Urban Metabolism: Ecologically sensitive construction for a sustainable New Orleans

I Background: New Orleans and Hurricane Katrina

New Orleans experienced a severe hurricane followed by flooding in August 2005. Over 1500 people died with many more missing in the aftermath.

The storm brought heavy winds and rain to the city and the storm surge which followed, breached several levees that protect New Orleans. The damaged levees allowed water to enter which resulted in up to 80% of the city being flooded.

Estimated flood depths after the levees broke based on satellite data (image courtesy of LAGIC)

Over 100,000 houses were severely damaged or destroyed. An estimated 450 000 people were made homeless as a result of the storm. The total damage has been estimated in the region of $100 billion.

New Orleans house in the Ninth Ward after Hurricane Katrina

Over 30 million cubic yards of waste were generated as a result of the hurricane. As the waste is mixed with many contaminants, it is difficult to segregate prior to disposal or possible reuse.

Debris being gathered after Hurricane Katrina

Sources:
LAGIC - Louisiana Geographic Information Center: http://lagic.lsu.edu
GNOCDC - Greater New Orleans Community Data Centre: http://www.gnocdc.org
US Census Bureau: www.census.gov

II Research Questions:

- Can analysis of the urban metabolism help decision-making during the reconstruction of houses in New Orleans?
- What metrics are most appropriate to evaluate material usage and flow?

Urban Metabolism and analysis of cities

Cities are viewed as organisms which require nutrients, energy, storage and produce waste. Raw material, fuel and water are transformed into the urban built environment, human biomass and waste.[1]

Metabolism is measured by examining the flow of matter and energy within the city illustrating trends in human energy and material fluxes.

Sum of Material and Energetic Inputs = Sum of Outputs + Changes In Stock[2]

Urban metabolism analysis can assist in decision-making regarding resource usage, pollution, material efficiency and closing of material cycles.

We are approaching a time when more than 50% of the global population live in cities.

Modern megacities will start to reach equilibrium only when global fossil fuel reserves are exhausted and global water and food are utilized to the maximum level possible.[3]

Cities are sites which concentrate demands for natural resources and are sites which generate the greatest amount of industrial wastes

Concentrating people and production in cities gives more possibilities of waste reduction and recycling. It also can enable linkages between industries.

References:
1: “The Metabolism of Cities”, Wolman, *Scientific American*, 1965
{Wolman suggested that the city should be viewed as an organic body with metabolic processes}
2: “Society’s Metabolism II” Fischer-Kowalski and Huttler, *Journal of Industrial Ecology*, 1999
3: “Energy and Material Flow Through the Urban Ecosystem”, Decker et al., *Annual Review of Energy and the Environment*, 2000

III Current Work:

By combining urban metabolism theories with physical accounting of material resources, a general method for examining cities is being developed. Material flows have been examined at an international level, and it is intended to analyse cities in a similar manner.

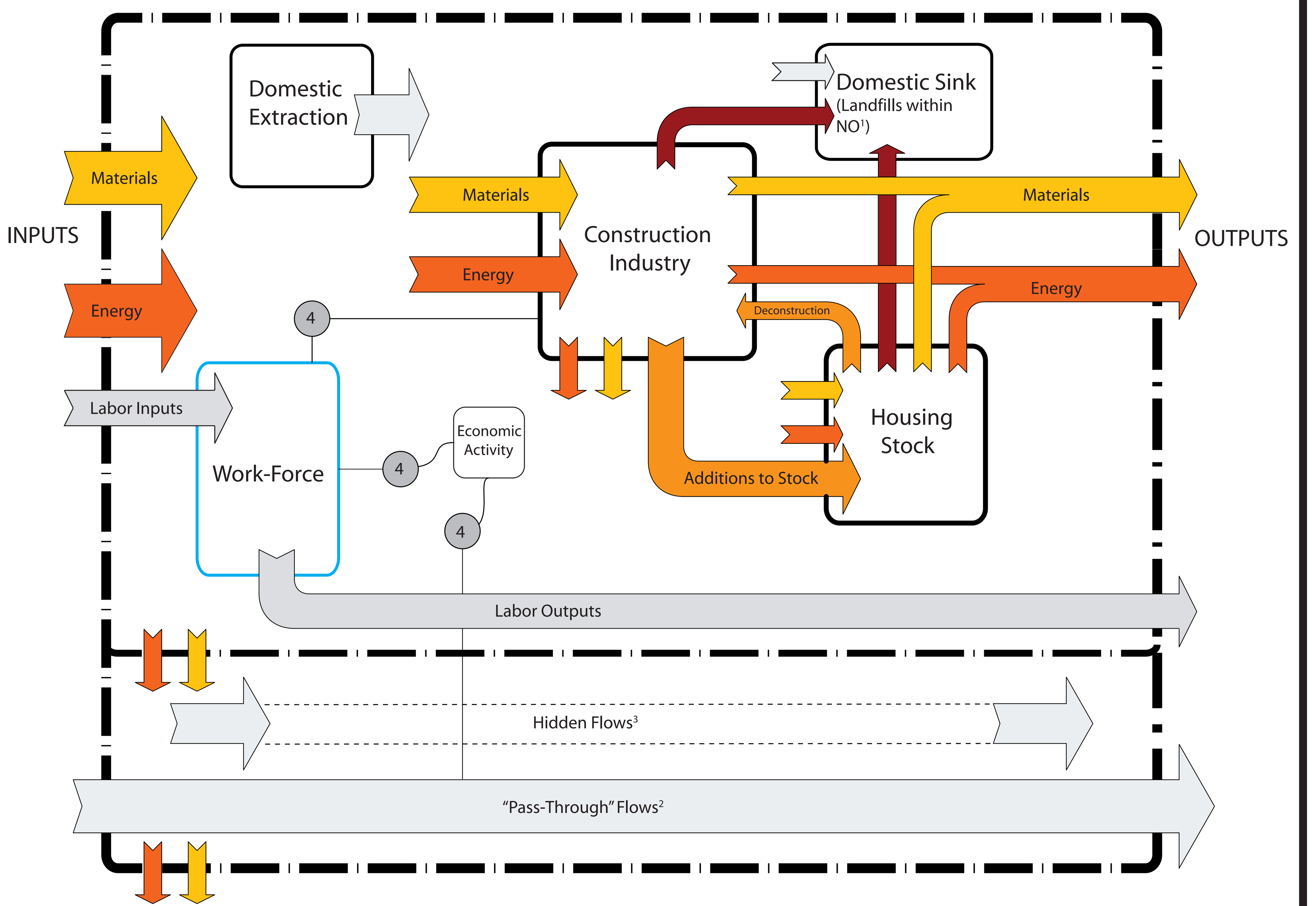
The project intends to establish a model of relationships between various systems of the city. The computational model is based on all available information about the metabolism of the city while extrapolating gaps in data with information from comparable American cities.

The project has begun the conceptual design and data assembly for constructing a computational systems model of the resource consumption of the city of New Orleans. MIT is working with the international engineering firm based in Cambridge Massachusetts, Camp, Dresser & McKee, in the construction of this systems model.

This model will aid in the identification of strategies for developing an “ecology of construction” for the city. This industrial ecology will suggest ways in which specific industrial components may be linked symbiotically in the productive exchange of materials and energy.

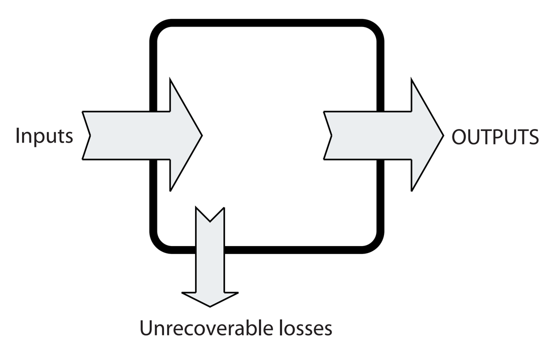
Physical accounting is being used to examine the resource consumption in the built environment. Currently, much of the focus of the consumption of materials examines construction waste, as this is a visible product of the linear flow of material through our urban societies. Although there is a growing emphasis on reuse and recycling (and consequently measurement) of certain materials there exist few studies which focus specifically on examining material inputs and outputs of the built environment.

In addition, a comparison of techniques for evaluating resource efficiency measures for housing is being completed. By examining the urban metabolism of this city, the goal is to identify improvements for future construction methods in the residential sector.



Flow of Materials, Energy and Labor within the System Boundary of New Orleans

Legend



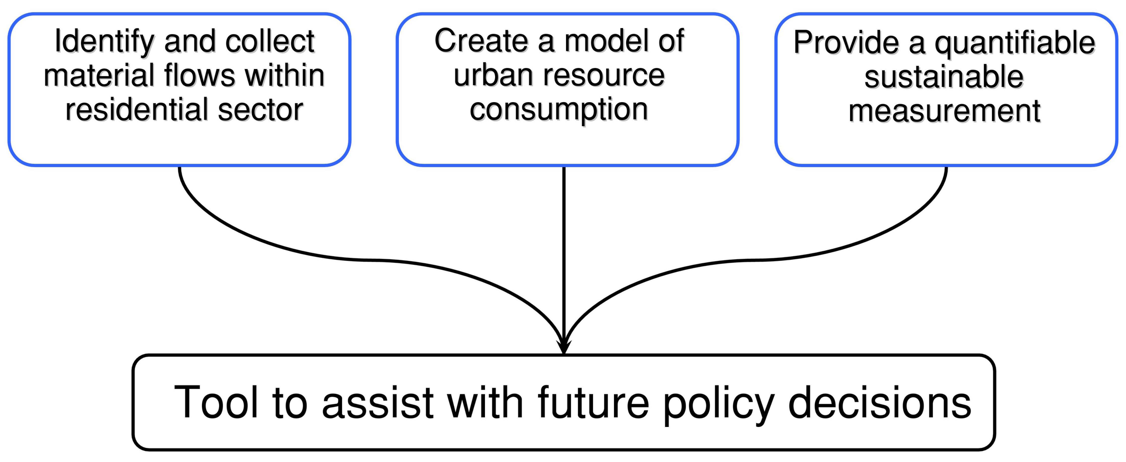
Notes:
1 NO = New Orleans
2 “Pass-Through” Flows refer to the large volume of material which passes through the port of New Orleans
3 Hidden Flows are materials that are mobilized in the course of providing materials for construction but do not actually enter the economy
4 Theoretical relationship between system components

IV Future Work:

Our intention is to develop a practical, real-world framework for combining environmental stewardship and community development through alternative modes of construction and materials handling.

We aim to develop a generic template so that this model can be applied to other cities.

We hope to identify practical strategies for developing ‘green’ cities and what can realistically be improved.



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