# National State of the Art
# Possibility of biogas production in Poland

**8-9.05.2008, Krakow**

**Polish partners:**
Oil and Gas Institute, Krakow
Małopolska Agency for Energy and Environmental, Krakow

## MAIN BIOGAS SOURCES

- Municipal waste landfills
- Wastewater treatment plants
- Agricultural biogas plants
  - Flora-based
  - Animal-based

## MUNICIPAL WASTE LANDFILLS

Currently in Poland there are 680 municipal waste landfills, 140 of those are larger than 5ha.

## MUNICIPAL WASTE LANDFILLS

Annual polish municipal waste production exceeds 10 million Mg, out of which 40% is biodegradable.

Landfills larger than 5 ha receive ca 70% of the total waste amount, 7 million Mg/a

# MUNICIPAL WASTE LANDFILLS

| Landfill size | | | Number of landfills in country | Biogas production mln $m^3$/a | |
|---|---|---|---|---|---|
| - | Area | Mass of received waste | - | Currently | |
| - | [ha] | [tys Mg/a] | (approximately) | single landfill | in country |
| small | 0,1 - 0,9 | 0,1 - 5,0 | 210 | 0,1 | 21,0 |
| middle | 1,0 - 4,9 | 5,0 - 50,0 | 330 | 0,6 | 198,0 |
| large | 5,0 - 9,9 | 50,0 - 100,0 | 80 | 4,5 | 360,0 |
| huge | > 9,9 | > 100,0 | 60 | 12,0 | 720,0 |
| | | | | SUMA: | 1 299,0 |

| - | Area | Mass of received waste | - | After 2013 | |
|---|---|---|---|---|---|
| - | [ha] | [tys Mg/a] | (approximately) | single landfill | in country |
| small | 0,1 - 0,9 | 0,1 - 5,0 | 210 | 0,1 | 12,6 |
| middle | 1,0 - 4,9 | 5,0 - 50,0 | 330 | 0,4 | 118,8 |
| large | 5,0 - 9,9 | 50,0 - 100,0 | 80 | 2,7 | 216,0 |
| huge | > 9,9 | > 100,0 | 60 | 7,2 | 432,0 |
| | | | | TOTAL: | 779,4 |

## MUNICIPAL WASTE LANDFILLS

A landfill receiving 15 000 Mg waste per annum, is capable of producing 1.5 million $m^3$ of biogas (170$m^3$/h), which, at CH4 concentration of 50%, is sufficient to produce 250 kW of power.

## MUNICIPAL WASTE LANDFILLS

Chosen landfills in Poland with a biogas energy production installation:

Bełchatów 340 kW,
Bydgoszcz 600 kW,
Dukla 40 kW,
Gdańsk 400 kW,
Gdynia Łężyce 2 MW,
Goranin 300 kW,
Grudziądz 160 kW,
Katowice 802 kW,
Koszalin 100 kW,
Kraków Barycz 875 kW,
Krosno 100 kW,
Krośniewice 180 kW
Kozodrza 407 kW,
Łubna 836 kW,
Olsztyn 802 kW,
Poznań 400 kW,
Słupsk 100 kW,
Sosnowiec 802 KW,
Toruń 550 kW,

**Total installed power – 9.8MW**

* Newest sources indicate 25MW of installed power

## MUNICIPAL WASTE LANDFILLS

It should be remembered, that current technologies allow only for retrieval of 60% of the available biogas amount. 60% of the volume flow is the maximum attainable value for landfill biogas productivity, depending on chosen method of degasification and technology of the degasification network.

Therefore, on landfills larger than 5ha, the total usable amount of landfill gas is 6500 million $m^3/a$, with a 50% concentration of methane.

Energy potential – 110 MW (after 2013 – 66 MW)

## WASTEWATER TREATMENT PLANTS (WWTP)

One of the basic method of sewage sludge management is fermentation in closed digester tanks.

In digesters, mesophilic digestion causes biogas production.

## WASTEWATER TREATMENT PLANTS (WWTP)

In optimal conditions, it is possible to attain 200m$^3$ of biogas out of 1000m$^3$ of wastewater directed to the WWTP. For the purposes of technical possibilities calculations a lower value of 100m$^3$ / 1000m$^3$ is used.

## WASTEWATER TREATMENT PLANTS (WWTP)

According to statistical data from 2003, the amount of municipal wastewater discharged to water or ground is 1323,7 million $m^3/a$, or 3 626 575 $m^3/d$.

## WASTEWATER TREATMENT PLANTS (WWTP)

Currently in Poland there are 2700 municipal WWTPs, including 2000 biological WWTPs, out of which 169 have a capacity exceeding 10000 $m^3/d$.

Due to economical reasons, use of biogas for energy production purposes is only viable in large WWTP's, of a capacity above 8000-10000 $m^3/d$.

# WASTEWATER TREATMENT PLANTS (WWTP)

| City / WWTP groups | Number of biological WWTPs | Municipal wastewater capacity | | Biogas production | | Biogas production | | **Biogas production** | |
|---|---|---|---|---|---|---|---|---|---|
| | | Per WWTP | | | | | | **All-in** | |
| **PE** | - | [thousand $m^3$ / day] | | [$m^3$ / day] | | [thousand $m^3$ / a] | | **[million $m^3$ / a]** | |
| < 5000 | 266 | 0,0 | 0,5 | 0,0 | 47,5 | - | 17,3 | **-** | **4,6** |
| 5000 - 9999 | 181 | 0,5 | 0,9 | 47,5 | 95,0 | 17,3 | 34,7 | **3,1** | **6,3** |
| 10000 - 19999 | 182 | 1,0 | 1,9 | 95,0 | 190,0 | 34,7 | 69,3 | **6,3** | **12,6** |
| 20000 - 49999 | 134 | 1,9 | 4,7 | 190,0 | 475,0 | 69,4 | 173,4 | **9,3** | **23,2** |
| 50000 - 99999 | 60 | 4,8 | 9,5 | 475,0 | 950,0 | 173,4 | 346,7 | **10,4** | **20,8** |
| 100000 - 199999 | 56 | 9,5 | 19,0 | 950,0 | 1900,0 | 346,8 | 693,5 | **19,4** | **38,8** |
| 200000 i więcej | 53 | 19,0 | | 1900,0 | 0,0 | 693,5 | - | **36,8** | **-** |
| | | | | | | **TOTAL:** | | **85,3** | **106,4** |

## AGRICULTURAL BIOGAS PLANTS

Biogas from agricultural biogas plants can be of the following origin:

- fermentation of 'green' waste
- fermentation of animal-based waste

# AGRICULTURAL BIOGAS PLANTS

- Poland, due to a high agricultural production, well-developed agricultural and food industry, and forest management producing a large amount of waste wood, has a relatively high biomass potential.

- Polish technology and constructions were successfully used in large-scale agricultural farms before 1990.

- Currently, only one agricultural biogas plant, of 1.5MW capacity, is in use. It was launched in 2006 by POLDANOR S.A., using Danish know-how.

## AGRICULTURAL BIOGAS PLANTS

- In near future another such unit is supposed to be commissioned. In total, Poldanor is planning to build 14 biogas plants.

- In the upcoming years (till 2013), several agricultural biogas plants, using animal excrements, farm waste and food production waste as power sources.

- Based on the information available from companies other than Poldanor, at least 8 other projects of value above 5 million € each are planned to be completed by 2014.

# AGRICULTURAL BIOGAS PLANTS

**Sample project: Agricultural biogas plant in Pawłowek I by Poldanor**

- Poldanor – agricultural farm – major producer of pigs in Poland
- Over 15000ha of floral production area
- Economical and ecological development strategy – investment in new technologies
- Reasons to build a biogas plant:
  - Reduction of the smell that accompanies fertilizing fields with liquid manure
  - Taking part in long-term ecological development in Europe - Production of green energy
  - Better fertilizing parameters of liquid manure

# AGRICULTURAL BIOGAS PLANTS

## Sample project: Agricultural biogas plant in Pawłowek I by Poldanor

- Biogas plant data:
  - Danish technology
  - Resources: - 25000 t of liquid pig manure per annum from Pawłówek farm
    - 3500 t of meat waste per annum from nearby Prime Food company
  - Energy production: - 790000 $m^3$/a of biogas (65% methane)
    - 1.4 MWh of electric power (230 kWe)
    - 2.6 MWh of heat power (equal to ca 350 detached houses per year)
  - Biogas plant operational since June 2005
  - Investment costs: 4.3 million PLN

# AGRICULTURAL BIOGAS PLANTS – FLORA-BASED

| | Production | Biogas production | | **Biogas production** | |
|---|---|---|---|---|---|
| | [thousand Mg / a] | [$m^3$ / Mg] | | **[million $m^3$ / a]** | |
| | | min | max | **min** | **max** |
| **Cereals** | 22 000 | 240 | 400 | **5 280** | **8 800** |
| **Maize** | 2 000 | 240 | 400 | **480** | **800** |
| **Beet** | 11 000 | 240 | 400 | **2 640** | **4 400** |
| **Sunflower seed** | 1 400 | 240 | 400 | **336** | **560** |
| **Rape** | 16 000 | 240 | 400 | **3 840** | **6 400** |
| **Potato** | 9 000 | 240 | 400 | **2 160** | **3 600** |
| | | **TOTAL:** | | **14 736** | **24 560** |

# AGRICULTURAL BIOGAS PLANTS – ANIMAL-BASED

| | Piece of animal species | Liquid dung production | Biogas production | **Biogas production** | |
|---|---|---|---|---|---|
| | [thousand] | [$dm^3$ / animal / day] | [$m^3$ / $m^3$ dung] | Animal | **All-in** |
| | | | | [thousand $m^3$ / a] | **[million $m^3$ / a]** |
| **Cattle** | 5 500 | 46,00 | 5,40 | 90,9 | **500,0** |
| **Pig** | 18 000 | 7,00 | 5,40 | 13,9 | **250,0** |
| **Poultry** | 140 000 | 0,07 | 7,50 | 0,2 | **27,0** |
| **Horse** | 300 | 45,00 | 4,10 | 66,7 | **20,0** |
| | | | | **TOTAL:** | **797,0** |

# POSSIBILITY OFBIOGAS PRODUCTION IN POLAND - SUMMARY

| Biogas sources | Biogas production [million $m^3$ / a] |
|---|---|
| Municipal waste landfills | 1 299,00 |
| Waste water treatment plants | 95,85 |
| Agricultural biogas plants - Flora-based | 19 648,00 |
| Agricultural biogas plants - Animal-based | 797,00 |
| **TOTAL:** | **21 839,85** |

# Legal status

## Ustawy / Law acts

- Ustawa z dnia 10 kwietnia 1997 Prawo energetyczne
- Ustawa z dnia 27 kwietnia 2001 r. Prawo ochrony środowiska
- Ustawa z dnia 22 grudnia 2004 r. o handlu uprawnieniami do emisji do powietrza gazów cieplarnianych i innych substancji

## Rozporządzenia / Ordinance

- Rozporządzenie Ministra Gospodarki z dnia 26 września 2007 r. w sprawie sposobu obliczania danych podanych we wniosku o wydanie świadectwa pochodzenia z kogeneracji oraz szczegółowego zakresu uzyskania i przedstawienia do umorzenia tych świadectw, uiszczania opłaty zastępczej i obowiązku potwierdzenia danych dotyczących ilości energii elektrycznej wytworzonej w wysokosprawnej kogeneracji.
- Rozporządzenie Ministra Gospodarki, z dnia 30 maja 2003 w sprawie szczegółowego zakresu zakupu energii elektrycznej i ciepła z odnawialnych źródeł energii oraz energii elektrycznej wytwarzanej w skojarzeniu z wytwarzaniem ciepła
- Rozporządzenie Ministra Środowiska z dnia 16 stycznia 2008 w sprawie szczegółowych warunków udzielania pomocy publicznej na przedsięwzięcia będące inwestycjami związanymi z OZE/RES

## Dokumenty Rządowe / Government Documents

- Projekt Polityki ekologicznej państwa na lata 2007-2010 z uwzględnieniem perspektywy na lata 2011-2014, Ministerstwo Środowiska, 2006

# ACTIONS FOR PROLIFERATION OF BIOGAS USAGE

1. There is a need to establish lobbying mechanisms in order to enhance interest of relevant authorities responsible for making gas networks available for biogas transfer.
2. There is a need to prepare standards for biogas discharged into the networks through creation of Polish Standard defining required biogas parameters, and indicating technical hazards.

# ACTIONS FOR PROLIFERATION OF BIOGAS USAGE

1. Preparation of an unequivocal support mechanism as an economical aid for biogas network discharge would be desirable.
2. Creating an inventory of all major producers of biogas in the country and analysis of all distribution systems capability of transferring biogas is advisable.