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TEMPLATE FOR COUNTRY PROFILES FOR ANIMAL WASTE MANAGEMENT

POLAND RESPONSE

1. Summary of emissions and characterization of the animal waste management sector

a. Briefly provide information on national and regional methane emissions for animal waste management systems by type of system and animal type.

Data is available from the National Atmospheric Emissions Inventory. These show that methane emissions from animal wastes have declined from 203kt CH4 in 1990, to 137kt in 2005. Of all livestock sectors, cattle are the biggest source of methane.

Detailed information on methane emissions from agriculture in Poland is contained in the tables, as follows:

Table.1.1. Livestock population, daily Gross Energy Intake (GE) and CH_4 emission factors in 2005

Livestock	Population [millions]	GE Gross Energy Intake [MJ/animal/day]	EF Emission Factor [kg CH_4/animal/year]
Enteric fermentation	24.365	-	-
1. Cattle	5.483	-	-
a. Dairy cattle	2.795	238.840	93.991
b. Non-dairy cattle	2.688	120.384	47.375
2. Sheep	0.316	18.285	8.112
3. Goats	0.142	-	5.000
4. Horses	0.312	-	18.000
5. Pigs	5.353	-	1.500

Table. 1.2. Livestock population, daily Gross Energy Intake (GE) and CH_4 emission factors in 1990

Livestock	Population [millions]	GE Gross Energy Intake [MJ/animal/day]	EF Emission Factor [kg CH_4/animal/year]
Enteric fermentation	34.792	-	-
1. Cattle	10.049	-	-
a. Dairy cattle	4.919	232.837	91.629
b. Non-dairy cattle	5.130	104.8557	41.264
2. Sheep	4.159	18.192	8.011
3. Goats	0.179	-	5.000
4. Horses	0.941	-	18.000
5. Pigs	19.464	-	1.500

Methane from Manure Management

The IPCC Tier 2 methodology was used to establish domestic CH_4 emission factors for cattle, sheep and swine. The Tier 1 methodology was used for estimation of default emission factors for goats, horses and poultry [IPCC 1997]. Animal population was taken from [GUS 2006].

Table 1.3. Livestock population, volatile solids excreted (Vs) and CH_4 emission factors in 2005

Livestock	Population [millions]	Vs Volatile Solids Excreted [kg dm/animal/day	EF Emission Factor [kg CH_4/animal/year]
Manure management	158.790	-	-
1. Cattle	5.483	-	-
a. Dairy cattle	2.795	4.435	9.329
b. Non-dairy cattle	2.688	2.065	5.833
2. Sheep	0.316	0.358	0.169
3. Goats	0.142	0.365	0.120
4. Horses	0.312	1.720	1.390
5. Pigs	18.112	0.500	6.536
6. Poultry	134.425	0.100	0.078

Table 1.4. Livestock population, volatile solids excreted (Vs) and CH_4 emission factors in 1990

Livestock	Population [millions]	Vs Volatile Solids Excreted [kg dm/animal/day	EF Emission Factor [kg CH_4/animal/year]
Manure management	262.813	-	-
1. Cattle	10.049	-	-
a. Dairy cattle	4.919	4.760	5.628
b. Non-dairy cattle	5.130	1.760	1.613
2. Sheep	4.159	0.363	0.169
3. Goats	0.179	0.280	0.120
4. Horses	0.941	1.720	1.390
5. Pigs	19.464	0.500	5.403
6. Poultry	228.021	0.100	0.078

The factors recommended for cool climate were used. The country specific CH_4 emission factors for dairy and non-dairy cattle, sheep and swine were calculated based on:

-country specific data on the fraction of manure management in given AWMS [Walczak 2003, 2006], B_0 (methane producing potential) factors were taken from [IPCC 1997], Vs (average daily volatile excreted solids) for dairy, non-dairy cattle and sheep were estimated based on country specific GE (average feed intake): VS for swine was the default value from [IPCC 1997], MCFs (methane conversion factors) for individual manure management systems…….

b. Briefly describe current animal waste management practices (e.g. land application, pasture/range, solid storage, liquid storage, and lagoon) and livestock types (e.g. swine, dairy cattle, beef cattle, and poultry).

The Farm Practice Survey contains data on animal waste management practices was done. These data show that, on average, the majority (62%) of those reporting as having farm yard manure (FYM) stored it in the concrete base not covered after removal from livestock buildings. However, manure handling practices vary with farm type, with ‘no further storage’ being the preferred options for pig systems and cattle/sheep kept on deep litter systems.

For slurry storage, unlined earthbank lagoons were the most commonly used across all farm systems, although circular tanks above ground and tanks/structures outside were also widely

used. As with FYM, different practices were popular under different agricultural systems – e.g. cellars, pits and channels were especially used in the pigs/cattle industry.

c. Briefly provide information on methane recovery and use practices in use.

There are only few examples of methane recovery systems using animal manures in use in Poland, but these are limited in number and cover only a very small proportion of the livestock sector.

An in-depth research report on plant has been commissioned to provide further information on systems in use, and is due to report at the end of the year.

Chapter 7 below lists those large-scale, animal manure, AD projects we are aware of in Poland, although many of these are still at a developmental stage.

It should also be noted that AD is more commonly used in the processing of other waste streams. Although the work of the Taskforce is focused on capturing agricultural methane, in practice methane recovery systems for agriculture may also be co-digesting food waste or municipal waste. This will affect the acceptability and economic viability of any such systems.

4. Describe the key stakeholders in the animal waste management sector

Key stakeholders so far identified include:

Farmers and their representative organizations such as National Farmers Union, the Country, Land and Business Association etc, as well as those who advise farmers e.g. Rural Development Service.

Industries involved in the production of AD technology, biogas companies, waste processors.

Regulators and Government Agencies tasked with monitoring pollution and environmental conditions etc, for example the Country Agency of Emission Inventory

Planning authorities, waste disposal authorities, and the Health and Safety Executive for centralised, large scale plants

Utilities sector – especially water utilities if related to diffuse pollution issues, electricity sector if gas production is used for energy generation

Researchers/Academics

Within government, policy interests include climate change, renewable energy, waste, sustainable agriculture, water quality, air quality, trade and industry, particularly within the Department for Environment, Ministry of Agriculture and Rural Development and the Ministry of Industry.

5. Overview of methane recovery potential

For the paper covering resources of natural fertilizers for energetical biogas production the following assumptions have been used:

1. Determination of approximate needs for natural fertilizers in Poland
2. Determination of estimated production of natural fertilizers in Poland.
3. Comparison of these values

Determination of approximate needs for natural fertilizers in Poland

Assumption – in four fields cultivations manure is used once per four years in amount 30 t/ha.
Total area of seeding in 2006.

Total area of seeding	10 764 300 ha
Including:	
- corn	8 293 700 ha
- legominous edible	45 400 ha
- potatoes	803 400 ha
- for industry (beetroot,rape)	757 500 ha
- fodder	562 100 ha
- fodder (vegetables and others)	302 200 ha

At total area of seeding 10 764 300 ha on cultivated grounds on which manure can be used,if during 4 years we use 30t/ha it means 7,5 t/ha per year. After multiplication by 10 764 300 we have got total need for manure equal to 80 732 250 tons.

Determination of manure production.

Amount of farming animals:

Poultry in total	198 460 750
- hens	174 789 965
- in this laying hens	5 109 920

Cattle in total	5 532 728
- in this 1-2 years old	1 083 309
- old	3 065 040
in this cows	2 873 165
milk cows	2 851 364
Pigs in total	18 628 910
- in this weaner piglets	5 318 673
- in this pigs>50kg	6 793 265

Table 5.1. Manure produced by livestock

Livestock group	Age group	Weight	Excrements t/year	Manure t/year	Manure units (OB)
Cattle					
Milk cow		650	25	15	1,00
Milk cow		550	20	12	0,80
Milk cow		450	15	11	0,75
Heifer	> 2 years	500	12	7,5	0,5
Heifer	1-2 years	400	9,5	6,0	0,40
Calf	0,5 – 1 years	180	5	3,0	0,20
Calf	<0,5 year	100	2,5	2	0,125
Pigs					
Sow with piglets		130-225	4	2	0,125
Piglet	3-7,5 t	7-18	0,50	0,375	0,025
Weaner piglet	7,5-11t	18-35	1,0	0,75	0,05
Fattener	11-23t	35-105	2,5	1,125	0,075
Other livestock groups					
Goats		50	1,5	0,75	0,05
Sheeps		70	2,2	1,5	0,10

Horses		450	13,0	9,0	0,60
Laying hens 1000 pcs		2,0	20,0	20,0	-
Broilers 1000 pcs		1,0	9,0	9,0	-

Table based on non published data – W.Grzebisz

Upon statistical data and below table the total manure production in Poland has been calculated.

Table 5.2

Kind of animal	Manure production (t/year)	Number of animals	Manure production (t/year)
Cattle		5 532 728	
milk cow (550 kg)	12	2 873 165	
matured cattle	15	3 065 040	36 780 480
young cattle	4	1 083 309	4 333 236
Pigs		18 628 910	
Weaner piglets	0,75	5 318 673	3 989 005
	1,125	6 793 265	7 642 423
Poultry		198 460 750	
Laying hens		5 109 920	102 180
The rest		174 789 965	925 109
TOTAL			53 772 433

Manure balance in Poland -production **53 772 433** t/year

-needs **80 732 250** t/year

-shortage **26 959 817** t/year

Fertilizer resources for potential production of biogas in Poland

Possibilities of production biogas in Poland are determined by the number of farming animals, animals breeding technology, number of animals in given (one) farm, and kind of animals. Also

financial capabilities of given farm should be considered keeping in mind high cost of installation. Next limitation is kind of a raw material. Installations described by IBMER used as raw material only liquid muck. It is next limitation of biogas production for two groups of animals – pigs and cattle, and only in bigger pig houses and barns where animals are raised on grill floor with continuous slurry outlet.

Installations checked by IBMER concern farms of various size – minimal number of animals at which biogas production is profitable is 20 – 30 SD (big animals) at usable production 17 m^3 (at calorific value 20-26 MJ/ m^3 , 40 – 60 SD at usable production 35 m^3 , 80 – 120 SD at usable production 70 m^3 , and for 250 SD with efficiency 150 m^3 / 24 hours.

For calculating potential amount of produced biogas calculation factor from animal to amount of liquid muck were assumed (data not published – W. Grzebisz)

Numbers of pigs in herds bigger than 20 animals

Animal	Amount in herd					
	20-49	50-99	100-199	200-499	500 or more	Totally
Pigs	3 986 282	3 219 392	2 029 352	2 029 352	1 864 767	13 834 322
in that sows	218 854	65 053	38 242	31 857	52 684	406 670

Assuming that both sow and fattener means 0,1 SD we have got 1 383 432 SD

Assuming that cow and other cattle means 1 SD we have got 1 657 126 SD

Totally 3 040 558 SD

Conclusion of the above is that in Poland we have 3 040 558 SD.

Analyzing amount of biogas from installation mentioned above for simplification we can assume that 1 SD gives 0,7 m^3 per day at calorific value 20-26 MJ/ m^3

So potential biogas production from liquid manure:

3 040 558 SD * 0,7 = 21 283 906 m^3

The Polish Department for Environment Food and Rural Affairs is continuing our research in this area to improve our understanding of current technical potential as well as market/economic

potential, investigation of any barriers that limit further development potential, and ways to overcome them. We are also drawing on experience and evidence from other Government Departments, Agencies, and Research Institutes.

6. Challenges and/or priorities to greater methane recovery and use.

Potential issues include:

For centralised/community digesters there are challenges around transport, nuisance, health and safety, biosecurity and planning

For all methane recovery systems, financial viability may be a challenge.

Barriers making difficult development of renewable energy sources

Till now in Poland usage of renewable energy sources systems in many cases is not economically justified. Financial mechanisms addressed directly to renewable energy producers are not sufficient. Existing law make possible to have investment concessions for cost and spends concerning amongst the others purchase and installation of natural energy sources (wind, biogas, sun , water falling down)- Act dated 15 November 1984 r. regarded to agriculture tax (Dz. U. z 1993 r. Nr 94, poz. 431), but addressee could be only those who pay agriculture tax.

Many years of tradition in using coal as main energetic fuel, used in the past, donations to energetic industry, and low process of traditional energy carriers made very difficult to introduce renewable sources energy (excluding water powered stations) Barrier difficult to fight with are high investments costs. Taking economical aspect into consideration (in turn having important input to energy balance from renewable energy sources) it must be remembered, that higher price of energy (from renewable sources) in comparison with prices of energy from traditional sources, in local usage, could be partially reduced by transportation (transmitting) not necessary here. Nevertheless reservation costs from electro-energetic and/or gas systems must be considered. Considering costs of renewable can be divided into three groups:

- Technologies, which show production cost lower or comparable with prices of substitution of traditional energy carriers. We include here: air solar connectors (cost of thermal energy production 20,2 zł/GJ), small boilers for wood and straw hand operated e (thermal energy production costs 20,2 - 25 zł/GJ), automatic thermal fabric fed with straw (thermal energy production costs 29,1 zł/GJ), small hydroelectric power stations built on

existing slopes (thermal energy production costs 0,23 zł/kWh) and installations using dump gas for electricity production (thermal energy production costs 0,22 zł/kWh);

- Technologies, which produce energy at costs higher from average country process, but can be competitive in such conditions: using available preferential credits and donations, or localization in regions of highest conventional energy process (caused by higher transportation, transmitting, and distribution costs on rural and peripheral places and higher costs of supplying energy to disseminated recipients). This group consist of large wind power plant (electrical energy production costs 0,51 zł/kWh), biomass supplied automatic thermal plant (thermal energy production costs 33,2 zł/GJ), and even in some rare regions less profitable now PV technologies (powering navigation signs ob the sea);
- Other technologies as water solar collectors (thermal energy production costs 147,3 zł/GJ), PV systems (electrical energy production costs 8,89 zł/kWh), small network power plants (electricity energy production costs 1,02 zł/kWh), rural bio-gas station (thermal energy production costs 57,1 zł/GJ), geothermal plants (thermal energy production costs 61,8 zł/GJ), are not competitive in comparison with highest Polish price of energy from installation using fossil fuels , even if donation equal to 50% total investment costs is granted
- Electrical and heat energy price in Poland were 2005 equal to:
- Electrical energy for households 0,261 zł/kWh
- Electrical energy for agriculture 0,266 zł/kWh
- Electrical energy for industry 0,123 zł/kWh
- Average selling price to network 0,215 zł/kWh
- Heat from thermal plants 26 zł/GJ
- Average heat selling price to network 24,90 zł/GJ

There are a lot of barriers limiting development of power industry from renewable energy sources. This is set of psychological, social, institutional ,law and economical factors.

Main of them are:

Law and financial barrier:

- Lack of relevant law with explicit description of program and politics in range of renewable energy
- Insufficient economical mechanisms especially fiscal, which make possible to gain profits after investing in objects, installations, devices used for creating renewable energy

- Relatively high investment costs of technologies using energy from renewable sources and also high workmanship costs (e.g. geologic) necessary for gaining energy from renewable sources
- Information barrier

7. List of existing or planned methane capture and/or use projects (if available)

FIRST AGRICULTURAL BIOGAS PLANT

In June 2005 r., in Pawłowek community Przechlewo (pomorskie voivodship), the first in Poland bio gas plant, producing methane from liquid slurry and slaughter waste in anaerobic fermentation process has been founded.

The object consists from two fermentation chambers of total effective volume 1,5 thousand m3, Raw material initial container, reception station for organic waste, lagoons of 20 thousand m3 devices for sanitizing slaughter waste, biological filter and cogeneration module.

Biogas make here is used for production electrical and heat energy respectively 240 kWe i 360 kWt. According to assumption energy production till the end of 2005 should increase to 720 kWe i 900 kWt, thanks to optimisation of anaerobic fermentation and addition use of maize silage and glycerine (wastes from production of rape oil methyl esters)

After full optimisation air pollution emission will be reduced including CO2 by 68 thousand tobs per year, coal and CH4 by 98 thousand . m3 per year and N2O by 370 kg per year relatively to raw liquid muck. Energy is partially used for bio gas plant own needs (20% of electricity and 40% of heat).The rest of electrical energy is sold to power network, rest of heat is used for heating farms and technical buildings. The Poldanor company plans to build New bio gas stations - in 2006 in Nacław, later in Czarnowąsy and Świetlin in West-Pomerania Voivodeship.

Source: Data from Ministry of Environment:.

Planned biogas plant

Agricultural biogas plant (liquid manure as raw material). Community Grabica Region Piotrkowskiego

Applying for realization in 2004 – 2008. 20 tyś zł

8. Market assessment and reform issues

We are conducting research at the moment which will focus significantly on market issues relating to economic potential for methane recovery systems, including the issues discussed in question 6 above.

In more dynamic development of this renewable energy branch the biggest obstacle are high investment costs covering biogas station erection. 200 kW system costs about two million PLZ, and bigger, of 2 MW, several million. It is problematic to have this kind of donation from EU, because they are addressed to small and medium size enterprises, so for building bigger one could be covered only by biggest companies

.**9. Financing Options (characterise)**

Financial problem arise for developing projects regarded to using renewable energy sources. These are problems with high investment expenses, for renewable energy sources at relatively low exploitation expenses. This cost structure at present price of fossil fuels is the reason for long term of return of investment expenses. The other problem is the fact, that devices for producing renewable energy are manufactured mainly by small factories, of small capitalization level which at present credit system can not sustain at frozen financial means. The other problem is lack of knowledge and experience in formulating projects and starting proper sources of their financing.

At present in the country there are several institutions supporting renewable energy sources including Narodowy Fundusz Ochrony Środowiska i Gospodarki Wodnej, EkoFundusz, Fundusz Termomodernizacji, voivodship funds for environment protection and water management. There are also financial organizations which can support projects of using renewable energy sources if the latter cause development of rural areas. Fundacja Programów Pomocy dla Rolnictwa, Agencja Własności Rolnej Skarbu Państwa, Fundacja Rolnicza - these institutions give preferential loans and donations usually not higher than 50% of project costs, nevertheless from country financing sources, foreign possibilities increased. Not only banks financing large energy projects increase possibilities of financing in Poland renewable energy projects from targeted European Commission as Altener II, Synergy, Life, 5. Frame Programme of Technical Development Research and Presentation. In many cases these funds and programs make possible to be granted with donations for preparing investment projects and building of presentation installation. In connection with process of integration with European Union PHARE programme , and also pre-accessing funds ISPA SAPARD can be helpful. Supplementary for

international funds could be funds possible to gain in bilateral co-operation with Western countries e.g. Danmark, Sweden, Germany.

10. Current cooperation among countries or non-governmental organizations

Possibilities in international co-operation and European trends in supporting development of renewable energy.

In a range o international co-operation Polish Government answered for initiative included in White Book : determine quantity target - 12% of input of renewable energy in fuel-energy balance of the Union till 2010 and formulating strategy for that sector together with Implementing strategy till 2003. Accepted in February 2002 “Assumptions of energy politics till 2020” not cover AIDS from White Book. Not enough activity in promoting renewable energy give negative results in introduction of Polish enterprises and institutions in targeted Union plans (as ALTENER II) what can limit possibilities of using helping funds and processing and in turn competitiveness of Polish enterprises after access to Union.

According last Union report of renewable energy in 15 Union countries more than 170 support mechanisms is functioning. Only European Commission administer now several unified large programmes of support, including ALTENER II (only for promotion of OZE), SYNERGY (politics development), LIFE Environment (nature and environment protection) CRAFT (development of small land medium size enterprises), ERDF (European Fund for Regional Development), EUREKA (technological innovation), PHARE and pre-accession SAPARD and ISPA (only for countries associated with Union, including Poland) and the biggest of them – covering a few sub-programmes broadly financing development of using OZE (ENERGY and SUSTAINABLE DEVELOPMENT, QUALITY of LIFE) – 5 frame programme regarded to scientific-technical co-operation and promotion. In accepted for 1999-2003 Development Campany for renewable energy Union totally allots 7 mld. EURO from public money for financing OZE technology implementation. Active approach of Government to participation of Polish institutions and enterprises could make possible gaining external means for financing renewable energy sector in closest years and increase chances of broader participation in targeted and structural programs after official accessing of Poland into Union structures.

Project of Directive concerning usage of renewable energy sources at present under consulting by Union Members will be the tool of support renewable energetic sector of liberalization market of electrical energy. It assumes necessity of giving foreign energy supplier the same support mechanisms , which are used for country supplier after extending 5% renewable input energy in

energy enterprises balance. If Directive will be approved, country strategy of OZE usage, for making stronger its competitiveness should assumes stronger support for country energy suppliers and technology producers in a period in which 5% level will be reached. Choice of proper support mechanisms for country renewable energy sector should be based on experience and foreign experience but include also different level of renewable energy development in Poland, with many years of delay, and level in EU countries.

11. Country Priorities

Poland is determined to keep action to tackle climate change high on the international agenda. We have made climate change a key priority for policy. Agriculture accounts for over 40% of methane emisisons in the Poland and we are actively exploring ways to try and minimise these emissions. We agree that the main issue for the Agricultural Taskforce is related to animal

Poland response to Country Profile for Methane to Markets Agriculture Taskforce wastes, however, given that 80% of emissions of methane are from enteric fermentation, we would also be interested in looking into options to address this issue in the future, consistent with the overall focus of the Partnership.

Our research suggests that the technology in this area offers promising opportunities, although there are still further technological advances to be made, in addition to market supply issues. We are keen to learn from other countries' experience and best practice to tackle barriers to implementation. We therefore strongly support the inclusion of agriculture in the work of the Methane to Markets Partnership, and firmly believe that it should have the same status as methane emissions from coal, oil and gas, and landfill.

12. Other issues related to animal waste management

We recognise that sustainable animal waste management has a number of benefits wider than methane mitigation, including improved water quality, waste management, renewable energy generation, farm diversification and a potential additional income stream for rural communities.

Development of a market for methane from agriculture should be promoted in a way that is compatible with these and wider sustainability objectives, at local, national and international level.

In Poland government provided "green certificate" for energy producer which could help in development of renewable source of energy (including biogas)

Country contacts

- EBC Biogaz/Gaz Wysypiskowy 64-920 Piła, Masztowa 4 Str.
- Europejskie Centrum Energii Odnawialnej dla Państw Regionu Bałtyckiego 02-532 Warszawa, Rakowiecka 32 Str.
  Fundacja na rzecz Efektywnego Wykorzystania Energii 00-201 Warszawa, Andersa 20a/17 Str.
- Krajowa Agencja Poszanowania Energii 00-950 Warszawa, Nowogrodzka 35/41 Str.
- POLBIOM Polskie Towarzystwo Biomasy 02-532 Warszawa, Rakowiecka 32 Str.
- Polska Asocjacja Geotermiczna 31-261 Kraków, Wybickiego 7 Str.
- Polskie Towarzystwo Energetyki Słonecznej 00-049 Warszawa, Świętokrzyska 21 Str.
- Towarzystwo Rozwoju Małych Elektrowni Wodnych 80-308 Gdańsk-Oliwa, Polanki 12 Str.

13. Conclusions and Observations

Poland is highly supportive of the Agricultural Taskforce and its work is in keeping with our commitment to address greenhouse gas emissions from all sources. The international experience which the Taskforce brings will be particularly helpful to Poland in addressing emissions from the agricultural sector.

We are conducting further research and evaluation in this area, particularly in relation to market issues for methane in agriculture.

We believe it would be helpful for the Taskforce, and hopefully the future Agricultural Sub-Committee, to consider how it will include environmental and social considerations in discussions on market development. For example, large pig units may provide an economically viable biogas plant, but there are potential environmental (and animal health and social) implications of intensive production on this scale.

14. References and Sources

Polish Greenhouse Gas Inventory 1990-2005. (Source: http://emissions.ios.edu.pl/kcie/)

Farm Practice Survey – IBMER

Polish Statistic Year Book (Source: www.stat.gov.pl)

Data and projects of Institute for Building mechanization and Electrification of Agriculture

Data from Ministry of Enviroment

Elaborated by Kamila Kreis

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