

Biogas Wastewater Assessment Technology Tool (BioWATT)

Global Methane Forum
Washington, DC, USA

29 March 2016
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Overview

- Introduction to tool
- Technologies assessed
- Tool structure and how to use
- Examples

Purpose

- Provide a quick and preliminary assessment of wastewater-to-energy projects
 - Biogas production
 - Electricity generation
 - Greenhouse gas savings
 - Design parameters of major components of a wastewater-to-energy project (e.g., digester volume, required gas holder volume, and combined heat and power (CHP) electric power output)
 - Operating expense (OPEX) savings

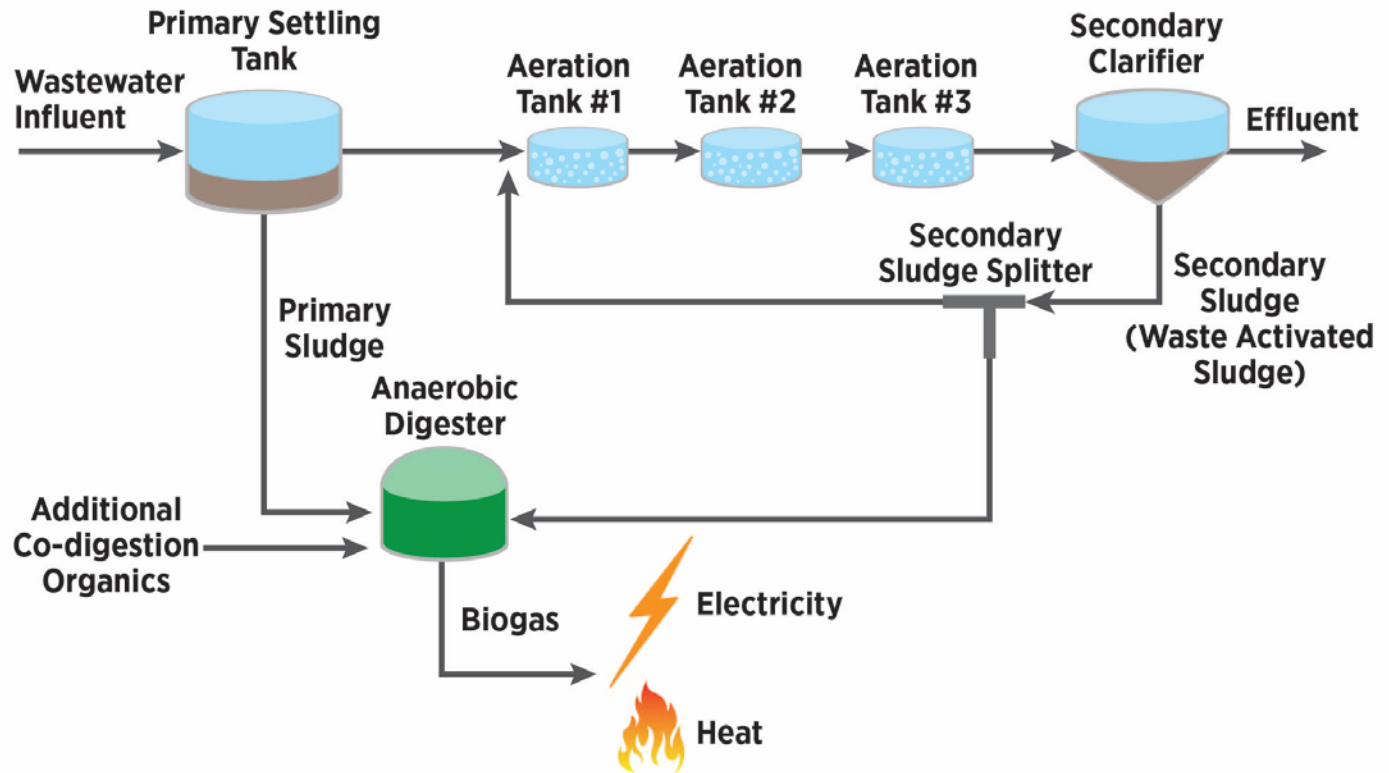
Intended Users

- Wastewater treatment facility operators
- Project developers
- Federal/state/local decision makers

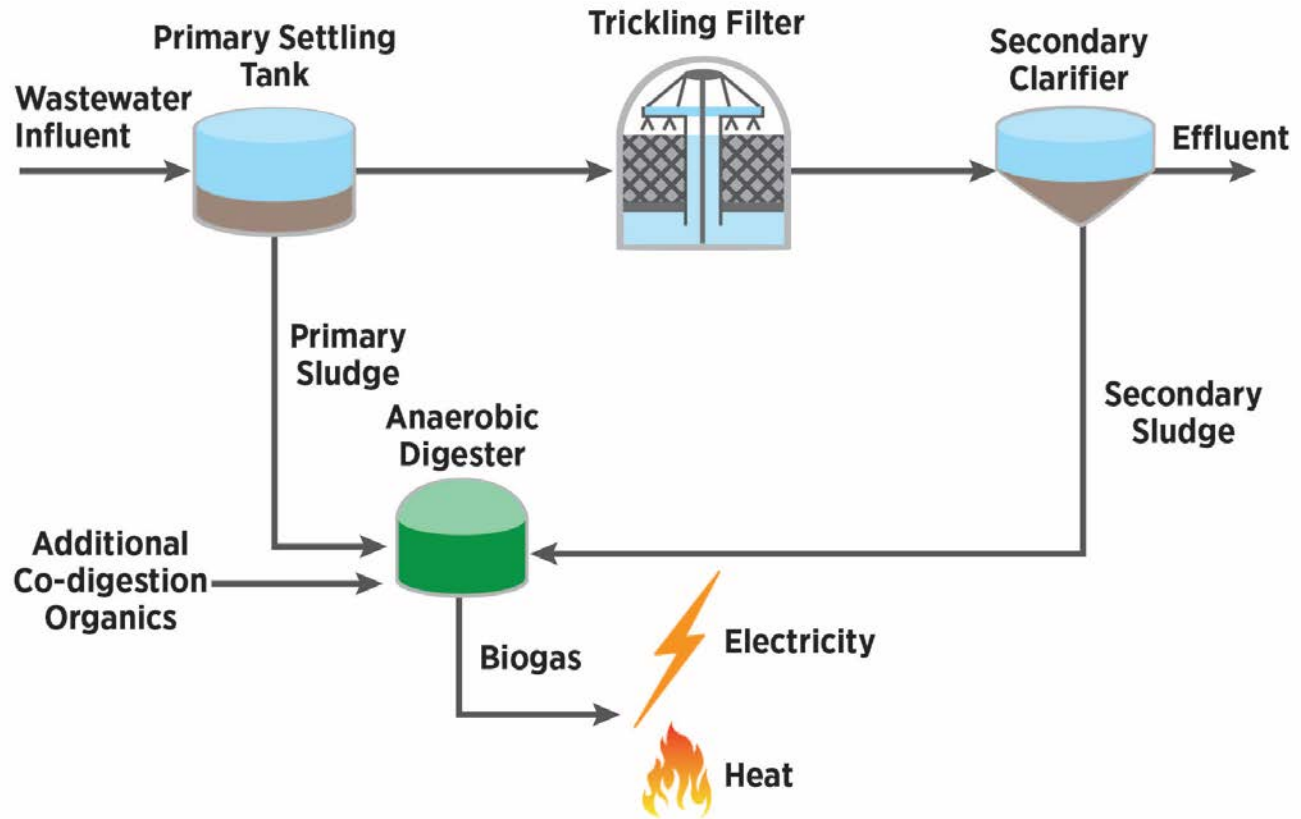
Technologies Evaluated

- Conventional activated sludge (CAS) with anaerobic digester (plus optional co-digestion)
- Trickling filter (TF) with anaerobic digester (plus optional co-digestion)
- Upflow anaerobic sludge blanket (UASB) reactor
- Covered anaerobic pond

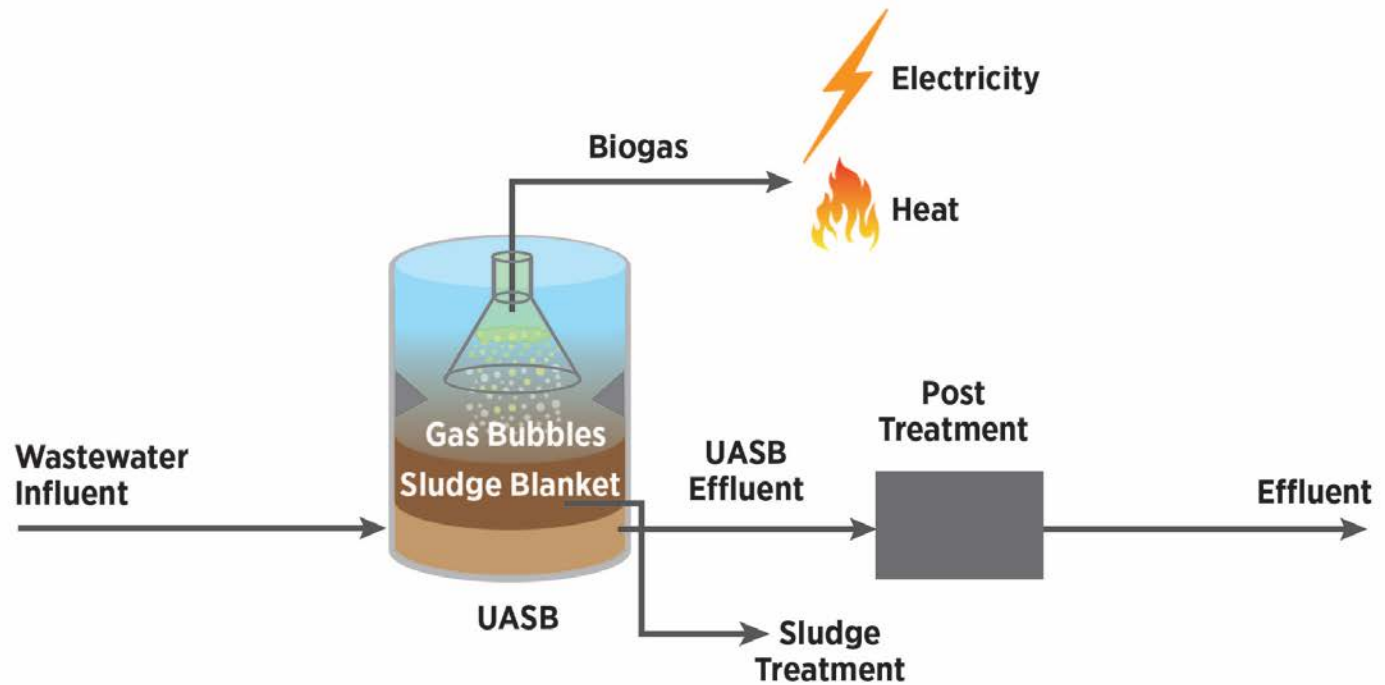
Conventional Activated Sludge (CAS)



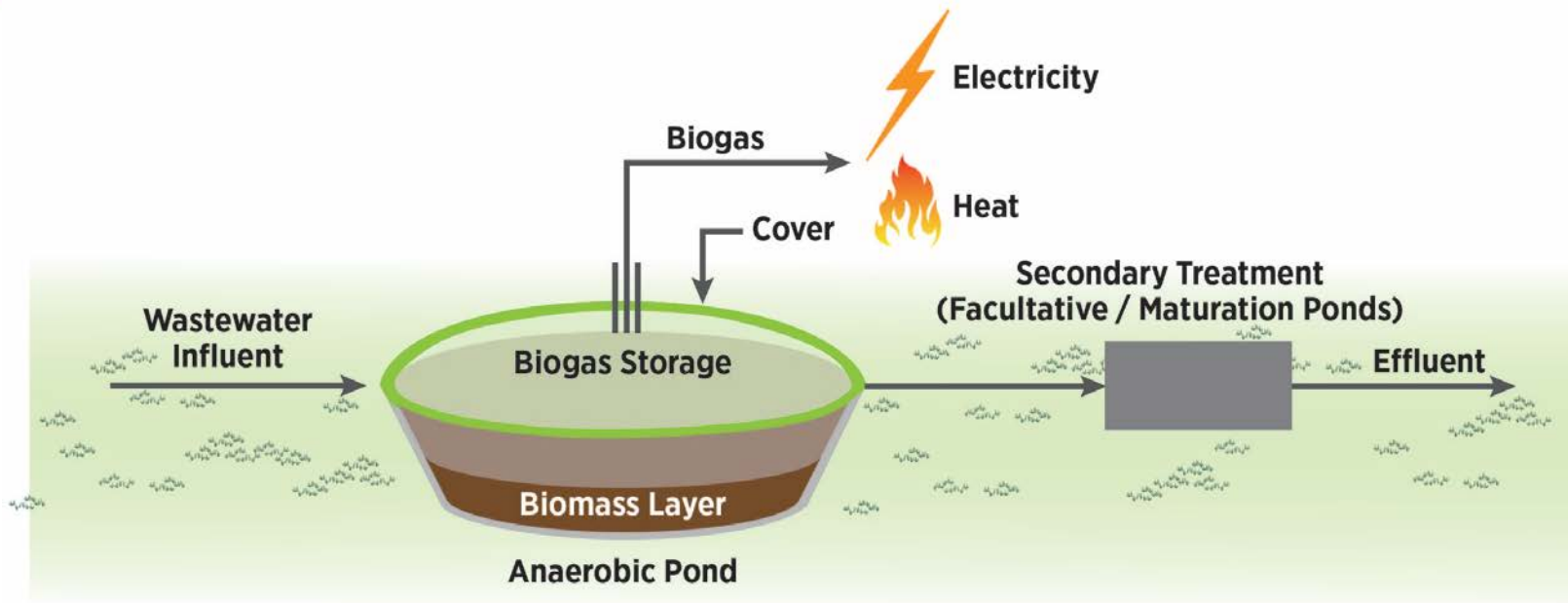
Trickling Filter



Upflow Anaerobic Sludge Blanket (UASB)



Covered Anaerobic Pond



Structure

- 3 Worksheets
 - Introduction
 - Basic Module
 - Advanced Module

Basic Module

- Intended for most users
- Upper part of worksheet = Inputs
- Lower part of worksheet = Summary Results
- Limited inputs:
 - Wastewater parameters (hydraulic load, BOD5 concentration)
 - GHG emissions (local electric grid emission factor)
 - Cost (electricity tariff, sludge disposal unit cost, average labor cost)

Advanced Module

- Intended for users with more advanced knowledge
- Allows entry of specific wastewater data and overwrite tool defaults
- **All BioWATT calculations are made in Advanced Module and select outputs are copied into Basic Module**

How to Use BioWATT

Inputs = Green

Outputs = Orange

Two Modules:

- Basic
- Advanced

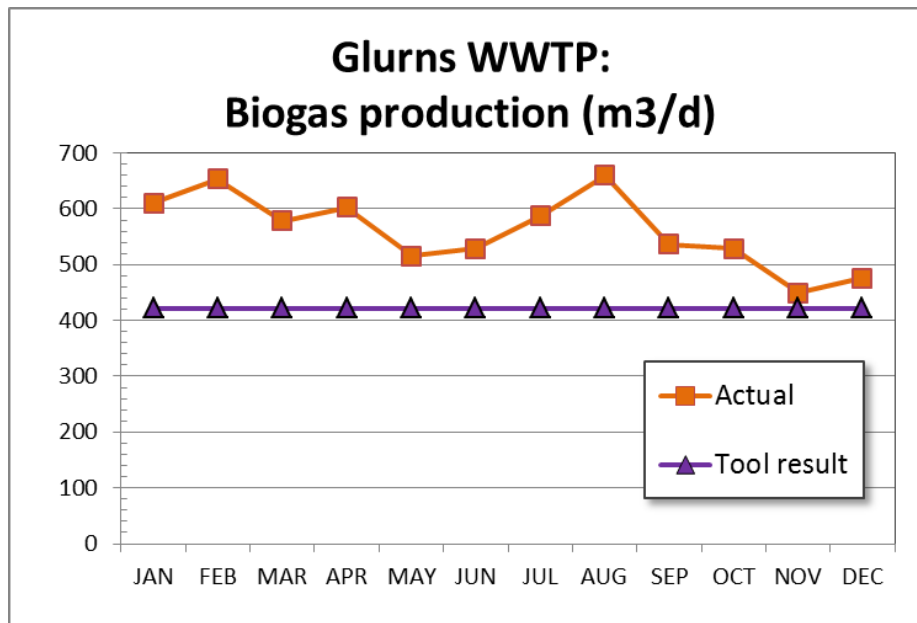
BioWATT (Biogas Wastewater Assessment Technology Tool)				v1.0 (19 Jan 2016)
Project:	(Name of WWTP)			
Date:	(Date)			
INPUT DATA				
WASTEWATER ENTERING WWTP	Value	Unit	Comment	
Average hydraulic load	40,000	m ³ /d	Provide estimate of the expected average daily wastewater flow reaching the WWTP. A rough estimate can be made by utilizing about 80% of the water supply to the same catchment, and by adding an assumption for stormwater flow and ground-water intrusion. For separate sewer systems this may add up to another 30% flow, for combined sewer systems this may add up to another 100-200%.	
Average inflow BOD ₅ concentration	120	mg/L	Provide estimate of the expected average BOD ₅ concentration entering the WWTP.	
GREENHOUSE GAS EMISSIONS	Value	Unit	Comment	
Local GHG emissions for electricity generation	565	g CO ₂ /kWh	Select appropriate value from drop-down menu, or utilize data from other sources (e.g. International Energy Agency IEA: "CO ₂ Emissions From Fuel Combustion")	
Do you have a UASB that is not collecting biogas?	NO		Select "YES" or "NO" from drop-down menu	
Do you have an Anaerobic Pond that is not collecting biogas?	NO		Select "YES" or "NO" from drop-down menu	
UNIT COST	Value	Unit	Comment	
Electricity tariff	0.15	US\$/kWh	Insert locally prevailing unit cost for power purchase from public grid	
Sludge disposal unit cost	10.00	US\$/m ³	Insert locally prevailing unit cost for sludge disposal / reuse	
Average labor cost	10,000	US\$/personnel/year	Insert locally prevailing average unit cost for operators at WWTP	
SUMMARY OUTPUT RESULTS				
CAS + DIGESTER	Result	Unit	Comment	
Biogas production	567,648	m ³ /year		
Electricity generation from biogas	1,106,914	kWh/year		
Including co-digestion	NO	--		
Including ultrasound sludge disintegration	NO	--		
GHG emission reduction through electricity from biogas	-625	tons CO ₂ /year		
Elimination of existing GHG emissions from digester	0	tons CO ₂ /year		
Total GHG emission reduction	-625	tons CO_{2e}/year		
Reduction of electricity cost	-166,037	US\$/year		
Reduction of aeration cost in aeration tank	-75,600	US\$/year		
Reduction of sludge disposal cost	-28,337	US\$/year		
Introduction Basic Module Advanced Module				

Examples

- Glurns (Northern Italy) Wastewater Treatment Plant (CAS + Digester)
- Managua Wastewater Treatment Plant (Trickling Filter + Digester)
- Betim Central (Minas Gerais, Brazil) Wastewater Treatment Plant (UASB)
- Santa Cruz (Bolivia) Wastewater Treatment Plant (Covered Anaerobic Ponds)

Glurns WWTP (CAS + Digester)

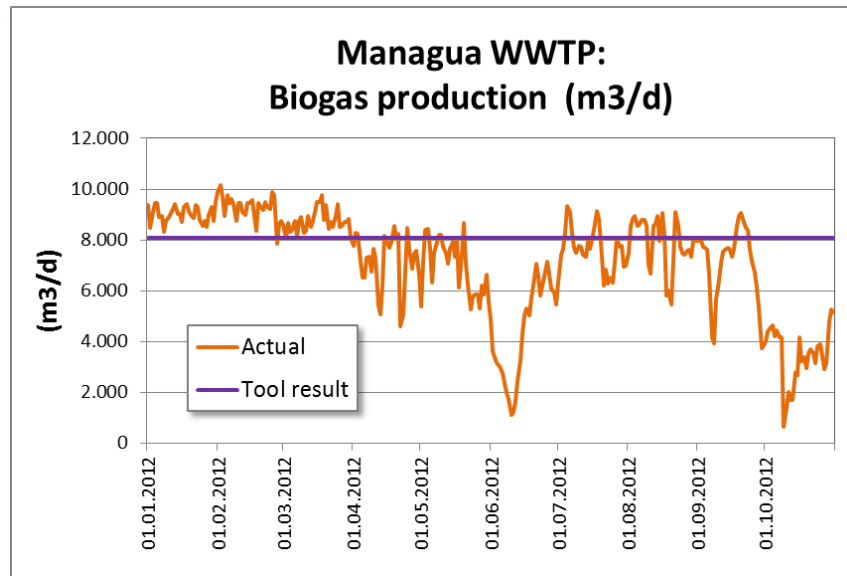
Glurns WWTP (Northern Italy, Europe) CAS + digester	Average hydraulic load (m3/d)	Biogas production (m3/year)	Electricity generation from biogas (kWh/year)	GHG emission reduction (tons CO2e/year)	Total OPEX saving (US\$/year)
- Actual operation data	3,191	204,480	302,576	n.a.	n.a.
- Tool result	3,191	153,966	300,234	-122	-109,165
- Difference	0%	-25%	-1%		



Gas Holder

Managua WWTP (TF + Digester)

Managua WWTP (Nicaragua)	Average hydraulic load	Biogas production	Electricity generation from biogas	GHG emission reduction	Total OPEX saving
TF + digester	(m3/d)	(m3/year)	(kWh/year)	(tons CO2e/year)	(US\$/year)
- Actual operation data	100,750	2,613,035	5,448,000	n.a.	n.a.
- Tool result	100,750	2,820,782	5,500,525	-2,530	-438,782
- Difference	0%	8%	1%		



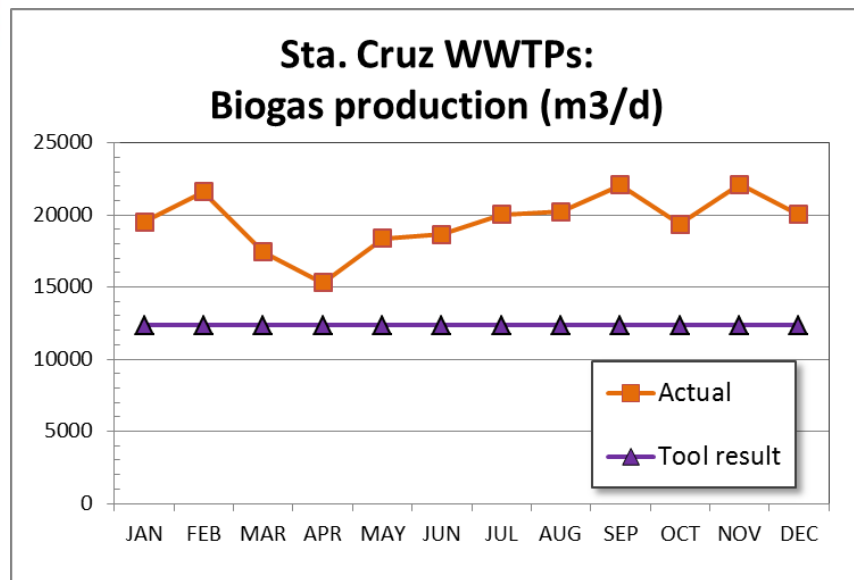
Betim Central WWTP (UASB)

Betim Central WWTP (Minas Gerais, Brazil) UASB	Average hydraulic load (m3/d)	Biogas production (m3/year)	Electricity generation from biogas (kWh/year)	GHG emission reduction (tons CO2e/year)	Total OPEX saving (US\$/year)
- Actual operation data	19,855	333,072	n.a.	n.a.	n.a.
- Tool result	19,855	254,760	496,782	-43	-60,701
- Difference	0%	-24%	---		



Santa Cruz WWTP (Covered Anaerobic Ponds)

Sta. Cruz WWTPs (Bolivia) - 4 systems taken together Covered Anaerobic Pond	Average hydraulic load (m3/d)	Biogas production (m3/year)	Electricity generation from biogas (kWh/year)	GHG emission reduction (tons CO2e/year)	Total OPEX saving (US\$/year)
- Actual operation data	118,009	7,138,305	n.a.	n.a.	-590,000
- Tool result	118,009	4,507,932	9,466,656	-4,004	n.a.
- Difference	0%	-37%	---		



Contact

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Download BioWATT at:

<http://www.globalmethane.org/tools-resources/tools.aspx#five>