should be supported. Electric cars can of course be supported if they operate in a small area (like for example in historical city centres). Before making the decision about the initiation of a new project it should be looked at the place of operation and the possibilities for the usage of different EFVs.
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<td>Progetto MERCI - Mobilità Ecologica Risorsa per la Città</td>
<td>2005</td>
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### Persons who provided material on Waste transport and logistics in urban areas

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<tr>
<th>Country</th>
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### Persons who provides material on Experiments and incentives for environment friendly vehicles

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<th>Name</th>
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# Abbreviations

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<td>ACEA</td>
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<td>Abroll-Container-Transport-System</td>
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<tr>
<td>GHG</td>
<td>Greenhouse Gas</td>
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<tr>
<td>GIS</td>
<td>Geographic Information System</td>
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<tr>
<td>GWV</td>
<td>Gross Vehicle Weight</td>
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<tr>
<td>HEV</td>
<td>Hybrid Electric Vehicles</td>
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<tr>
<td>HWD</td>
<td>Hazardous Waste Directive</td>
</tr>
<tr>
<td>ICE</td>
<td>Internal Combustion Engine</td>
</tr>
<tr>
<td>ICL</td>
<td>Institute for City Logistics</td>
</tr>
<tr>
<td>IDIOMA</td>
<td>Innovative distribution with intermodal freight operation in metropolitan areas</td>
</tr>
<tr>
<td>IE</td>
<td>Ireland</td>
</tr>
<tr>
<td>IES</td>
<td>Integral disposal System</td>
</tr>
<tr>
<td>IMPACTS</td>
<td>Information Management Policies Assessment for City Transportation System</td>
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<tr>
<td>IT</td>
<td>Italy</td>
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<tr>
<td>ITS</td>
<td>Intelligent Transport System</td>
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<tr>
<td>IWMO</td>
<td>Intermunicipal Waste Management Organisation</td>
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<tr>
<td>JP</td>
<td>Japan</td>
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<tr>
<td>Abbreviation</td>
<td>Description</td>
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<tr>
<td>KVA</td>
<td>Kehrichtverbrennungsanlage</td>
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<tr>
<td>LPG</td>
<td>Liquefied Petroleum Gas</td>
</tr>
<tr>
<td>LSDP</td>
<td>London Sustainable Distribution Partnership</td>
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<tr>
<td>NAS</td>
<td>Newly Associated States</td>
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<tr>
<td>NEAP</td>
<td>National Environmental Action Programme</td>
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<td>NEC</td>
<td>National emission Ceilings</td>
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<td>NL</td>
<td>The Netherlands</td>
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<td>NWMP</td>
<td>National Waste Management Programme</td>
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<tr>
<td>OECD</td>
<td>Organisation for Economic Co-operation and Development</td>
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<td>OEM</td>
<td>Original Equipment Manufacturer</td>
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<td>ONR</td>
<td>National Observatory on Waste</td>
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<tr>
<td>ÖNS</td>
<td>Österreichische Nachhaltigkeits-Strategie (Austrian sustainability strategy)</td>
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<tr>
<td>OPTTRANS</td>
<td>Optimale Transporte in der Abfall- und Kreislaufwirtschaft</td>
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<tr>
<td>PHEM</td>
<td>Passenger car and Heavy duty vehicle Emission Model</td>
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<tr>
<td>PM</td>
<td>Particulate Matter</td>
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<tr>
<td>POLIS</td>
<td>Promotion of operated Links and integrated Services</td>
</tr>
<tr>
<td>PPP</td>
<td>Public Private Partnership</td>
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<tr>
<td>PR</td>
<td>Public Relation</td>
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<tr>
<td>R&amp;D</td>
<td>Research and Development</td>
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<td>RAZ</td>
<td>Regionale Annahmeregionen</td>
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<td>RCV</td>
<td>Refuse Collection Vehicles</td>
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<tr>
<td>RID</td>
<td>Verordnung über die internationale Eisenbahnbeförderung</td>
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<tr>
<td>SHAFRA</td>
<td>Shift in waste transport modality in the Randstad area</td>
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<tr>
<td>STRAW</td>
<td>Sustainable Transport Resources and Waste Project</td>
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<tr>
<td>STREAMS</td>
<td>Strategic Transport Research For European Member States</td>
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<tr>
<td>TN</td>
<td>Thematic Network</td>
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<tr>
<td>T-TAP</td>
<td>Transport Telematics Application Programme</td>
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<tr>
<td>UFS</td>
<td>Urban Freight Solutions</td>
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<td>UK</td>
<td>United Kingdom</td>
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<tr>
<td>VAT</td>
<td>Value Added Tax</td>
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<tr>
<td>VBZ</td>
<td>Verkehrsbetriebe Zürich</td>
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<tr>
<td>VMS</td>
<td>Variable Messaging Sign</td>
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<tr>
<td>WE</td>
<td>Western Europe</td>
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<tr>
<td>WMA</td>
<td>Waste Management Act</td>
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<td>WMP</td>
<td>Waste Management Programme</td>
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ANNEX

ANNEX I General country situation – Waste transport and logistics in urban areas

ANNEX II Collected case studies (projects-level) – Waste transport and logistics in urban areas

ANNEX III General country situation – Experiments and incentives for environment friendly vehicles

ANNEX IV Collected case studies (projects-level) – Experiments and incentives for environment friendly vehicles
ANNEX I: General situation within countries - waste disposal and waste logistics

<table>
<thead>
<tr>
<th>Country</th>
<th>Description</th>
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| Australia | 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, unbeneicial 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 18: 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.
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;
- 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”
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 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 logistic 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
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.

<table>
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<th>France</th>
<th>History of waste management and logistics:</th>
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|        | 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-Comté.

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 dumsites 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 (grünner 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 recyler 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 transshipped 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 transshipment to the long haul leg takes place. Such a transshipment 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 transshipment 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 focusing 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 (foresee 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.
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| 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. |
| 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. |
| 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. |
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 manage 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 mechanical 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-outskirts 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
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<td>Latvia</td>
<td>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 &quot;500-&quot; 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 serve 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.</td>
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<td>Lithuania</td>
<td>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 of waste recovery technologies. A national municipal solid waste management strategy for Lithuania was finished in November 1997 with an implementation period from 1997 to 2015. The strategy includes several aspects: improvement of waste management, including development of new regional landfills; elaboration of an economical system for waste management. The implementation of programme &quot;500-&quot; 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 serve 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.</td>
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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.
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 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.

Importance of waste collection and waste transport and logistics in the Netherlands:
In the past 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 hinders 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 logistical 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 landfills. 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.

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**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 mechanical 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: transfilt, 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
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 Restormel 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

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<tr>
<th>Code</th>
<th>City/Region</th>
<th>Name of concept</th>
<th>Short description of concept</th>
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<tbody>
<tr>
<td>AT - 01</td>
<td>Austria – region of Oberösterreich, Steiermark, Vorarlberg</td>
<td>Potential of optimisation in waste disposal logistics</td>
<td>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.</td>
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<tr>
<td>AT – 02</td>
<td>Austria</td>
<td>CARGOtrade.net</td>
<td>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.</td>
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<tr>
<td>BE – 01</td>
<td>Liege, Walloon region</td>
<td>Inland waterway transport of household waste</td>
<td>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 Flémalle) 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 avoids allowing the transit of 40 waste lorries a day through the city of Liege.</td>
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<td>BE – 02</td>
<td>Brussels</td>
<td>Future usage of inland waterway transport in household waste transport</td>
<td>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 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</td>
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### Annex II

#### Code | City/Region | Name of concept | Short description of concept
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| | | | 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 transshipment 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 logic 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. |

<p>| 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 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. |</p>
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<tr>
<td>DE – 01</td>
<td>Ulm</td>
<td>Waste container management RWE Umwelt Süd</td>
<td>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.</td>
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<tr>
<td>DE – 02</td>
<td>German cities</td>
<td>OPTRANS</td>
<td>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.</td>
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<td>DK – 01</td>
<td>All municipalities in Denmark</td>
<td>MijeLogistik</td>
<td>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.</td>
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<tr>
<td>FI – 01</td>
<td>Helsinki Metropolitan Area</td>
<td>PUZER XMIT</td>
<td>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 Puzaire 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.</td>
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<tr>
<td>FI – 02</td>
<td>Finland</td>
<td>MOLOK - Smart collection system for solid waste</td>
<td>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 contaminating process is lower. In order to cut transport costs further, research has been directed on the ways 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. 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.</td>
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### Annex II

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<td>FR – 01</td>
<td>263 municipalities from the eastern part of the Oise Department (Oise Vallee), 60 km North of Paris</td>
<td>VERDI (Valorisation Et Recyclage des Déchets en Intercommunalité)</td>
<td>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 berce” 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).</td>
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<td>FR – 02</td>
<td>Lille</td>
<td>Lille municipal waste waterborne transport from Lille to Blaringhem</td>
<td>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 bulky and recycling material. Some technological investments and logistic reorganisation 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 « ampiroll » 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.</td>
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<td>GR – 01</td>
<td>Kifissia, Attica</td>
<td>Waste transhipment and compression</td>
<td>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 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</td>
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<tr>
<td>GR – 02</td>
<td>Thessaloniki</td>
<td>Waste transhipment and compression</td>
<td>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. 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.</td>
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<td>IRE – 01</td>
<td>Dublin</td>
<td>Glass Collection</td>
<td>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 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</td>
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<td>IT-01</td>
<td>Latium region, metropolitan area of Rome</td>
<td>INTERMODAL SYSTEM, ROAD-RAILWAY FOR THE TRANSPORT OF WASTE - AMA (Environmental Municipal Company) Rome</td>
<td>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. 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: <a href="http://www.amaroma.it/web/web2004/home.cfm?content=servizi/gestionerifiuti">http://www.amaroma.it/web/web2004/home.cfm?content=servizi/gestionerifiuti</a> <a href="http://www.amaroma.it/web/web2004/home.cfm?content=impiantitecnologie/innovazione_rifiuti">http://www.amaroma.it/web/web2004/home.cfm?content=impiantitecnologie/innovazione_rifiuti</a></td>
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<td>IT-02</td>
<td>Rome and other Italian cities</td>
<td>Waste collection with environment-friendly vehicles</td>
<td>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 of the Malagrotta dumping site and the methane gas production plant.</td>
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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.

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 transshipped 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 transshipped. Also traditional vehicles can be used, but then the waste needs to be transshipped 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 transshipment locations to pick up full containers and to deliver empty ones. The following figure presents the sailing network and the locations where containers are transshipped to/from the barge.

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<td>NL – 01</td>
<td>Randstad area</td>
<td>SHAFRA Zuid-West (Shift in waste transport modality in the Randstad area – pilot South-West)</td>
<td>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. 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 transshipped 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 transshipped. Also traditional vehicles can be used, but then the waste needs to be transshipped 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 transshipment locations to pick up full containers and to deliver empty ones. The following figure presents the sailing network and the locations where containers are transshipped to/from the barge.</td>
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At the end of the roundtrip the vessel goes to the processing plant where full containers are emptied again. The empty containers are 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.

ES – 01  Barcelona  Mallorca Stationary system.  Narrow streets and historical elements make it impossible to enter Palma de Mallorca’s 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 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
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<td>UK – 02</td>
<td>England and Wales</td>
<td>Sustainable Transport Resources and Waste Project, STRAW</td>
<td>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, 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.</td>
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ANNEX III: General situation within countries – ‘Experiments and incentives in favour of environment-friendly vehicles and equipment’

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| Austria | There have always been efforts to further develop alternative fuel systems, which were driven by the automotive companies and supported by the state; especially in individual transport and public transport (e.g. bus fleets). Transport and measures aimed at reducing the subsequent negative effects on the environment are dealt with in two key objectives of the “österreichische Nachhaltigkeitsstrategie (ÖNS)” [Austrian Sustainability Strategy]. Key Objective 14, “Shaping Sustainable Mobility”, focuses primarily on changes in “mobility pressures” caused by the spatial separation of functions (housing, work and leisure). Analyses show that in order to be able to transpose the bio-fuels Directive in the transport sector, it will be necessary to blend higher proportions of bio-fuels (than planned in the “National indicative targets for the minimum proportion of bio-fuels and other renewable fuels”) or market them in a pure form.

**National indicative targets for the minimum proportion of bio-fuels and other renewable fuels:**
The proposal from the Federal Minister for Agriculture, Forestry, the Environment and Water Management for the revision of the Fuels Ordinance provides that the following quantities should be substituted with bio-fuels or other renewable fuels: from 1st April 2005: 2.5%, based on energy content, calculated on the basis of the total petrol and diesel placed on the market in Austria in the transport sector each year, from 1st April 2007: 4.3% and from 1st April 2008: 5.75%.

**Measures to promote the use of bio-fuels in the transport sector are** tax exemption and substitution requirements: In accordance with Article 4(1)(7) of the “Mineralölsteuergesetz” (Mineral Oil Tax Law), fuels produced from biogenic substances are exempt from mineral oil tax. Substitution requirement: the proposal for Article 6a, which was amended in the framework of the draft report on the revision of the Fuels Ordinance, requires those who are subject to the substitution requirement to place on the market from 1 April 2005 a proportion of 2.5% bio-fuels or other renewable fuels calculated on the basis of the total energy content of the petrol and diesel placed on the market in the transport sector each year by those subject to mineral oil tax in Austria. This proportion should increase to 4.3% from 1 April 2007 and to 5.75% from 1 April 2008. Persons subject to the substitution requirement are any taxable persons in accordance with Article 22 of the Mineral Oil Tax Law, who are liable to tax for petrol or diesel in accordance with Article 2(1) and (2) of the Fuels Ordinance.

**Research & Development:** There are various research and development projects from automotive OEM’s – original equipment manufacturers in cooperation with research institutions, universities and the supply industry to develop new technologies. Concepts for implementing new systems on company level in broader scale are not known.

**EFV and urban freight transport:** there are existing fields of application of EFV in the context of urban freight transport. Most of theme are in the field of city distribution, city access schemes and environmental zone management.

Belgium

Belgium shows a lot of efforts to support and promote the usage of EFV, but mainly with focus on public transport and private car usage.

The « Direction Générale Environnement du Service public fédéral Santé publique, Sécurité de la chaîne alimentaire et Environnement » worked out a complete data base of clean cars, called « CO2 guide ». This guide is very handy as it helps the consumer to choose a clean and economical car that may benefit of a tax reduction. This guide includes information about the fuel consumption and CO2 emission rate of all “private” vehicles sold in Belgium since the end of September 2004. Since the first of January 2005, people buying a new car with a lower emission rate may benefit of a tax reduction:
- if the new car emits less than 105 grams of CO2 per km, the tax reduction equals 15% of the purchasing price, VAT included (with an upper limit of €3,280)
• If the new car emits between 105 and 115 grams of CO2 per km, the tax reduction equals 3% of the purchasing price, VAT included (with an upper limit of €615).

In order to encourage the member states to produce less polluting fuels, the European Union allowed them to resort to tax exemption for these fuels. In this context, the Belgian government adopted the principle of a tax exemption of 0.36€ per litre on bio fuels. This would bring the production cost of bio fuel at the same level as the one of gasoline.

**Initial Road Tax relief:** Vehicles whose engine is propelled with fuel or gasoline and are responding to the “Euro IV” norm may benefit from a reduction of the initial road tax relief. This tax reduction reached in 2003:
- 490€ for gasoline vehicles
- 249€ for fuel vehicles

- Vehicles equipped with a LPG system may benefit from a tax reduction of 298€.

All these measures aim at encouraging private people as well as companies to use clean vehicles.

### Bulgaria

There were on freight specific activities concerning EFV identified. Main focus of activities in Bulgaria is on the development of public passenger transport network and the vehicles used in this system. However Bulgarian universities and manufacturers take part in research and development of hybrid compulsion, filter systems etc. that can also be applied in freight vehicles.

### Czech Republic

In general, Czech public authorities support environment-friendly vehicle usage, proclaiming programs and adopting measures. In fact, financial support is addressed to the public passenger transport, it means to bus operators. The reason probably is, that government supports the public passenger transport as an alternative to the private cars usage, which is increasing continuously and causing environmental harms.

**Policy:**

The Czech government adopted “Assistance program for alternative fuels in transport – Natural gas” in May 2005. The goal is to substitute 20-23% of conventional fuels with alternative fuels by year 2020.

Up to now no incentive programmes for the usage of environment-friendly vehicles exist. In general, Czech public authorities support environment-friendly vehicle usage, proclaiming programs and adopting measures. The reason probably is that government supports the public passenger transport as an alternative of the private cars usage, which is increasing continuously and causing environmental harms. Since Czech Republic joined the European Union in May 2004, it will have to follow the European legal norm and strategies. The situation should become better in favour of EFV.

**Alternative fuel usage:**

**CNG:** The main obstacle for wider use of environment-friendly vehicles with CNG propulsion is the insufficient infrastructure of filling stations. Uncertainty of the future price development is another negative factor. In current time, about 250 vehicles use CNG propulsion. 150 of them are passenger cars and vans (pick-up) together and 100 are busses. There is only one lorry with CNG propulsion – it is special vehicle for waste transport.

**Bio-fuel:** is the most used alternative fuel in the Czech Republic.

There is currently only one private company providing waste transport that operates one vehicle with CNG propulsion and intends to buy more of them.

**Filling station net:**

CNG: 15 stations, 8 of the are public stations, 7 are private stations
LPG: 500 public stations, 200 of them are located in the usual petrol filling stations.

### Denmark

**Framework conditions:**

A special effort has been made in urban areas to minimise the effects of traffic on city and town environments. By the year 2010, the Government aims to reduce emissions of nitrogen oxides and hydrocarbons by 60% compared to the 1988 level and to halve emissions of particles from urban traffic during the same period.

The Government will consider ways of promoting the retrofitting of effective particulate filters in lorries and buses. The technology for the installation of filters has yet to be fully developed for diesel-fuelled vans and passenger cars, which account for some 60 per cent of particulate emissions. However, some new car models are equipped with filters.

The Government will consider how market-oriented measures can promote the sale of these models. Diesel cars are more energy efficient than petrol-powered cars and, therefore, cause lower CO2 emissions. On the
other hand, diesel cars cause higher emissions of nitrogen oxides (NOX), and particles.

Local initiatives:
Municipalities can utilise the possibilities in the Road Traffic Act to strengthen local initiatives for a better urban environment. The Road Traffic Act provides examples of possible pilot projects involving environmental zones and other initiatives.

Main initiative concerning urban freight started in 1993 on the initiative of the Danish Minister for Transport between Danske Fragtmaend and DSB Gods, the two largest collective distributors in Denmark. On the basis of their experience of daily distribution in city areas they set out to create feasible solution models which would benefit the local environment and also accommodate the interests of the local authorities, carriers and traders alike.

Exploration of other solutions and testing of alternative models in smaller city areas led three Danish municipalities – Aalborg, Aarhus and Copenhagen – to prepare a joint programme for the development of goods transport in city areas.

The primary objective is to create transport solutions to the benefit of the city environment in terms of road safety, air and noise pollution, accessibility, energy consumption, safety and the visual environment. This applies to transport of goods and services to and from city areas. This takes also into account the energy consumption of vehicles by a certificate that allows operators to enter those cities more easily and also a better capacity usage. The three cities have also embarked on trial development projects to test various models and parameters of city logistics.

The three cities and the Ministry of Transport have thus created a steering group which has established a joint forum – the Forum for City Logistics – with its own secretariat.

On the basis of practical experience the Forum is to investigate which environmental benefits can be gained by applying various distribution models with or without local restrictions.

Estonia
The Estonian Environmental Strategy, elaborated in 1996, identifies the principal environmental problems in Estonia, establishes short-term and long-term objectives and activities to tackle these problems and proposes economic and institutional reforms in environmental management. The Strategy declares that in the near future, the quality of air in the towns and the health of people will highly depend on the number of vehicles, regulation of traffic and the quality of fuel. Within the urban freight domain no projects and concepts in favour of EFV do exist.

Finland
There is already a long tradition in Finland for the production and the experimental use of electric vehicles and also for the research and development of alternative fuels. Both of these activities have been started because of concern on environmental degradation among administration and companies as well as other citizens.

Technology needed in electric vehicles has been available for a long time therefore commercial production of electric vehicles – suitable also for urban freight transport – has already started in Finland. There is also a usage of electric vehicles in urban freight transport but to a lesser extend. The development of alternative fuels has been more complicated and no commercial activities in urban freight transport exist. However, various research projects on alternative fuels have been carried out mainly by VTT, and a part of Helsinki bus fleet is regularly using CNG. One of the issues which have been considered in the development and research work is severe winter conditions in the Nordic countries.

The failure for the wide use of electric vehicles is clearly a technical one: the short mileage provided by one charging of batteries together with the excess weight of batteries and relatively high purchase prices. A wide use of alternative fuels is still waiting for suitable commercial solutions. There are a lot of hinders including the inertia from the current oil-based fuel supply system and the limited advances provided by the alternative fuels.

Standard cisterns of LPG are available everywhere in Finland, because they are already used for various purposes like heating or cooking. No filling station network for other alternative propulsion vehicles exists.

The awareness for environment-friendly vehicles is still low. Low level of air pollution together with modest congestion has not given impetus for major actions. However, in the future increasing oil prices may increase the interest.

France
Awareness: Awareness is growing rapidly in France, especially regarding health problems caused by air quality and noise emissions. This awareness does not appear yet to be sufficient to drive local politicians to implement local access regulation in favour of EFVs.


**Experiments for freight EFVs:**

Current experiments for freight EFVs can be divided into 5 categories.

1. **Experiments of CNG and electric trucks in Paris**

They all benefit from promotional help from the City of Paris, which has been a key player in initiating the experiments.

- **“Green truck” experiment (electric).** Led by Gefco (transport operator) for the transport of L’OREAL products to retailers such as hairdressers, cosmetics and department stores in the centre of Paris. They benefit from a financial support from ADEME and a label from the City of Paris.

- **CNG test from DHL.** This CNG 3.5t van (Iveco Daily) is currently being tested in the Paris region.

- **CNG trucks for Monoprix (a dominant supermarket chain in Paris) deliveries.** Two CNG trucks (Iveco, 19 tons) have been tested since 2003 to deliver goods to Monoprix stores. A bigger scale experiment will start in January 2006 with 50 to 60 more trucks. Geodis, Staf and GT Location are the three transport operators which will be using the vehicles. Vehicles are 21 pallet trucks. Overcost is 50 000 €, including 10 000 € for ‘noise reduction equipment’. Interestingly enough, operational costs for these vehicles have been estimated so far as 20% higher than diesel trucks.

- **CNG trucks for Carrefour, operated by TNT.** Two CNG trucks have been tested in 2003-2004 in Paris. Their environmental performance has been compared to 2 diesel trucks run in the same conditions. The results of the comparisons are not available yet.

- **CNG vans (PSA Citroen, 3.5 tons) for the deliveries of OOSHOP (a Carrefour ecommerce subsidiary) and Monoprix.** These vans are operated by STAR SERVICES (a home delivery transport operator). Currently being tested. No results available yet.

2. **La Rochelle ELCIDIS experiment since 2001**

3. **Projects to implement truck access regulations based on environmental criteria.**

Very few French cities have integrated environmental criteria within their truck access and delivery regulation. Langres, since 2003, authorises all electric and CNG delivery vehicles to access the city between 9:00 and 22:00 (while regular trucks are prohibited). Paris and Lyon plan to introduce a regulation based on the age of the vehicles or the Euro standard. These two projects are not effective yet.

4. **Electricité de France activities for electric delivery trucks.** EDF has been sponsoring experiments of urban deliveries with electric vehicles using a Midium 10t PVI (with a Renault chassis). Its “e-lease” and “SODETREL” subsidiaries help potential users test electric delivery vehicles. A partnership with Bollore group to develop lithium air batteries has been established. In the short to medium term, EDF is developing a 3.5 ton delivery vehicle. EDF is an active member of the French Programme national “Marchandises en ville” (national program on goods in cities).

5. **Other experiments (not 4 wheel vehicles) :** electric bikes with containers (La Petite Reine, which is presented in a specific file) and innovative container technology (Chrono City, which is presented in a specific file)

**National programmes:** The national program on goods in cities (Programme national “Marchandises en ville”). ADEME (Agency for the Environment and Energy), Electricité de France and Gas de France have been promoting and financing research and experiments for cleaner trucks.

On a more global level, the national Plan Vehicules Propres (Clean Vehicles Program) has been launched in September 2003 by the government. The measures which have a direct impact on urban freight include: 40 M€ on R&D (2004-2008) for developing public and private research efforts on clean vehicles (motors and fuels, electricity storage, fuel cells, noise reduction, demonstrators and experiments); Reinforcing tax incentives for buying clean vehicles (these tax incentives have been existing for about 10 years, for all CNG, LPG and electric vehicles); Subsidy of 3’000 to 4’000€ per vehicle.

**Experiences:** On the whole, limited loading capacity and the high price of the vehicles have been a major drawback for the use of electric delivery vehicles. For CNG vehicles, cost is also a problem, and some technical reliability issues have been mentioned. More “niche” experiments (La petite Reine, Chrono City) have proven very reliable and satisfactory. However, they have a very limited perspective of market share.

**Filling station net:** LPG filling facilities do exist in a rather extended number of regular gas stations (about 2000 in the whole of France). As far as CNG is concerned, the filling station network is still rather small. It is mostly based on the existence of a public transport CNG bus network. More common is the availability of
<table>
<thead>
<tr>
<th>Germany</th>
<th>Alternatively propelled vehicles became of great importance in the late 80 and beginning of the 90s of the last century. To that time increasing awareness on environmentally issues especially in city areas favoured research and funding for environmentally friendly vehicles. Various technologies and fuels were tested and evaluated systematically in particular with regard to the environmental and operational performance parameters. Similar experimentations were carried out using different kind of Biodiesel, LPG, Biogas etc. In 1995 DaimlerChrysler started the NECAR project using methanol and hydrogen as alternative fuel. Since 2000 first demonstration vehicles are available.</th>
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<tbody>
<tr>
<td><strong>Current situation:</strong></td>
<td>Presently it is to state that most common alternatively fuelled vehicles operating in urban area are CNG propelled vehicles. About 30,000 vehicles are operating in Germany and the CNG fuelling infrastructure is continuously growing (about 600 stations), mainly in densely populated areas. Goods vehicles offered on the market are mainly vans, light trucks and waste/municipal trucks suited for urban commercial and goods transport operations. With regard to the hydrogen technology first prototypes are developed and the first fuelling station opened in Berlin in 2005 (<a href="http://www.cep-berlin.de">www.cep-berlin.de</a>). The incentives provided to use alternatively fuelled vehicles are:</td>
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<td></td>
<td>- Reduced fuel tax; CNG vehicles are charged with a reduced fuel tax up to 2020, for LPG up to 2009</td>
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<td>- Reduced vehicle taxes, due to the low exhausts of CNG engines fulfil already Euro 4 norm by reduced vehicle tax rate</td>
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<td>- Grants for vehicle investment, up to 10% offered by the Minister for environment</td>
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<td>- Reduced interest rates for vehicle investments provided by the national development bank (KW and ERP)</td>
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<td></td>
<td>- Grants from regional gas providers, e.g. in terms of tank vouchers or direct grants</td>
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<td></td>
<td>In addition 2 CIVITAS projects in Bremen (VIVALDI) and Berlin (TELLUS) are running providing incentives for clean fleets, both passenger and goods transport. The experiences made with using alternatively propelled vehicles in urban goods transport are various. Result of the research activities are that rather good evaluation results on the different technologies exist contributing to the development of the national fuel strategy. With regard to urban goods transport CNG is favoured by operators. However, various praxis tests showed that for these vehicles higher annual overall costs are to recognise (about 1000 Euro per van and year depending on the vehicle) as well as problems in the performance and reliability are to recognise. However, with the grants provided and the increasing fuel infrastructure CNG will be the most promising alternative fuel and propulsion technology to be employed in goods vehicles in German cities.</td>
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<tr>
<td><strong>Research:</strong></td>
<td>On industrial as well as on governmental level there are many research activities going on in Germany.</td>
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<td></td>
<td>- For the promotion of CNG vehicles in goods and commercial transport fleets a programme was set up by the Minister of Environment to support the purchase of CNG vehicles &quot;Für die letzte Meile auf die sichere Seite&quot;. The commercial and goods transport fleet of different companies was (partly) converted due to this programme (e.g. TNT or T-COM).</td>
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<tr>
<td></td>
<td>- In 2002 the Clean Energy Partnership was initiated. This European demonstration project was established with support from the German government by the partners Aral, BMW Group, Berliner Verkehrsbetriebe (Berlin Public Transport– BVG), DaimlerChrysler, Ford, GM/Opel, Hydro, Linde and Vattenfall Europe. In 2005, TOTAL joined CEP. The aim in Berlin is to show the system viability of a range of readily developed technologies. The technologies include the – decentral – production of gaseous hydrogen by electrolysis respectively by reforming of LPG at the filling stations, plus the central extraction of liquid hydrogen in an external production facility, as well as its delivery to, and storage at, the station. The goals are to test the viability of commercial production and distribution of hydrogen from renewable energy at a commercial filling station in daily operation, to achieve rapid hydrogen fuelling and to demonstrate the everyday use of high-performance vehicles approaching series production quality.</td>
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<tr>
<td><strong>Awareness:</strong></td>
<td>Alternatively propelled vehicles will become of more importance in the future as administrations have to take care and guarantee high air quality standards in the future. Beside that alternative fuels, e.g. CNG are</td>
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</table>
cheaper than Diesel making this propulsion technology attractive for operators. Furthermore, the number of CNG fuelling station will further increase.

| Greece | Vehicles using CNG are in use since 2000, for public passenger transports in Athens. 300 vehicles on basis of CNG are in operation. Initiatives have not taken place for urban freight transports till now. Having the first successful example of the CNG buses and under the pressure to substitute conventional fuels, plans for new vehicles for local public transport and waste disposal are in a premature stage of development by some local authorities. The only measure promoting urban freight transport by using EFV is an access restriction measure. In order to reduce SMOG, light trucks and vans using diesel are forbidden to enter the cities of Athens and Thessalonica. The current plans for environment-friendly vehicles do not focus on freight transports. The general plans concern the production of bio fuels in Greece and the elimination of taxes for the environment-friendly fuels and vehicles. These measures are expected to affect freight transport too. |
| Hungary | Framework conditions: The main priorities of the Hungarian Transport Policy can be described by “Developing an environmentally friendly transportation system through environmental measures and preferences for environmentally sensitive approaches.” Moreover “The social, economic and ecological effects of transport cannot be separated from one another. All three aspects must be given equal consideration in designing transport policy, development, and regulation. The transport policy proposes to use the following tools for sustainable growth: …Introduce technical and economic measures directly targeting the reduction of pollutant emissions; modernize vehicle fleets to meet progressively adopted EU emission norms; improve fuel quality by encouraging alternative energy carriers and programs supporting the replacement of an aging vehicle fleet.” The environmental situation of Hungarian cities is not the best compared to other European cities. It became better in the last years of the 1990ies by a forced energy policy with focus on reduction of energy consumption and modernisation of industrial production processes and private households’ heating systems. The following cities are known as the most polluted ones: Budapest, Szeged, Sopron and Esztergom. In all four cities the 24-hour air quality limits were exceeded. The ambient air quality was adequate only in 50 communities out of 109. In Hungary recently almost all air quality protection legal regulations were completed and came into effect, which comply with the European Union’s law harmonisation requirements. Research activities: In this theme the following research projects was reported by the Institute for Transport Sciences (KTI). Most of those research activities are with focus on vehicles technology: ▪ Considering the possible applications of bio-ethanol in Hungary as the fuel for the operation of vehicle. ▪ The possibilities of the utilisation of environmentally friendly electric vehicles and their conditions in a special environment. ▪ Investigation of fine and ultra fine particle emissions of diesel engines (development of EU compliant background for the measurement techniques). Usage of EFV: There are a lot of efforts to stop increasing air pollution. EFV are one main important issue. There are existing concepts for the usage of EFV mainly in the field of public transport. But until now no city logistics concepts exist taking the usage of EFV into account. |
| Ireland | While there is recently a welcome awareness at political level of the need to encourage EFVs, the activities on the ground are still on a pilot scale. It is hoped that the Irish Bio-fuels programme will grow substantially and that excise relief will be more widely available to encourage a major expansion of the supply. Significant excise and tax incentives would be needed to encourage the Irish market for LPG and for CNG because the price differentials with conventional fuels are too low. The focus on Irish policy regarding the usage of environment-friendly fuels is on biofuels. Over 6 million EUR in excise relief will be permitted for the production of 16 million litres of biofuels under the scheme over a two year period commencing in 2005. The granting of excise relief for these projects will help to kick start Ireland’s biofuels market and will provide valuable insights and experiences for biofuel operators and policy makers, for the development of a sustainable long term biofuels sector in Ireland. |
Regarding the operation of EFV there are no efforts in Ireland until now. Main focus has been on the usage of EFV in public transport or by LGV.

Access regulations for city centres – these may be considered for low noise vehicles under the programme of RTD into Low Noise/Low Cost Solutions for Night Distribution.

### Italy

**Framework conditions**

The critical environmental situation in many Italian urban realities is doubtless, especially in certain areas like the Po Valley, where in 2004 the number of times the damaging concentration limits were exceeded was higher than that allowed by European regulations on the quality of the air. The part of freight traffic in the major cities generally exceeds 20%, it is usually carried out on an own-account basis using vehicles with a capacity of no more than 3.5 tons and with a considerably higher age than the European average.

In almost all the main Italian municipalities, at least 40-45% of light vans are PRE-EURO type-tested (2003 figures). Therefore, an extremely polluting commercial fleet, above all in reference to PM10.

According to estimates of the Tuscany Regional Council, in the urban environment, transport accounts for over 50% of the emissions of PM10, over 50% of which is caused by light commercial vehicles (2001 estimates).

Over the past few years the Ministry of the Environment and Protection of the Territory (MATT) has promoted a number of ventures and projects aimed at reducing the environmental impact and energy consumption levels deriving from the urban traffic of persons and freight transport.

The list below in chronological order contains the main government actions co-funded by the MATT (Ministry of the Environment and Protection of the Territory) for sustainable urban mobility involving promotions or incentives for the use of environment-friendly vehicles:

- **1993 – 1994–1996 three-year Environment Protection Plan that provided funds for the purchase of environment-friendly vehicles in the aim of “cleaning the atmosphere and lowering noise levels in urban areas”**:  
- **1996 – Programme agreement between the Ministry of the Budget and Economic Programming and FIAT for activities in the research, experimentation, production and distribution of environment-friendly vehicles;**  
- **1999 – Transitional environment protection programme which has provided funds for 32 local authorities also for purchasing fleets of electric and methane vehicles;**  
- **2000 – “Environment-friendly Sundays” Ministry’s Decree – Structural actions that provided funds in favour of local authorities for the promotion of the use of environment-friendly fuels;**  
- **2001 – “Environment-friendly fuels” venture – ICBI, Agreement Protocol between the MATT – Municipalities at risk of atmospheric pollution – Associations of the methane/LPG sector (system manufacturers and installers) which made available funds to be allocated to private citizens residing in the participating Municipalities for conversion to methane gas or LPG of petrol cars registered between 1988 and 1995 (contribution of 309.87 euros/vehicle) and contributions to the cities for the development of the methane/LPG filling station network.**  
- **2000 and 2002 – Radical programmes for sustainable mobility in urban areas.**  
- **2001 – Programme agreement between the MATT – FIAT – UNIONE PETROLIFERA which aims to encourage the spreading of methane in the main Italian urban areas, specifically in favour of its use in city freight transport, taxis, buses, waste collection vehicles together with stepping up the number of filling stations for this “clean” fuel. The agreement involved a total financial commitment of approx. 578 million Euros in the 2002–2005 four-year period.**  
- **2005 – Programme agreement of 19/10/2005 between the MATT and the categories involved to encourage the conversion of Euro 1 and Euro 2 petrol vehicles to methane or to LPG. The incentives, amounting to 350 euros/vehicle, will be available as from December 2005. The total sum allocated amounts to 15 million euros. Another 5 million euros will be set aside to finance the construction of new gas filling stations.**

Other local ventures worthy of mention include:

- participation of a number of Italian cities in the European CIVITAS project (Genoa, Rome, Venice, Potenza). In particular Genoa has implemented interventions for urban freight transport involving the use of environment-friendly vehicles (see sheet).
- participation of the Emilia Romagna Region in the European CITYPORTS project. Within this project,
certain key concepts have been highlighted in logistics management in view of environmental sustainability, including the importance for public administrations to plan, along with restrictive traffic regulations, facilitations for environment-friendly or small-sized vehicles, or those used for transport on account of third parties (generally more efficient and with a younger fleet), such as:

**Lithuania**

**Focus:** Main development concerning EFV is the increasing use of Euro1, Euro2 and Euro3 standards in total freight vehicles fleet owned by Lithuanian carriers. Implementation of these and other innovations has economical rather than concern about surrounding environment base. Most of the environmental friendlier vehicles are used only for international haulage, while carriages on the urban transport level in most cases are performed by these, not certified, vehicles.

**Awareness:** General level of awareness can be presented as quite high on the level of national legal bodies, since after entering the EU, Lithuania is obliged (TREATY OF ACCESSION TO THE EUROPEAN UNION 2003) to increase share of bio fuels up to 2 percents till end of 2005. By the 2010 12 31 this share should increase up to 5.75 percents. Because of that reason, “Statute on bio fuels” foresees responsibilities and duties of legal bodies assuring all the measures required to promote and control manufacturing of bio fuels. But the main failure factor could be the lack of measures to persuade road freight carriers to use alternative fuels.

**Activities and their effect:** There are no experiments in this particular field of EFV and no specific programmes and financial support measures that would promote the use of EFV. No private activities can be observed (except for passenger carriers).

There is an indirect measure in favour for EFV: The main incentive programs that concern with EFV are related to promotion of production of bio fuels. The main document in this field is “Law on bio fuels” accepted in 2000 and corrected in 2004 (Regulation Nr. VIII-1875/2004 02 05). This statute foresees special support measures for the producers of bio fuels as well as some particular measures to the users of bio fuels. Among the users of bio fuels there are no road freight carriers so far.

**Filling station net:** Currently there are 11 filling stations that provide vehicles with bio fuels. All these filling stations belong to “Lukoil Baltija Servisas”.

**Poland**

Today the use of EFV in urban freight transport is not very widespread. Main EFVs are used in the field of public transport or private car usage. Nevertheless alternative fuels become more and more of interest because of growing fuel prices and the dynamic development of the LPG branch.

LPG (propane-butane) is used especially in passenger cars and delivery vans (up to 3,5t). The reason for that is low costs of gas fittings and low price of the gas itself. Dynamically growing prices of petroleum were the reason why in short time Poland has become a Europe leader in a number of LPG cars (over 2 000 000). LPG cars are used in city logistics by individual private individuals and companies but there is no reliable data about it. Moreover, LPG is not used in municipal vehicles.

CNG is not popular in Poland. The reason for that is small number of CNG refuelling stations and high cost of gas-fittings.

**The Netherlands**

**Framework conditions:**

Many municipalities are increasingly confronted with bad environmental conditions due to high exhaust gas and noise emissions, even in less densely populated areas that have not been considered problem areas before. In the recent past some municipalities had to postpone new housing and infrastructure projects because European environmental limits would be exceeded.
### Policy initiatives:

At national level policies have been defined to develop and stimulate cleaner and safer vehicles. The new Order in Council aimed at controlling noise levels. The Order in Council is mainly concerned with noise levels caused by retailers and trading businesses loading and unloading their goods in built-up areas during the period from the evening to the early morning.

In the Netherlands, experiments and incentives concerning the main environmental effects of urban freight, pollutant emissions and noise, are dealt with separately within the SenterNovem organisation. SenterNovem is an agency of the Dutch Ministry of Economic Affairs for implementing policies on innovation, energy and climate, environment and spatial planning. By clustering knowledge, SenterNovem aims to strengthen the economy through sustainable development and innovation.

The noise emissions are treated in the PIEK (Eng: PEAK, means peak noise levels, in contrast to continuous noise levels) programme. Given the products currently used, industry and commerce cannot comply with the stricter standards. These noise emission standards are forcing shops and the transport sector to come up with innovative measures. At the same time, however, it must be possible to implement these innovations both technically and economically within a few years. The Ministry of Housing, Spatial Planning and Environment, the Ministry for Economic Affairs and the Ministry for Transport, Public Works and Water Management introduced a long-term PIEK (peak noise) programme in 1999 in order to bring about the necessary technical adjustments, by tackling the source, the materials used when loading and unloading goods and the loading-unloading locations. The long-term PIEK programme comprises 10 main projects.

Within SenterNovem the pollutant emissions are the working area of the DEMO (Demonstratieprojecten Mobiele Bronnen, Eng: Demonstrator projects mobile sources) program. This project was intended to encourage the market introduction of clean and fuel efficient vehicles (and vessels). The DEMO project was targeted at removing barriers that withhold the market introduction of cleaner and more efficient vehicles. The program contains vehicle concepts, knowledge transfer projects and the Platform Cleaner Vehicles. Until advice and financial support was given. After 2003 the financial support options were stopped.

Based on the success of PEAK and DEMO the awareness for these kinds of initiatives has grown. Apart from subsidies for acquisition of cleaner vehicles some cities have carried out tests with vehicles driving on alternative fuels. The Netherlands has a dense network of liquid gas fuel. A small number of filling stations for other fuel types is present.

### South-Africa

Recently the Department of Minerals and Energy (DEM) was charged with creating the Energy Efficient Strategy (EES). The Strategy takes its mandate from the White Paper on Energy Policy published in 1998.

The Strategy allows for immediate implementation of low cost and no cost interventions as well as high cost measures with a short pay back period. One of the numerous goals of the Energy Efficient Strategy is to reduce transport related pollutant levels by reducing the combustion of petroleum products in motor vehicles. A 9% reduction in transport energy demand, especially from fossil fuels by 2015 has been put forward.


The Vehicle Emission Strategy (VES) sets out a road map for government, the oil industry as well as the vehicle manufacturing industry aimed at achieving improved air quality through the control of vehicle emissions. The backbone of this strategy is the implementation timetable of clearly defined European standards for vehicle exhaust emissions and appropriate fuel specifications. Initial vehicle emissions limits began in 2005 for newly homologated vehicles and will come into full effect in 2006 when all new vehicles will be subjected to emissions controls. The fuel specification will change in 2006 when a total ban on the use of leaded petrol will come into effect. Other environment-friendly vehicle/equipment related interventions that have developed in South Africa include the use of alternate motor fuels such as liquefied petroleum gas (LPG), coal to liquid fuels (CTL), biomass to liquid fuels (BTL) and the zero emission car which will be discussed in greater detail later in the document.

The motivation for the recent emissions legislations, the use of alternative motor fuels and other technological initiatives was not only as a result of environmental and health issues but economic issues in the light of energy savings and the unsustainability of current energy consumption practises. Government was also concerned about the high dependency of the economy on crude oil and in containing its impact, South Africa needed to develop its own energy management strategy. The efficient energy strategy also tied in with addressing the environmental issues of reducing fuel pollutants and therefore also addressed health and social issues.
### Slovenia

The development of environment-friendly vehicles in Slovenia was and still is narrowly connected with the ECE/UN, EEC directives and currently with EU directives. After the accession the motor vehicles had to meet the tightened emissions limits EURO I – EURO IV.

In Slovak Republic are presently existing plans of action, research and support programs, which solutions, within the legislative arrangements, are directly or indirectly focused to support the increased alternative fuel usage in transport, as well as the energetic efficiency of passenger and goods transport.

**Framework conditions:**

- *The plan of action in transport and environment area* – the plan includes the actions concerning the energetic and environmental transport strategies, they are focused on e.g. the analysis of current status and the proposal of programs for energy consumption reduce in transport sector.
- *Slovak Republic’s transport policy* – the merit of transport policy is the permanent sustainable development in the economic, social and ecological term.
- *Program for rationalization of fuel and energy consumption in transport* – includes except analytic materials also the principles and arrangements summary in transport sector, which should help to the energy severity reduce as well as reduce of negative transport impacts on environment.
- *National program of bio-fuels development* – objective of the program is to work out a national program proposal and to create incentive economic and legislative conditions for the accomplishment of indicative objectives presented in 2003/30/EC directive.

**Usage of alternative fuels and infrastructure:**

From the alternative fuels, LPG and CNG are being used in Slovak Republic. A filling station for LPG is located nearly in every city. This type of alternative fuel is used mainly by passenger cars. CNG, this type of alternative fuel is typical for bus transport, especially for urban bus transport in bigger cities. The CNG filling stations network includes 6 distributing places/statations (Bratislava, Nitra, Zvolen, Poprad, Košice, Michalovce). Examples for the usage of alternative fuels in freight transport are not known so far in Slovak Republic.

### Spain

In a general framework there is a Plan for the Promotion of Renewable Energy approved in December 1999, but the fact is that the repercussion in the transport is not significant. As exception, the Plan RENOVE tried to encourage the replacement of old cars to achieve environmental improvements and the renewal of heavy vehicles fleet.

Nowadays, the experiences that include the environment-friendly vehicles are related mostly to public transport: Barcelona, Madrid, Valencia, Malaga, Pamplona. As any city in an industrialised country, the ecological situation in the Spanish cities is characterised by a high contamination (11% CO2 causes by transport) or noise emissions (approx. 55 dB in urban areas). The congestion situation in similar as in other countries. The freight transport means aprox. 12 – 15% road traffic. According to the last information from the National Institute for Statistics, transport caused 24,4% CO2 emissions. The major efforts in Spain are required to reduce this emission to achieve its EU burden-sharing agreement to limit its GHC ones at 15% above the 1990 level by 2008-2012. Some big cities are implementing AGENDA 21 protocol, for example Alicante, Avila, Barcelona, Madrid, Valencia, Vitoria, Valladolid, etc. This trends improved the situation in small cities as well. Some measures are associated to increase the energy efficiency of road transport services (implemented by Ministry of Promotion) or the tax reduction for environmental friendly vehicles or for bio-fuels and tax rise of fossil fuels (adopted by Ministry of Finance).

The fact is that the environmental priorities are focused to other items, and not to the freight transport in the
In ratifying the Kyoto agreement Switzerland has committed itself to a ten percent reduction of fossil fuel consumption from the 1990 level by the year 2010. The Swiss Federal Office of Energy (SFOE), the Federal Office for the Environment, Forests and Landscape and the Federal Office for Regional Planning share responsibility for efforts to reduce fossil fuel consumption. The potential for reduction is particularly great in the field of transport, which accounts for roughly a third of the total demand, almost exclusively consisting of fossil fuels. Mobility is therefore a key sector.

In Switzerland 36% of the total fossil energy consumption is caused by road transport. Especially in cities the situation is critical. In Zurich a main problem is caused by urban freight transport. The special historical situation and the road system cause congestion and noise and air pollution. The transit traffic from the north of Switzerland and Germany to the South Eastern Countries (highway to Chur) is directly passing the city centre. In Basle the old city centre shows problems in delivery and the highway link from Germany/Italy to Switzerland/Italy passes Basel. Most of the Swiss cities are characterized by historical centres with old buildings and a small building structure and narrow streets. In Canton Ticino the problem of climate and air pollution from neighbouring Milano often leads to SMOG-situations and critical ozone pollution.

The SFOE is responsible for SwissEnergy, a government programme that promotes renewable forms of energy and efficient energy use. This programme involves the cantons, numerous municipalities, the energy industry, environmental and consumer organisations. In the area of road transport, measures aimed at achieving the required reduction include regulations and, in particular, a goods declaration that has become compulsory for new cars on 1st of January 2003. An agreement with the Swiss association for car importers to reduce fuel consumption of new cars to an average of 6.4 litres per 100 km by 2008 and criteria concerning energy consumption of motor vehicles together with a variety of incentives are other important measures. The Swiss Association for Electrical and Efficient Road Vehicles e’mobile (http://www.e-mobile.ch/) has the objective to promote and support environment-friendly vehicles. The activities are basically on sensitisation of people regarding the practical application of those vehicles. E’mobile and its partners are supporting a project called EcoCar; EcoCar is a common project for the promotion and marketing of efficient vehicles. EcoCar offers a platform for political authorities, associations and the research community.

The filling station net for environment-friendly vehicles covers today 200 public loading stations for electric vehicles and about 50 natural gas stations and LPG-stations.

There are a lot of efforts and supporting measures to launch projects with direct regard to environment-
friendly vehicles. But there are nearly no examples and research efforts in the field of urban freight transport and logistics. Two examples of using environment-friendly vehicles are the tourism villages of Zermatt and Saas Fee. In those villages it not allowed to use cares wit traditional combustion. For goods and person transports electric vehicles are used. A part of the goods supply takes place by train. But it has to be mentioned that those villages have no typical city characteristics and therefore can not be taken as example for urban freight transport.

In the field of transport technologies (equipment) more concrete projects in the field of logistics with regard to city logistics have been initiated. One project for example has been the Combibox-system.

### United Kingdom

Most of the efforts in the UK to research, promote and encourage the use of environmentally friendly goods vehicles have taken place at a national Government level. In July 2002, the UK Prime Minister launched the Powering Future Vehicles Strategy (PFV), which “seeks to ensure that the UK will lead the global shift to clean, low-carbon vehicles and fuels, reduce transport’s impact on the environment globally and locally, and build competitive advantage for UK auto industries” (DIT, Consultation on the Transport Energy Clean Vehicle Grant Programmes, 2004).

The objectives of the Powering Future Vehicles strategy are:

- to promote the development, introduction and take-up of new vehicle technologies and fuels;
- and to ensure the full involvement of the UK automotive industry in the new technologies.

In addition, the UK Government is intending to set carbon targets for heavy and light goods vehicles as part of the PVF strategy.

**Key incentives and programmes** promoted by the Government in the UK to encourage the use of environmentally friendly goods vehicles include:

- Government fiscal measures: The UK Government introduced tax incentives from 1 January 1999 to tackle the problem of traffic pollution. Operators of commercially operated goods vehicles over 3.5 tonnes gross weight whose vehicles have either been modified by fitting an approved device to the exhaust system, been re-engineered to a higher environmental standard or fitted/ converted to run on petrol or gas may be eligible to be licensed in new taxation classes with lower rates of Vehicle Excise Duty (VED). These are known as Reduced Pollution rates. These rates are available for new vehicles that meet the required emissions criteria, and also for existing vehicles that have been retro-fitted to the required emissions criteria. Reduced Pollution rates vary according to vehicle size. The concession is currently worth up to a maximum of £500 for goods vehicles. The most significant savings are for goods vehicles over 21 tonnes revenue weight.

- the Low Carbon Vehicle Partnership (LCVP), which brings together the vehicle and fuel industries with environmental and other stakeholders and the Government: The Low Carbon Vehicle Partnership (LowCVP) was launched by the UK Government in January 2003 as part of the Powering Future Vehicles Strategy. Its role is to take the lead in the shift to clean low carbon vehicles and fuels in the UK. LowCVP is a partnership of organisations from the automotive and fuel industries, Government, academia, environmental NGOs and other stakeholders who are working together on shared goals to make the shift happen.

- the TransportEnergy grant programmes (which includes Powershift, CleanUp and the New Vehicle Technology Fund (NVTF): The TransportEnergy grant programmes are an important element of the UK Government’s and devolved administrations’ strategy to reduce emissions from road vehicles. The aim of the programmes is to help the market for clean, low carbon vehicles and technologies develop. The three programmes are:
  - PowerShift – which provides grants towards the additional purchase costs of new electric, hybrid (i.e. diesel or petrol/electric), and gas powered vehicles
  - CleanUp – which provides grants towards the costs of purchasing and fitting emission reduction equipment, such as particulate traps, to existing, mainly diesel vehicles and
  - The New Vehicle Technology Fund (NVTF) – which provides grants to developers for the production of demonstration models of clean, low carbon vehicles and technologies.

Also city authorities have attempted to improve the number of environmentally friendly goods vehicles through purchasing such vehicles for their own use: Scarborough (battery promenade/city centre refuse vehicles), Hull (various), Sheffield (various vans on alternative fuel), York (Load-bikes parcel couriers) or Bristol (Electric.
London has exempted vehicles (also heavy goods vehicles) from congestion charge. This incentive has been made for vehicles with the following characteristics:

- Vehicles manufactured or converted to run on alternative fuels (that meet emissions standards devised by the UK Government)
- Vehicles wholly powered by stored electricity (that are licensed with the UK Government as “electric” vehicles)
## ANNEX IV: Collected case studies (projects-level) – Experiments and incentives in favour of environment-friendly vehicles and equipment

<table>
<thead>
<tr>
<th>Code</th>
<th>City/Region</th>
<th>Name of concept</th>
<th>Description of concept</th>
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<tr>
<td>AT – 01</td>
<td>Vienna</td>
<td>Clean city traffic</td>
<td>Clean city traffic is a field trial of ecological and economical efficiency of NGVs in parcel distribution. The project started in 2004. The study was made in collaboration with the project “clean city traffic”, sponsored by ÖAMTC Akademie, General Motors Austria, DHL Express and OMV Gas. For the first time on board emission measurement on comparable vans from the type Opel Combo were made by the technical university on Vienna. A realistic trip of the parcels delivering company DHL was fixed and comparable vans with Diesel, Gasoline and Natural Gas engines were measured during the trip on board. The result is convincing for natural gas as a vehicles fuel. Especially the comparison for CO2 emissions were surprisingly clear in favour of natural gas compared with diesel. Of course the results for NOx were excellent and also the particle emissions were convincing. The realised perceived benefits have been: lower costs, stable service and less reductions.</td>
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<td>AT – 02</td>
<td>national</td>
<td>A3 – Austrian Advanced Automotive Technology</td>
<td>A3 is a national programme started in 2002 with duration of four years. Automotive Industry and especially alternative fuel systems and environment friendly vehicles are regarded as a key branch for the future. On national level the decision was made, that a funding programme for innovative research and development projects is needed, in order to enforce cooperative innovation in that field. The aim is to fund projects that support the following goals: clean, safe, quiet, intelligent, flexible, comfortable, vehicle concepts for person as well as goods transportation. The programme was initiated by the Austrian Ministry of Transport, Innovation and Technology. The focus of the programme is to support and fund actors to start innovative projects. The programme is open to all actors in automotive industry, research and development institutions as well as universities. The programme will be extended as there is high interest from industry and public authorities. Also a first “Lead Programme” specially focused on alternative fuels has been started, in which more specific project shall be generated in the future. This programme is called the “Austrian hydrogen- and fuel-cell initiative”. The realised benefit is that research and development in the field of alternative fuels and environmental friendly vehicles has been increased. Studies and surveys have been conducted, and various trials and demonstration projects are the basis for further development. This programme has positive impact on all involved parties, as industry is constantly developing in the field of EVV and alternative fuels, service providers and potential users are willing to gain their first experiences with test and trial projects and the public will have benefits from innovation that will be available on market earlier.</td>
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<tr>
<td>BG-01</td>
<td>Sofia</td>
<td>Development of high performance energy storages for mobile and steady state applications</td>
<td>Three concrete R&amp;D projects (with participation of University of Transport) which will be executed within the framework of the COST 542 Action Project 1: Development of a low emission/emission free hybrid vehicle based on the implementation of stacked high voltage super-capacitor modules (breaking energy recuperation and peak power supply).</td>
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<td>CH – 01</td>
<td>Zurich</td>
<td>IDIOMA, COMBIBOX-System</td>
<td>Within the EU-project IDIOMA a combibox-system for intermodal transport has been developed and tested with the aim to reduce vehicle mileage and to improve the overall capacity usage in pre- and end-haulage.</td>
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<td>CZ – 01</td>
<td>Prague</td>
<td>Vehicle for transport of waste with CNG propulsion</td>
<td>Since 2004 the municipal waste transport operator of Prague started a trial by using a vehicle on basis of CNG. The reasons for this operation are image wins and environment-friendly operation in the city centre. Prague has the highest level of air pollution in the Czech Republic. The trial brought good results. The company intends to purchase two new vehicles every year. The main problem is the price for such a vehicle. The original CNG refuse collecting vehicle costs 900 000 CZK (30 000 EUR) more than the usual refuse collecting vehicle. There are not any incentives for purchase of these vehicles. The company tries to get a sponsor, probably a gas company. Another problem is the law density of the refuelling infrastructure. There are only 2 charging plants in Prague. The vehicle is able to run 240 – 250 km by one refuelling. There are not enough charging plants for the operation in the area of the Czech Republic. E.g., the company intended to rent a vehicle in Munich (Germany) for the trial. But it was not possible to drive the vehicle to Prague; there are not enough charging plants on the route.</td>
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<td>DE – 01</td>
<td>Different German cities</td>
<td>Hermes Versand Service</td>
<td>Since 1995 Hermes is testing the capabilities of alternative propelled vehicles within its fleet. Within the period 1995 to 2001 several technologies were tested:  - From 1995 to 1997 a trial with electronic vehicles was made  - From 1995 up to now CNG propelled vehicles have been tested  - From 1999 to 2001 tests with hydrogen propelled vans were made Within regular delivery trips environmentally friendly vehicles were employed. The vehicles are mostly standard vans refitted with alternative propulsions. The CNG vans were refitted diesel vans (bivalent technology). The hydrogen propelled vehicle was a refitted Mercedes Sprinter. In a second trial using hydrogen the first fuel cell propelled van (based on Mercedes Sprinter) was used.</td>
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<tr>
<td>DE – 02</td>
<td>Different German cities</td>
<td>TNT</td>
<td>Aim of the TNT concept is to reach a high level of CNG usage within its fleet. In the depot Berlin TNT employs 22 CNG. Target for the fleet operating in the city area of Berlin is 100%. In the city area of Dortmund and Bochum already a 100% coverage is reached. Here overall 12 CNG vehicles are employed being 20% of the entire fleet at the depot Dortmund. Here the aim is to increase the CNG share on the entire fleet to 30% by the end of 2005. Approach of the TNT concept is to actively promote the employment of CNG vehicles by TNT transport operators. In 2004</td>
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<td><strong>TNT</strong> took part in the funding programme “Für die letzte Meile auf die sichere Seite” providing grants to the purchasing of EURO 4 norm and monovalent CNG vehicles. <strong>TNT</strong> passes these grant through to its operators. For those operators that employs CNG vehicles that are not subject of funding (bivalent CNG vehicle) <strong>TNT</strong> provides an extra grant of 1000 Euro per vehicle.</td>
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<td>In the year 2000 <strong>TNT</strong> started to introduce CNG vehicles within its distribution processes. First experiences showed that due tootechnical reasons • a lack of sufficient fuelling infrastructure • in combination with a low range of operation.The employment of CNG vehicles was only in some cases viable. Hence 21 instead of the targeted 30 vehicles were employed by 2002. Main problem experienced were that a higher maintenance effort is needed for CNG trucks leading to higher bad times that has to be bridged with additional rented vehicles. As the vehicles used were mainly bivalent vehicles the liability on these damages was not clear. Overall, positive experiences with regard to the environmental performance (air pollution and noise) could be made as well as with a reduction in fuel costs. Due to the funding provided a cost neutral approach could be reached.</td>
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| DK-01 | Municipality of Copenhagen | City Gods       | In the period of the 1st of February 2002 until the 31st of October 2003, the Municipality of Copenhagen has conducted an obligatory trial ordinance that stipulates that all vehicles over 2,500-kg registrated total weight must have a certificate to stop in the medieval city of Copenhagen. Vehicles over 18,000-kg registrated total weight must have special permission to stop in the medieval city of Copenhagen. The three types of City Gods Certificates:

The Green Certificate may be issued to vehicles with an engine that is a maximum of 8 years old that also utilise at least 60% of its carrying capacity on average. The certificate is valid for the entire trial ordinance period of time and gives the right to use special loading zones. This certificate requires that the quantities of goods transported be reported.

The Yellow Certificate is for vehicles that cannot fulfil the conditions for acquiring the Green Certificate. Until the 31st of January 2003, all transport vehicles may purchase a Yellow Certificate without fulfilling any demands for the vehicle. After this date, it will only be possible to acquire a Yellow Certificate if certain conditions are met.

The Red Certificate is a one-day certificate created for vehicles that seldom transport goods in the medieval city of Copenhagen. There are no special demands or conditions in association with this certificate.

Loading zones are marked off areas that have a special sign. The loading zones may only be used by vehicles with a valid Green Certificate within the hours of 8-12 Monday through Friday. Outside these hours, these zones go back to normal use. These loading zones are a supplemental offer in addition to already existing loading and unloading possibilities. The black marks on the map on the front page of this instruction give the location of the 26 loading zones. Vehicles that are exempt include white plates, Electric cars, Hybrid cars and vehicles registered to public transport.

The project is not seen as a success. Following reasons have contributed to that perception:
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| DK-02 | Aalborg City         | Effective freight transport in Aalborg city          | The project was supported by the Danish Ministry of Transport and started 1. April 2000 and ended 31. December 2003. Based on voluntarily participation a steering committee with members of organizations involved in freight distribution in Aalborg was formed in order to coordinate the actions between the actors. The following project objectives were formulated: 1. Delivery on time; 2. More efficient freight distribution; 3. Improved working conditions for the distributors; 4. Less heavy traffic in the city. During the project period and in order to meet the project objectives the following measures were implemented:  
  - Creation of loading and unloading zones;  
  - Two persons in each vehicle;  
  - Creation of a consignment note among the distributors  
  - Change of driving direction in pedestrian area;  
  - A coordination of freight delivery among the distributors;  
  - Regulation and access restriction in the pedestrian area;  
  The measures implemented had in relation to the project objectives the following results: 1. No shop experienced late deliverances; 2. There freight distribution time was reduced significantly; 3. The working condition of the freight distributors was significantly improved; 4. No reduction in traffic load was noted. The first pilot project in Aalborg is perceived to be a success by all partners involved, while the second pilot project is currently been submitted. The second pilot project is planned to be executed from 1. November 2005 – 31. October 2008. |
| DK-03 | Municipality of Aarhus | Distribution of goods in Aarhus City                 | Whereas an average of 333 lorries drive into five street sections in Aarhus daily, only 16 lorries would theoretically be needed if they were maximally loaded. The “Distribution of goods in Aarhus City” project proposes three specific solutions for making more rational use of lorry capacity:  
  1. Establish environmental zones: This proposal recommends establishing an environmental zone where access for vehicles over two tonnes is only allowed if they comply with the Euro 2 standard, have particulate filters, have a permitted total weight of less than 12 tonnes and have at least 60% capacity utilisation. The scheme requires substantial supervision. An environmental zone reduces the number of lorries in the zone, thus fostering a slight improvement in the area of air pollution.  
  2. Coordinate goods distribution on a voluntary basis: Distributors join forces to initiate shared transportation of goods, most effectively by forming a company for managing the distribution of goods. Shop owners and distributors are part of the company, but not the local authority, since the company is intended to operate under commercial market conditions. The company is established purely as a management company that has no vehicles or terminals of its own, but which buys services from existing companies. |
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<td>ES – 01</td>
<td>Malaga</td>
<td>CUDE – Malaga Distribution Center in Street Camas</td>
<td>In 2004 the Municipality of Malaga with Transport Association has initiated a project concentrating of environment-friendly usage of distribution with long vehicles. The main objective was to improve the general transport situation in the city centre regarding negative environmental impacts. The measures taken into account have been city hub building and the usage of electrical vehicles in distribution processes. The project has been set up in co-operation between the municipality of Malaga and local transport operators. The failure of the cooperation between different parties, as well as, the opposition to added costs for the transport cause the lack of project continuation. Due to the missing acceptance of the project, especially between the freight providers this project could be considered as a failure. These main discouraging factors have been additional costs because of the use of the electric vehicles.</td>
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| FI – 01 | Various Finnish cities | Post delivery by electric vehicles | Finland Post Corporation has own environmental programme initiated by the company’s concern on ecological issues. The use of electric vehicles forms a part of this programme. 1999-2000 the EVD-Post took part in a project supported under Thermie research programme. Within the programme a French model Citroën Berlingo Electric was tested in 2002; since 2005 only 3 electric vehicles are in use. As can be seen from the dropout of the usage electric vehicles have not been a success mainly because:  
- high purchase price of the vehicles and batteries;  
- competitive development of gasoline and diesel vehicles regarding all vehicle characteristics;  
- in cold climate extra heating facility using gasoline or diesel oil is necessary in electric vehicles;  
- short operation range – actually in post delivery only 35-50 km – after a charge of batteries. |
<p>| FI-02 | Various Finnish cities | New fuels and propulsion technologies for urban vehicles | The main aim of the project was to monitor eight heavy lorries using LPG and one light lorry using CNG; in addition to these the project monitored also buses using LPG and CNG. Heavy lorries with a motor: 6-cyl., 125 kW/2400 rpm; total weight 17 tonnes; light lorry was a Mercedes-Benz Sprinter model with a motor 4-cyl., 92 kW/5200 rpm, total weight 4,6 tonnes. The heavy lorries were used in road maintenance work in two cities and for goods delivery in another city, and the light lorry was used for post delivery. All vehicles were checked two or four times per year in order to monitor the operation of fuel systems and catalysts. Results: LPG and CNG can be used in duty vehicles in Finland. In the trials there have been some problems with |</p>
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| FR-01 | La Rochelle metropolitan area | Elcids (Plate-forme logistique et de service) | From the Elcids terminal (located close to the city centre), 6 electric vans and one electric small truck are used to deliver the goods to the historic centre of La Rochelle. No deliveries can be made in La Rochelle city centre with trucks (above 3.5 tons) after 7:30 in the morning. These deliveries have to be subcontracted to the Elcids terminal operator. The project works well, with continuous subsidies from the city of La Rochelle. The vehicles have proven technically successful. On an organisational point of view, the vehicles used (small vans) have proven too limited in capacity. This has been a major drawback of the system, inducing additional costs. Delivers of refrigerated goods, deliveries of large volume parcels and home deliveries have been recently added to the range of services provided by Elcids. La Rochelle is to stop giving financial subsidies to operate the Elcids system. It is expected that by 2006, the terminal will be self operated (with no subsidies). On the whole, this study indicates that:  
1. Electric vehicles have brought a huge benefit regarding exhaust gas emissions, noise emissions and CO2 emissions.  
2. It has increased urban congestion and visual impacts, due to the very small loading capacity (3 m3) of the vehicles used. |
| FR-02 | City of Paris | La Petite Reine | A private operator, La Petite Reine, delivers goods (mostly parcels) to customers by ways of electrically assisted bicycles. 16 bikes are currently in use (the company has started 2 years ago with 6 bikes). The company takes advantage of a terminal (600 m2) provided by the City of Paris within one of Paris central underground parking facilities. La Petite Reine’s clients are mostly large parcel transport companies (DHL, Fedex and Coliposte make up more than 90% of La Petite Reine traffic). Other clients are: 2 ecommerce grocery companies, one company selling office products. Further applications are expected in a few other French cities. La Petite Reine is currently opening another service in Bordeaux.  
1. Economic results: The economic result of the service is very good. Gross revenues have been growing constantly and the company has always been beneficial.  
2. Environmental results: On the whole, this monitoring has calculated that from November 2004 till May 2005, this system has avoided 188 969 T-km (equivalent to 28 Tep) made by motorised vans; the emission of 64 t of CO2, 166 kg of NOX, 848 kg of CO, 164 kg of COVNM and 26 kg of particulates in Paris city streets. Operators which have subcontracted to la Petite Reine are very satisfied with the service (quality of service, reliability, cost). This experience seems very transferable to other places and projects. On lesson learned is the need for a high loading capacity (therefore, containers placed behind the back are preferable to containers placed in front of the bike). |
Another lesson learned is that the support of the City of Paris has been critical in making La Petite Reine a success. This support is not a direct subsidy but a help in looking for and finding premises well located in the centre of Paris, at a lower cost.

FR – 03  
City centre of Toulouse  
Urban deliveries with electric and CNG vehicles and Chrono City container

5 clean vehicles (3 electric and 2 CNG) and 1 “Chrono City” (container rolling system, developed by Chronopost) are being used to deliver Chronopost parcels (subsidiary of La Poste) to the most urban core of the city of Toulouse. A Logistic Urban Terminal has been opened in the city centre, with the help of the city of Toulouse (low rent).

Chrono City has proven to be well accepted by employees. It has not decreased Chronopost efficiency and productivity to deliver goods in city centres.

FR – 04  
Paris  
Monoprix Test

CNG trucks for Monoprix (a dominant supermarket chain in Paris) deliveries. Two CNG trucks (Iveco, 19 tons) have been tested since 2003 to deliver goods to Monoprix stores. A bigger scale experiment will start in January 2006 with 50 to 60 more trucks. Geodis, Staf and GT Location are the three transport operators which will be using the vehicles. Vehicles are 21 pallet trucks. Overcost is 50 000 €, including 10 000 € for noise reduction equipment. Interestingly enough, operational costs for these vehicles have been estimated so far as 20% higher than diesel trucks.

FR – 05  
Paris  
Green Truck

“Green truck” experiment (electric). Led by Gefco (transport operator) for the transport of L’OREAL products to retailers such as hairdressers, cosmetics and department stores in the centre of Paris. They benefit from a financial support from ADEME and a label from the City of Paris.

IE – 01  
City of Cork  
Municipal Fleet Vehicles – Project MIRACLES

Prior to MIRACLES Cork City Council owned approximately 250 vehicles shared amongst 8 different subsections of the local authority. The only fuels used were petrol (lead and unleaded) (2.5%) and diesel (duty paid and duty free) (97.5%). The projects objectives were to:

- Investigate the current and future benefits accruing from the use of less polluting vehicles in an Irish context.
- Promote the use of clean fleet vehicles in Ireland.
- Assess the pros and cons associated with a range of lower emission vehicle technology options in an Irish context.
- Convert at least 5-10 vehicles (2 – 5% of fleet vehicles) to lower emissions.
- Monitor the socio-environmental, economic and technical sustainability of the clean fleet options being investigated.
- Promote the use of lower emission vehicles locally, nationally and internationally.

In particular, MIRACLES would assess the opportunities, government policy and likely economic costs associated with electric vehicles being used for goods distribution with reference to the ZEUS and ELCIDIS Project Reports in addition to the projects underway by Power Electronics Ireland (PEI) Technologies and the Engineering Department UCC.

It was decided not to proceed with the use of CNG because the costs of establishing the requisite refuelling infrastructure were deemed to be prohibitive and it would not have been practically possible to adapt the fuel depot in use by the City Council to accommodate the high pressure gas supply system. LPG was ruled out because the use of vehicles with a
**ANNEX IV**

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<td>IT – 01</td>
<td>Various Italian cities</td>
<td>TADIRAM</td>
<td>Because of environmental problems and the negative congestion situation in various Italian cities the project trial has been introduced in several Italian cities beginning of 2001. Main objectives have been: ecological (reduction of exhaust and noise emission) and traffic flow optimisation (congestion situation). Within different Italian cities alternative propelled vehicles in combination with cargo tram usage have been tested. The project aims to improve the knowledge indispensable to the development of logistics schemes based on new technologies and innovative transport systems. The TADIRAM project was created in 2001 by Consorzio TRAIN (ENEA, FS and Uniontrasporti) and also involves major companies in the sector such as AnsaldoBreda, Bertolotti, D’Apollonia. With the TADIRAM scheme, in the presence of a tram network and sufficient demand, part of the distribution routes can be developed with the SIRIO cargo tram (AnsaldoBreda), aided by a fleet of small-sized vehicles with minimal or no environmental impact for total coverage of the territory. Rome and Milan have shown interest for an application of this type (see article in Giornale della Logistica (no. 6 year 2005)).</td>
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<td>IT – 02</td>
<td>COOPSER / ECOPORTO</td>
<td>Ferrara municipality</td>
<td>ECOPORTO is a logistic platform of over 20,000 sq.m located near the Ferrara South motorway junction. The aim of this facility is to intercept freight coming from the south (province of Bologna) and then distribute it to all areas of the city with environment-friendly vehicles. The ECOPORTO was created by a co-operative of private services named COOPSER, a logistics company specialised in the distribution of fresh food products, established in 1982 which offers work to about 700 people and has a total of approx. 1000 customers. A decisive choice in this direction is that of having focussed on methane to fuel its vehicles: of the 80 cooled trucks, 51 run on methane (in 2003 on methane were only 30 vehicles). COOPSER is collaborating with the Council and with other trade associations in the project for a second platform, which ought to be operational in 2006 and located north of Ferrara with the aim of intercepting freight coming from the north (Veneto). Together with the existing platform they will create a single co-ordinated transport system managed by a single software system in a freight distribution and supply system in an urban environment. The Council will fund 60% of the total costs of the facility. It is foreseeable that COOPSER will use environment-friendly vehicles for this platform, too.</td>
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<td>IT – 03</td>
<td>Progetto MERCI</td>
<td>Genoa</td>
<td>In 2000 the city council of Genoa started a project on Urban Freight Transport Distribution called M.E.R.CI. (Environment-friendly Mobility Resource for the City), within the Environment protection Plan, co-funded by the Ministry of the Environment with a contribution of approximately one and a half million euros. The MERCI project (Environment-friendly Mobility Resource for the City) was created to reduce the environmental impact (noise, atmospheric pollution and congestion) caused by deliveries to traders in the old part of Genoa (Pré, Wharf, Maddalena area) and to rationalise distribution itself, through: renewal of the vehicle fleet with vehicles with minimal or no environmental impact and small-sized ones suitable for...</td>
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<td>deliveries in the narrow alleys, which are characteristic of the city of Genoa; the development of an urban exchange platform; the development of a computerised freight handling control system.</td>
<td>The pilot project was started in March 2003 and ended in December 2004, owing to the depletion of the funds available. This period saw the development of the platform (located 2.3 km from the motorway junction and 5 km from the shops to be served) and the use of three electric FAAM Jolly 600 vehicles (used for small-sized streets), five electric FAAM Jolly 1200 vehicles and two methane-powered IVECO vehicles. Facilities have been provided inside the HUB to support the vehicle fleet, such as the possibility to recharge the batteries which have an autonomy of about 50 - 60 Km and various maintenance services. In addition, to reduce the levels of congestion and pollution, the Council of Genoa has included in the feasibility plan measures to restrict access of non environment-friendly vehicles to the central area and at the same time measures to support the project. At just under a year from the start of the experimentation, the result has been more than satisfactory: 1. the number of forwarders and sales outlets who have joined the project has gradually grown; 2. 40%-45% of parcels delivered in the old town centre passed through the platform; 3. the distribution vehicle load rate was around 100%; 4. the delivery price per parcel was gradually reduced down to 62% (from 16 to 6 euros per parcel).</td>
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<td>JP – 01</td>
<td>Osaka City</td>
<td>New distribution system using EFV</td>
<td>Osaka City has suffered from high level of traffic congestion, hazardous gas emissions and noise problems generated by traffic in urban areas. Solving these problems are urgent issues for the City authority. Therefore a concept has been worked out that combines the individual usage of electric vans for delivery. The main concept of the system is that an organisation provides some electric vans (EV) at various public parking places to be used cooperatively by many companies. The objectives of the system proposed here are: a) Alleviate traffic congestion by reducing freight traffic b) Provide environment friendly logistics systems c) Reduce the costs for freight carriers. The system sees for that the user companies should register in advance for using electric vans. A user can book for using an electric van through Internet in advance. He/she may walk or go by bicycle to the parking place where the electric van is prepared. He/she starts the commercial trip by the electric van to pickup some goods at the company. Then he/she visits some customers to deliver commodities and returns the electric van at the nearest parking place to the last customer. Then he/she takes subway or bus to come back to the office. The last trip from the parking place to the office by</td>
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<td>electric van without load</td>
<td>is replaced by the subway or bus. This conversion to public transport from truck can reduce freight traffic without carrying goods. The electric vans are kept in 8 parking places with the full charge of electricity in the central Osaka to be picked up. The users can return electric vans to any of these 8 parking places after using for business. They can park at 16 parking places during the trip that include these 8 parking places. The test in Osaka City started on 13th December 1999 and last until March 2001. During the test period, users can use electric vans without paying any charge. The results of a survey showed that the business for which the electric van was used in the test has been carried out; by the company’s own vehicles (53.8%) and by rental vehicles (23.1%). Regarding the characteristics of the electric vans, about 73% of users recognised that the electric vans have better or same capability of conventional vehicles. Some users hope to use it for longer distance than 50 km that is normally allowed at the moment in urban areas. On the overall convenience of returning the electric van to different parking place, the system was; convenient (34.6%), not convenient (19.2%) and neutral (46.2%). Some users require denser allocation of parking places for returning the electric van, in particular in the suburb of the city. Most important lessons learned in this project is that co-operative use of electric vans is possible for delivering goods in urban areas. As well, intermodal systems of vans and subways for urban goods transport are also possible if a driver takes subways while the vacant van is returned to a parking place after delivering goods to customers.</td>
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<td>NL – 01</td>
<td>national</td>
<td>PIEK-programme</td>
<td>The noise emissions are treated in the PIEK (Eng: PEAK, means peak noise levels, in contrast to continuous noise levels) programme. Given the products currently used, industry and commerce cannot comply with the stricter standards. These noise emission standards are forcing shops and the transport sector to come up with innovative measures. At the same time, however, it must be possible to implement these innovations both technically and economically within a few years. The Ministry of Housing, Spatial Planning and Environment, the Ministry for Economic Affairs and the Ministry for Transport, Public Works and Water Management introduced a long-term PIEK (peak noise) programme in 1999 in order to bring about the necessary technical adjustments, by tackling the source, the materials used when loading and unloading goods and the loading-unloading locations. The long-term PIEK programme comprises 10 main projects. With the exception of the truck and the shopping trolley, all solutions meet the 60 dB(A) requirement. Trucks and shopping trolleys meet the 65 dB(A) requirement. The long-term PIEK programme comprises the following 10 main projects: • Transfer of knowledge to relevant companies; • Encouraging quiet behaviour; • Optimal loading and unloading locations; • Low-noise distribution vehicles up to 7.5 tons; • Low-noise distribution vehicles over 7.5 tons; • Low-noise refrigerated transport installations; • Low-noise portable forklift trucks;</td>
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<td>NL – 02</td>
<td>national</td>
<td>DEMO</td>
<td>Within SenterNovem the pollutant emissions are the working area of the DEMO (Demonstratieprojecten Mobiele Bronnen, Eng: Demonstrator projects mobile sources) program. This project was intended to encourage the market introduction of clean and fuel efficient vehicles (and vessels). The DEMO project was targeted at removing barriers that withhold the market introduction of cleaner and more efficient vehicles. The program contains vehicle concepts, knowledge transfer projects and the Platform Cleaner Vehicles. Until advise and financial support was given. After 2003 the financial support options were stopped.</td>
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<td>UK – 01</td>
<td>Oxfordshire</td>
<td>Joynson Bruvers Ltd – TransportEnergy Powershift</td>
<td>Joynson Bruvers Ltd (JBL) is a family-owned independent office supply company based in Oxfordshire, near the city of Oxford. JBL operated a fleet of six car-derived vans. These vehicles operate multi-drop rounds in Oxford City Centre and the rest of Oxfordshire five days per week. Each vehicle carries out approximately 40 deliveries per day and travels approximately 2,400 km per month. The company decided that, based on the cost and reliability of the existing vehicle fleet, it was necessary to replace some of the vehicles. The company decided to invest in three new LPG powered vans as it felt that this would provide the company with a competitive advantage through lower operating costs and would allow the vehicles to operate in any future low emission zones that could be introduced. The LPG-powered vehicle acquisition has proved to be very successful for JBL. The company is achieving similar running costs for the LPG/petrol Mercedes Sprinters compared to the petrol Mercedes Sprinters. It is experiencing significant running cost savings for the LPG/petrol Vauxhall Combo compared with the petrol vehicle it replaced. The LPG fuelled Mercedes Sprinter and Vauxhall Combo produce considerably fewer emissions than the petrol fuelled versions of these same vehicles.</td>
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<tr>
<td>UK – 02</td>
<td>Aberdeen, Glasgow, Portsmouth and Yeovil</td>
<td>Denholm Industrial Services Ltd – TransportEnergy Best Practice Programme</td>
<td>Denholm Industrial Services Ltd is part of J &amp; J Denholm Group. It offers a range of services including scaffolding and containment, surface preparation and painting, industrial cleaning and high pressure water jetting. The company appointed a transport manager in 2001 who was given the task of improving fleet operating efficiency. Following the advice and action plan report from the fuel economy advisor, the Transport Manager and his team have been able to start making significant fleet cost savings. This has been achieved through the reduction in vehicles, distance travelled and fuel use. Total annual fleet distance travelled has been reduced by 240,000 km, and the total fleet has been reduced from 100 to 94 vehicles. This reduction in distance travelled has resulted in annual fuel cost savings of £28,000. The impact of monitoring and targeting vehicle fuel consumption has resulted in fuel savings of £5,700. The revised fuel purchasing procedures has led to fuel cost savings of £2,000. Therefore total fuel cost savings of £36,000 were achieved in the first year which is</td>
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<tr>
<td>Code</td>
<td>City/Region</td>
<td>Name of concept</td>
<td>Description of concept</td>
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| UK – 03 | national | HyTrans project | Denholm Industrial Services Ltd has demonstrated that installing simple management controls it has been possible to reduce distance travelled and improve fuel consumption. By using an independent expert advisor they have been able to implement cost-effective measures that are suited to their operations. The Hytrans project is being carried out by Ricardo plc in partnership with Ford Motor Company, Valeo SA and the Gates Corporation. It aims to demonstrate technologies for an affordable and production-feasible micro-hybrid diesel delivery vehicle based on the existing Ford Transit. Ricardo defines a ‘micro’ hybrid as being a vehicle in which an electric machine is used for applications such as stop/start and regenerative braking but is not used to supply additional torque when the engine is running. The project has produced a demonstrator vehicle which is intended to:  
- Be of comparable performance and driveability to current products  
- Represent an ‘affordable’ engineering solution which has the potential for implementation in products  
- Involve no reduction in payload capacity or space.  
- The HyTrans demonstrator can achieve an improvement in fuel consumption of up to 21% based on urban stop/start driving conditions.  
The team has put the vehicle to the test around two actual driving cycles, taken from existing Transit fleet users. In a door-to-door delivery cycle the HyTrans Transit used 21.3% less fuel. In a neighbourhood-to-neighbourhood cycle, the fuel reduction was 6.3%. Putting the HyTrans through the New European Drive Cycle resulted in a fuel saving of 3.7%. It would therefore appear that this demonstrator vehicle is likely to be best deployed in multi-stop urban operations. |