Urban Metabolism of Lisbon: ReMAP

ReMAP: Resource Management and Planning

Intellectual Foundation

Urban Metabolism:
Characterizing the resource consumption of urban zones as a complex set of metabolic functions requires a broad perspective and a diversity of methods. As a field of study, urban metabolism benefits from regional accounting of resource flows (MFA), analysis of complex systems (SD) and the relationship between the location, agglomeration and dispersion of economic activities (EG). In addition, urban metabolism requires the consideration of the relationship between biogeochemical and socioeconomic phenomenon in a holistic explanation for the growth of cities and their attendant resource requirements (Pickett et al. 2001). This project presents a framework in which the analytical methods of these fields can be integrated into a scenario-building tool for assessing the best possible pathways for a sustainable urban future.

Urban Material Flow Analysis (UMFA):
MFA is a method for analyzing the flows into and out of a defined area. Inputs, Outputs and Additions to Stock are calculated for the LMA using data from trade statistics. The development of conventions and standards in defining and accounting for all types of production and consumption in the urban zone will be used as a template for future work. In addition, the development of density metrics related to urban districts that constitute the metropolitan area will be used as another lens in which to assess urban resource consumption.

System Dynamics (SD):
System Dynamics is a method for understanding the dynamic behavior of complex systems. The basis of the method is the recognition that the structure of any system has an interlinked causality amongst the components of the system. The system is described using stocks, flows, flow-variables and connectors. SD is used in situations in which a particular phenomena of dynamic complexity has been identified and is in need of a deeper explanation to understand unintended consequences, time lags and other unanticipated results (Sterman 2000).

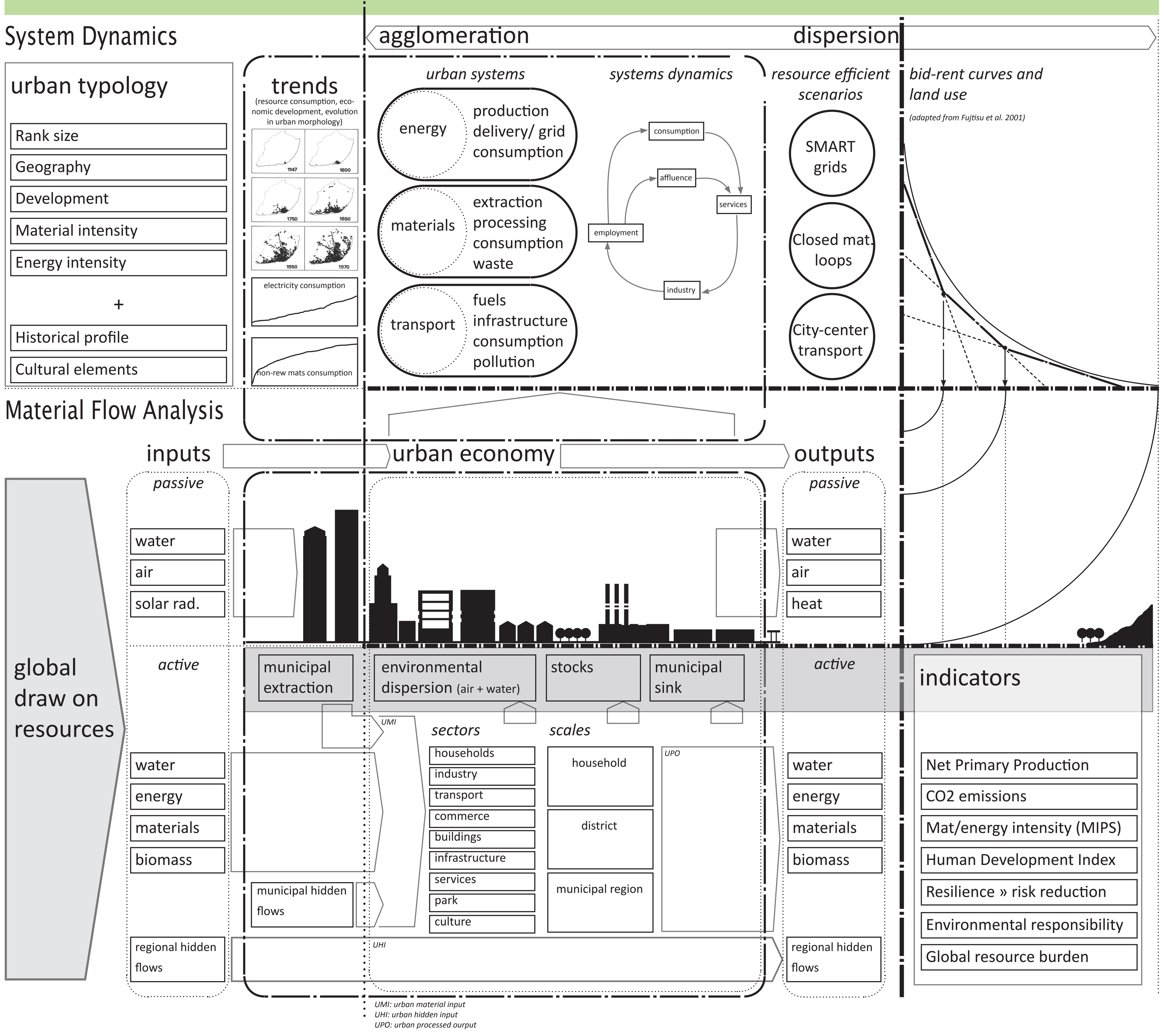
Economic Geography (EG):
EG "...explain[s] concentrations of population and of economic activity: the distinction between manufacturing belt and farm belt, the existence of cities, the role of industry clusters (Fujita et al. 2001). Fujita and Krugman have attempted to understand cities with this approach and to assess the environmental responsibility of a city.

Biogeochemical and Socioeconomic Interactions:
It is clear that a renewed concept of a humane and resource efficient city will benefit from an understanding of the interactions between biogeochemical and socioeconomic processes within and around the urban center. The daunting complexity of this relationship can be approached by outlining a framework for these interactions and adding detail complexity as further study is advanced (Liu et al. 2007)(Alberti 2000, 1999).

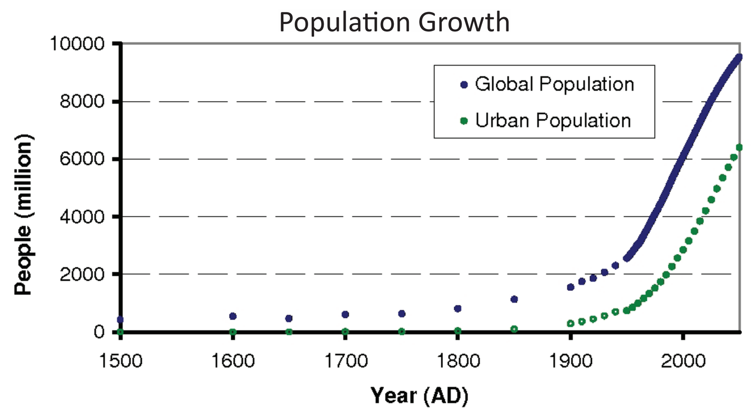
Project Description

This project involves the analysis of the Lisbon Metroplitan Area (LMA) using a systems theory approach. The methodologies used incorporate *Material Flow Analysis*, *System Dynamics* and *Economic Geography*.

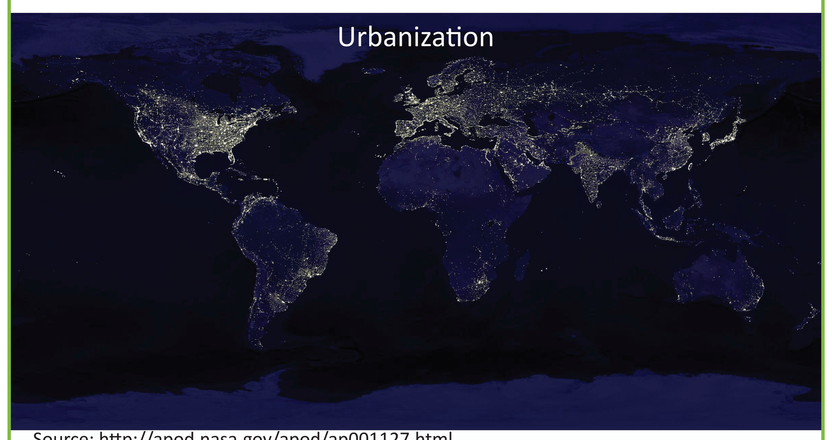
ReMAP Schematic



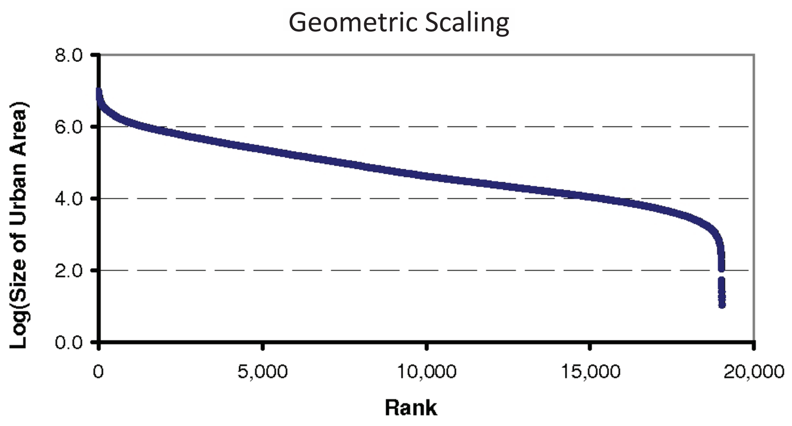
Urban Trends



Data Source: www.census.gov/ipc



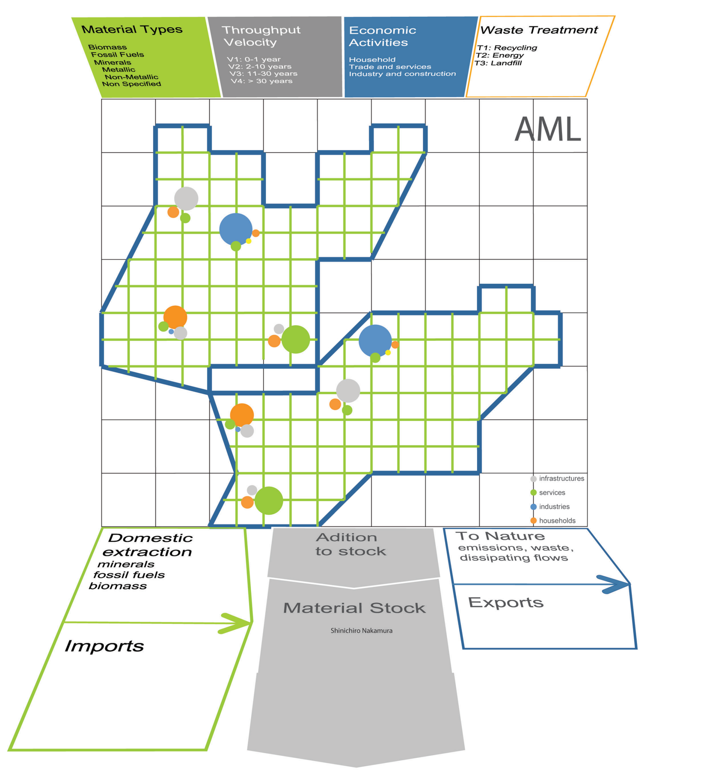
Source: http://apod.nasa.gov/apod/ap001127.html



Data Source: Decker EH, Kerkhoff AJ, Moses ME 2007 Global Patterns of City Size Distributions and Their Fundamental Drivers. PLoS ONE 2(9): e934 doi:10.1371/journal.pone.0000934

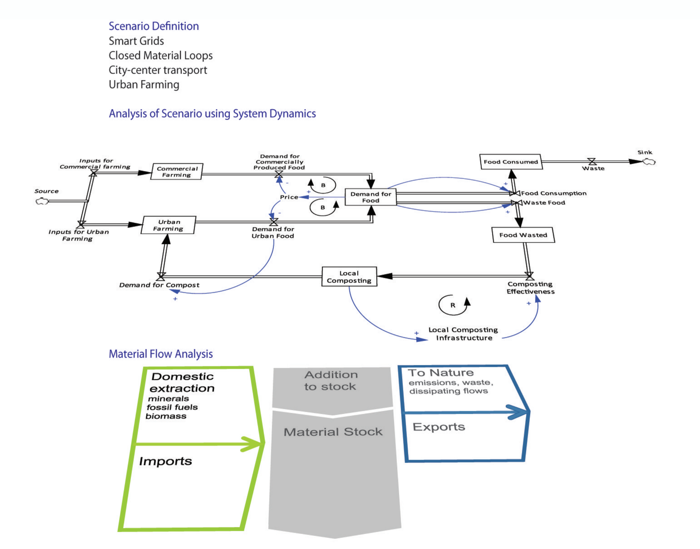
Projects

Material Flow Anaalysis



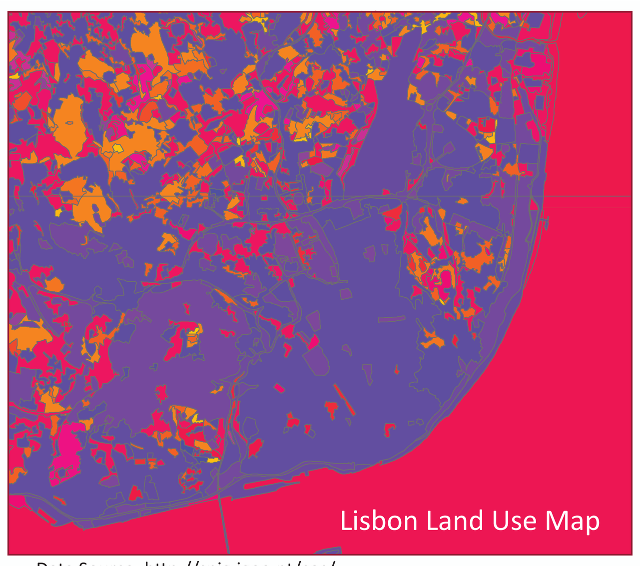
See poster at AGS for further details

System Dynamics



- SD model identifies causality and explains driving factors
- Four scenarios examined using an interlinked SD and MFA model
- Dynamic model illustrates effects of scenarios

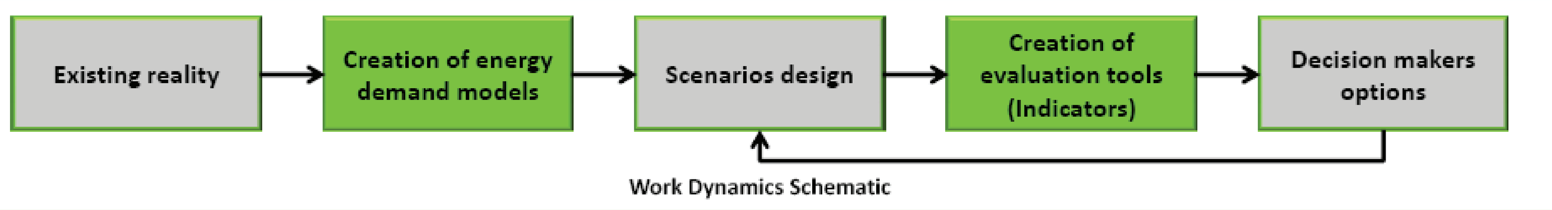
Neighborhood Characterisation



Data Source: http://snig.igeo.pt/cos/

- Characterization of districts through resource consumption patterns
- Analysis of physical structure and land use to estimate resource consumption potential
- Decomposition of behavioral and structural components of resource consumption

Models for Urban Energy Demand and Sustainability Evaluation



This project aims to understand and model urban energy demand grows and create tools to evaluate its sustainability.

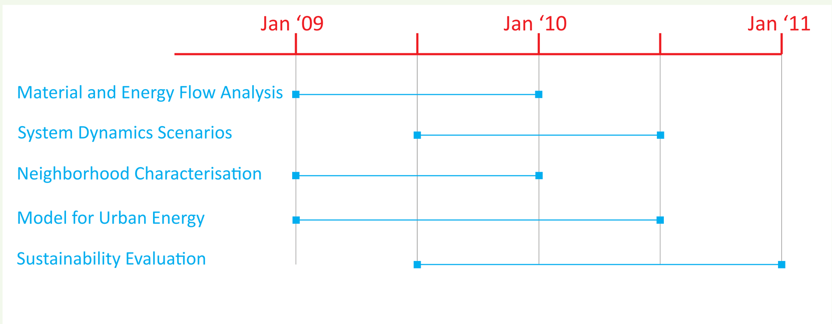
See poster at AGS for further details

Goals

A model illustrating city resource consumption for the following purpose:

- detailed understanding of material and energy flows using MFA
- rich description of the behavior of the city through SD 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

Timeline



Indicators

Two types of indicators will be used to assess the best possible pathways toward responsible city planning.

Biogeochemical
- Net primary production
- Carbon cycle
- N, P, and other cycles
- Hydrological cycle
- CO2 emissions

Socioeconomic
- Material/energy intensity (MIPS)
- Human development index
- Environmental responsibility
- Resilience » risk reduction

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