

In defense of coal

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The Polish power industry is based on coal. In connection with the international conference (climate summit) held in Warsaw, there were many critic voices, in Poland and abroad, that blamed Poland for polluting atmosphere with largest amounts of CO₂, greenhouse gas. Our (Polish) only fault is that we still do not have any nuclear power plants. If there were at least two such objects of capacity 3k MW each, just as it is planned, then coal share in power production would be much lower.

It seems surprising that Polish environmentalists, who fight against coal-based power industry, are at the same time fighting against nuclear power, instead of supporting it strongly. However, in foreseeable future, about 50 to 100 years from now, Polish and global power industry will be based on coal-fired or uranium-based power plants. Among non-renewable energy source crude oil and natural gas still hold the most important place.

It may seem strange that environmental discussions often omit the fact, that combustion of oil and gas in power plants, as well as combustion of petrol by cars, also produces carbon dioxide. Combustion of one tonne of gas (methane) produces 2.68 tonne of carbon dioxide, while combustion of one tonne of oil or petrol is equal to production of 2.7 tonnes of CO₂. Burning crude oil and gas to generate power is an unrecoverable waste of these precious resources. They are necessary for production of nitrogen fertilizers, rubber, methanol, plastics, household chemicals, and fuels for motor vehicles and aircraft.

But combustion of coal and hydrocarbons is not the only source of carbon dioxide. Cement plants are a source of 7% of global CO₂ emission. Humans and all animals also emit CO₂ – most of it is produced by herbivores. Elephants, antelopes, giraffes, hippos, stags, deers, buffalos, bisons and domestic animals, including 1.5 bln cows emit large amounts of carbon dioxide. Carbon dioxide emitted naturally, as well as the one emitted by industry and households, is converted by plants into their building blocks. Atmospheric CO₂ concentration is so low, that if it was not recreated, in 30 years carbon dioxide would be completely eliminated from the atmosphere causing the end of all life on Earth. This conversion can be very well described by saying from Gospel: "Ashes to ashes, dust to dust". CO₂ generation and absorption resembles so-called bicycle model, which when stops to rotate and move, falls.

Due to low atmospheric concentration and quick circulation of carbon dioxide in the environment, such an equilibrium can be very easily disturbed. Therefore, large variations of atmospheric concentrations of this gas were and still are common thing. Dry atmospheric air (with no steam) contains about 0.03 mol % (and v/v%) CO₂ (i.e. about 300 ppm). The increased atmospheric concentration of carbon dioxide has very advantageous effect on plant growth, thus on crop yield in farming. Rate of photosynthesis in plants similarly to the vast majority of chemical reactions is proportional to reagent concentration, i.e. in this case to CO₂ concentration. Currently, there are higher yields of cereals, potatoes, soybean, cotton, oil plants and other crops.

Carbon dioxide is not the only, or even the most important, greenhouse gas. All gases, which molecules contain 3 or more atoms are greenhouse gases. The more atoms in gas molecule, the stronger

a greenhouse gas it is. Steam (water) is also one of greenhouse gases. The higher temperature, the higher steam content in atmosphere and this cannot be changed in any way. The more sunspots and the more energy sun emits, the higher steam content in atmosphere. Probably the changes of energy intensity emitted by sun are the most important reasons behind climate change. Another greenhouse gas is methane, acting about 21 times stronger than carbon dioxide. Methane is emitted during extraction of coal, crude oil and natural gas, as well as in putrefactive processes of plants. An important source of methane are rice fields, swamps and lakes as well as decomposition of animal husbandry manure. Agriculture is responsible for production of approx. 15% of all greenhouse gases.

In high temperatures nitrogen and oxygen from air used for fuel combustion form nitrogen oxides. Nitrous oxides generated in power plants in high temperature combustion of crude oil, gas and coal are also greenhouse gases. Chemical industry is also responsible for nitrogen oxides, which are emitted in manufacture of nitric acid, important substrate for production of nitrogen fertilizers and explosives. Moreover, there is plenty of other greenhouse gases emitted to the atmosphere by chemical and automotive industry. Automotive industry and households are responsible for atmospheric emissions of paint solvers, while furniture industry emits unpolymerized adhesive components. Chemical industry usually burns catalytically most of chemical unreacted in technological process, but still many of them are emitted to the atmosphere, among others benzene, acetone and formaldehyde.

Very often environmentalists tend to promote energy production from renewable sources instead of energy based on coal, crude oil or gas. It is a noble goal, but impossible to achieve immediately and on a large scale. The most important renewable energy sources are hydropower plants, wind farms and solar energy. The construction of hydropower plants requires large water flows or very large height differences, preferably both. Poland has no such conditions, thus, there are only small hydropower plants constructed mainly near reservoirs. Poland still has problem with flow equalization (flood prevention), since for some rivers there is even a thousandfold difference between minimum and maximum flowrates. While for the wind farm to be efficient, the wind speed on average should be at least 4 m/s and there are almost no locations with so strong wind in Poland. Great Britain and Denmark have the best conditions for construction of wind turbines among European countries. Denmark generates the most electricity from wind farms and it also has the highest electricity prices in Europe. Furthermore, Germany has definitely better conditions for construction of wind farms than Poland and at the same time the highest installed capacity of wind turbines in Europe, but share of produced wind power is minute (3%), therefore there are no plans to further development of this kind of power plants in Germany.

We should observe changes that occur in German power industry and draw the conclusions. Hastily made decision on closing nuclear power plants may come to life within 20 years. Germany is a rich country, but it will not be able to replace power generated by nuclear plants with renewable energy sources. Currently, Germany turned to brown coal, and probably in future will also reach for hard coal, crude oil and gas. Renewable (green) energy is expensive, but in Germany it is assumed that it will become cheaper as its use grows. Such an assumption may prove to be illusory.

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The renewable energy fashion may as well pass very quickly just as the biofuel fashion had passed. The European Union stopped increasing limits for biofuel admixtures in petrol. Biofuel production competes with food production, which translates into the increase of food prices.

The only unlimited renewable energy source is solar energy. If we were to burn all the crude oil, all the natural gas and all the coal still underground and all the trees growing on our planet, the obtained amount of energy would be equal to energy transmitted from Sun to Earth in a period of only 4 days. Sun will shine relatively stably for another approx. 1 bln years. Life on Earth will not last so long, possibly even not as long as another 500 mln years. According to some sources, after such time there will be no more water on Earth. Regardless there can be no doubt that even use of small portion of solar energy for production of electricity could satisfy humankind needs forever. This is confirmed by calculations, according to which if we used only 10% of solar energy incident on 20% of Australian desert land, all global current power needs would be satisfied.

Since 1970's there is an ongoing research on production of electricity using solar energy. There are four main methods of using solar energy: photocatalytic hydrogen generation from water, photovoltaics, solar-heated ground air and heating water using systems of moving mirrors. Two last methods could be implemented immediately. Photovoltaic cells still need some work in order to decrease their price. Areas for construction of solar power plants must be excluded from agricultural use. Therefore, deserts seem to be the best locations for construction of solar power plants and they take large enough portion of land. Solar power plants located in North Africa could fully satisfy all European and African energy demands. There are still unresolved problems regarding how to store large power amounts during night-time and how to transfer energy over long distances. The European Union should attempt to solve these issues. Europe has only one small solar (photovoltaic) power station in Portugal. Portugal has no own deposits of coal, crude oil and gas. The power plant was located in the most sunlit area in Europe.

Returning to the subject of Polish power industry, it must be said that possible use of renewable energy in Poland is very limited. There are no high water flows and height differences, we will have no stronger winds (we almost have none); sun will not shine more and we have no deserts. The only possible use of solar energy on a larger scale in Poland, is combustion of wood, straw and cane, which is already used in Polish power plants. Households and some municipalities use solar panels and photovoltaics, but this cannot be used in commercial power industry. They do not operate in night-time or in low insolation periods and pay for themselves only after 15 to 30 years, with substantial subsidies. Wind turbines can be used on large farms for heating water just as it has place in the United States. In such a case, there are no problems with power grid synchronization and heated water can keep high temperature even for a week, in case of no wind.

Polish energy industry is condemned to use coal and nuclear energy. Therefore, Poland needs to quickly build new power units in Opole and two planned nuclear power plants of 3k MW capacity each. Polish nuclear power industry could be established immediately starting from Polish participation in the construction of nuclear power plant in Kaliningrad Oblast. This could solve power problems of north-east Poland. There are high hopes in Poland regarding shale gas. Some, even prominent people absurdly propose to invest in shale gas instead of in nuclear power plant. At this time shale gas shall be seen as "castles in the air". About 2 bln PLN have been invested in exploring without any great successes. In order to determine how much shale gas really is there and whether its exploitation will be worth it, it is still necessary to invest another funds corresponding to half of funds needed for construction of nuclear power plant of capacity of 3 thousands MW

and we still need another about 10 years. Currently we cannot be sure, whether exploitation of shale gas will be profitable. However, this does not mean we should stop exploratory drilling, but there is no need for undue enthusiasm. If drilling proves to be successful, as we shall hope for, gas can be used in chemical industry and households – it does not have to be used in power plants.

In the past, German scientists Friedrich Bergius as well as Franz Fischer and Hans Tropsch have developed independently two methods for production of liquid fuels from carbon. However, at this time both of them are unprofitable. When price of crude oil was 3 USD/barrel it was predicted that when price doubles, production of fuel from oil will become profitable. In the meantime, crude oil price has increased 10 fold and new calculations were conducted. Again, just as before, it turned out that production of petrol from coal will become profitable, if crude oil price doubles. Problems related to costs of such production become evident only after third coal-to-fuel method was developed, i.e. catalytic dehydration of methanol using zeolite. Coal liquefaction process requires hydrogen and the cheapest material for hydrogen generation is methane, second – crude oil, and only third is coke (high quality, sulphurless). After the WWII coke was still used for production of syngas (hydrogen and carbon monoxide mixture) which is used in chemical industry, among others for production of hydrogen and ammonia. Currently, all these products, including methanol are produced from natural gas.

Polish national wealth, coal, is only suitable for power generation and production of coke used in steel industry. There are new ideas in Poland to focus on underground coal gasification. Research on underground coal gasification ended almost 50 years ago in the former Soviet Union. Proponents of underground coal gasification claim that all contaminants will stay underground. However, this is not true. The most important impurity in coal is sulphur, which is all transferred into obtained gas in form of sulphur dioxide. Underground coal gasification gives gas, which contains mainly nitrogen and carbon dioxide, as well as small quantities of hydrogen, carbon monoxide, argon and sulphur dioxide. This gas has low calorific value, is highly toxic and is completely unsuitable for any uses in chemical industry. Such gas could be only used for combustion in some environmentally unfriendly boiler house.

Poland has no deposits of crude oil, so far it has no natural gas, there are also no large flows or height differences. If you don't have what you like, you must like what you have. We have hard and brown coal and it should be used as well as possible for the good of the Polish economy. And the best possible way of using it is to produce power from coal.

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