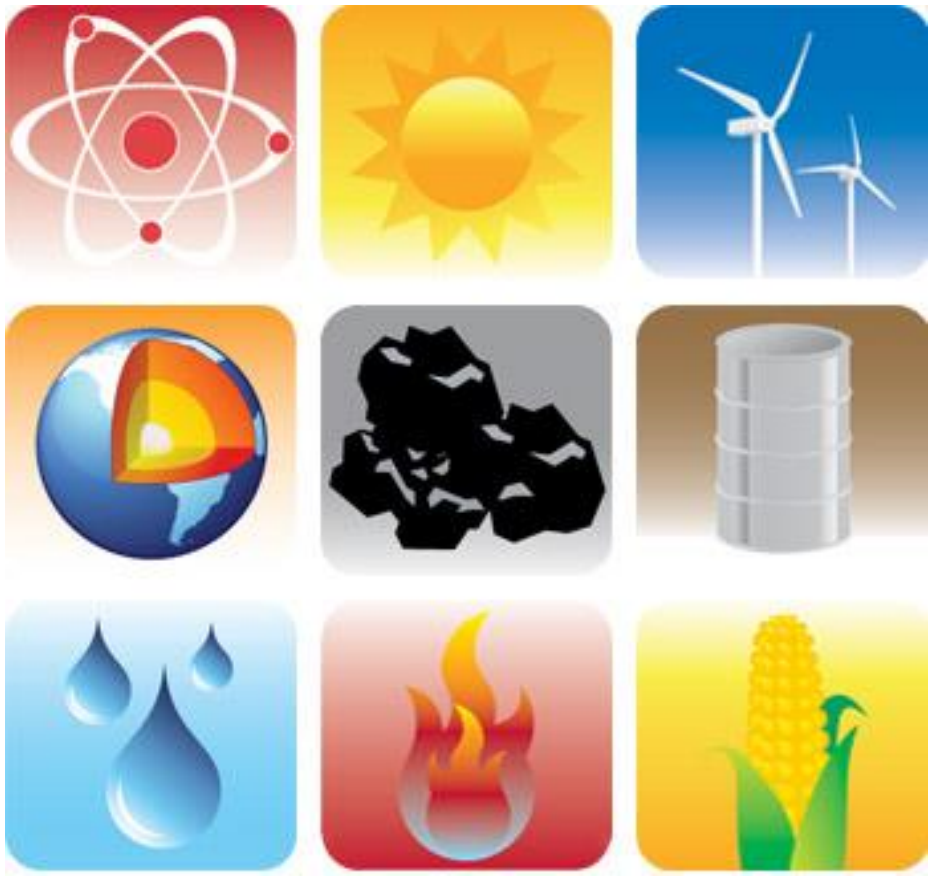


Natural Resources, Energy, Population Growth & Poverty

http://www.ozgurzeydan.com/

Natural Resources

- Previously natural resources are considered as:
  - Fossil fuels (coal, natural gas, oil)
  - Minerals
- Today, below resources are included:
  - Air, water, sunlight, plants and animals

Natural Resources

Natural Resource	Products or Services
Air	Wind energy, tires
Animals	Foods (milk, cheese, steak, bacon) and clothing (wool sweater, silk shirt, leather belt)
Coal	Electricity
Minerals	Coins, wire, steel, aluminum cans, jewelry
Natural Gas	Electricity, heating
Oil	Electricity, fuel for cars and airplanes, plastic
Plants	Wood, paper, cotton clothing, fruits, vegetables
Sunlight	Solar power, photosynthesis
Water	Hydroelectric energy, drinking, cleaning

http://education-portal.com/academy/lesson/what-are-natural-resources-definition-lesson-quiz.html

Water

- 1.7 billion people have gained access to safe drinking water since 1990, but 884 million people are still without.
- 2.6 billion people lack access to basic sanitation services, such as toilets or latrines.
- Each day, an average of 5,000 children die due to preventable water and sanitation-related diseases.
- Hydropower is the most important and widely-used renewable source of energy, representing 19 per cent of total electricity production worldwide.
- Approximately 70 per cent of all available water is used for irrigation.

http://www.un.org/en/sustainablefuture/water.asp

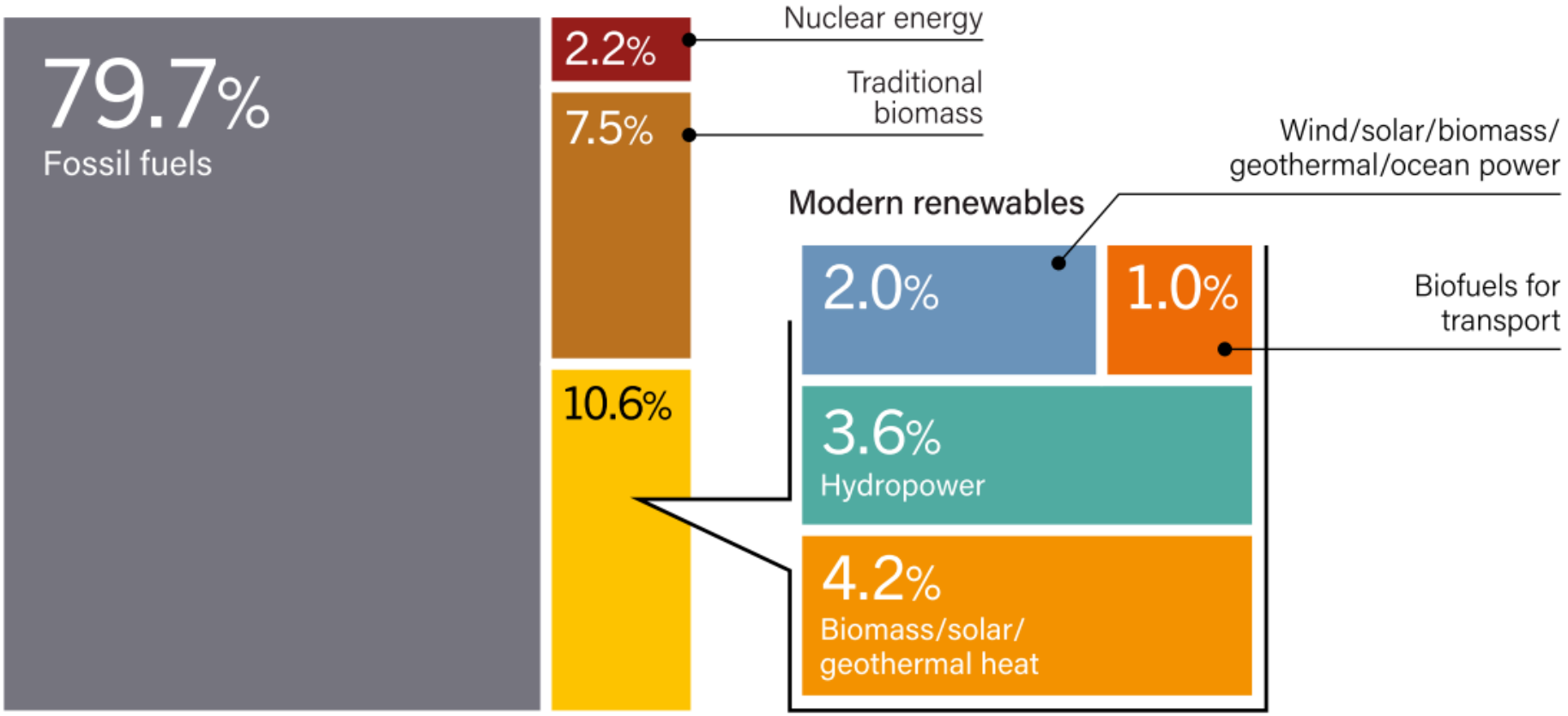
Sustainable Energy

- One in five people still lacks access to modern electricity.
- 3 billion people rely on wood, coal, charcoal or animal waster for cooking and heating.
- Energy is the dominant contributor to climate change, accounting for around 60 per cent of total global greenhouse gas emissions.
- Reducing the carbon intensity of energy is a key objective in long-term climate goals.

http://www.un.org/en/sustainablefuture/energy.asp

RENEWABLES 2019 GLOBAL STATUS REPORT

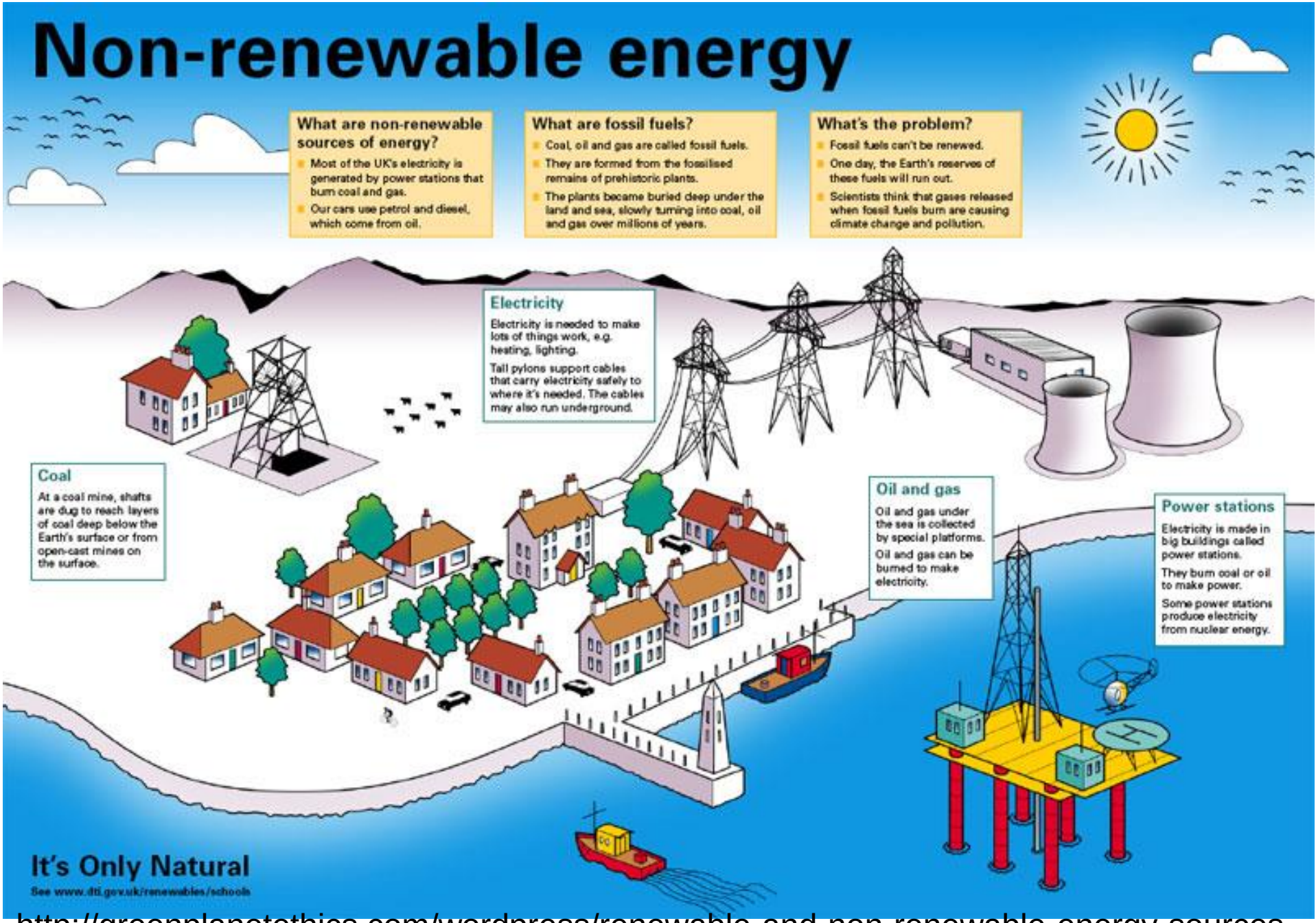
FIGURE 1. Estimated Renewable Share of Total Final Energy Consumption, 2017



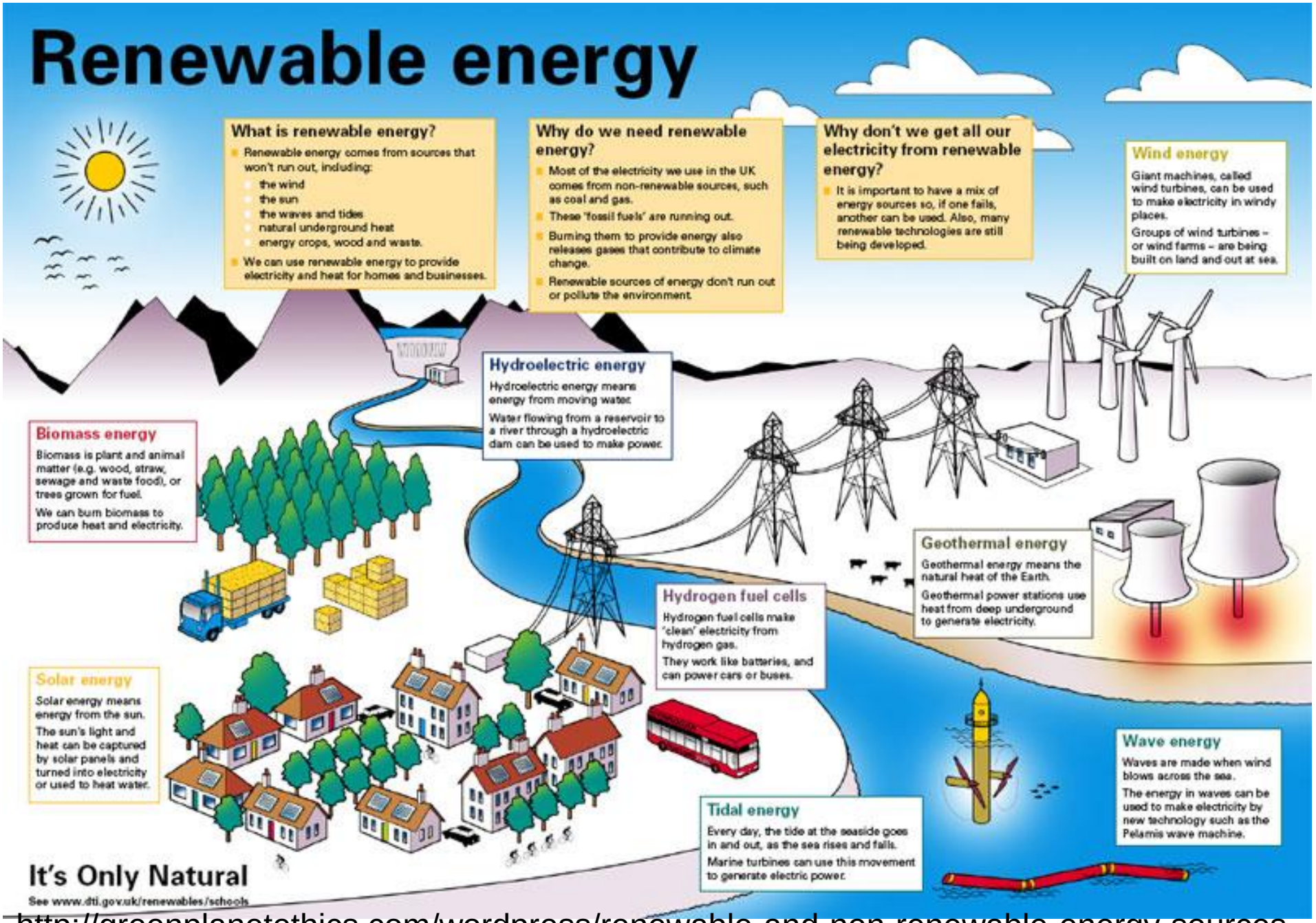
Note: Data should not be compared with previous years because of revisions due to improved or adjusted data or methodology. Totals may not add up due to rounding.

Source: Based on OECD/IEA and IEA SHC. See endnote 54 for this chapter.

Non-renewable energy



http://greenplanetethics.com/wordpress/renewable-and-non-renewable-energy-sources-explained/



http://greenplanetethics.com/wordpress/renewable-and-non-renewable-energy-sources-explained/

Environmental Science & Technology

Reducing Energy Demand: What Are the Practical Limits?

Jonathan M. Cullen, Julian M. Allwood,* and Edward H. Borgstein

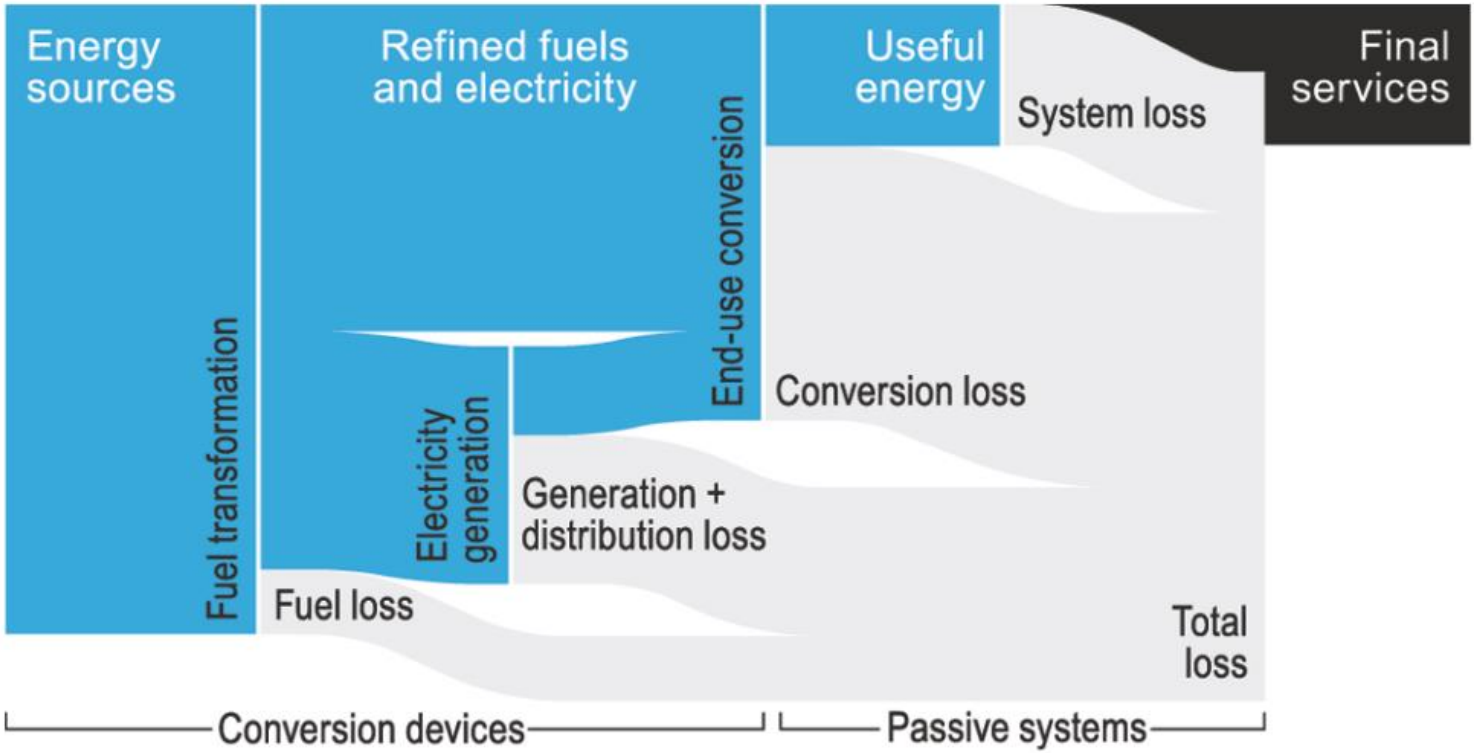


Figure 1. Schematic Sankey diagram for provision of energy and material services showing losses, reproduced with permission from ref 22.

dx.doi.org/10.1021/es102641n Environ. Sci. Technol. 2011, 45, 1711 – 1718

Energy Returned On Energy Invested

$$\text{EROEI} = \frac{\text{ENERGY RETURNED}}{\text{ENERGY INVESTED}}$$

EROEI (for the USA)	Fuel
1.3	Biodiesel
1.3	Ethanol corn
1.6	Solar collector
1.9	Solar flat plate
3.0	Bitumen tar sands
5.0	Ethanol sugarcane
5.0	Shale oil
6.8	Photovoltaic
8.0	Oil discoveries
10.0	Nuclear
14.5	Oil and gas 2005
18.0	Wind
30.0	Oil and gas 1970
35.0	World oil production
80.0	Coal
100.0	Hydro

Dr. Jonathan Tomkin
Introduction to Sustainability Course
The University of Illinois
at Urbana-Champaign

Energy Policy 64 (2014) 141–152

Contents lists available at ScienceDirect

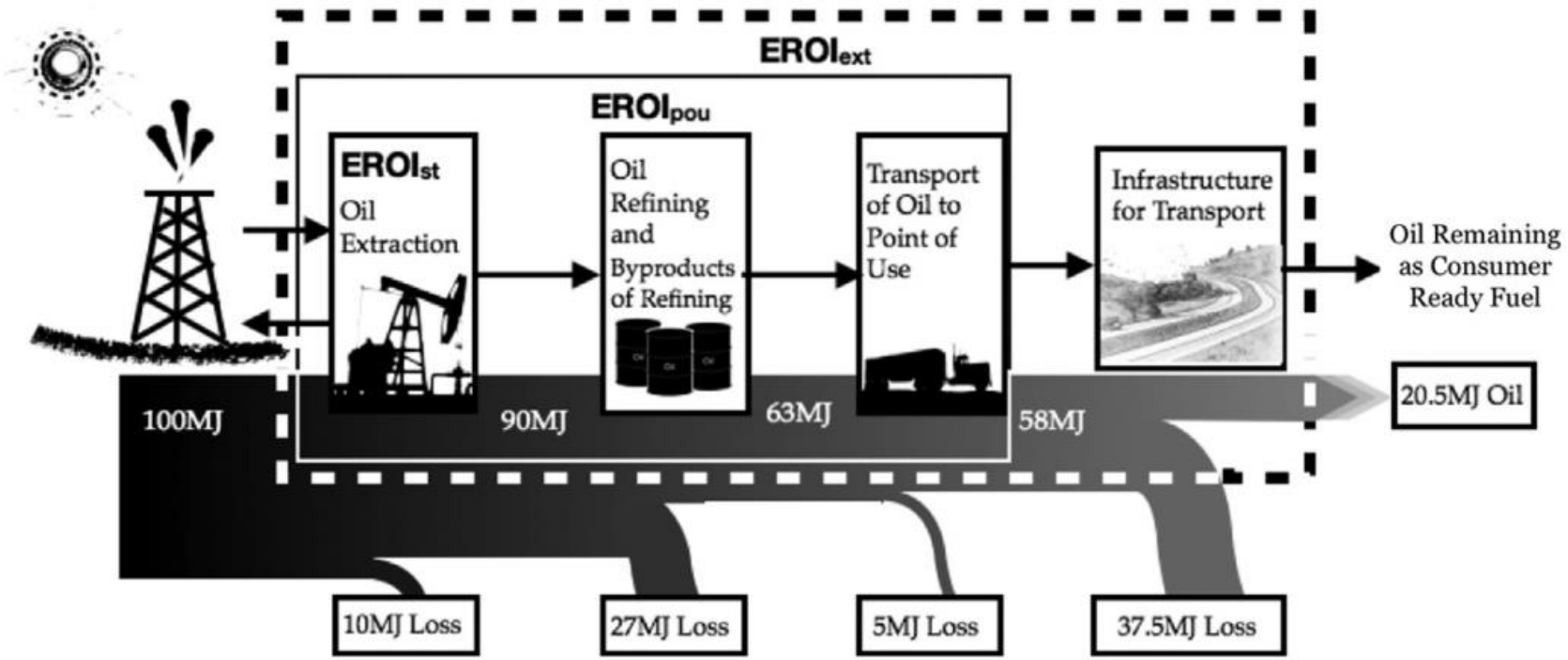
Energy Policy

journal homepage: www.elsevier.com/locate/enpol

EROI of different fuels and the implications for society

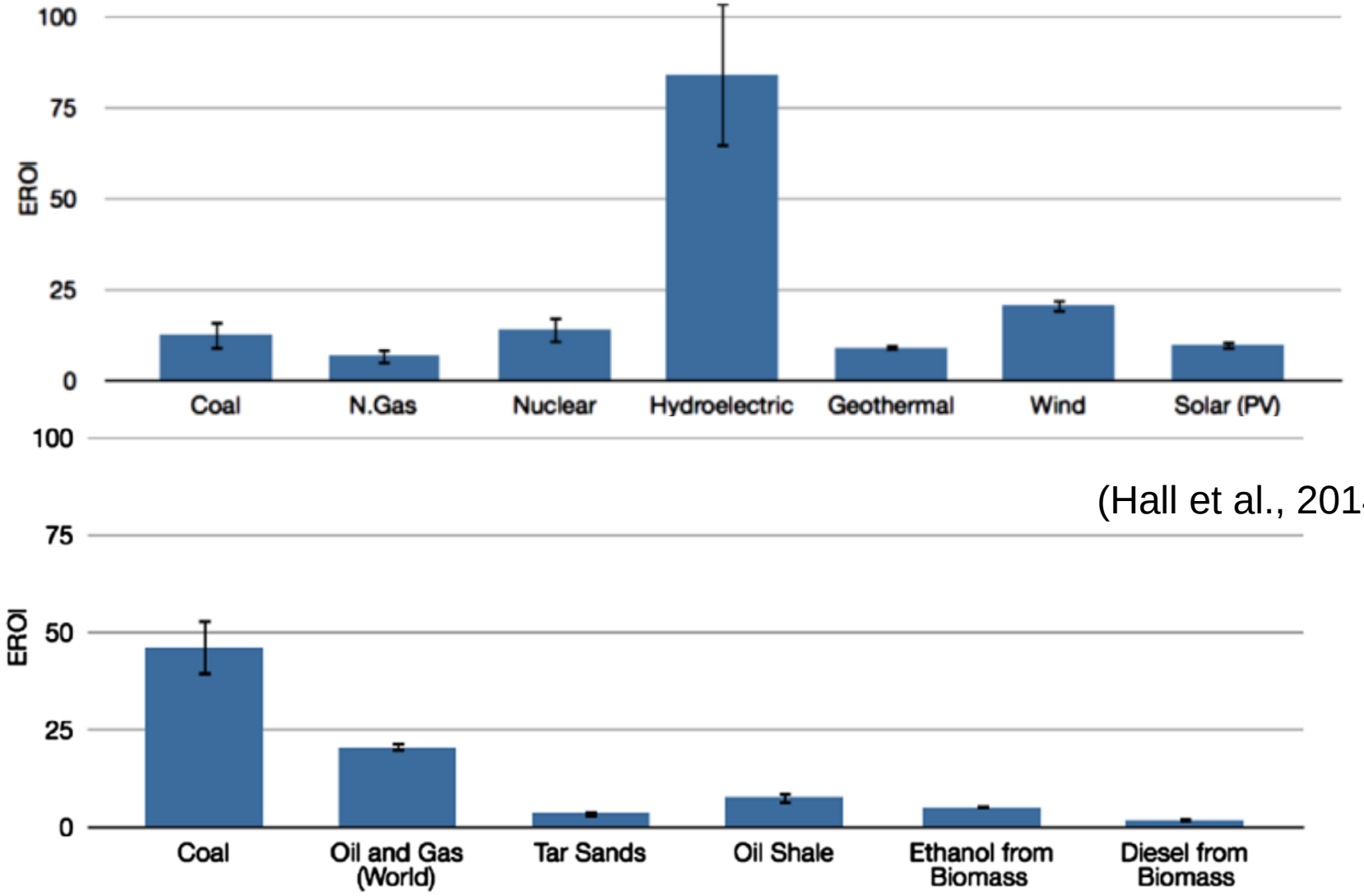
Charles A.S. Hall*, Jessica G. Lambert, Stephen B. Balogh

State University of New York, College of Environmental Science and Forestry, 1 Forestry Dr., Syracuse, NY 13210, USA



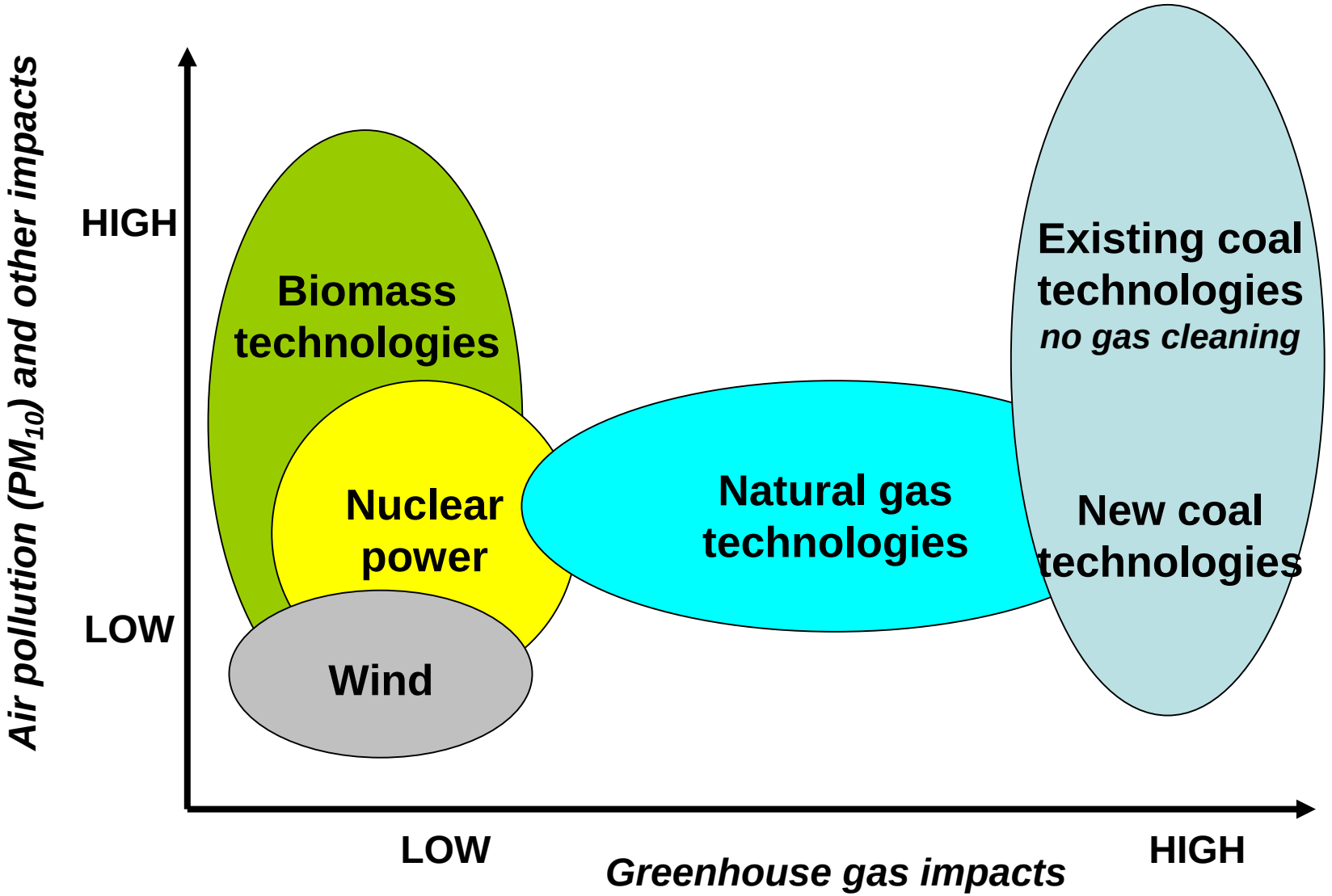
https://doi.org/10.1016/j.enpol.2013.05.049

Mean EROI (and standard error) values for different energy types



(Hall et al., 2014)

Externalities of different electricity generating options



Source: EU-EUR 20198, 2003

Trade-Offs

Coal

Advantages

Ample supplies (225–900 years)

High net energy yield

Low cost

Well-developed technology

Air pollution can be reduced with improved technology

Disadvantages

Severe land disturbance, air pollution, and water pollution

Severe threat to human health when burned

Environmental costs not included in market price

Large government subsidies

High CO_2 emissions when produced and burned

Radioactive particle and toxic mercury emissions

Trade-Offs

Conventional Oil

Advantages

Ample supply for 42–93 years

Low cost

High net energy yield

Easily transported within and between countries

Low land use

Technology is well developed

Efficient distribution system

Disadvantages

Need to find substitutes within 50 years

Large government subsidies

Environmental costs not included in market price

Artificially low price encourages waste and discourages search for alternatives

Pollutes air when produced and burned

Releases CO_2 when burned

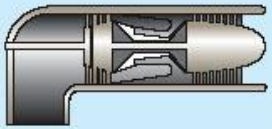
Can cause water pollution

Trade-Offs

Conventional Natural Gas

Advantages

- Ample supplies
- High net energy yield
- Low cost
- Less air pollution than other fossil fuels
- Lower CO_2 emissions than other fossil fuels
- Easily transported by pipeline
- Low land use
- Good fuel for fuel cells, gas turbines, and motor vehicles



Gas turbine

Disadvantages

- Nonrenewable resource
- Releases CO_2 when burned
- Government subsidies
- Environmental costs not included in market price
- Methane (a greenhouse gas) can leak from pipelines
- Difficult to transfer from one country to another
- Can be shipped across ocean only as highly explosive LNG

Trade-Offs

Solar Cells

Advantages

Fairly high net energy yield

Work on cloudy days

Quick installation

Easily expanded or moved

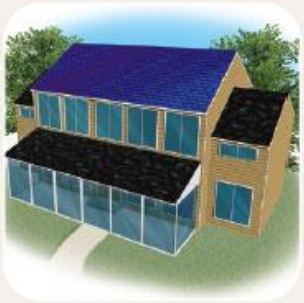
No CO_2 emissions

Low environmental impact

Last 20–40 years

Low land use (if on roof or built into walls or windows)

Reduces dependence on fossil fuels



Disadvantages

Need access to sun

Low efficiency

Need electricity storage system or backup

Environmental costs not included in market price

High costs (but should be competitive in 5–15 years)

High land use (solar-cell power plants) could disrupt desert areas

DC current must be converted to AC

Trade-Offs

Wind Power

Advantages

Moderate to high net energy yield

High efficiency

Moderate capital cost

Low electricity cost (and falling)

Very low environmental impact

No CO_2 emissions

Quick construction

Easily expanded

Can be located at sea

Land below turbines can be used to grow crops or graze livestock

Disadvantages

Steady winds needed

Backup systems needed when winds are low

Plastic components produced from oil

Environmental costs not included in market price

High land use for wind farm

Visual pollution

Noise when located near populated areas

Can kill birds and interfere with flights of migratory birds if not sited properly

Trade-Offs

Large-Scale Hydropower

Advantages

Moderate to high net energy

High efficiency (80%)

Large untapped potential

Low-cost electricity

Long life span

No CO_2 emissions during operation in temperate areas

Can provide flood control below dam

Provides irrigation water

Reservoir useful for fishing and recreation

Disadvantages

High construction costs

High environmental impact from flooding land to form a reservoir

Environmental costs not included in market price

High CH_4 emissions from rapid biomass decay in shallow tropical reservoirs

Danger of collapse

Uproots people

Decreases fish harvest below dam

Decreases flow of natural fertilizer (silt) to land below dam

Trade-Offs

Biodiesel

Advantages

Reduced CO emissions

Reduced CO_2 emissions (78%)

High net energy yield for oil palm crops

Moderate net energy yield for rapeseed crops

Reduced hydrocarbon emissions

Better gas mileage (40%)

Potentially renewable

Disadvantages

Increased NO_x emissions and more smog

Higher cost than regular diesel

Environmental costs not included in market price

Low net energy yield for soybean crops

May compete with growing food on cropland and raise food prices

Loss and degradation of biodiversity from crop plantations

Can make engines hard to start in cold weather

Trade-Offs

Geothermal Energy

Advantages

Very high efficiency

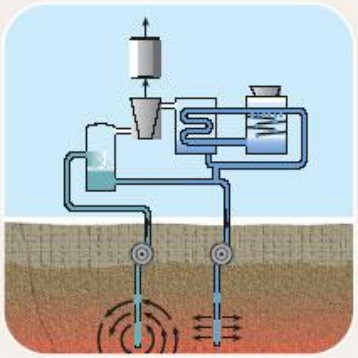
Moderate net energy at accessible sites

Lower CO_2 emissions than fossil fuels

Low cost at favorable sites

Low land use and disturbance

Moderate environmental impact



Disadvantages

Scarcity of suitable sites

Can be depleted if used too rapidly

Environmental costs not included in market price

CO_2 emissions

Moderate to high local air pollution

Noise and odor (H_2S)

High cost except at the most concentrated and accessible sources

Trade-Offs

Hydrogen

Advantages

Can be produced from plentiful water

Low environmental impact

Renewable if produced from renewable energy resources

No CO_2 emissions if produced from water

Good substitute for oil

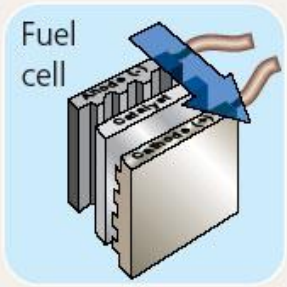
Competitive price if environmental and social costs are included in cost comparisons

Easier to store than electricity

Safer than gasoline and natural gas

Nontoxic

High efficiency (45–65%) in fuel cells



Disadvantages

Not found as H_2 in nature

Energy is needed to produce fuel

Negative net energy

CO_2 emissions if produced from carbon-containing compounds

Environmental costs not included in market price

Nonrenewable if generated by fossil fuels or nuclear power

High costs (that may eventually come down)

Will take 25 to 50 years to phase in

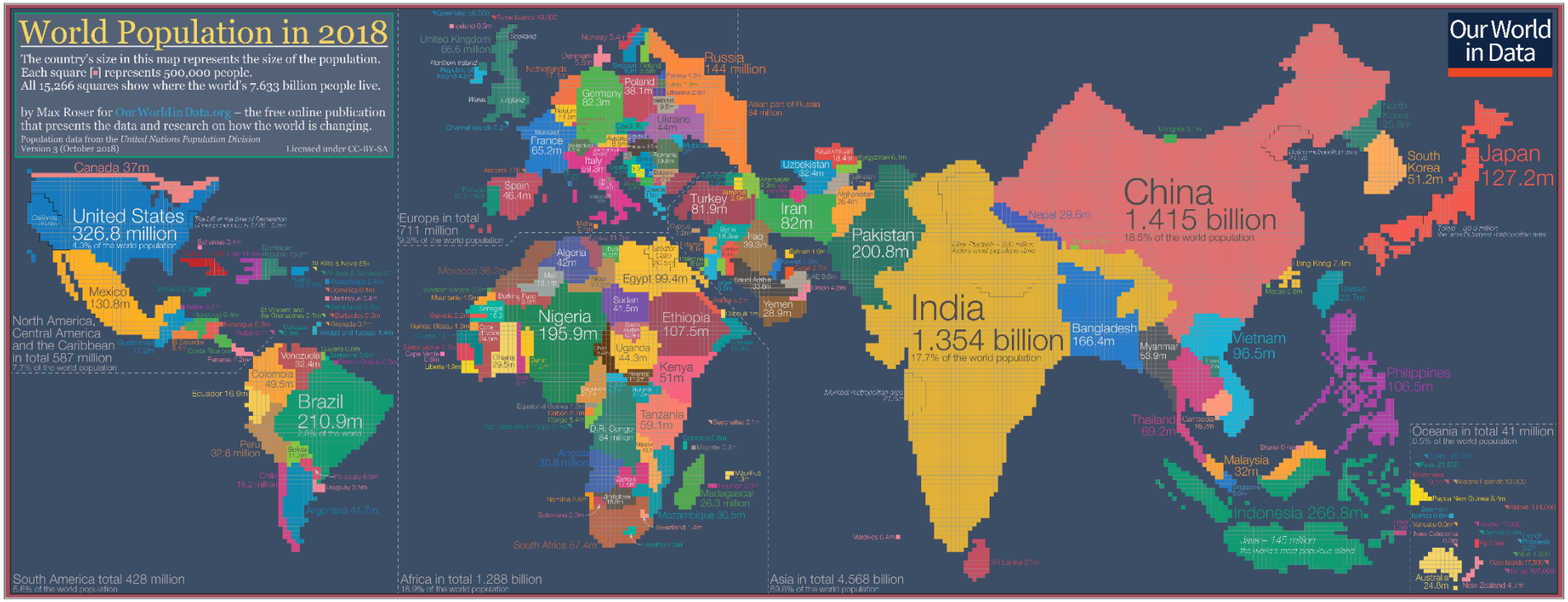
Short driving range for current fuel-cell cars

No fuel distribution system in place

Excessive H_2 leaks may deplete ozone in the atmosphere

Population

- The world's population of 7.7 billion is likely to increase to 9 billion by 2050.
- The demand for diminishing natural resources is growing.
- Income gaps are widening.
- Living in megacities are becoming a problem due to overpopulation.

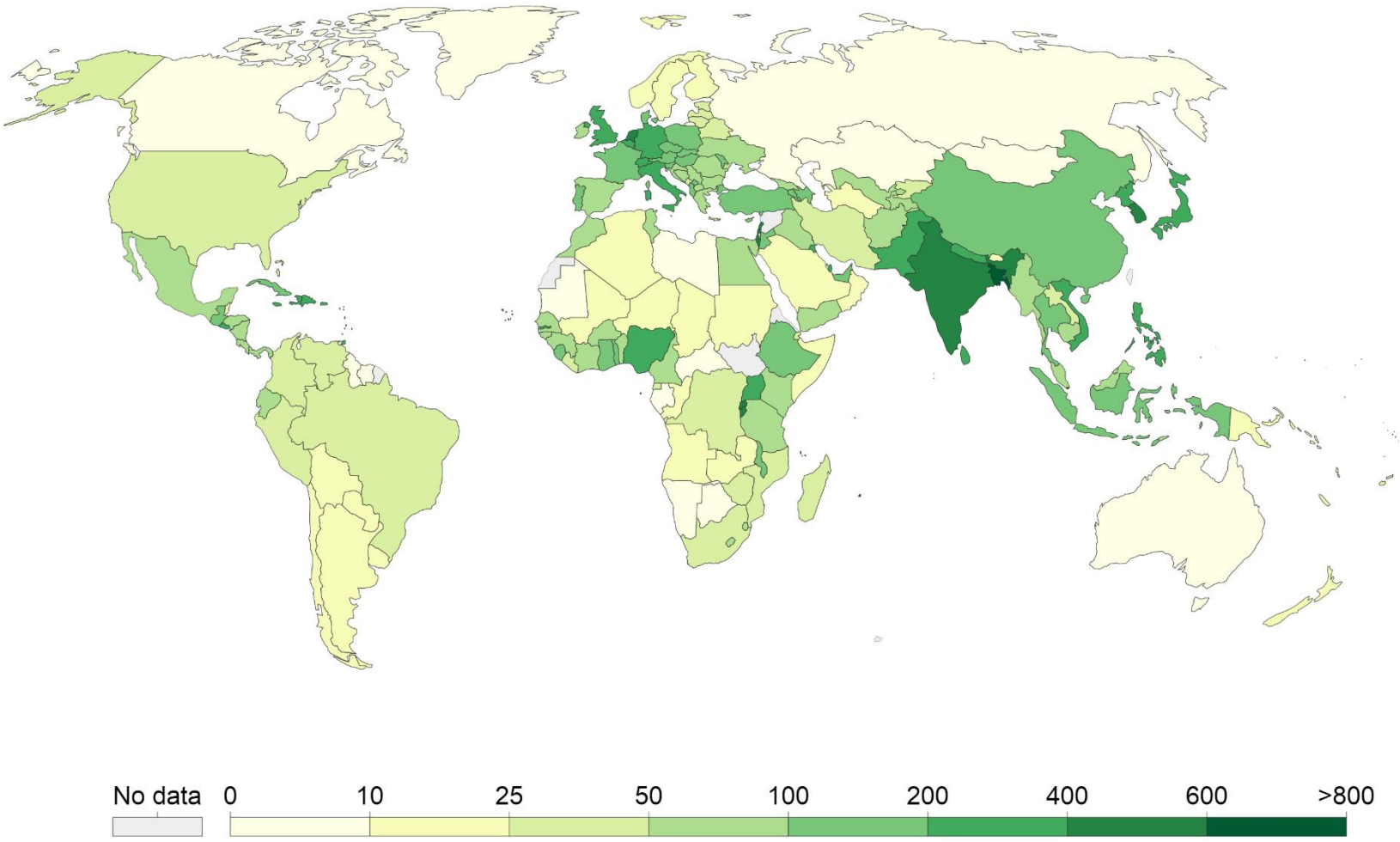


https://ourworldindata.org/uploads/2018/09/Population-cartogram_World-2.png

Population density, 2017

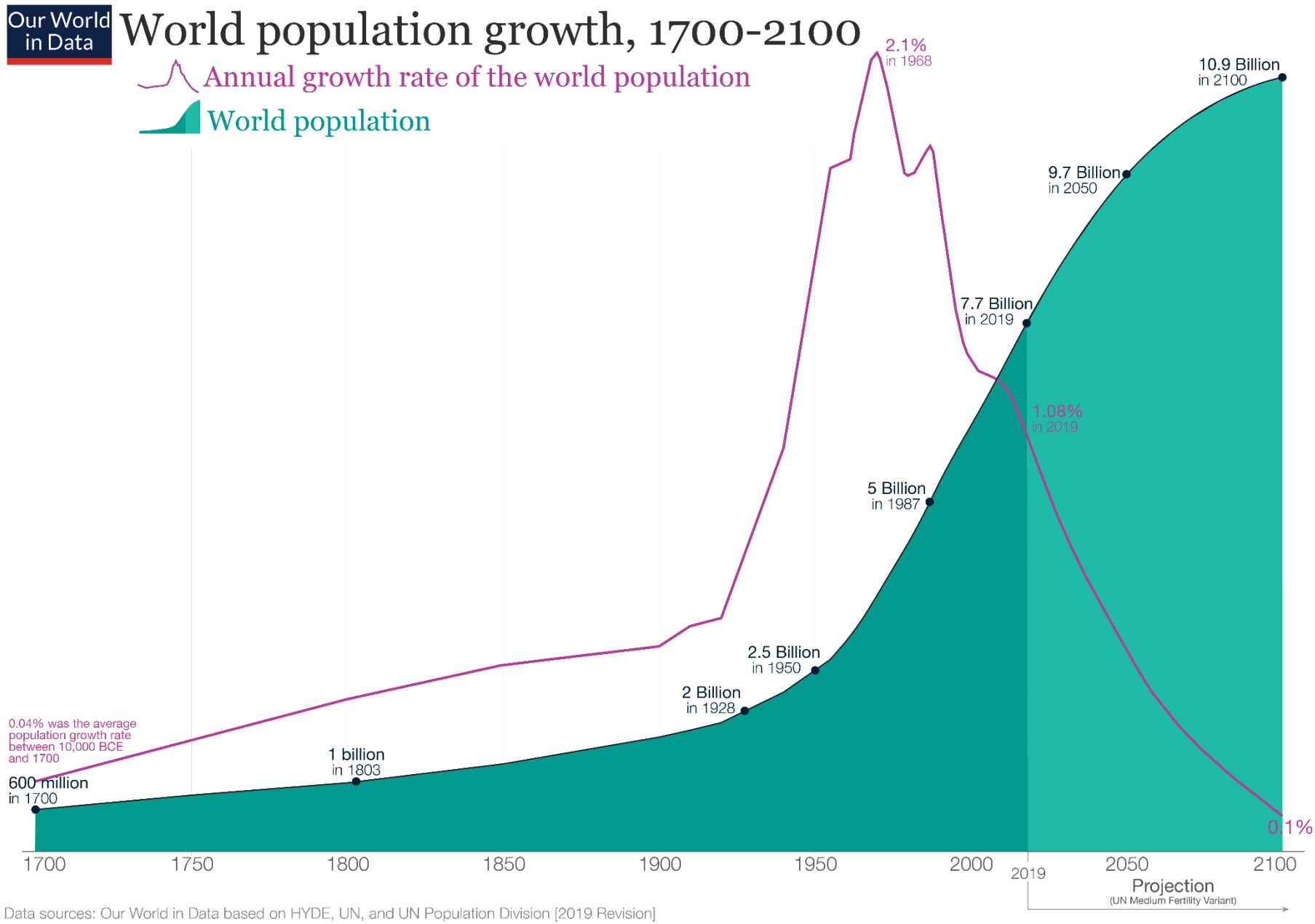
Population density is defined as the number of people divided by land area, measured in square kilometers (km²).

Our World in Data



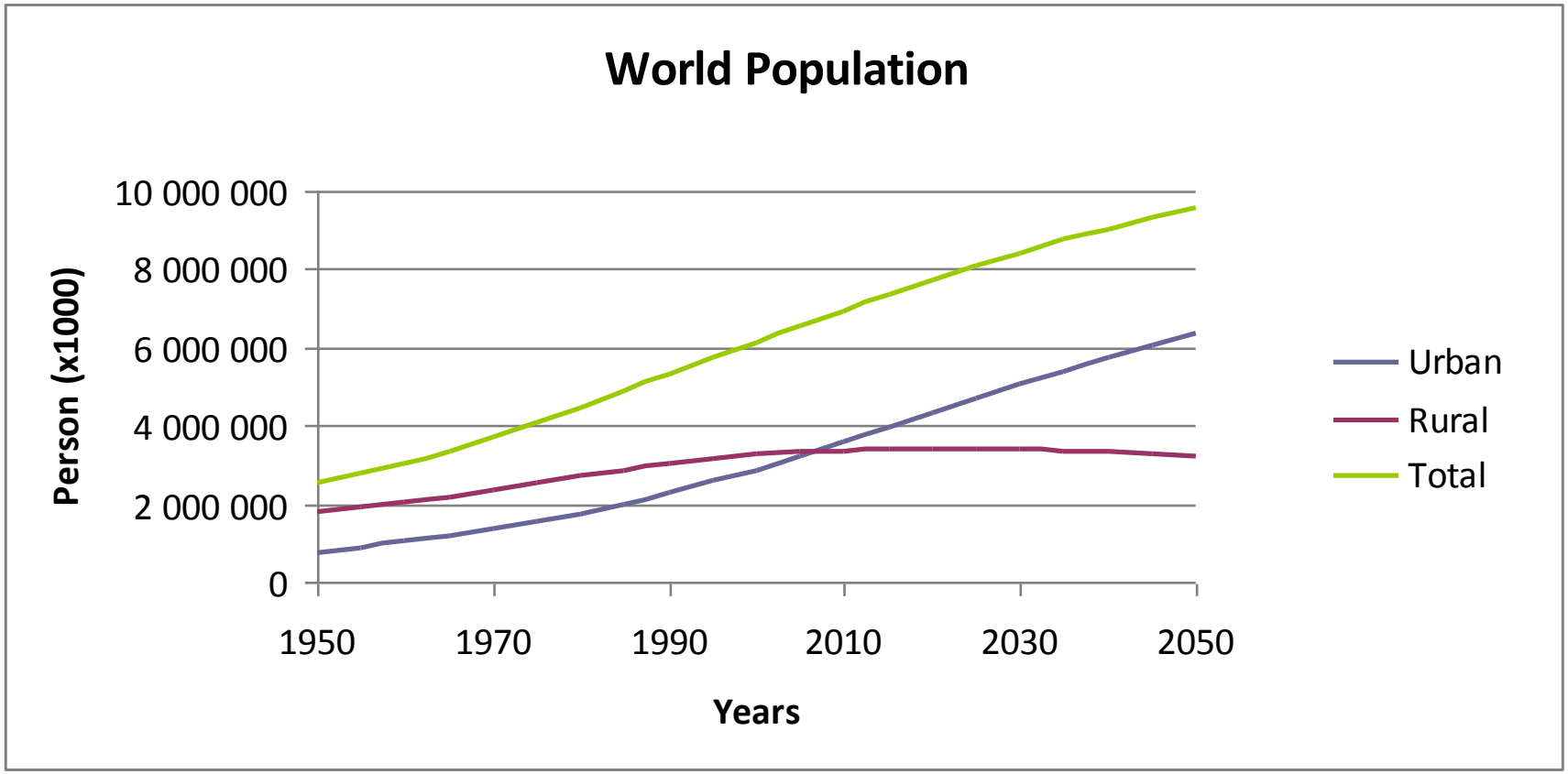
Source: World Bank

https://ourworldindata.org/world-population-growth

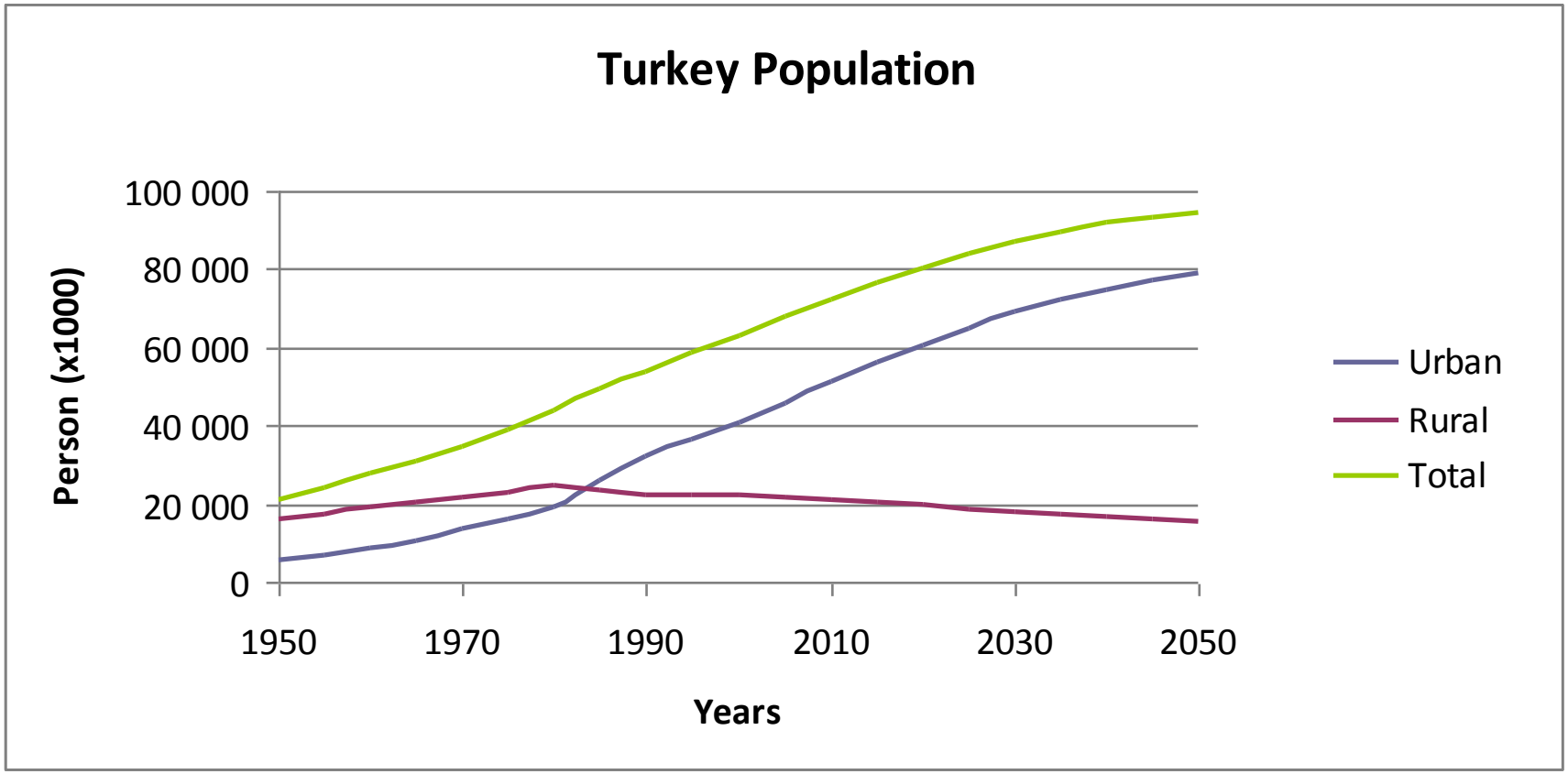


Data sources: Our World in Data based on HYDE, UN, and UN Population Division [2019 Revision]
This is a visualization from OurWorldinData.org, where you find data and research on how the world is changing.

https://ourworldindata.org/world-population-growth



World Urbanization Prospects: The 2014 Revision



Urban population: 55 279 (×1000)
Rural population: 20 559 (×1000)
Proportion urban: %73

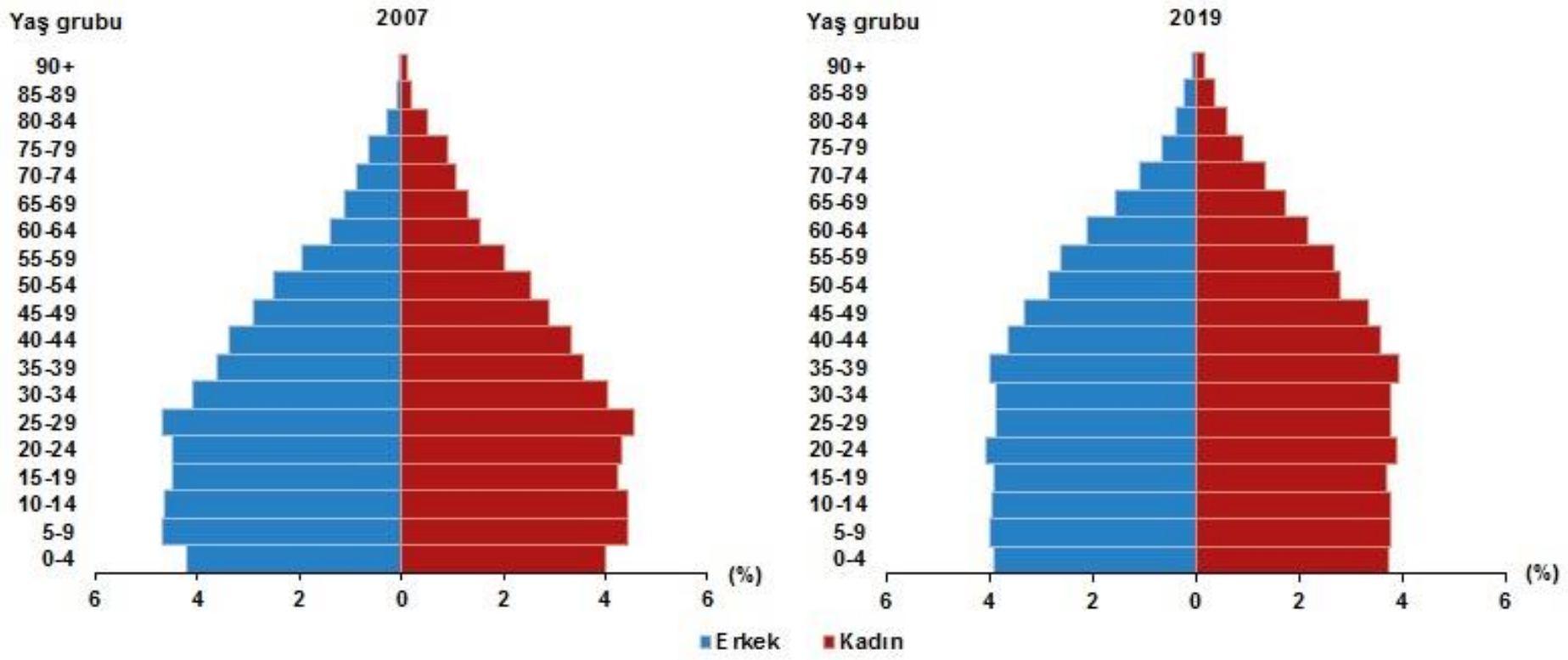
World Urbanization Prospects: The 2014 Revision

Turkey Population Data (2019)

	Population	Rate
Male	41 721 136	%50,2
Female	41 433 861	%49,8
Total	83 154 997	%100

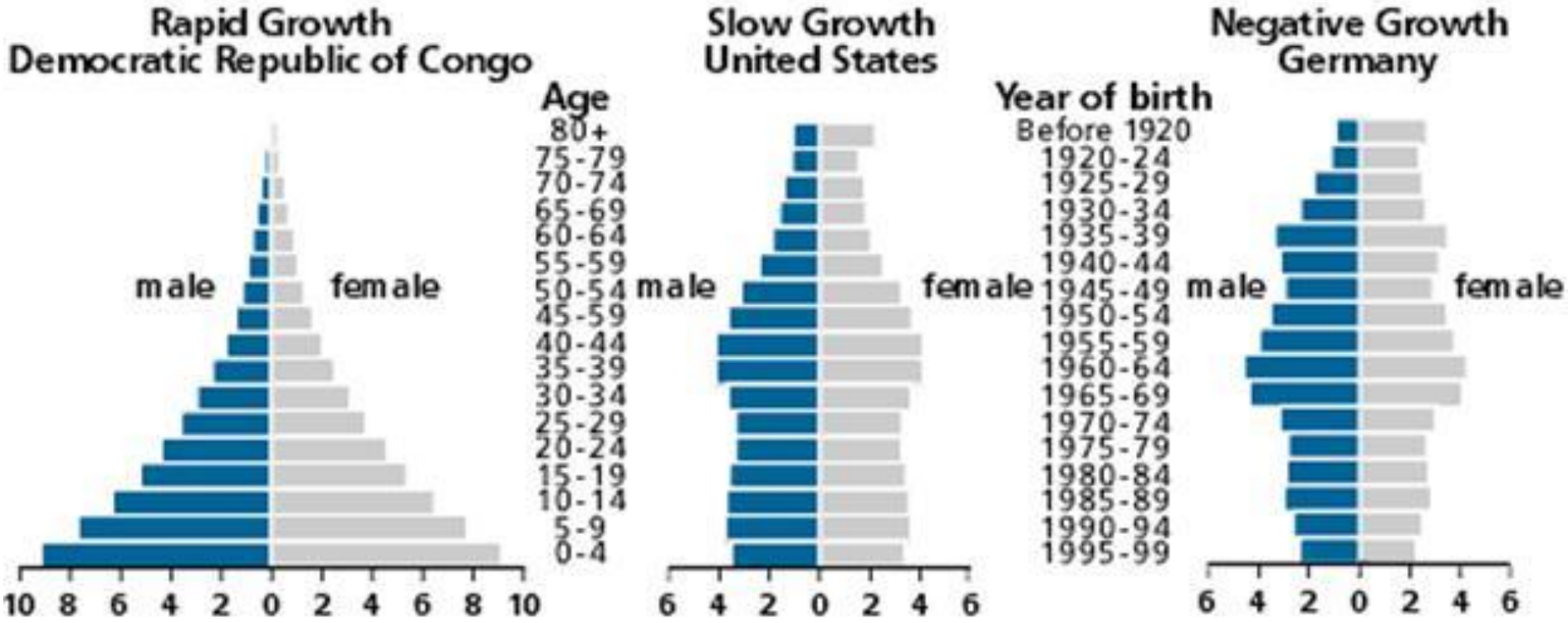
http://www.tuik.gov.tr/HbGetirHTML.do?id=33705

Turkey Population Pyramid (2019)



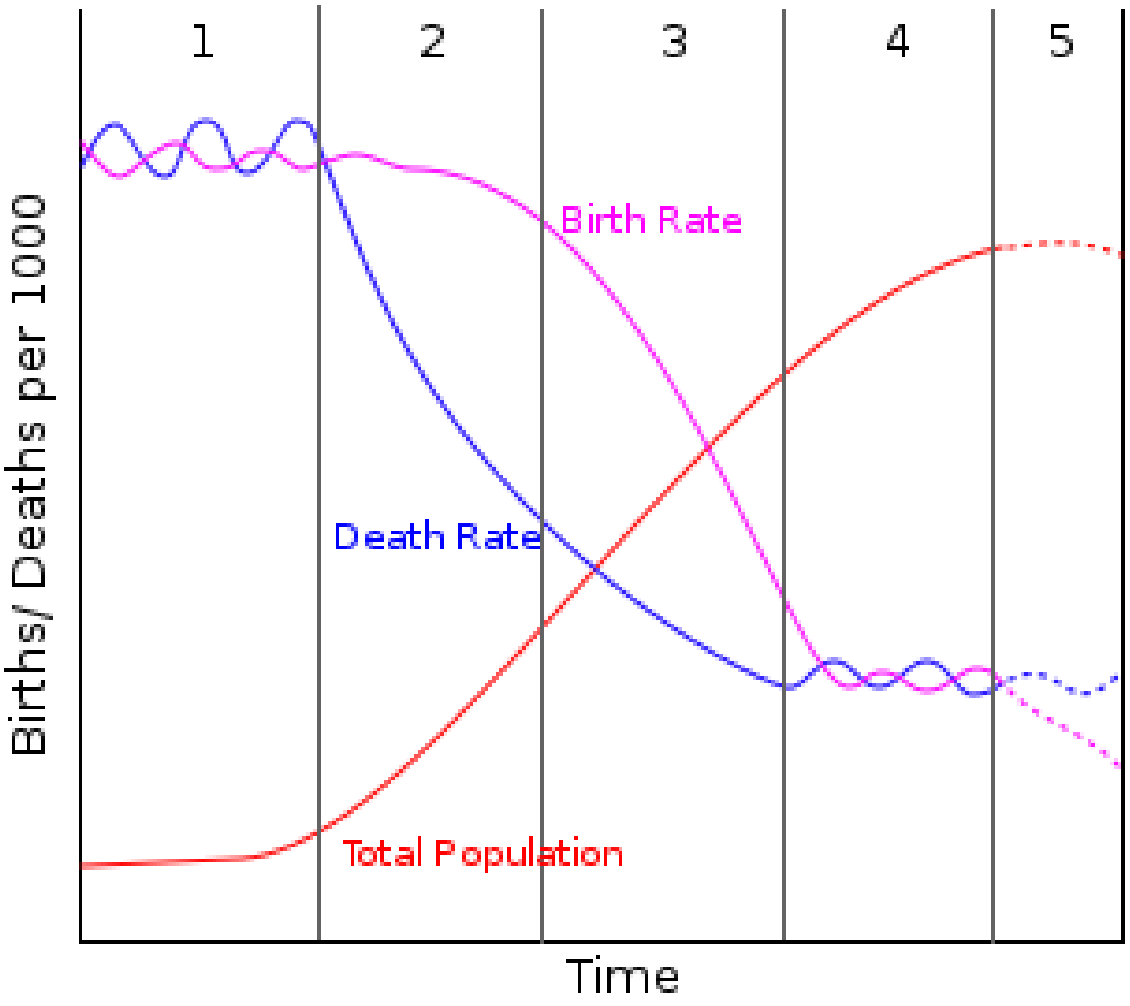
http://www.tuik.gov.tr/HbGetirHTML.do?id=33705

Population Pyramid Types



http://www.globalchange.umich.edu/gctext/Inquiries/Inquiries_by_Unit/Unit_6c.htm

Demographic Transition



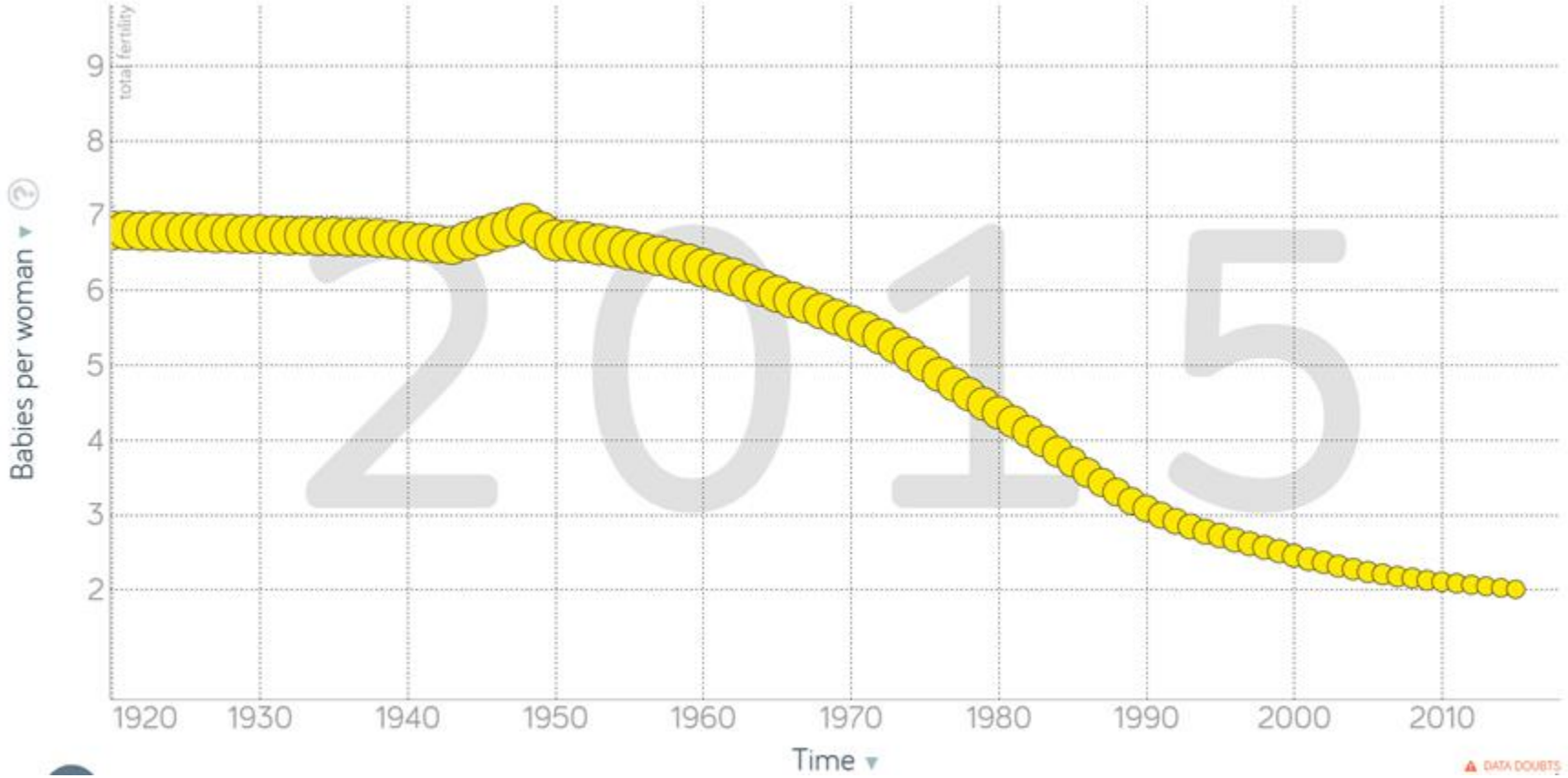
http://en.wikipedia.org/wiki/Demographic_transition

Demographic Theory

Stages	**Level of technology**	**Population growth**	**Characteristics of population trends**
1: pre-industrial societies	Pre industrial	Death rates neutralize birth rates	Slow
2: the onset of industrialisation	Early industrial	Increasing birth rates and decreasing death rates	Rapid
3: a mature industrial economy	Industrial	Birth rates decreased considerably, and death rates as well	Slow
4: post industrial economy	Post industrial	Birth rates and death rates very low- resulting in ageing population	Very slow

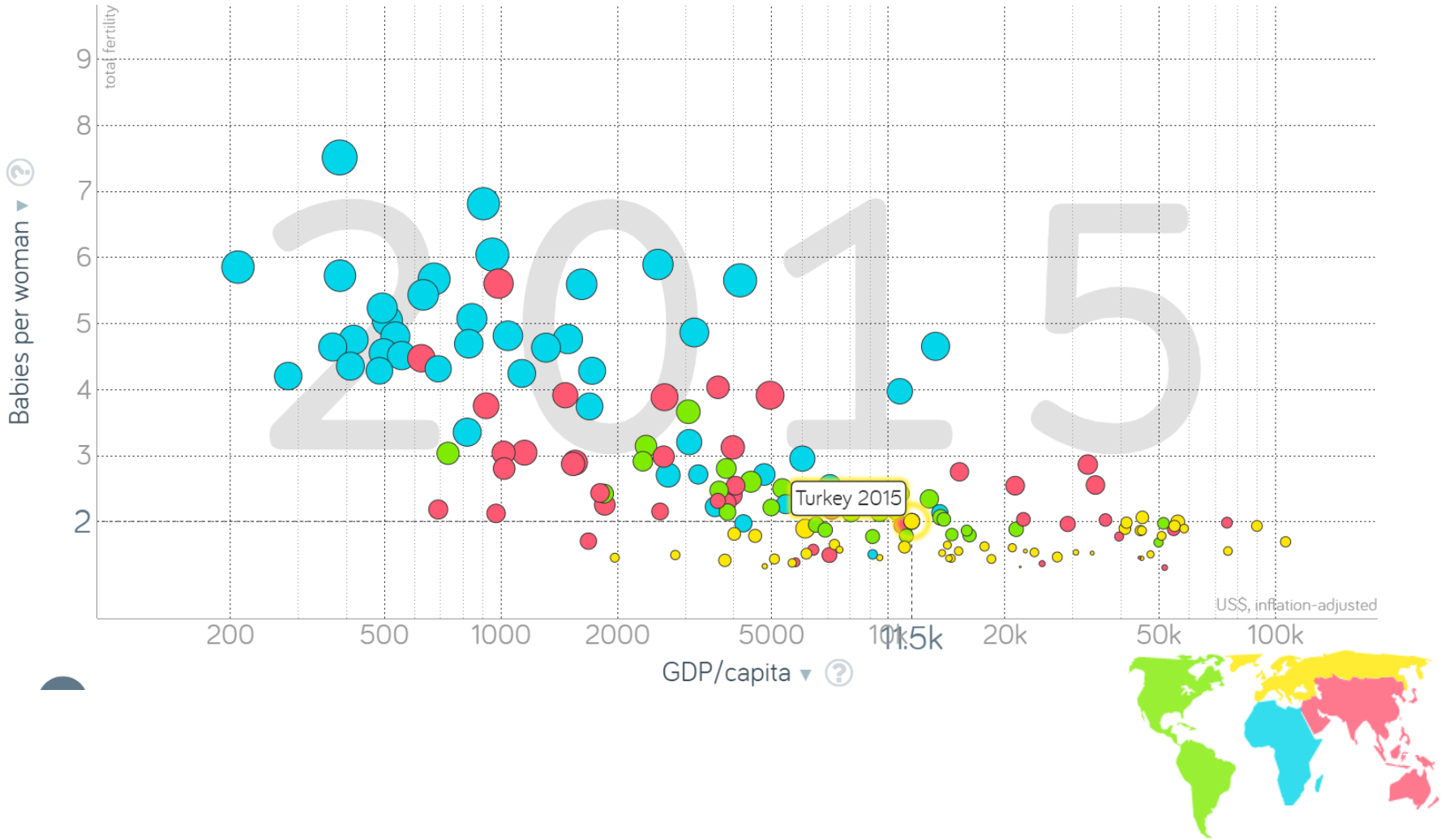
http://vcampus.uom.ac.mu/soci1101/652_demographic_theory.html

Fertility Rate in Turkey (1923-2015)



http://www.gapminder.org/tools/

Fertility rate vs. GDP/capita

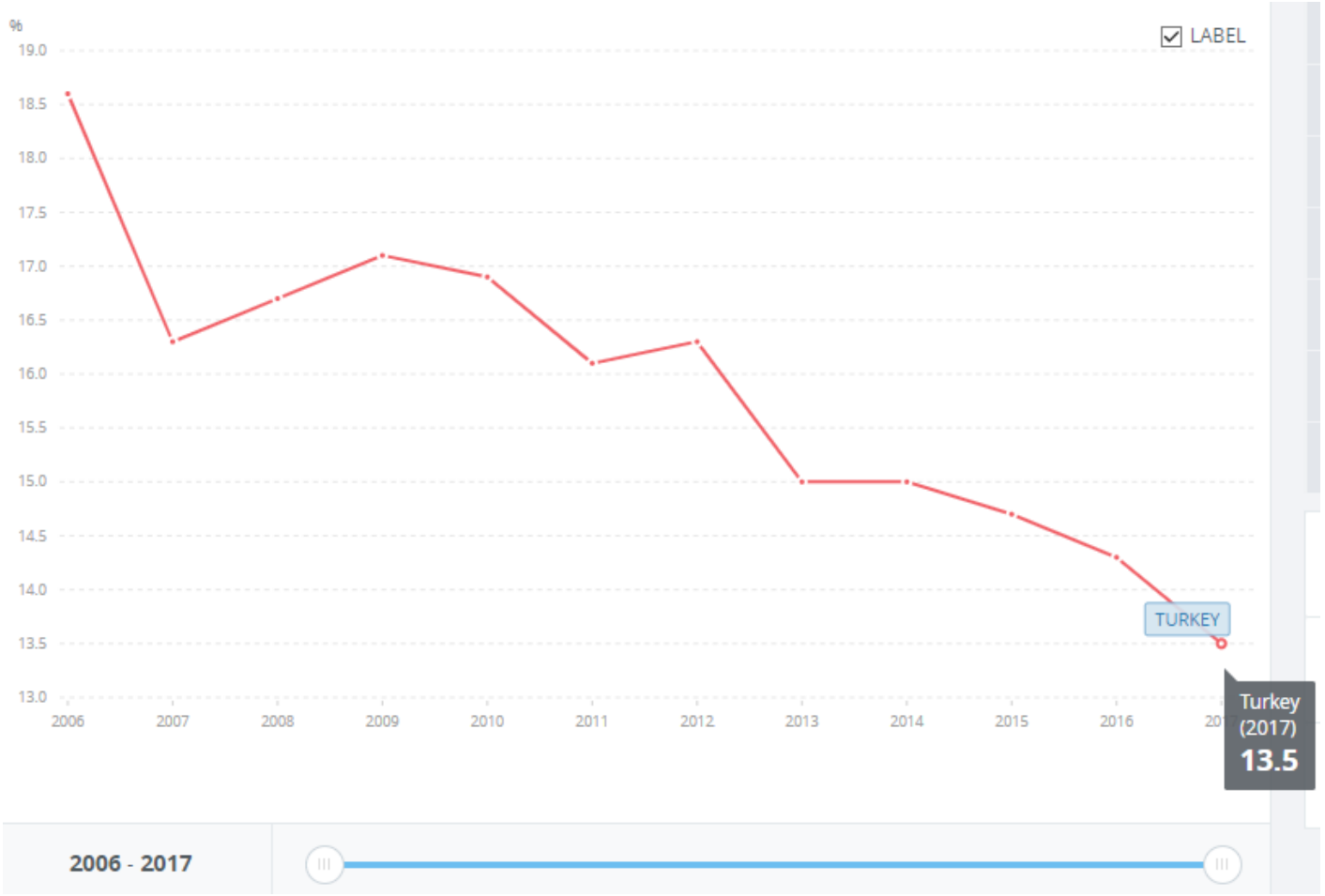


Poverty

- Almost half the world — over 3 billion people — live on less than $2.50 a day.
- The GDP (Gross Domestic Product) of the 41 Heavily Indebted Poor Countries (567 million people) is less than the wealth of the world's 7 richest people combined.
- 1 billion children live in poverty (1 in 2 children in the world). 640 million live without adequate shelter, 400 million have no access to safe water, 270 million have no access to health services. 10.6 million died in 2003 before they reached the age of 5 (or roughly 29,000 children per day).

http://www.globalissues.org/issue/2/causes-of-poverty

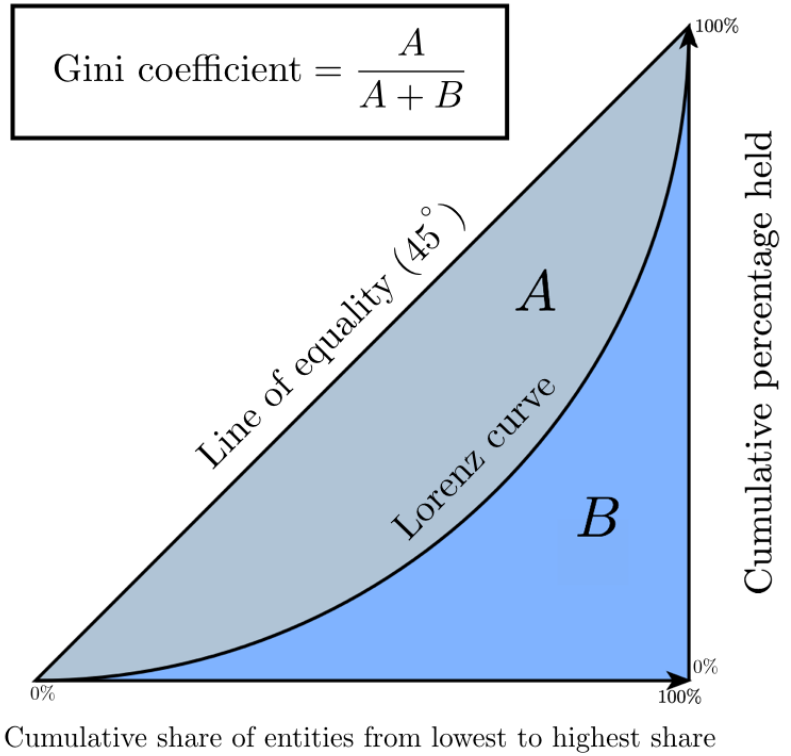
Poverty headcount ratio at national poverty lines (% of population)

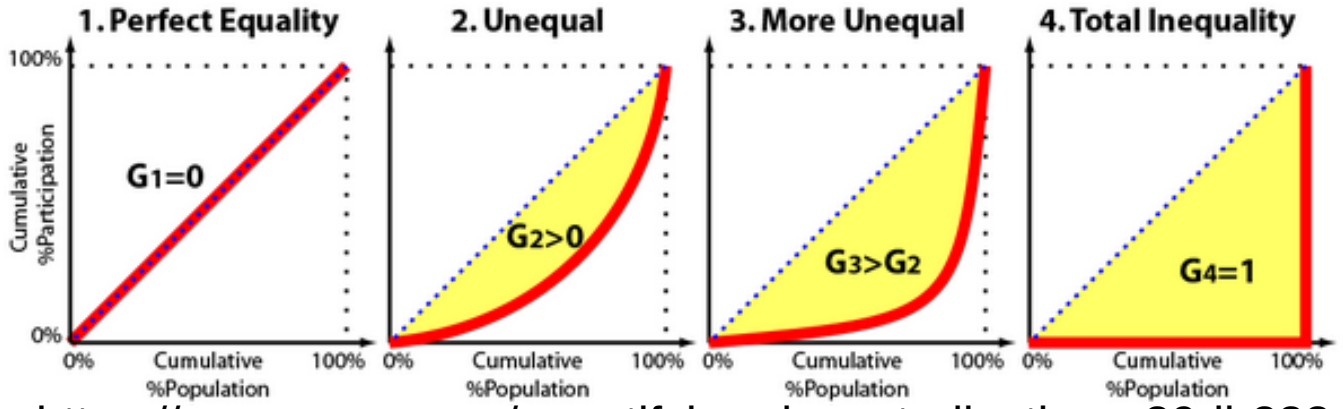


https://data.worldbank.org/indicator/SI.POV.NAHC?end=2017&locations=TR&start=2006&view=chart

Gini coefficient

$$\text{Gini coefficient} = \frac{A}{A+B}$$





https://news.earn.com/quantifying-decentralization-e39db233c28e

Regional Human Development Report 2016

Progress at Risk

Inequalities and Human Development in Eastern Europe, Turkey, and Central Asia

Empowered lives. Resilient nations.

The CASE STUDY on Income and Social Inequalities in Turkey

Table 1: Gini coefficients of Turkey and other OECD countries, 2012[10]

Country	Gini Coefficient	Country	Gini Coefficient
Denmark	0.249	Korea	0.307
Slovak Republic	0.25	Canada*	0.315
Slovenia	0.25	OECD Average	0.32
Norway	0.253	Australia	0.326
Czech Republic	0.256	Italy	0.327
Iceland	0.257	New Zealand	0.333
Finland	0.26	Spain	0.335
Belgium	0.268	Japan*	0.336
Sweden	0.274	Estonia	0.338
Austria	0.276	Portugal	0.338
Netherlands	0.281	Greece	0.34
Switzerland	0.285	United Kingdom	0.351
Germany	0.289	Israel	0.371
Hungary	0.289	United States	0.39
Poland	0.298	Russia*	0.396
Luxembourg	0.302	Turkey	**0.402**
Ireland	0.304	Mexico	0.457
France	0.306	Chile*	0.503

Source: OECD Income Distribution Database, http://www.oecd.org/social/income-distribution-database.htm