Climate change, land use, and health: the case of Madrid
Universal Access: about 450 million people in Africa—or more than 70% of its total rural population—are estimated to have been left unconnected to transport.

Efficiency: transporting a container of avocados from Kenya to the Netherlands requires 200 interactions and more than 20 documents, at a cost equal to that of shipping. Efficient supply chains can increase farmer income 10-100%.

Safety: almost 1.3 million people die on the world’s roads every year and tens of millions are seriously injured. Traffic crashes are the leading cause of death among young people aged 15-29.

Green mobility: transport emits 23% of all energy-related greenhouse gases; its CO2 emissions could grow by 40% by 2040.

“The world is off track to achieving sustainable mobility. The growing demand for moving people and goods is increasingly met at the expense of future generations,” said José Luis Irigoyen, Senior Director of the Transport & ICT Global Practice at the World Bank.
Transport networks: how dealing with climate change and health consequences?

- Could electric cars penetration be enough?
- Compariring CO2 and NOX/PM10 emissions in TECH scenario:
  - 2030 CO2 34% less
  - 2030 Nox and PM10 9% less
- Clima impact is better
- Health impact is more complicate
- Other kind of regulation is needed: remodeling of infrastructure
Congestion, city efficiency and emissions problems seem not being solved by increasing road capacity

- **Infrastructures share**
  - 80% cars infrastructure
  - 75% expenditure for urban highways
  - Strongly regressive infrastructure: 0.6 costs for upper income people in respect to low-income people

**Modal share**

- **Active modes**
- **Public Transport**
- **Private Transport**

(source: Mobility Survey for MADRID 2004 and EMTA (European Metropolitan Transport Authorities) barometer)
Congestion, health and other social impacts

Socio-economic impacts
- LUTI MODEL and CBA analysis:
  - Time saving
  - Costs
  - Social discount rates
- Real state impacts

Environmental, health and human rights effects
- Traffic-Emission and health model:
  - Exposition to the emissions
  - Risk characterization
  - Hospital discharges
  - Health costs

Gender impacts
- Quantitative method: mobility of caring
  - Mobility in space and time
  - Pollution effects on health
- Qualitative study: Focus group
  - Security and green space
Land Use and Transport Interaction Model

External scenarios
- Demographic evolution
- Economic evolution
- Car ownership
- Car fleet

Policy instrument
- Road charge pricing policy

Household and workplace location

Land use sub-model
- Housing development model
- Employment location model
- Household location model

Transport sub-model
- Transport model
- Time of day model
- Attractiveness

Accessibility

Objective function
- Transport users
- Transport operators
- Government
- Externalities

CBA function

Optimization
- Powell

Feedback information

Dynamic loop
TRES-cambiaMO MODEL

Exposure assessment
- Traffic Data
- Emission Data
- Atmospheric dispersion

Risk characterisation
- Basic health conditions
- Modelling of health impacts
- Response to exposure
  - No. of hospital discharges attributable to contamination
  - Cost of health care
Method for calculating hospital admissions

Group 1: Less than 14
Grupo2: Adultes 15-74
Grupo3: Elderly 75

fD-R_1 → # admissions NO₂ G1
fD-R_2 → # admissions NO₂ G2
fD-R_3 → # admissions NO₂ G3

Validation according to actual data of hospital admissions
The case of Madrid: M-30 covering location

Periods of assessment

- 2015. End of the period of analysis
- Behind 2017. Trend checking

Source: Own elaboration from IGN and Madrid City Council data
Location of entrances and exits of M-30 underground tunnel of ventilation perimeters and emission measurement stations
Trends of NO$_2$ emissions and noise in the city and traffic data
Superposition of both cutting areas of the census sections with 500 m buffer with respect to the emission focuses
### Benefited and affected

<table>
<thead>
<tr>
<th>Project</th>
<th>1. Users of infrastructures</th>
<th>2. Benefited by Green space (i.e. residents farway from emissions perimeters)</th>
<th>3. Benefited by Madrid Rio, but not by the infrastructure (e.g. do not use by car)</th>
<th>4. Non-users of the M-30 and affected by emissions and noise</th>
</tr>
</thead>
<tbody>
<tr>
<td>M-30 Tunnel and road capacity increasing</td>
<td>Benefited</td>
<td>Neutral</td>
<td>Affected</td>
<td>Affected</td>
</tr>
<tr>
<td>Madrid Rio-Green Park</td>
<td>Neutral</td>
<td>Benefited</td>
<td>Beneficiados/as</td>
<td>Neutral</td>
</tr>
</tbody>
</table>

Fuente: Own Elaboration
Costs/benefits related to the income levels

\[ WF = \sum_{t=0}^{n} \sum_{ijm} \left[ \frac{1}{1 + r_l} \cdot \Delta CS_{ijm}(t) + \frac{1}{1 + r_a} \cdot \Delta CS_{ijm}(t) + \frac{1}{1 + r_h} \cdot \Delta CS_{ijm}(t) \right] \cdot (1) \]

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Ratio</th>
<th>Scenario 1</th>
<th>Scenario 2</th>
<th>Scenario 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time saving per capita</td>
<td>X high income / X low income</td>
<td>1.69</td>
<td>2.24</td>
<td>2.11</td>
</tr>
<tr>
<td></td>
<td>X high income</td>
<td>1.31</td>
<td>1.54</td>
<td>1.48</td>
</tr>
<tr>
<td></td>
<td>X medium income</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cost per capita / income</td>
<td>X high income / X low income</td>
<td>0.61</td>
<td>0.55</td>
<td>0.51</td>
</tr>
<tr>
<td></td>
<td>X high income</td>
<td>0.62</td>
<td>0.53</td>
<td>0.51</td>
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<tr>
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<td></td>
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</table>
Hospital admissions for lung diseases and asthma
We mainly move for caring

- ...walking and in public transport
- Lower Satisfaction Index

<table>
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<th>Trip purpose (one way)</th>
<th>Gender</th>
<th></th>
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<tr>
<td></td>
<td>Female</td>
<td>Male</td>
<td></td>
</tr>
<tr>
<td>Work</td>
<td>9.5%</td>
<td>12.1%</td>
<td>21.6%</td>
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<tr>
<td>Study</td>
<td>5.2%</td>
<td>5.2%</td>
<td>10.5%</td>
</tr>
<tr>
<td>Care</td>
<td>26.6%</td>
<td>14.7%</td>
<td>41.3%</td>
</tr>
<tr>
<td>Leisure</td>
<td>8.6%</td>
<td>10.4%</td>
<td>19.0%</td>
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<tr>
<td>Other</td>
<td>4.0%</td>
<td>3.7%</td>
<td>7.7%</td>
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<tr>
<td>Total</td>
<td>53.9%</td>
<td>46.1%</td>
<td>100.0%</td>
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<tr>
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<td>51.7%</td>
<td>48.3%</td>
<td>100.0%</td>
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More women than men affected by pollution
A young woman walks through the city. She is very aware of her appearance and the reaction (supposed or real) she provokes in the people she encounters. She walks through a group of construction workers eating their meals, lined up on the sidewalk. Her stomach stirs in terror; her face tightens under self-control and inattention; her way of walking and carrying becomes rigid and dehumanized. No matter what they tell him, he will be unbearable. She knows that she will not be physically assaulted or hurt. They will only do it metaphorically. What they are going to do is invade her. They are going to use their body with their eyes. They will evaluate your market price. They will comment on your shortcomings or compare them with those of other passers-by. They will involve you in their fantasies without asking you if you are willing to do so. They will make you feel ridiculous, grotesquely sexual, or horribly ugly. Above all, they're going to make it feel like a thing.

Tax Meredith, 1970, The Woman and Her Mind
...to be able to transform it from an universal point of view

- Assessing before acting
- Rethinking planning including socio-economic and health
- Rethink the organization of services
- Rethinking the design of public space
Thanks

contact

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cambiaMO | changing MObility

Investigación e innovación para transformar la movilidad