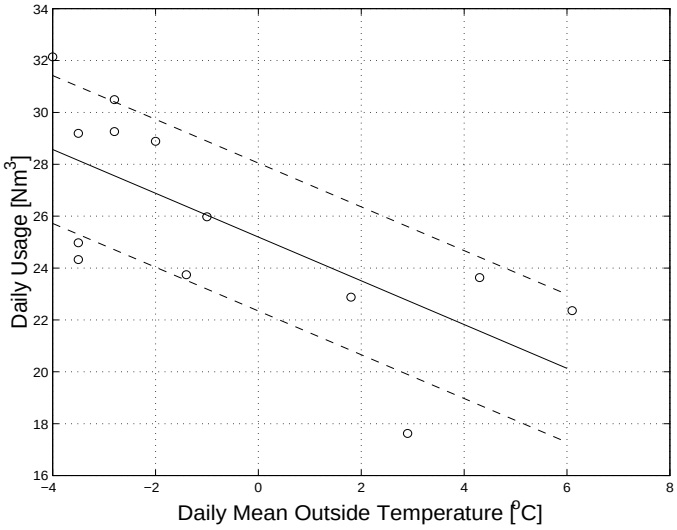
CERTIFICATE

VPGEO Home Energy Label 2010

Blue Energy Str. 14, 5000 KK Eindhoven, The Netherlands

Brief Description.

Bungalow, double pane windows, central heating with high efficiency heater
Built 1994, home ground floor area 250 m^2, home volume 750 m^3
Location: residential area with no trees



Energy-weather correlation. Gas-energy usage and local temperatures in February 2010.

Summary of Energy Usage

QUANTITY	UNIT	RESULT
Yearly electricity usage	kWh	1800
Yearly gas-energy usage	normal cubic meters [Nm^3]	2200
HEE_0	Nm^3 per day per degree Celsius	0.84
Standard Error	”	0.24
HEE_0	Nm^3 per month per degree Celsius	25.7
”	normalized tot national average	+ 68%
Home energy audit		recommended

VPGEO $HEE_0 = 0.84 \pm 0.24$ Nm^3 per day per ^oC

Valid through 2012

Measurements of usage

Measurement point	Usage [m^3]	Usage [Nm^3]	$< T_{\text{outside}} >$ [$^{\text{O}}$C]	Date
1	23.050	22.357	6.1	3/2/2010
2	24.365	23.633	4.3	4/2/2010
3	18.170	17.624	2.9	5/2/2010
4	23.585	22.876	1.8	6/2/2010
5	24.479	23.743	-1.4	7/2/2010
6	25.081	24.327	-3.5	8/2/2010
7	33.140	32.144	-4.0	9/2/2010
8	31.440	30.495	-2.8	10/2/2010
9	30.100	29.195	-3.5	11/2/2010
10	29.780	28.885	-2.0	12/2/2010
11	30.167	29.260	-2.8	13/2/2010
12	25.747	24.973	-3.5	14/2/2010
13	26.780	25.975	-1.0	15/2/2010

Conversion to normal volume [Nm^3, P_0=1 atm, $T_0 = 0$ $^{\text{O}}$C].

$$V[\text{Nm}^3] = V[\text{m}^3]\frac{P[\text{gas}]}{P_0}\frac{T_0}{T_0 + T[\text{bellow meter}]} \tag{1}$$

T[bellow meter]= 20$^{\text{O}}$ [1], P[gas]=P[ambient]+28 mbar, bellow meter error=+1%

Calculation of Standard Error in VPGEO HEE$_x$

$$\text{SE}[\text{HEE}_x] = \frac{1}{\sqrt{n-1}\sigma_x}\sqrt{\frac{\Sigma_i \epsilon_i^2}{n-2}}, \tag{2}$$

x and σ_x are, respectively, the mean and standard deviation of the outside temperatures, ϵ_i denotes the descrepancy between measured normal volume and best fit linear interpolation of usage to outside temperature, and n denotes the total number of measurement points.

Remark. HEE$_x$ is preferably determined with $n = 12$ over the course of 3 months. It is essentially independent of x for $x \leq 11$ 11 degrees Celsius with a national average of 0.5 (0.6) Nm^3 day^{-1} $^{\text{O}}$ C^{-1} in the Netherlands (in California).

Reference.

Residential Gas Metering: How Good is it?, Invited Report to the Minister of Economic Affairs Maria van der Hoeven, 2007, AnMar Research Laboratories B.V., ISBN 0-978-90-9022005-5