Fuel Ethanol Plant Energy per Litre (Meredith)

Thermal and electrical energy of a fuel ethanol plant per litre of undenatured ethanol from figures per denatured gallon (Meredith, Alcohol Textbook ch. 25).

Method: Jacques; Lyons and Kelsall (eds.); ...

Input parameters

Unit system: SI

Parameter	Value	Unit
Ethanol made (undenatured)	12,500	L/h
Fuel (natural gas) per denatured gallon, BTU Alcohol Textbook: about 36 000 BTU of gas per gallon in modern plants.	36,000	
Boiler efficiency	82.000	%
Electricity per denatured gallon, kWh 0.7–1.2 kWh per gallon; 1.1 as a conservative average.	1.1000	
Denaturant added per volume of ethanol	5.0000	%

Calculated results

Parameter	Value	Unit
Fuel per kg of undenatured ethanol	13.349	MJ/kg
Fuel per litre of undenatured ethanol	2.9265	kWh/L
Steam heat per litre	2.3997	kWh/L
Electricity per litre	0.30512	kWh/L
Fuel input	36.582	MW
Electric load	3,814.0	kW

Notes for this case

• Meredith's example: 36 000 BTU/gal of gas × 105/100 = 37 800 BTU per undenatured gallon; at 82 % boiler efficiency about 31 000 steam BTU; electricity 1.155 kWh per undenatured gallon. Fuel per kg uses 789.24 kg/m³.

Formula and method

$$q_L = q_g \frac{1+\delta}{3.785\ \mathrm{L}}, \quad s_L = \eta_b q_L, \quad w_L = w \frac{1+\delta}{3.785\ \mathrm{L}}, \quad q_u = \frac{q_L}{\rho_e}$$

Variables

$\dot{V}_E$	Ethanol made (undenatured)	m³/s
q_g	Fuel (natural gas) per denatured gallon, BTU	-
η_b	Boiler efficiency	-
w	Electricity per denatured gallon, kWh	-
δ	Denaturant added per volume of ethanol	-
q_u	Fuel per kg of undenatured ethanol	J/kg
q_L	Fuel per litre of undenatured ethanol	J/m³
s_L	Steam heat per litre	J/m³
w_L	Electricity per litre	J/m³
$\dot{Q}_g$	Fuel input	W
P	Electric load	W
ρ_e	Ethanol density at 20 °C, 789.24 kg/m³ (OIML R 22)	kg/m³

Method and standards

Meredith's accounting converted to SI.

Assumptions and limits

- US gallon basis of the source; BTU and kWh per gallon are entered as plain numbers and converted inside with the exact NIST factors.
- The gas BTU are on whatever heating value basis the source figure uses (gross or net); the boiler efficiency must be on the same basis.

References

• Jacques
• Lyons and Kelsall (eds.)
• The Alcohol Textbook
• 4th ed. (Nottingham University Press, 2003)
• ch. 25 (Meredith)
• energy use and energy users in contemporary ethanol plants
• US gallon 3.785 411 784 L and IT BTU 1 055.055 852 62 J (NIST SP 811)

Report details

Report reference	FCC-WNSY-0X71 (the same inputs always give the same reference)
Generated	17 November 2026, 19:50 UTC
Calculator	Fuel Ethanol Plant Energy per Litre (Meredith)
Method last reviewed	13 November 2026
Software release	FireCAD Calc, release of 17 November 2026
Release checks	2 reference cases of this calculator, computed independently, are checked on every release

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/sugar-ethanol/ethanol/ethanol-plant-energy-meredith

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.