

HUMAN IMPACTS by the numbers

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

¹Department of Applied Physics, California Institute of Technology, Pasadena, CA, 91125

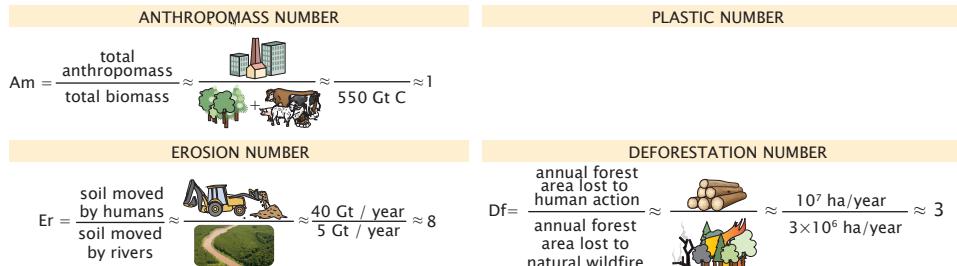
²Division of Biology and Biological Engineering, California Institute of Technology, Pasadena, CA, 91125

³Division of Chemistry and Chemical Engineering, California Institute of Technology, Pasadena, CA, 91125

⁴Department of Plant and Environmental Sciences, Weizmann Institute of Science, Rehovot 7610001, Israel

⁵Department of Physics, California Institute of Technology, Pasadena, CA, 91125

THE ANTHROPOCENE BY THE NUMBERS

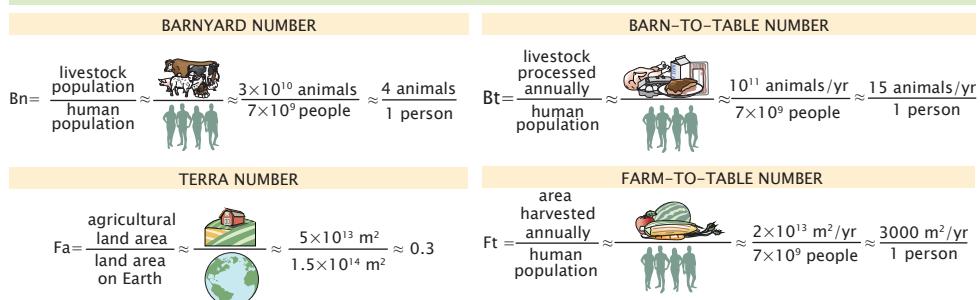


SUMMARY



Total anthropomass (non-biological mass of human origin) is approximately equal to the planetary biomass.

AGRICULTURE BY THE NUMBERS



SUMMARY

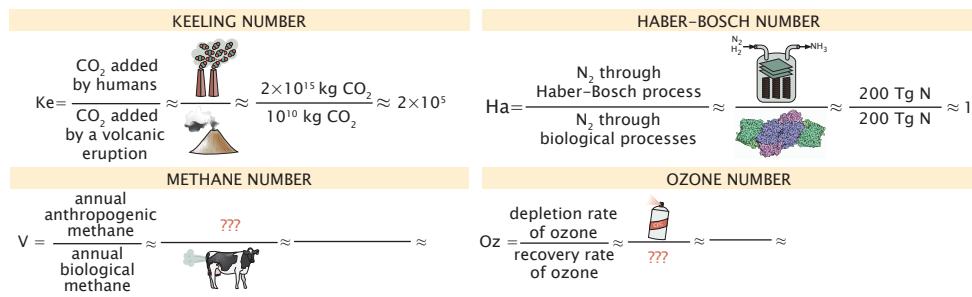


Humans rival natural processes as the planets' most significant geomorphological agent, moving $\approx 40 \text{ Gt}$ of soil annually.



Annual forest loss due to human activity (including agriculture, logging, and forestry) is ≈ 3 times larger than that due to wildfires of natural origin.

ATMOSPHERIC EMISSIONS BY THE NUMBERS



SUMMARY

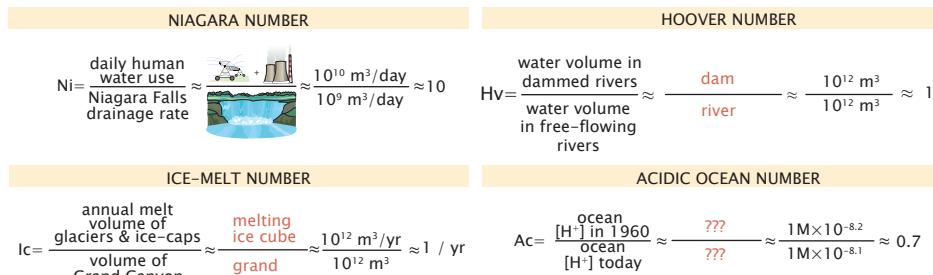


Humans have released 1500 Gt of CO_2 , equal to $\approx 200,000$ large volcanic eruptions. Of this, 40% is absorbed by the ocean, leading to a net increase of $\approx 1000 \text{ Gt}$ of atmospheric CO_2 .



Through synthetic means, humans convert as much nitrogen to ammonia as does the biosphere, but at much lower efficiency.

WATER BY THE NUMBERS



SUMMARY



Daily human fresh water usage is equivalent to the daily discharge of 10 Niagara Falls or 1 Amazon river.



Around half of the world river volume is used in the generation of hydroelectric power. The Amazon alone accounts for $\approx 25\%$ of the global free-flowing (undammed) river volume.

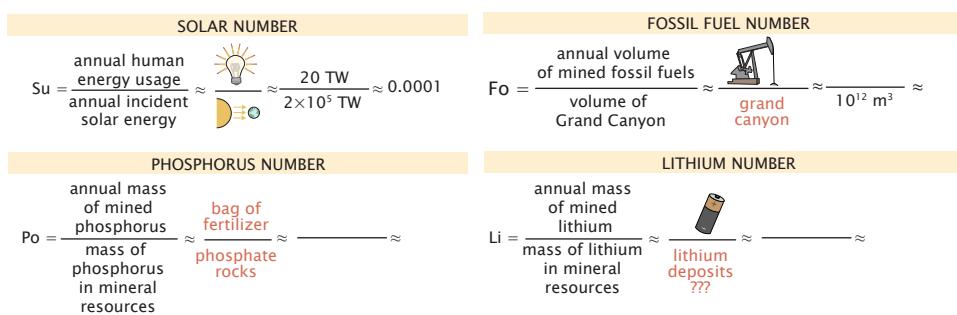


Increasing global temperature leads to a volume of $\approx 1000 \text{ km}^3$ of water released per year from glaciers, permafrost, and ice caps, a volume comparable to that of the Grand Canyon.



Over the past sixty years, increased CO_2 in the atmosphere has decreased the pH of the ocean by $\approx 0.1 \text{ pH units}$, corresponding to a $\approx 30\%$ increase in H^+ concentration.

RESOURCE EXTRACTION BY THE NUMBERS



SUMMARY



Total human energy usage is $\approx 0.01\%$ of the solar energy incident on the planet.



Fossil fuels (crude oil and natural gas) is responsible for XX% of the global energy usage. Mining produces XX m^3 per year, comparable to XX the volume of the Grand Canyon.



xx phosphorus number description



xx lithium number description