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## Energy and Emissions Conflicts in Urban Areas

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## “ENERGY AND EMISSIONS CONFLICTS IN URBAN AREAS”

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**ABSTRACT.** The main aim of this paper is to observe the environmental behaviour in some cities of the world, by analyzing for each city the trends of several energy and emissions indicators that appear as explanatory variables in both energy and labour average productivity equations. At the same time we also consider the some health indicators like the life expectancy at birth as an endogenous variable which be partially explained by these explanatory variables to observe the carbon dioxide (CO<sub>2</sub>) effects on the population health. The paper also examines some conflicts coming from competition for energy resources, energy dependence and the spillover effects of the emissions on neighboring cities. To quantify how affect changes in carbon dioxide emissions, energy production and consumption on the life expectancy, climate change, labor and energy productivities, we used panel data techniques across some metropolitan areas, using IEA annual data.

Following the results obtained for the proposed indicators, the energy consumption per inhabitant and CO<sub>2</sub> emissions by Km<sup>2</sup> are highest around the oil producer countries, like Qatar, Emirates and Kuwait, and also among the High-Tech user countries like China, Japan, South Korea and Singapore. The more high energy productivity is in Japan, Singapore and Turkey. With respect to pollution, only carbon dioxide emissions are addressed in this paper, but it does not address other emissions such as NO<sub>x</sub> or SO<sub>x</sub>. In the other hand we assume, by simplicity, perfect competition in the good markets to can calculate an energy price indicator for the renewable and non-renewable energies in each city.

The paper relates issues to central questions of international politics and theoretical debates concerning to the levels of consumption per head, carbon dioxide emissions/surface and the role of the renewable energies on the climate change and the wellbeing of the consumers. We classifying the cities in Oil producers, Coal producers, High-Tech users, and Poor cities, and by assuming perfect rationality in the energy producers we calculate the costs for change the use of fossil energies by renewable energies.

**Keywords:** Emissions, Renewable Energy, Cities, Economic Conflicts, Political Conflicts.

**JEL Class:** Q01, Q42, Q47, Q53.

## **1. Introduction**

The environment is an area of complex study where physical, chemical, biological, cultural and social factors are involved and related, and where the hand of man is omnipresent. The environment becomes part of a globalized world. The involvement of every continent, country, city, or village is important for managing and channeling energy resources, and use of them must be made in the most optimal way possible. Much has been done and written about the use of energy resources produced in each location: how to get them, exploit them, treat them, use them, recycle and manage waste. But when a man hits on the environment, the environment, in turn, impacts on man by air pollutants, water and earth, causing sometimes illness and even deaths. Technology is an important factor to obtain a better management of energy resources. Increased technology is usually associated with less pollution, and the application of technology can solve some environmental problems associated with technological development. The problem associated with the global overpopulation is a factor to consider in terms of environment and waste aggression.

We will focus on the air pollution and its impact on cities and megacities in terms of pollution, health, potential border disputes; and possible solutions.

## **2. Effects of the air pollution**

Air pollution has negative influences in the environment and in humans. Increasing the carbon dioxide concentration in the atmosphere (CO<sub>2</sub>), because of different combustion processes of different materials, means that there is a greater absorption of infrared radiation escapes off the earth, which causes an increase in the atmosphere temperature and also in the Earth's temperature, causing the ice caps to melt and also a greenhouse effect. Acid rain, destruction of the ozone layer and smog are problems associated with air pollution. But it is at the local level where pollution control is important, especially with regard to people. It is important to know the standard values of air quality. Dust, fiber, soot, fumes, mist, fog, haze and smog (the union of both the smoke haze and photochemical due to solar radiation), load the environment so that these particles greater or lesser degree affecting not only the health of individuals, but also the visibility and environmental degradation.

The CO<sub>2</sub> in natural proportions is not harmful, but as mentioned above, as a result of the combustion of fossil fuels, the concentration in the atmosphere is increasing, become a pollutant greenhouse gas. Other pollutants that directly affect health are:

- Carbon monoxide (CO), mainly associated with traffic and the effect on man is the interference of oxygen transport in the blood, causing intoxication and whose symptoms are drowsiness, headache, fatigue, dysfunction in the central nervous system, heart and lung, followed by coma, respiratory failure and ultimately death.
- Sulphur dioxide (SO<sub>2</sub>), associated with the combustion of coal and petroleum products. The effect in man focuses on respiratory and whose symptoms are irritation of nose and throat, runny nose, breathing problems, pulmonary edema and death.
- Nitrogen oxides (NO<sub>x</sub>), associated with the combustion of fossil fuels, with the effect in humans reducing blood oxygen transport to a lesser extent than the CO and inflammation of lung tissue.
- Suspended particles, called aerosols, are particles depending on their size can be inhaled (trapped by mucus) or respirable. It influences the formation of sulfurous smog.
- hydrocarbons (CH<sub>x</sub>), substances that contain only hydrogen and carbon and influences the formation of photochemical smog.
- Lead (Pb), toxic element affecting the hematopoietic, nervous system and kidney.

The union of the concentration of pollutants in the atmosphere, the weather and the topographical conditions are the problem of air pollution, where we must pay attention to the source of the contaminant, to the proper contaminant and to the receptor of pollution when it is dispersed.

All these affects the health of human beings, but also fossil fuels can be a source of conflict between neighboring countries and even between neighboring cities, due to contamination by toxic gas emissions to a less polluted area.

Energy production, energy consumption, the PM10 pollution index, life expectancy, deaths from emissions, CO2 emissions, to clean the environment and the relationship between population and area, are the main indicators to be treated in this paper.

### 3. Indicators

We performed a study on megacities and countries ranging from the poorest to the richest in the world, taking into account the most populous places with small technology to less populated places with highest technology, also considering the area in km<sup>2</sup> of each city and country. The megacities studied are collected in Table 1:

**Table 1. Population of the agglomerations analyzed**

Agglomerations ordered by population	Population 2012 (millions)	Agglomerations ordered by population	Population 2012 (millions)
TOKYO-YOKOHAMA	37.126	TIANJIN	13.266
CHONGQUING	29.101	RIO JANEIRO	12.700
JAKARTA	28.019	LAHORE	12.500
GUANGZHOU	25.800	PARIS	11.940
SHANGHAI	25.700	KOLN-RUHR	11.215
SEOUL	25.600	CHENGDU	11.001
MEXICO	24.178	IZMIR	10.046
DELHI	23.500	NAGOYA	10.027
MUMBAI	22.376	WUHAN	10.020
KARACHI	22.100	HARBIN	9.874
NEW YORK	22.000	CHICAGO	9.800
METRO-MANILA	21.951	KINSHASA	9.518
BEIJING	21.900	LIMA	9.400
SAO PAULO	21.100	CHENNAI	9.182
CAIRO	20.384	BANGALURU	9.044
LOS ANGELES	18.100	BOGOTA	9.009
OSAKA-KOBE	17.550		
MOSKOW	17.000	MILAN	8.014
KOLKATA	15.835	JOHANNESBURG	7.900
DHAKA	15.414	HONG KONG	7.134
SHENZHEN	15.250	MADRID	6.600
LONDON	15.211	SINGAPORE	6.500
BANGKOK	14.566	TORONTO	5.900
BUENOS AIRES	14.300	SYDNEY	4.700
ISTANBUL	13.855	FRANKFURT	4.323
TEHRAN	13.500	AMSTERDAM-ROTT	3.004
LAGOS	13.400	ZURICH	1.470

Source: United Nations-Habitat and Price Waterhouse Cooper.

Bangalore (India), Bangkok (Thailand), Beijing (China), Bogota (Colombia), Buenos Aires (Argentina), Cairo (Egypt), Chengdu (China), Chennai (India), Chicago (USA),

Chongqing (China) , Dhaka (Bangladesh), Delhi (India), Guangzho (China), Harbin (China), Istanbul (Turkey), Izmir (Turkey), Jakarta (Indonesia), Karachi (Pakistan), Calcutta (India), Kinshasa (Democratic Republic of the Congo), KolnRuhr (Germany), Lagos (Nigeria), Lahore (Pakistan), Lima (Peru), London (UK), Los Angeles (USA), Manila (Philippines), Mexico City (Mexico), Moscow (Russian Federation ), Mumbai (India), Nagoya (Japan), New York (USA), Osaka (Japan), Paris (France), Rio de Janeiro (Brazil), Sao Paulo (Brazil), Seoul (South Korea), Shanghai (China), Shenzhen (China), Tehran (Iran), Tianjin (China), Tokyo (Japan) and Wuhan (China).

Besides the countries which contains mega-cities, other countries that have been analyzed in this paper are: Saudi Arabia, Azerbaijan, Bahrain, Belgium, Brunei Darussalam, Canada, United Arab Emirates, Finland, Iceland, Kazakhstan, Kuwait, Luxembourg, Malaysia, Norway, Oman, Qatar, Singapore, Turkmenistan and Uzbekistan.

The indicators used in this paper for estimating the effects of pollution on health are those indicated below:

- POP / S: population density, is the ratio between the population and the urban area or country:

- A high value indicates a higher concentration of inhabitants per km<sup>2</sup>, which leads to a mass per unit area and greater possibility of contamination per capita, especially in less developed or emerging countries, because they could use more dirty energy for consumption. Turn to be more exposed to contamination risk to health is higher, and increased risk of mortality.

- In fossil fuel producing countries, a high value indicates that although there is high technology, the level of contamination is high. The processes of production and distribution are the major cause of environmental emissions, followed by the transport and the use of energy industries, businesses, institutions and homes.

- In developed countries, a high value indicates a high technology and low emissions, as there are no industries that require combustion of fossil fuels. The crowds here are

usually temporary, the most important being the risk of CO2 emissions due to traffic.

Below, in Table 2 are listed some megacities with a population density are high:

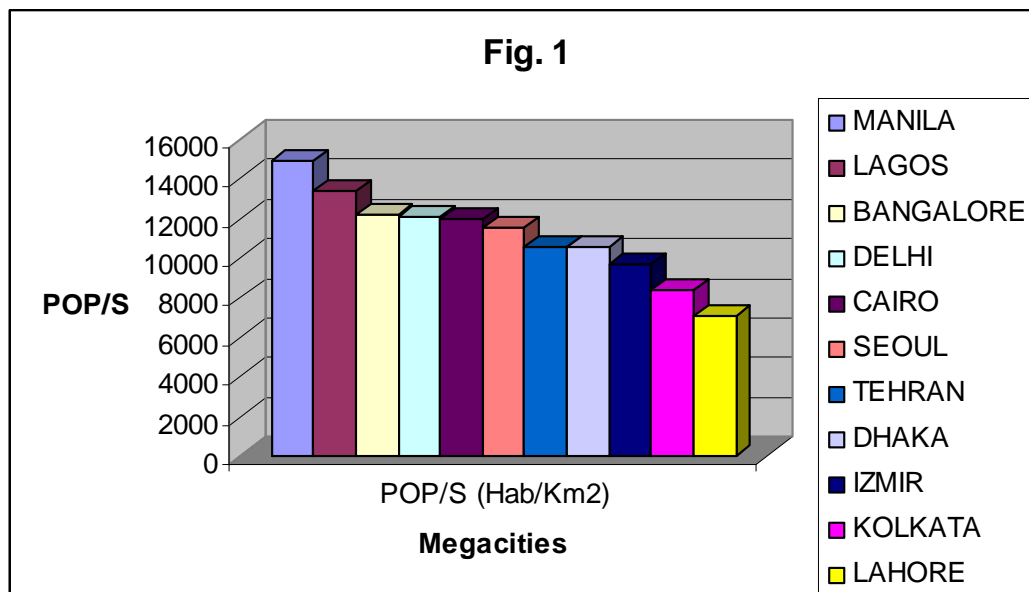
**Table 2. Megacities with high population density**

CITY	POP/S (Hab/Km <sup>2</sup> )
MANILA	14882,03
LAGOS	13400,00
BANGALORE	12205,13
DELHI	12094,70
CAIRO	11927,44
SEOUL	11541,93
TEHRAN	10596,54
DHAKA	10535,88
IZMIR	9706,28
KOLKATA	8391,62
LAHORE	7054,17
	Very poor Cities
	Lessdeveloped Cities
	Emerging Cities
	Developed Cities
	High Developed Cities

Source: World Bank Data

It is noted that in the case of Manila, Lagos, Delhi, Bangalore, Cairo, Dhaka or Tehran population density is very high, being between megacities and underdeveloped emerging, fulfilling the first case. Seoul's case is peculiar, since there is high level of contamination, and a high concentration of inhabitants per km2. (See Figure 1).

**Figure 1. Megacities with high population density.**



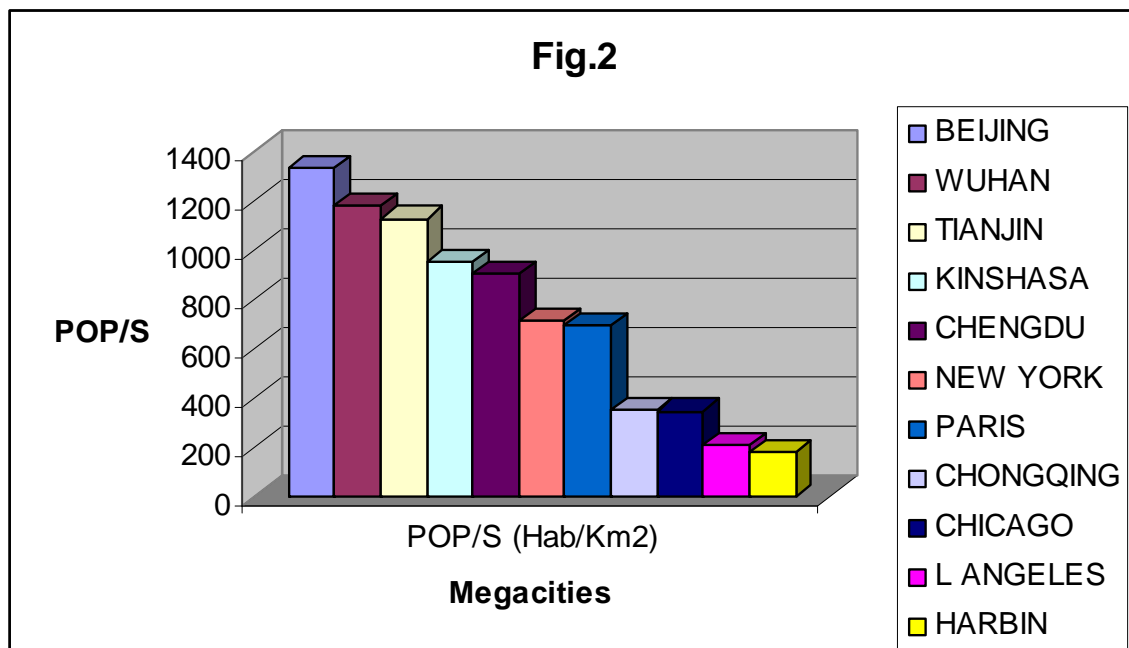
This may be due to the use of other energy sources alternative such as nuclear, which employs about 18% of the total energy produced. Some megacities with a population density are low below in Table 3 and Figure 2:

**Table 3. Megacities with low population density**

CITY	POP/S (Hab/Km <sup>2</sup> )
BEIJING	1334,47
WUHAN	1179,51
TIANJIN	1128,06
KINSHASA	955,14
CHENGDU	906,77
NEW YORK	717,31
PARIS	695,23
CHONGQING	353,15
CHICAGO	348,50
L ANGELES	206,88
HARBIN	185,95
	Very poor Cities
	Lessdeveloped Cities
	Emerging Cities
	Developed Cities
	High Developed Cities

Source: World Bank Data

**Figure 2. Megacities with low population density**





In this case, it appears that less-developed or emerging megacities have a very low population density, because they have a large area, despite having more than 9 million people. This does not indicate that pollutes less, but has much more surface to pollute.

The most developed cities like Los Angeles, Chicago, Paris or New York, have a high tech and less pollution index, mainly due to traffic and some industries outside the urban core. Countries like Bangladesh, South Korea, India, Japan and Bahrain are overcrowded and cover all ranges of development. Conversely if you have a small population countries like Iceland with 3.0 inhabitants per square kilometer, Canada with 3.3 Inh/Km<sup>2</sup>, Oman, Norway, Finland and Brunei, all with a population density of less than 100 Inh/Km<sup>2</sup>

- PM10, particulate matter, are small solid or liquid particles of dust, ashes, soot, metal particles, cement or pollen dispersed in the atmosphere. The PM10 includes values less than 10 microns (micrometers). The daily limit value for the protection of human health is 50 ug/m<sup>3</sup> PM10 not to be exceeded more than 7 times per year and the annual limit value for the protection of human health is 20 ug/m<sup>3</sup>. Megacities of further development are most close to the limit of PM10, which could be interpreted as the safest places for health and are indicated in the following table 4:

**Table 4. No air pollution Megacities**

CITY	PM10
MOSCOW	33
SAO PAULO	38
PARIS	38
B. AIRES	38
NEW YORK	21
L ANGELES	25
LONDON	29
KOLNRUHR	23
TOKYO	23
CHICAGO	22
OSAKA	27
	Very poor Cities
	Lessdeveloped Cities
	Emerging Cities
	Developed Cities
	High Developed Cities

Fuente: World Bank Data

Also for that far exceed the limit of PM10 are less suitable for health and mostly correspond to the less developed and less technology. And the life expectancy will be lower. (See Table 5)

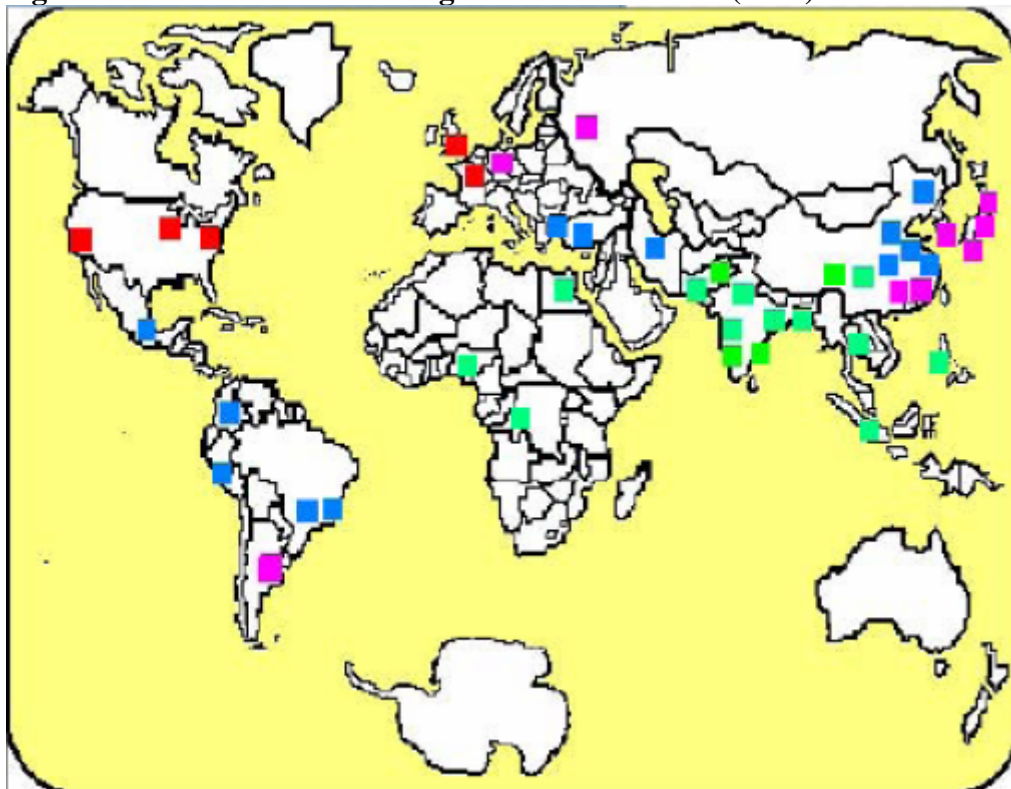
**Table 5. Air pollution Megacities**

CITY	PM10
DHAKA	134
LAGOS	122
CAIRO	138
KARACHI	193
KOLKATA	148
MUMBAI	132
BEIJING	121
DELHI	198
LAHORE	200
CHONGQING	105
CHENGDU	111

	Very poor Cities
	Lessdeveloped Cities
	Emerging Cities
	Developed Cities
	High Developed Cities

**Figure 3. Distribution of the Megacities in the World (2012)**



For countries that have an index close to PM10 are Russia, Brazil, France, Argentina, USA, UK, Germany, Japan, Iceland, Finland, Norway, Belgium, Canada, Luxembourg and Malaysia.

The highest PM10 countries are Pakistan, Bangladesh, Nigeria, Egypt, India, China, Saudi Arabia, UAE and Kuwait, this latter, associated with the production and distribution of fossil fuels.

#### **4. Concluding remarks**

The main conclusions are the following:

##### **1.- On the sources of conflicts:**

- Energy dependence between neighbouring countries or cities.
- CO2 emissions to a neighbouring country or city.
- Neighboring countries with different levels of development.

##### **2.- On the impact of emissions:**

- Impact on health, especially in the respiratory tract and blood oxygen.
- Environmental impact.
- Emissions cause conflicts in neighbouring countries.

##### **3.- On the solutions of conflicts:**

- To reduce CO2 emissions.
- If possible, it is necessary to reduce fossil energy (coal and oil) using a convenient treatment in the production of recycling the gases expelled.
- To augment the use of renewable Energy (non dependence between countries).

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