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Mitigation of Greenhouse Effect by Reduction of the Methane Emissions

Łagodzenie efektu cieplarnianego poprzez redukcję emisji metanu

Sustainable development mainly pertains to social relationships. The pioneering report entitled *Our Common Future*, included the appeal for such behaviour that does not deprive future generations from conditions suitable for their development. This paradigm is mainly related to non-renewable natural resources and environment (Olkiewicz, Bober, Majchrzak-Lepczyk, 2015). Implementation of both paradigms is threatened (Cao, Piecuch, 2012; Glasby, 2002; Galdwin et al., 1995; IPPC, 2014; Cholewa, Pawłowski, 2009; Pawłowski, 2008), because dominance of free market, that is rooted in ruthless competition, eliminates from social life the co-operation which is the basis for the care for other people, both living now and yet to be born. Moreover, the belief in the infinite growth of production causes to a rapid depletion of resources, including non-renewable ones. The depletion of primary energy resources may be especially dangerous (Chefurka, Berg et al., 2002; Yohe et al., 2007; Banur, Opschoor, 2007). This is because it is difficult to imagine how modern civilization could function without energy.

The second important problem is the degradation of environment, especially the anticipated climatic changes, which according to IPCC report (2007) will lead to serious catastrophic changes in the Earth's ecosystems, especially that inhabited by the poorest. For, the CO₂ emissions are mainly responsible on the rich societies. The richest group of people, constituting 10% of world's population, emits 49% of CO₂, whereas the poorest people, which make up 50% of population, emit only 10% of CO₂. Therefore, the costs of remedial measures should be borne by the ones who emit the most.

Moreover, the actions aimed at decreasing of greenhouse gases emissions in order to mitigate the climatic changes should take the social context into account. From this standpoint, one should pay more attention to the intensification of natural processes of CO₂ sequestration, including the sequestration by forests and agricultural (Hooijer et al., 2010; Jones,

Donnelley, 2004; Kruger et al., 2015; Lal, 2010; Smith et al., 2007).

The impact of carbon dioxide on climatic changes is a well-known phenomenon. However, awareness about the role of methane, which is the second largest contributor to the greenhouse effect, is not well known. The characteristics of methane-emitting sources are presented in Table 1.

Table 1. Estimated global anthropogenic methane emissions from main sources, data for 2010 (EPA, 2010)

Source	%
Enteric Fermentation	29
Oil and gas industry	20
Landfills	11
Rice cultivation	10
Emissions from wastewater	9
Coal mining	6
Manure from farms	4
Biomass	3

The greatest amount of methane is emitted by oil and gas industry, as well as agriculture (cattle and rice cultivation) (Johnson et al., 1994).

Various actions are undertaken in order to mitigate methane emissions. The biggest emissions from enteric fermentation are the most difficult to control. They require decreasing consumption of beef in the most developed countries. Mitigation of methane emissions from the oil and gas industries requires reducing or eliminating venting and fugitive emissions from gas installations (Howarth et al., 2011; Mallya, 2016),

The most important approach to reduce methane emission from landfills is its extraction using series of wells and utilizing it as energy source or combusting in a flare. Residual emissions which lasted for tenth of year could be oxidized in passive filters (Staszewska, Pawłowska 2011; Stępniewski, Pawłowska 1996; Montusiewicz et al., 2008).

Since rice is basic food in the most of Asia, it is difficult to decrease emissions from that source. Reduction of methane emissions from wastewater requires upgrading sewage and wastewater treatment plants by wide application of anaerobic sludge digestion, biogas capture and its utilization as a source of energy or combustion in a flare (Bogner et al., 2008).

In the case of coal industry, two methods may be used. The most profitable one is recovery of methane from coal deposits by degassing coal seams prior to their exploitation through drilling holes which enable methane to flow out (Bibler et al., 1998).

Emission from manure can be mitigated by containing it in a sealed manure lagoon, while the collected methane is best used as a source of energy or, less profitably, combusted in a flare.

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Mitigation of emissions from other sources is complicated and the obtained results are insignificant in a global scale.

Since climate change in the most cases will affect the poorest people of the future generations to mitigate this effect in negative way the sustainable approach it is necessary require to undertake measures. The methods of mitigations which is based on utilization of biological process are the most sustainable.

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