

Density – Energy consumption – Urban texture

*Paris / Shanghai
Beijing / Los Angeles
Shanghai / Hong Kong*

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More than half of the global population now live in cities and the United Nations says that by 2030, 60 percent of us will live in them. Naturally these cities are and will continue to be resource-hungry. Despite only representing 2 percent of the world's surface area, they are responsible for 75 percent of the world's energy consumption.

It is interesting to compare cities in order to highlight differences and common points which have an influence on the energy consumption. Here is a summary of three comparisons focussing on the density, the energy consumption and the urban texture: Paris and Shanghai, Beijing and Los Angeles, Hong Kong and Shanghai.

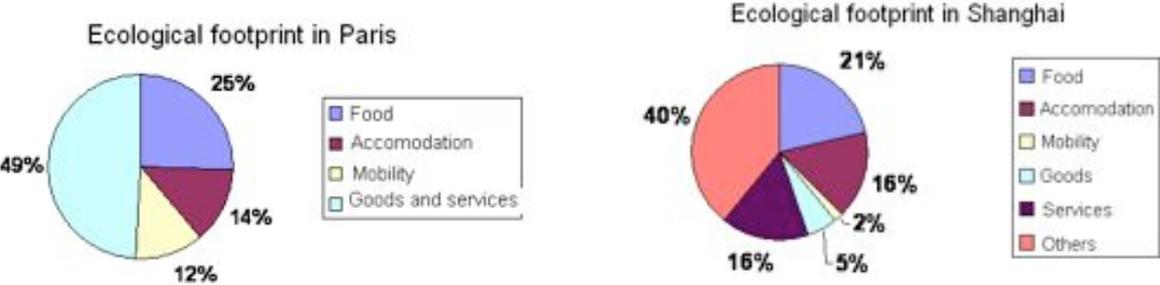
Paris / Shanghai

Shanghai and Paris have the same ecological footprint, although Shanghai is considered as one of the most polluted city of the world and Paris as an example of sustainable urban development.

	Paris intramuros	Paris Metropolis (Ile de France)	Shanghai (city centre)	Shanghai Metropolis
Density (hab/km ²)	20400	3500	40000	2400
Population (millions hab.)	2,15	11,3	9,8	18
GDP per capita (US\$)		42700		7700
Area (km ²)	105	12500		6340
Motorization rate	44%	70%		0,6%
Energy consumption per capita (toe/year)	1,28	2,07		2,16 (global) 0,117 (domestic)
Ecological footprint	6	5,58		5,8

Shanghai metropolis has a very low density; an inhabitant of Shanghai consume quite twice more energy as a Parisian for an eight times less important GDP. Nevertheless, for the domestic energy consumption a Shanghaiese consume ten times less energy than a Parisian. The difference is due to the important part of industry in Shanghai.

It is also noteworthy that the motorization rate in Shanghai is very low and will rise with the increase of the standard of living, and thus the energy consumption and the part of mobility in the ecological footprint too.



Distribution of energy consumption



Let us consider the morphology of both of the cities.



Shanghai (altitude 3km)



Paris (altitude 3km)

Shanghai is covered with important roads but without a geometric structure, whereas Paris has a network of straight streets. In Paris, big places are also roads nodes whereas in Shanghai nodes don't have public places.



Shanghai (altitude 600m)



Paris (altitude 600m)

Roads and streets are important in both cities but they are more “green” in Paris than in Shanghai.



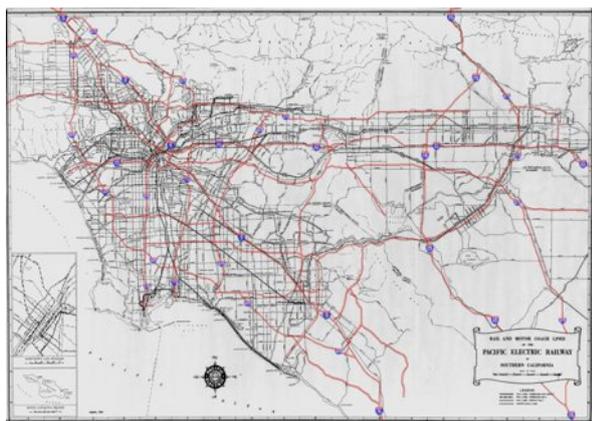
There is also a big density difference between the old lilongs (right on the picture) and new areas (left on the picture) of Shanghai. The last ones are much less dense; they are mostly big blocks or towers.

Beijing / Los Angeles

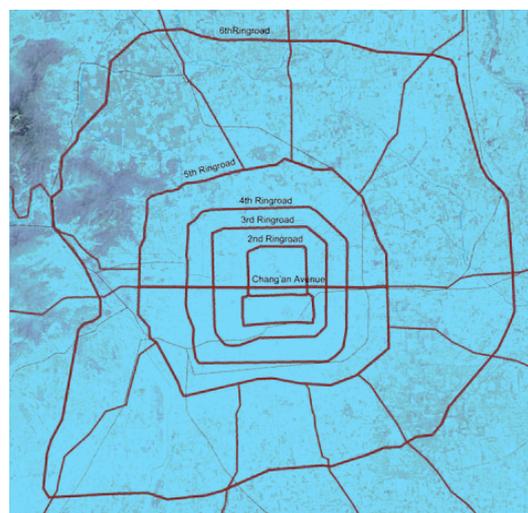
Beijing and Los Angeles are both examples of sprawled cities, with a very low density.

	Beijing	Los Angeles
Density (hab/km ²)	3700	7876,8
Population (millions hab.)	13,82	14,6
GDP per capita (US\$)	8000	53300
Area (Mha)	1,68	1,26
Motorization rate	40%	93%
Energy consumption per capita (toe/year)	2,535	2,8
Ecological footprint	3,1	10,1

There is no real city centre in Los Angeles; that is one of the reasons, and also a consequence, of urban sprawl. Beijing presents a centric development with six belts; the first one is the Forbidden City. Little by little, the urban sprawl in Beijing has erased the limitation between the city and its suburb.



Los Angeles: a grid texture



Beijing: a concentric structure



Beijing (altitude 3km)

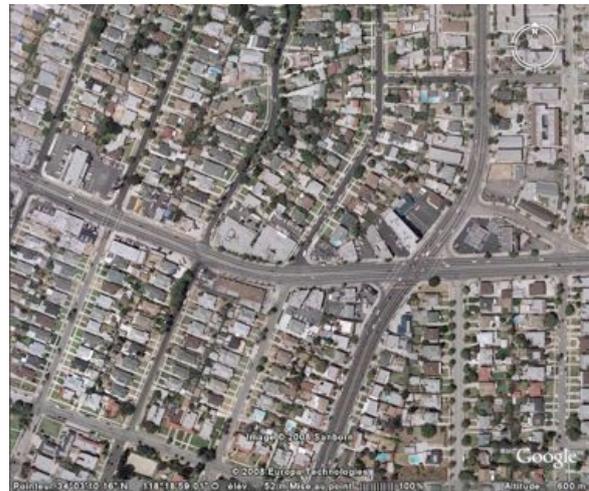


Los Angeles (altitude 3km)

Beijing and Los Angeles are both covered with very large roads, but they are more organized in Los Angeles. From 3 kilometres, Beijing has higher buildings but its floor occupation is lower.



Beijing (altitude 600m)



Los Angeles (altitude 600m)

Beijing has big towers but with a huge space between them. Los Angeles has towers downtown and then private housing estates. Both conduct to low density.

Of course, since both cities have a very low density because of the urban sprawl, the public transportation network is not well developed and it encourages the use of cars. Los Angeles has a very high motorization rate but Beijing still has a lower one, which is likely to increase very fast in the next years and is already very high for China.

Hong Kong / Shanghai

Hong Kong and Shanghai were both little fishing village until respectively the 19th and 18th century. They are now the two big economic cities of China.

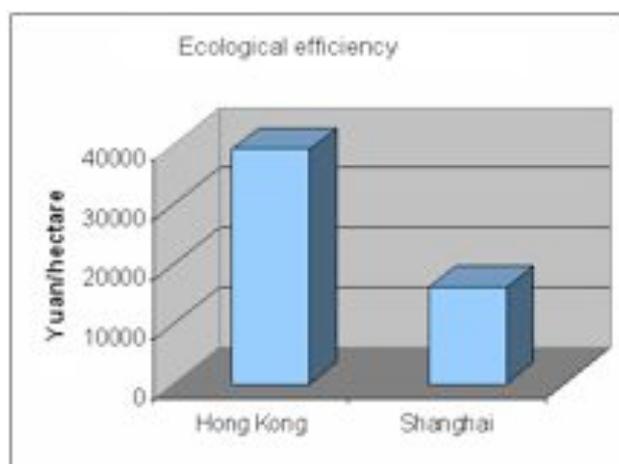
	Hong Kong	Shanghai (city centre)	Shanghai (metropolis)
Density (hab/km ²)	29400	40000	2400
Population (millions hab.)		9,8	18
GDP per capita (US\$)	38127		7700
Area (km ²)	1104		6340
Motorization rate	0,48		0,6%
Energy consumption per capita (toe/year)	2,398		2,16 (global) 0,117 (domestic)
Ecological footprint	4,87		5,8

Due to its geography, Hong Kong has a very low biocapacity and everything is import.

City	Ecological footprint	Biocapacity	Ecological deficit
Hong Kong	4.8676	0.0399	4.8277
Shanghai	3.4236	0.2131	3.2105

Units: ha/inhabitant

Nevertheless, comparing the ecological efficiency, we can notice that Hong Kong is more efficient than Shanghai.



Hong Kong is known for its very high density, whereas Shanghai has a low density, especially in the new areas. The old lilongs from Shanghai are dense, with very confined streets, at the opposite of the new areas with towers and blocks.



Hong Kong (altitude 1km)



Shanghai (altitude 1km)

These are views from Hong Kong and from a new area of Shanghai. Both cities have high rise constructions, but it is obvious that Hong Kong has a very higher density than Shanghai. Moreover Shanghai is covered with large roads.



Hong Kong (altitude 600m)



Shanghai (altitude 600m)

More closely, the photography confirms the density difference between the cities. We have an example of high rise density with Hong Kong and low density, in spite of high rise buildings, in Shanghai.

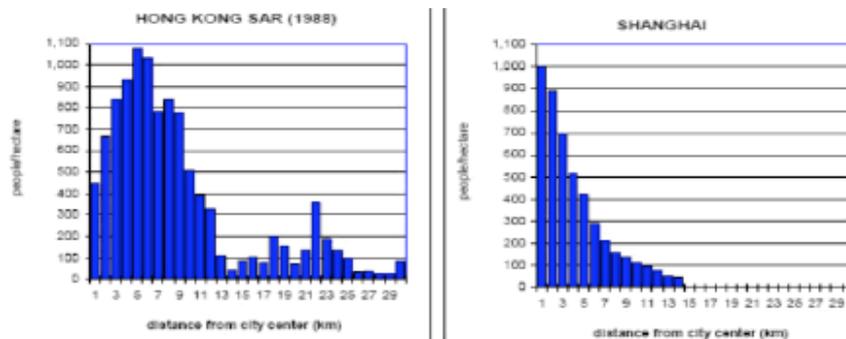


Aerial view of Hong Kong



Aerial view of Shanghai

Distance from city centre:



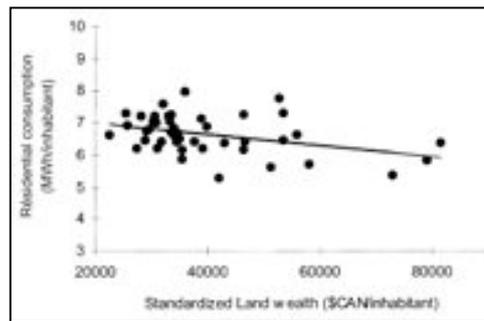
The comparison between the distance from the city centre in Shanghai and Hong Kong highlight the urban sprawl of Shanghai and its low density.

Hong Kong has a quite hard policy to minimize the number of cars in the city; that is why in spite of a higher standard of living, the city has a very low motorization rate.

International perspective

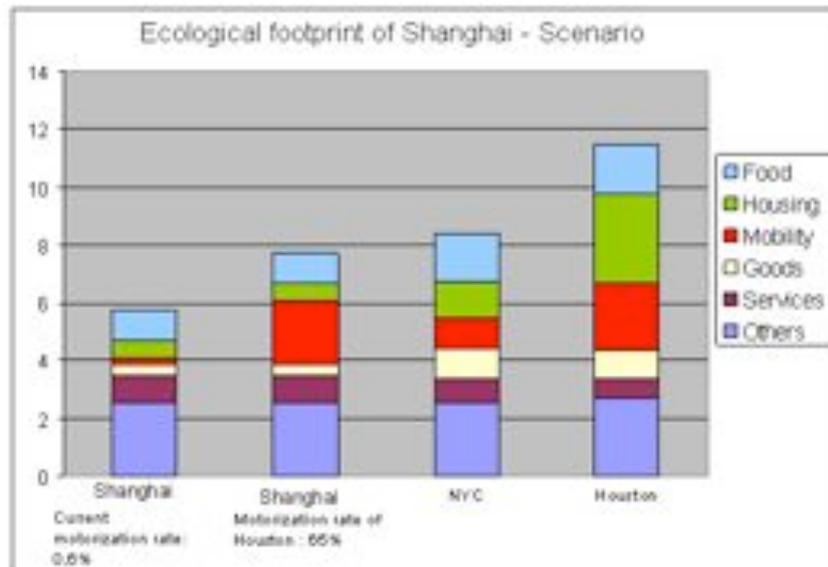
Such comparisons can be conducted at an international level or between more than two cities, like Newman and Kenworthy did twenty years ago studying the energy consumption for transportation in 32 cities all over the world. This leads to general conclusions or trends. For example Newman and Kenworthy concluded that the denser a city is the less energy is used for transportation.

A study was conducted in Canada and seems to show that the electricity consumption also decrease with the increase of density.



Per capita Electricity consumption functions of density

It is also interesting to let variables vary, like the GDP per capita, the motorization rate, to make scenarios for the future of cities with relative low standard of living, and to situate where a city stands in comparison with the other ones.



But the more cities we compare the more difficult it is to find the data we need...