



ORIGINAL ARTICLE

Our responsibility in climate change

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ABSTRACT

Almost half of the world's carbon dioxide emissions come from heat and electricity production. The rise of renewables' share can barely keep up with the growing energy demand. The environmental impact and material consumption of renewable energy production and electromobility cannot be neglected either, as confirmed by the ecological footprint, Life Cycle Analysis (LCA), or Material Input per Service Unit (MIPS) methodologies.

In addition, the individual's energy consumption (electricity, fuel, material consumption) is very significant. The latter is also shown by the significant production of waste. But does the individual have any influence at all on these processes, because a single person is very small compared to the 8 billion inhabitants of the earth? How could one take personal responsibility for the world's problems?

The first step forward the solution is for the individual to be aware of the source, amount, and environmental impact of the energy and materials they consume. He/she must understand the sustainability of the current system. This can be followed by energy awareness, which strives to be frugal in all its actions. The best energy is energy that is not consumed (not produced) or consumed (but not stored) during renewable production.

Education for moderation begins in kindergarten and should not only cover energy. It is our responsibility to be aware, to do a little for the greater good - but the physics in the world works independently of us. The solution is the triple E, as the Energy consciousness – Environment consciousness – Earth consciousness.

Keywords: Energy industry, sustainability, personal responsibility, towards sustainability

Citation: KADAR, P., Our responsibility in climate change. *Journal of Global Climate Change*. 2022; 1(2): 77-85, DOI: 10.56768/jytp.1.2.05

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1. INTRODUCTION

There are many phenomena and happenings in the world that are partly caused by humans, and which we consider bad and absolutely to be avoided. These include wars, famine, all-encompassing waste, environmental pollution, depletion of natural and energy resources, and epidemics...

There is truth in the fact that we are personally causing problems, but on the other hand, we are the only ones among the 8 billion inhabitants of the earth who have a small impact on the environment. According to them, our responsibility is also very small. Community solutions are obviously needed to remedy the problems. These can only be created in a functioning community, as a result of actions taken in one direction by the individuals of the community. In the following, we will explore the problem area of energy production.

2. ENERGY AND CARBON DIOXIDE

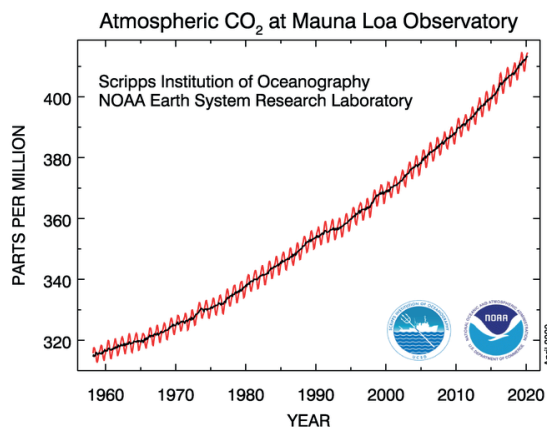
Energy, in a narrower sense, means the thermal energy necessary for human existence and activity and the nowadays indispensable electricity. Of course, as energy consumers, this includes industry, transport, mining, services, etc. Energy has long been in the crosshairs of those concerned about the environment. Not only the depletion of traditional resources but also the high level of carbon dioxide (CO₂) emissions is a matter of fact, the electricity industry alone is responsible for more than 40% of the world's carbon dioxide emissions. In the last millennia the carbon dioxide ratio of 275 ppm has risen to 415 ppm since 1700, i.e. it has doubled since the beginning of the industrial revolution as discussed by QUBIT (2018). There is no doubt that at the current rate we will achieve doubling soon. We only have indirect information about the effect of carbon dioxide, but based on compelling reasons, we suspect that it contributes to climate change. By KOVACS, R. (2019) the issue of climate is much more complex.

In the 1960s, they envisioned global cooling. Currently, the climate has changed from a cold

period to a warmer one, a fact of no one denies. In the last 400,000 years, there were 5 shorter warm periods. Meanwhile, the peaks of carbon dioxide concentration almost coincided with the temperature peaks. Still, it is not clear whether it increased the temperature as a cause or as a result of the temperature increase. The scientific facts are well presented in different sites, but the conclusions are not clear (e.g. in GLOBAL Warming). In addition, the greenhouse effect water vapor absorbs three times as much energy as carbon dioxide, which is thus only a 20% factor in the energy balance in addition to the other greenhouse gases. In addition, the influence of sunspots and possibly volcanic eruptions on the climate is also very significant. It was indeed the industrial revolution that started the intense anthropogenic carbon dioxide emissions, but at the same time, it was what made humanity's existence independent of the climate and weather conditions, enabled intensive food production and healthier well-being – writes BEHRINGER, W. (2017).

Based on all this, carbon dioxide has become the *indicator and symbol* of man's use of nature and excessive consumption. Although we cannot see carbon dioxide, it can still be easily measured and calculated, both worldwide emissions and individual loads. Just think of the fact that registered coal, oil, and gas are all burned after a few months of transport and storage. So, e.g. it was mined in the year 2000, and all of it has now gone into the atmosphere.

1. Figure: An increase in the carbon dioxide content of the atmosphere



Source: Trends in Atmospheric Carbon Dioxide; Global Monitoring Laboratory - Earth System Research Laboratories

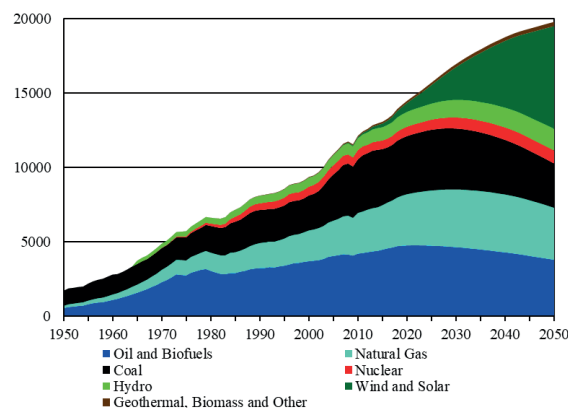
3. ENERGY MIX

If we accept that it is not a good idea to further increase the amount of carbon dioxide, then we have to look for other ways of producing heat and electricity. One form of this is nuclear energy, while the other group consists of renewable energy sources. It is interesting that all of these are renewed by the Sun, just as the water cycle is driven by evaporation caused by the Sun's heat, the wind is nothing but the equalization of atmospheric warming anomalies, biomass is created by photosynthesis, and solar thermal and solar power plants they directly convert solar radiation into electricity. We can look at geothermal energy as energy that will not run out in our little short life,, and even as the planet Earth was formed from a mass of hot matter similar to the Sun.

Among other things, primary energy carriers occurring in nature are used for transportation, industry, and household, and more than 40% of them are used for electricity generation. Compared to 1950, the amount of primary energy used annually has increased 7-fold, while the renewable share is still only around 20%. Despite the massive expansion of renewable energy sources, total demand is still rising. Growth at this rate will soon hit limits, but the fossil energy reserves will not be exhausted, but the climate will change significantly first.

According to optimistic estimates for the next decades, the expansion of all uses may turn into a decline by the third of this century, while the growth of fossil use may stop in a decade.

2. Figure: World primary energy consumption, 1950-2050, (Mtoe)



Source: World Energy 2018-2050: World Energy Annual Report (Part 1) By Dr. Minqi Li, Professor, Department of Economics, University of Utah

In every country, electricity production goes back about a century, so many power plants have been built, some power plants have already been demolished, others are still being planned, but there is always a group of power plants that are still operating. They produce on the same electricity network, and we cannot distinguish on the network which power plant produced the electricity we consume. The power plants produced by all the operating power plants produce a so-called energy mix. Half of the Hungarian domestic energy mix is nuclear, twelve percent is renewable, and the rest is based on fossil energy carriers. This power plant has a common CO₂ emission of approx. 400 g/kWh. If the proportion of fossil fuels in the energy mix can be reduced, the specific CO₂ emissions will also decrease. In 2018, the share of electricity produced on a renewable basis in the 27 EU member states was 18.88%, while in Hungary this figure was 12.49% by EUROSTAT (2022).

4. GOOD POWER PLANTS

Engineers have developed countless power plant solutions, and their operation, efficiency, and environmental impact are known, and can be planned and calculated. Of course, solutions

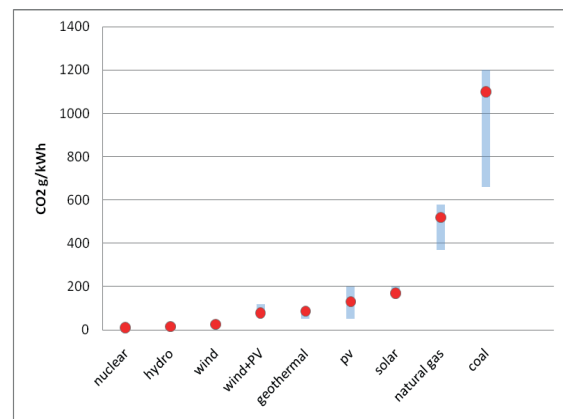
unimagined today will be developed in the future as well, but the current problems are caused by the currently known technologies, there are no surprises, and the many bad effects are foreseeable.

If there were no financial and resource constraints, and if we didn't have the power plants that have been operating for decades, we wouldn't be able to show a power plant that would provide the clean and cheap energy that everyone wants with a minimum amount of materials and emissions. In addition, there are mathematical methods that help to choose which of the available technologies, how to expand and develop the system so that carbon dioxide emissions, the impact on the environment, the use of materials or even the costs are minimal. Here, however, two problems arise: Among the many aspects, we cannot decide on which one to optimize as is in KADAR, P. (2010) and KADAR, P. (2013). And who even says this? Should it be the fastest-building, cheapest, lowest-emitting power plant? Should all of this fit into the landscape, but not take up land, water, or air? Moreover, the question does not arise as to exactly how big a power plant should be built, but whether one or two blocks (units) or none, so decision alternatives are formulated.

At the level of energy strategy, there is a better and a worse solution, or what we think is the solution based on the currently available knowledge. Unfortunately, previous bad decisions are also revealed in some cases.

Of course, we should not think that power plants declared to be renewable – similar to electric vehicles – do not burden the environment. It is true that no carbon dioxide is emitted at the point of use, or during operation, but a lot of materials and energy must be invested (consumed) during the creation (and subsequent dismantling), and undoubtedly the carbon dioxide emission is also significant.

3. Figure: CO₂ emissions of power plant technologies in Hungary



Source: Own collection/calculation

A clear methodology is available for calculating the environmental effects (LCA – Life Cycle Assessment), which is now increasingly used. With its application, not only carbon dioxide but also other greenhouses, acidifying and toxic emissions can be easily calculated. The MIPS methodology investigates the Material Input per Service Units in RITTHOF, M. et al. (2002), and the Ecological Footprint measures sustainability. In addition to all this, this methodology can examine not only the impact of the transport or energy industry but also every single human activity and product. It is called a life cycle, when something is not yet there (e.g. a chair or an event or even a trip), then everything is finished, happens, and then passes away - and it has consumed material and energy from the environment and emitted something and left it behind, e.g. carbon dioxide, waste, natural damage.

In general, we can say that power plants producing electricity from renewable forms of energy (wind, solar, water) have a lower environmental impact than their fossil counterparts, but overall, even here, emissions are significant. The combined emissions of the best electric cars are approx. 70% of its vehicles use conventional fuel.

5. INDIVIDUAL ENVIRONMENTAL IMPACT

The environmental load of the individual (each person) can also be precisely known. A family

car, driven 15,000 km per year and using 1,000 liters of gasoline, emits 3,170 kg of carbon dioxide. The average production of 3,300 kWh of electricity per person per year results in 1,500 kg of carbon dioxide emissions.

What is left behind from our activities yesterday, from last year, from our childhood, from the people who were here 100 years ago, from the history of humanity so far? As time goes on, there are fewer and fewer, but the resources are running out irreversibly.

The conscious customer buys domestic yogurt from a plastic cup, receives the meat, bread, and vegetables in a plastic bag, and throws away the plastic bottle. He can't choose, there's no other choice. A paper bag – if you have one – causes a similar burden on the environment. If he can no longer walk for kilometers, he takes the bus, goes by car, or takes the tram. Your bicycle also uses asphalt road, which is made from crude oil. We have no choice, no chance, we are unwittingly part of the environmental destruction. All of this was already true for the ancient man, who sharpened axes from larger stones, snapped stone blades, cleared forests, and exterminated animal species. Our existence on earth involves using the resources of planet Earth and transforming the environment. We feel that we were once given the authority to "Subjugate the

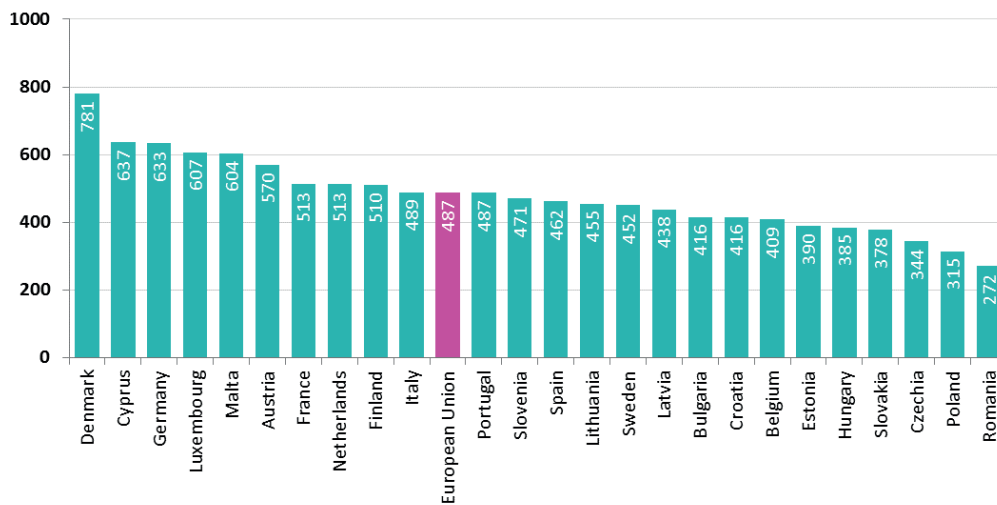
earth!" as it is written in the BIBLE, yet seeing the current trends, it will be difficult to stand before the Creator at the final reckoning. The individual has no choice, when we are born our ecological and economic environment determines many things. Or maybe not?

6. AWARE OF SUSTAINABILITY

Humanity, individual countries, and even individual persons can be counted on to have an ecological footprint, which expresses how much land, water, raw materials, and energy carriers they need to sustain themselves (for the way of life they lead) - in a sustainable, renewable way. All of this includes ensuring that your wastewater is purified, that the necessary food can be produced, etc. Consider that the few ancient people did not change their environment much, and today the changes are almost irreversible. The size of the converted biologically productive area per person (biocapacity) was 2.18 hectares in 1996, but this is decreasing with the desertification of the areas and the increase of the population. Most countries use more than their own available biocapacity would allow.

But how could we remedy the problems of the world at home, provide hundreds of millions with enough food, stop wars, reduce mountains of waste, and moderate carbon dioxide emissions?

4. Figure: Annual waste production per capita in EU countries (kg), 2017



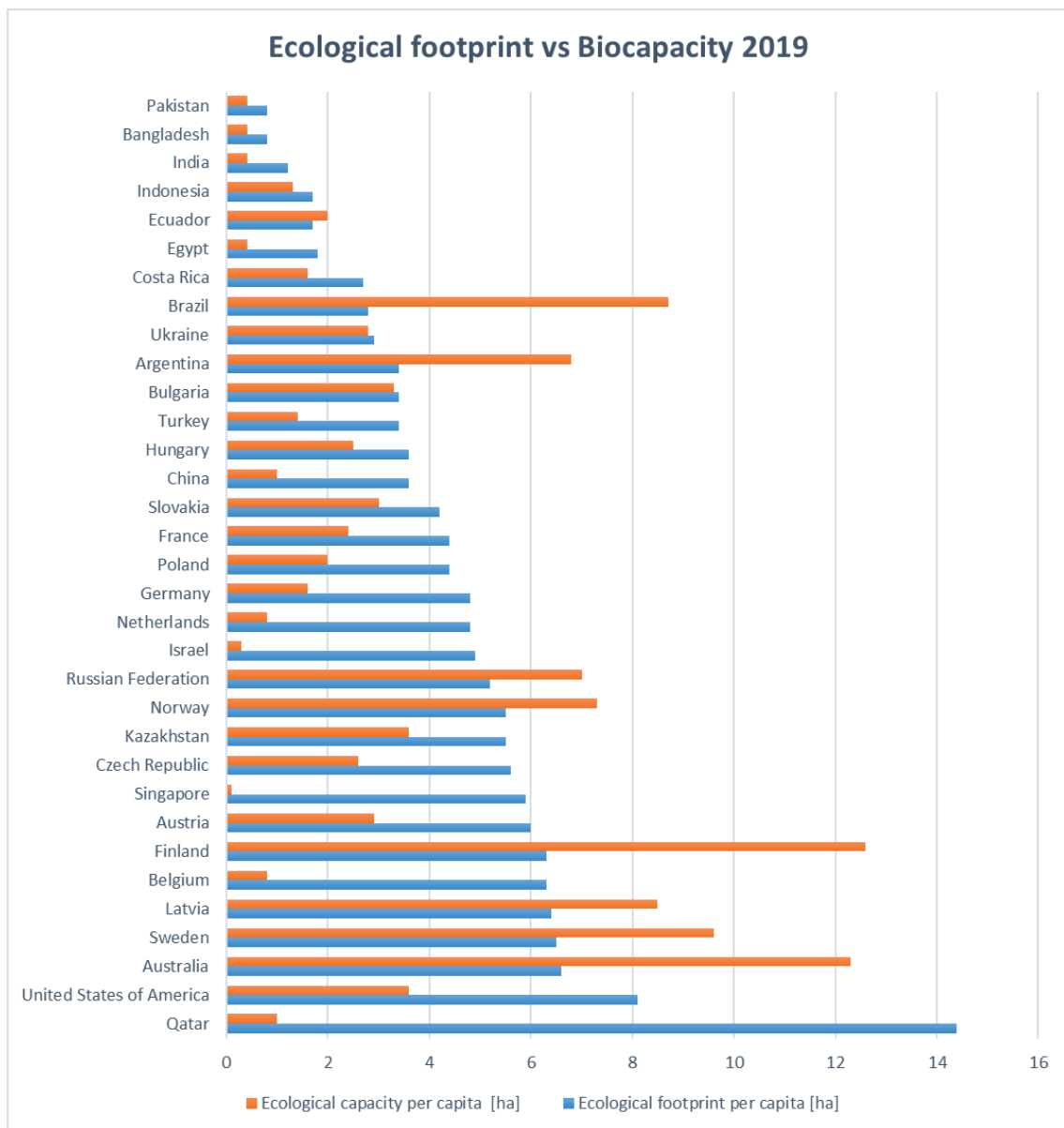
Source: EUROSTAT Database - Waste - Eurostat (europa.eu) <https://ec.europa.eu/eurostat/web/waste/data/database>

Foremost, we need to become aware, to find out and understand to some extent how and what we live, what we do, and cause. Of course, if we see the whole picture, it is not certain that we should feel guilty about everything. If we look at the consumption of the world's goods, Hungary is in the richest half of the world. There are countries that are greedier and more selfish than us, while the rapidly developing China and India have a huge prospect of expanding consumption. Yes, we march into the abyss together. We need to recognize whether we are speeding up or slowing down this process. Despite the fact that we are not unconditional

environmental protection specialists, we must have our own energy awareness, environmental awareness - universal awareness.

Let's see our place and role in the world to some extent, and don't believe everything right away! Not only in the energy industry, but their products are also praised by those interested in the given project. We can hear many true and honest recommendations as to why a nuclear power plant is needed and why a nuclear power plant should not be built. Why should we still use coal, and why is coal harmful? Why renewable energy is good and bad, and more...

5. Figure: The ecological footprint vs biocapacity of consumption



Own graphics based on Global Footprint Network – <https://www.footprintnetwork.org/>; 2020 [Date Accessed: 1/09/2022]

Even in the world of faith and morality, similar to good deeds: let's add our small positive part to the world!

Professionals can smile that with the amount of plastic bags we save each year, we do not even touch 1% of our own petroleum consumption. If we turn off the unnecessary light in the pantry, we might not even notice it on our wallet. However, if this becomes ingrained in our culture, sooner or later others will do the same, and eventually, hopefully, those who make more far-reaching decisions will also decide in this way, which will actually have an effect. And in the end, we use nature's resources responsibly, expediently, and only to the extent necessary. The most effective way to teach energy awareness is somewhere in the preschool years. Love, respect, and thrift for nature can still be taught there.

It is unlikely that decision-makers would be able to free themselves from the captivity of self-interest, money, or lobbies in one fell swoop. Despite everything, great individuals appear in history who are able to convey their correct insights to large masses of people, who are able to influence the processes of the entire world. By BOTOS, C. (2019) such persons were, for example, the Indian Joseph Kumarappa, who developed a sustainable economic policy for Gandhi; Ernst Friedrich Schumacher, who fought for sustainable European industry and

agriculture; or the American Rachel Carson, who fought successfully against the environmentally damaging pesticide DDT - and the list could be continued for a long time.

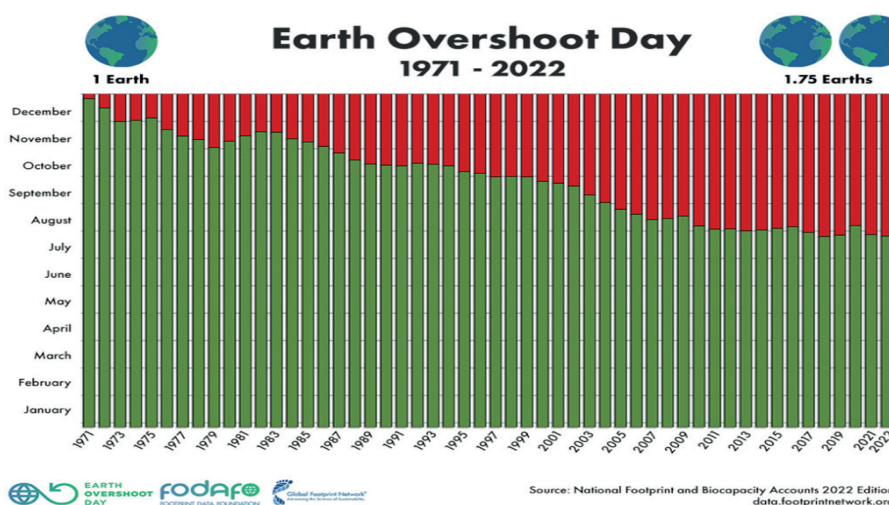
There is currently a worldwide game in which people have been weaned from the traditional way of life, they are fed international food, they are made to travel as global citizens, and they consume the shortest-lived products of overworked industry. Of course, the focus is on money, so don't get your hopes up that the goals of the providers will change. In addition, it is likely that the present social system will not be swallowed up by the Sun growing into a red giant in 7 billion years. Not only SZABO, I. (2020) but the above-mentioned facts show also that the current direction is unsustainable in every respect.

The overshoot day arrived far earlier close to the middle of July. It means we consume instead of the available on Earth (capacity) 1,75 Earth (benefits) per year.

7. CONCLUSION

One thing can be said for sure: The cleanest energy is energy that is not consumed, that is, the energy that is not produced. Likewise for non-manufactured packaging or non-wasted food. If we have saved something here compared to our

6. Figure: Earth overshoot day 1971-2022



National Footprint and Biocapacity Accounts 2022 Edition data.footprintnetwork.org; <https://www.overshootday.org/>, [Date Accessed: 1/09/2022]

previous habits, then we must have made a small contribution to the unchanging nature of the universe. Of course, the question immediately arises: Is it really our job to make it as small as possible? Do we really not need to build the tallest skyscraper in the world? Probably not, as long as we don't have a strong argument for this. We'd rather rely on ourselves to build a sky-high skyscraper, we'll go as far as we can. Until then, we can live in more modest conditions, use more durable tools, and consume products close to home that have traveled a shorter transportation route. For the concept of a simpler way of life, it is excellent to get to know a little more complicated ones or even those who live in much more modest conditions than ours. A new car is always more attractive than an old one, but if we can, we don't have to change it every year. This applies to the bicycle, to the two-year-old skis that have gone out of fashion, and to all our utility devices. Of course, exaggerated "planned obsolescence" in the interests of manufacturers works against this. We don't have to immediately throw out our energy-consuming consumer equipment, either, only if we can thereby save the energy invested in the production of the new equipment. (The reverse of this is that a well-built power plant – e.g. German nuclear power plants – should not be shut down at the dawn of its planned lifetime because this will make its specific environmental impact even greater since it barely produced according to our previous plans.) The solution is the triple E:

*Energy consciousness – Environment consciousness
– Earth consciousness*

One needs to save Energy – Raw materials – Water and all other natural resources. The really renewable is the good solution -taking into continuously the Life Cycle Assessment approach.

It is our responsibility to be aware, to do a little for the greater good - but in the world, physics works independently of us.

FOOTNOTE:

1- ppm – pars pro million – pieces of among 1 million air molecules, recently approx. 0,4 % of the total number of molecules and volume; approx. 0,6% of the mass %.

2- Amount of the emitted CO₂ during the production of 1 kilowatt-hour

3- Planned obsolescence – a policy of planning or designing a product with an artificially limited useful life or a purposely frail design / Wiki

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