

Table 1. – Calculation of the major parameters related to biogas potential production from livestock residues. Nm³= normal cubic meter;.

Parameter	Cow sludge	Pig sludge	Cow manure	Poultry manure	Poultry litter
Effective availability of biomass (Mg/y)	1,104,810	2,039,788	1,507,690	39,880	317,902
Biogas yield (Nm ³ /Mg FM)	2.4	10.4	63.3	97.8	241.6
Biogas gross production (Nm ³ /y)	2,651,544	21,213,795	95,436,777	3,900,264	76,805,123
% CH ₄ in biogas	62.5	62.5	62.5	62.5	62.5
Biomethane gross production (Nm ³ /y)	1,675,000	13,260,000	59,648,000	2,438,000	48,003,000
Low heating value (LHV) of CH ₄ (kWh/m ³)			9.1		
low heating value (LHV) of biogas (kWh/m ³)	5.69	5.69	5.69	5.69	5.69
Energy in biogas (kWh/y)	15,080,656	120,653,460	542,796,669	22,182,751	436,829,138
Plant electric energy yield (%)			32%		
Total electric energy production (kWh/y)	4,825,810	38,609,107	173,694,934	7,098,480	139,785,324
Working hours			8,000		
Potential electric installed power (MW)	0.6	4.8	21.7	0.9	17.5

Nm³= normal cubic meter; FM= fresh matter.

Table 2. – Calculation of the major parameters related to biogas potential production from agri-food waste and agricultural residues.

Parameter	Tomato pomace	Potato residues	Vegetable, fruits and legumes waste	Beet pulp	Grapes and vinasses	Slaughterhouse waste	Oil press residues	Straws, cobs, stalks
Effective availability of biomass (Mg/y)	43,920	15,600	6,400	40,000	67,062	39,500	1,138	79,662
Biogas yield (Nm ³ /Mg FM)	101.8	126.8	158.1	104.5	150.0	102.5	301.0	124.4
Biogas gross production (Nm ³ /y)	4,471,056	1,978,080	1,011,840	4,180,000	10,059,300	4,048,750	342,538	9,909,952
% CH ₄ in biogas	52.5	51.5	55.0	57.5	52.5	62.5	52.5	54.0
Biomethane gross production (Nm ³ /y)	2,323,000	1,013,000	556,000	2,392,000	5,566,000	2,530,000	179,000	5,334,000
Low heating value (LHV) of CH ₄ (kWh/m ³)				9.1				
low heating value (LHV) of biogas (kWh/m ³)	4.78	4.69	5.01	5.23	4.78	5.69	4.78	4.91
Energy in biogas (kWh/y)	21,360,470	9,270,272	5,064,259	21,871,850	48,058,306	23,027,266	1,636,475	48,697,508
Plant electric energy yield (%)				32%				
Total electric energy production (kWh/y)	6,835,350	2,966,487	1,620,563	6,998,992	15,378,658	7,368,725	523,672	15,583,203
Working hours				8,000				

Potential electric installed power (MW)	0.9	0.4	0.2	0.9	1.9	0.9	0.1	1.9
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Nm³= normal cubic meter; FM= fresh matter.

Table 3. – Calculation of the GHG savings, expressed as MgCO₂eq/y.

Parameter	Livestock	Agricultural residues	Agri-food waste	Unit
Total amount of biomass available (from Table 5)	5,010,067	79,662	213,617	Mg/y
Agri-food waste landfilling GHG emissions		2,240		kgCO ₂ eq/Mg FM
Livestock by-products storage and direct land spreading		34.5		kgCO ₂ eq/Mg FM
Emission savings avoiding landfilling (1st column Table 7)	-	-	478,502	MgCO₂eq/y
Emission savings avoiding direct land spreading (2nd column Table 7)	172,346	-	-	MgCO₂eq/y
Potential installed electric power (from Table 5)	45,5	1,9	5,3	MW
GHG emissions from fossil fuel		83.8		gCO ₂ eq/MJ
Theoretical emissions from fossil fuel		13.73	1,59	MgCO ₂ eq/y
Biogas production from livestock waste		10	-	gCO ₂ eq/MJ
Biogas production agri-food industry waste		-	25	gCO ₂ eq/MJ
Theoretical emissions from biogas production		1.706	0.477	MgCO ₂ eq/y
Producing biogas and replacing fossil fuel (3rd column of Table 7)		12,02	1.12	MgCO₂eq/y
Digestate yield		0.830		
Digestate production		4,224,475	177,302	Mg/y
Total-N content		439,345	18,439	Mg/y
K-content		215,448	9,042	Mg/y
P-content		156,305	6,560	Mg/y
Producing digestate and replacing mineral fertilizers (4th column of Table 7)		2,122,587	89,085	Mg/y

Nm³= normal cubic meter; FM= fresh matter; FM=fresh matter.