Renewable Energy Statistics Training

Exercise 5d: Energy balance biogas energy

The purpose of this exercise is to take raw data from a project monitoring report, convert it into the correct units required for the IRENA questionnaires and complete an energy balance based on this data. This exercise, is based on the UNDP project "BioEnergy for Sustainable Rural Development" which was developed in Egypt[1]. As part of this project, they installed **950 family size** biogas units and **7 large** biogas units that each serves three houses.

Use this information together with the tables below to estimate the production of biogas energy in Egypt. This is estimated from number of biodigesters, the production of gas in cubic metres per day, with an assumed methane content (%) and the energy content of pure methane.

Notes:

1. For this exercise, we assume that the family size units are 8 m^3 and the large units are 24 m^3 in total volume. We assume they are all fixed dome and still operational.
2. For estimating the gas production, the table 2 Multiplication factor can be used.
3. To convert the gas production to the energy content, the conversion factors on the next page can be used.

From: IRENA (2016), Measuring small-scale biogas capacity and production, p.8 & 12

BIOGAS PRODUCTION AND CONSUMPTION

Table 2: Proportions and multiplication factors to convert total plant volume and rated daily gas production into digester volume and gas storage volume

Biogas plant type	Digester and gas storage volumes as a share of total plant volume			Multiplication factors to convert gas production to plant volume		
	Digester volume	Gas storage volume	Total volume	Digester volume	Gas storage volume	Total volume
Fixed dome plant	80%	20%	100%	2.4	0.6	3.0
Floating drum plant	70%	30%	100%	1.4	0.6	2.0
Balloon/bag digester	75%	25%	100%	1.8	0.6	2.4

Note: If a fixed dome plant has a rated daily gas production of 1.2 m^3/day, the multiplier above suggests that total plant volume would be 1.2 x 3 = 3.6 m^3. However, the above figures are averages and should be replaced by figures based on local biogas plant designs where available (e.g. see Table 1).

CONVERSION FACTORS

- 1 m^3 of biogas = 0.65 m^3 of methane
- 1 m^3 of methane = 34 MJ of energy
- 1 m^3 of biogas = 22 MJ of energy
- 1 m^3/day of biogas = 8,060 MJ/year

[1] http://www.eg.undp.org/content/egypt/en/home/operations/projects/sustainable-development/BioEnergyforSustainableRuralDevelopment.html

Answer sheet:

Supply and consumption 2016		Other biogases from anaerobic digestion TJ
Production	(+)	
Imports	(+)	
Exports	(-)	
Stock changes	(+)	
International Bunkers	(-)	
Domestic supply	(=)	
Transfers		
Statistical Differences		
Power plants		
CHP plants		
Commercial heat plants		
Charcoal production		
Biomass pellet and briquette production		
Other transformation		
Energy sector and own use		
Distribution losses		
Total final consumption		
Industry sector		
Transport sector		
of which road transport		
Commercial and public services		
Residential		
of which traditional uses		
Other		

Biogas

1. The UNDP report shows that 950 small digesters and 7 large ones have been installed.
2. With table 2 the biogas production can be estimated
3. The conversion factors help to estimate the energy content in TJ.

	Small	Large
Installed digesters	950	7
Digester sizes (m3)	8	24
Gas production per plant (m3/day)	2.7	8
Gas production per plant (MJ/day)	59	177
Gas production per plant (MJ/year)	21511	64532
Gas production (TJ/year)	20.4	0.5
Total gas production (TJ/year)	20.9	

It can be assumed that this is all residential.