Future of Urbanization

Nebojsa Nakicenovic
Deputy Director General
International Institute for Applied Systems Analysis
Professor Emeritus of Energy Economics
Vienna University of Technology

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Nakicenovic

Urban Energy Systems

Energizing Sustainable Cities

Chapter 12
Human Settlements, Infrastructure and Spatial Planning

2015 #2
## How Urban is the World AD2000?

<table>
<thead>
<tr>
<th>Indicator</th>
<th>Data Source</th>
<th>Range</th>
<th>References for uncertainty range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Area (1000 km²)</td>
<td>2929</td>
<td>313-3524</td>
<td>Schneider et al., 2009 range of GlobCover-GRUMP data</td>
</tr>
<tr>
<td>% of total</td>
<td>2.2</td>
<td>0.2-2.7</td>
<td></td>
</tr>
<tr>
<td>Population (million)</td>
<td>2855</td>
<td>2650-3150</td>
<td>Uchida &amp; Nelson, 2008 size threshold: 50,000-100,000</td>
</tr>
<tr>
<td>% of total</td>
<td>47</td>
<td>44-52</td>
<td></td>
</tr>
<tr>
<td>GDP (MER 2005$) (billion)</td>
<td>32008</td>
<td>176-246</td>
<td>this assessment</td>
</tr>
<tr>
<td>% of total</td>
<td>81</td>
<td>??</td>
<td>not available</td>
</tr>
<tr>
<td>Final energy use (EJ)</td>
<td>239</td>
<td>176-246</td>
<td>(see Section 18.4.1)</td>
</tr>
<tr>
<td>% of total</td>
<td>76</td>
<td>56-78</td>
<td></td>
</tr>
<tr>
<td>Light luminosity (million NLIS)</td>
<td>33</td>
<td>50-82</td>
<td>KM18 estimate</td>
</tr>
<tr>
<td>% of total</td>
<td>57</td>
<td>50-82</td>
<td></td>
</tr>
<tr>
<td>Internet routers (number in 1000)</td>
<td>592</td>
<td>73-97</td>
<td>KM18 estimate</td>
</tr>
<tr>
<td>% of total</td>
<td>96</td>
<td>73-97</td>
<td></td>
</tr>
</tbody>
</table>

Notes: MER: Market Exchange Rates, NLIS: Light Luminosity Intensity Sum (index)
City Hierarchies (Rank Size)

Source: Gruebler et al, 2012
City Hierarchies (Rank Size)

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City Hierarchies (Rank Size)

<table>
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<th>Rank</th>
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<tr>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>2</td>
<td>100</td>
</tr>
<tr>
<td>3</td>
<td>1000</td>
</tr>
</tbody>
</table>

- Baghdad
- Peking
- Constantinople (AD 1700)

Source: Gruebler et al, 2012
City Hierarchies (Rank Size)

[Graph showing city hierarchies over time, with 'Pekking AD 1800' highlighted.]

Source: Gruebler et al, 2012
City Hierarchies (Rank Size)

Source: Gruebler et al, 2012
City Hierarchies (Rank Size)

Source: Gruebler et al, 2012
City Hierarchies (Rank Size)

Tokyo
AD 2000

Source: Gruebler et al, 2012
City Hierarchies (Rank Size)

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<td>1000</td>
</tr>
<tr>
<td>4</td>
<td>10000</td>
</tr>
<tr>
<td>5</td>
<td>100000</td>
</tr>
<tr>
<td>6</td>
<td>1000000</td>
</tr>
<tr>
<td>7</td>
<td>10000000</td>
</tr>
<tr>
<td>8</td>
<td>100000000</td>
</tr>
</tbody>
</table>

**City Hierarchies**

- **Chinese Sea**
  - Tokyo: AD 2000
  - New York: AD 1950
  - London: AD 1900
  - Peking: AD 1800
  - Constantinople: AD 1700
  - Bagdad: AD 900

**Source:** Gruebler et al, 2012
Evolution of global mobility

- **Walk, horse, bicycle**: Steady decrease in person-km per cap per year from 1850 to 1990.
- **Cars**: Steep increase from 1950 onwards.
- **Bus**: Moderate increase from 1930 to 1990.
- **Rail**: Gradual increase from 1900 to 1990.
- **Air**: Steady increase from 1940 to 1990.
- **Ocean**: Minimal change from 1850 to 1990.

Source: Geerlings et al., 2012
Into 24 Little Hours
Sleep is still the champion. Then there’s work, followed closely by television. Oh, and don’t forget your chores.

Watching TV and Videos
154 minutes

Household Chores
66 minutes

Grocery Shopping
16 minutes

Eating
53 minutes

Reading
43 minutes

In Transit/Commute
61 minutes

Child and Pet Care
25 minutes

Continued on Page C6

Source: NY Times/NPD Group
Urban Transport Modal Split

Legend of colours:
- Cities in Asia and South America
- Cities in USA and Australia
- Cities in Europe

- Reference year 2001
- Average over cities of the cited areas, reference year 1995

Non-motorized mode (walking, cycling)
- USA
- Australia
- China
- Western Europe
- Asia, high income
- Asia, low income

Private motorized mode (car, motorcycle)
- Lebanon
- Lacknau India
- Shanghai 1995
- Sao Paulo
- Graz 2004
- Zurich
- Moscow
- Warsaw
- Singapore

Public transport (transit)
- Delhi 1994
- Hong Kong
- Shanghai 1995
- Sao Paulo
- Graz 2004
- Zurich
- Moscow
- Warsaw
- Singapore

Reference year 2001

Legend of colours:
- Cities in Asia and South America
- Cities in USA and Australia
- Cities in Europe

Nakicenovic GEA, 2012 2015 #15
Urban Metabolism or Ecology

- plant cell
- stored energy, oxygen
- photosynthetic human settlement
- homeostasis, growth
- carbon dioxide, sunlight, water
- solar panels & green space
- mitochondrion power plant
- nucleus administration
- vacuole storage, waste handling & reuse
Final Energy per Capita
annex1

Cumulative population in million

TFC: GJ/capita

Global Energy Assessment
Toward a Sustainable Future

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GEA, 2012

2015 #17
Final Energy per Capita
non-annex1

Cumulative population in million

TFC: GJ / capita

Final Energy per Capita
non-annex1

Cumulative population in million

TFC: GJ / capita
Energy Footprint of Asian Urban Agglomerations

Beijing - Tianjin
18 Million POP
2 EJ FE

Yangtze River Delta
27 Million POP
3 EJ FE

Shinkansen
42 Million POP
3 EJ FE

Pearl River Delta
22 Million POP
2 EJ FE

Renewable energy Hinterland:
100 Million people
Direct final energy 10 EJ
635,000 km² (@ 0.5 W/m²)

Source: Gruebler et al, 2012
Energy Footprint of Asian Urban Agglomerations

Beijing - Tianjin
18 Million POP

Yangtze River Delta
27 Million POP

Shinkansen
42 Million POP

Pearl River Delta
22 Million POP

Renewable energy Hinterland:
100 Million people
Direct final energy: 10 EJ
635,000 km2 (@ 0.5 W/m2)
or Afghanistan
Total (incl. embodied) energy: 40 EJ
2,500,000 km2
or EURO Area

Source: Gruebler et al, 2012
THANK YOU

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Policy Integration at the Urban Scale

- Energy sector only
- Urban density & form only
- Buildings efficiency only
- Integrated policies

- Energy consumption: Sprawl, Efficient buildings, Compact layout, Optimized distributed energy, Minimum
Potential Synergies between New Energy and Transport Infrastructures

Super Cables
Power lines

Source: Y. Yamagata, NIES. 2010
Transformation of Energy Systems

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GEA, 2012

2015 #25
Transformation of Energy Systems

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GEA, 2012
Transformation of Energy Systems and Urbanization

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GEA, 2012

2015 #27