My 2c - What are the major drivers for building energy (> or <) per capita?

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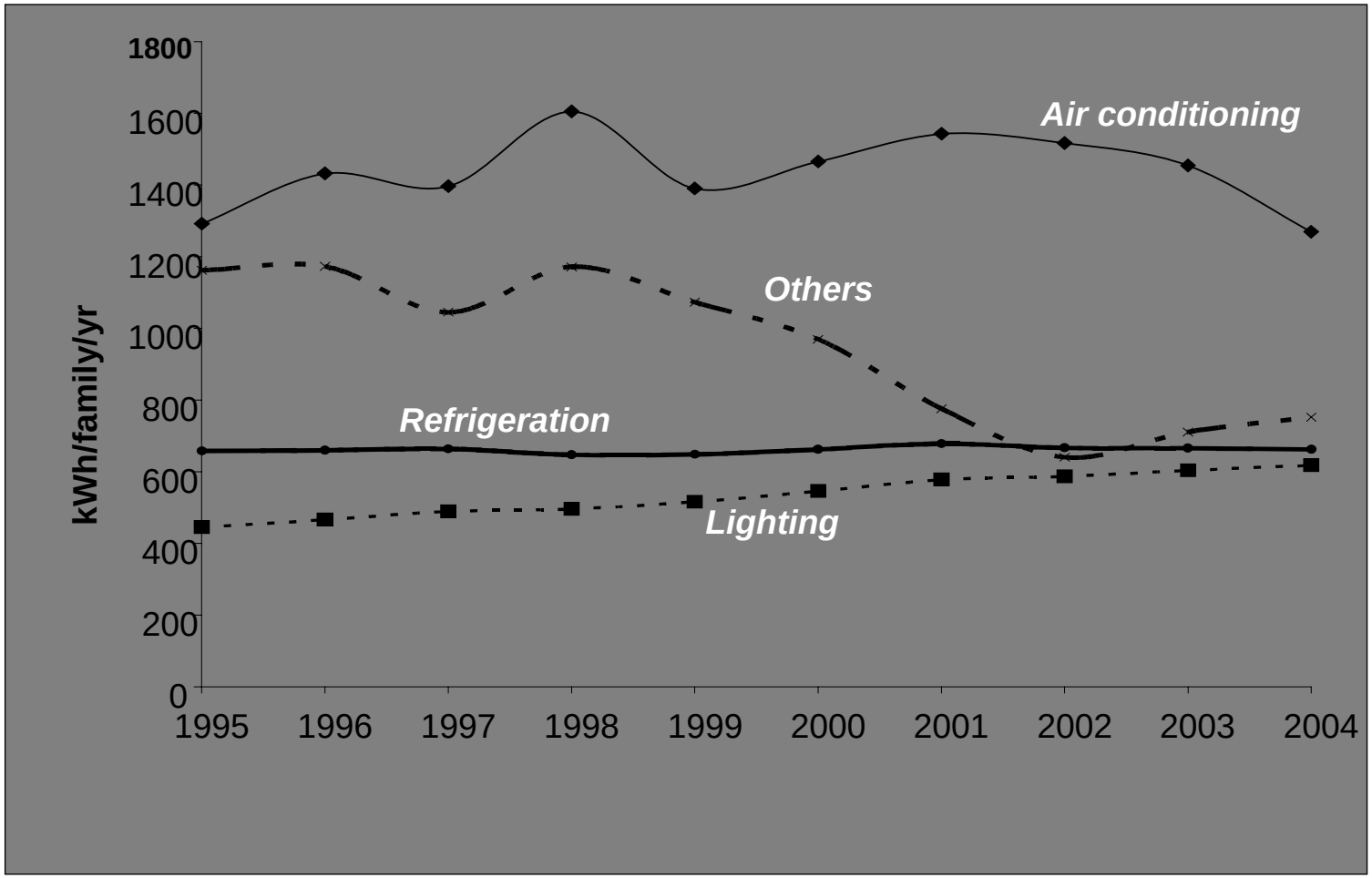
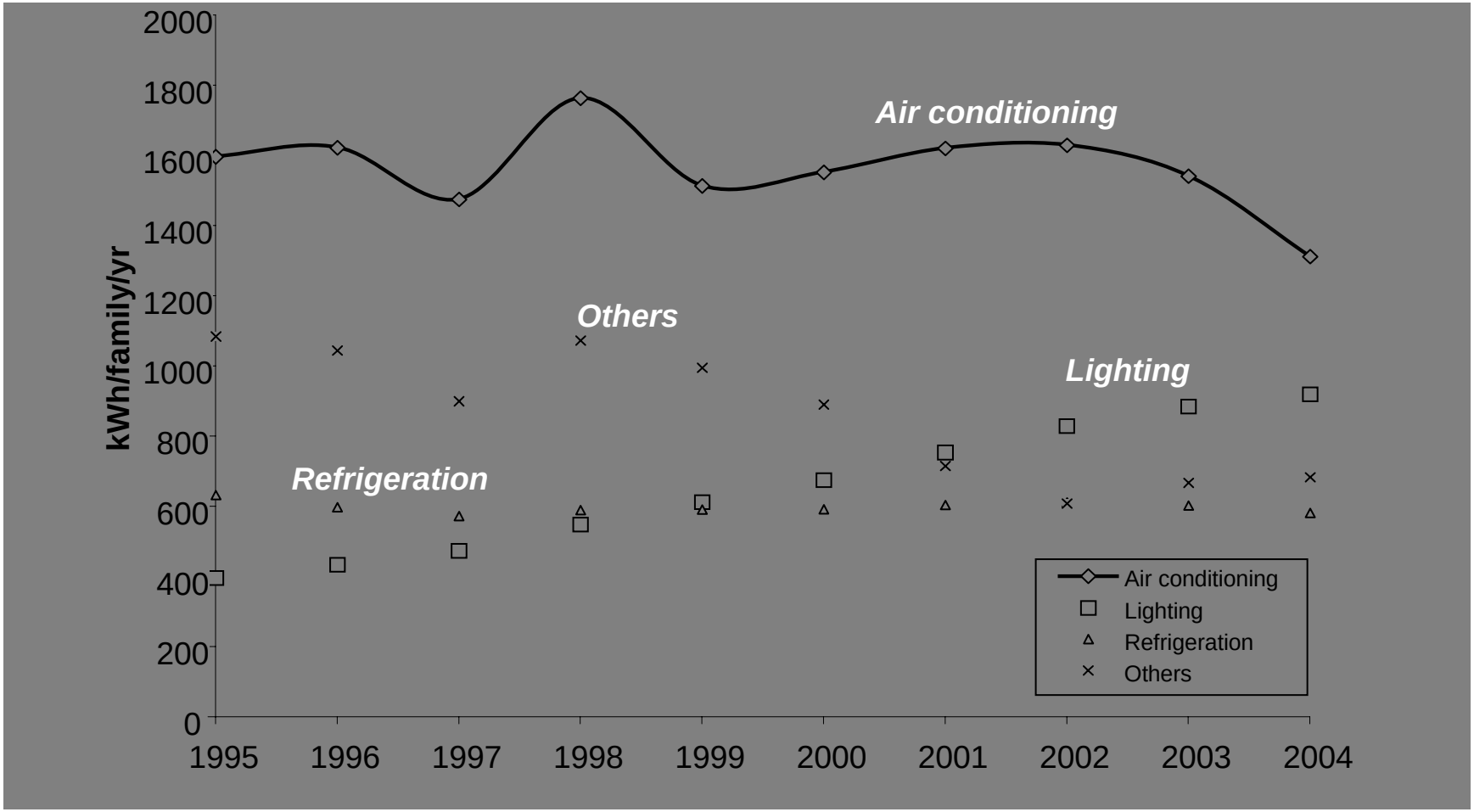
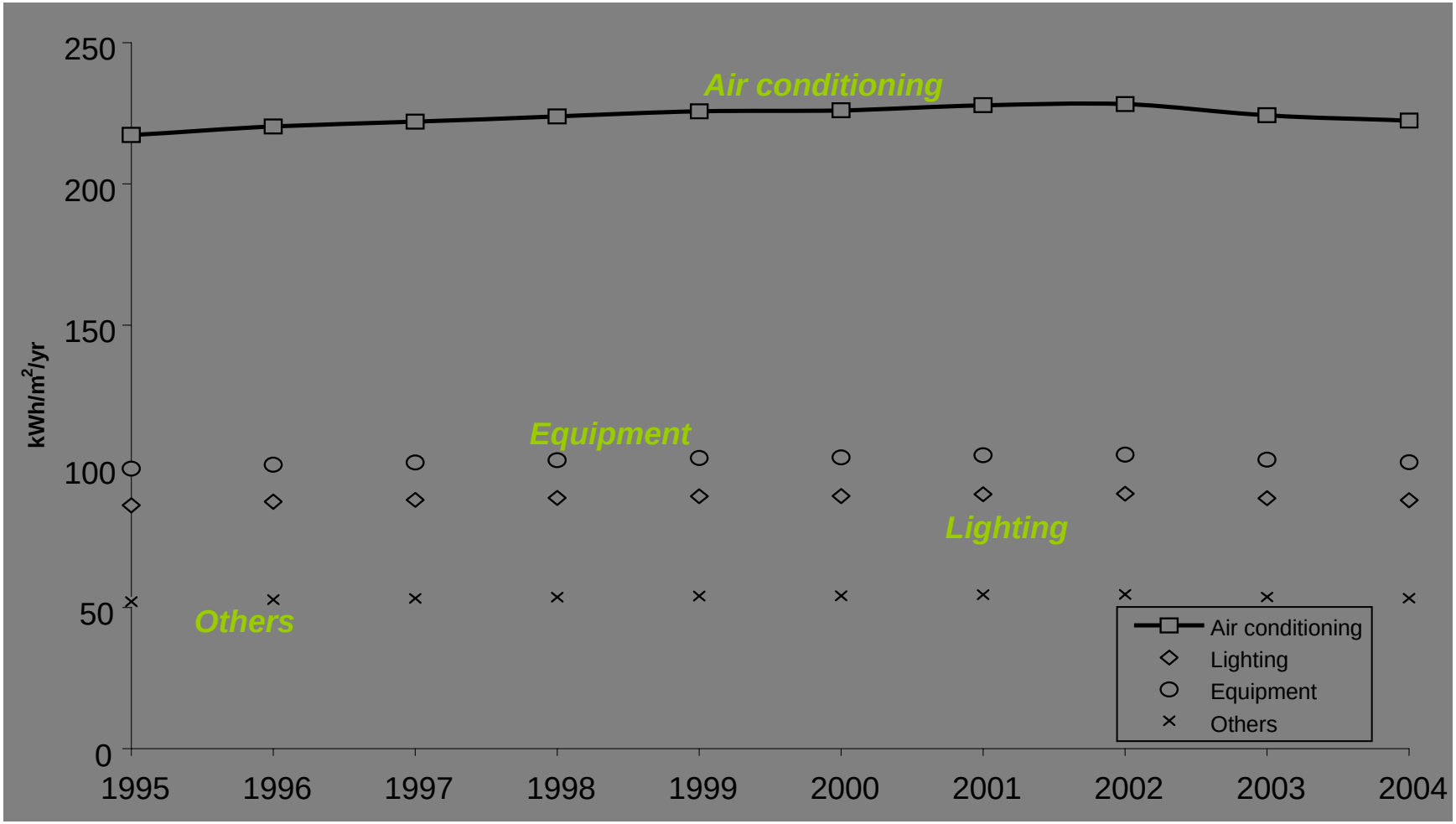
Electricity consumption in public housing – Hong Kong



Electricity consumption in private housing – Hong Kong



Electricity consumption in offices– Hong Kong



Introduction of energy efficient technologies have not made any significant overall impact on building energy saving in Hong Kong in the last 10 years, or perhaps also for other places.

Why there exists a huge difference in average building energy consumption per capita in different countries?

e.g. US = 12 ×China, and for urban buildings US = 7 ×China? Why Europe or Japan < US?

We need to understand the building energy data and identifying the major driving forces

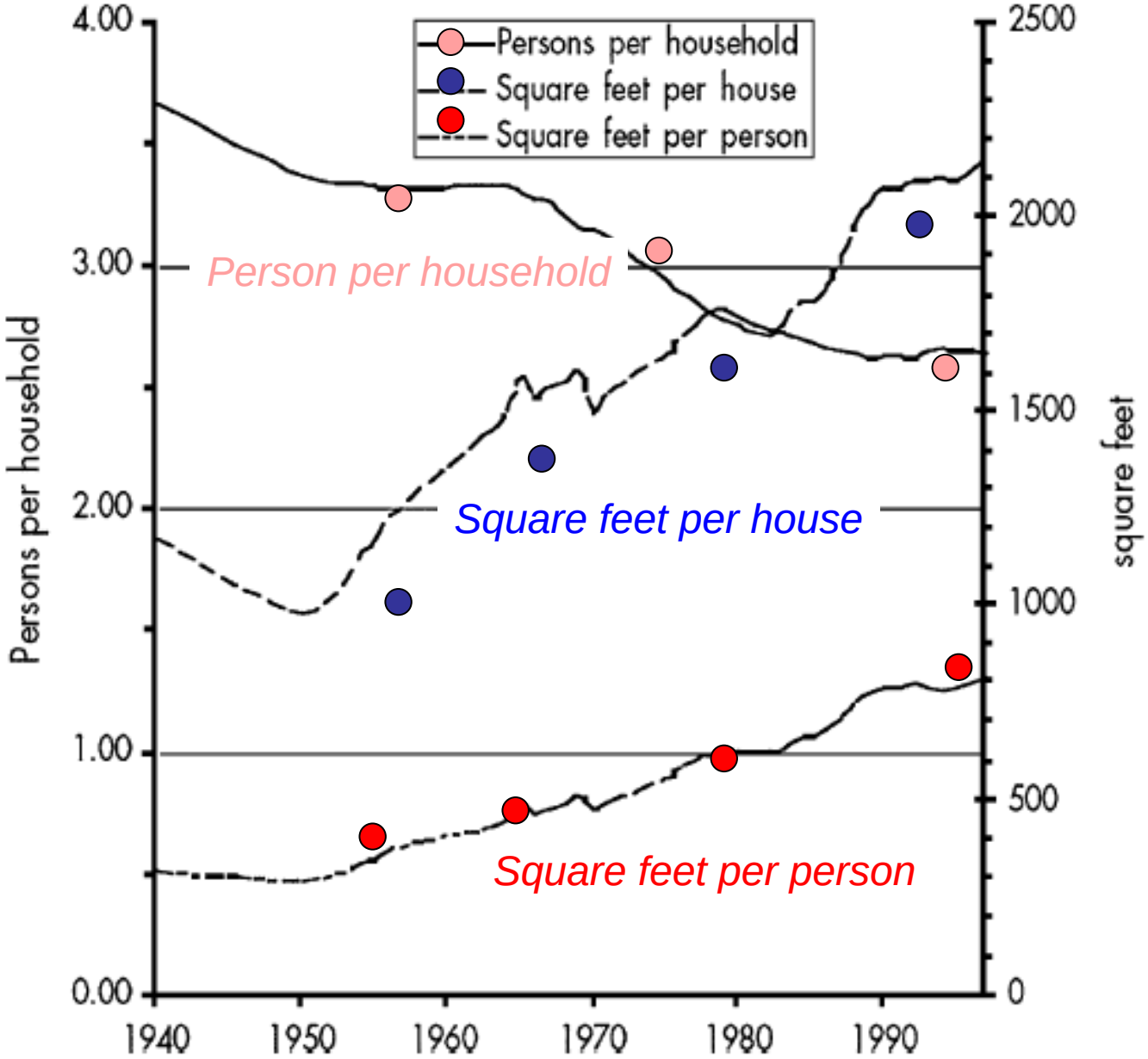
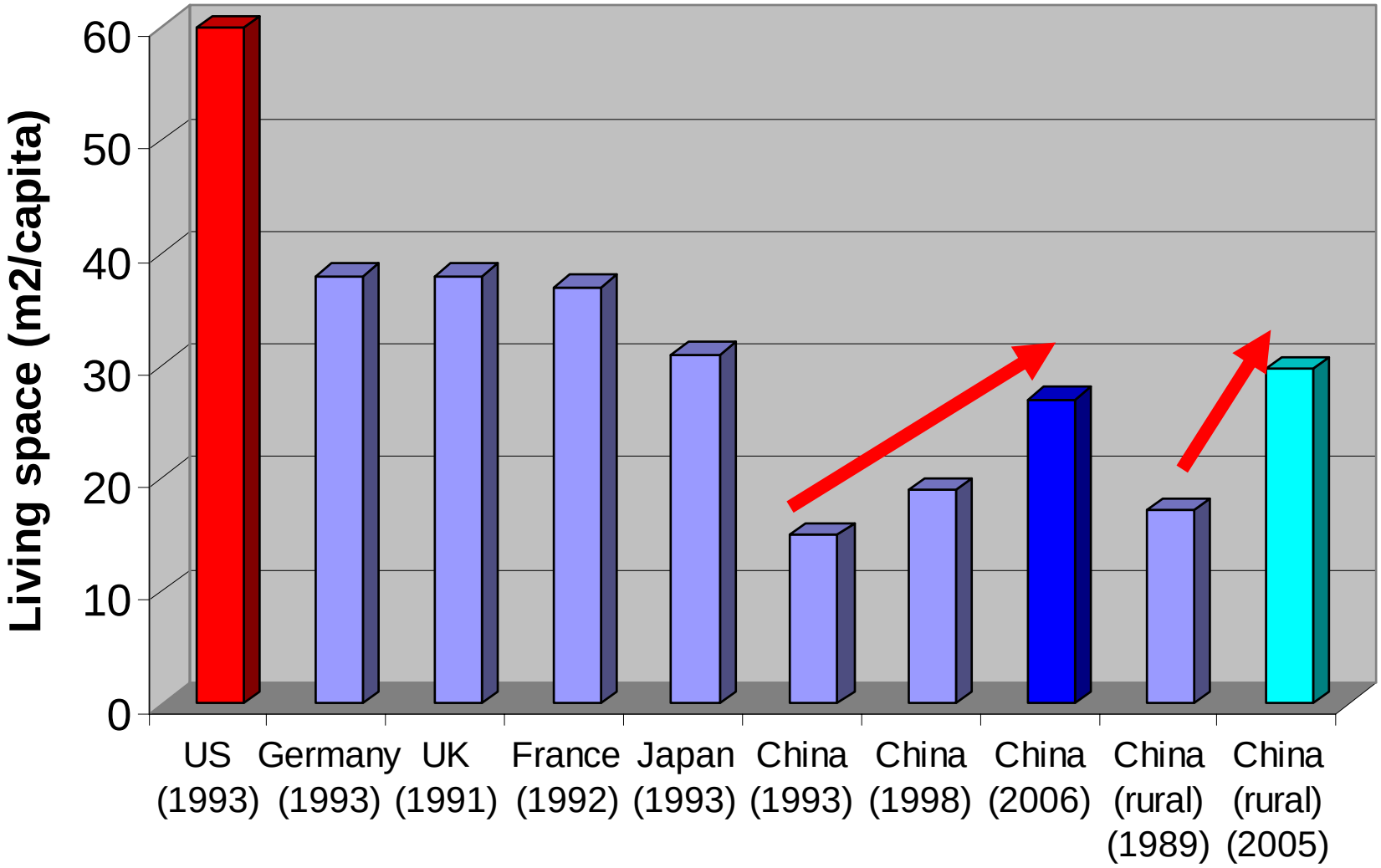


Figure 1 The floor area of new homes is going up although family size is going down. Data from the U.S. Bureau of the Census and the National Association of Home Builders.

Wilson, J Indus Ecology, 9, 2005


Living space (m2/capita)
60
50
40
30
20
10
0
US (1993)
Germany (1993)
UK (1991)
France (1992)
Japan (1993)
China (1993)
China (1998)
China (2006)
China (rural) (1989)
China (rural) (2005)

Live Better by Consuming Less?

Is There a "Double Dividend" in Sustainable Consumption?

Jackson T: Journal of Industrial Ecology, 9, 19-

Keywords

consumer behavior
consumer choice
consumer culture
evolutionary psychology
industrial ecology
symbolic interactionism

Summary

Industrial ecology has mainly been concerned with improving the efficiency of production systems. But addressing consumption is also vital in reducing the impact of society on its environment. The concept of sustainable consumption is a response to this. But the debates about sustainable consumption can only really be understood in the context of much wider and deeper

Hypotheses – needs confirmation

- Building size is the primary factor.
- Human behavior is the secondary factor.
- Technology is the tertiary (but important) factor.

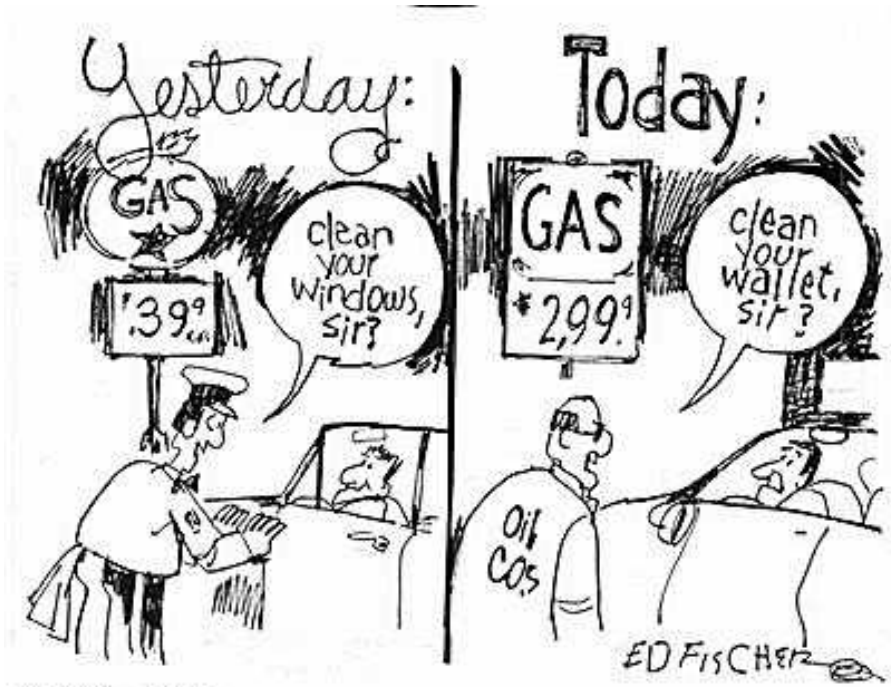
Index or indicator? - A driver and a governor

Driver – the purpose is to reduce fuel cost or $ or do not care

- Car type fuel intensity: km/liter or mile/gallon
- Fuel intensity $\neq$ fuel economy
- Fuel consumption = travel distance $\times$ fuel economy

Governor – Minister of transportation or energy

- Overall car fuel use



An investor and a governor

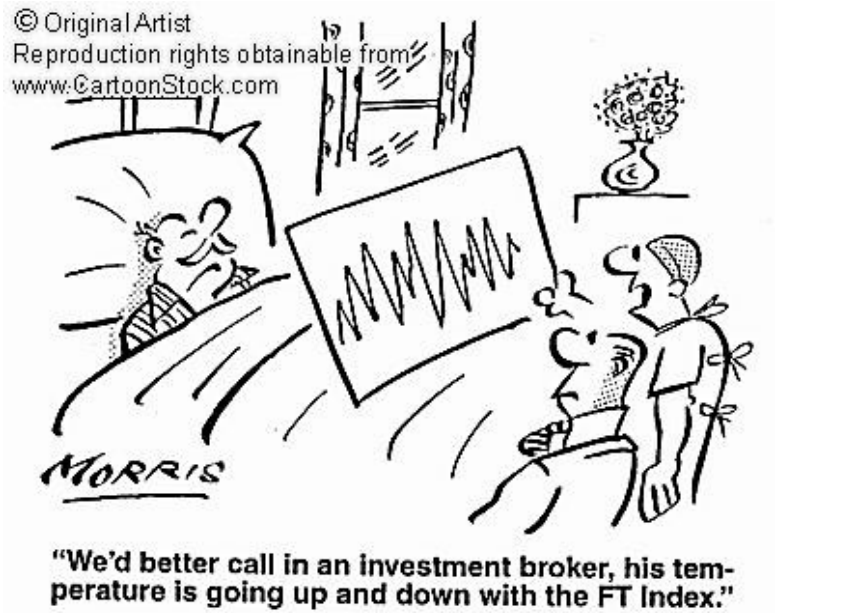
Investor –to learn about the trend of the market

- Stock market index: Heng Seng Index as a reference
- Heng Seng $\neq$ Investment
- Individual company – profile and potential – financial statement

Governor (Financial Minister) - finance policy

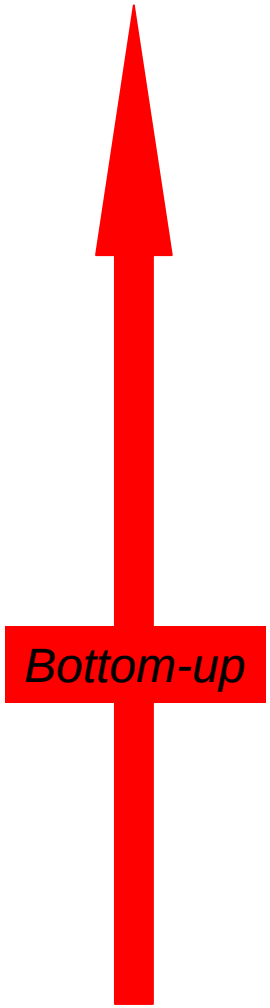
- Stock market index plus other economy parameters

"How should I know up or down? All I heard was the FT was 74.95."

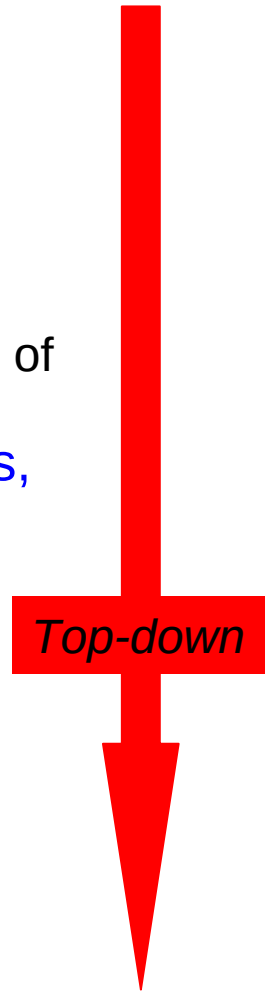


"We'd better call in an investment broker, his temperature is going up and down with the FT Index."

Hierarchy of Building Energy Indicators



- Governing level – energy policy, planning, comparison in a country or a city
  - building type – kWh/capita, kWh/a, kWh/$GDP
  - function type – kWh/capita, kWh/a
  - entire building stock – kWh/capita, kWh/a
  - energy index – similar to stock indexes – top 20% of buildings
- Sectoral level – energy saving, new technologies, regulation/standard
  - building type – kWh/m2, kWh/a, kWh/capita
  - function type (AC, Vent etc) – kWh/m2, kWh/a, kWh/occupant
  - occupant type – low/middle/high income – kWh/a
- Individual level – cost, green, innovation
  - building owner – kWh/a
  - Individual component/system – kWh/a
  - building user – kWh/a



Index or indicator? Index is a weighted performance indicator. IEA uses energy indicator

Analyzing building energy data is a statistical problem

- The sample size for a meaningful trend analysis (% of building stock or number of buildings)
- How to select samples
- How to avoid bias? Confounding factors
- How to collect reliable data (accuracy)
- What information to be included in a meaningful database? (all influencing factors??? incomplete information, Energy Statistics)
- Data mining techniques?
- The need to estimate the statistical errors, confidence level. For association claims, careful significance test is needed.
- Correlation does not necessarily mean a relationship. Coincidence?
- Fundamental building physics, reliable computer modelling can help.

Some quick ideas for IEA new Annex
Title: Building energy consumption - database and data mining

Objectives

- To identify the major driving force(s) in building energy consumption through data mining
- To identify major proven effective building energy technologies
- Develop consistent building energy indicators and statistical analysis tools

Possible subtasks

- Building energy data center (smart metering offers new possibility)
- Data benchmarking – developing useful energy indicators
- Data mining – identifying proven technologies

Focusing on residential buildings

- We spend 2/3 time in homes (not for HK people)
- Easier to compare internationally
- Family size is comparable
- Residential buildings – an indicator of economy development
- Rural and urban buildings
- Natural and mechanical systems
- Human behavior important!

√

Focusing on office buildings

- Work performance
- Modern HVAC
- Large buildings
- Size – differs in different cities/countries
- Difficult to compare

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Focusing on public buildings

- Modern HVAC
- Large buildings
- Size – differs in different cities/countries
- Different to compare

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Focusing on school buildings

- Mostly ignored
- Size – differs in different cities/countries
- Sample size may be small in some cities

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