TRANSPHORM deliverable

Report from analysis of traffic activity in selected cities

D1.1.1

Lead beneficiary: TML

Person months: 12

Nature: REPORT (R)

Dissemination level: PUBLIC (PU)

Delivery date from ANNEX I: MONTH 10

Notes:

Table of contents

TRANSPHORM

Transport related Air Pollution and Health impacts –

Integrated Methodologies for Assessing Particulate Matter

Collaborative project, Large-scale Integrating Project

SEVENTH FRAMEWORK PROGRAMME

ENV.2009.1.2.2.1 Transport related air pollution and health impacts

Deliverable D1.1.1, type X

Analysis of Traffic Activity

Due date of deliverable:	project month 15
Actual submission date:	project month 15

Start date of project:	1 January 2010	Duration:	48 months
Organisation name of lead contractor for this deliverable:		Transport & Mobility Leuven	
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Revision: [1]

Contents

Report from Analysis of Traffic Activity

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1. Introduction

Deliverable D1.1.1 concerns the collection and analysis of traffic activity data on the urban level. A database of traffic activity is constructed for selected TRANSPHORM case-study cities. Deliverable D1.1.1 describes how this database is set up. This is illustrated by data from the city of Rotterdam, which is one of the case-study cities that are considered in the TRANSPHORM project. A complete database of traffic activity for all case-study cities (Rotterdam, London, Oslo, Helsinki and Athens) will be included in Deliverable D1.3.1.

The database of traffic activity includes data for base year 2005 and future years 2020 and 2030. Where possible, data from 1990 to 2030 (every 5 years) are included as well.

The traffic activity database will be used for different purposes:

(i) Transport activity data are combined with improved emission factors to allow for the construction of an improved emission baseline for the core cities. This is done in D1.3.5 of Work Package 1.3.

(ii) Transport activity data are also used to calibrate the Urban Transport Model that is developed in D5.2.2 of Sub-Project 5.

In consideration of these purposes, traffic activity data are requested from the cities. The requested data include:

For base year 2005 and future years 2020 and 2030:

- GIS network of roads, railways, inland waterways, ports, airports (spatial resolution: as detailed as possible/available)
- For all links (roads / railways / inland waterways) in this GIS network:
    - traffic volumes per vehicle category
    - traffic speeds per vehicle category
    - capacities
    - speed limits
    - link types
    - link lengths
- Vehicle categories as detailed as available (ideally: slow mode, moped, motorcycle, car, van, bus, light duty truck <3.5T, heavy duty truck 3.5T – 7.5T – 16T – 32T, metro, tram, passenger train, freight train, plane, inland ship, maritime ship)
- For ports / airports: traffic volumes per vehicle category
- Composition of vehicle fleet, vehicle stocks per age class and technology
- Time resolution as detailed as available (e.g. per typical (peak or off-peak) hour, per typical day, per year)

Not all of these data are available for the case-study cities. The analysis of traffic activity includes verification of data availability. Furthermore, we analyze whether the available data can be used as a basis i) to construct emission inventories and ii) to calibrate the Urban Transport Model.

In Section 2, the parameterization and disaggregation of transport activity is discussed. Section 3 presents the database of transport activity for the city of Rotterdam. Conclusions are formulated in Section 4.

2. Parameterization and disaggregation of transport activity

Transport activity in its general sense refers to activities for all vehicles in a particular region during a particular time. Activities are typically expressed in terms of vehicle kilometers (vkm), passenger kilometers (pkm), or ton kilometers (tkm). Other parameters to characterize transport activity are for example speed, density, degree of saturation, level of congestion, ….

Transport activity can be disaggregated by vehicle category and by vehicle type. A certain disaggregation by time and by space is common as well.

In order for the database of transport activity to be a useful input for the emission baseline and for the Urban Transport Model, the parameterization and the level of disaggregation of traffic activity should meet certain criteria:

- Since emission factors are a function of transport activity, the parameters of transport activity need to be in accordance with the emission factor variables. Traffic activity data are combined with emission factors to construct an emission inventory for the core cities (cf. D1.3.5).
- The level of disaggregation of traffic activity should allow for the construction of the emission baseline at its required level of detail. The level of disaggregation should also allow for a proper calibration of the Urban Transport Model.

For a description on how exactly the activity data are used as a basis i) to construct emission inventories and ii) to calibrate the Urban Transport Model, we refer to D1.3.5 and D5.2.2 respectively. In the remainder of this Deliverable D1.1.1, we give an overview of the available data for the city of Rotterdam and we analyze for which purposes these data can be used.

3. Database of transport activity for the city of Rotterdam

Since data availability for road transport significantly differs from data availability for other transport modes, both are discussed separately below.

3.1. Road Traffic data

The database of traffic activity for the city of Rotterdam can be found on http://www.tmleuven.be/temp/20110408_TRANSPHORM/Database_Traffic_Activity_Rotterdam.zip. The contents of the database is discussed in following Sections.

3.1.1. Spatial disaggregation

A GIS network of roads is available for the city of Rotterdam. The network includes two GIS-layers (files *'HWNyyyy.shp'* and *'OWNyyyy.shp'* in database-folders *'Road Traffic Activity Rotterdam yyyy'*), that respectively represent the highway road network and the underlying road network. Both networks consist of links that represent the most important roads in the city. Figure 1 depicts the geographical layout of the GIS road networks for highways (indicated in yellow) and underlying roads (indicated in red).

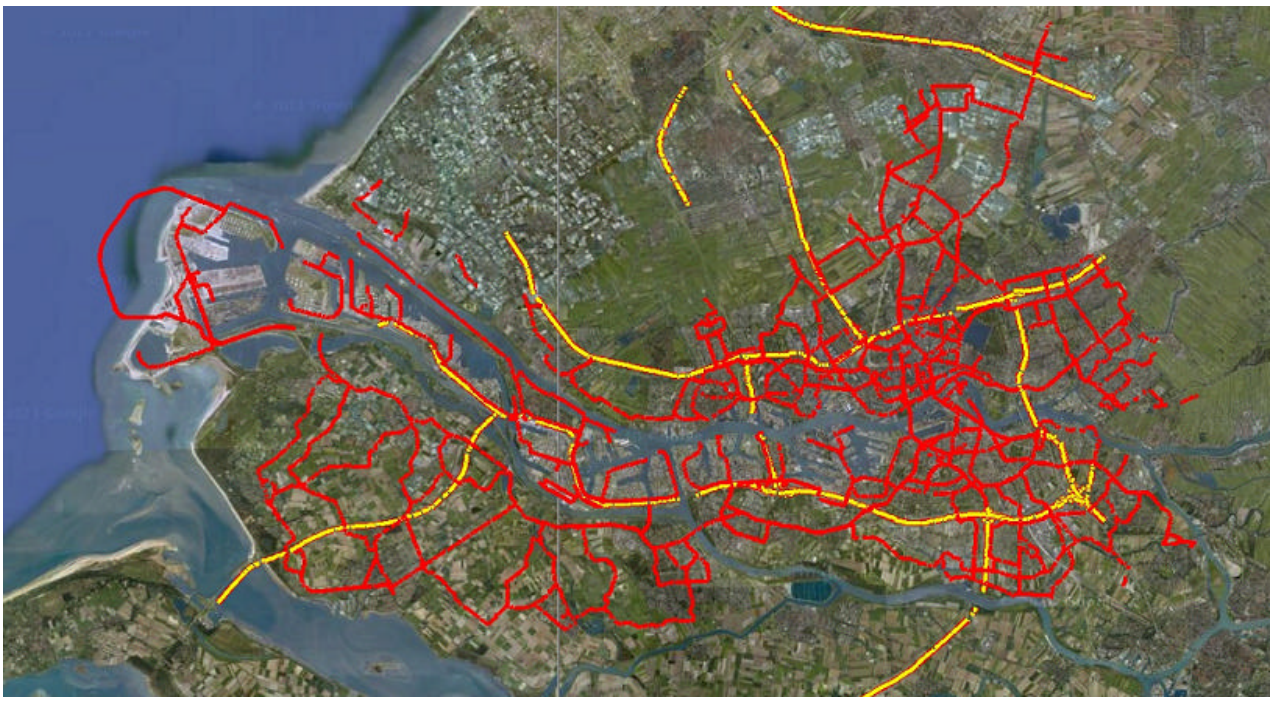

Figure 1: GIS road networks (highways and underlying roads) for the city of Rotterdam

The GIS networks cover al important roads in the city. Traffic activity on the remaining streets is not explicitly modelled. Emissions and concentrations from activities on these remaining streets are modelled as background concentrations.

The files '*HWNyyyy.dbf*' and '*OWNyyyy.dbf*' in database-folders '*Road Traffic Activity Rotterdam yyyy*' include detailed information for all network links, such as start- and end-coordinates, road-type, treefactor, roughness of the road, etc…

For all network links, information on traffic activity is available as explained in the Sections below.

3.1.2. Parameterization of traffic activity

Road traffic activity for the city of Rotterdam is characterized by following parameters:

For each link:

- Amount of vehicles per day per vehicle category (see also next Section)
- Speeds and maximum speeds per vehicle category

The files '*HWNyyyy.dbf*' in database-folders '*Road Traffic Activity Rotterdam yyyy*' include two speeds:

- "Snelh" = maximum speed for cars and light duty vehicles
- "Snvr" = maximum speed for heavy duty vehicles

The files '*OWNyyyy.dbf*' in database-folders '*Road Traffic Activity Rotterdam yyyy*' indicate maximum speeds and typical speed regimes ("Carspeed") for each link:

- "Vlv" = maximum speed for light weighing traffic
- "Vvv" = maximum speed for heavy weighing traffic
- "Carspeed" a: mean speed ~ 65 km/h
- "Carspeed" b: mean speed ~ 60 km/h
- "Carspeed" c: mean speed ~ 15-30 km/h

- "Carspeed" d: mean speed < 15 km/h (congested traffic)
- "Carspeed" e: mean speed ˜ 30-45 km/h

3.1.3. Disaggregation by vehicle category

Transport activity data are disaggregated by vehicle category. The considered vehicle categories for road traffic are as follows:

- Motorcycle
- Car
- Van
- Light Duty Truck
- Heavy Duty Truck
- Bus

In the files '*HWNyyyy.dbf*' and '*OWNyyyy.dbf*' in database-folders '*Road Traffic Activity Rotterdam yyyy*', the amount of vehicles per day on all network links are given on following level of aggregation for vehicle categories:

Files '*OWNyyyy.dbf*':

- "lv" = Amount of vehicles per day for light weighing traffic (cars & vans)
- "mv" = Amount of vehicles per day for medium weighing traffic (Light Duty Trucks)
- "zv" = Amount of vehicles per day for heavy weighing traffic (Heavy Duty Trucks)
- "bv" = Amount of vehicles per day for bus traffic (Bus)

Files '*HWNyyyy.dbf*':

- "Pv" = Amount of vehicles per day for passenger traffic (cars and motorcycles)
- "Mv" = Amount of vehicles per day for medium weighing traffic (Light Duty Trucks, Vans, Coaches)
- "Zv" = Amount of vehicles per day for heavy weighing traffic (Heavy Duty Trucks)

3.1.4. Disaggregation by vehicle type (Vehicle fleet composition)

Traffic activity data for different vehicle categories can be further disaggregated by vehicle type, vehicle technology and vehicle age. For the city of Rotterdam, specific data on the vehicle fleet composition were not available. Therefore, we apply national fleet composition data of the Netherlands to the city of Rotterdam. Data are taken from the TREMOVE model (De Ceuster et al. (2007)), where a detailed modeling and forecasting of the vehicle fleet for each vehicle category is included.

The road traffic vehicle fleet evolution is modeled in TREMOVE using a classic scrap-and-sales approach. Each year scrap rates are applied to estimate the number of scrapped vehicles. Total vehicle sales per vehicle category then can be derived by comparing remaining vehicle stock to the stock needed to fulfill transport demands. The following step then is to disaggregate total sales by mode into sales by vehicle type and technology.

For cars, motorcycles, vans, light duty trucks and buses the disaggregation by vehicle type is performed using a discrete choice (multinomial) logit model. The logit models have been calibrated on (mainly) data from COWI, EUROSTAT and ACEA. More information can be found in TREMOVE (De Ceuster et al. (2007)).

Traffic activity per vehicle type and vehicle technology can be found in file '*Vehicle Fleet Composition Rotterdam.xls*' of database-folder '*Vehicle Fleet Composition Rotterdam*'. Table 1 represents vehicle fleet data (proportion of vehicle kilometers per category) for cars. The other vehicle categories are also included in the database.

Table 1: Vehicle fleet composition (% vkm per category) for cars (source: TREMOVE v3.3.2)

vehicle category	vehicle type	vehicle technology	fuel type	% vkm per vehicle category		
				2005 (%)	2020 (%)	2030 (%)
car	car >2.0l - diesel	car - diesel & LPG - Conventional	(Blended) road vehicle diesel	0.2	0.0	0.0
		car - diesel & LPG - Euro 1	(Blended) road vehicle diesel	0.4	0.0	0.0
		car - diesel & LPG - Euro 2	(Blended) road vehicle diesel	2.7	0.0	0.0
		car - diesel & LPG - Euro 3	(Blended) road vehicle diesel	4.6	0.6	0.0
		car - diesel & LPG - Euro 4	(Blended) road vehicle diesel	0.0	1.2	0.0
		car - diesel & LPG - Euro 5	(Blended) road vehicle diesel	0.0	3.0	0.2
		car - diesel & LPG - Euro 6	(Blended) road vehicle diesel	0.0	6.3	11.4
	car 1.4-2.0l - diesel	car - diesel & LPG - Conventional	(Blended) road vehicle diesel	2.1	0.0	0.0
		car - diesel & LPG - Euro 1	(Blended) road vehicle diesel	3.3	0.1	0.0
		car - diesel & LPG - Euro 2	(Blended) road vehicle diesel	6.5	0.4	0.0
		car - diesel & LPG - Euro 3	(Blended) road vehicle diesel	15.8	2.0	0.1
		car - diesel & LPG - Euro 4	(Blended) road vehicle diesel	0.0	2.9	0.3
		car - diesel & LPG - Euro 5	(Blended) road vehicle diesel	0.0	9.2	1.5
		car - diesel & LPG - Euro 6	(Blended) road vehicle diesel	0.0	22.2	37.1
	car <1.4l - diesel	car - diesel & LPG - Euro 2	(Blended) road vehicle diesel	0.0	0.0	0.0
		car - diesel & LPG - Euro 3	(Blended) road vehicle diesel	0.6	0.1	0.0
		car - diesel & LPG - Euro 4	(Blended) road vehicle diesel	0.0	0.2	0.0
		car - diesel & LPG - Euro 5	(Blended) road vehicle diesel	0.0	0.6	0.1
		car - diesel & LPG - Euro 6	(Blended) road vehicle diesel	0.0	1.7	2.6
	car >2.0l - petrol	car - petrol - ECE 15 03	(Blended) road vehicle gasoline	0.0	0.0	0.0
		car - petrol - ECE 15 04	(Blended) road vehicle gasoline	0.0	0.0	0.0
		car - petrol - Euro 3	(Blended) road vehicle gasoline	2.0	0.1	0.0
		car - petrol - Euro 4	(Blended) road vehicle gasoline	0.0	0.4	0.0
		car - petrol - Euro 5	(Blended) road vehicle gasoline	0.0	3.4	3.7
		car - petrol - Euro 1	(Blended) road vehicle gasoline	0.6	0.0	0.0
		car - petrol - Euro 2	(Blended) road vehicle gasoline	2.6	0.0	0.0
	car >2.0l - CNG	car - petrol - Euro 4	Compressed natural gas	0.0	0.0	0.0
		car - petrol - Euro 5	Compressed natural gas	0.0	0.0	0.0
	car 1.4-2.0l - petrol	car - petrol - ECE 15 04	(Blended) road vehicle gasoline	0.3	0.0	0.0
		car - petrol - ECE Improved Convent	(Blended) road vehicle gasoline	0.6	0.0	0.0
		car - petrol - Open Loop	(Blended) road vehicle gasoline	2.3	0.1	0.0
		car - petrol - Euro 3	(Blended) road vehicle gasoline	14.2	2.6	0.3
		car - petrol - Euro 4	(Blended) road vehicle gasoline	0.0	2.1	0.3
		car - petrol - Euro 5	(Blended) road vehicle gasoline	0.0	20.1	23.6
		car - petrol - Euro 1	(Blended) road vehicle gasoline	7.9	0.4	0.0
		car - petrol - Euro 2	(Blended) road vehicle gasoline	9.3	1.0	0.1
	car 1.4-2.0l - CNG	car - petrol - Euro 4	Compressed natural gas	0.0	0.0	0.0
		car - petrol - Euro 5	Compressed natural gas	0.0	0.0	0.0
	car <1.4l - petrol	car - petrol - ECE 15 04	(Blended) road vehicle gasoline	0.4	0.0	0.0
		car - petrol - ECE Improved Convent	(Blended) road vehicle gasoline	2.1	0.2	0.0
		car - petrol - Open Loop	(Blended) road vehicle gasoline	0.8	0.1	0.0
		car - petrol - Euro 3	(Blended) road vehicle gasoline	8.7	1.5	0.3
		car - petrol - Euro 4	(Blended) road vehicle gasoline	0.0	1.3	0.3
		car - petrol - Euro 5	(Blended) road vehicle gasoline	0.0	13.8	16.2
		car - petrol - Euro 1	(Blended) road vehicle gasoline	5.4	0.5	0.1
		car - petrol - Euro 2	(Blended) road vehicle gasoline	4.1	0.5	0.1
	car <1.4l - CNG	car - petrol - Euro 4	Compressed natural gas	0.0	0.0	0.0
		car - petrol - Euro 5	Compressed natural gas	0.0	0.0	0.0
	car - LPG	car - diesel & LPG - Conventional	Liquefied petroleum gas	0.0	0.0	0.0
		car - diesel & LPG - Euro 1	Liquefied petroleum gas	0.3	0.0	0.0
		car - diesel & LPG - Euro 2	Liquefied petroleum gas	1.1	0.0	0.0
		car - diesel & LPG - Euro 3	Liquefied petroleum gas	1.1	0.0	0.0
		car - diesel & LPG - Euro 4	Liquefied petroleum gas	0.0	0.0	0.0
		car - diesel & LPG - Euro 5	Liquefied petroleum gas	0.0	0.4	0.0
		car - diesel & LPG - Euro 6	Liquefied petroleum gas	0.0	1.2	1.4
car Total				**100.0**	**100.0**	**100.0**

3.1.5. Temporal profiles

For the city of Rotterdam, temporal profiles are available as indicated in Figure 2 and Figure 3. These Figures report traffic activity per hour for vehicle categories car (orange), public transport

(green) and bicycle (blue). Figure 2 and Figure 3 report traffic activity from the centre of Rotterdam and towards the centre of Rotterdam respectively.

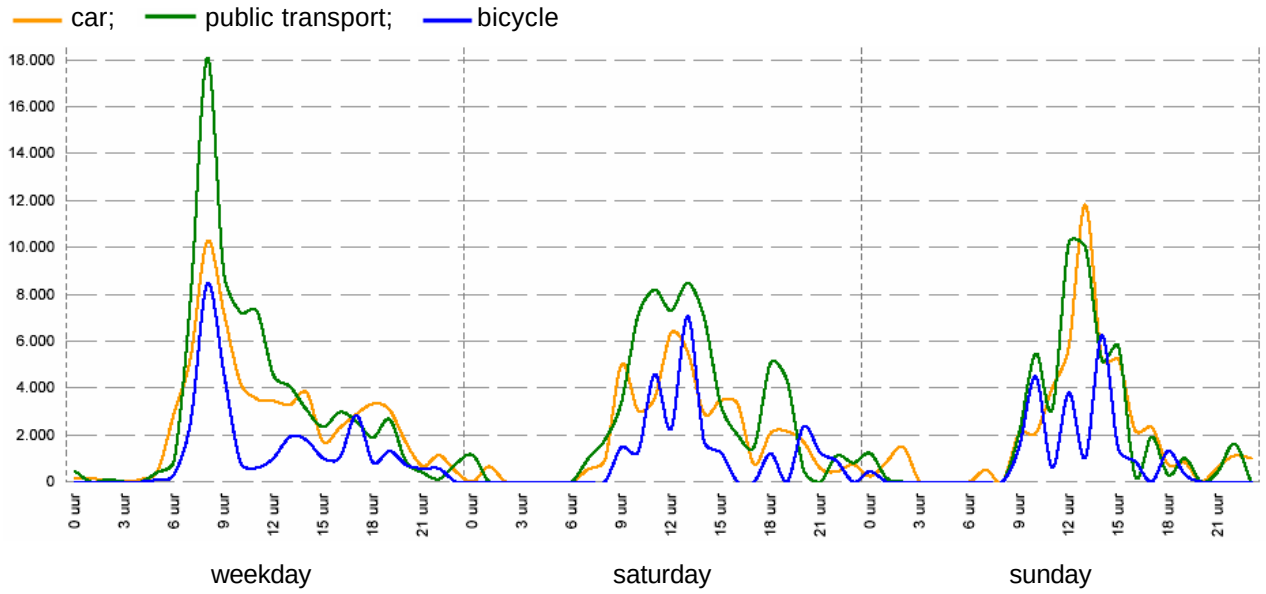

Figure 2: Traffic activity per hour from the centre of Rotterdam on a weekday, saturday and sunday (years 2004 – 2008) (source: de Vries, C. (2010))

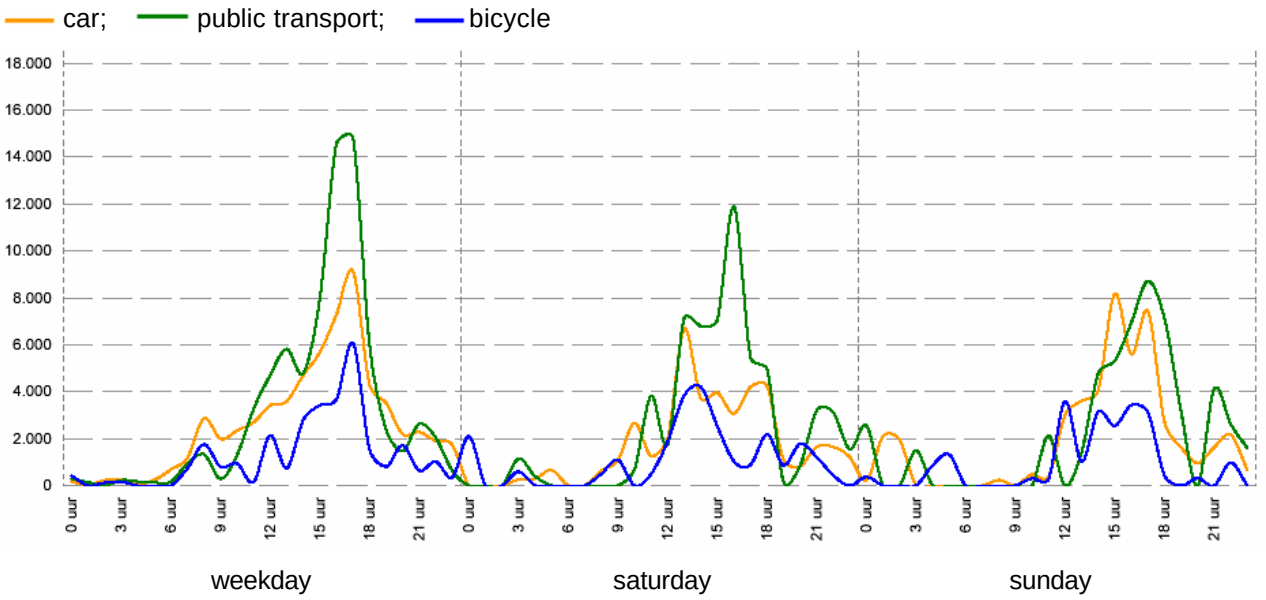

Figure 3: Traffic activity per hour towards the centre of Rotterdam on a weekday, saturday and sunday (years 2004 – 2008) (source: de Vries, C. (2010))

3.1.6. Extensions to other years

Road traffic activity data for the city of Rotterdam are available for year 2011. However, the database needs to include traffic activity data for years 2005, 2020 and 2030, and where possible also data for years 1990 to 2030 (every five years). Projections of future transport activities can be made based on expected demographic and socio-economic evolutions. Since socio-economic evolutions are available on the national level, but not on the city level, we use national forecasts as a basis for activity projections for the city of Rotterdam.

In the recently published report of the PRIMES energy model (Caprus et al. (2010)), new estimates for transport activity on the national level are given for years 1990 to 2030. Estimates of traffic ac-

tivities in the past are based on national measurements. Projections of future activities are based on expected demographic and socio-economic evolutions. Table 2 gives an overview of road transport activity in the Netherlands (PRIMES Baseline scenario 2009). Table 3 includes the annual % change in road transport activity for every five years between 1990 and 2030.

Table 2: Evolution of road transport activity (Gpkm and Gtkm) in the Netherlands (source: PRIMES energy model (Caprus et al. (2010)) - baseline 2009)

Netherlands: Baseline 2009	1990	1995	2000	2005	2010	2015	2020	2025	2030
Passenger transport activity (Gpkm)	**172.2**	**172.3**	**184.4**	**194.8**	**197.9**	**213.8**	**226.7**	**240.0**	**254.4**
Private cars and motorcycles	138.6	133.0	143.3	151.5	151.7	162.2	169.2	177.5	187.4
Other transport modes	33.6	39.3	41.1	43.3	46.2	51.6	57.5	62.6	67.0
Freight transport activity (Gtkm)	**93.2**	**105.7**	**125.4**	**132.3**	**129.2**	**134.5**	**139.4**	**146.1**	**153.8**
Trucks	54.5	67.1	79.6	84.2	80.0	83.8	86.6	91.2	96.8
Other transport modes	38.7	38.6	45.8	48.1	49.2	50.7	52.8	55.0	57.1

Table 3: Annual % Change of road transport activity (pkm and tkm) in the Netherlands (source: PRIMES energy model (Caprus et al. (2010)) – baseline 2009)

Netherlands: Baseline 2009	'90-'95	'95-'00	'00-'05	'05-'10	'10-'15	'15-'20	'20-'25	'25-'30
Passenger transport activity (Annual % Change in pkm)	**0.0**	**1.4**	**1.1**	**0.3**	**1.6**	**1.2**	**1.2**	**1.2**
Private cars and motorcycles	-0.8	1.5	1.1	0.0	1.4	0.9	1.0	1.1
Freight transport activity (Annual % Change in tkm)	**2.7**	**3.7**	**1.1**	**-0.5**	**0.8**	**0.7**	**1.0**	**1.1**
Trucks	4.6	3.7	1.2	-1.0	0.9	0.7	1.0	1.2

Projections of transport activity for the city of Rotterdam are based on these national data. To differentiate between the national and the urban level, we use data from the TREMOVE model, where a distinction is made between the country level and the 'metropolitan' level (cf. De Ceuster et al. (2007), p. 232). The relation between national activity changes and metropolitan activity changes for the Netherlands is taken into account.

The resulting annual % change in road transport activity (vehicle kilometers) for the city of Rotterdam is given in Table 4.

Table 4: Annual % change of road transport activity (vehicle-kilometers) in Rotterdam per vehicle category

Transport activity (Annual % Change in vkm)	'90-'95	'95-'00	'00-'05	'05-'10	'10-'15	'15-'20	'20-'25	'25-'30
motorcycle		0.0	-1.6	7.9	2.2	2.2	1.4	1.4
car	-0.8	1.5	1.1	0.0	1.6	1.0	1.0	1.1
van		4.4	1.4	2.4	1.6	1.6	1.4	1.4
bus	-1.5	-1.3	0.9	1.0	1.3	0.9	0.4	0.3
light duty truck	4.6	3.7	1.2	-0.9	0.3	0.2	1.0	1.0
heavy duty truck 3.5-7.5t	4.6	3.7	1.2	-0.4	1.4	1.1	1.0	1.0
heavy duty truck 7.5-16t	4.6	3.7	1.2	-0.4	1.4	1.1	1.0	1.0
heavy duty truck 16-32t	4.6	3.7	1.2	-0.5	1.4	1.1	1.0	1.0
heavy duty truck >32t	4.6	3.7	1.2	-0.5	1.4	1.1	1.0	1.0

Projections of transport activity for the city of Rotterdam are made for every five years between 1990 to 2030 based on these figures. It is assumed that traffic activity parameters other than volumes (i.e. speeds) and road infrastructures remain unchanged. Results can be found in database-folders *'Road Traffic Activity Rotterdam 1990'*, *'Road Traffic Activity Rotterdam 1995'*, …, *'Road Traffic Activity Rotterdam 2030'*.

Table 2, Table 3 and Table 4 show a trend break for period 2005-2010 compared to all other 5-year periods. Between 2005 and 2010, there is only a minor increase in passenger traffic activity and there is a decrease in freight transport activity, whereas both activities increase for all other 5-year

periods. These results are attributed to the economic crisis. From 2010 onwards, trends are in line with records of the 2000-2005 period.

3.1.7. Usefulness of road traffic activity data

Road traffic activity data for the city of Rotterdam are available in GIS files that include detailed information for all network links. The parameterization (traffic volumes and speeds) and detailed levels of disaggregation allow for a bottom-up approach when constructing emission baselines. Road traffic activity data can be combined with emission factors to produce these emission baselines (cf. D1.3.5).

The collected road traffic activity data are considerably valuable as well for calibration of the Urban Transport Model. For a description of how exactly the activity data are used in this context, we refer to D5.2.2.

3.2. Data for other transport modes

'Other transport modes' include slow modes (pedestrians & bicycles), mopeds, metro & tram, train, shipping and aviation. The database of traffic activity for other modes can be found in database-folder '*Traffic Activity Rotterdam Other Modes*'. The contents of the database is discussed in following Sections.

3.2.1. Spatial disaggregation

The collected data for other transport modes from the city of Rotterdam are not spatially disaggregated. GIS networks for non-road networks (e.g. railways or inland waterways) are not available. The collected data refer to the city as a whole.

3.2.2. Parameterization of traffic activity

For the city of Rotterdam, slow modes, mopeds, rail traffic, shipping and aviation are characterized by the following traffic activity parameter (cf. database-file '*Traffic Activity Rotterdam Other Modes.xls*'):

- Slow modes: amount of passenger kilometers per day
- Mopeds: amount of passenger kilometers per day
- Rail traffic: amount of passenger kilometers per day per vehicle category
- Shipping: amount of incoming ships per year per vehicle category
- Aviation: amount of flights per year

Information for other traffic activity parameters (speed, density, level of congestion, …) are not available. Note that the data on aviation relate to the airport of Rotterdam - The Hague (not Amsterdam Schiphol).

3.2.3. Disaggregation by vehicle category

Transport activity data are disaggregated by vehicle category. The considered vehicle categories for 'other transport modes' are as follows:

- Slow mode (pedestrian & bicycle)
- Moped
- Metro & Tram
- Passenger Train
- Freight Train

- Inland Ship
- Maritime Ship
- Plane

In the database-file *'Traffic Activity Rotterdam Other Modes.xls'* for the city of Rotterdam, traffic activity data are given per vehicle category, as indicated in Table 5.

Table 5: Traffic activity for 'other transport modes' in the city of Rotterdam

	unit	2005	source
Slow mode	(passenger kilometers per day)	1,579,000	de Vries & Stevense (2010)
Moped	(passenger kilometers per day)	61,000	de Vries & Stevense (2010)
Metro & Tram	(passenger kilometers per day)	1,336,000	de Vries & Stevense (2010)
Passenger Train	(passenger kilometers per day)	1,944,000	de Vries & Stevense (2010)
Inland Ship	(amount of incoming ships per year)	133,000	Port of Rotterdam (2010)
Maritime Ship	(amount of incoming ships per year)	35,989	Port of Rotterdam (2010)
Plane	(amount of flights per year)	65,154	Rotterdam The Hague Airport (2010)

3.2.4. Disaggregation by vehicle type (Vehicle fleet composition)

Traffic activity data are further disaggregated by vehicle type, vehicle technology and vehicle age. Since specific data on the vehicle fleet composition for the city of Rotterdam were not available, we apply national fleet composition data of the Netherlands (from TREMOVE) to the city of Rotterdam.

The rail traffic vehicle fleet evolution is modelled using a classic scrap-and-sales approach, as was the case for the road traffic vehicle fleet (cf. Section 3.1.4).

The train sales disaggregation is based upon exogenous inputs. Sale shares for trains have been determined such that the evolution of the train fleet is consistent with the long-term trends in the TRENDS database (De Ceuster et al. (2007)).

For shipping, TREMOVE distinguishes 21 inland waterway vessel types, classified according to size and freight category. The model does not include an explicit scrap-and-sales model for vessels. Instead, shares of`different vessel types in total transport are exogenous. However, the model includes a module for the simulation of engine replacements/maintenance, retrofit of after-treatment equipment and alternative fuel quality standards. The baseline fleet composition forecast for the 21 vessel types in TREMOVE is based upon detailed Dutch statistics (CBS4) and predictions (AVV5) on domestic and international movements.

For aviation, a further disaggregation by vehicle type is not available.

Traffic activity per vehicle type and vehicle technology can be found in file *'Vehicle Fleet Composition Rotterdam.xls*' of database-folder '*Vehicle Fleet Composition Rotterdam*'. Table 6 represents vehicle fleet data (proportion of vehicle kilometers per category) for inland ships. Other vehicle categories are included in the database.

Table 6: Vehicle fleet composition (% vkm per category) for inland ships (source: TREMOVE v3.3.2)

vehicle category	vehicle type	% vkm per vehicle category		
		2005 (%)	2020 (%)	2030 (%)
inland ship	Dry Cargo <250 ton	0.2	0.1	0.1
	Dry Cargo > 3000 ton	1.3	2.0	2.2
	Dry Cargo 1000-1500 ton	23.5	22.8	22.4
	Dry Cargo 1500-3000 ton	19.9	23.4	23.7
	Dry Cargo 250-400 ton	3.3	2.9	2.9
	Dry Cargo 400-650 ton	9.9	7.6	7.5
	Dry Cargo 650-1000 ton	21.2	18.7	18.3
	Push barge <250 ton	1.5	0.6	0.6
	Push barge > 3000 ton	0.4	0.6	0.7
	Push barge 1000-1500 ton	2.5	2.5	2.5
	Push barge 1500-3000 ton	5.0	6.1	6.3
	Push barge 250-400 ton	1.0	0.8	0.8
	Push barge 400-650 ton	0.5	0.3	0.3
	Push barge 650-1000 ton	0.9	0.8	0.8
	Tanker <250 ton	0.1	0.0	0.0
	Tanker > 3000 ton	0.7	1.2	1.2
	Tanker 1000-1500 ton	2.9	3.3	3.4
	Tanker 1500-3000 ton	3.4	4.6	4.8
	Tanker 250-400 ton	0.3	0.3	0.3
	Tanker 400-650 ton	0.4	0.3	0.3
	Tanker 650-1000 ton	1.1	1.0	1.0
inland ship Total		**100.0**	**100.0**	**100.0**

3.2.5. Temporal profiles

Activity data for slow modes, mopeds and rail traffic are given per day (cf. Table 5). Temporal profiles are available from Figure 2 and Figure 3 (cf. Section 3.1.5).

Activity data for shipping and aviation are given per year. Specific information for a further temporal disaggregation was not available.

3.2.6 Extensions to other years

The procedure to make projections of transport activities for other transport modes is similar to the procedure for road traffic (cf. Section 3.1.6).

Table 7 gives an overview of transport activity for other modes in the Netherlands (source: PRIMES energy model (Caprus et al. (2010))). Table 8 includes the annual % change in transport activity for every five years between 1990 and 2030.

Table 7: Evolution of transport activity for 'other transport modes' (Gpkm and Gtkm) in the Netherlands (source: PRIMES energy model (Caprus et al. (2010)) – baseline 2009)

Netherlands: Baseline 2009	1990	1995	2000	2005	2010	2015	2020	2025	2030
Passenger transport activity (Gpkm)	**172.2**	**172.3**	**184.4**	**194.8**	**197.9**	**213.8**	**226.7**	**240.0**	**254.4**
Public road transport	13.0	12.0	11.3	11.8	12.4	13.2	13.8	14.1	14.3
Rail	12.3	17.7	16.1	16.7	18.1	19.6	21.2	22.6	23.9
Aviation	7.0	8.5	13.0	14.2	15.1	18.0	21.7	25.1	28.0
Inland navigation	1.2	1.0	0.7	0.7	0.7	0.8	0.8	0.8	0.8
Road traffic (cars and motorcycles)	138.6	133.0	143.3	151.5	151.7	162.2	169.2	177.5	187.4
Freight transport activity (Gtkm)	**93.2**	**105.7**	**125.4**	**132.3**	**129.2**	**134.5**	**139.4**	**146.1**	**153.8**
Rail	3.1	3.1	4.5	5.9	7.4	7.7	7.9	8.1	8.1
Inland navigation	35.7	35.5	41.3	42.2	41.8	43.0	44.8	46.9	48.9
Road traffic (Trucks)	54.5	67.1	79.6	84.2	80.0	83.8	86.6	91.2	96.8

Table 8: Annual % Change in transport activity for 'other transport modes' (pkm and tkm) in the Netherlands (source: PRIMES energy model (Caprus et al. (2010)) – baseline 2009)

Netherlands: Baseline 2009	'90-'95	'95-'00	'00-'05	'05-'10	'10-'15	'15-'20	'20-'25	'25-'30
Passenger transport activity (Annual % Change in pkm)	**0.0**	**1.4**	**1.1**	**0.3**	**1.6**	**1.2**	**1.2**	**1.2**
Public road transport	-1.5	-1.3	0.9	1.0	1.3	0.9	0.4	0.3
Rail	8.8	-1.8	0.7	1.7	1.7	1.6	1.3	1.2
Aviation	4.3	10.4	1.8	1.3	3.9	4.1	3.1	2.3
Inland navigation	-3.8	-5.2	-0.3	0.7	0.7	0.5	0.5	0.5
Road traffic (cars and motorcycles)	-0.8	1.5	1.1	0.0	1.4	0.9	1.0	1.1
Freight transport activity (Annual % Change in tkm)	**2.7**	**3.7**	**1.1**	**-0.5**	**0.8**	**0.7**	**1.0**	**1.1**
Rail	0.2	9.2	5.9	5.1	1.0	0.5	0.4	0.1
Inland navigation	-0.1	3.3	0.5	-0.2	0.6	0.8	0.9	0.9
Road traffic (Trucks)	4.6	3.7	1.2	-1.0	0.9	0.7	1.0	1.2

The annual % change in transport activity for the city of Rotterdam is given in Table 9, Table 10 and Table 11. For slow mode, moped, metro & tram and passenger train, the relation between national activity changes and metropolitan activity changes for the Netherlands is taken into account (cf. Section 3.1.6). For shipping and aviation, this information is unavailable. Therefore only national forecasts are considered for these two transport modes.

Table 9: Annual % change of transport activity for 'other transport modes' (vehicle-kilometers) in Rotterdam per vehicle category

Transport activity (Annual % Change in vkm)	'90-'95	'95-'00	'00-'05	'05-'10	'10-'15	'15-'20	'20-'25	'25-'30
slow mode		0.5	-2.8	2.4	0.2	0.2	0.0	0.0
moped		0.0	-1.6	5.8	1.6	1.6	1.4	1.4
metro and tram		1.0	-1.2	9.8	2.1	2.1	1.6	*1.5*
passenger train	8.8	-0.6	0.5	2.2	2.0	1.9	1.4	1.2

Table 9 shows a strong increase in metro and tram vehicle kilometres between 2005 and 2010. The annual growth of 9.8% corresponds to a growth of 49% over the 5-year period, which at first sight seems a bit excessive. The evolution for metro and tram in Rotterdam will be reviewed in D1.3.1.

Table 10: Table Y: Annual % change of transport activity for aviation (passenger-kilometers) in Rotterdam per vehicle category

Transport activity (Annual % Change in pkm)	'90-'95	'95-'00	'00-'05	'05-'10	'10-'15	'15-'20	'20-'25	'25-'30
plane	4.3	10.4	1.8	1.3	3.9	4.1	3.1	2.3

Table 11: Annual % change of transport activity for freight train & inland ship (ton-kilometers) in Rotterdam per vehicle category

Transport activity (Annual % Change in tkm)	'90-'95	'95-'00	'00-'05	'05-'10	'10-'15	'15-'20	'20-'25	'25-'30
freight train	0.2	9.2	5.9	5.1	1.0	0.5	0.4	0.1
inland ship	-0.1	3.3	0.5	-0.2	0.6	0.8	0.9	0.9

Projections of transport activity for the city of Rotterdam are made for years 2020 and 2030. Results can be found in database-file '*Traffic Activity Rotterdam Other Modes.xls*'.

3.2.7. Usefulness of traffic activity data for other transport modes

Traffic activity data for other transport modes (other than roads) for the city of Rotterdam are considerably less detailed compared to road traffic activity data. Concerning the construction of emission baselines, the parameterization and the level of disaggregation of these data do not allow for a bottom-up approach (starting from activities and emission factors). However, the activity data may be useful for source apportionment in a top-down approach. More information is given in D1.3.5.

The collected activity data for other transport modes are also useful as an input for the Urban Transport Model. For a description of how exactly the activity data are used in this model, we refer to D5.2.2. More (detailed) activity data that become available and that are useful for the Urban Transport Model will be included in the final database of traffic activity (D1.3.1).

4. Conclusions

A database of transport activity is constructed for the city of Rotterdam, which is one of the TRANSPHORM case-study cities. The database of traffic activity includes data for base year 2005 and future years 2020 and 2030. For road traffic, data from 1990 and 2030 (every five years) are included as well. Projections of transport activities are made based on expected demographic and socio-economic evolutions.

In general, a trend break can be seen for period 2005-2010 compared to other 5-year periods between 1990 and 2030. Between 2005 and 2010, passenger traffic activity remains more or less status quo and freight transport activity decreases, whereas both activities increase for all other 5-year periods. These results are attributed to the economic crisis.

Transport activity is disaggregated by vehicle category and vehicle type. For the city of Rotterdam, the vehicle fleet composition is adopted from the national fleet structure. Transport activity is also characterized by a certain level of spatial and temporal disaggregation.

Data for road transport are significantly more detailed than data and data availability for other transport modes.

Road traffic activity data for the city of Rotterdam are available on a detailed level of disaggregation (by space, by vehicle category, by vehicle type,…). The parameterization and detailed levels of disaggregation allow for a bottom-up approach when constructing emission baselines (starting from activities and emission factors).

Traffic activity data for other transport modes are considerably less detailed compared to road traffic activity data. The parameterization and the levels of disaggregation of these data do not allow for a bottom-up approach. However, the activity data may be useful for source apportionment in a top-down approach (cf. D1.3.5).

The collected activity data for road transport and for other transport modes are a considerably valuable input for the Urban Transport Model as well (cf. D5.2.2).

5. References

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