

Case Study: Karlsruhe, Germany

A case study was performed on a neighbourhood in Karlsruhe, a city with ample safe active transport (walking and cycling) and a high performance public transport system. Such a city was selected to be used as a base “best case” scenario in order to compare all future urban regions to this case study.

Karlsruhe (population approx. 285,000) is located in the South West of Germany and close to the French border. Karlsruhe is famous in transport circles for pioneering the concept of using rail tracks for the combined use of passenger trams and regional and freight trains. The city layout also provides for easy walking and cycling. In addition, neighbourhoods contain a variety of activities (medical services, restaurants, schools etc.) within the residential areas as shown in *Figure 1*, ensuring that many activities are within walking or cycling distance of residents.



Figure 1: Typical residential building in Karlsruhe with activities (book/wine stores) on the first floor

The case study focuses on a typical small urban neighbourhood in the Oststadt district of Karlsruhe containing approximately 2250 residents. The region is contained by three streets forming a triangle. The three streets forming the study region triangle are: Karl-Wilhelm St, Georg-Friedr. St., and Durlacher

Allee. The Durlacher Allee side of the triangle is approximately 500m in length. Karlsruhe University is located to the immediate Northwest of the study region as shown in *Figure 2*.

From observation of the paths and roads within and surrounding the study region, it was determined that cycling and walking are both safe. Many cyclists and pedestrians were also observed accessing their activities during the study region assessment. Cycle storage facilities were present at all major activity centres (schools, shops etc.) and it was also observed to be possible to store cycles close to smaller activity centres (securing to lampposts etc.). Many tram routes pass close to the study region, with many residents being located within 200m of a tram stop. The tram routes and stops are shown in *Figure 2*, surrounding activities are also highlighted.

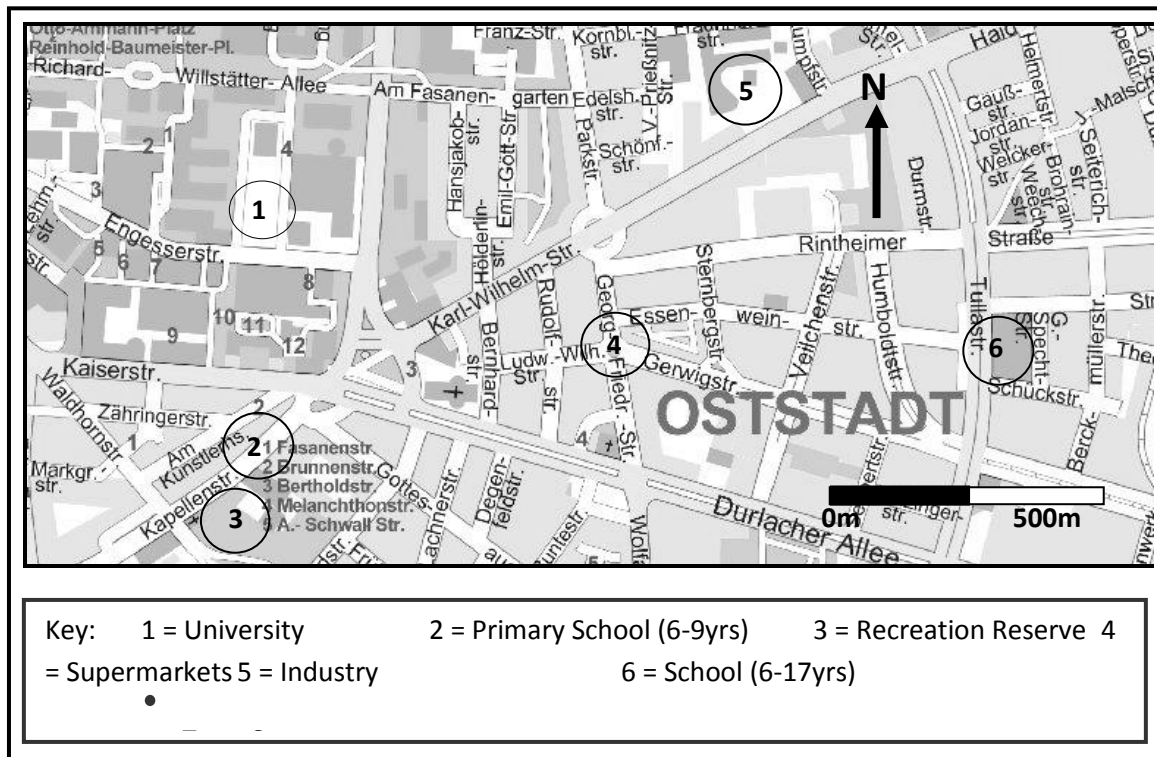


Figure2: Oststadt study region showing surrounding activities and tram stops

Demographic and employment data was provided by Karlsruhe University for the study region. There are approximately 2250 people within the study region, 1225 male and 1025 female, 16% of the adult population are students and 16% are unemployed. The closest available employment is located at the University and a nearby industry sector (Numbers 1 and 5 in *Figure 2*). These two locations provide over

4000 jobs. Following the TES method, workers travel to the closest available work sites; therefore all workers will travel to these two locations.

A visual inspection of the location of residences within the study region was performed. It was assumed all residents were evenly distributed amongst the available housing in the study region. The housing and activity locations were then plotted onto a map to allow trip distances to be calculated using the different modes according to the mode rules specified in the TES. The following Western European energy consumption data (KENWORTHY, 2003) was used for the available modes:

- | | |
|-------------------|------------------------------|
| 1. Walk and Cycle | 0MJ/km |
| 2. Tram | 0.72MJ/pkm |
| 3. Car | 3.3MJ/km or 9.65Litres/100km |

Energy calculations were performed for all residents following the TES method, the results of these calculations are presented in *Table 1*.

Table1: Energy and trip data for the study area separated into “common activities”

Age Group	No.	Main Activity (5x/week) - School/University/Work										
		Walk		Cycle		Tram		Car (3.3MJ/km)				
		Trip	Dist.	Trips	Dist.	Trip	Dist.	Energy	Trip	Dist.	Energy	Petro
0 to 2	29	0		0		0		0	0			
3 to 5	27	18	200	0		0		0	9	360	106.9	3.12
6 to 9	35	0		0		12	103	89.0	23	640	485.8	14.2
10 to 17	71	0		71	820	0		0	0		0	0
18 to 64:	973	348	85	625	450	0		0	0		0	0
-students	546	286	350	260	500	0		0	0		0	0
-	290											
65 and	279											
Total	2250	652	187.	956	490.	12	103	89.0	32	561.	592.7	17.33
		Food Shopping (2x/week)										
		Walk		Cycle		Tram		Car (3.3MJ/km)				
		Trip	Dist.	Trips	Dist.	Trip	Dist.	Energy	Trip	Dist.	Energy	Petro
0 to 17	162	0		0		0		0	0			
18 to 64	1809	180	300	0		0		0	0			
65 and	279	264	180	0		0		0	15	350	69.3	2.03
Total	2250	207	284.	0	0	0	0	0	15	350	69.3	2.03
		Recreation (1x/week)										
		Walk		Cycle		Tram		Car (3.3MJ/km)				
		Trip	Dist.	Trips	Dist.	Trip	Dist.	Energy	Trip	Dist.	Energy	Petro
0 to 9	91	2	390	0		0		0	89	600	352.4	10.3
10 to 17	71	2	390	69	600	0		0	0			
18 to 64	1809	40	390	1680	600	0		0	89	N/A ^b	0	0
65 and	279	6	390	0		0		0	273	600	1081.	31.6
Total	2250	50	390	1749	600	0	0	0	451	600	1433.	41.9
		Weekly Totals										
		Walk		Cycle		Tram (0.4%)		Car (4.4%)				
		Trip	Dist.	Trips	Dist.	Trip	Dist.	Energy	Trip	Dist.	Energy	Petro
Trips/Wee	1468	745	243.	6529	519.	60	103	89.0	641	578.	2095.	61.28

a “Dist.” = Average one way distance (m) to activity.

b In the case of children travelling by car, parents accompany them using zero energy.

c “Energy” units are MJ/Week; “Petrol” units are Litres/week of petroleum.

According to the specification guidelines, 95.3% of trips can comfortably be performed by active transport (cycling or walking). The high possibility for cycling and walking results in an overall low transport energy requirement. Of the motorised transport (cars and trams), about 10% of these trips could be completed by tram following the TES mode rules. Several factors contribute to this low mode share, such as no tram routes connecting the study region to the recreation reserve or the supermarket and tram stops not being within 200 metres of all residents and the value used here of 200 metres. If this 200 metre mode-distance was doubled (as it is in the current TES version) so that residents were allowed to access tram stops 400 metres from an origin, the tram share would most likely markedly increase.

The summarised TES for the study region is presented in *Table 2*, which shows that an average of 0.97MJ of transport energy would be consumed per person per week. This is equivalent to the energy required to power a 60W light bulb for about four and a half hours. However, estimated observed energy use in German urban areas is closer to 310MJ/Week (MOP, 2006). This infers that there is a large possibility for behavioural change in German urban areas. However, while German residents choose to use transport energy, they are not entirely dependent upon high energy use to access their activities, at least not in the study area of Oststadt.

Table 2: The Transport Energy Specification summary for the Karlsruhe study area

TES Summary Karlsruhe, Germany					
Car		Electric Tram		Total	
MJ/Trip ^a	3.27	MJ/Trip	1.48	MJ/Week	2184
L/Trip	0.096	L/Trip	N/A	%Energy Petrol	95.9%
MJ/Person/Week	0.93	MJ/Person/Week	0.040	%Electricity	4.1%
L/Person/Week	0.027	L/Person/Week	N/A		
Cars/1000 people	605			MJ/Trip	0.15
Area					
Total Area (hectares)	9.84			MJ/Person/Week	0.97
Density (ppl/hect)	228.6				

The TES specifies a minimal transport energy dependence for the urban layout of the study area. High population density (229 people per hectare) and a large share of jobs being located within or close to the study area contribute to this very low TES transport energy dependence value.