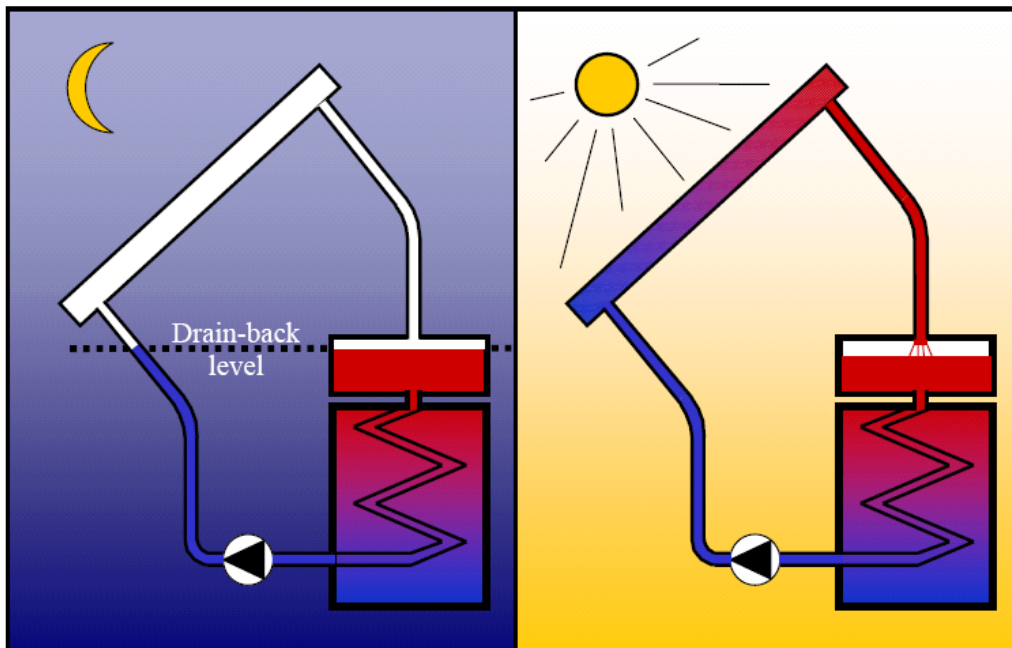


ZEN-International drain-back solar water heating systems

CO₂ Savings



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1 Introduction

This document constitutes a short report, including relevant calculations, relating to the potential Carbon Dioxide (CO₂) savings obtainable by a typical household with a ZEN international drain back solar water heating system installed.

The calculations are based on a well-designed, well-installed system with a Southerly aspect and a pitch of 30°. Incoming solar radiation is based on the 20-year average at Kew, London. Other locations, aspects and pitch may well vary from the results shown in this report, but generally the information gives a good guideline for CO₂ savings in the UK.

Results are shown for systems equipped with a collector area of 1.38m² (Thermic 14), 2.75m² (Thermic 28), 4.12m² (Thermic 42), and are measured against both electricity and natural gas as the heating mediums.

2 Calculations

2.1 System Outputs

Annual energy output from 1.38m² system:

$$\begin{aligned} \text{Aperture area} &= 1.38\text{m}^2 \\ \text{Annual energy output} &= 1.458 \text{ GJ/m}^2/\text{yr} && [1] \\ \text{Parasitic energy (pump \& controller)} &= 0.179 \text{ GJ/yr} && [1] \end{aligned}$$

$$\begin{aligned} \text{Annual energy output} &= (1.38 \times 1.458) - 0.179 \\ &= \mathbf{1.833 \text{ GJ/yr}} \end{aligned}$$

Annual energy output from 2.75m² system:

$$\begin{aligned} \text{Aperture area} &= 2.75\text{m}^2 \\ \text{Annual energy output} &= 1.458 \text{ GJ/m}^2/\text{yr} && [1] \\ \text{Parasitic energy (pump \& controller)} &= 0.179 \text{ GJ/yr} && [1] \end{aligned}$$

$$\begin{aligned} \text{Annual energy output} &= (2.75 \times 1.458) - 0.179 \\ &= \mathbf{3.830 \text{ GJ/yr}} \end{aligned}$$

Annual energy output from 4.12m² system:

$$\begin{aligned} \text{Aperture area} &= 4.12\text{m}^2 \\ \text{Annual energy output} &= 1.458 \text{ GJ/m}^2/\text{yr} && [1] \\ \text{Parasitic energy (pump \& controller)} &= 0.179 \text{ GJ/yr} && [1] \end{aligned}$$

$$\begin{aligned} \text{Annual energy output} &= (4.12 \times 1.458) - 0.179 \\ &= \mathbf{5.828 \text{ GJ/yr}} \end{aligned}$$

2.2 CO₂ Savings Based on Electrical Heating

Production of CO₂ associated with electrical energy = 188 kg/GJ [2]

CO₂ Savings from 1.38m² system:

$$\begin{aligned}\text{CO}_2 \text{ saving} &= 1.833 \times 188 \\ &= \mathbf{344 \text{ kg/yr}} \\ &= \mathbf{8,600 \text{ kg}} \text{ (total CO}_2 \text{ savings in 25yr system life expectancy)}\end{aligned}$$

CO₂ Savings from 2.75m² system:

$$\begin{aligned}\text{CO}_2 \text{ saving} &= 3.830 \times 188 \\ &= \mathbf{720 \text{ kg/yr}} \\ &= \mathbf{18,000 \text{ kg}} \text{ (total CO}_2 \text{ savings in 25yr system life expectancy)}\end{aligned}$$

CO₂ Savings from 4.12m² system:

$$\begin{aligned}\text{CO}_2 \text{ saving} &= 5.828 \times 188 \\ &= \mathbf{1095 \text{ kg/yr}} \\ &= \mathbf{27,375 \text{ kg}} \text{ (total CO}_2 \text{ savings in 25yr system life expectancy)}\end{aligned}$$

2.3 CO₂ Savings Based on Natural Gas Heating

Production of associated with energy from natural gas = 52 kg/GJ [2]

Typical efficiency of heating water with natural gas = 70% [2]

CO₂ Savings from 1.38m² system:

$$\begin{aligned}\text{CO}_2 \text{ saving} &= 1.833 \times \frac{52}{0.7} \\ &= \mathbf{136 \text{ kg/yr}} \\ &= \mathbf{3,400 \text{ kg}} \text{ (total CO}_2 \text{ savings in 25yr system life expectancy)}\end{aligned}$$

CO₂ Savings from 2.75m² system:

$$\begin{aligned}\text{CO}_2 \text{ saving} &= 3.830 \times \frac{52}{0.7} \\ &= \mathbf{284 \text{ kg/yr}} \\ &= \mathbf{7,100 \text{ kg}} \text{ (total CO}_2 \text{ savings in 25yr system life expectancy)}\end{aligned}$$

CO₂ Savings from 4.12m² system:

$$\begin{aligned}\text{CO}_2 \text{ saving} &= 5.828 \times \frac{52}{0.7} \\ &= \mathbf{433 \text{ kg/yr}} \\ &= \mathbf{10,825 \text{ kg}} \text{ (total CO}_2 \text{ savings in 25yr system life expectancy)}\end{aligned}$$

3 Quick Reference Table

System Size (m ²)	CO ₂ Savings Electricity		CO ₂ Savings Natural gas	
	(kg/year)	(kg/25 year)	(kg/year)	(kg/25 year)
1.38	344	8,600	136	3,400
2.75	720	18,000	284	7,100
4.12	1,095	27,375	433	10,825

4 References

- [1] ETSU S/P3/00275/REP/2
UK Side By Side Testing of Eight Solar Water Heating Systems
DTI. 2001
- [2] *The UK Government's Standard Assessment Procedure for Energy Rating of Dwellings.*
Energy Efficiency Office, Department of the Environment UK. 1994