ORGANISATION
FOR ECONOMIC
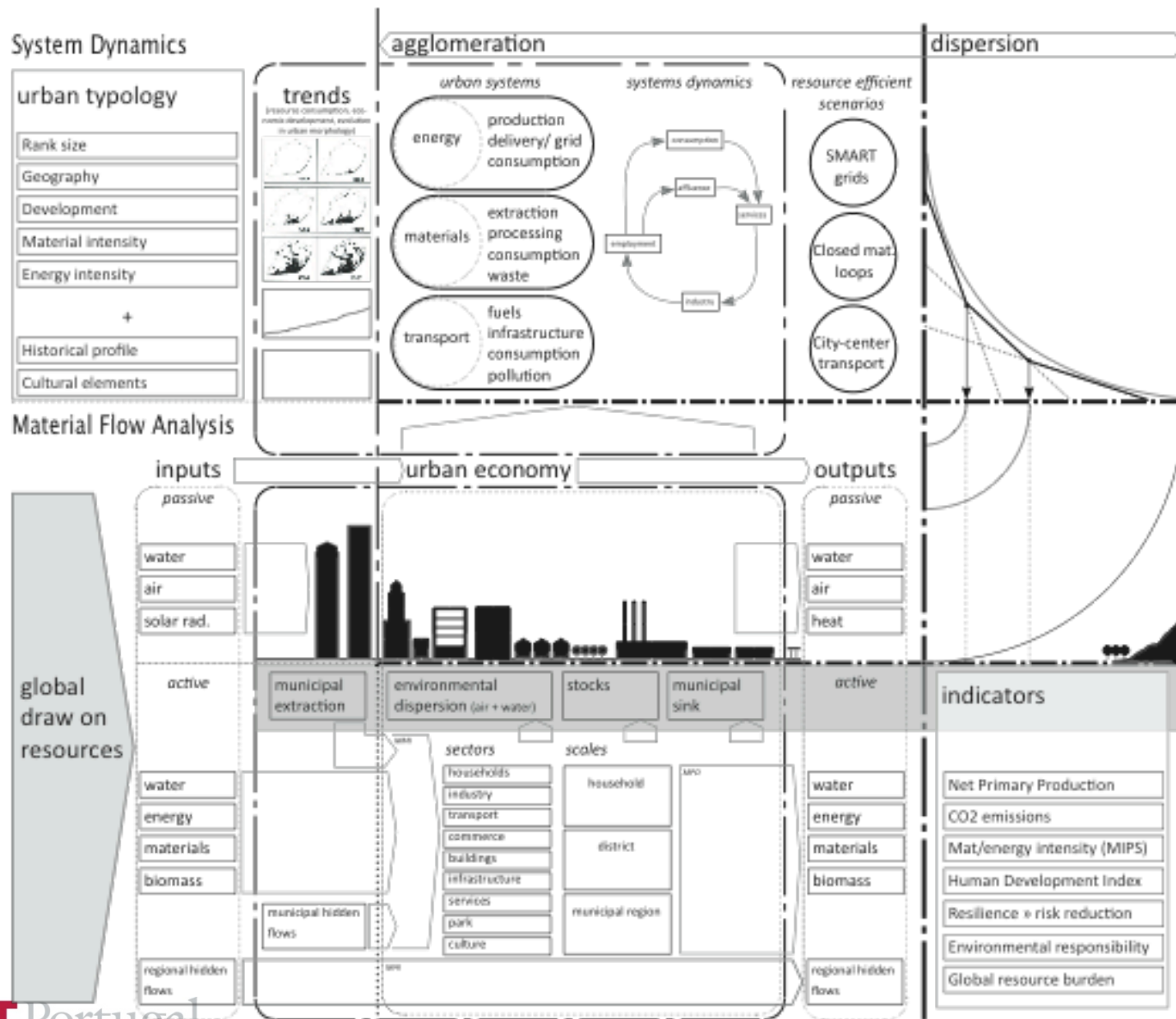CO-OPERATION
AND DEVELOPMENT

OECD

ICT innovation for sustainable urban infrastructures

Paulo Ferrão and John Fernandez

MIT-Portugal Program

www.mitportugal.org
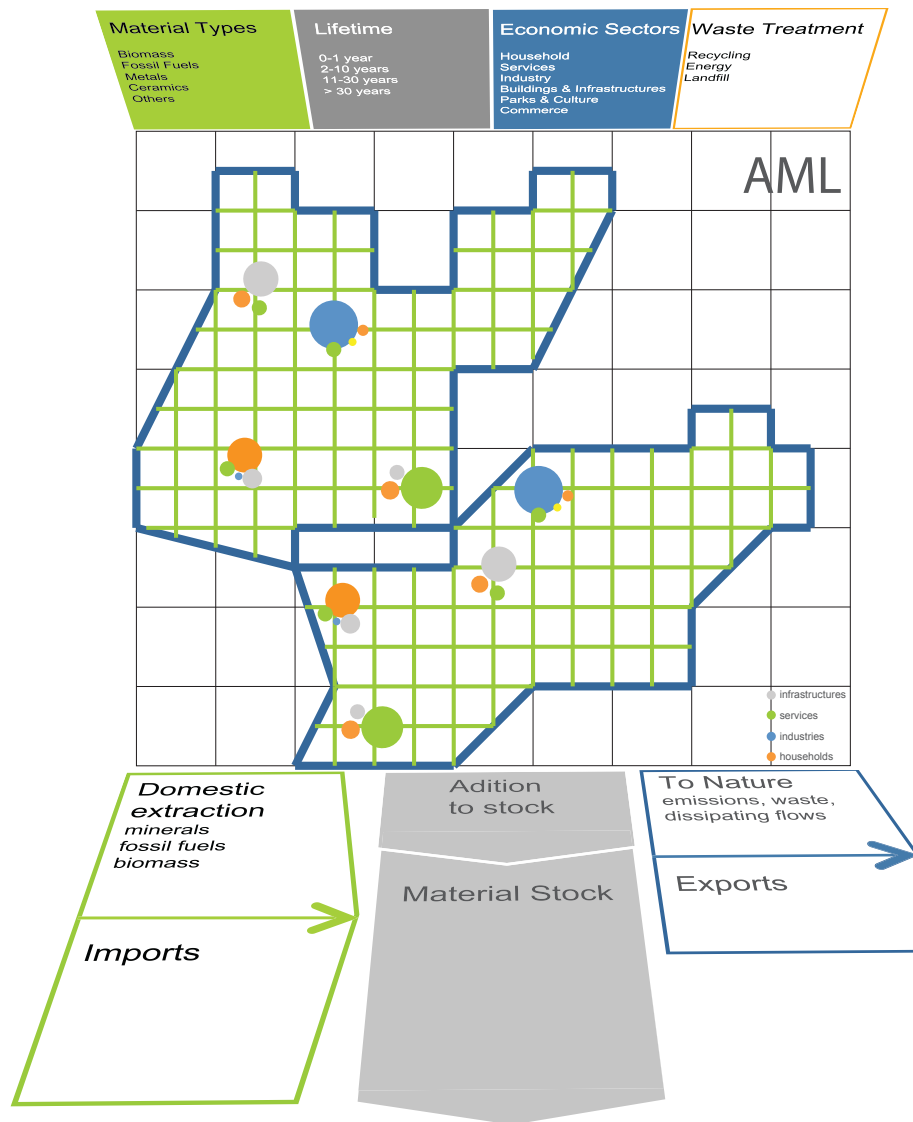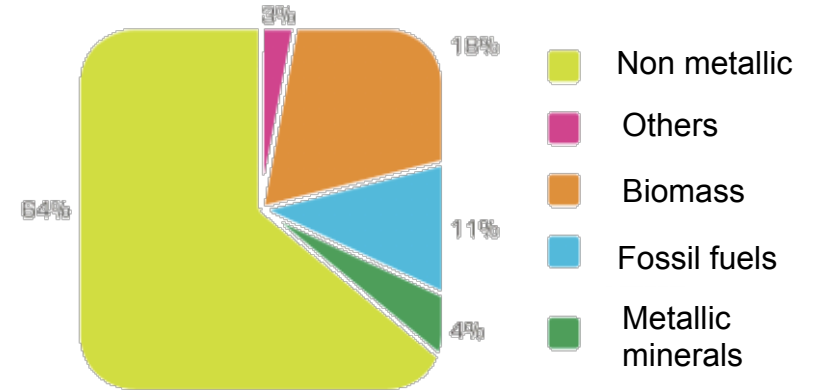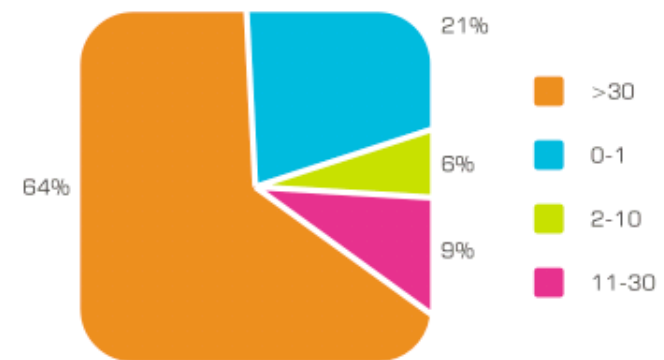
27-28 May 2009 Helsingør, Denmark

MITPortugal

Urban Metabolism

Material Flow Analysis Methodology

Material Types	Lifetime	Economic Sectors	Waste Treatment
Biomass Fossil Fuels Metals Ceramics Others	0-1 year 2-10 years 11-30 years > 30 years	Household Services Industry Buildings & Infrastructures Parks & Culture Commerce	Recycling Energy Landfill

AML

infrastructures
services
industries
households

Domestic extraction
minerals
fossil fuels
biomass

Imports

Adition to stock

Material Stock

To Nature
emissions, waste, dissipating flows

Exports

Total Material Consumption

- Non metallic — 64%
- Others — 3%
- Biomass — 18%
- Fossil fuels — 11%
- Metallic minerals — 4%

Addition to Stock

- >30 — 64%
- 0-1 — 21%
- 2-10 — 6%
- 11-30 — 9%

MITPortugal

Material flow analysis: What's next?

MFA

BIOMASS

FOSSIL FUELS

...

ICT

HOUSEHOLD

ONLINE SURVEY

HOME BASED SENSORS

SMART MEETERING

TRANSPORT

SMART PHONE ACTIVITY

BEHAVIOUR MODELLING

UrbanSIM

POLICY OPTIONS
for
SUSTAINABLE URBAN METABOLISM

MITPortugal
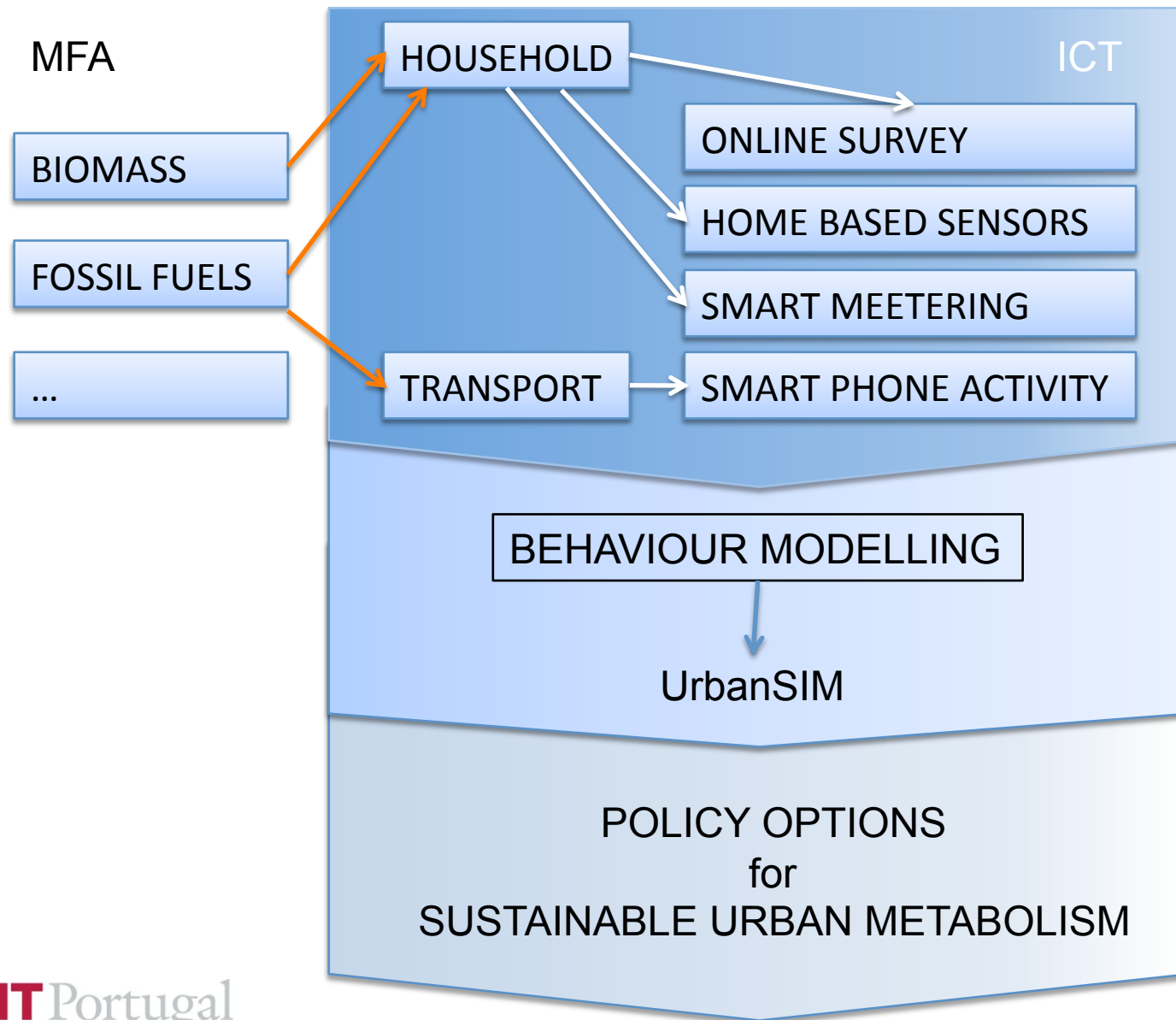
Demand responsive pilots:

20 years of findings

Technology driven	Savings
Direct display on monitor separate from the meter	5% - 15%
Basic metering without separate direct display monitors	10% - 20 %
Pay as you go (keypad meters, pre-payment)	15% - 20 %
Ambient displays	up to 16%
Indirect displays (TV's, PC's, frequent billings)	0% - 10%
Disaggregated feedback with internal control or network operator control	Unknown
Contractual arrangements	
Time of Use Critical Peak Pricing Real Time Pricing	up to 30% of reduction during peak demand

Adapted from Darby, 2006

MIT Portugal

The Need for ICT based Experimentation

- Drivers for change in energy use patterns are not well understood

- Most pilot studies have been developed as demonstration studies

- There is a need for scientifically designed experiments:
  - The covariance of different intervening variables needs to be taken in account: In an experiment many variables interact and contribute to change (household characteristics, affluence, price, communication channels)
  - Social segmentation is key to understand the effectiveness of the above on the test population
  - Follow the major drivers for behavior change, such as specific communication strategies, feedback and price signals, or man-machine interactions
  - Establish a control group, where the educational and technological change did not occur, maintaining the same social characteristics

MIT Portugal

The future – Intelligent Energy Networks, the energy software revolution
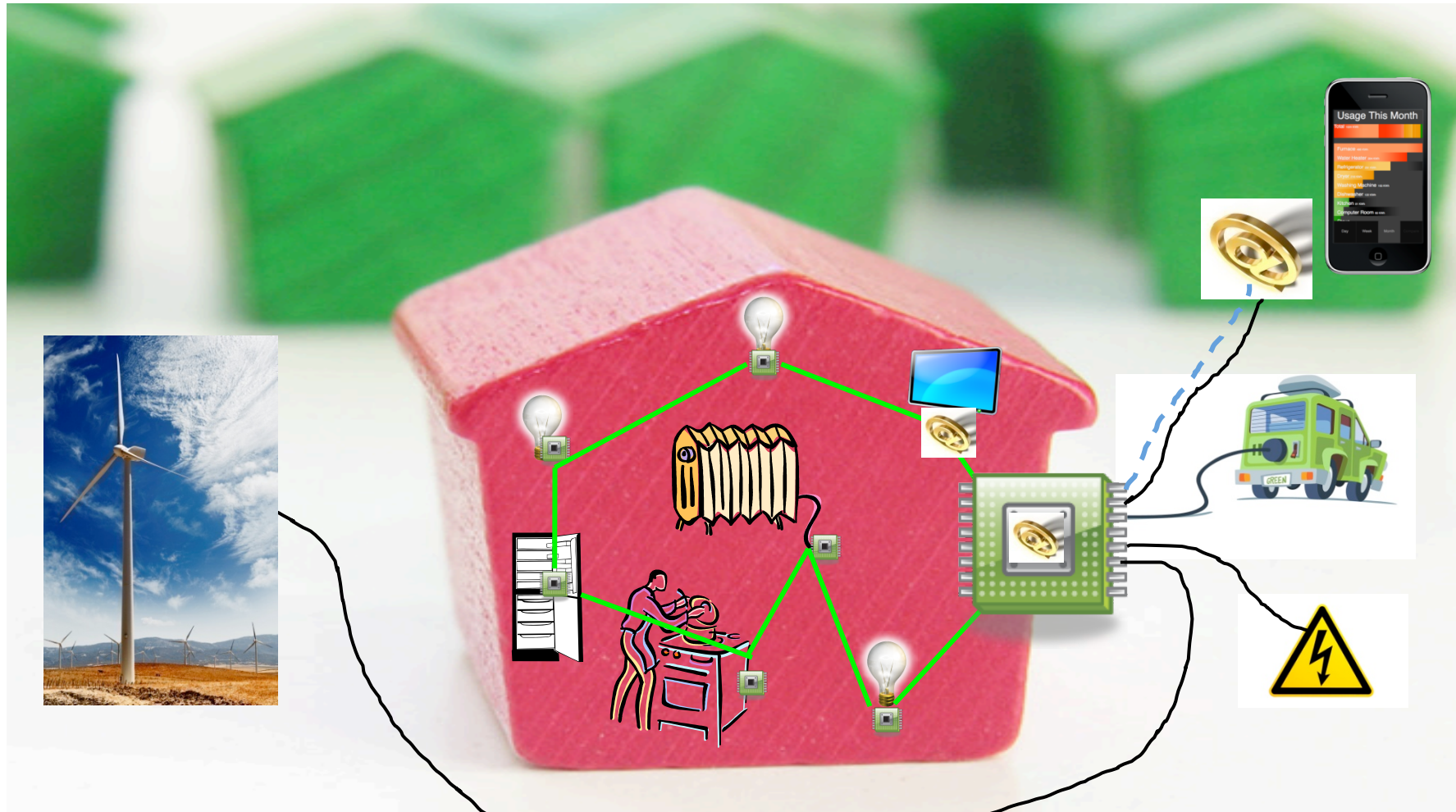
Small scale scientific experiments

Conceptual design

Experiment	Aggregation	Feedback	Price signals	Active / Passive	Optimization	System Control
1	Aggregated	Direct real time feedback	Yes	Passive	No	Internal
2	Disaggregated	Real time feedback	Yes	Active	At the level of the appliance	Internal
3	Disaggregated	Real time feedback	Yes	Active	At the level of the appliance	External

School

Family 1

Family 2

Family ...

Usage This Month

The future – Intelligent Energy Networks, the energy software revolution