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SOCIAL RESPONSIBILITY CONCEPT AND STRATEGY FOR SUSTAINABLE DEVELOPMENT IN THE ENERGY SECTOR AND PRINCIPLE OF GEOETHICS

Abstract: *Intangible resources of energy companies such as reputation, people and mutual interaction between economics, politics, and cultural processes are beginning to play an increasingly important role in the value-added of the company.*
Geoethics, which combines the ethical problems with geological and biological sciences and exploitation of Earth's resources, fits this concept of business perception. Geoethics, the concept of corporate social responsibility and sustainable development strategy form the principles and standards of business focused on Earth, as the geological, social and economic object.

In the article the author makes a brief review of the main research areas of geoethics – definitions and principles, proposed by the various authors, which can be found in the literature. The relationship between geoethics, a sustainable development strategy and the social responsibility of business has also been presented. In the second part of the article the author presents opportunities and challenges for the energy sector and the challenges of geoethics in the context of the "shale gas revolution".

Key words: *geoethical principles, social responsibility, sustainable development, shale gas*

Geoethics, corporate social responsibility and sustainable development strategy form the principles and standards of conduct aimed at the Earth as a geological, social and economic object. Ethical and responsible decisions, particularly in the mining sector, are subject to continuous social assessment, as the acquisition of raw materials and their processing is the form of human activity which is the most onerous to the environment. Mutual interaction between economics, politics and cultural processes can be the driving force of the global economy of the 21st century. Geoethics fits such a development concept. Geoethics combines ethical problems with geological and biological sciences, as well as the practical aspect of the use of the Earth's resources. The basic principle of geoethics is also the idea of corporate social responsibility and sustainable development, as the idea of building an economic model that ensures the progress of humanity and will enable a better life without destroying the systems that support it.

"Geoethics" is not a new term, it has been in use for decades - usually in the context of the anthropogenic – human impact on the environment. Institutionalization of geoethics and geo-diversity occurred quite recently, in 2004, with the creation of the Working Group for the Association of Geoscientists for International Development (AGID).

There is no clearly established research area of research of geoethics and various authors ascribe different meanings to the concept. Overview of the publications related to the geoethics indicates two main areas of research. In the first one, in defining the scope and principles of geoethics, the authors draw attention to the consequences of technological developments, in particular bioethics. The study area focuses on the effect of technology on ecosystems of the Earth. The second theme directs research area towards human activities associated with the use of Earth's natural resources and the monitoring and forecasting of natural disasters. The Polish scientists who in February

2013 initiated the creation of the Polish section of geoethics are part of this research trend.

In the article, the author describes the main research areas of geoethics – definitions and principles, proposed by the various authors in the literature. She has also presented the relationship between geoethics, a sustainable development strategy and the social responsibility of business. In the second part of the article the author emphasizes the importance of perceiving the principles of geoethics in the context of the "shale gas revolution".

1. The area of research and principles of geoethics

In publications about geoethics is difficult to find a clear definition of the concept. Probably for some time theorists and practitioners will discuss the scope and area of research, which is understandable in the case of a new discipline. The origin and evolution of the term "geoethics" can be found in the publication "Geoethics and Deontology. From fundamentals to applications in Planetary Protection" (Martinez-Frias et al. 2011), the authors emphasize the multidisciplinary nature of geoethics.

Not everyone treats geoethics as a field of science, but rather as a set of rules of ethical conduct. Michael Treder defines geoethics as a set of commonly agreed and accepted principles for the application of new technology, which can have an impact on the environment, including humans (Treder 2006).

According to Jamais Cascio, geoethics is “the set of guidelines pertaining to human behaviors that can affect larger planetary geophysical systems, including atmospheric, oceanic, geological, and plant/animal ecosystems. These guidelines are most relevant when the behaviors can result in long-term, widespread and/or hard-to-reverse changes in planetary systems" (Cascio 2005). Table 1 contains six principles of geoethics proposed by Cascio.

Martine Rothblatt, an American ethicist, understands geoethics as a set of three basic principles: consent, equipoise, assurance. The application of these rules allows the ethical conflict resolution at the interface between public and private interests. The author sets out the principles of geoethics on the basis of a related area of knowledge – bioethics (Rothblatt 2007). Table 2 illustrates the relationship of principles of bio and geoethics (the equivalent of a patient in bioethics are millions of people in geoethics).

The geoethical consent principle requires consent for any action from whoever is to be affected it. The principle of equipoise is a duty to treat everyone according to the same criteria. The third principle of geoethics is the consent to monitoring, assurance. In bioethics, any ethical medical procedure must be in accordance with the best practices and be subject to institutional control or at least free consultation by specialists. Geoethics gives green light to independent organizations to ensure that the action is in line with the principle of consent and equipoise.

TABLE 1. The principles of geoethics by Jamais Cascio

Principle:	Definition:
Interconnectedness	The occurrence of significant relationships between ecosystems – systems of the Earth do not exist independently and changes made to one system will have an impact on other systems.
Diversity	A diverse ecosystem is more resilient and flexible, better able to adapt to natural changes. Variety is the opposite of monoculture, which is the result of intentional or unintentional human activity. Monoculture makes ecosystems less able to survive the shock.
Foresight	Decisions taken by the people, relating to interference in any ecosystem should take into account the planetary pace. Forecasting the effects of interference in the ecosystem requires a distinction between the time from the perspective of human and the time from the perspective of ecosystems. These two perspectives of perceiving time make unnoticeable effects of the behavior of one generation cause slow but uncontrollable changes in the ecosystems (biocenosis and biotope).
Integration	Perceiving Earth's systems as common good - man is part of these systems, and should be aware of the fact that changes made by him have consequences for the whole Earth and all human societies. The basis of planetary thinking is the belief that no social group or any generation has the right to be the only entity in the possession and distribution of goods of the Earth, especially since they are not inexhaustible. "So no one can take possession in an absolute and selfish way of the environment which is not a 'res nullius' – something not belonging to anyone - but the 'res omnium' – the patrimony of mankind" (from the letter of Pope Paul VI to the delegates of the United Nations Conference in Stockholm in 1972, the first conference on environmental issues).
Expansion of Options	Finding a sustainable balance of use and preservation of Earth's resources, seeking behaviors that emphasize renewal and reuse of resources.
Reversibility	Changes made to planetary system should be done in a way that will allow making adjustments in the future, if the consequences of these changes are unintended or unexpected.

Source: *Own study based on (Cascio 2005)*

TABLE 2. The principles of geoethics and bioethics – relations by Martine Rothblatt

Principle:	In bioethics:	In geoethics:
Intent to help the patient	Non-malfeasance; Beneficence; Respect Autonomy	Consent
Treat similar patients similarly	Justice	Equipoise
Accountability	Peer Review	Assurance

Source: *Own study based on (Rothblatt 2007)*

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For several years, a group of Spanish researchers have promoted inclusion in the geoethics planetary geology and astrobiology (Martinez-Frias 2008; Martinez-Frias et al. 2011). According to the authors, the principles of ethics and ethical behavior should be applied not only in the field of earth sciences, but also in space research.

The latest topic that is being increasingly discussed in the context of the tasks and challenges facing geoethicists is the environmental consequences of the development of nanotechnology. Until recently, nanobots were the subject of science fiction films and books, today it is a rapidly developing field of science. David Nunez-Mujica believes that the principles of geoethics presented in Table 1 should be the basis for creation of ethical conduct regulation of nanotechnology. The author states that non-compliance with geoethical principles can lead to uncontrolled and dangerous for the Planet distribution of technology, increase the poverty of the undeveloped countries rich in raw materials (limited demand) and environmental degradation (Nunez-Mujica 2006).

The above-mentioned principles and definitions of geoethics are slightly different from the proposals of scientists belonging to another trend, which focuses on the geological resources of the Earth – the documenting, managing and mining.

1.1. “Geological trend” in geoethics

The precursors of the "geological trend" in geoethics are Czech economists Václav Němec and Lidmila Němcová. In 1992, in the Czech city of Příbram the first European symposium was held, which marked the beginning of the formulation of the principles of geoethics – an independent scientific discipline. Every two years the International Conference in Příbram (since 2005 held under the auspices of the AGID) is attended by a growing number of environmental representatives, geologists and geoethicists from many countries of Europe and Asia. Thanks to the activity of Dr. Václav Němec in promotion of geoethics and with the support of the geologists' circles, this new scientific discipline appeared at the International Geological Congress already in 1992, and since 2000 the Symposium of geoethics has been organized as an independent part of the Congress.

Geoethics, according to the "geological trend", is a set of moral standards that must be respected in every action at the contact point with the geosphere. As a scientific discipline, geoethics deals with the processes of making ethical decisions in the mining, operation and exploitation of non-renewable mineral resources. Representatives of the "European school" pay particular attention to the ethical dimension in the management of mineral resources (Němec, Němcová 2001, Němec 2003, Gold 2005, Shilin 1997).
Stefan Szabo proposes a very radical code of conduct in the management of mineral resources (Szabo 1997):

- prohibit mining deposits in areas with a significant impact on the ecological stability of the Earth (oceans, primeval forests) in undisturbed natural areas (e.g. Antarctica);
- maximize spending on rehabilitation and revitalization of former mining sites;
- pay more heed to production waste and improve its recycling;
- replace non-renewable energy sources by renewable (if possible), and scarce resources (or from protected areas) by substitutes;
- introduce new technologies to reduce consumption of non-renewable energy sources;
- realistic pricing of minerals, taking into account the costs of rehabilitation of post-mining areas and treatment of diseases caused by the extraction of raw materials.
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According to Alvin Toffler, geoethics rules are in its pronunciation ethical principles for a post-industrial and tele-informatic society, whose development is based primarily on knowledge rather than raw materials. The author notes: "as long as we have to move minerals such as bauxite, nickel from one end of the planet to the other, this means that we have a paucity of information to replace the minerals by local resources" (Toffler, Tofflerova 1996).

The challenge for geoethics is the process of globalization, as a result of which developed countries have minimized or even stopped harmful effects of exploitation of mineral resources on the environment by moving the extractive industry to developing countries. The genuine geoethical problems appear in the "raw material" countries, including Russia and former Soviet republics. It is therefore not surprising that geologists and geoethicists from these countries participate actively in the discussion on the challenges of the 21st century facing the mining companies – this is evident at the international conferences and congresses in the number of publications and presentations. Monograph *"Geoethics: theory, principles, problems"* by Natalia Nikitina is a voice in this discussion (Nikitina 2012). According to the author, geoethics is the science of the Earth, and the subject of her research are situations, problems and dilemmas associated with the use of geological and geographical environment, as well as the relationship between systems of the biosphere, including inanimate nature. Natalia Nikitina formulates "seven commandments", which should be the basis of geoethical conduct, i.e.:

- mineral resources and geological features of the Earth have the right to exist, regardless of immediate needs and benefits;
- nature, including mineral resources, is invaluable and should not be evaluated at market prices;
- the uneven geographical distribution of reserves requires global governance and global distribution of income from their use;
- the depletion of mineral resources requires international instruments governing their use;
- geography exploitation of minerals depends on the social and environmental requirements of the region/country, so mineral production centers develop in underdeveloped countries;
- landscape and mineral resources of the Earth should be seen not only as an object of protection and material resources, but above all as a heritage for future generations;
- secondary use of mineral resources (recycling) should be priority of the sustainable development strategy.
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Geoethics, according to a group of Polish scientists and practitioners-geologists, is a way of thinking based on sound knowledge and humanism, seeking to formulate rules of conduct and develop best practices in research and the use of Earth's natural resources and the minimization of geohazards.

The study area of geoethics, combining such broad fields as geology knowledge and ethics, is wide – some representatives of this discipline focus on the theoretical aspects (Gold 2005, Nemec 2003, Toffler, Tofflerova 1996, Shilin 1997), the others on the methodology of application of the principles in practice (Byrska-Rąpała 2005, Nieć, Radwanek-Bąk 2011, Nishiwaki 2008, Szabo 1997, Trembecki 2007), and others on the educational and cultural role of the geoethics (Abel, Varet 2007, Ahluwalia 2005).

2. The concept of corporate social responsibility and sustainable development strategy in the mining sector

The basic principle of geoethics is social responsibility and sustainable development – principles of constructing an economic model which will ensure human progress, and improve life without destruction of the systems which support this progress. The mining industry has understood that its wealth was flowing not only from the mining fields and other material values, but also its intangible resources, such as reputation and human resources. Those intangible resources have begun to play a greater role in the creation of the new value of the company.

Mining firms seek more and more new ways of attracting customers. One of the methods appears to be improving the way in which the company is perceived by society, employees and customers. Competing firms, as a result of the unification of economic systems, have reached a similar organizational and technological level, they operate in similar economic and social conditions. Since it is extremely difficult to achieve an advantage over competitors in the industry on traditional fields, such as production technology, management system or marketing techniques, mining companies have begun to seek sources of uniqueness of their own offer in the sphere of social expectations or those desired by society.

For this reason, the strategic objective of the sector should be the implementation of corporate social responsibility principles:

- equal access to the atmosphere as a resource and honesty in taking responsibility for reducing greenhouse emissions;
- recognition of the fact that economic or other activities undertaken in one country may not lead to damage and deterioration in others;
- intergenerational justice, indicating lack of consent for transferring the costs of climate change to the next generations;
- historical responsibility for changes made.

Mining raw materials and processing them is the most troublesome human activity for the environment. Therefore, the principle of sustainable development is a challenge of the 21st century for the mining sector. Sustainable development or eco-development was defined as 27 principles during United Nations Framework Convention on Climate Change. This document was signed by the majority of world countries at the Earth Summit in Rio in 1992. In 1997, during the conference in Kyoto these policies were

adopted as the Kyoto Protocol. One of the most important items is the obligation of countries to reduce the emission of greenhouse gases. Serious economic effects connected with the implementation of the stipulations of the Kyoto Protocol make negotiations difficult and ultimate solutions have not yet been reached. Mining companies can successfully influence the policy of the country where they pay taxes. Another factor which influences the political force of these companies is the fact that they employ thousands of people. Mining companies take numerous pro-ecological actions. It can be exemplified by actions taken by the biggest oil companies (Exxon Mobil, Royal Dutch Shell, BP Amoco or Chevron Corporation), i.e.:

- financing research on ecologically clean energy sources and improving existing technologies of obtaining energy (e.g. cogeneration which combines electricity and heating steam production);
- financing projects for renewable energy sources (co-financing works on creating materials for the production of materials for rotor blades and water-power plant turbines, which will be able to secure adequate technical parameters at low production costs);
- sponsoring research on creating a more efficient technology of processing oil and gas into the energy of hybrid engines.

Mining and raw materials processing companies are the most harmful economic entities for the environment. Mining of deposits and products themselves are the source of harm. Therefore, the sector will still be attacked by international ecological organizations – it has to diminish the degradation it causes and it must try to repair what has been already destroyed.

3. Ethical challenges and the "shale gas revolution"

Burning shale gas emits much less carbon dioxide (CO^2) and sulphur-dioxide than in the case of coal and crude oil. While using effective power plants in the combined cycle, natural burning of gas may emit less than half of CO^2 than in the case of coal per unit of electricity production.

Shale gas and its extraction are becoming an increasingly heated topic of discussion throughout the world. Impact of shale gas on the world geopolitical order has created the term "shale gas revolution". This revolution will be a zero-sum game, which is why different environments, institutions and organizations lead a debate on the advantages and disadvantages of this energy source. Experts – geologists and ethicists – are rarely involved in discussions, especially in the media, so the battle between the supporters and opponents of the gas takes the form of more and more doctrinal propaganda struggle. It is expected that key decisions on the possible extraction of these sources will be taken in political offices.

Shale gas extraction changed the gas market in the United States. Since 2000, shale gas production has leapt from accounting for only 1% of US production to 23% in As shown in Figure 1, in recent years there has been a significant increase in gas reserves in the USA. Since 2000, shale gas production has leapt from accounting for only 1% of U.S. production to 23% in 2010. The consequence of the increase of gas reserves and the share of shale gas in total gas production is a drop of the prices on the domestic market (Fig.2).

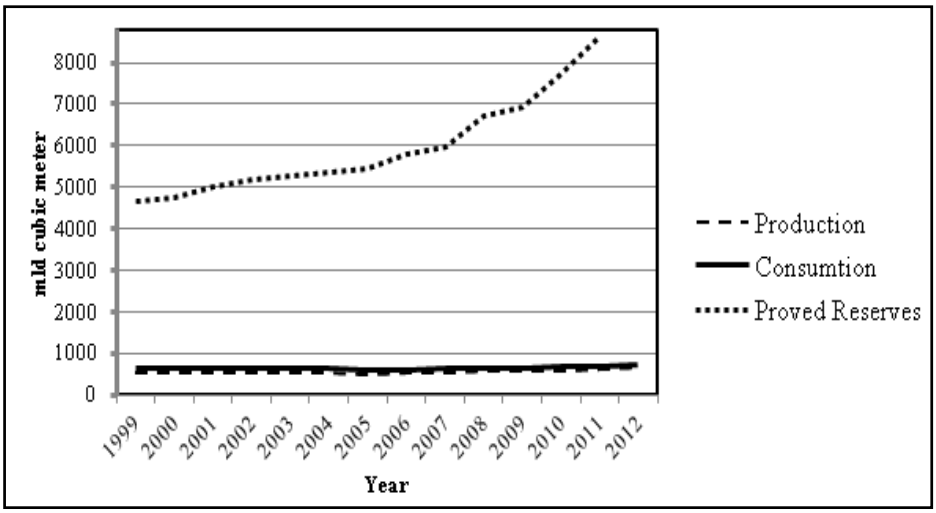

Fig. 1. U.S. – natural gas production, consumption and proved reserves (1999–2012)
Source*: Own study based on data of IA, (http://www.eia.gov/countries).*

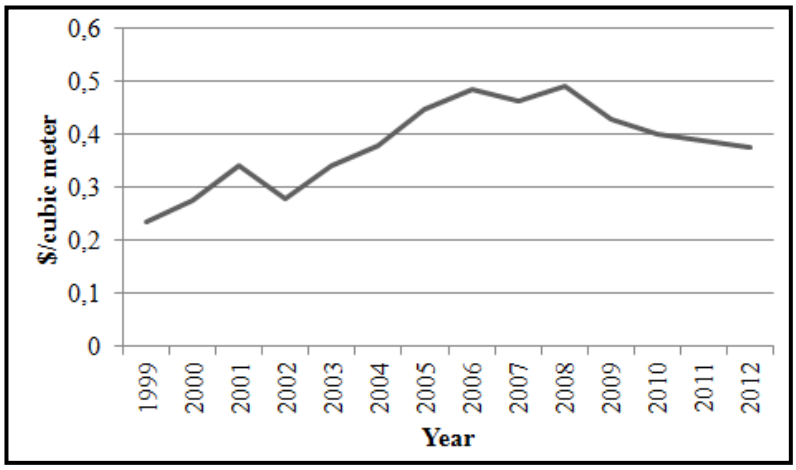

Fig. 2. USA – price of natural gas delivered to residential consumers (1999–2012)

Source: *Own study based on data of IAE (http://www.eia.gov/countries)*

The U.S. success currently inspires the intensive search for unconventional natural gas deposits in other countries, including in Europe.

Poland has become one of the most active markets in exploration of shale gas in the old continent. The search for unconventional gas deposits is at the stage of identification work.

Shale gas has been named a "game changer", in which the new technology of vertical drilling and multi-stage hydraulic fracturing has been used. These technologies were for the first time used at the industrial scale at the Barnett formation in eastern Texas, and showed that gas closed in previously inaccessible deposits with very low permeability can be extracted.

Shale gas raises a lot of emotions in Poland – its extraction gives a chance for becoming independent of external energy supplies and for creating an independent energy policy. Gas production could stimulate economic and technological development of the country. Moreover, gas is the cleanest environmentally source of energy of all fossil fuels, which could reduce greenhouse emissions. Gas is one of the least expensive methods of generating electricity.

Figure 3 shows how the internal gas market in Poland changes - the level of production and consumption of natural gas. According to the EIA (U.S. *Energy Information Administration)*, proved resources decreased at the level of 165 billion m^3 in 2011 to 95 billion in 2012 – is one of the causes of emotions associated with the perspective of major shale gas reserves in Poland.

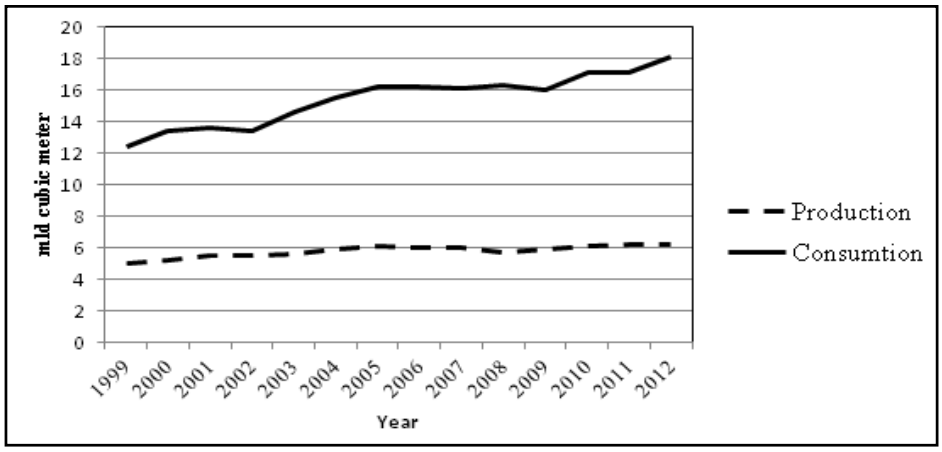

Fig. 3. Poland – natural gas production and consumption (1999–2012)
Source: *Own study based on data of EIA (http://www.eia.gov/countries)*

U.S. *Energy Information Administration* estimated technically recoverable shale gas resources in Poland at 5.3 bln m^3 (Report U.S. EIA April 2011; at 4.2 bln m^3 in Report U.S. EIA June 2013). These optimistic estimates were verified by the Polish Geological Institute – most probable range of recoverable shale gas resources: 346.1 – 767.9 mld m^3 (Report PIG, March 2012).
Many articles have been published over the past couple of years on the environmental impacts of shale gas production. It is no secret that the production of shale gas has an extraordinary impact on the environment compared with conventional gas drilling. Adverse factors are:

- Drilling and hydraulic fracturing process involves the injection of water (on average from 9,000 m^3 to 36,400 m^3 per well), chemicals and sand at a high pressure down the well to facilitate the fracturing and propping open of the fractures after their creation (Arthur at al. 2008). Between 15% and 80% of the injected water is brought back to the surface. Most of this water is produced in the first few months of production and, as it is toxic, must be disposed of through recycling, through reinjection, or, on the surface, through processing at wastewater treatment facilities.
- Contamination of groundwater directly through hydraulic fracturing and as a result of compromised cementing jobs in near-surface casing.
- Contamination of surface water, and potentially drinking water, through improper disposal of toxic produced drilling fluids containing salts, radioactive elements, and other toxins.
- The surface impacts of road and drill pad construction and the requirement for hundreds of truck trips for each well to move the drilling rig, storage tanks, water, proppant, chemicals, compressors, and other equipment.
- Higher full-cycle greenhouse gas (GHG) emissions. Full-cycle GHG emissions from shale gas are far larger than the burner-tip emissions of the gas itself.
- Induced earthquakes through fluid injection both during the hydraulic fracturing process and during the disposal of waste fluid through injection wells. Seismic activity related to the injection of waste flowback fluids from hydraulic fracturing seems to be the largest source of induced seismic activity.

The documentary movie "Gasland" shows spectacular consequences for humans and the environment, involved in hydraulic fracturing and shale gas production (http://www.pbs.org/now/shows/613/index.html).

These and other risks do not disqualify shale gas as a fuel. Geological surveys, local authorities of the exploration/production regions, governments and environmental organizations are required to monitor the impact of the effects of exploration on the environment. Residents of exploration regions are less concerned about environmental issues and purely technical ones, but also want to have a guarantee that the exploration and production of shale gas is safe and under control of the respective institutions. The purpose of social communication should be to facilitate access to information for local communities about investment projects which are carried out.

Conclusion

Geoethics should integrate moral principles with special regard to the Earth as a geological body, as well as social, cultural and economic aspects of all varieties.

The basic principle of geoethics is also the idea of corporate social responsibility and sustainable development, as the idea of building an economic model that ensures the progress of humanity and will enable a better life without destroying the systems that support it.

Ethics is the subject of the publications whose number is growing by the year. An overview of the publications indicates two main areas:

- the impact of technology on the development of the Earth's ecosystems,
- the human activities associated with the use of Earth's natural resources and the monitoring and forecasting of natural disasters.

Exploration and production of shale gas combines these two areas: the use of technology and exploitation of natural resources of the Earth. The production of shale gas involves extraordinary environmental impacts which relate mainly to:

- contamination of groundwater,
- very high water consumption, which is potentially problematic, particularly in arid areas,
- contamination of surface water, and potentially drinking water,
- the surface impacts of road and drill pad construction and other equipment,
- higher full-cycle greenhouse gas emissions; this potentially defuses a major argument of the natural gas lobby that natural gas is a significantly lower source of GHG emissions than coal or oil (Arthur 2008),
- induction of earthquakes through fluid injection both during the hydraulic fracturing process and during the disposal of waste fluid through injection wells. Seismic activity related to the injection of waste flowback fluids from hydraulic fracturing seems to be the largest source of induced seismic activity.

The shale gas revolution is a challenge for ecologists and geoethicists. They need to learn the whole cycle of production, to be able to distinguish between propaganda or lobbyists.

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