Urban Metabolism of Lisbon: ReMAP

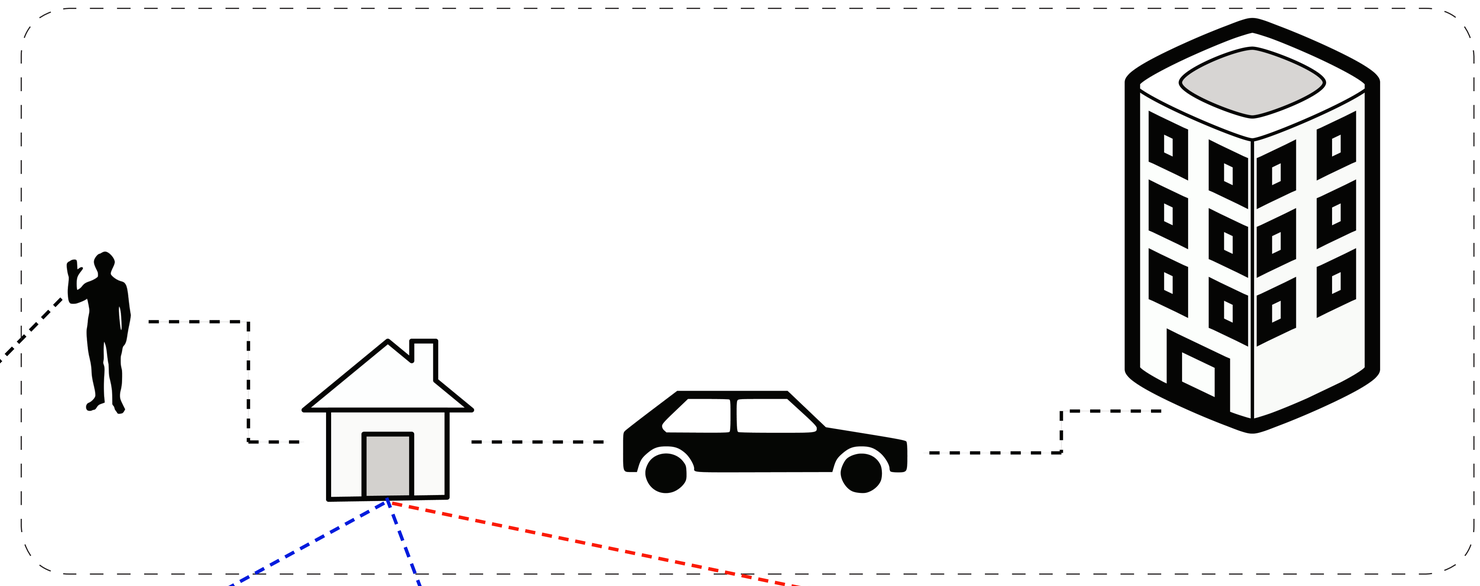
ReMAP: Resource Management and Planning

Project Description

This project involves the analysis of Lisbon using a systems theory approach. The methodologies used incorporate *Material Flow Analysis*, *System Dynamics* and *Economic Geography.* This poster illustrates one part of the approach, examining how user behavior, individual energy usage, and energy flows in Lisbon are connected.

Human Behavior

iTeam, another MIT Portugal project is gathering data on human behavior through the use of smartphones and smartmeters. Smartphones will track user locations using GPS and monitor users behaviors. Smartmeters will measure energy consumption and can be linked to user behavior.



- water: 55.3 m^3
- gas: 0.15 TOE
- food: 986 kg
- electricity:0.36 TOE

Personal Hygiene
Shower/Bath/Toilet
44.5 m^3 of water per year

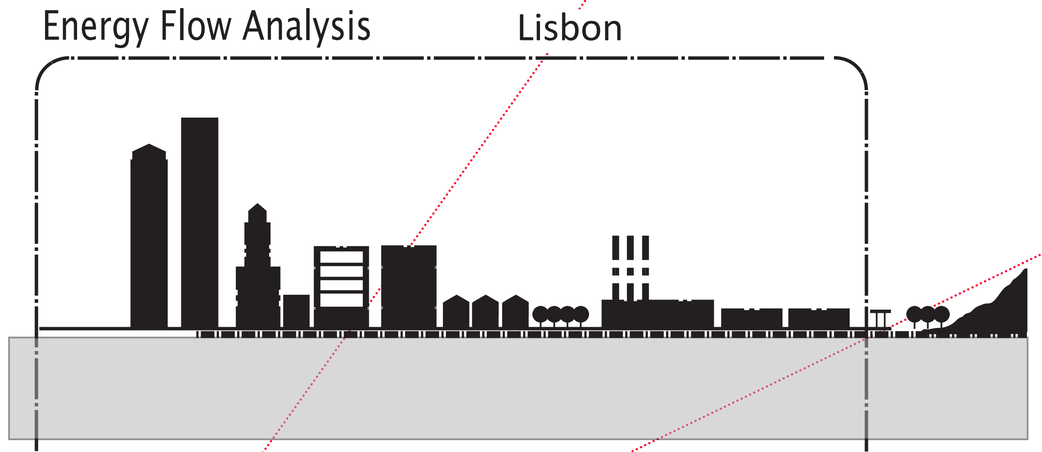
General Cleaning
Dishwasher/Washing Machine
44.5 m^3 of water per year

Electrical Equipment
TV / Computer/Stereo
0.05 TOE per year

Internal Space
Heating / Cooling / Light
0.15 TOE per year

Cooking
Cookers / Microwaves
0.10 TOE per year

Energy Flow Analysis — Lisbon



sectors

Households:	284539 TOE
Banks and Insurance:	71243 TOE
Public Administration:	57250 TOE
Health Services:	34130 TOE
Education:	37743 TOE
Other Services:	315962 TOE
Hotels and Restaurants:	80200 TOE
Road Transport:	665677 TOE
Water Transport:	2580 TOE
Industry:	139443 TOE
Other:	22632 TOE

inputs
City uses 17 x 10^5 TOE* per year

outputs
City produces 58 x 10^5 Tons CO^2 per year

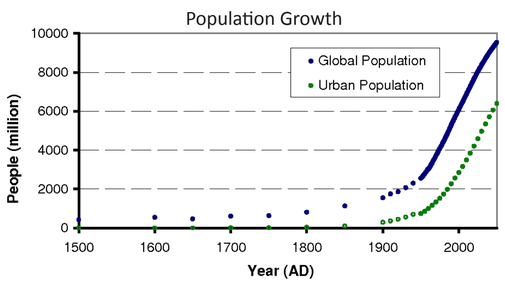
*TOE: Tons of Oil Equivalent (metric)

Goals

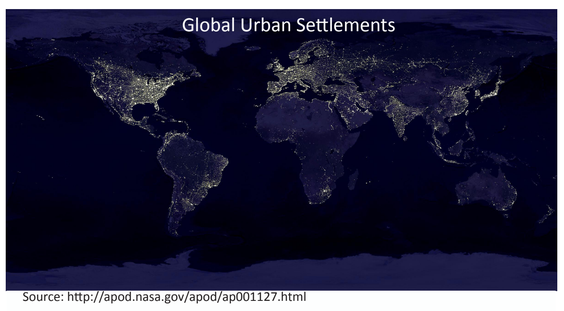
A model illustrating city resource consumption for the following purpose:

- detailed understanding of material and energy flows using resource flow analysis
- rich description of the behavior of the city through System Dynamic feedback loops
- robust understanding of the evolution of urban energy demand
- an urban district resource consumption analysis and characterization
- analysis of future scenarios for testing policy recommendations

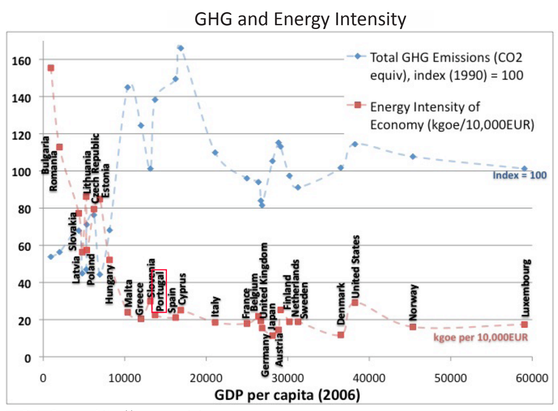
Global Trends



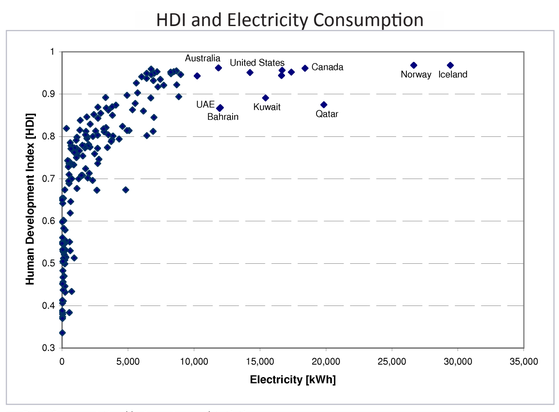
Data Source: www.census.gov/ipc



Source: http://apod.nasa.gov/apod/ap001127.html



Data Source: http://epp.eurostat.ec.europa.eu



Data Source: http://hdr.undp.org/statistics

Indicators

Two types of indicators will be used to assess the possible pathways toward resource efficient management and planning, in order to incorporate environmental, societal, and economic development goals.

Biogeochemical
- Net primary production
- Carbon cycle
- N, P, and other cycles
- Hydrological cycle
- Total GHG Emissions

Socioeconomic
- Material/energy intensity (MIPS)
- Human development index
- Environmental responsibility
- Energy Intensity

References
Energy data: Edifícios Saudáveis Consultores (2005).Matriz Energética de Lisboa. Lisboa e-nova.
Water data: EPAL (2006).Matriz da Água de Lisboa. Lisboa e-nova.
Material data: Ferrão, P., Niza, S. & Rosado, L. (2007).Matriz dos Materiais de Lisboa. Lisboa e-nova.
Note: All of data is based on average per capita use of resources in Lisbon City

Professors:
John E. Fernández (MIT)
Paulo Ferrão (IST)
Post-Doctoral Researcher:
Samuel Niza
Graduate Students:
Artessa Saldivar-Sali
Daniel Wiesmann
David Quinn
Leonardo Rosado

urbanmetabolism@mit.edu
MIT Portugal