Sustaining our Future

Introduction to Sustainable Development

AEGEE Event

“Danube - Let it Flow”

Delta of Danube River

August 2009

UCDAVIS
UNIVERSITY OF CALIFORNIA

ITS UCDAVIS

Giovanni Circella: about me…

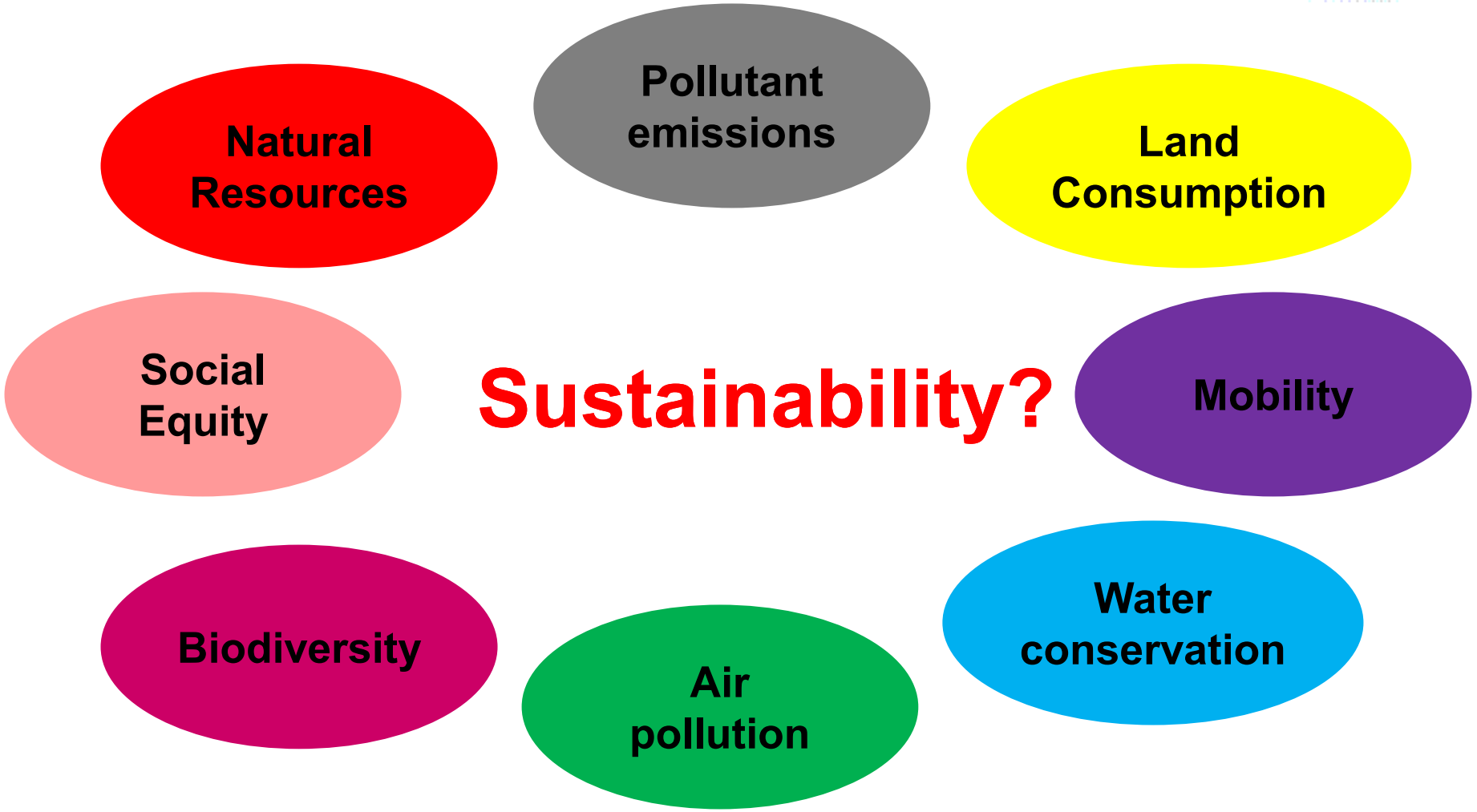
- BS+MS in Civil Engineering (IT)
- Exchange Student (Erasmus) in Valencia (Spain)
- Ph.D. in Transportation Planning (IT)
- Visiting Scholar (Fulbright) in Davis, CA (USA)
- Visiting Scholar in Vienna (Austria)
- MS in Agricultural and Resource Economics (USA)
- Post-Doc Researcher at the Land Use and Transportation Center of UC-Davis, CA
- Member of WWF since 1993
- Deeply convinced we can change our world!!!

Two Questions

1.

…What is sustainability?

Two Questions



Two Questions

2.

…can we really achieve effective sustainability?

Two Questions

Complex issue…

Many reasons to be worried about the future!

Apart from a lot of good attitudes and "desires", few steps so far…

Current trends in the opposite direction (use of resources, pollutant emissions, consumption of land, irreversible changes on ecosystems)

Environmental impact of human activities

Every activity has huge impact on the ecosystem (much more than we can imagine…, e.g.:

- Good consumption
- Energy issues
- Water conservation
- Mobility & transportation

Much more complex issues than we may think with a simple approach

Energy production/consumption

Any issue is quite complex to deal with:

- **Reduction of consumption**
- **Investments for abatement (with negative externalities)**
- **Use of alternative energy sources (but what about landscape and land consumption??)**
- **Nuclear energy?**
- **Social conflicts**
- **Etc.**

Waste/Water management

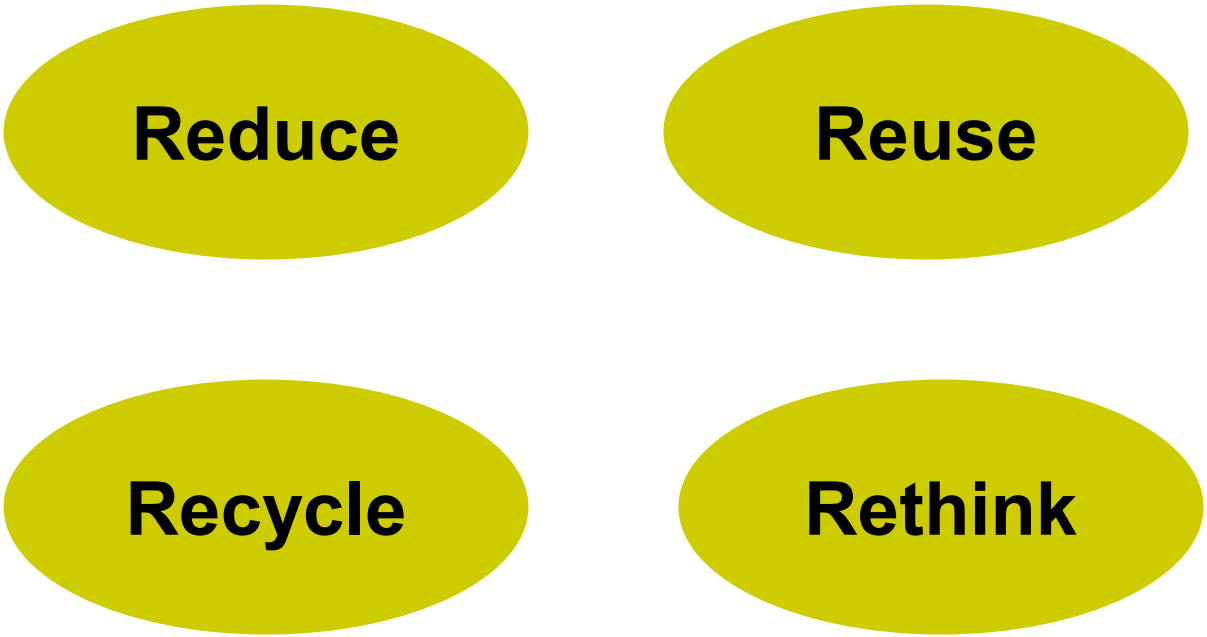
Big issues related to the best way to deal with production/consumption, management and abatement

Pollution problems have no boundaries!

Think about this for rivers (the *Danube river collects waste and pollution from a huge part of Europe…*)

Responsibilities and risks need to be shared!

The “4R” rule



Our challenge…

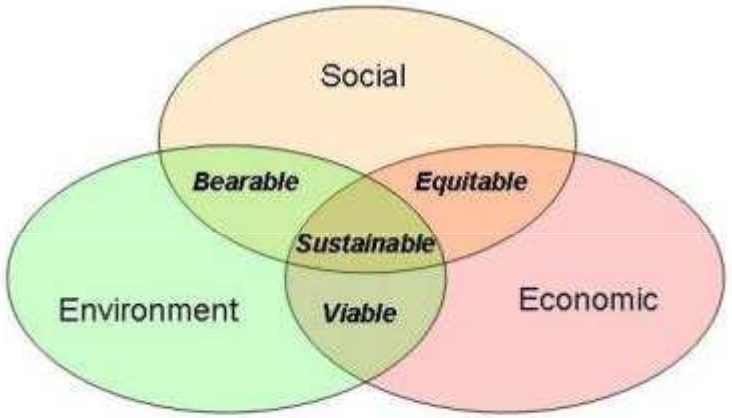
- **Will we (AEGEE SuFu members) be able to have a really "sustainable" event?**
- **Many things to evaluate…. Let's see on August 21!**

A LONG DEBATE ON SUSTAINABILITY

A long way towards Sustainable Development

The issue of sustainability of human development stated for the first time by the ***club of Rome.***

Report of MIT (1972) "*The limits to growth*" on the consumption of natural resources. Echoing the concerns of Robert Malthus (1798), it predicted catastrophic forecasts on environmental conditions and energy supply.



These forecasts were too pessimistic. However, the real data show an ***absolutely unsustainable trend*** on the use of natural resources and a steadily decreasing level of environmental quality on the Earth

A long way towards Sustainable Development

The 1987 report of the Brundtland Commission (the "World Commission on Environment and Development" of the United Nations) focused on the long-term impact of human activites on the environment.

Sustainable development was defined as:

the development that "meets the needs of the present generation without compromising the ability of future generations to meet their own needs"

"If present trends continue, the world in 2000 will be more crowded, and more vulnerable to disruption than the world we live in now. Serious stresses involving population, resources, and environment are clearly visible ahead. […] people will be poorer in may ways than they are today.

[from the "Global report to the president", 1980]

A long way towards Sustainable Development

Adopted in the United Nations Conference on Environment and Development (UNCED) – the *Conference of Rio de Janeiro* – in 1992, the ***Agenda 21*** includes a comprehensive plan of action to be taken globally, nationally and locally in every area in which human impacts on the environment.

Important actions are required in order to address sustainability in every process of development. This involves interventions in all fields of the economics: agriculture and farming, mining, production of goods and services, energy consumption, transportation, etc.

A long way towards Sustainable Development

Climate change is expected to bring heavy effects on populations of LDC, worsening social/economic problems, increasing wars and ethnical Diasporas

A long way towards Sustainable Development

A long way towards Sustainable Development

Different approaches

- Economic studies (e.g. Solow)
- Environmental studies (e.g. Daly)

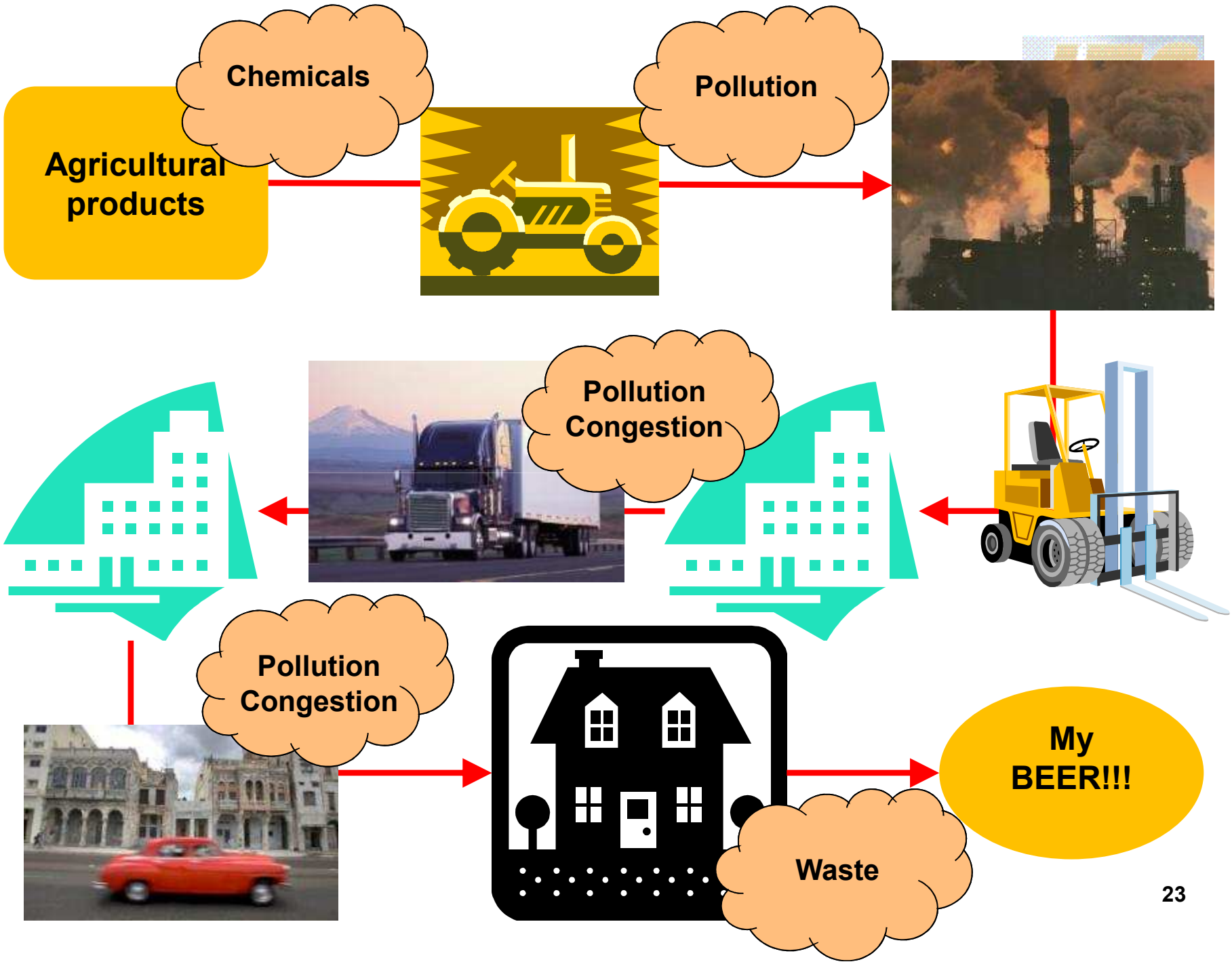
Economists say… (Solow)

- Need to integrate environmental and income accounts
- Environmental quality can be treated as a stock or environmental capital
- Sustainability: Conservation of **Economic well-being** over the *very* long-run
- Resources valued for what they DO

Environmental approach (Daly)

- Human economy is a subsystem of a finite global ecosystem
- Growth of the economy cannot be sustainable over **long** periods of time
- Qualitative development of non-growing systems possible over **long** periods of time

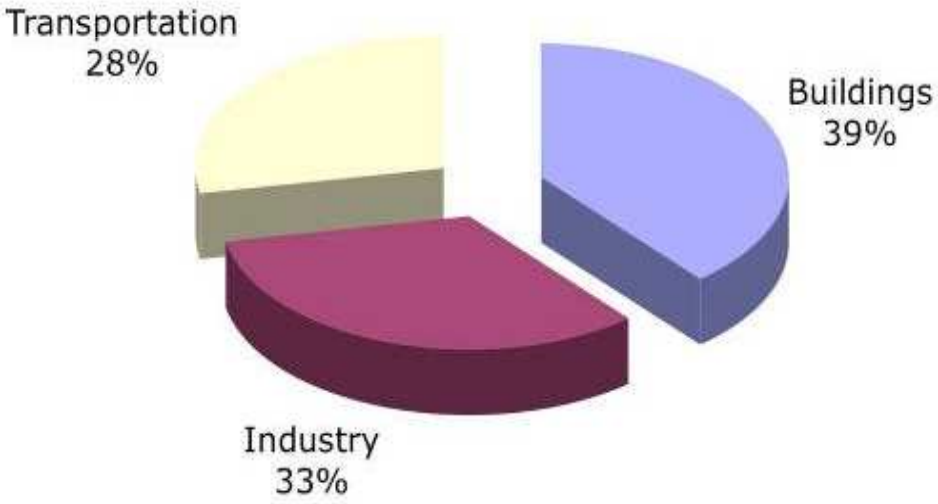
Let's go for a BEER…


Agricultural products
Chemicals
Pollution
Pollution Congestion
Pollution Congestion
Waste
My BEER!!!

SUSTAINABLE MOBILITY

Introduction

Heavy impact of ***transportation activities*** on the environment: they represent a relevant source for pollutant emissions and energy consumptions.



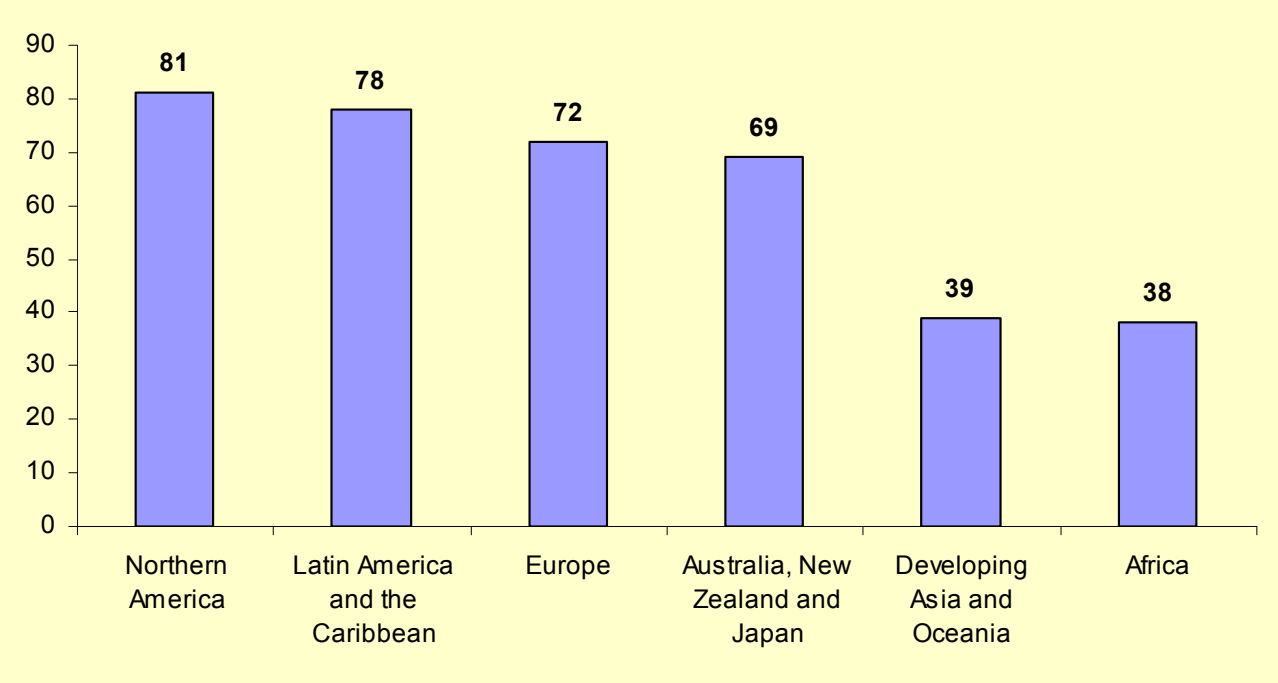
[Source: US Dept. of Energy, 2006]

Introduction

- Passengers' transport: 81% on the road network, 13% by air
- Energy supply for transport activities: 97% oil
- 98% of VMT in 2001 by private vehicles (very high level of LDT)
- Mode share "driving alone": 73% in 1990 → 76% in 2000
- Congestion: +23.9% in NYC (since 1982 to 2002)
  +36.2% in L.A.
  +30.5% in Chicago
  +27.1% Washington DC, Boston
  +31.5% Atlanta
  [*Source*: US Dept. of Transportation, 2006]

Introduction

Metropolitan and urban areas are **energy-wasting systems** that include a relevant portion of world population



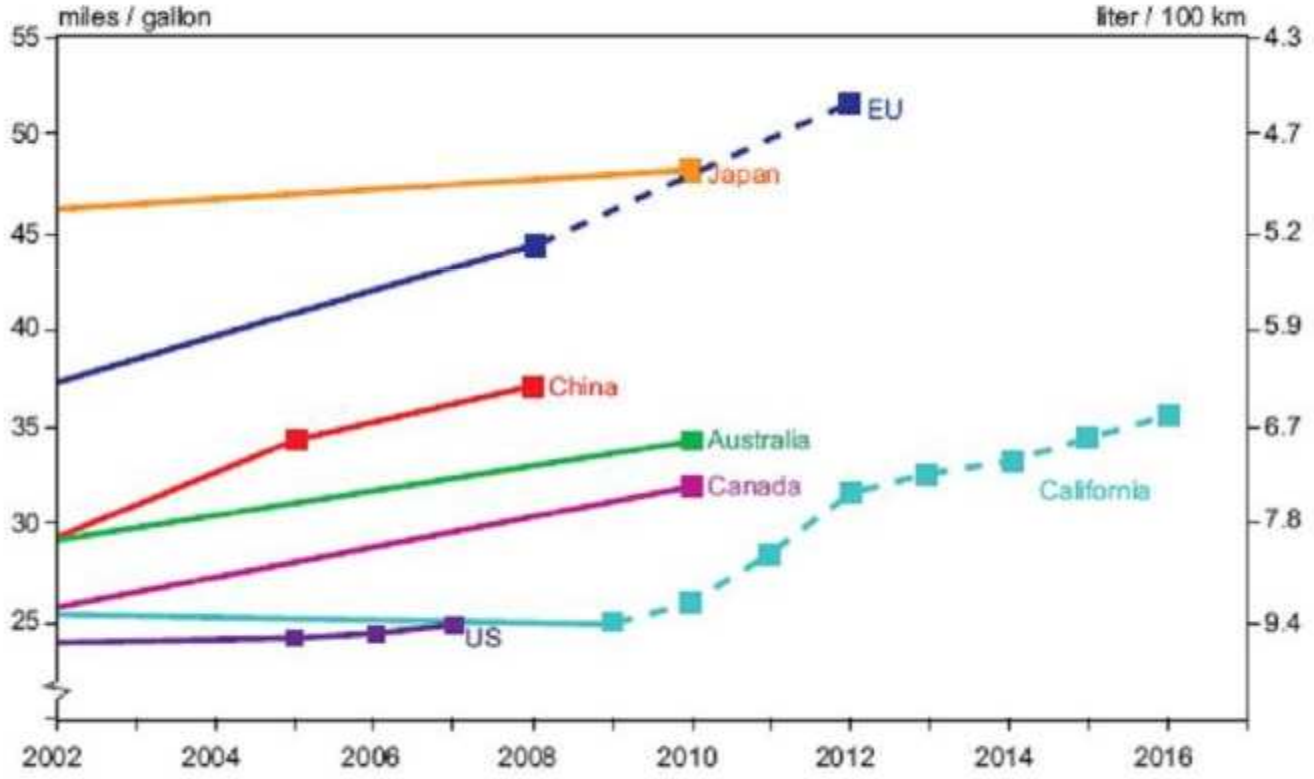
Urban population [%] in 2005 [*Source:* UN Department of Economic and Social Affairs, Population Division].

Sustainable Mobility

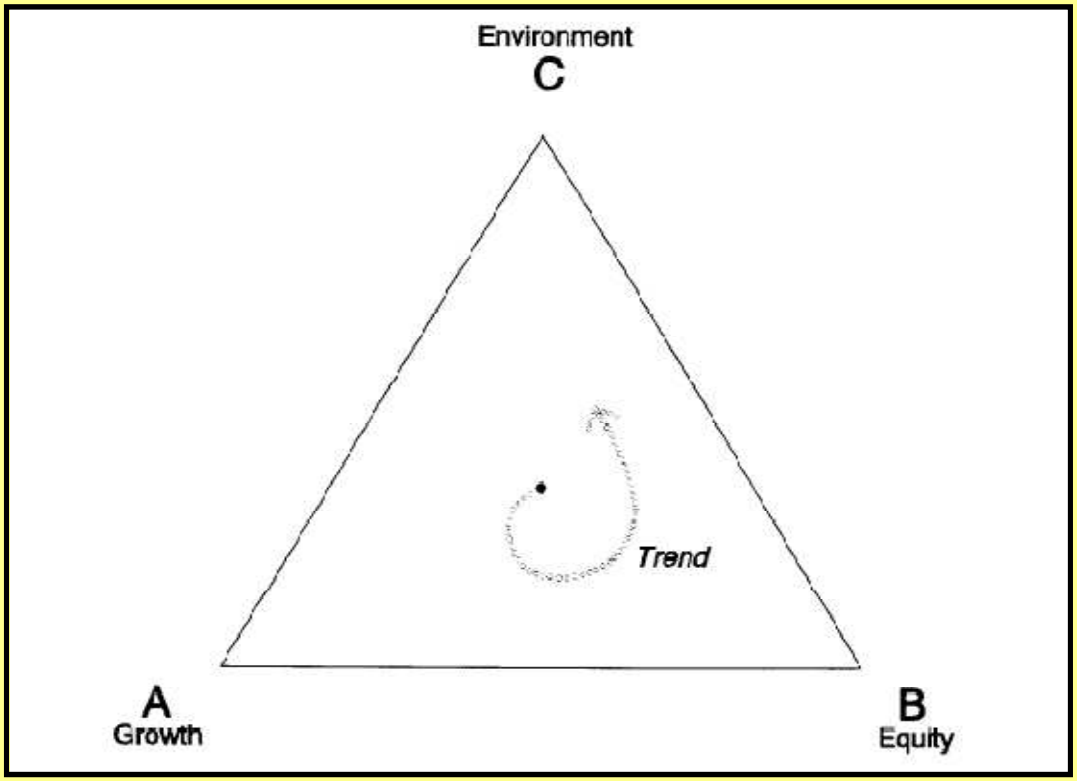
The Ten Melbourne Principles for Sustainable Cities	
1. Vision	Provide a long-term vision for cities based on sustainability; intergenerational, social, economic, and political equity; and their individuality.
2. Economy and Society	Achieve long-term economic and social security.
3. Biodiversity	Recognize the intrinsic value of biodiversity and natural ecosystems, and protect and restore them.
4. Ecological Footprints	Enable communities to minimize their ecological footprints.
5. Model Cities on Ecosystems	Build on the characteristics of ecosystems in the development and nurturing of healthy and sustainable cities.
6. Sense of Place	Recognize and build on the distinctive characteristics of cities.
7. Empowerment	Empower people and foster participation.
8. Partnerships	Expand and enable cooperative networks to work toward a common, sustainable future.
9. Sustainable Production and Consumption	Promote sustainable production and consumption through appropriate use of environmentally sound technologies and effective demand management.
10. Government and Hope	Enable continual improvement based on accountability, transparency, and good governance.
Source: *UNEP/IETP, 2002*	

Sustainable Mobility

Average consumptions (Miles/Gallon and Liter/100 km) in different geographical areas:



Introduction



Trend of policies in the European Union
(Source: Masser *et al.*, 1992)

LAND USE – TRANSPORT INTERACTION: THE ROAD TO MORE EFFICIENT AND SUSTAINABLE TRANSPORTATION SYSTEMS

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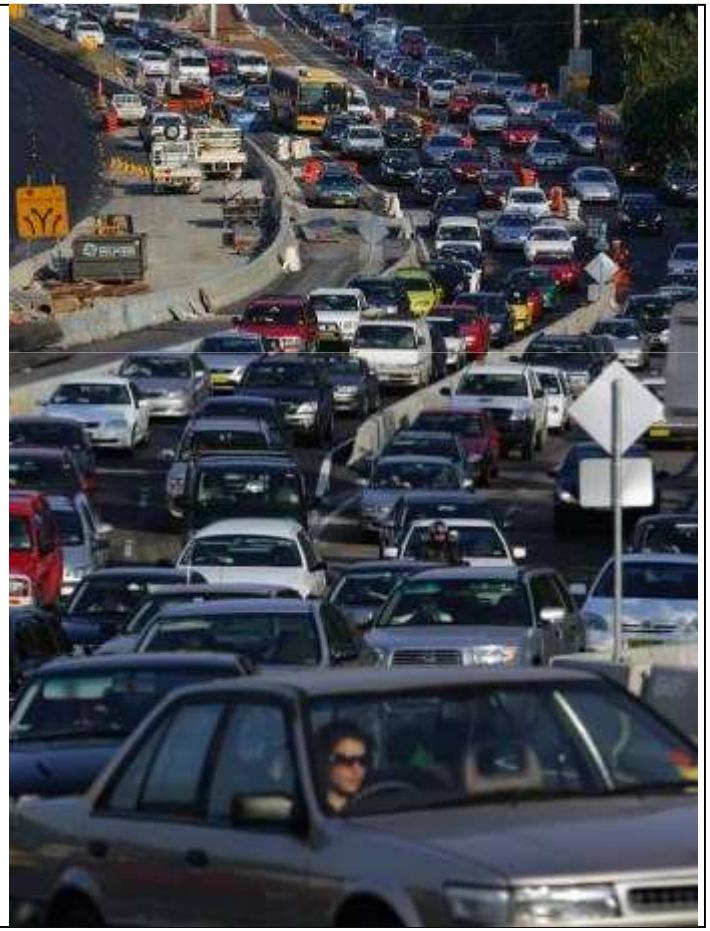


LAND USE – TRANSPORT INTERACTION: THE ROAD TO MORE EFFICIENT AND SUSTAINABLE TRANSPORTATION SYSTEMS

Trends show a progressive increase of pollutant emissions from transportation activities. There is an urgent need of interventions to reduce the impact on the environment dramatically, at the same time ensuring ***people's mobility*** and supporting the economic activities.

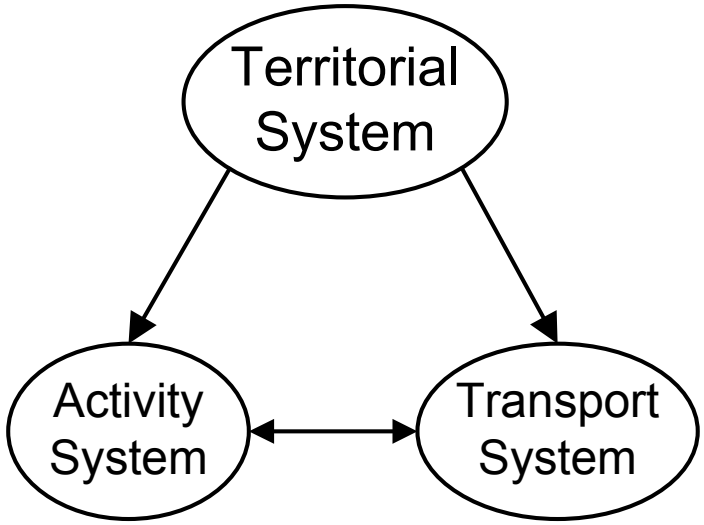
Interventions should be addressed for:

- mitigation technologies and strategies (e.g. alternative fuels);
- reductions of transport volumes;
- mode share;
- organization and planning of transportation systems;
- policies and measures

[See: Chapter 5 of the Report of the "Intergovernmental Panel on Climate Change", 2007].

BUILT ENVIRONMENT AND TRAVEL BEHAVIOR

LAND USE – TRANSPORT INTERACTION: THE ROAD TO MORE EFFICIENT AND SUSTAINABLE TRANSPORTATION SYSTEMS



The transportation system is part of the territorial system, strongly interrelated with the system of the activities.

A comprehensive study of mobility and transport activities should consider the relationships between the system of the activities and the transportation system.

LAND USE – TRANSPORT INTERACTION: THE ROAD TO MORE EFFICIENT AND SUSTAINABLE TRANSPORTATION SYSTEMS

Evidences that the urban form have had strong impact on transportation

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Evidences that the urban form have had strong impact on transportation

LAND USE – TRANSPORTATION INTERACTION: THE ROAD TO MORE EFFICIENT AND SUSTAINABLE TRANSPORTATION

For many years, the development of infrastructures has followed a "*predict and provide*" approach…

…creating an increasing dependence of passengers transport on private vehicles and the highway network

LAND USE – TRANSPORTATION INTERACTION: THE ROAD TO MORE EFFICIENT AND SUSTAINABLE TRANSPORTATION

The dominant way of addressing transportation planning has rapidly re-shaped cities all over the world

Transforming many urban areas and neighborhoods in *"automobile slums"*.

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INTEGRATED LAND USE AND TRANSPORTATION MODELING FOR SUSTAINABLE TRANSPORT SOLUTIONS

Planning for sustainable development *is a complex objective, which involves different competencies and requires willingness of public authorities and the interaction of expert knowledge and of public participation.*

Need of serious commitment of public authorities, at local, regional and national level, to pursue objectives of sustainability in a long term perspective

LAND USE – TRANSPORT INTERACTION: THE ROAD TO MORE EFFICIENT AND SUSTAINABLE TRANSPORTATION SYSTEMS

LAND USE – TRANSPORTATION INTERACTION: THE ROAD TO MORE EFFICIENT AND SUSTAINABLE TRANSPORTATION

Different use of transportation, depending on the built environment:

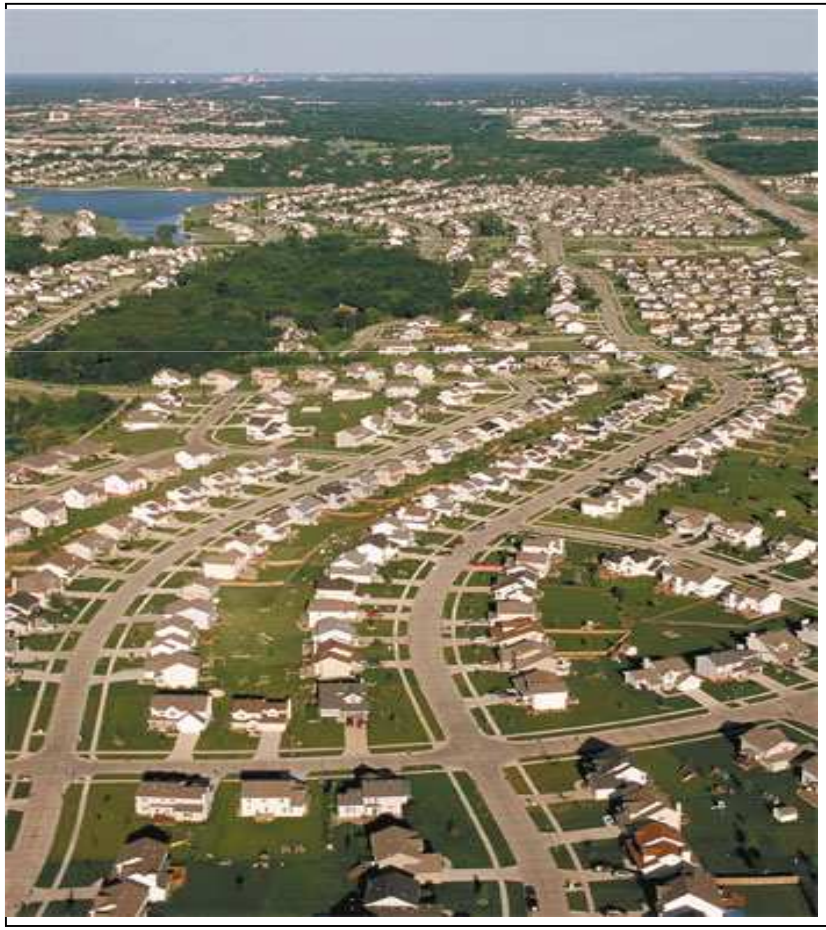
Mixed land use in San José, CA

LAND USE – TRANSPORTATION INTERACTION: THE ROAD TO MORE EFFICIENT AND SUSTAINABLE TRANSPORTATION

Different use of transportation, depending on the built environment:

Urban Sprawl in Davis, CA

LAND USE – TRANSPORT INTERACTION: THE ROAD TO MORE EFFICIENT AND SUSTAINABLE TRANSPORTATION SYSTEMS



Enormous impact related to the widespread of this kind of urban form.

Negative impact of urban legislation in the US after WWII, avoiding mixed Land Use, as a way to organize cities, and improve the quality of life of residential areas.

LAND USE – TRANSPORTATION INTERACTION: THE ROAD TO MORE EFFICIENT AND SUSTAINABLE TRANSPORTATION

Effect of Land Use on the use of Transportation




LAND USE – TRANSPORTATION INTERACTION: THE ROAD TO MORE EFFICIENT AND SUSTAINABLE TRANSPORTATION

Influences of the transportation policies that are adopted

IMPLEMENTATION OF MARS – BARI: L.U.T.I. MODEL FOR THE METROPOLITAN AREA OF BARI (ITALY)

Scenarios for LU interventions:

- Polycentric city (more centers of development);
- Redevelopment of brown-fields;

Scenarios for upgrade of transportation infrastructures:

- Light rail system;
- Subway lines;
- Rapid transit (tramways) lines;

Test of the impact of ICT and technological innovations:

- Spread of telecommuting;
- Impact of e-shopping;
- Etc.

Policies for sustainable transportation:

- Limitations to traffic;
- *Congestion charge*;
- Regulations on vehicle fleet;
- Changes in *fuel price*;
- Changes in parking cost & bus fees;
- Changes in headways of Public Transportation;
- Etc.

LAND USE – TRANSPORT INTERACTION: THE ROAD TO MORE EFFICIENT AND SUSTAINABLE TRANSPORTATION SYSTEMS

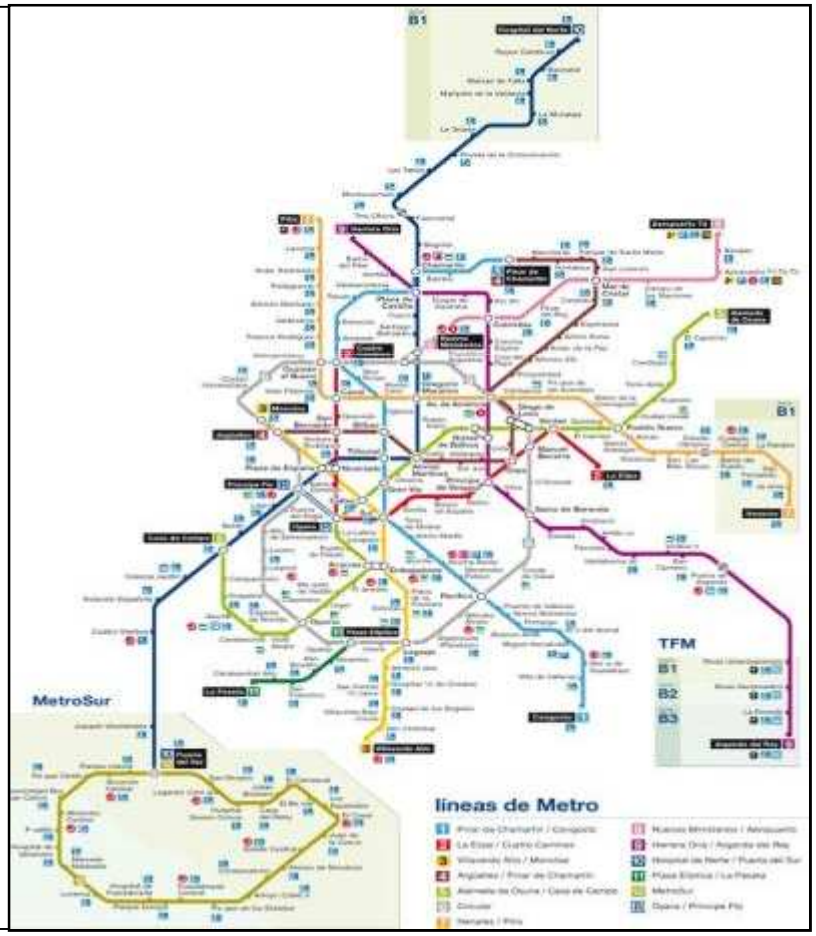
Important actions of decision-making for the future of the urban and metropolitan system.

Implementation of Transport Policies (regulatory, economic/financial, transport regulations, fares) which modifies the availability of transport solutions

Physical intervention on the Transport System (infrastructure and road development, Public Transport, Rapid Transit)

Implementation of Transit Oriented Development (T.O.D.)

Implementation of Land Use Policies (urban structure, high density settlement, mixed Land Use)



LAND USE – TRANSPORT INTERACTION: THE ROAD TO MORE EFFICIENT AND SUSTAINABLE TRANSPORTATION SYSTEMS

Scenarios for LU interventions:

- Polycentric city with more centers of development;
- Renovation/development of brown-fields;

Scenarios for upgrade of the transportation infrastructures:

- Light rail system;
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Test of the impact of ICT and technological innovations:

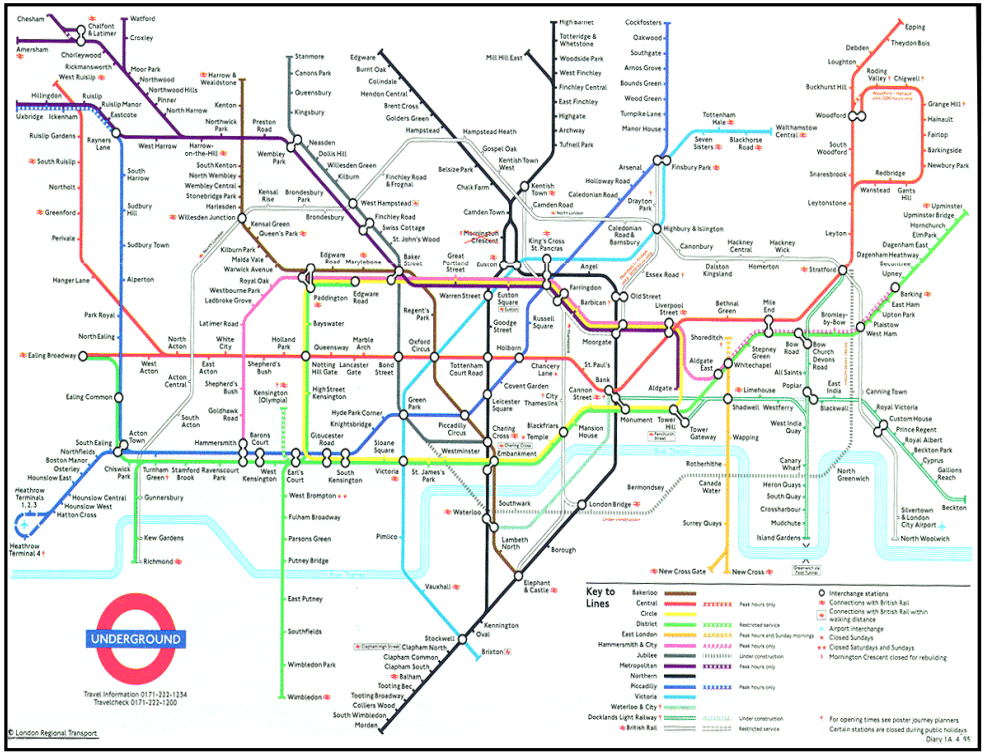
- Spread of telecommuting;
- Impact of e-shopping

Policies for sustainable transportation:

- Limitation to traffic;
- Congestion charge;
- Regulation on vehicle fleet allowed by the law;
- Changes in fuel price;
- Adjustment of parking cost/bus fees;
- Changes in frequencies and features of Public Transportation;

Scenario of no interventions.

LAND USE – TRANSPORT INTERACTION: THE ROAD TO MORE EFFICIENT AND SUSTAINABLE TRANSPORTATION SYSTEMS



INTEGRATED LAND USE AND TRANSPORTATION MODELING FOR SUSTAINABLE TRANSPORT SOLUTIONS

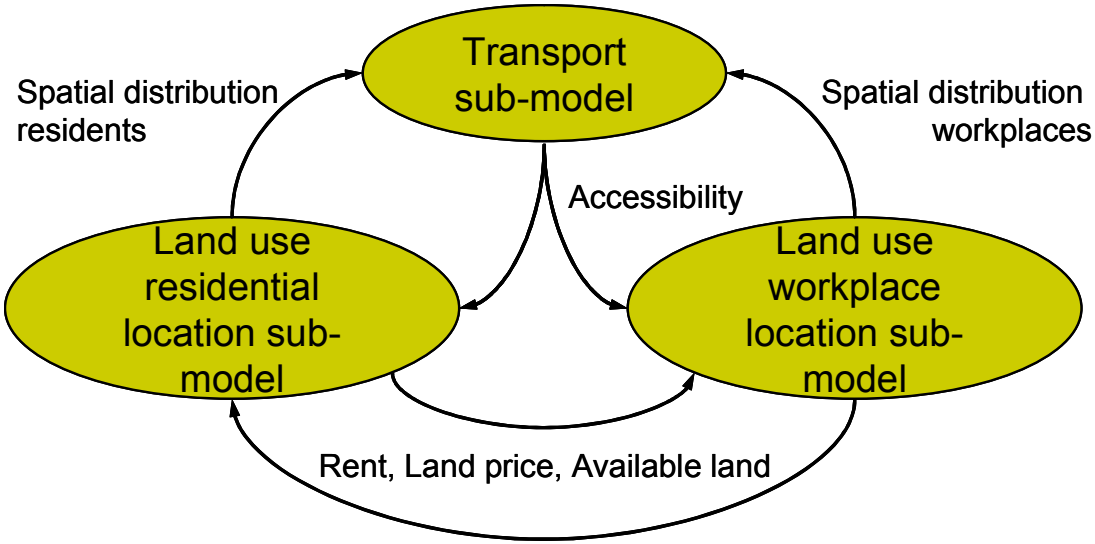
- Need for policies to address ***sustainable development (if it exists)***
- Need for tools to evaluate the outcomes (e.g. ***interactions between the LU and Transportation***)
- Analysis of ***transferability*** of policies to different contexts

Sustainable Mobility

Objectives of the Research

- Analysis of policies for ***sustainable transportation in urban and metropolitan areas***
- Development of an ***Integrated Land Use Transportation Modeling System*** for the analysis of future scenarios
- Modeling approach to support ***strategic planning of cities***

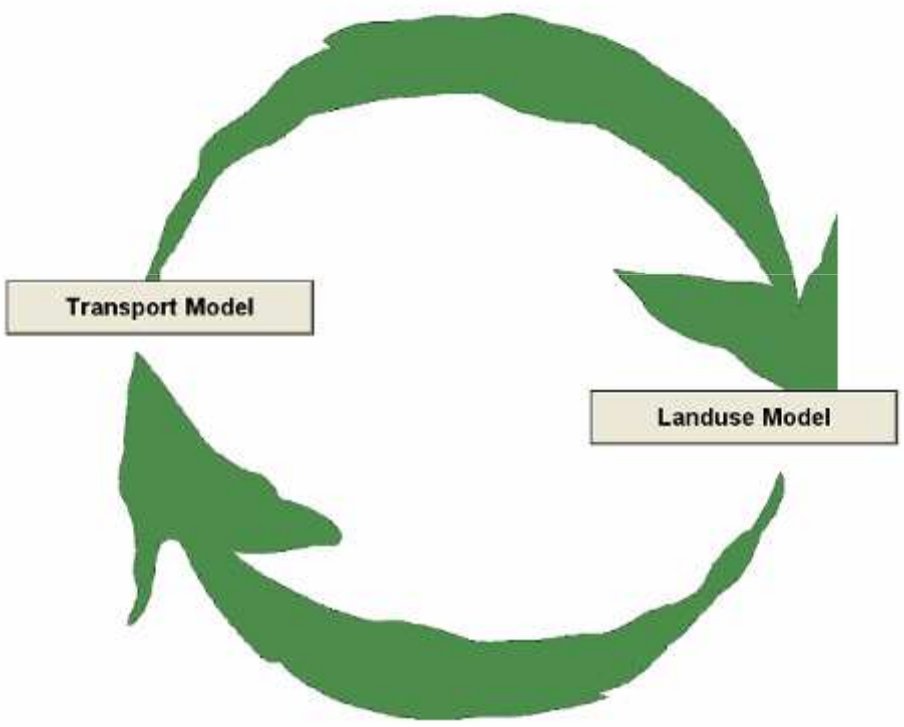
MARS – Metropolitan Activity Relocation Simulator



MARS (Metropolitan Activity Relocation Simulator) is a fast integrated strategic and dynamic land-use and transport (LUTI) model system.

The basic underlying hypothesis of MARS is that settlements and activities within them are *self-organizing systems*.

MARS – Metropolitan Activity Relocation Simulator



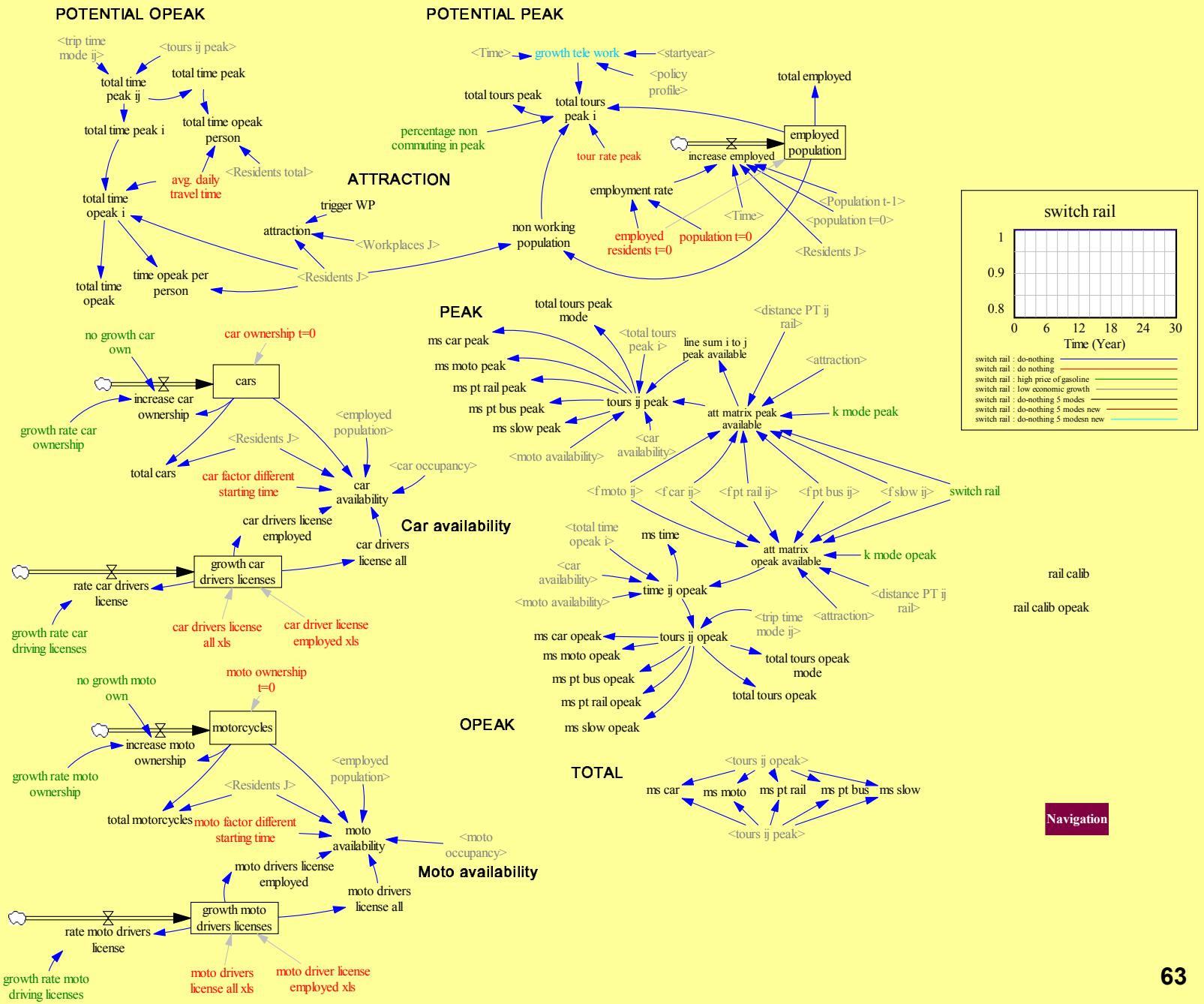
The implementation of MARS started at the Technische Universität Wien in 2000.

MARS is based on the assumptions of ***Systems Dynamics***

It is a ***white-box***, with opportunity of adding, removing, implementing additional models and features

MARS works at a high level of ***spatial aggregation***

The model system runs in a **Vensim** environment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switch rail : do nothing
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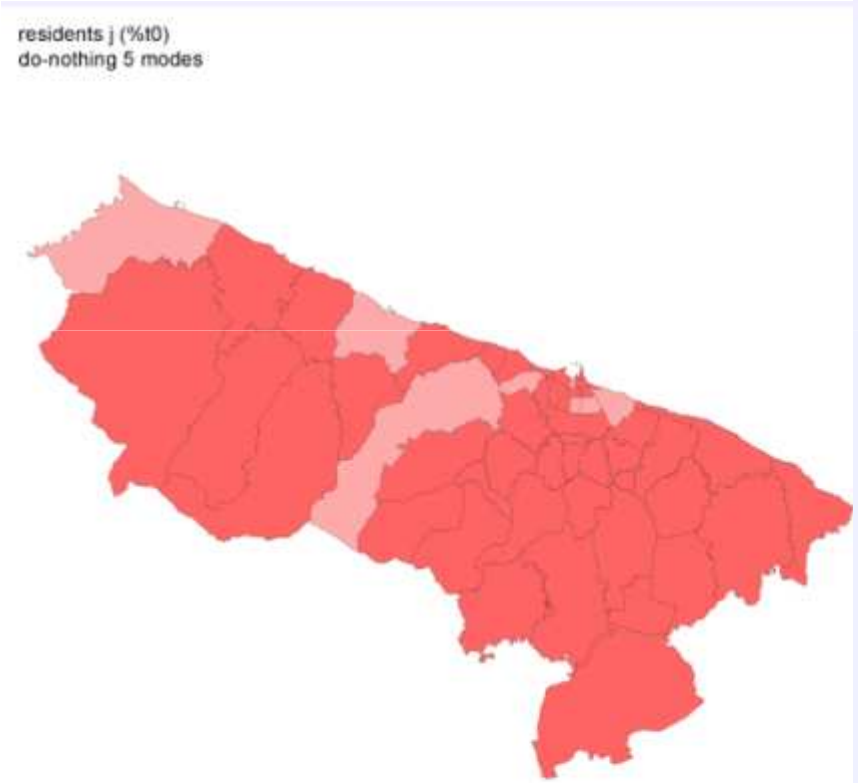
Navigation

IMPLEMENTATION OF MARS – BARI: L.U.T.I. MODEL FOR THE METROPOLITAN AREA OF BARI (ITALY)

Do-nothing scenario



(forecast for 2031)

MARS-Zone 1, MURAT, 140.95 ha

Time	residents j (%t0) Value	Orig	workplaces pr j (%t0) Value	Orig	workplaces sv j (%t0) Value	Orig
0	100.0	21024	100.0	2003	100.0	19792
1	116.3	24443	100.0	2003	99.7	19728
2	117.7	24737	100.0	2002	99.3	19657
3	116.8	24548	99.9	2002	98.9	19578
4	115.7	24328	99.9	2002	98.5	19492
5	114.8	24146	99.9	2001	98.0	19403
6	114.3	24021	99.9	2001	97.6	19316
7	114.0	23960	99.9	2001	97.2	19233
8	114.1	23982	99.9	2000	96.8	19155
9	114.6	24096	99.8	2000	96.4	19082
10	115.5	24287	99.8	1999	96.1	19015
11	116.7	24544	99.8	1999	95.8	18954
12	118.1	24838	99.8	1999	95.5	18897
13	119.6	25143	99.8	1998	95.2	18843
14	121.0	25448	99.7	1998	94.9	18792
15	122.5	25746	99.7	1998	94.7	18742
16	123.7	26015	99.7	1997	94.4	18692
17	124.7	26219	99.7	1997	94.2	18642
18	125.1	26308	99.7	1996	93.9	18591
19	125.3	26336	99.6	1996	93.7	18539
20	125.3	26345	99.6	1996	93.4	18485
21	125.3	26348	99.6	1995	93.1	18429
22	125.3	26349	99.6	1995	92.8	18371
23	125.3	26349	99.6	1994	92.5	18311
24	125.3	26349	99.6	1994	92.2	18248
25	125.3	26349	99.5	1994	91.9	18182
26	125.3	26349	99.5	1993	91.5	18114
27	125.3	26349	99.5	1993	91.2	18043
28	125.3	26349	99.5	1992	90.8	17968
29	125.3	26349	99.5	1992	90.4	17890
30	125.3	26349	99.4	1992	90.0	17808

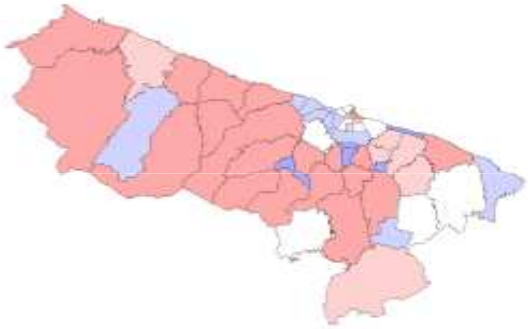
MARS-Zone 10, JAPIGIA, 1475.60 ha

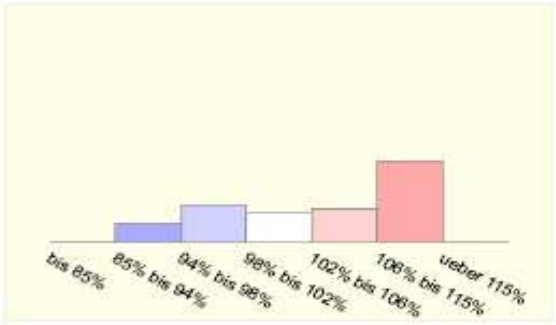
Time	residents j (%t0) Value	Orig	workplaces pr j (%t0) Value	Orig	workplaces sv j (%t0) Value	Orig
0	100.0	30148	100.0	1515	100.0	3131
1	97.0	29246	100.1	1516	100.3	3140
2	96.0	28954	100.2	1518	100.6	3149
3	95.6	28823	100.3	1520	100.8	3158
4	95.4	28758	100.4	1521	101.1	3167
5	95.4	28755	100.6	1523	101.4	3176
6	95.6	28826	100.7	1525	101.7	3185
7	96.0	28953	100.8	1526	102.0	3195
8	96.6	29119	100.9	1528	102.3	3204
9	97.2	29304	101.0	1530	102.7	3215
10	97.8	29498	101.1	1532	103.0	3225
11	98.5	29696	101.2	1533	103.3	3236
12	99.0	29855	101.4	1535	103.7	3248
13	99.4	29965	101.5	1537	104.1	3259
14	99.7	30048	101.6	1539	104.4	3270
15	99.9	30121	101.7	1541	104.8	3282
16	100.1	30192	101.8	1542	105.2	3293
17	100.4	30260	102.0	1544	105.5	3305
18	100.6	30318	102.1	1546	105.9	3316
19	100.8	30388	102.2	1548	106.3	3328
20	101.0	30462	102.3	1550	106.6	3340
21	101.3	30537	102.4	1551	107.0	3351
22	101.5	30610	102.6	1553	107.4	3363
23	101.8	30687	102.7	1555	107.8	3375
24	102.1	30787	102.8	1557	108.2	3387
25	102.3	30849	102.9	1559	108.5	3399
26	102.5	30915	103.1	1561	108.9	3411
27	102.8	30963	103.2	1563	109.3	3423
28	103.1	31077	103.3	1565	109.7	3435
29	103.3	31142	103.4	1567	110.1	3448
30	103.5	31212	103.6	1568	110.5	3460

IMPLEMENTATION OF MARS – BARI: L.U.T.I. MODEL FOR THE METROPOLITAN AREA OF BARI (ITALY)

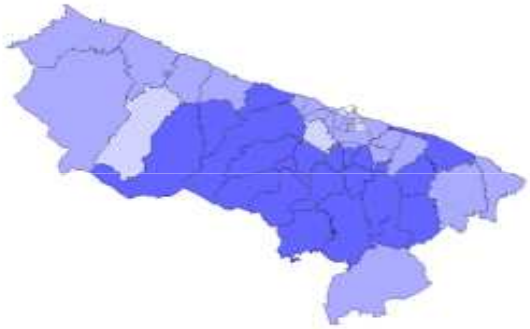
Do-nothing scenario

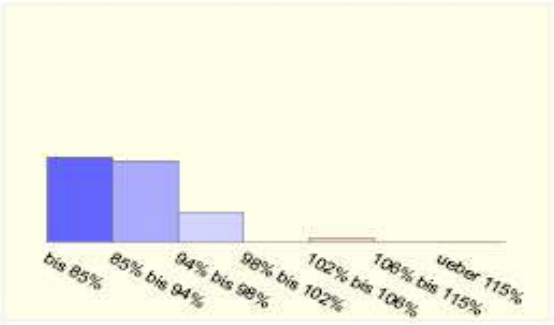
modal split origin i car (%t0)
do-nothing 5 modes



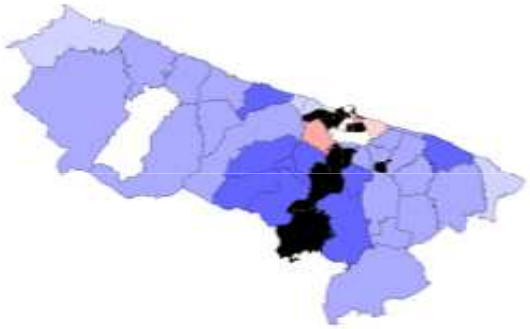


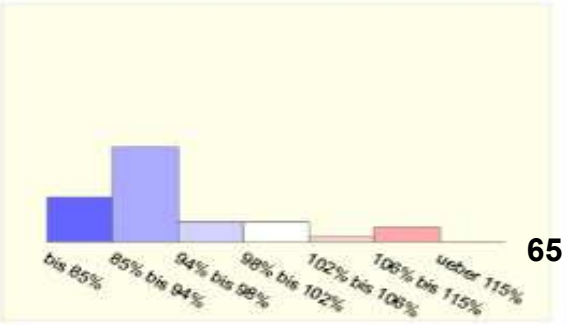
modal split origin i pt bus (%t0)
do-nothing 5 modes





modal split origin i pt rail (%t0)
do-nothing 5 modes

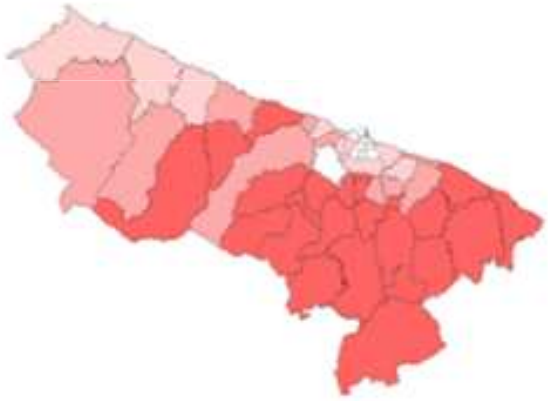




IMPLEMENTATION OF MARS – BARI: L.U.T.I. MODEL FOR THE METROPOLITAN AREA OF BARI (ITALY)

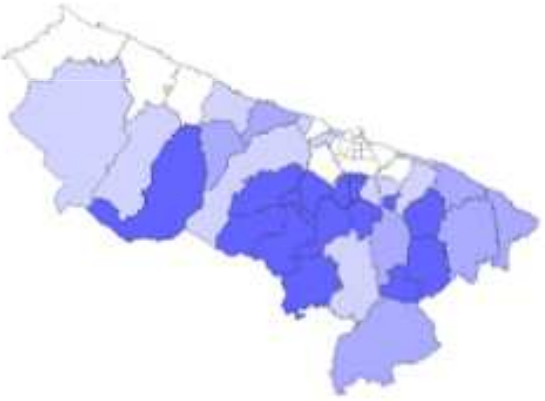
Comparison of scenarios

workplaces pr j (%t0)
do-nothing 5 modes



workplaces pr j (%t0)
low economic growth

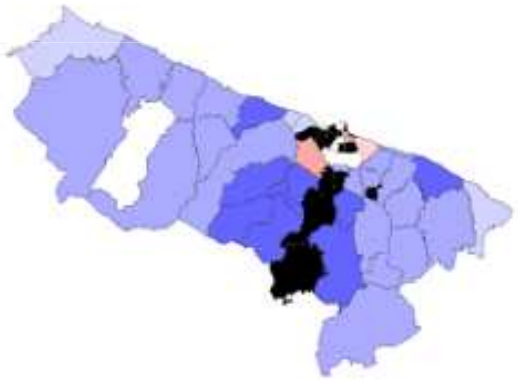
difference
low economic growth - do-nothing 5 modes



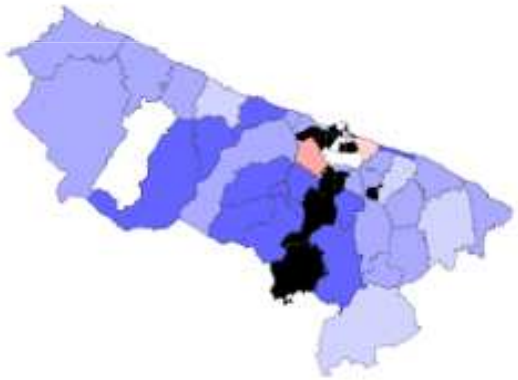
IMPLEMENTATION OF MARS – BARI: L.U.T.I. MODEL FOR THE METROPOLITAN AREA OF BARI (ITALY)

Comparison of scenarios

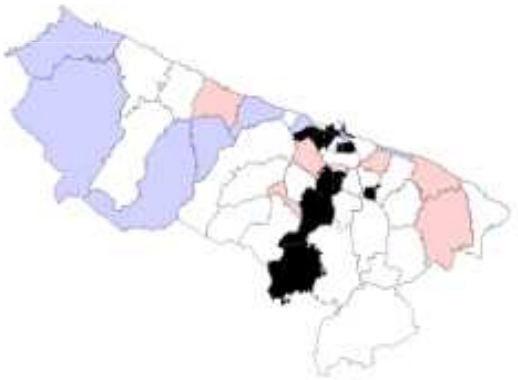
modal split origin i pt rail (%t0)
do-nothing 5 modes



modal split origin i pt rail (%t0)
low economic growth



difference
low economic growth - do-nothing 5 modes



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