



MINIK T. ROSING. Professor in Geology, Nordic Center for Earth Evolution, Natural History Museum of Denmark, University of Copenhagen.  
minik@snm.ku.dk

## FUEL THE FUTURE BY THE POWER OF THE IMAGINATION

Human ideas, aspiration and desires deeply impact the functionality of our planet because our activities claim large shares of Earth's total energy budget.

The dominant source of Energy on Earth is sunlight, which provides 342 watt of energy to every square meter of Earth's surface. One third is reflected directly back to space. The remaining two thirds are mostly converted to heat, but a very small fraction – about one watt in a thousand – is used by plants and algae to produce biomass from water, CO<sub>2</sub> and mineral nutrients. The global production of biomass by plants and algae captures solar energy equivalent to about one quarter of a watt per square meter of Earth's surface. This is the energy that fuels the activities of all animals and most other organisms. This quarter of a watt controlled by life is two to three times greater than the amount of energy Earth expends on keeping its interior glowing hot, producing the magma that pours out of volcanoes, moving the continents across Earth's surface and building mountain ranges where the continents collide.

Humankind impacts the global environment not so much because of our physiological needs but more severely due to our behavior. We only need one thousandth of a watt of energy per square meter of Earth's surface. With the development of thermodynamics during the 18th and 19th centuries, humans realized that energy could be transformed from one form to another. This insight gave us the means to use our passion for fire to get work done. Cultures that understood thermodynamics became major world powers, because they could perform work similar to populations far greater than the biological productivity that their land could sustain. However, the concept of thermodynamics not only completely transformed society but also changed the trajectory of Earth's geological

evolution through the deep environmental impact of CO<sub>2</sub> emissions.

Industrialization made humanism affordable, and paved the way for the abolition of slavery. As soon as it became less expensive to perform hard labour by machines rather than by feeding people to do the work, the ethical aspiration of freeing the human race became practicable. The Enlightenment in the 18th-19th century was contemporaneous with, and probably spurred by, the decreasing need for human physical work. As innovation became the main provider of prosperity, the human spirit became a more valuable resource than human body force. Democracy and humanism form the basis of some present societies because it is easily affordable.

What makes us human is that we spend lots of energy beyond our physiological needs on activities related to arts, culture and social interaction. Modern society causes massive environmental problems, because we acquire most of our energy from fossil sources, but that should not fool us into regarding the spending of energy as an evil for which we all share guilt. It is useful to remember that solar energy is available at a rate of 342 watt per square meter, more than ten thousand times as much as the three hundredth of a watt per square meter we currently get from burning fossil fuels. Even at 7 billion people or more, our physiological needs can be accommodated by Earth's ecosystems, and renewable sources derived from sunlight can provide ample energy to sustain healthy societies for everyone.

*See the slides from Minik Rosling's lecture at the first In100Y-seminar about the power of imagination at [www.in100y.dk/cph-seminars/1-mind-the-from-the-seminar/](http://www.in100y.dk/cph-seminars/1-mind-the-from-the-seminar/)*