ENVE203
Environmental Engineering Ecology

Environmental Science and Sustainability

Melting iceberg: Water streams from an iceberg

Raven, Hassenzahl and Berg, 2012. Environment

Earth

- Life has existed on Earth for about 3.8 billion years
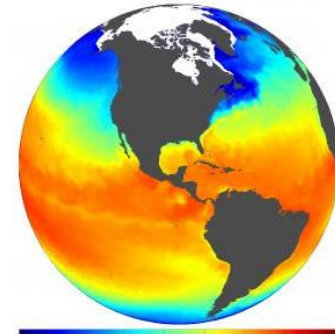- A broad range of biological diversity
- Remarkably suited for life
  - Water
    - Internal composition of organisms
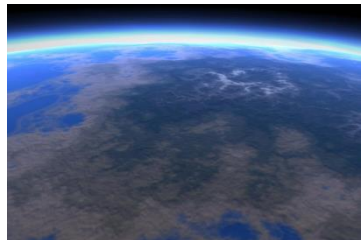   - External environmental factor, ¾ of the planet
  - Temperature
    - Not too hot (Mercury, Venus)
    - Not too cold (Mars and other outer planets)
    - Moderate amount of sunlight, enough to power photosynthesis
  - Atmosphere
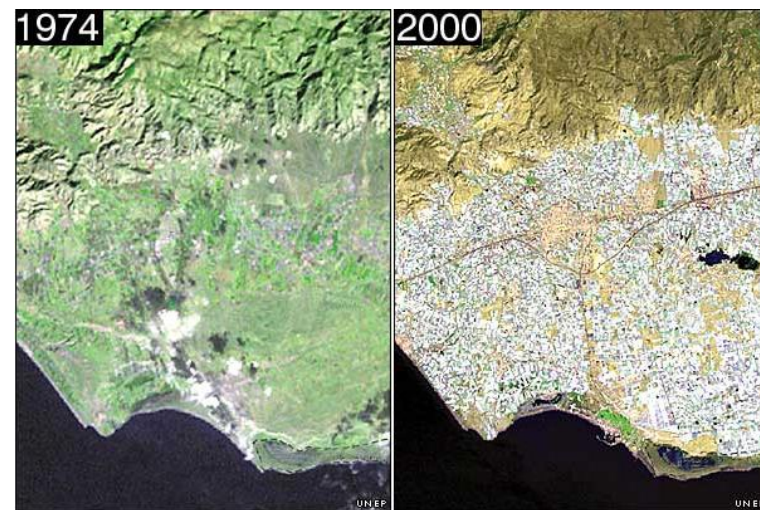   - Bathes the gases & provides essential O_2 and CO_2

Why is Earth Suitable for Life?

http://www.natgeotv.com/ca/webisodes/web-shows/known-universe

Our Changing Environment

- Human species: most significant agent of environmental change
- Increasing
  - population,
  - use of energy, materials, and land

Transform natural systems to meet our needs & desires

Increasing Human Numbers

Most major cities and metropolitan areas in the United States, Mexico, and Canada

North America at night, satellite image

http://www.sciencephoto.com

7 billion is a big number!

http://video.nationalgeographic.com/video/news/7-billion/ngm-7billion?source=relatedvideo

Increasing Human Numbers

1950: only 8 cities with a population > 5 million, the largest NYC, N=12.3 million (source: United Nations)

1960: human population was only 3 billion

1975: 4 billion people

1999: a significant milestone → 6 billion individuals

Increasing Human Numbers

Currently...

- 7 billion people

    - Consume great quantities of food & water
    - Use a great deal of energy and raw materials
    - Produce much waste

Increasing Human Numbers
&
Fossil fuels

If the average person in 1999 used about 30% more fossil fuels than did the average person in 1960, by what percent did total fossil-fuel use increase in those 39 years?

Earth's Shrinking Biosphere

With each new person added to our growing population, the amount of our living space decreases

Land Area hectare per/capita

1900 7.91
1950 5.12
1960 4.29
1970 3.51
1980 2.93
1990 2.47
2000 2.15

ONE PLANET MANY PEOPLE   Atlas of Our Changing Environment

UNEP

Atlas of Our Changing Environment   http://na.unep.net/atlas/onePlanetManyPeople/book.php
United Nations Environment Program (UNEP)

Increasing Human Numbers

Slum in Bombay, India

- Nearly one of every two people live in extreme poverty
  income < $2 per day per capita

- More than 2.5 billion people –about 40% of the total world population- currently live at this level of poverty.
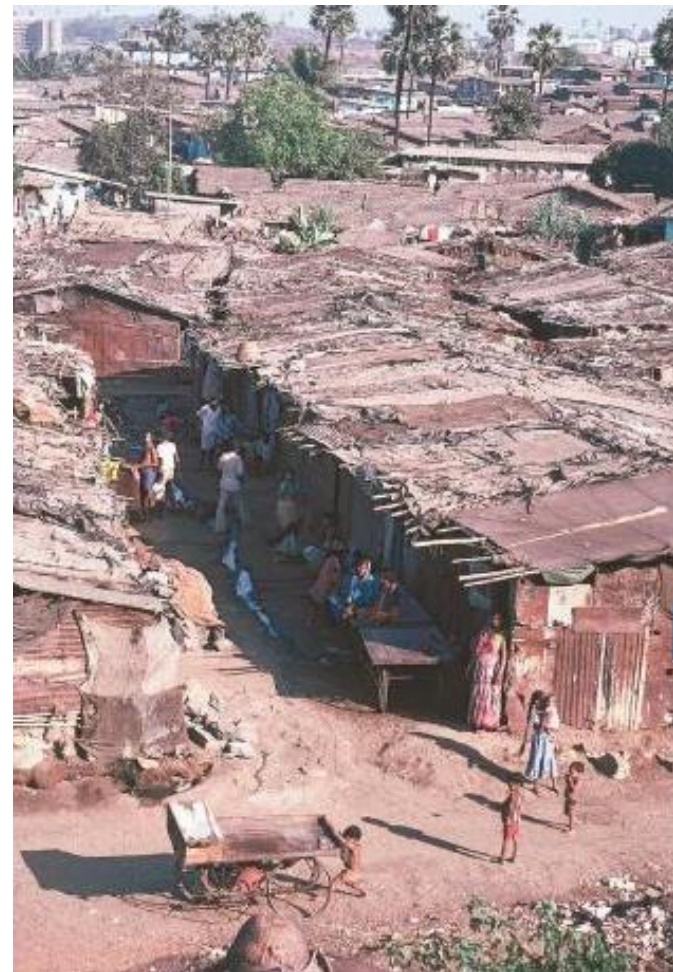
MOST POPULOUS COUNTRIES, 2012 AND 2050

2012

COUNTRY	POPULATION (MILLIONS)
China	1,350
India	1,260
United States	314
Indonesia	241
Brazil	194
Pakistan	180
Nigeria	170
Bangladesh	153
Russia	143
Japan	128

2050

COUNTRY	POPULATION (MILLIONS)
India	1,691
China	1,311
United States	423
Nigeria	402
Pakistan	314
Indonesia	309
Bangladesh	226
Brazil	213
Congo, Dem. Rep.	194
Ethiopia	166

© 2012 Population Reference Bureau

2012 WORLD POPULATION DATA SHEET

MOST POPULOUS COUNTRIES, 2013 AND 2050

2013

COUNTRY	POPULATION (MILLIONS)
China	1,357
India	1,277
United States	316
Indonesia	249
Brazil	196
Pakistan	191
Nigeria	174
Bangladesh	157
Russia	143
Japan	127

2050

COUNTRY	POPULATION (MILLIONS)
India	1,652
China	1,314
Nigeria	440
United States	400
Indonesia	366
Pakistan	363
Brazil	227
Bangladesh	202
Congo, Dem. Rep.	182
Ethiopia	178

POPULATION CLOCK, 2012

		WORLD	MORE DEVELOPED COUNTRIES	LESS DEVELOPED COUNTRIES
Population		7,057,075,000	1,243,018,000	5,814,057,000
Births per	Year	140,541,944	13,923,718	126,618,226
	Day	385,046	38,147	346,899
	Minute	267	26	241
Deaths per	Year	56,238,002	12,191,662	44,046,340
	Day	154,077	33,402	120,675
	Minute	107	23	84
Natural increase per	Year	84,303,942	1,732,056	82,571,886
	Day	230,970	4,745	226,224
	Minute	160	3	157
Infant deaths per	Year	5,779,276	72,128	5,707,148
	Day	15,834	198	15,636
	Minute	11	0	11

2012 WORLD POPULATION DATA SHEET

POPULATION CLOCK, 2013

		WORLD	MORE DEVELOPED COUNTRIES	LESS DEVELOPED COUNTRIES
Population		7,136,796,000	1,245,911,000	5,890,885,000
Births per	Year	142,634,000	13,934,000	128,670,000
	Day	390,778	38,175	352,521
	Minute	271	27	245
Deaths per	Year	55,973,000	12,305,000	43,668,000
	Day	153,351	33,712	119,638
	Minute	106	23	83
Natural increase per	Year	86,661,000	1,629,000	85,002,000
	Day	237,427	4,463	232,882
	Minute	165	3	162
Infant deaths per	Year	5,763,000	70,500	5,693,000
	Day	15,789	193	15,597
	Minute	11	0.1	11

Fertility rate, total (births per woman)

Total fertility rate represents the number of children that would be born to a woman if she were to live to the end of her childbearing years and bear children in accordance with current age-specific fertility rates.

http://data.worldbank.org/indicator/SP.DYN.TFRT.IN

COUNTRIES WITH THE HIGHEST AND LOWEST TOTAL FERTILITY RATES

HIGHEST	TFR	LOWEST	TFR
Niger	7.6	Bosnia-Herzegovina	1.2
Chad	7.0	Taiwan	1.3
Somalia	6.8	Moldova	1.3
Congo, Dem. Rep.	6.3	Poland	1.3
Angola	6.3	Portugal	1.3
Burundi	6.2	Singapore	1.3
Uganda	6.2	South Korea	1.3
Central African Republic	6.2	Spain	1.3
Mali	6.1	Slovakia	1.3
Burkina Faso	6.0	Hungary	1.3

Africa will have the largest population (billions) growth from now to 2050

Population (billions)

Legend: 2013, 2050

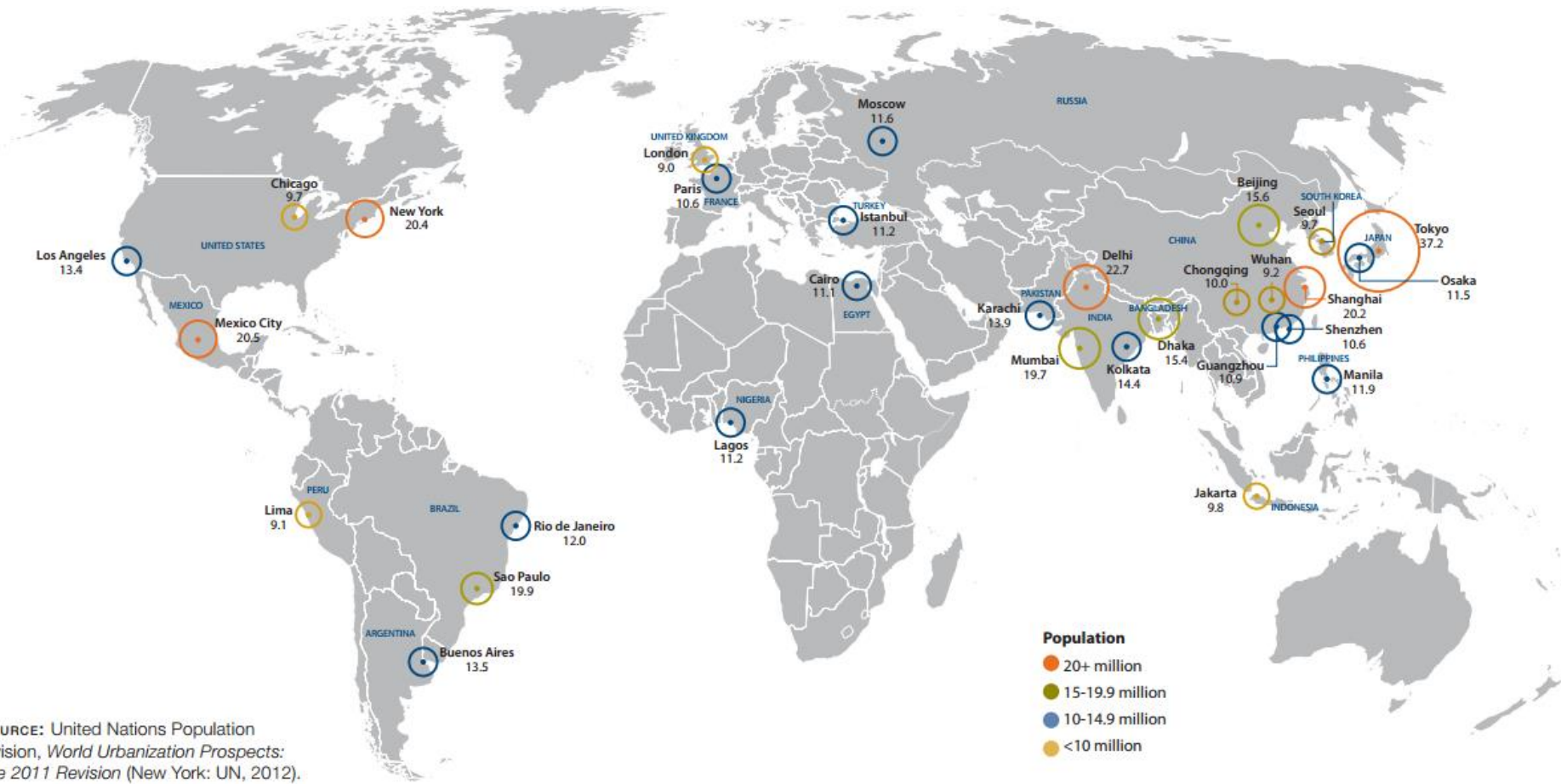| Region	2013	2050
All Africa	1.1	2.4
Sub-Saharan Africa	0.9	2.2
Latin America/Caribbean	0.6	0.8
Asia	4.3	5.3
North America	0.4	0.4
Europe	0.7	0.7
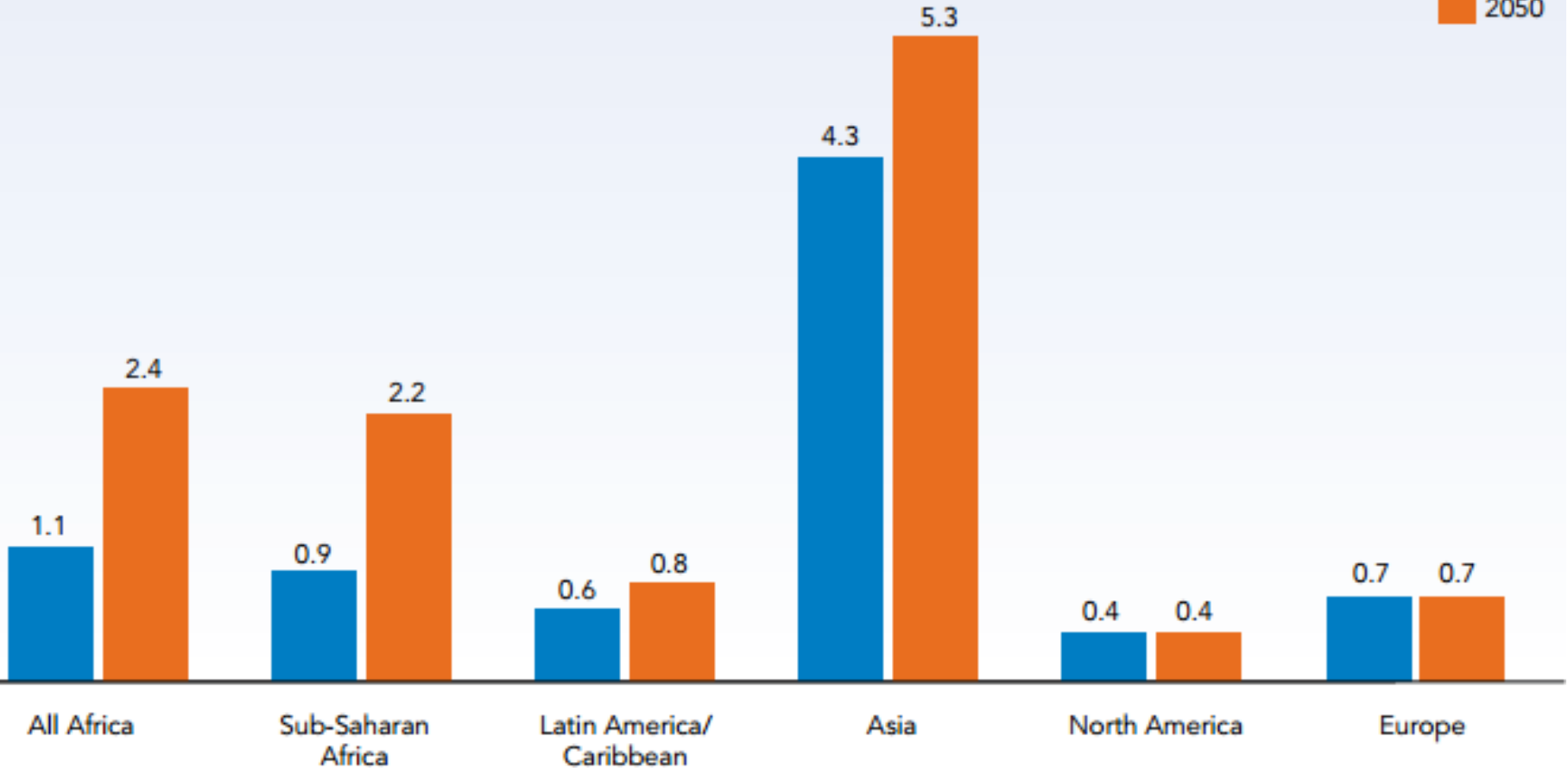
Source: Carl Haub and Toshiko Kaneda, 2013 World Population Data Sheet (Washington, DC: Population Reference Bureau, 2013).

Moscow
11.6

UNITED KINGDOM
London
9.0
Paris
10.6
FRANCE

Chicago
9.7

New York
20.4

Los Angeles
13.4

UNITED STATES

MEXICO

Mexico City
20.5

TURKEY
Istanbul
11.2

Cairo
11.1
EGYPT

Karachi
13.9
PAKISTAN

Delhi
22.7
INDIA

Mumbai
19.7

Kolkata
14.4

BANGLADESH
Dhaka
15.4

Beijing
15.6

SOUTH KOREA
Seoul
9.7
JAPAN

Tokyo
37.2

Osaka
11.5

CHINA

Chongqing
10.0

Wuhan
9.2

Shanghai
20.2

Shenzhen
10.6

Guangzhou
10.9

PHILIPPINES
Manila
11.9

RUSSIA

NIGERIA

Lagos
11.2

Jakarta
9.8
INDONESIA

PERU
Lima
9.1

BRAZIL

Rio de Janeiro
12.0

Sao Paulo
19.9

ARGENTINA

Buenos Aires
13.5

Population

- 20+ million
- 15–19.9 million
- 10–14.9 million
- <10 million

SOURCE: United Nations Population
Division, *World Urbanization Prospects:
The 2011 Revision* (New York: UN, 2012).

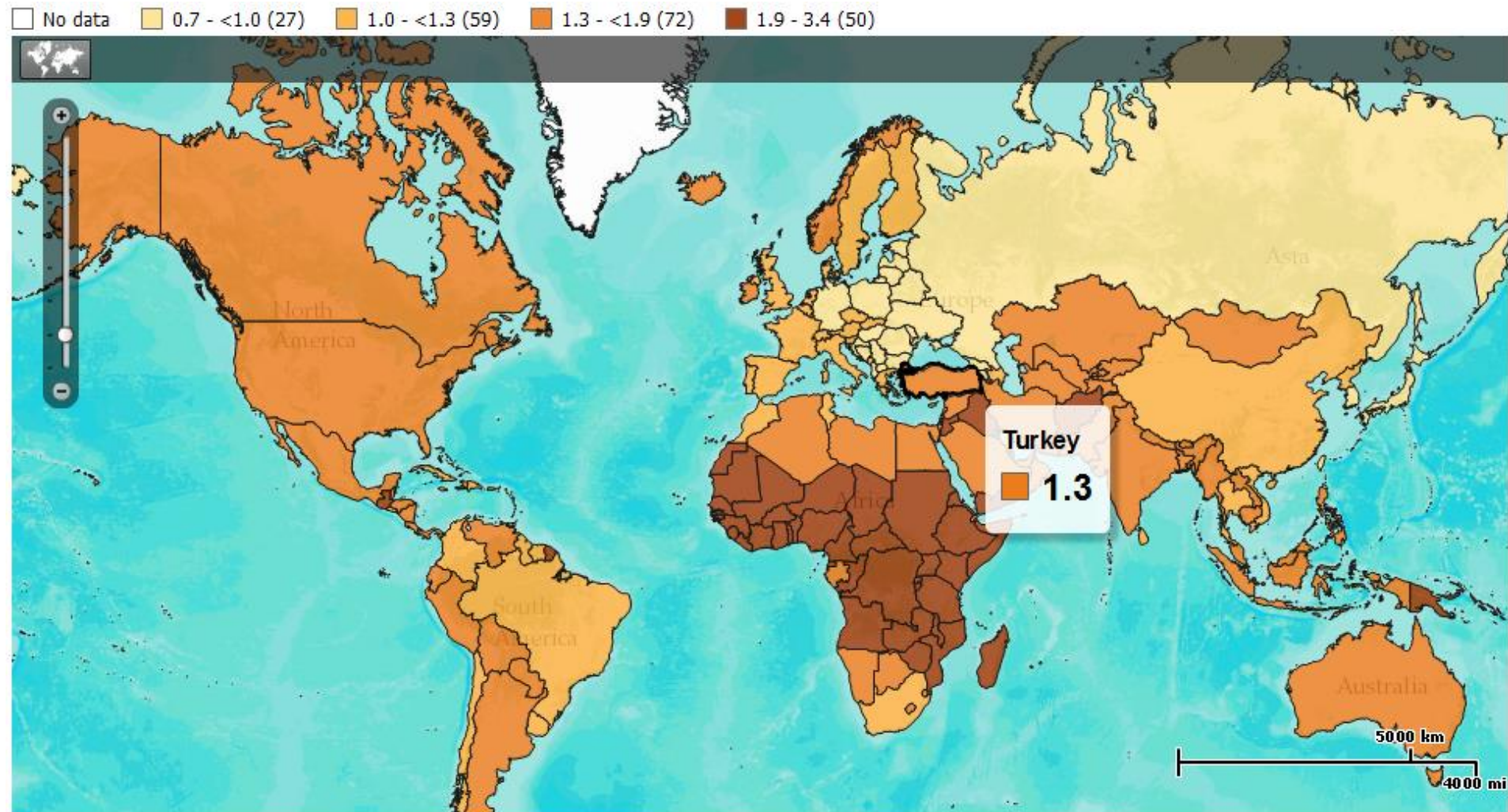○ 2012 Population   ○ 2050 Estimate   ○ Natural Increase   ○ 2050 Population as a Multiple of 2012
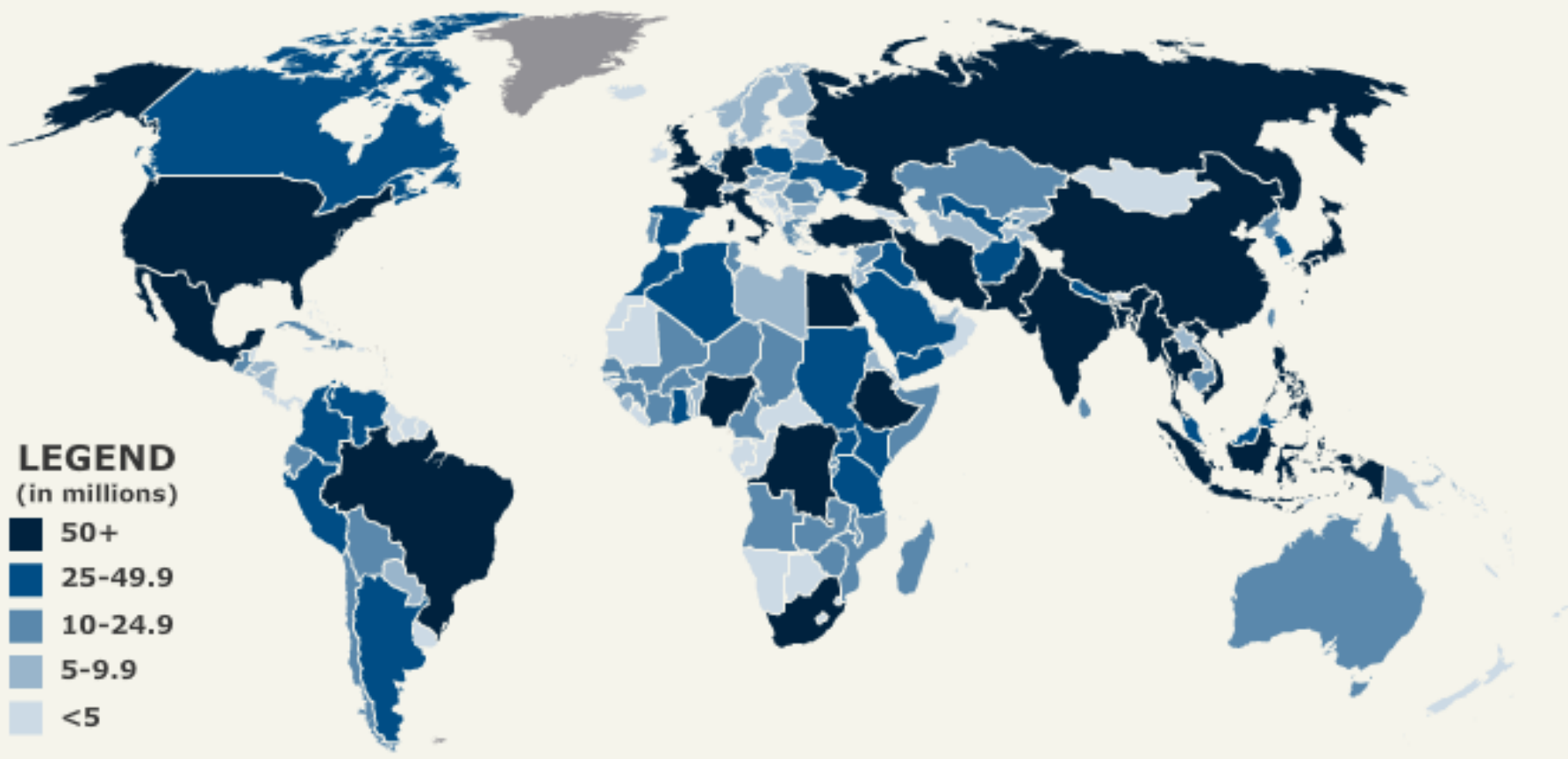
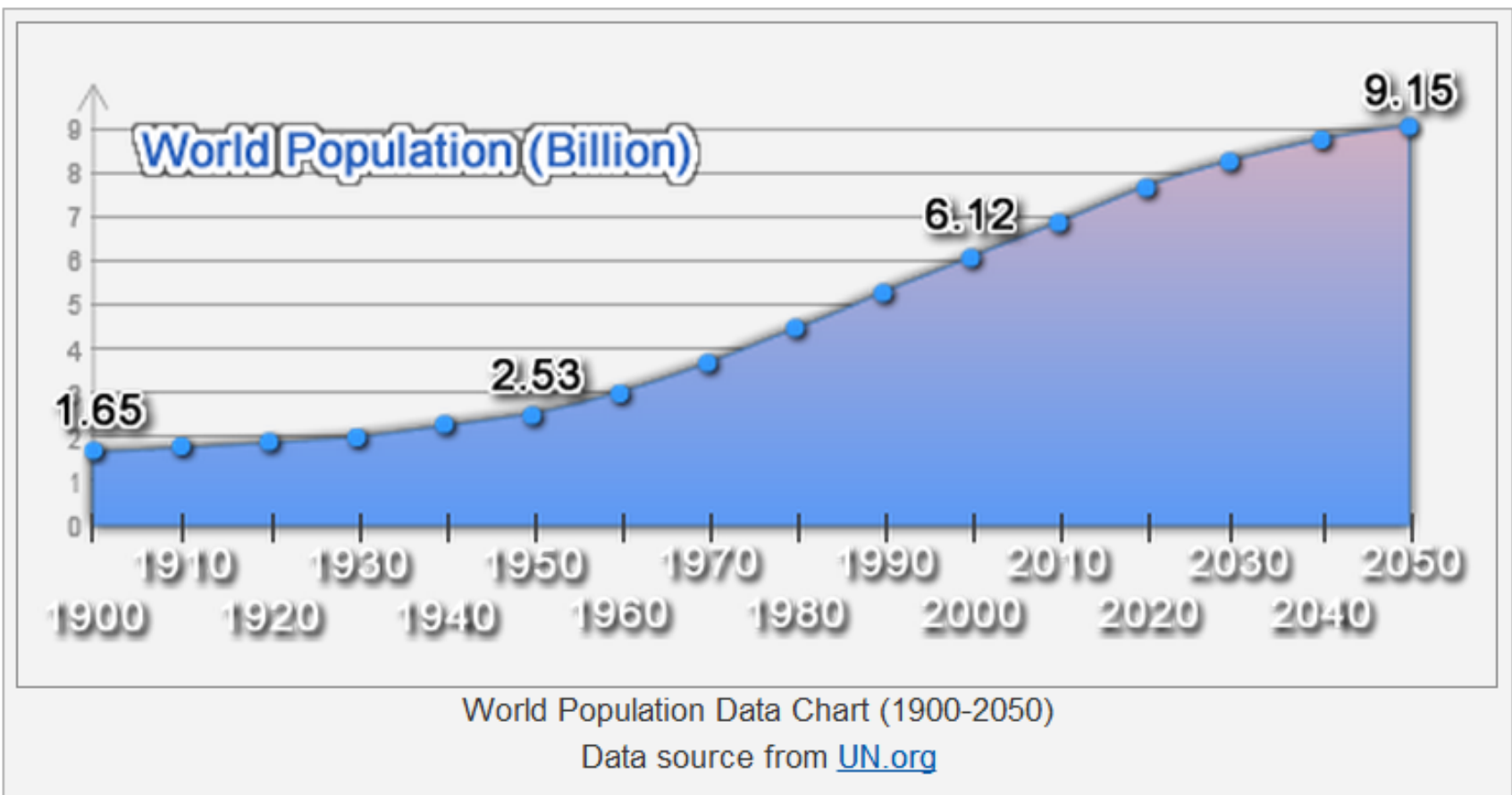**LEGEND**
(in millions)
■ 50+
■ 25–49.9
■ 10–24.9
■ 5–9.9
■ <5

2050 Population as a Multiple of 2011

Legend: No data | 0.7 - <1.0 (27) | 1.0 - <1.3 (59) | 1.3 - <1.9 (72) | 1.9 - 3.4 (50)

Turkey 1.3

http://www.prb.org

Source: PRB 2011 World Population Data Sheet

Population Reference Bureau

Population clock (as of Sep 16, 2012 11:12)

7 040 769 061

To reach 7.1 billion
276 days 04:31:36

World Population (Billion)

9.15

6.12

2.53

1.65

World Population Data Chart (1900-2050)
Data source from UN.org

Population clock (as of Sep 27, 2013 10:30)

http://www.census.gov/popclock/
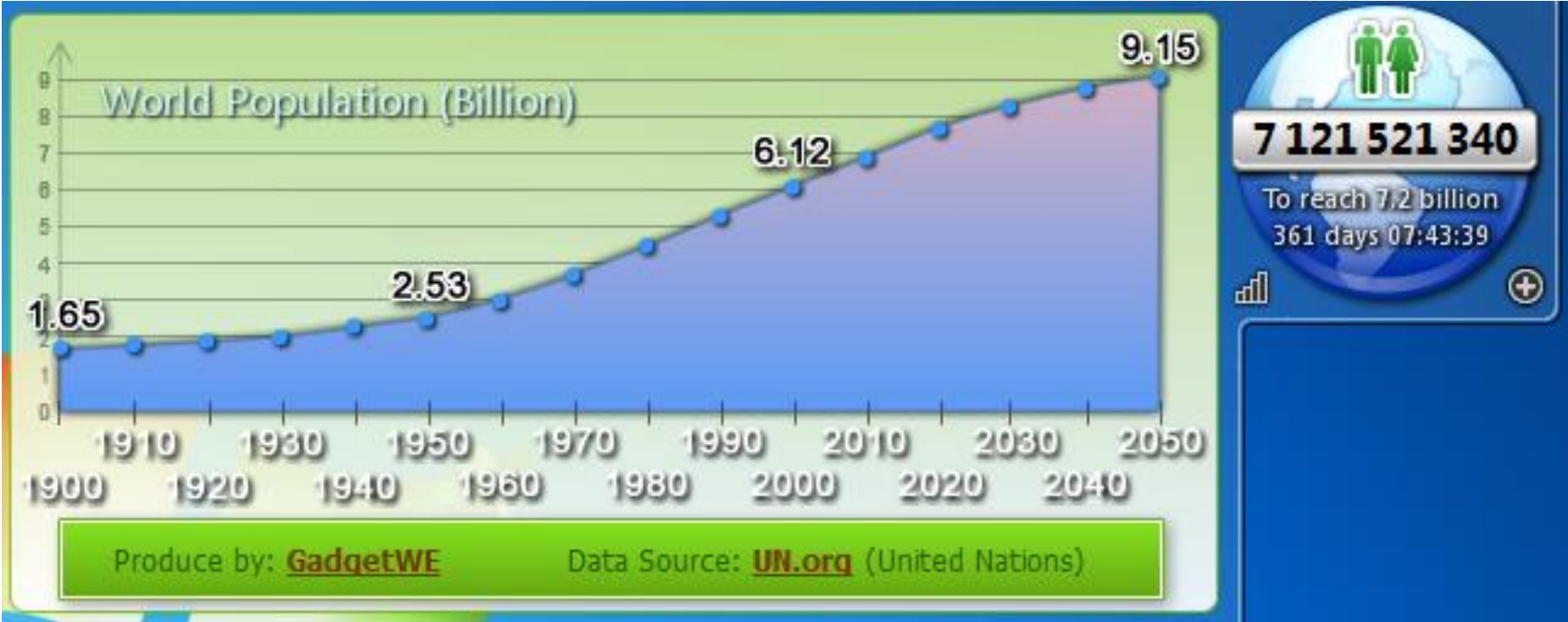
U.S. and World Population Clock

Note: The Population Clock is consistent with 2010 Census data and the most recent national population estimates.

Sep 27, 2013 06:20 UTC (3)

🇺🇸 U.S. Population

3 1 6 , 7 6 6 , 9 3 1

🌐 World Population

7 , 1 1 3 , 9 7 8 , 7 9 9

COMPONENTS OF POPULATION CHANGE

06:20:01 UTC

One birth every **8 seconds**

One death every **12 seconds**

One international migrant (net) every **44 seconds**

Net gain of one person every **12 seconds**
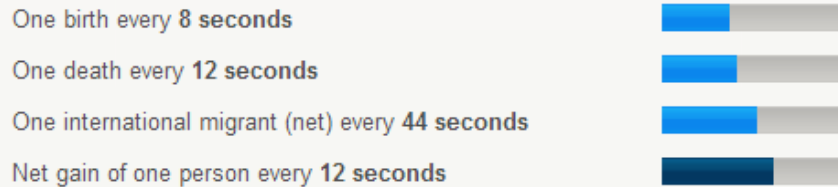
TOP 10 MOST POPULOUS COUNTRIES

1. China	1,349,585,838	6. Pakistan	193,238,868
2. India	1,220,800,359	7. Nigeria	174,507,539
3. United States	316,668,567	8. Bangladesh	163,654,860
4. Indonesia	251,160,124	9. Russia	142,500,482
5. Brazil	201,009,622	10. Japan	127,253,075

POPULATION, HEALTH, AND ENVIRONMENT DATA AND ESTIMATES FOR THE COUNTRIES AND REGIONS OF THE WORLD

	Population mid-2012 (millions)	Births per 1,000 Population	Deaths per 1,000 Population	Rate of Natural Increase %	Net Migration Rate per 1,000	Projected Population (millions)		2050 Population as a Multiple of 2012	Infant Mortality Rate[a]
						mid-2025	mid-2050		
Turkey	74.9	17	5	1.2	0	85.4	93.2	1.2	22

a   Infant deaths per 1,000 live births. Rates shown with decimals indicate national statistics reported as completely registered, while those without are estimates from the sources cited on reverse. Rates shown in italics are based upon fewer than 50 annual infant deaths and, as a result, are subject to considerable yearly variability.

The gap between rich & poor countries

Highly developed countries:
- Countries with complex industrial bases, low rates of population growth, and high per capita incomes

    '*rich countries*'
- US, Canada, Japan, and most of Europe
- 19% of the world's population

The gap between rich & poor countries

Moderately developed countries:
- Developing countries with a medium level of industrialization and average per capita incomes that are lower than those of highly developed countries
- Examples: Mexico, Turkey, South Africa, and Thailand

The gap between rich & poor countries

Less developed countries:
- Developing countries with a low level of industrialization, a high fertility rate, a high infant mortality rate, and a low per capita income
- Cheap, unskilled labor is abundant
- Capital for investment is scarce
- Most are agriculturally based
- Hunger, disease, and illiteracy common
- Examples: Bangladesh, Mali, Ethiopia

China and India?
Mix of moderately and less developed countries

ENVIRONMENTAL ENGINEERING DEPARTMENT
enve.eng.marmara.edu.tr
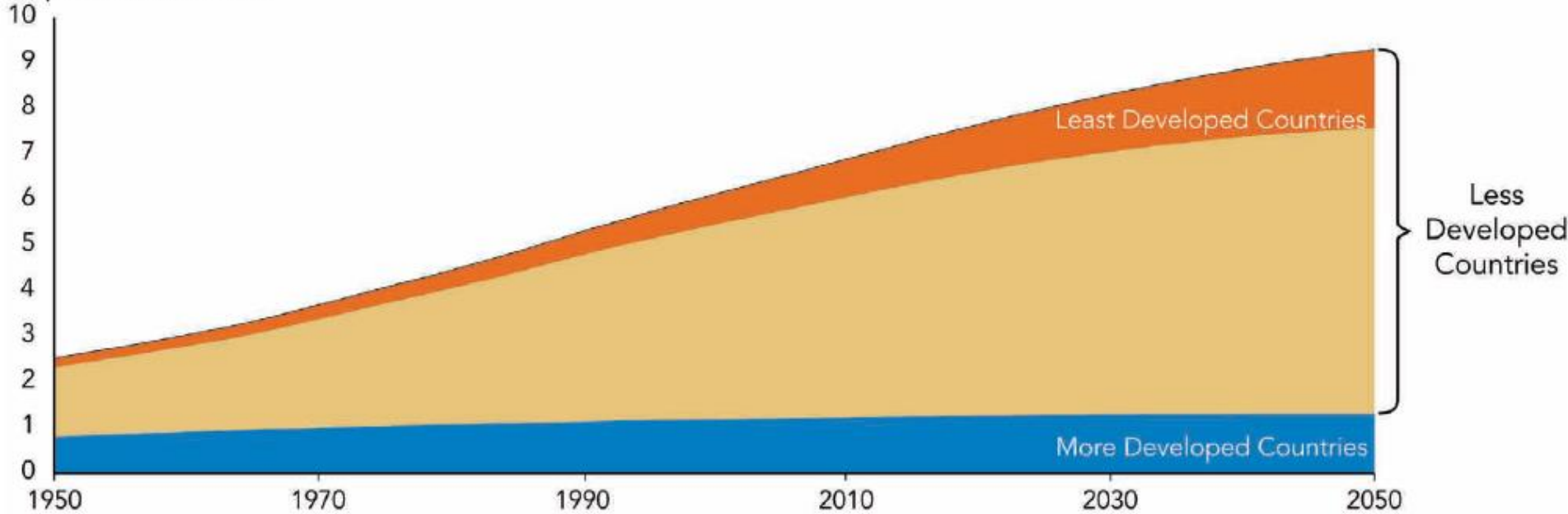
Nearly all future population growth will be in the world's less developed countries

Overpopulated?

http://www.youtube.com/watch?v=-UbmG8gtBPM
Professor Hans Rossling

Population, Resources, and the Environment

(1) Essential resources are small, but a rapidly increasing population (as in developing countries) tends to overwhelm and deplete local soils, forests, and other natural resources

(2) In highly developed countries, individual resource demands are large, far above what is needed for survival.

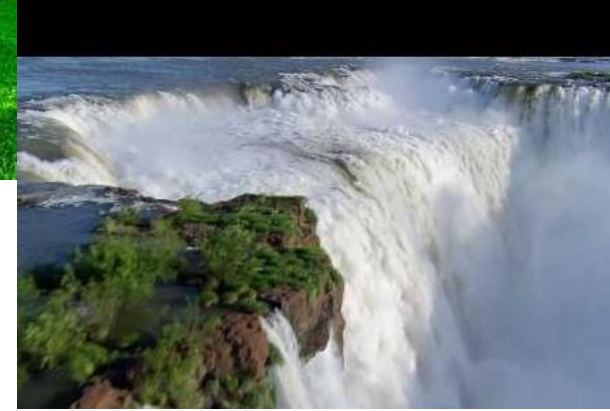# Types of Resources

Two types of natural resources:

       Nonrenewable and Renewable resources

- Nonrenewable resources
    - Present in limited supplies
    - Depleted by use
    - Can not be replenished by natural processes within a reasonable period on the human time scale
    - Minerals (e.g. Al, Cu, Ur) and fossil fuels (coal, oil, and natural gas)

coal

Types of Resources

- Renewable resources
  - Can be replaced by nature fairly rapidly (on a scale of days to centuries)
  - Can be used forever as long as they are not overexploited in short term.
  - Trees, fishes, fertile agricultural soil, and fresh water
  - They are only *potentially* renewable
  - Must be used in a *sustainable* way –in a manner that gives them time to replace or replenish themselves

Natural Resources

Renewable Natural Resources

Direct solar energy

Energy of winds, tides, flowing water

Fertile soil

Clean air

Fresh water

Biological diversity (forests, food crops, fishes)

Nonrenewable Natural Resources

Metallic minerals (gold, tin)

Nonmetallic minerals (salt, phosphates, stone)

Fossil fuels (coal, oil, natural gas)

Why care about water?

http://video.nationalgeographic.com/video/env-freshwater-whycare