

# Mobility and Transportation



Solutions for Future Megacities

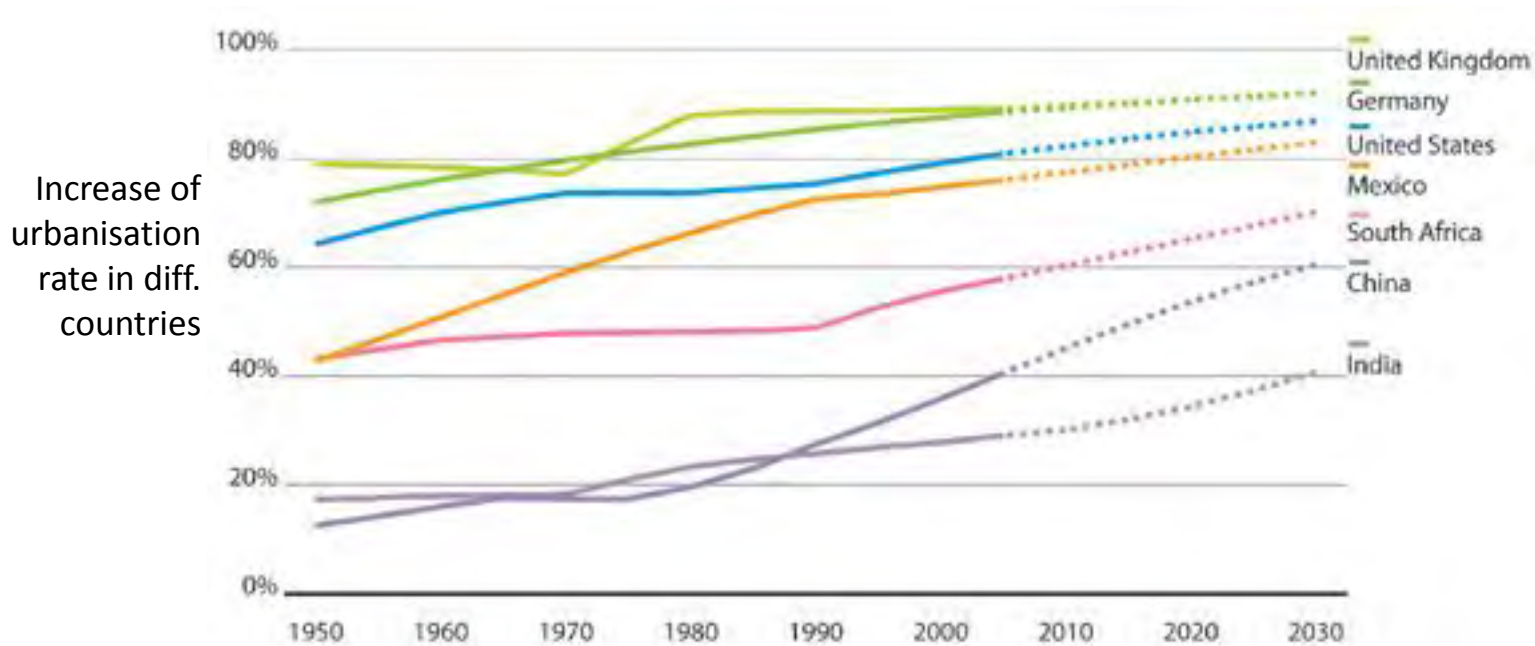
**Sino-German Dialogue Forum on Sustainable Urban Development**

Beijing 22<sup>nd</sup> Sep. 2015

Dr.-Ing. Wulf-Holger Arndt

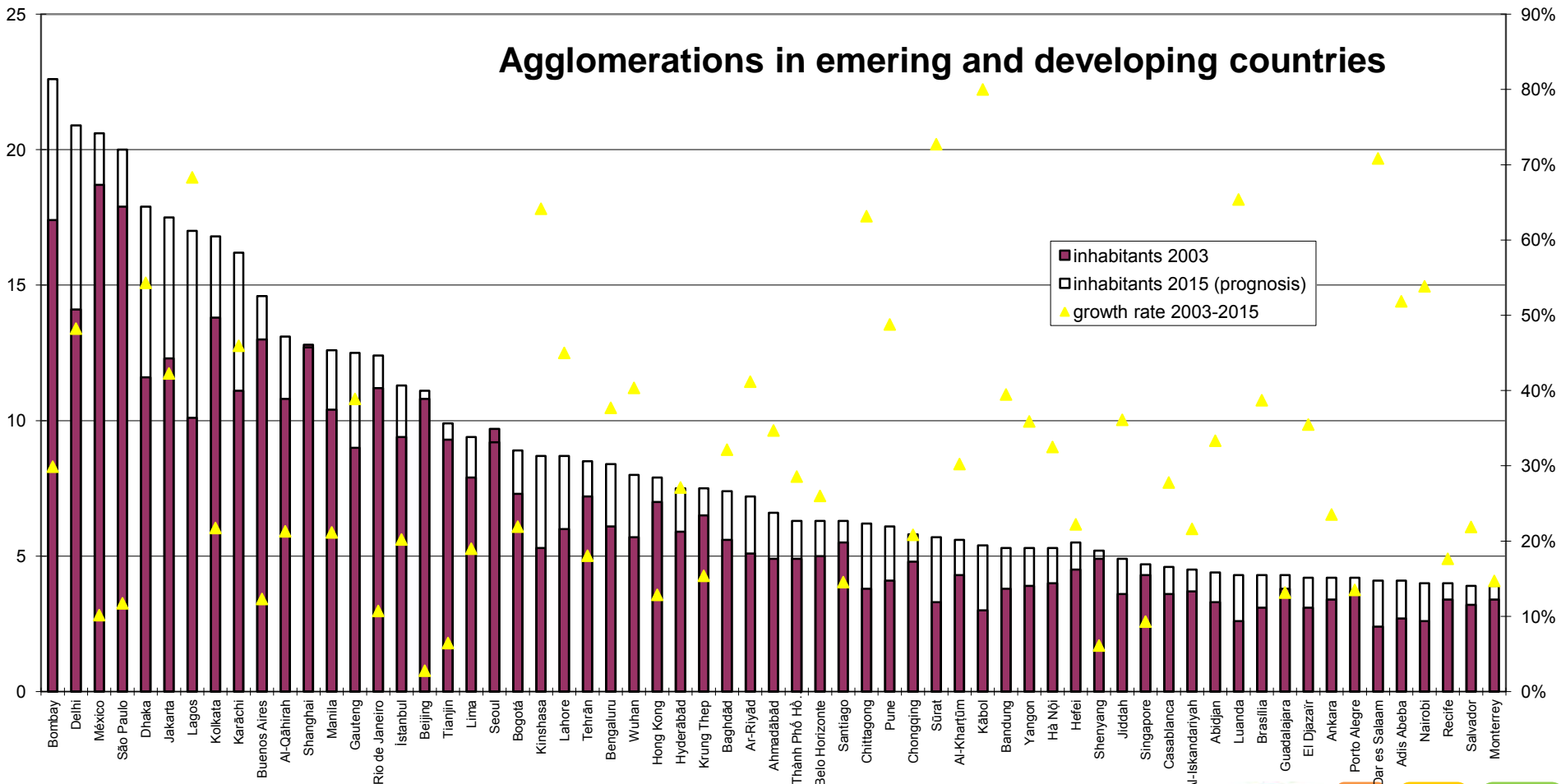
# Urbanisation growth

- Over 50% of world civilisation is living in cities
- Increasing in all countries
- Even in countries with stagnation and decreasing number of inhabitants



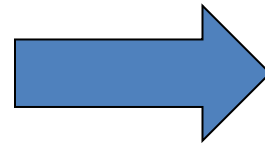
The Endless City 2007

# Urbanisation growth

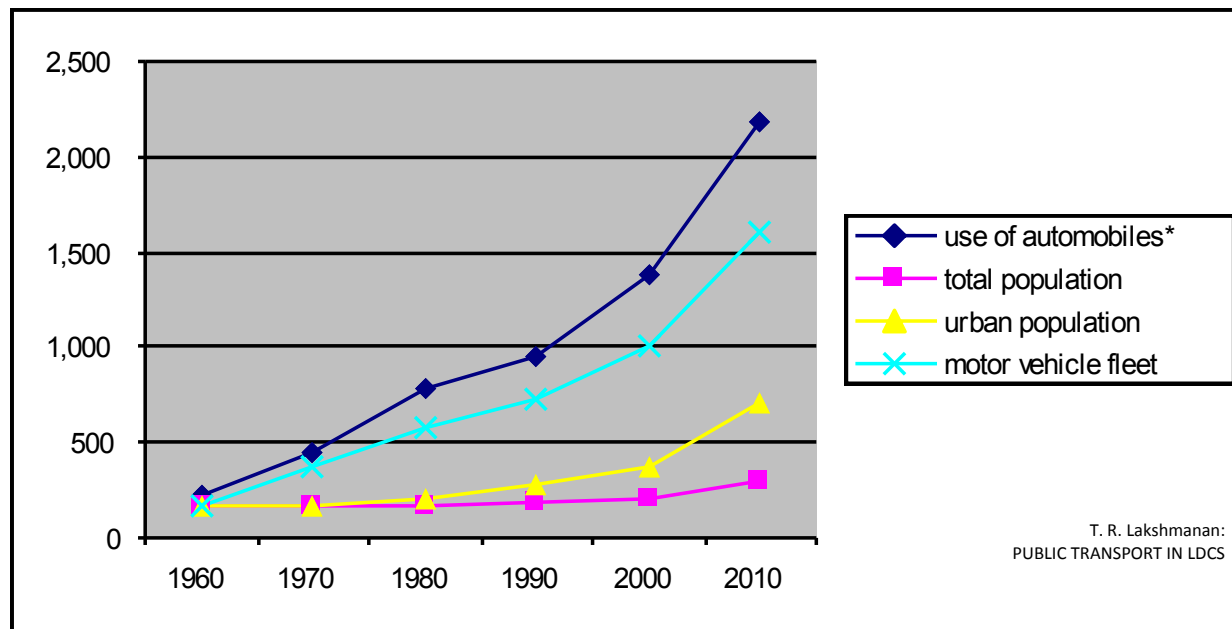


# Growth of population and traffic

- Growth of population
- Population density
- Settlement structure
- Growth of income
- Production methods/Trade relations
- ...

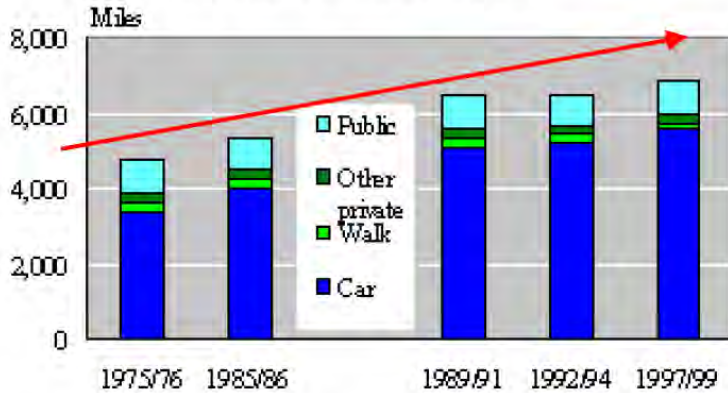


Traffic growth



# Traffic mode and energy consumption in traffic

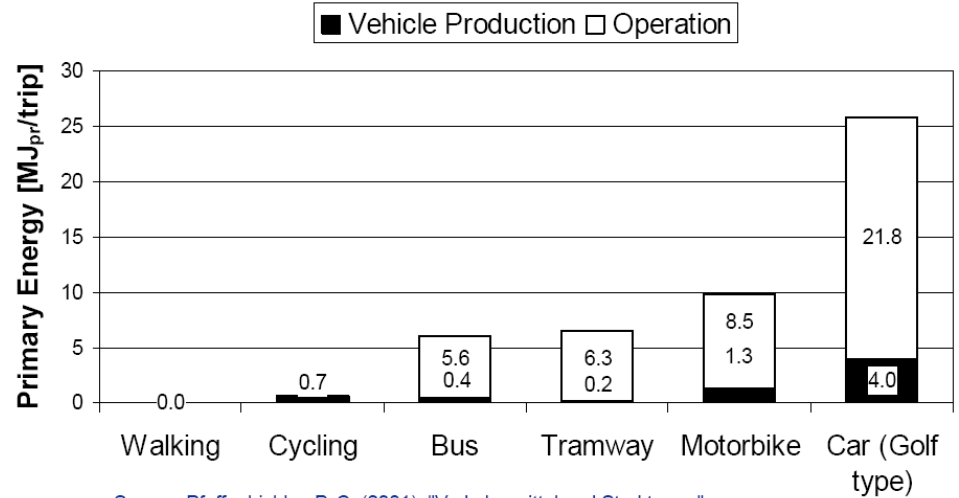
What increases is the distance travelled per person per year by main mode!



Source: Prof. Emberger, TU Wien, 2010

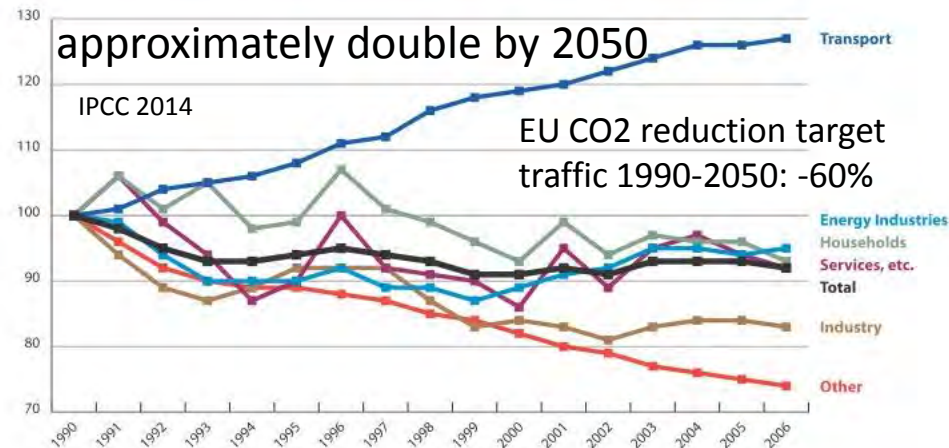
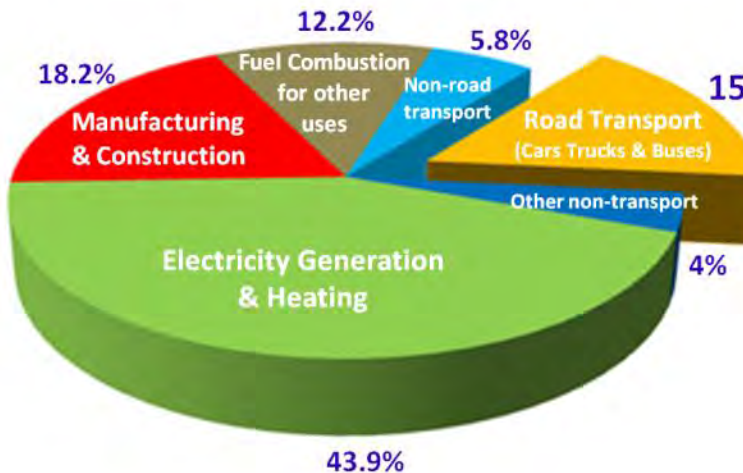
source: <http://www.transtat.dft.gov.uk/>

Comparison energy consumptions per trip



Source: Pfaffenbichler, P. C. (2001). "Verkehrsmittel und Strukturen."

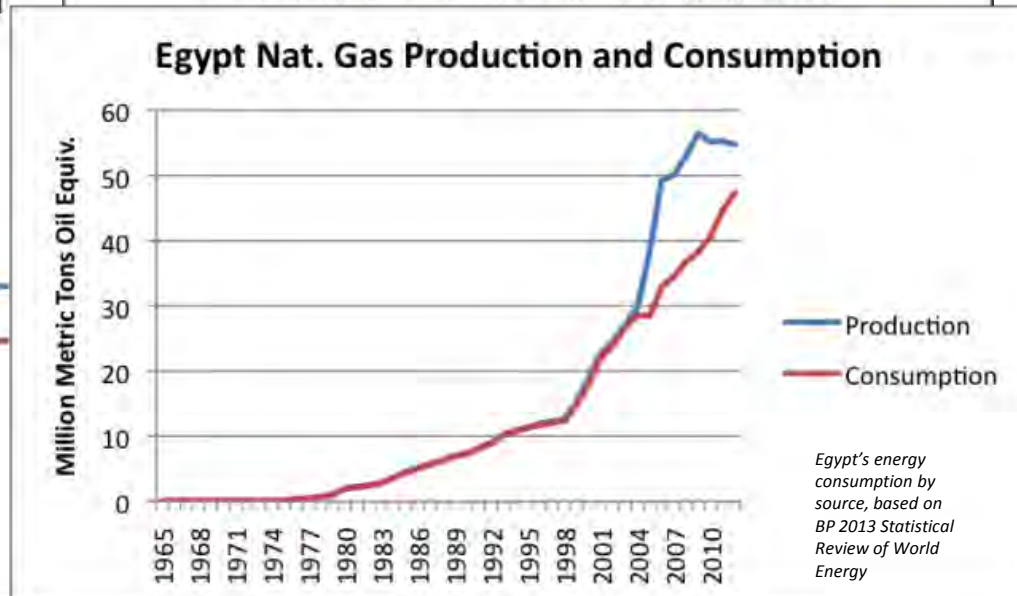
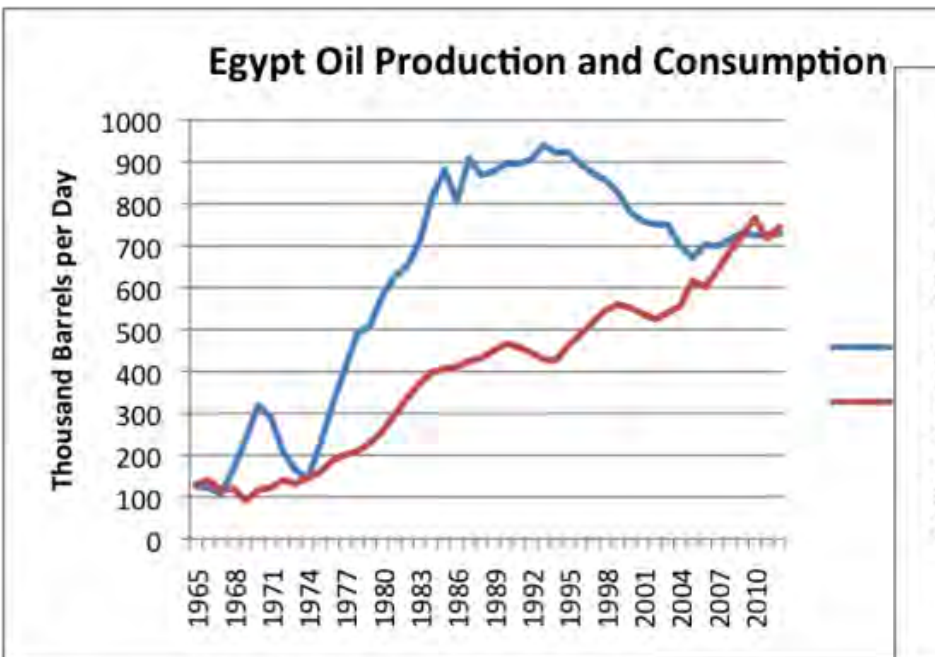
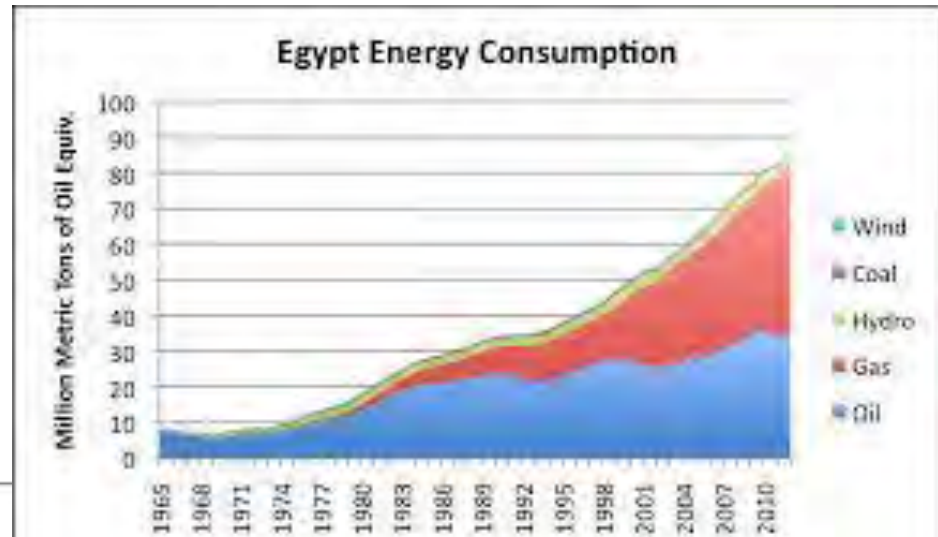
Figure 3: GHG emissions in the EU-27, by sector (1990 = 100)



Source: EU energy and transport in figures — Statistical pocketbook 2009.

# Energy consumption and Oil production in Egypt

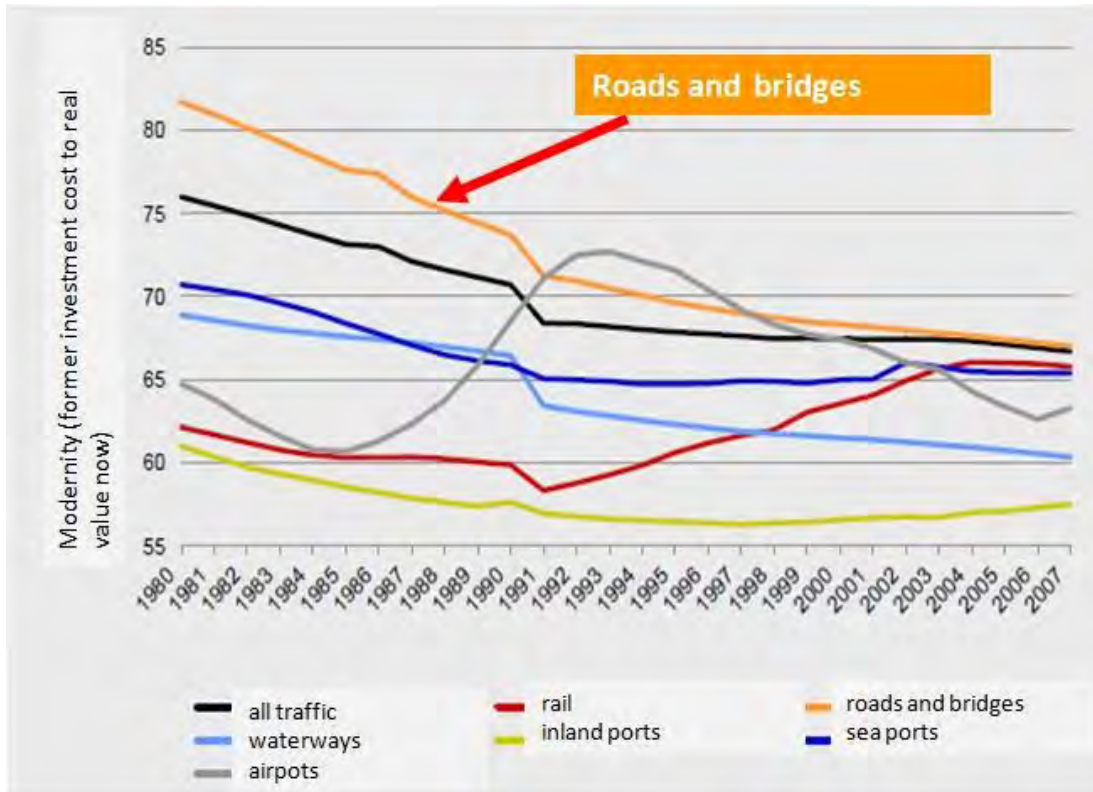
- Egypt's primary energy consumption has grown at an average annual rate of 4.6%, primarily from rapid urbanization and associated increases in demand for electricity and **transport services**.
- Growing **fuel subsidies** that are equivalent to USD 20 billion in 2011, estimated to be 20% of Egypt's state budget and 10% of its GDP



*Egypt's energy consumption by source, based on BP 2013 Statistical Review of World Energy*

# German Transport Infrastructure – increasing follow-up cost

## Modernity Change Infrastructure in Germany 1980 to 2007

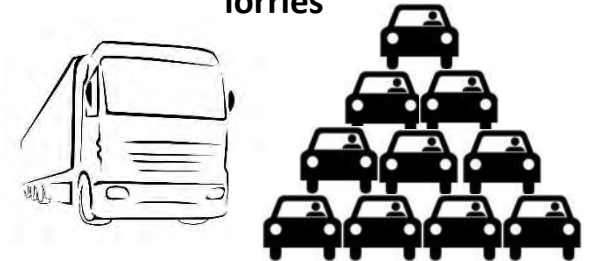


Source: ProgTrans AG, Basel 2009, from: Ralf Pagenkopf, GF Straßen.NRW (Bunzel (Difu) Pres. at BPPP, July 2013)

Investment demand in German municipality road bridges 2013-2020: 1 bill. € per year!

Arndt 2013  
<http://www.difu.de/projekte/2012/ersatzneubau-kommunale-bruecken.html>

**Abrasion (by vibration) of roads by lorries**



**1 lorry (24 t) = 10.000 cars (1,4 t)**

# Traffic Impact

## Traditional solutions in the West



Pic+Text: Prof. Emberger, TUWien, 2010



Pic.: suburbanpermaculture.org





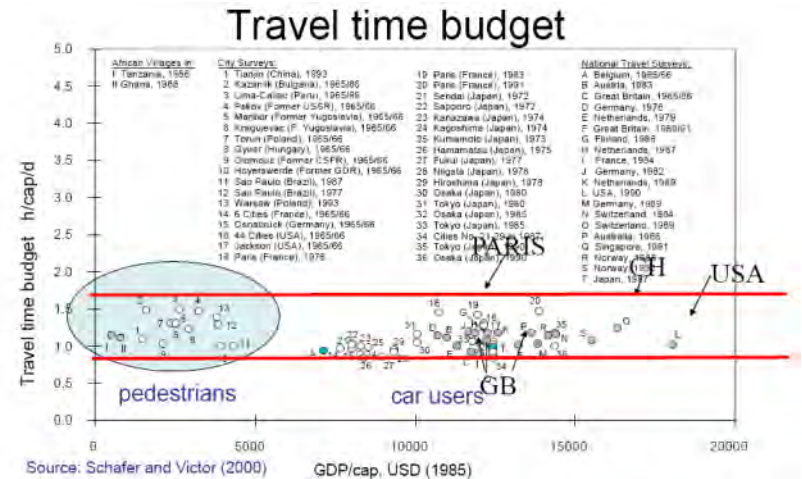
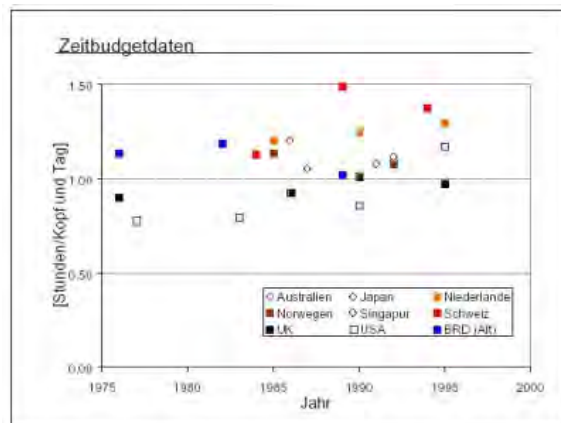
# Land use and transport

- strong correlation between increasing land use and traffic behaviour
- Klaus Töpfer, United Nations Environment Programme (UNEP), said: “Tell me your spatial structure and I will say how high the fuel price was in the past.”
- assumption that distance (s) is constant was incorrect
- constant at long term time (t)
- relative constantly travel budget: Germany: ~ 85 min/day

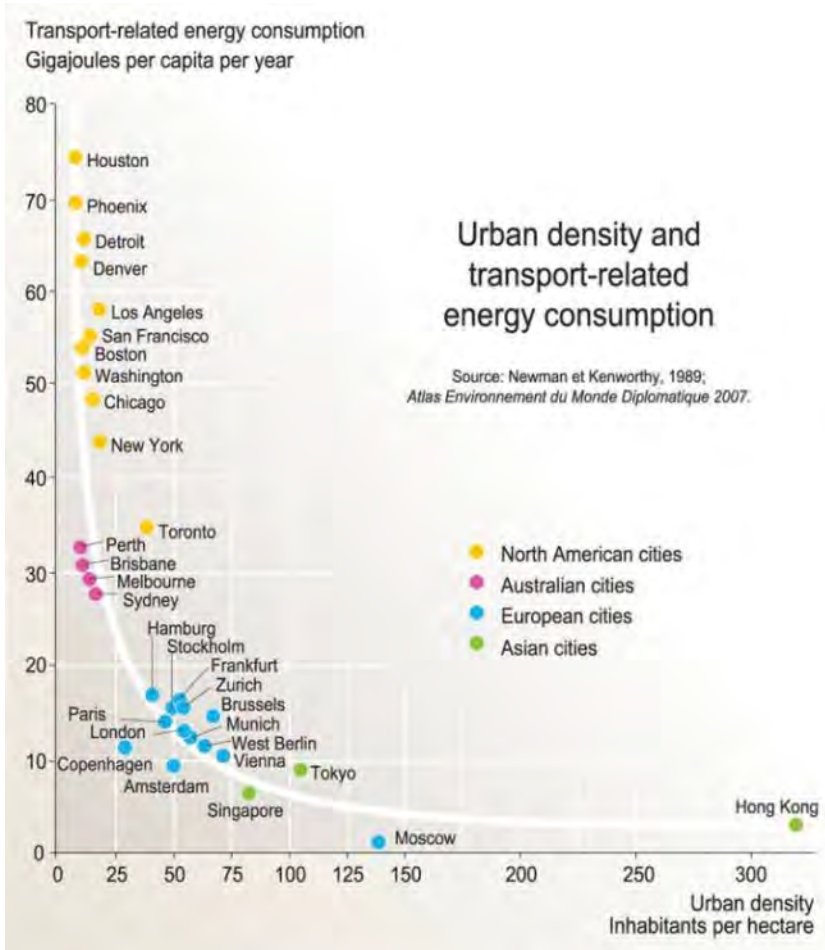
Wrong interpretation of the relation:

$$v = \frac{s}{t}$$

↑  $\sim \text{const.}$   
 ↓  $\sim \text{const.}$



# Energy intensity comparsion



(nach Newmann & Kenworthy 1989)

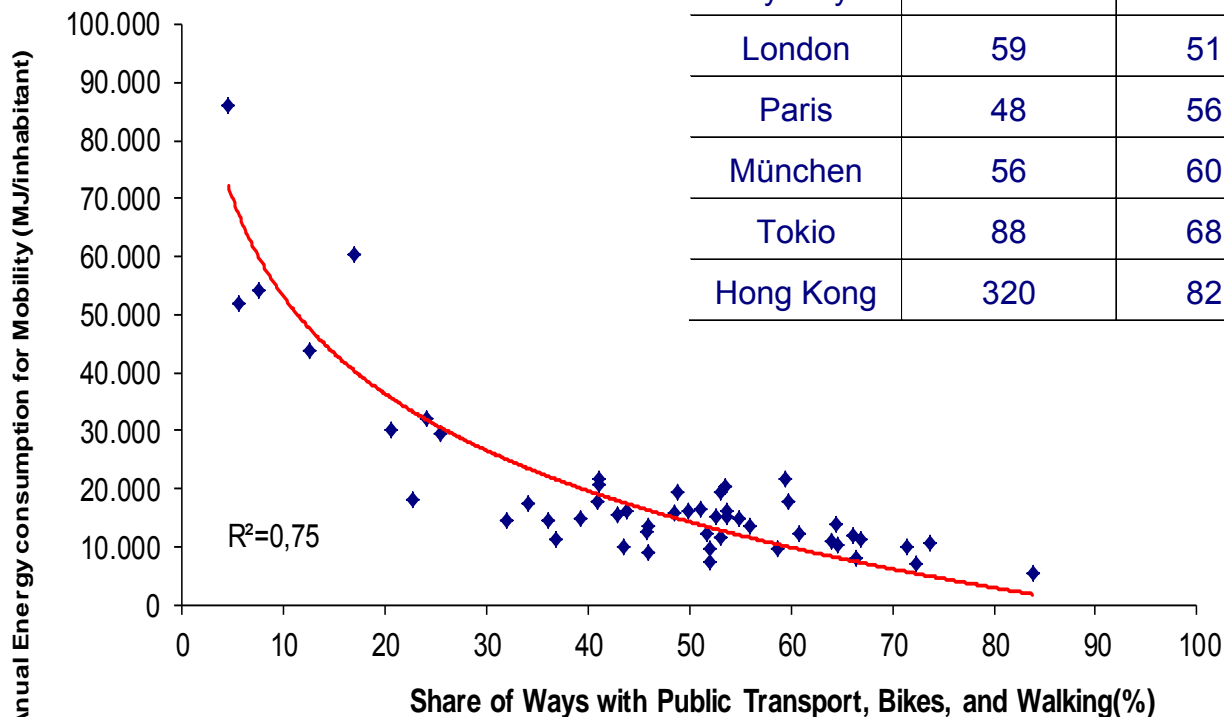
- Effect of increasing of distances and car-dependency: high fuel consumption per capita
- Decreasing of population density
- Attention: some side effects, e.g. Fuel price (compare Australia – USA)

# Promoting energy efficient transport modes

Impacts of Modal Split to mobility costs and energy consumption

Consommation d'énergie pour les déplacements vs Répartition modale

Cities	Population density (sh./ha)	Share of walking, biking, PT %	Mobility costs (%GDP)	Energy (MJ/Inh.)
Houston	9	5 %	14,1 %	86.000
Sydney	19	25 %	11,0 %	30.000
London	59	51 %	7,1 %	14.500
Paris	48	56 %	6,7 %	15.500
München	56	60 %	5,8 %	17.500
Tokio	88	68 %	5,0 %	11.500
Hong Kong	320	82 %	5,0 %	6.500

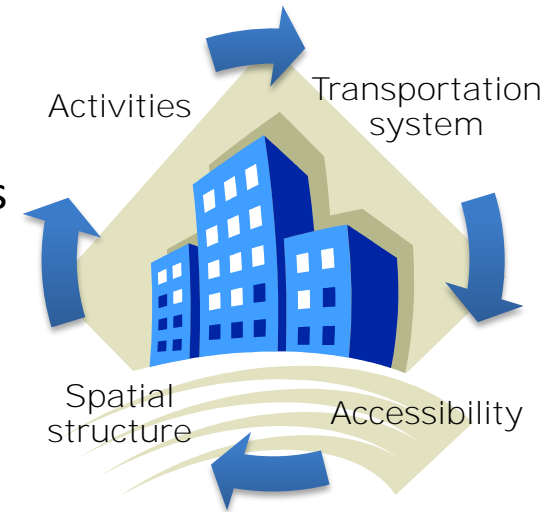


Mohamed Mezghani, UITP, 2006 [www.translearning.net](http://www.translearning.net)

# Integrated Transportation Planning - ITP

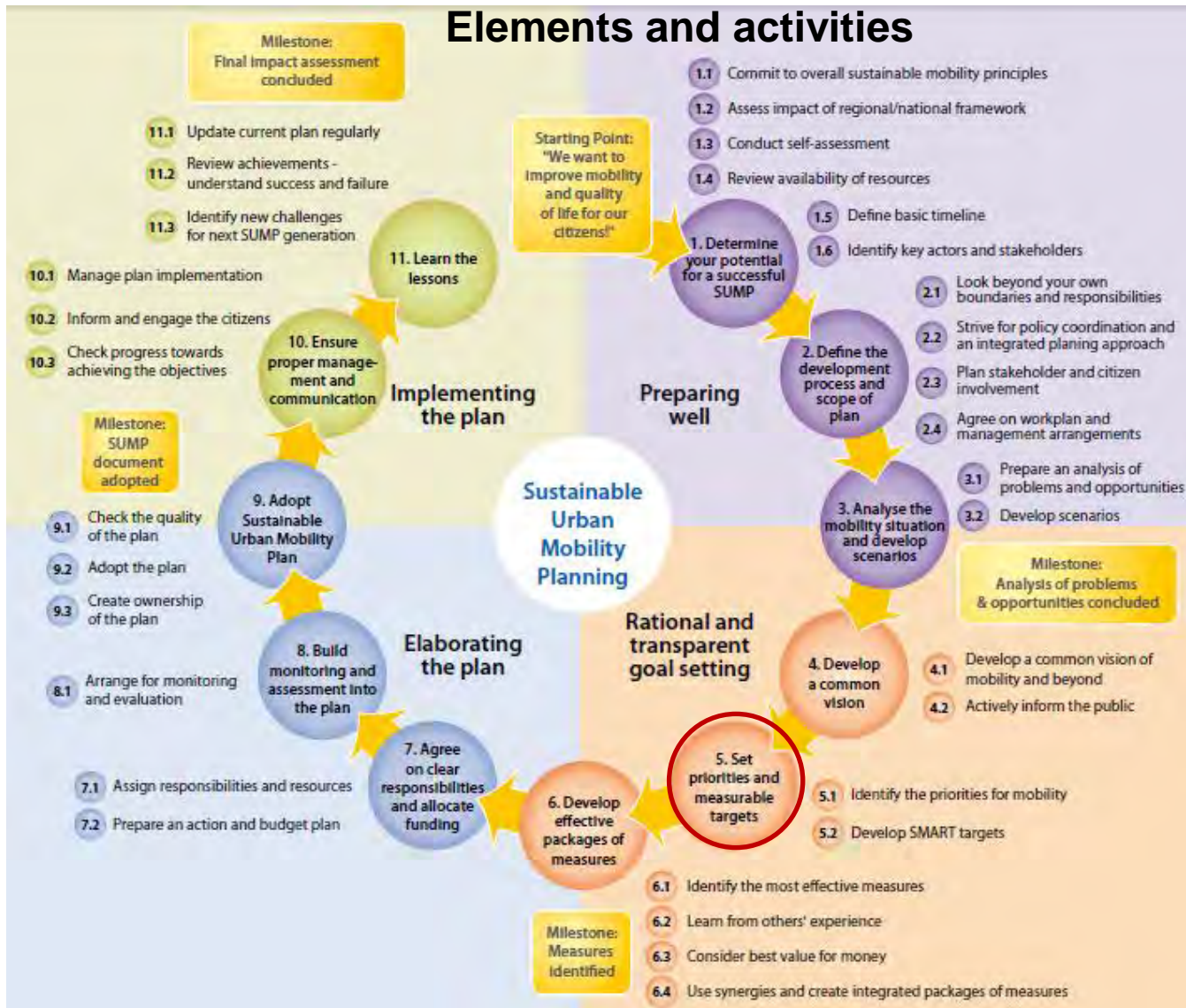
## Integration

- **Vertical – planning level**  
from international level, country, regions till communes
- **Horizontal – neighbourhoods**  
neighbouring planning areas
- **Sectoral – departmental planning**  
regional and land-use planning, landscape planning, economic promotion
- successful implementation in transportation planning:
  - participation of all stakeholders (use the local creativity)
  - cooperation between planning authorities
  - flexibility of concepts
  - consistency among the measures
  - interdisciplinarity
  - continuous evaluation



# SUMP-planning process

## Elements and activities

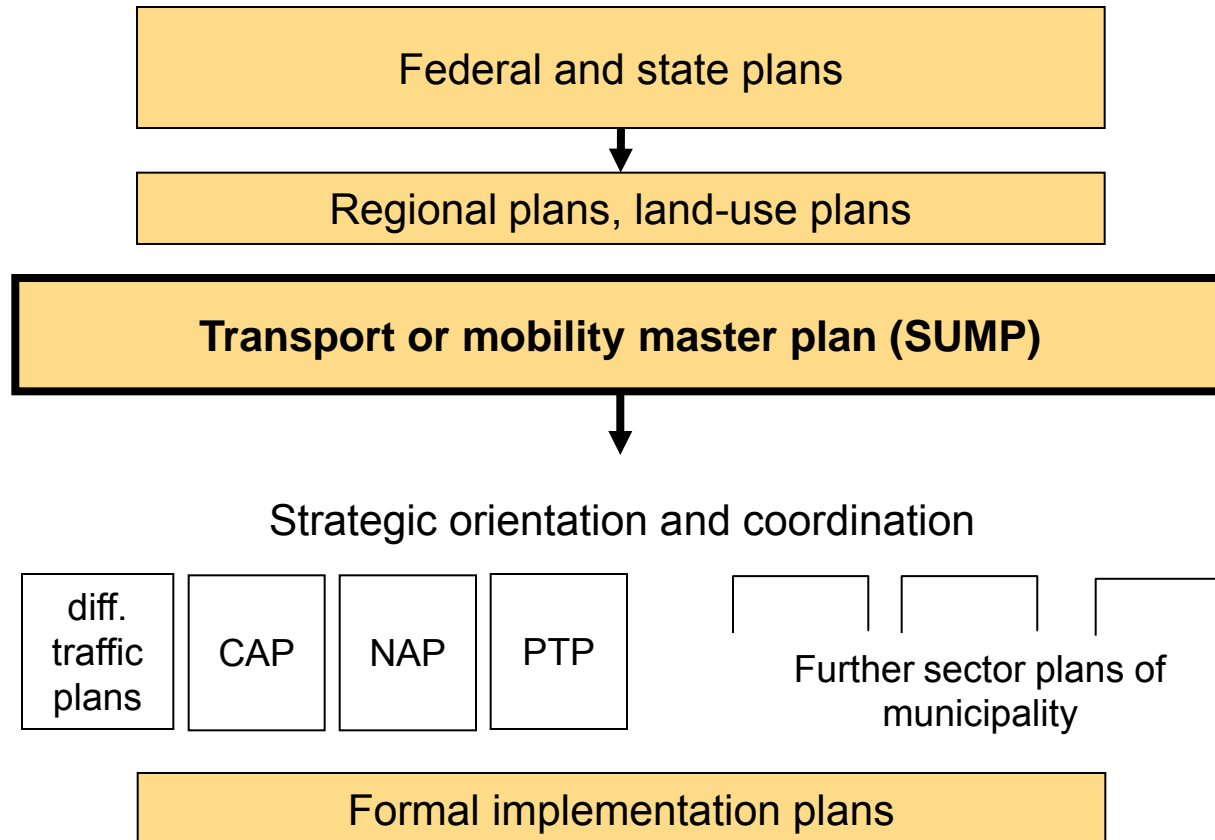


## Characteristics:

- Continuous process
- Clear goals and objectives
- Control of transport demand
- Use of scenarios
- Evaluation and control (quality management)
- Integrated hard and soft measures
- Step by step development with high transparency
- Participation of the public

# Transport or mobility master plan (SUMP)

## Strategy and coordination tool



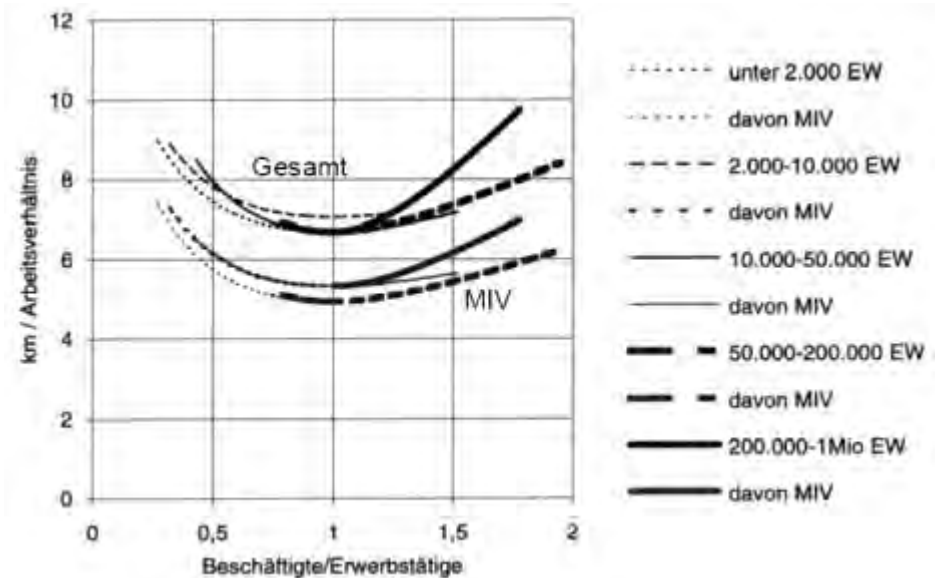
# District of short ways exp. Freiburg Vauban

- Re-cycling of land-use: former military barracks
- Area in cycling distance to city center:
  - >> dense
  - >> mixed use
  - >> quality green spaces
- End of tramline extension
- Natural water regime
- High „solar standards“
- **Parking concentrated outside in two garages**



# Integrated Transportation Planning and land use

- short distances between different places of activity such as living, shopping, labour, leisure important for reducing traffic demand
  - ITP aims at a balanced mixture of all these opportunities in high density settlements
  - in particular a harmonic balance between the number of employees and employment opportunities is very important
- ➔ Improvement of mixed-use areas
- ➔ Promotion of jobs in short distance to the living areas



(Holz-Rau/Kutter et al 1995)

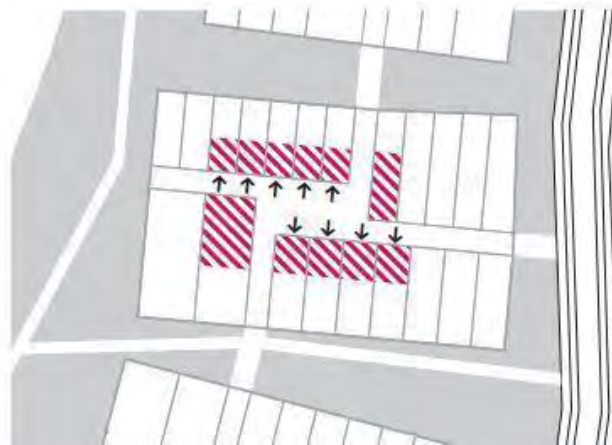


# New Towns: Compactness, Intensification and Mixed use

- Gross population density in Iran's towns is about 100 to 110 persons per ha
- Hashtgerd New Town meets the targets: gross population density of 148 per ha
- The gross population density for the Pilot Project "Shahre Javan Community" >200 p/ha
- Intensification promotes for an effective public transport and efficient land use for energy supply
- However, quantitative approach is insufficient, since it does not shed light on the living situations of the inhabitants or on the qualities and attractiveness of the urban form and public realm.



Scheme of commercial areas on the ground floor



Small-scale mixed-use areas around the courtyards



Urban form

Source: Young Cities Research Paper Series, Volume 03, The Shahre Javan Community Detailed Plan  
 Planning for a Climate Responsive and Sustainable Iranian Urban Quarter



# Support of eco-mobility: Mobility Management

Support sustainable traffic use routines (public awareness ↑)

Change of residence → to Hashtgerd as a “sustainable city”



Choice of traffic mode set → promote a set for use public transport and slow modes (“environmentally traffic”)



Realized traffic use → restriction of car use ↓  
promote environmentally transport system ↑

Measurement: mix of “hard- and soft-policies”

Traffic reduced spatial structure → mixed-use

Enhance attractiveness of public transport an slow modes →  
high service quality, dense network, mobility management

Restriction to car traffic → e.g. permeability of space, reduced parking lot factor

# Public Transport Network

→ Decisive criteria is the spatial-horizontal integration

Levels/Parameters

## 4 BRT / LRT lines

for main inner city connection (centre, railway station, industry areas,...)

(2 000 – 30 000 Passengers/h)



## 8 City-Buses:

connection between quarters and centre

(1 000 – 4 000 Passengers/h)



## 9 Local quarter buses:

inner area access

temporally demand responsive service

and flexible stops

(Midi/Minibus)



## Taxi/car sharing

Route taxi

Call taxi

Normal taxi



## Regional commuter traffic

Interaction to Karaj and Tehran by train

Regional busses

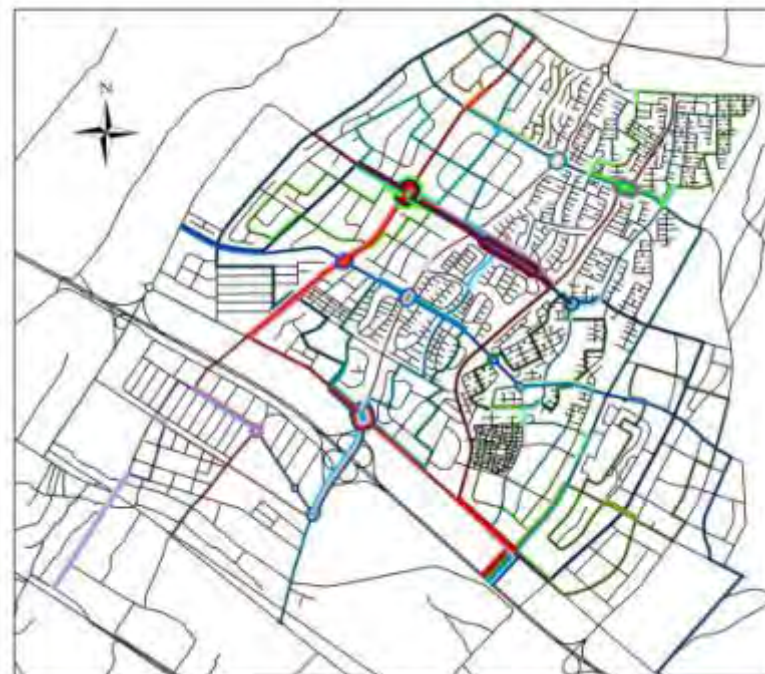
## Catchment areas:

Minibus: 250 m

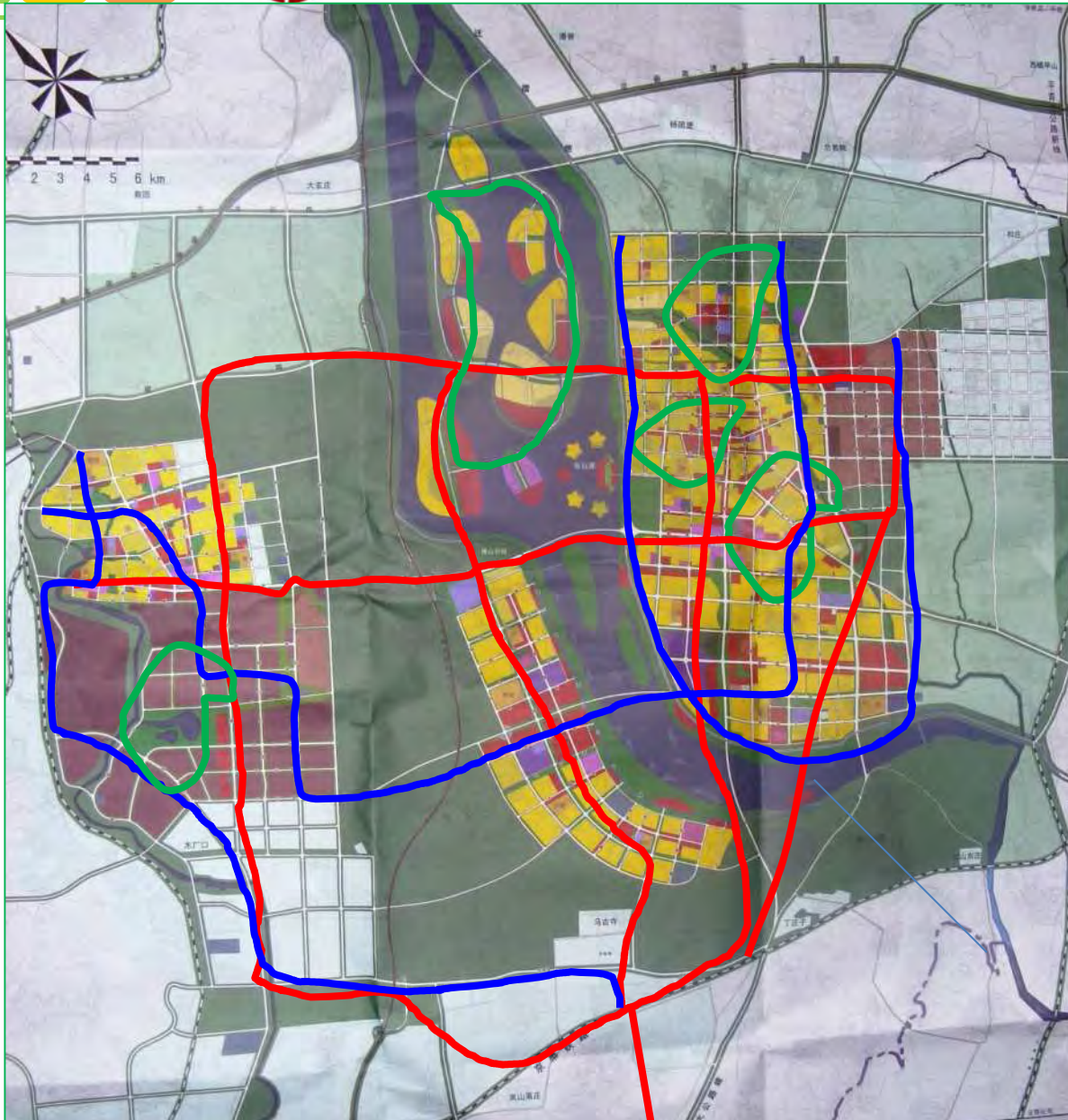
City-Bus: 250-300 m

BRT/LRT: 300m

## Network principle scheme



# Qian'an / China



## Trams:

on main flows

## City Busses:

connections  
between quarters

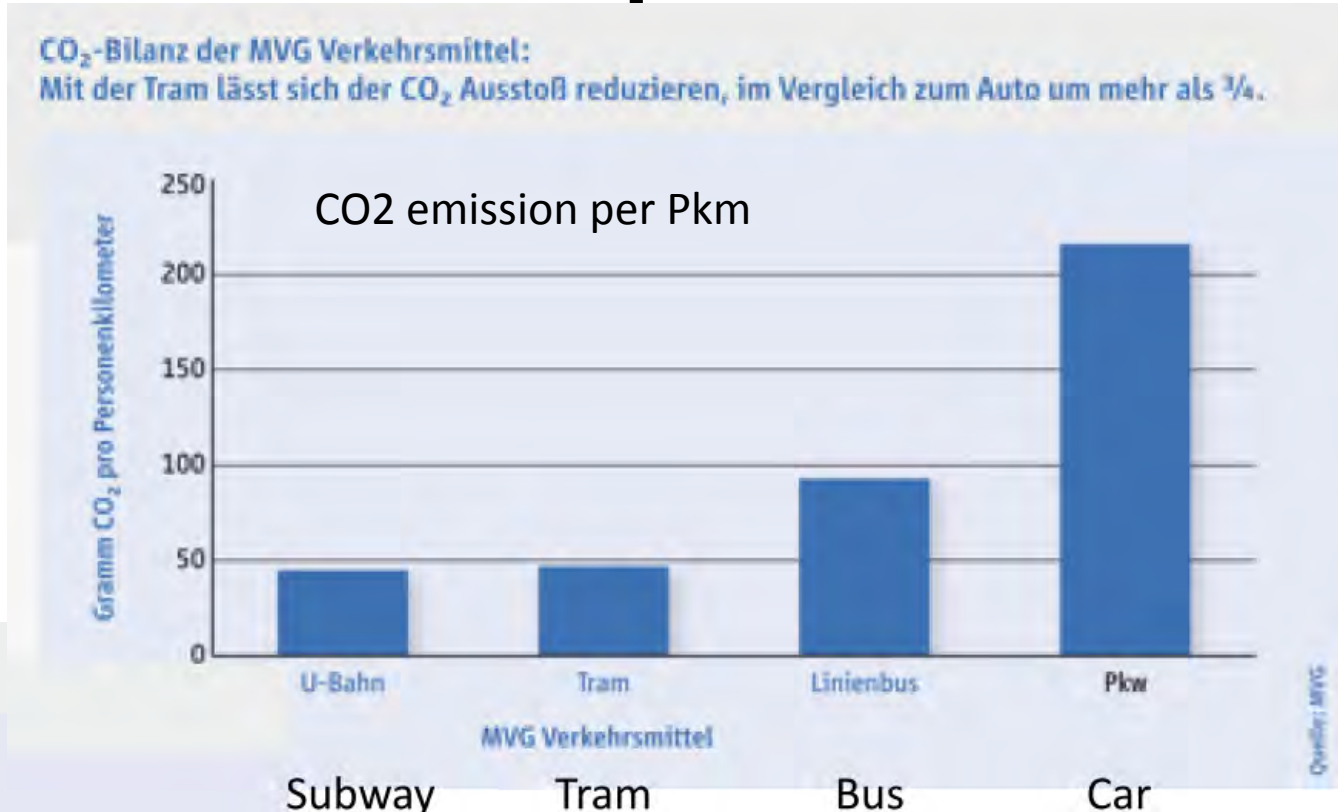
## Neighborhood Busses:

inner area access



Qian'an transit system [Photo: Stefan Baguette]

# CO2 emission & spatial consumption



## Space consumption

Transportkapazitäten im Vergleich (Beispiel München):  
218 Personen = 1 Straßenbahn = 2 Gelenkbusse = 145 Pkws





# High Quality Public Transport

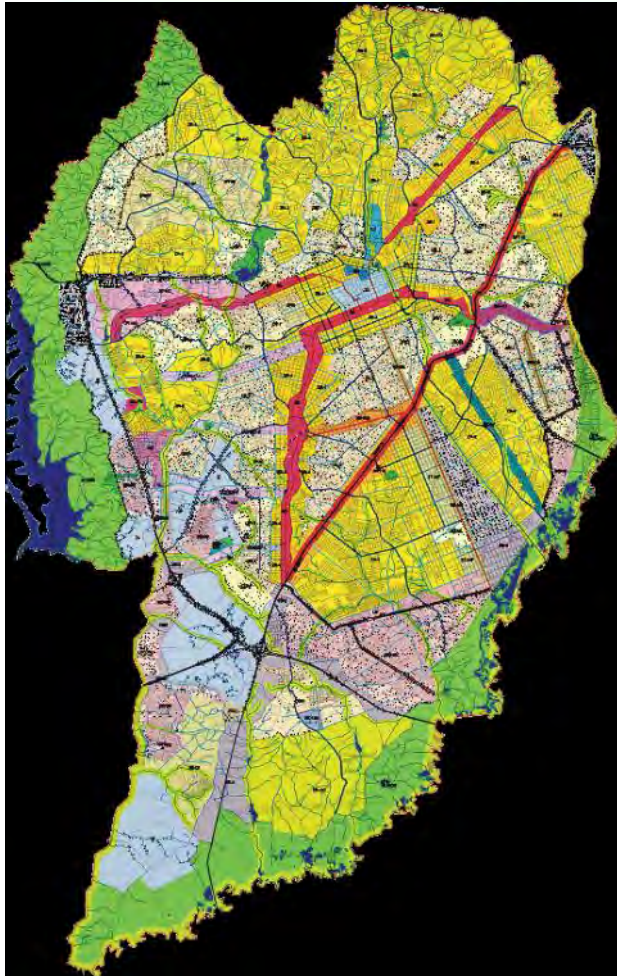
## Berlin Germany – Integrated Network

➤ 24h integrated network



# Structural axes

## Transportation and land use



Duarte 2014

### Approach of Curitiba (Brazil)

- transportation and zoning
- transportation and road system
- transportation hierarchical network



# Buenos Aires: Bus Rapid Transport



ANNUAL  
REDUCTION  
**5321 CO<sub>2</sub>**  
EQ TONS



# Traffic calming



all pictures: © Wulf-Holger Arndt 2014

# Seoul: Road removing

- Removed the Cheonggye Elevated Highway (5.6 km)
- Only for cars. 150 thousands cars per day
- Terrible traffic congestion and cause regional slum.

Before



After

# Electromobility

- Not only cars!
- Bikes (persons, goods)
- Lorries
- Public transport



The urban future:

- 50% motorised traffic (PT, car)
- **20% Pedelects**
- 30% walk, bike



Prof. Jürgen Gerlach, Uni Wuppertal AGFS-Kongress „Nahmobilität und Gesundheit“ am 21. Februar 2014 in Essen

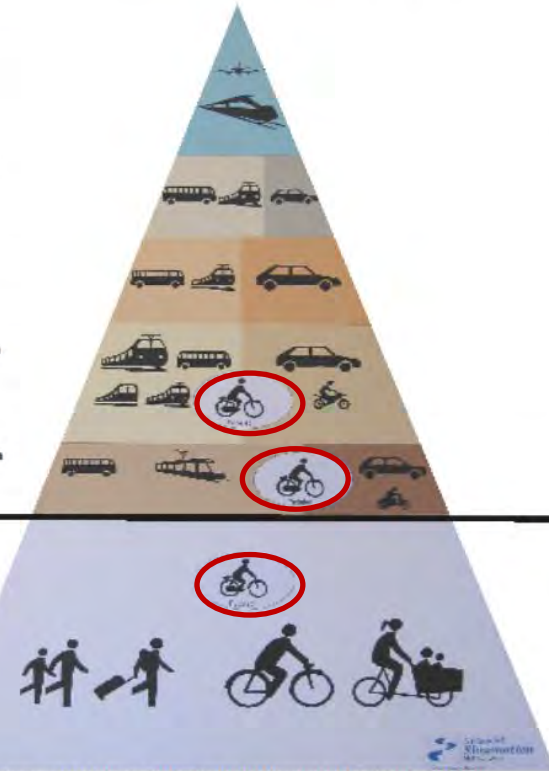
Mobilitätspyramide 2010

## Passive Mobilität

- 5. Stock:  
Weite Fernreisen  
> 600/800 km  
Anteil: ca. 4%
- 4. Stock:  
Fernreisen  
100/150 – 600/800 km  
Anteil: ca. 6%
- 3. Stock:  
Erweiterte Region  
30/50 – 100/150 km  
Anteil: ca. 8%
- 2. Stock:  
Region ca. 5 – 30/50 km  
Anteil: ca. 16%
- 1. Stock:  
Nahbereich bis ca. 5 km  
Anteil: ca. 11%

## Aktive Mobilität

- Basis/Erdgeschoss:  
Alle Entfernungen  
Anteil: ca. 55%



Passive Mobilität  
Fremdenergie - motorisiert  
Nach Entfernungen differenziert

Aktive Mobilität  
Eigene Körperkraft  
Alle Entfernungen

© Netzwerk Slowmotion, München 2010 / Design und Gestaltung: Ingrid Schorn, Tutzing

## Pyramide – Zeitbudget für Mobilität

Flächen der jeweiligen Stockwerke bzw. der Basis/Erdgeschoss entsprechen dem Mobilitätszeitanteil

Mobilität genießen: menschenfreundlich – postfossil – klimaverträglich

[www.netzwerk-slowmotion.org](http://www.netzwerk-slowmotion.org)

Quelle: Ev. Akad. Tutzing 2013

# Mobility Behavioral Change

- Decreasing of car use and car ownership in younger age groups
- Use of public transport is increasing
- Increasing of use of sharing services
- (car sharing, ride sharing, rent a bike,
- Number of car less households are increasing in inner city areas (exp. joint building ventures in München: 25% car households onl
- More flexible mobility pattern: in particular young urban inhabitants use less cars and combine flexible different transport services
- They are looking for suitable information services
- New mobility service with web and app support influencing the transport market

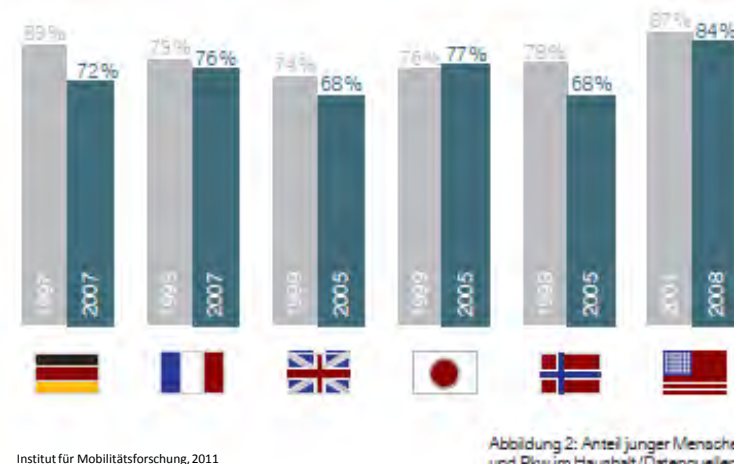
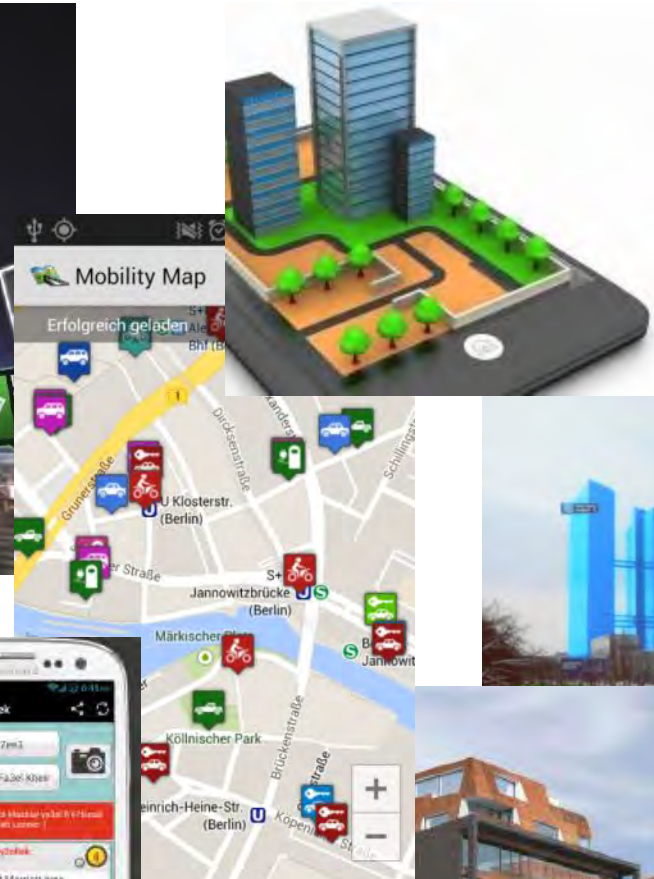


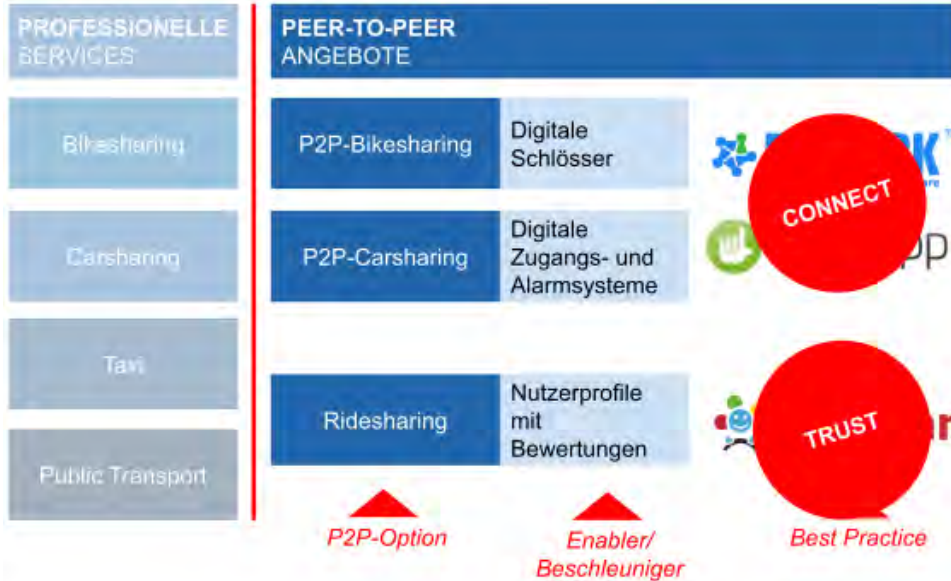
Abbildung 2: Anteil junger Menschen (Alter 20 bis 29) mit Führerschein und Pkw im Haushalt (Datenquellen: 8, 9, 13-19)

# Multimodality and Walkability

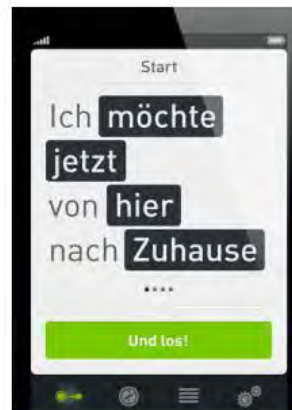
## „Augmented Reality“



# Flexible and self-organized Mobility



- User know what they want
- Let create them their own services



# Automatisiertes Fahren

## „Zero traffic accidents“



Quelle: Navigant Research: <http://www.navigantresearch.com/newsroom/autonomous-vehicles-will-surpass-95-million-in-annual-sales-by-2035>, 30.06.2014

- ❑ Reducing car fleet in Germany from 43 mil to 4 mil (!) vehicles only are possible Honsel 2013
- ❑ Land consumption for parking space in Urban Business Districts 41 big cities around 31% of whole space Anderson et al. 2014
- ❑ But may be: Rebound effects, data security, legal issues



# Conclusions

Sustainable urban mobility needs:

- High urban density
- Mixed used areas
- High density of foot paths and bike lane
- High quality public transport system
- Adapted systems for other collective transportation systems (taxis, car sharing, call bus, ...)
- Restriction for car traffic
- High-tech versus “middle-tech” and durable solutions
- Capacity building for planers and stakeholders with special attention to the knowledge for interrelation between traffic and settlement structure
- Public awareness for promotion eco-mobility
- Transparency of planning and participation of all stakeholders
- Easy used planning tools





# Thank you!

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Mülheim, Foto: Kalwitzki

