

HUMAN IMPACTS by the numbers

Griffin Chure¹, Avi Flamholz², Nicholas S. Sarai³, Tine Valencic¹, Yinon Bar-On⁴, Ron Milo⁴, Rob Phillips^{2,5,*}

California Institute of Technology, Pasadena, CA, USA, 91125:

¹Department of Applied Physics; ²Division of Biology and Biological Engineering; ³Division of Chemistry and Chemical Engineering; ⁴Department of Physics

⁵Weizmann Institute of Science, Rehovot 7610001, Israel:

Department of Plant and Environmental Sciences

ABSTRACT

The greatest experiment of the last 10,000 years is the presence and action of modern human beings on planet Earth. At this point, the consequences of this experiment are being felt on many fronts. Yet, many people still hold the view that because the world is so "huge", humans cannot really make a substantial impact. One way to organize our thinking about what these impacts might be, with tongue in cheek, is to focus on Empedocles's classic elements, earth, air, water and fire, with the idea being to explore how humans have altered the land and its inhabitants, the atmosphere, the oceans and how our quest for cheaper and cheaper energy (fire) from the world around us has altered that world. This snapshot represents a small collection of numbers that summarize the broad reach of human action across the planet, presenting a view of the impact of human presence on Earth.

UNITS OF REFERENCE

human population = $\approx 7 \times 10^9$ mass of an elephant = ≈ 5000 kg

area of soccer pitch = ≈ 3000 m² power of a lightbulb = ≈ 100 W

volume of olympic pool = ≈ 2000 m³

MELT WATER

glacial melt volume $\approx ???$ / yr
ice-cap melt volume $\approx ???$ / yr
permafrost melt volume $\approx ???$ / yr
total melt volume $\approx 10^{12}$ m³

DAMMING OF RIVERS

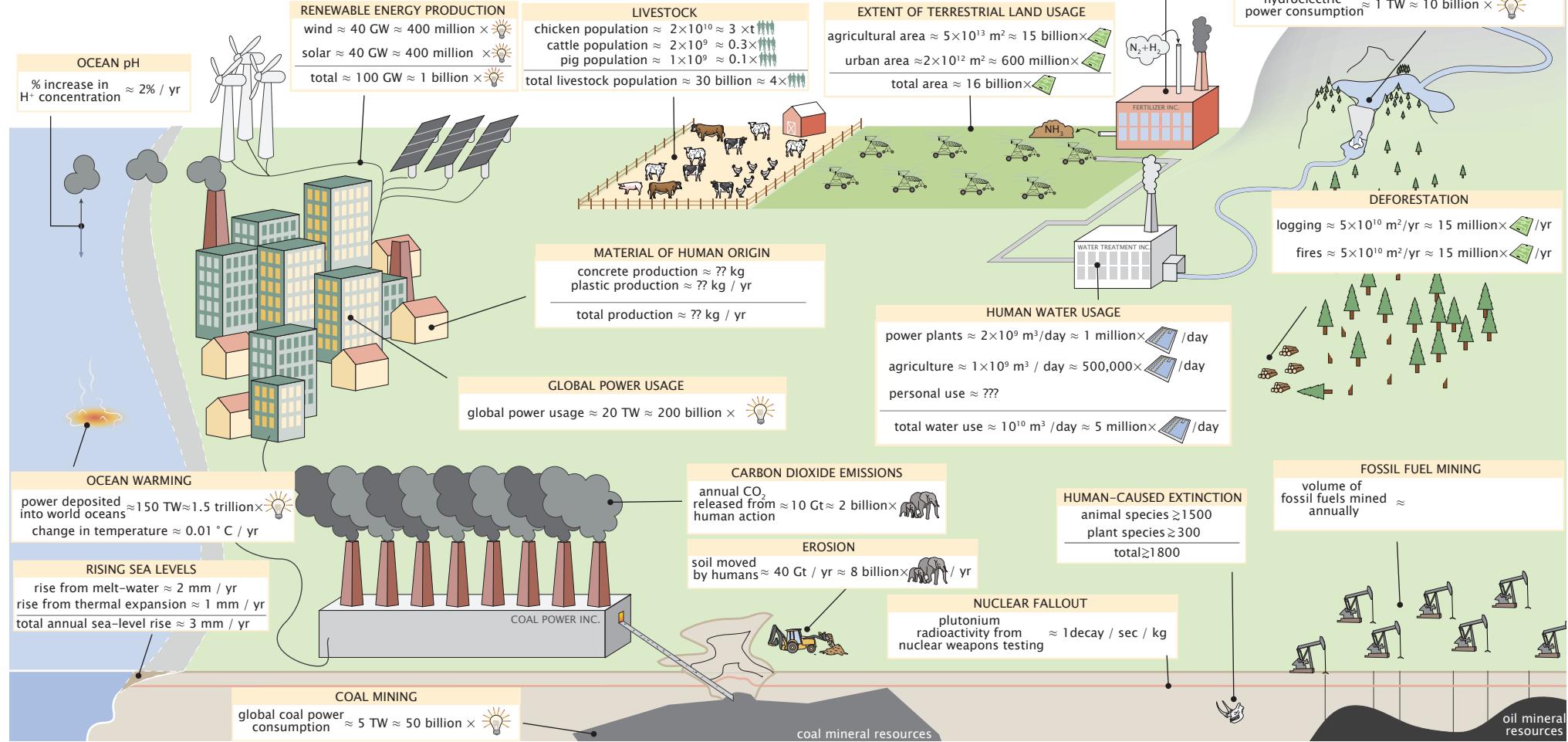
global volume of dammed rivers $\approx 10^{12}$ m³ ≈ 500 million \times
hydroelectric power consumption ≈ 1 TW ≈ 10 billion \times

DEFORESTATION

logging $\approx 5 \times 10^{10}$ m²/yr ≈ 15 million \times /yr
fires $\approx 5 \times 10^{10}$ m²/yr ≈ 15 million \times /yr

FOSSIL FUEL MINING

volume of fossil fuels mined \approx
annually



HUMAN IMPACTS by the magnitudes

Griffin Chure¹, Avi Flamholz², Nicholas Sarai³, Tine Valencic¹,
Yinon Bar-On⁴, Ron Milo⁴, and Rob Phillips^{2,5,*}

THE ANTHROPOCENE

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed diam nonummy nibh euismod tincidunt ut laoreet dolore magna aliquam erat volutpat. Ut wisi enim ad minim veniam, quis nostrud exerci tation ullamcorper suscipit lobortis nisl ut aliquip ex ea commodo consequat. Duis autem vel eum iriure dolor in hendrerit in vulputate velit esse molestie consequat, vel illum dolore eu feugiat nulla facilisis at vero eros et accumsan et iusto odio dignissim qui blandit praesent luptatum zzril delenit augue duis dolore te feugait nulla facilisi. Lorem ipsum dolor sit amet, cons ectetuer adipiscing elit, sed diam nonummy nibh euismod tincidunt ut laoreet dolore magna aliquam erat volutpat. Ut wisi enim ad minim veniam, quis nostrud exerci tation ullamcorper suscipit lobortis nisl ut aliquip ex ea commodo consequat. Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed diam nonummy nibh euismod

THE MAGNITUDE OF HUMAN WATER USAGE

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed diam nonummy nibh euismod tincidunt ut laoreet dolore magna aliquam erat volutpat. Ut wisi enim ad minim veniam, quis nostrud exerci tation ullamcorper suscipit lobortis nisl ut aliquip ex ea commodo consequat. Duis autem vel eum iriure dolor in hendrerit in vulputate velit esse molestie consequat, vel illum dolore eu feugiat nulla facilisis at vero eros et accumsan et iusto odio dignissim qui blandit praesent luptatum zzril delenit augue duis dolore te feugait nulla facilisi. Lorem ipsum dolor sit amet, cons ectetuer adipiscing elit, sed diam nonummy nibh euismod tincidunt ut laoreet dolore magna aliquam erat volutpat. Ut wisi enim ad minim veniam, quis nostrud exerci tation ullamcorper suscipit lobortis nisl ut aliquip ex ea commodo consequat. Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed diam nonummy nibh euismod

HUMANS AS THE EARTH'S GREATEST EVOLUTIONARY FORCE

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed diam nonummy nibh euismod tincidunt ut laoreet dolore magna aliquam erat volutpat. Ut wisi enim ad minim veniam, quis nostrud exerci tation ullamcorper suscipit lobortis nisl ut aliquip ex ea commodo consequat. Duis autem vel eum iriure dolor in hendrerit in vulputate velit esse molestie consequat, vel illum dolore eu feugiat nulla facilisis at vero eros et accumsan et iusto odio dignissim qui blandit praesent luptatum zzril delenit augue duis dolore te feugait nulla facilisi. Lorem ipsum dolor sit amet, cons ectetuer adipiscing elit, sed diam nonummy nibh euismod tincidunt ut laoreet dolore magna aliquam erat volutpat. Ut wisi enim ad minim veniam, quis nostrud exerci tation ullamcorper suscipit lobortis nisl ut aliquip ex ea commodo consequat. Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed diam nonummy nibh euismod

HUMAN IMPACTS ON ATMOSPHERIC AND BIOGEOCHEMICAL CYCLES

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed diam nonummy nibh euismod tincidunt ut laoreet dolore magna aliquam erat volutpat. Ut wisi enim ad minim veniam, quis nostrud exerci tation ullamcorper suscipit lobortis nisl ut aliquip ex ea commodo consequat. Duis autem vel eum iriure dolor in hendrerit in vulputate velit esse molestie consequat, vel illum dolore eu feugiat nulla facilisis at vero eros et accumsan et iusto odio dignissim qui blandit praesent luptatum zzril delenit augue duis dolore te feugait nulla facilisi. Lorem ipsum dolor sit amet, cons ectetuer adipiscing elit, sed diam nonummy nibh euismod tincidunt ut laoreet dolore magna aliquam erat volutpat. Ut wisi enim ad minim veniam, quis nostrud exerci tation ullamcorper suscipit lobortis nisl ut aliquip ex ea commodo consequat. Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed diam nonummy nibh euismod

THE MAGNITUDE OF HUMAN ENERGY USAGE

Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed diam nonummy nibh euismod tincidunt ut laoreet dolore magna aliquam erat volutpat. Ut wisi enim ad minim veniam, quis nostrud exerci tation ullamcorper suscipit lobortis nisl ut aliquip ex ea commodo consequat. Duis autem vel eum iriure dolor in hendrerit in vulputate velit esse molestie consequat, vel illum dolore eu feugiat nulla facilisis at vero eros et accumsan et iusto odio dignissim qui blandit praesent luptatum zzril delenit augue duis dolore te feugait nulla facilisi. Lorem ipsum dolor sit amet, cons ectetuer adipiscing elit, sed diam nonummy nibh euismod tincidunt ut laoreet dolore magna aliquam erat volutpat. Ut wisi enim ad minim veniam, quis nostrud exerci tation ullamcorper suscipit lobortis nisl ut aliquip ex ea commodo consequat. Lorem ipsum dolor sit amet, consectetur adipiscing elit, sed diam nonummy nibh euismod

