

## ARE FOSSIL FUELS THE MAIN CAUSE OF TODAY'S GLOBAL WARMING?

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**Abstract.** *Gas will increasingly be seen as the fossil fuel of choice, especially when considering environmental impacts. Natural gas is the chance for Serbia for sustainable development and with its intensive consumption in the XXI century to conciliate the 4Es (Energy, Economy, Efficiency and Environment). In this paper we will compare the impact of different fossil fuels used for domestic heating with a special emphasis on natural gas. Some other causes of climate changes will be also discussed such as the Milanković astronomical cycles. These factors will be compared with climate changes caused by the consumption of fossil fuels.*

**Key Words:** *Natural gas, Fossil fuels, Domestic heating, Ecology, Milanković cycles*

### INTRODUCTION

Many factors affect climate change at orbital time scales, including external forcing (insolation) and the results are changes in ice volume and greenhouse gases that produce interactions within the climate system.

Natural gas in Serbia is expected to be the primary substitute for electricity based heating either through district heating in densely populated areas or individual boilers [5, 6]. The extension of the gas networks is extremely important for Serbia's overall energy and environment strategy [7, 8]. An increase in the share of natural gas energy is the strategic option and its consumption should increase at the highest rate as the result of substitution of other fuels and increased demand. These issues are especially in focus these days since the oil and gas agreement with Russia was signed [7, 8]. In a discussion on the environmental impact of fossil fuels oriented heating, one has to be very careful since in the global earth climate system other factors of influence exist, such as astronomical ones [24]. The Milanković cycles, named after the Serbian scientist Milutin Milanković have a great impact on earth's climate [24]. Fossil fuels are the dominant polluter today, but are

they main cause of obvious climate changes today? Today in the post-Kyoto world, reduction of CO<sub>2</sub> is very important, but the main question is if this increased value of greenhouse gases is the main cause of climate changes, or to the contrary, is this increased level of greenhouse gas only a consequence of climate changes caused by other sources. The fact is that the current level of atmospheric CO<sub>2</sub> is far below the maximal values which had been occurring in some of the old geological eras [33] (Figure 1). Urban areas have experienced a local increase of temperature usually noted as the ‘urban heat island’ [1]. This local temperature anomaly is possible caused by the increased presence of urban gasses.

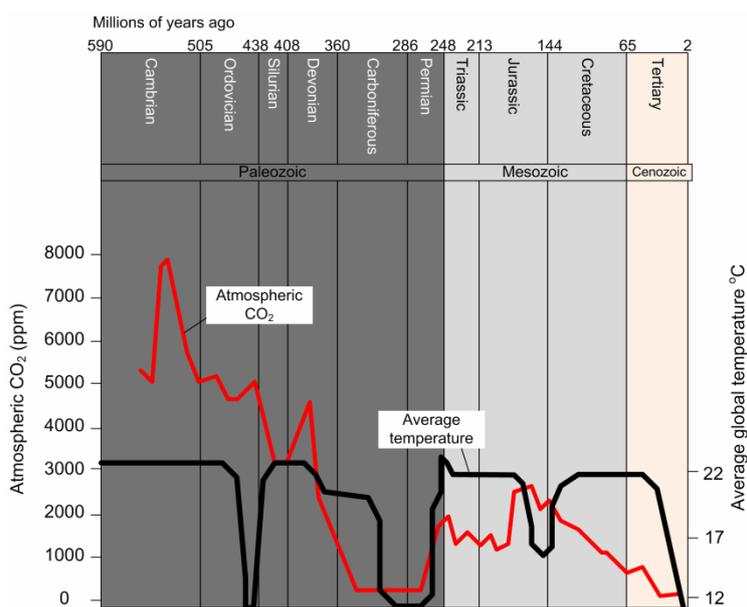


Fig. 1. The average temperature and atmospheric CO<sub>2</sub> for the last 600 million years (according to data from [www.geokraft.com](http://www.geokraft.com); temperature after C.T. Scotese, CO<sub>2</sub> after R.A. Berner)

Evidence of warming is often presented as evidence of human-caused warming. The logical construction of this argument is as follows:

1. If human activity causes global warming, then the Earth will warm.
2. The Earth is warming.
3. Therefore, human activity causes global warming.

This argument is invalid because the conclusion is drawn from a common logical error known as the converse error. As a clarifying example of a converse error, consider the argument:

1. If Joe drops the glass, the glass will break.
2. The glass is broken.
3. Therefore Joe dropped the glass.

The conclusion that Joe dropped the glass is invalid because the glass might have been dropped by anyone else, or it could have been broken by some entirely different means. By the same logic, evidence of warming is simply evidence of warming. No conclusion about the role of human activity can be drawn from it. Another invalid argument is the claim that, "If there is a consensus of scientists that global warming is human-caused, then human-caused global warming must be true". This argument is invalid for at least two reasons: first of all, the premise is not true. Consider, for example, the consensus of scientists long ago who believed the Sun and stars revolve around the Earth. Clearly, a consensus does not make it true.

#### ENVIRONMENTAL IMPACTS OF NATURAL GAS FUELED HEATING

Gas utilization in Serbia started half a century ago. The program of introducing a gas pipeline, approved in the year 1973, enabled the import of natural gas from the USSR in 1978 as well as intense development of the gas pipeline system of Serbia. Now the gas pipeline system connects all gas fields with consumers, enables gas import from Russia through Hungary and transit of gas for the Republic of Srpska. Due to the oil and gas agreement signed with Russia, Serbia will become a transient country for Russian gas to the western countries of Europe [7, 8].

Natural gas for domestic heating can be used in two opposite heating systems, i.e. through an indirect system where natural gas is being combusted in a heating plant and household heat supply is provided by a district-heating (DH) system and the other possibility is through a direct system where dwellings are being heated by natural gas brought through a gas distribution system and then combusted in domestic gas boilers in each dwelling individually (G). Extended research during 2003-2006 performed by Brkić and Tanasković compared different influences of gas oriented heating in Serbian settlements [5, 6]. In this study, 96 types of Serbian settlements which differed according to different urban parameters were compared (Figure 2). This is unique research in Serbia. Abroad, researchers have done analyses of local or district natural gas heating from energetic, environmental and economic points of view [15, 19]. The strategy for heating of dwellings in the urban areas of Serbia, since the communist period, had been created to favor DH systems in towns. The consumer area of Belgrade is being supplied with thermal energy by a DH system consisting of 15 heating plants, which use gas (83%= $265 \cdot 10^6$  m<sup>3</sup>/year) and crude oil as a basic fuel. Statistical data show that 38% of the buildings are connected to the DH system. In their study, Brkić and Tanasković concluded that natural gas has a similar environment impact in both cases, i.e. in terms of direct (G) or indirect (DH) domestic heating [5]. Pollution in both observed systems are approximately equal in sum, but dispersions of pollutants are not equal. In direct heating system (G) the main victims of pollution are the consumers of domestic heating themselves.

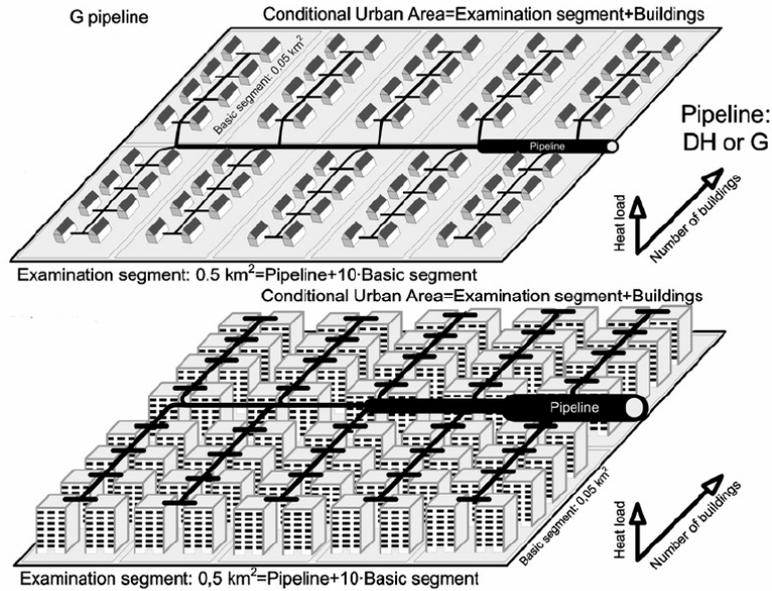


Fig. 2. Two examples of Serbian settlements of the 96 examined [5].

In gas plant oriented heating (DH) all pollution comes from a single source which is entirely released through the chimney into high levels of atmosphere. Very high chimneys can be more dangerous for the environment because they launch greenhouse gases (Figure 3) directly into the high parts of the atmosphere where they are most dangerous [4, 11, 32].

The fact is that natural gas is a minor pollutant compared to other fossil fuels (Table 1) [17, 20].

Table 1. Impact of environmental impact of different energy sources

	Coal	Liquid fuel	Natural gas
SO <sub>2</sub>	620	140	0.1
NO <sub>x</sub>	40	40	40
Particles	200	5	0.1
HCl	20	-	-
HF	2	-	-
CO	6000	70	70
Formaldehydes	1	5	1
HC <sub>x</sub> total	200	15	15
CO <sub>2</sub> (+CO)	99000	74000	57000
Heavy metals			
Cd	0.011	-	-
Hg	0.004	0.0001	0.0001
Pb	0.1	-	-

But can we use natural gas or other fossil fuels without dire consequences? The answer is maybe but we do not really know [28]. The fact is that we have to heat our dwellings and maybe it is not a certain fact that CO<sub>2</sub> released from the fossil fuel is the major reason for global warming [3, 20, 25].

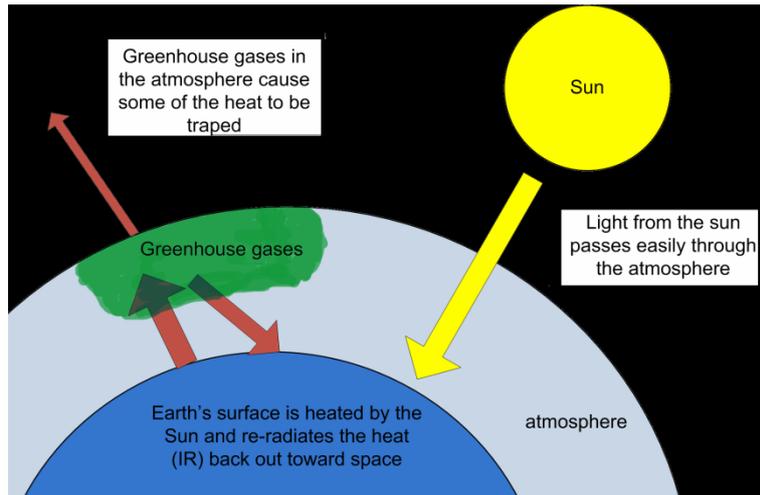


Fig. 3. Greenhouse effect

Natural gas is almost always a secondary product which occurs during the exploitation of oil fields (Figure 4). The main problem is what to do with this produced gas in the distant regions in absence of infrastructure for the utilization of natural gas.

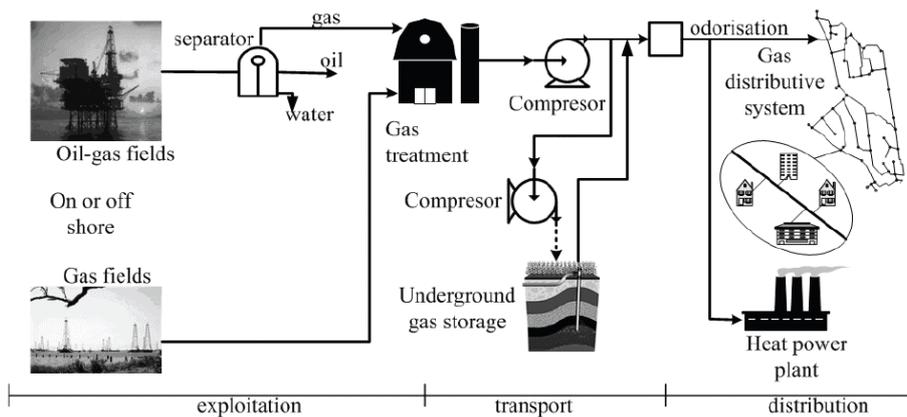


Fig. 4. Natural gas from deposit to final consumers [6].

In a distant part of the world oil infrastructure exists but natural gas pipelines do not. This is the main reason why many oil companies discard natural gas as a less interesting energy source compared with oil in the observed conditions. In that way large amounts of natural gas are burned off in the flares in oil gas fields. A consequence is that these amounts of gas are released into the atmosphere without rational preliminary usage. Annual gas flaring of natural gas in oil fields sends 84000 tonnes of carbon into the atmosphere worldwide every year [2] (Figure 5).

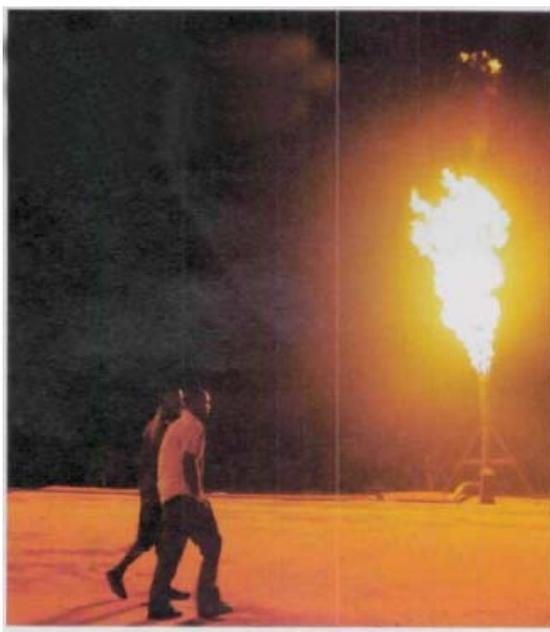


Fig. 5. What a waste: gas is burned off in oil producing areas where there are no facilities to make use of it

Gas flaring is widely recognized as a waste of energy and an added source of atmospheric carbon emission. This flaring has fluctuated between 150 billion and 170 billion  $\text{m}^3$  a year. Note that the peak of annual Serbian indigenous production of natural gas is about 0.6 billion  $\text{m}^3$ , and today is several times lower. Russia, Nigeria, Iran, Iraq, Angola and Venezuela respectively, are the biggest contributors to natural gas flaring. The UK is between the 15th and 20th biggest flarer with 0.6 billion  $\text{m}^3$  per year [2].

Here it has to be noted that the amount of  $\text{CO}_2$  is measured in ppm (parts per million) in the atmosphere, compared to the  $\text{CH}_4$  in ppb (parts per billion). Such small shares of these gases have a great impact on the greenhouse effect [17, 34]. Methane ( $\text{CH}_4$ ) is the main ingredient of typical natural gas. The estimated amount of  $\text{CO}_2$  in the atmosphere increased by 19 billion tonnes in 2007. This is a rise of 0.6%, lifting the concentration of  $\text{CO}_2$  to 385 ppm.

ASTRONOMICAL CAUSES OF CLIMATE CHANGES

The Milanković theory, named after Serbian civil engineer and mathematician Milutin Milanković (1879-1958), describes the collective effects of changes in the Earth's movements upon its climate. Milanković mathematically theorized that variations in eccentricity, axial tilt, and precession of the Earth's orbit determined the climatic patterns on Earth, resulting in 100,000-year ice age cycles of the Quaternary glaciation over the last few million years [24, 31]. The Earth's axis completes one full cycle of precession approximately every 26,000 years. At the same time, the elliptical orbit rotates, more slowly, leading to a 23,000-year cycle between the seasons and the orbit. In addition, the angle between the Earth's rotational axis and the normal to the plane of its orbit moves from 22.1 degrees to 24.5 degrees and back again on a 41,000-year cycle. Currently, this angle is 23.44 degrees and is decreasing. The Milanković theory of climate change is not perfectly worked out; in particular, the largest observed response is at the 100,000-year time-scale, but the forcing is apparently small at this scale, in regard to the ice ages [16]. Various types of feedback (from CO<sub>2</sub>, or from ice sheet dynamics) are invoked to explain this discrepancy [23, 29, 30]. Some researchers have found a connection between monsoons and Milanković cycles [10].

Ignoring anthropogenic and other possible sources of variation acting at frequencies higher than one cycle per 19,000 years, the Milanković model predicts that the long-term cooling trend which began some 6000 years ago will continue for the next 23,000 years. Now, the Earth is in a hot period between two glaciations. The amount of solar radiation (insolation) in the Northern Hemisphere at 65° N seems to be related to occurrence of an ice age. Astronomical calculations show that the 65° N summer insolation should increase gradually over the next 25,000 years, and that no declines in the 65° N summer insolation sufficient to cause an ice age are expected in the next 50,000 to 100,000 years [9, 18, 21] (Figure 6).

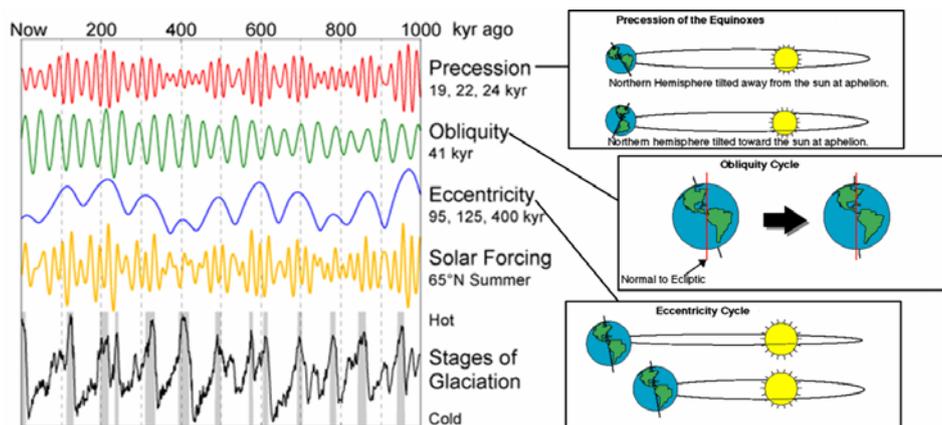


Fig. 6. The Milanković cycles and climate changes

Thus the Southern Hemisphere seasons should tend to be somewhat more extreme than the Northern Hemisphere seasons. The relatively low eccentricity of the present orbit results in a 6.8% difference in the amount of solar radiation during summer in the two hemispheres.

The Milanković hypothesis was proved and became a theory by the correlations of its astronomical parameters and the oxygen isotope samples from deep ice core (500–952 m) from Antarctica [16]. Hays et al. [16] measured the oxygen isotopic composition of planktonic foraminifera which are sensitive to climate changes. In the nineteen-twenties the theory was also applied to the temperatures of the Moon, Mars and Venus (very successful in the first two cases, but failed in the third).

### CONCLUSION

When I decided to submit this paper, I had planned to discuss only the environmental impact caused by natural gas and other fossil fuels used for domestic heating in settlements. But I believe it would be also appropriate to discuss some other influences on global climate, which is also connected with local climate in each settlement. Is it true that all climate changes are caused by human influences [23, 30]? The fact is that only 1% of all the species that have ever lived on the Earth is still living today. All the other, i.e. 99% of species that have ever lived on this planet disappeared before the dawn of modern man. The conclusion is that the human race has to decrease pollution, but this pollution is not always the main reason for the disturbances in the fragile nature balance. Good, clean and fresh air has no alternative [14, 27, 35]. Despite the fact that some researchers have found that CH<sub>4</sub> concentration in the atmosphere has been increased by human activity for 250 ppb and CO<sub>2</sub> for 40 ppm above natural values [29, 30], human activity maybe is not the main reason for global warming, but for e.g. acid rain it is [12] and very possibly for great disturbances in the ozone layer [13, 26].

Finally, some hypotheses claim that the particulates emitted when burning fossil fuels could even be shielding us from the full impact of global warming.

Additional alternatives to petroleum, non-fossil fuels, include, most importantly, a spectrum of bio-fuels, electricity from other sources, and hydrogen. Bio-fuels derive their energy from photosynthesis (the Sun) while electricity and hydrogen are energy carriers that can be produced from a wide range of energy sources, including fossil fuel, nuclear, hydro, geothermal, solar, and wind energy. In Serbia, the long-term strategy lies in the increased use of natural gas. Natural gas is fossil fuel, but with the least pollution effects among all other fossil fuels. Unfortunately, some researchers have found that coal will be the energy of future despite of its negative environmental impacts since coal is by far the largest fossil fuel resource in the world [22].

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## **DA LI SU FOSILNA GORIVA GLAVNI UZROK SADAŠNJEG GLOBALNOG ZAGREVANJA?**

**Dejan Brkić**

*Gas se uobičajeno uzima kao poželjno gorivo, naročito kada se uzme u obzir očuvanje životne sredine. Prirodni gas je šansa da Srbija ostvari održivi razvoj i da sa njegovom intenzivnom potrošnjom uskladi ideal tzv. 4E (Energija, Ekonomija, Efikasnost i Životna sredina; eng. Environment). U ovom radu se upoređuju uticaji različitih fosilnih goriva koja se koriste za grejanje u domaćinstvima sa posebnim osvrtom na prirodni gas. Neki od ostalih uzročnika klimatskih promena se takođe razmatraju kao npr. Milankovićeви astronomski ciklusi. Uticaj ovih faktora na klimu će se uporediti sa klimatskim promenama uzrokovani upotrebom fosilnih goriva.*

**Ključne reči:** *Prirodni gas, Fosilna goriva, Grejanje u domaćinstvima, Ekologija, Milankovićeви ciklusi*