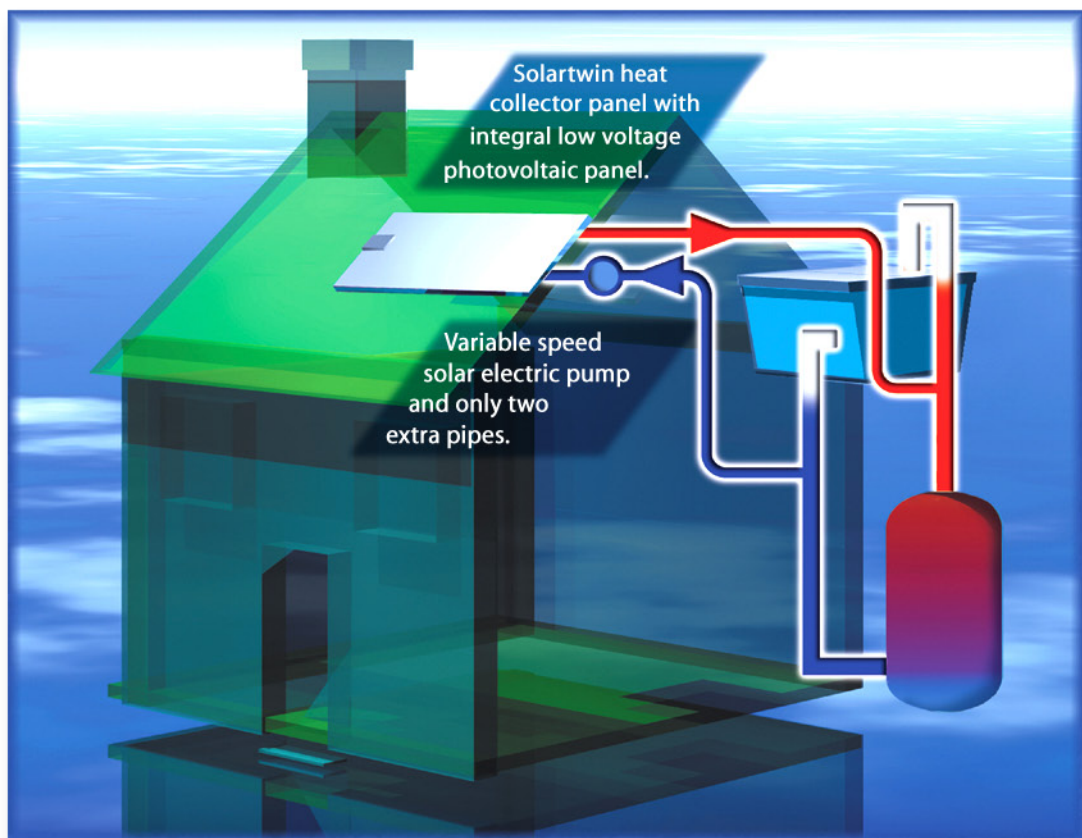


# Solartwin.com

30th June 2009

Surveying, specifying, installing & commissioning  
Solartwin



Seminar manual...

100% solar pumped solar water heating







# Welcome to the seminar...

Surveying, specifying, installing & commissioning Solartwin



## Today's agenda...

**10:00am**

Registration, tea and coffee

**10:30am How Solartwin works**

The Solartwin concept / Customer satisfaction / Installer expectations / Solar cost & benefits

**11:20am**

Tea & coffee

**11:30am The solar resource & components**

The solar resource / Direct heating / Stratified storage / See the components / CO<sub>2</sub>

**12:30pm**

Buffet Lunch

**1:30pm Installing Solartwin**

Pre-installation checks / Intalling, step by step / Useful do's and don'ts / Commissioning / Post commission checklist / Customer service

**2:45pm**

Tea & coffee

**3:00pm Surveying & specifying**

Grants / System sizing / Hardness control / Cylinders & legionella / Performance & user guide



Agenda...

**Solartwin.com**



1 Seminar Notes

37 Brochure

45 Installation Method Statement

111 Supplementary info

129 Case Studies

141 Photos

Contents...



# Seminar Notes



**Solartwin**  
© Solar Twin Ltd 2009  
Information correct at 30/6/2009

*Welcome To Chester!*

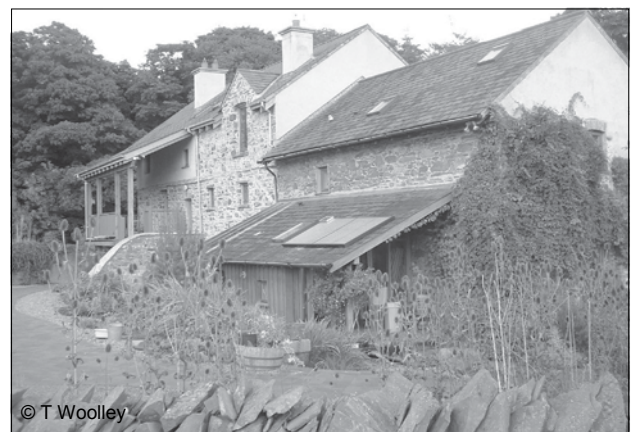
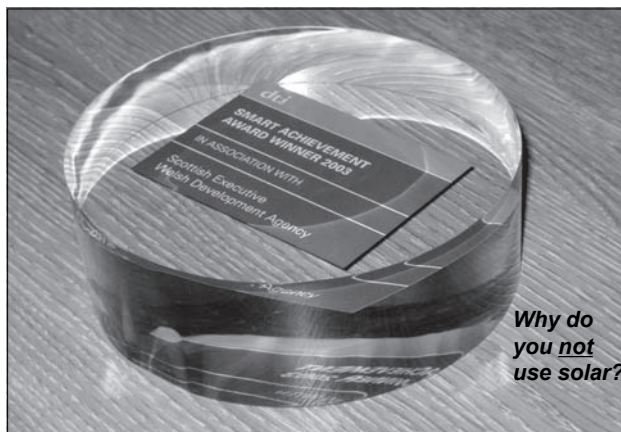
*Chris Wilcox  
Comm & Tech Manager*

[c.wilcox@solartwin.com](mailto:c.wilcox@solartwin.com) [www.solartwin.com](http://www.solartwin.com)

## Housekeeping:

Crowne Plaza Chester Chester Roodee Suite

- **Fire procedure:** on hearing the alarm
  - ☐ Out the door at the rear of the room
  - ☐ Turn right
  - ☐ Assemble as directed
- **Toilets**
  - ☐ Out the door, straight across the lobby
- **Lunch:** Silks Restaurant - on this floor
- **Mobile phones:** set to silent please.



[solartwin.com](http://solartwin.com)

## Programme

### 10.30 How Solartwin Works

- ☐ The Solartwin concept
- ☐ Customer satisfaction
- ☐ Installer expectations
- ☐ Solar cost / benefits

### 11.20 Tea & Coffee

### 11.30 The Solar Resource & Components

- ☐ The solar resource
- ☐ Cylinders
  - Direct heating
  - Stratified storage
- ☐ See the components
- ☐ CO<sub>2</sub>

### 12.30 Buffet Lunch

### 1.30 Installing Solartwin

- ☐ Outside demonstration if possible
- ☐ Pre-installation checks
- ☐ Installing, step by step
- ☐ Useful do's and don'ts
- ☐ Commissioning
- ☐ Post-commissioning checklist
- ☐ Customer service

### 2.45 Tea & Coffee

### 3.00 Surveying & Specifying

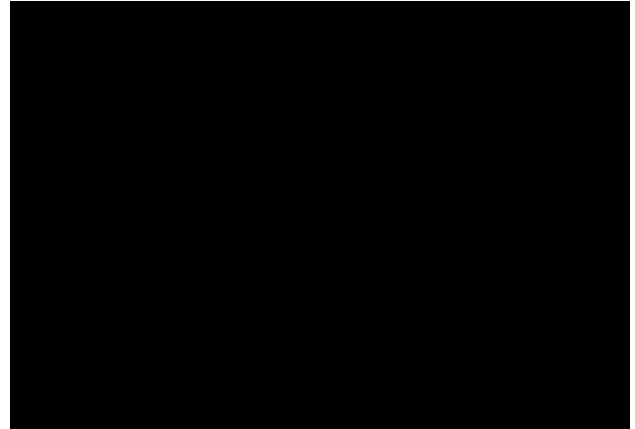
- ☐ Solar controller demonstration
- ☐ Grants
- ☐ Hardness control
- ☐ Legionella
- ☐ Performance / user guide

### 4.00 Close

© Solartwin 2009

## Quick Tour

© Solartwin 2009



## Solartwin's ambition

Significantly reduce the impact of global warming by becoming a major provider of affordable solar water heating systems

Become recognised as the company which brought solar water heating from the green ghetto into the mainstream

□ *but how? Combine*

- *the innovation of Dyson with*
- *the accessibility of the Easyjet website and*
- *the customer service of John Lewis.*

© Solartwin 2009

## Ten steps from a parked car □ solartwin.com

1. Park your car in the sun: 20C
2. Close all windows: 40C
3. Block all ventilators: 60C
4. Replace the roof with double glazing: 100C
5. Lean it towards the sun: 120C
6. Insulate its sides and underside: 140C
7. Paint it all black inside: 160C
8. Put a flexible pipe full of cold water in it
9. Pump hot water out using a solar pump
10. Enjoy a hot bath and shout "Eureka!"



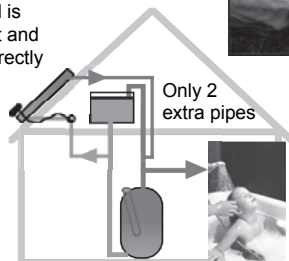
□ *to a Solartwin panel*



## Solartwin: simply different

Solartwin heat collector panel is freeze-tolerant and heats water directly

Safe low voltage variable speed low flow pump and photovoltaic panel



Hot water out to baths and sinks from stratified storage

*Simple design concept and operation.*

## Comparisons: traditional & new solar

Question □	TRADITIONAL	NEW
Roof work?	yes	yes
Mains electrics?	yes	no
Complex plumbing?	yes	no
Over a day to fit?	yes	no
Needs new cylinder?	yes	not usually
Needs antifreeze?	yes	no
Stratified storage?	low effect	high benefits

## Customer satisfaction

© Solartwin 2009



Hi, I'm Andy  
at Solartwin.

How may I  
help you?

© Solartwin 2009

## Quality from Continuous Improvement

- Accessible
  - ☐ We answer the phone 8am-6pm
- Have a customer service policy
  - ☐ Chartered engineers
  - ☐ Prioritise customer enquiries
  - ☐ Aim to solve problems first time
- Best to design out problems from square one
- Customers like the way we are sincere and green
- Joint Best buy winners for solar thermal in Ethical Consumer magazine 2005 & 2007.
- Our customers are also a fan base.

© Solartwin 2009

## The Quality Feedback Loop

- helps installers get it 101% right - fast.

- Phone support available if have a problem on site
- Digital photos = constructive feedback
- Installed customers are asked to give a 2 page satisfaction questionnaire.

© Solartwin 2009

**Solar Twin Ltd Customer Satisfaction - Help us to improve**

Dear Customer,  
We would be grateful if you would provide us with some valuable information by answering the questions below. It will only take a few minutes and your answers will help us to improve and develop our services. Please give comments where applicable.

Your answers will remain confidential to Solar Twin Ltd. Thank you for your comments.

Why did you choose to get solar?

Why did you choose Solartwin as a particular brand?

How would you describe Solartwin?

Was the installation carried out and completed to your satisfaction? Yes ☐ No ☐

How helpful did you find your installer during the installation process?  
 Unhelpful 1 2 3 4 5 6 7 8 9 10 Very helpful

How helpful did you find our literature?  
 Unhelpful 1 2 3 4 5 6 7 8 9 10 Very helpful

How easy to follow did you find your telephone survey?  
 Unhelpful 1 2 3 4 5 6 7 8 9 10 Confident and assisted

How helpful and easy to follow did you find our literature?  
 Unhelpful 1 2 3 4 5 6 7 8 9 10 Very helpful

2009

## Customer satisfaction: Solartwin data Nov 05

- Median scores of **9/10**
  - ☐ Did we respond speedily enough to your inquiries?  
0 = NO, 10 = Yes.
  - ☐ How easy to follow did you find your telephone survey?  
0 = all at sea, 10 = Confident and assisted
  - ☐ How helpful and easy to follow did you find our literature?  
0 = unhelpful, 10 = Helpful
- Median scores of **10/10**
  - ☐ How helpful did you find us when inquiring about Solartwin?  
0=unhelpful, 10 = Very helpful
  - ☐ How helpful did you find our installers during the installation process?  
0 = unhelpful, 10 = Very helpful.

© Solartwin 2009

## Customer satisfaction: Clear Skies data Nov 05

- ✓ **83%** of users ☐very satisfied☐with Solartwin installers.
- The others scored **74%**.
- ✓ Solartwin has fewer problems after installation.
- The other technologies had **25%** more problems.

© Solartwin 2009

## Customer Assurance

- Turnaround objectives
  - ☐ Inquiry to call back 80% in 24h
  - ☐ Order cool-off period 7 days
  - ☐ Cool off ends to installing 80% in 30 days
  - ☐ We cannot assure the weather!
  - ☐ We do ensure the customer is kept informed.

© Solartwin 2009

From Peter Till . Dear Angela,

Chris and his assistant installed our solar system yesterday. It took a great deal of time and effort to remove the old very heavy system, but once this was done you could tell they were very experienced in your product.

It was a pleasure to have workmen in our house who were very polite and efficient.

I would like to thank you for all the help you have given to us and for the installers who we could not fault. If the system proves to be as good as your service and the installers, then we have a brilliant product that is going to last for a very long time.

If I can recommend anyone to have a solar system it will most certainly be Solartwin.

Many Thanks.

Regards Peter Till.

© Solartwin 2009

## Our expectations of installers☐

Are high but fair☐

© Solartwin 2009

## A Great Solartwin Installer (1 of 2)

- ✓ Represents Solartwin, not just him/herself
- ✓ Operates way above any old building contractor
- ✓ Is considerate, skilled, 100% safe in plumbing & roofing
- ✓ Organises a schedule of work 1-12 w ahead
- ✓ Does not overbook and warns us of holidays
- ✓ Never cuts corners
- ✓ Gives rapid and outstanding customer service
- ✓ Prioritises customer service ahead of all other work
- ✓ Does not pass comment on another ST installer's work

© Solartwin 2009

## A great Solartwin installer (2 of 2)

- ✓ Leaves the house & patio cleaner than when they arrived
- ✓ Leaves a mobile phone number with the customer
- ✓ Politely declines a job if it's genuinely unhealthy or unsafe
- ✓ Generates unsolicited thank you☐testimonials
- ✓ Generates new referral business as well
- ✓ Tells us, constructively, where we can be even better
- ✓ Allows us to do the same
- ✓ Wears clean kit
- ✓ ***Wears a well earned smile, with pride!***

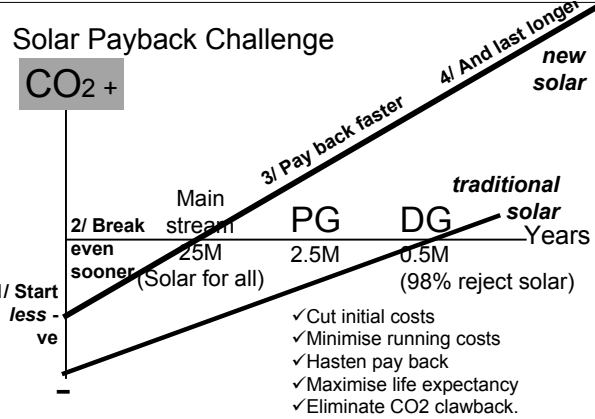
© Solartwin 2009



# Solar Costs-Benefits

solartwin.com

© Solartwin 2009



## How many of UK's homes are suitable for solar?

solartwin.com

- Over 90% plus have a suitable roof
- Of these, about two thirds have suitable plumbing
- Of these, under 10% have planning constraints
- So about 60% of UK homes are easily suitable for solar
- UK has 24 Million homes
- This means 14.4 million have solar feasibility!
- The current figure is around 0.1 million homes.

© Solartwin 2009

## Imminent mainstreaming

Year / market phase	Typical Rol	Imminent mainstreaming	Who thinks this?	Top USP
2005, the last year of the green ghetto	1-4%	I buy in proud defiance of economic logic because solar is deep green - like me.	2%	Green company and product.
2006-9, solar is a lifestyle statement	5%	It can pay as well as the bank. I ignore the capital issues since I am an ethical lifestyle person.	5-10%	Elegantly Zero Carbon.
2009-10, solar becomes a must have	10%	A sensible investment. I am not a greenie. I pay £2500. It adds over £1500 to the value of my home. I save nearly £100 a year.	50%	Simplicity, value and reliability.
2010+, solar is just obvious	20%	You are mad not to have Solar.	90%+	Brand leader.

© Solartwin 2009

## The Big Picture

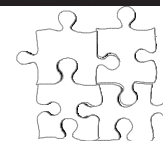
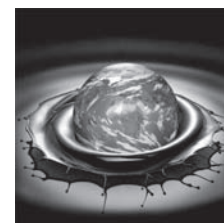
solartwin.com

© Solartwin 2009

## The Big Picture

solartwin.com

- Global warming
  - Melting ice sheets
- Dependence on fossil fuels
- Oil at \$70 per barrel
- Oil resource disputes
- Fuel poverty
- Sustainability
- Green business ethics
- Zero carbon technology.



© Solartwin 2009

# The Solar Resource

- Coffee / Tea Break

© Solartwin 2009



## Drilling down to Solartwin: overview

1. Why renewable energy at all?
2. What renewables are there?
3. Why solar?
4. Why solar in N Europe of all places?
5. What can the sun do? How does it vary?
6. How is solar water heating ahead of PV?
7. Why Solartwin?

© Solartwin 2009

## Drilling down to Solartwin

### 1/ Why renewable energy at all?

Alternatives to renewables all have problems:

- Fossil fuels
  - Falling reserves of oil and gas
  - Global warming / CO2 emissions
- Nuclear energy
  - Poor PR, waste, genetic damage issues
  - Strategic vulnerability to users
- Energy use reduction
  - Conflicts with a growth economy
  - Probably not enough on its own

Renewables do have a role to play

© Solartwin 2009

## Drilling down to Solartwin:

### 2/ What renewables are available?

*From movement energy of moon/earth:*

- Tidal energy

*From geothermal energy in earth:*

- ☐ Deep hot rocks

*From nuclear fusion in the sun:*

- Biomass fuels from photosynthesis
- Shallow geothermal and air sourcing
- Wind / waves
- Hydropower / dams
- Solar radiation harvested directly.

© Solartwin 2009

## Drilling down to Solartwin:

### 3/ Why solar of any type?

1. Solar is spread more evenly globally than most other renewable resources such as wind, tidal, hot rocks, geothermal and hydro.
2. It is very abundant, although seasonal
3. It is comparatively predictable
4. It has known peaks: unlike say wind, it does not need over-engineering
5. Direct solar can be efficient compared to indirect harvests like photosynthesis.

© Solartwin 2009

## Drilling down to Solartwin:

### 4/ Why solar in N Europe of all places?

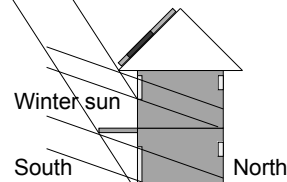
- Move away from imported fossil fuels
  - Fossil fuel depletion / Global instability issues
  - High energy demand in Europe
  - Balance of payments problems from imports
- Constraint: seasonality of around 6:1
  - Solar forms part of a solution
  - Solar is not the only answer.

© Solartwin 2009

## Solar in homes in UK: 3 direct harvests

1. Passive solar design in buildings
2. Solar electricity (Photovoltaics)
3. Solar heating (Solar Thermal) - today

Summer sun



**Why do you not use solar?**



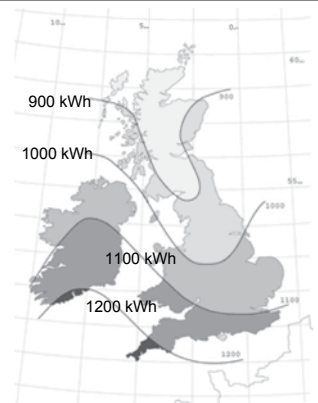
## Is the Sun OK in UK or Ireland?

- Yes! (Spain can use smaller panels.)
- UK / Ireland have best domestic solar resource per head in EU
  - Relatively few of us live in flats
  - Lots of suitable roof per head
- June sun offers 6 x more energy than December's.



© Solartwin 2009

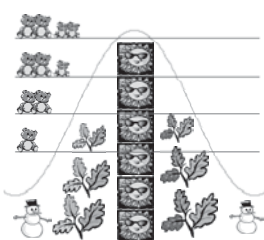
How much solar energy arrives per year in UK / Ireland per square metre facing south at 30 degrees pitch (ie 30 deg off flat)



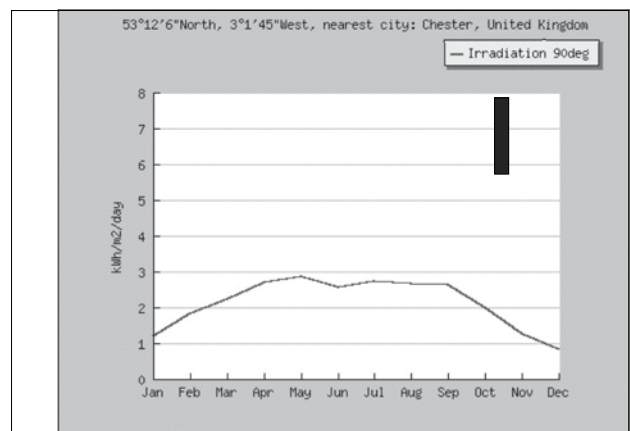
© Solartwin 2009

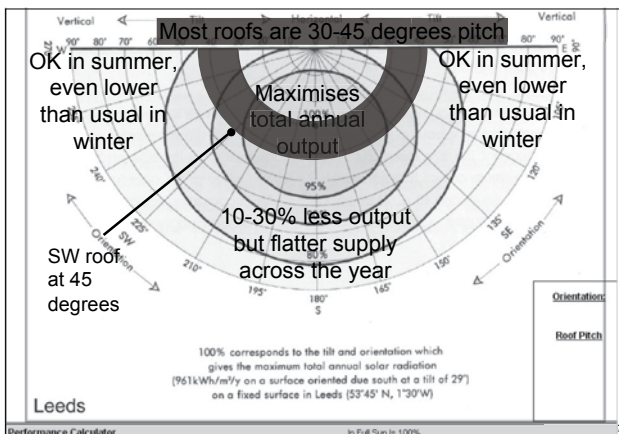
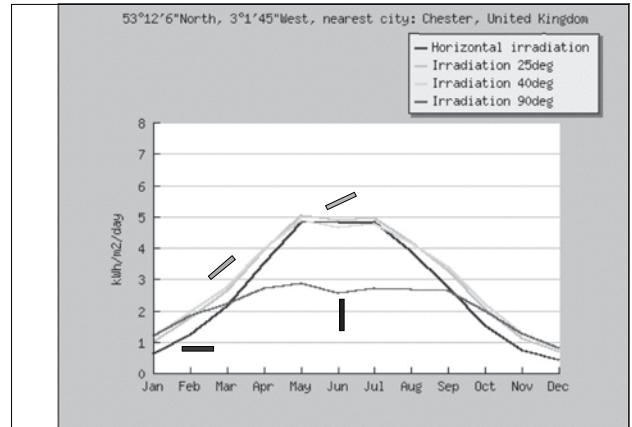
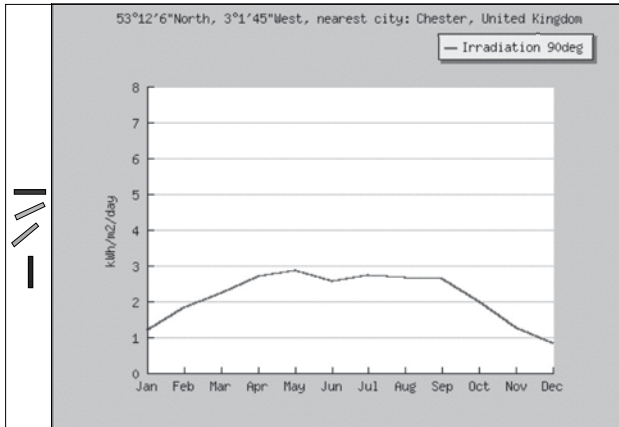
## Solar seasonality in UK

### Solar supply over a year



- **Seasonality:** six times more energy in June than Dec
- Winter: space heating needs are caused by lack of sun
- The space heating headbang: demand is inverse of supply
- **Hot water** from solar is better: demand is more level
- So take the best of what the sun does and fill in any gaps with fossil / other fuels.





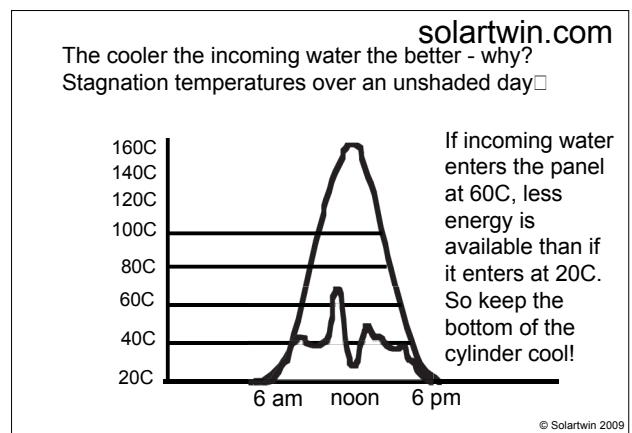
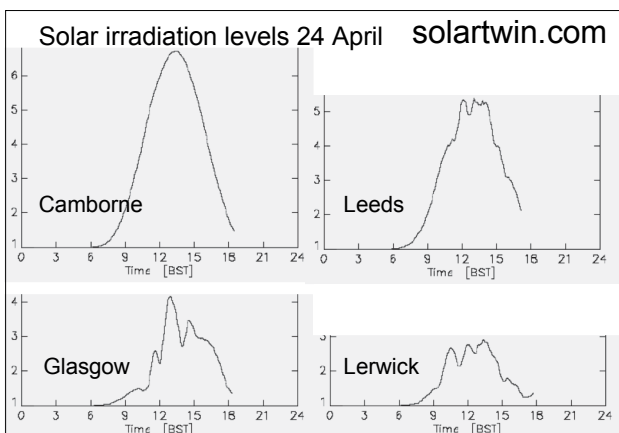
solartwin.com

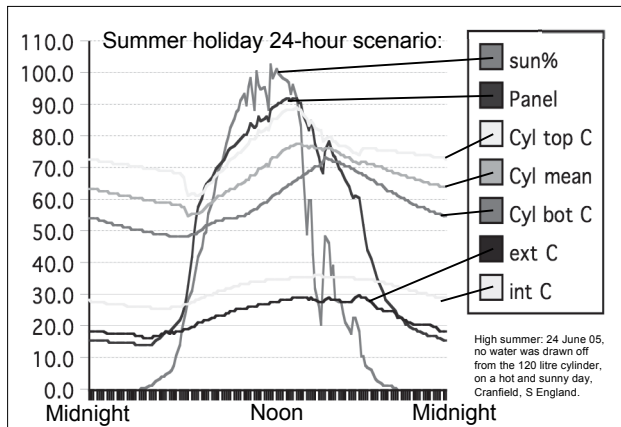
Drilling down from 365 days to 24 hours ☐

But ☐

- ☐ How does sunlight vary over a day?
- Or ☐
- ☐ Even on the same day, but in different parts of UK?

© Solartwin 2009





## Drilling down to Solartwin: 7/ Why Solartwin, compared to other solar thermal technologies?

- ✓ High quality, EU manufactured panel
- ✓ Robust
- ✓ Greener
- ✓ Simpler / technically elegant
- ✓ Rapid install
- ✓ Better value
- ✓ These then mean committed customers

© Solartwin 2009

## What can solar water heating do?

### DO BEST

- ✓ Match demand which is
  - ✓ 7 days a week
  - ✓ 365 days a year
  - ✓ Peak in summer
- ✓ Hot water for washing & bathing in:
  - ✓ Homes
  - ✓ Hospitals, hotels, airports, prisons
  - ✓ Schools (steeper with storage)
  - ✓ Pools
  - ✓ Off-grid sites
- ✓ Reduce fuel use by 30-70%

### DO LESS WELL

- o Replace boilers completely
- o Intermittently used sites (unless for base load only)
- o Central heating (unless vast scale interseasonal hot water storage)

### NOT DO SATISFACTORILY

- X Run electric lights!
- X North facing / shaded sites



We are 51 - 55° North of the equator.  
We must accept and work with seasonality.

© Solartwin 2009

## Various Perspectives on Efficiency

If you want to ☐ ☐ ..

- Minimise capital costs
  - ☐ Choose imported mains powered solar
- Maximise stagnation temperature
  - ☐ Selective coatings and evacuated tubes
- Maximise energy per sqm of absorber or roof
  - ☐ Maybe evacuated tubes, but is roof area limiting?
- Maximise environmental costs-benefits
  - ☐ Seek evidence of long life and low eco-impacts
  - ☐ Zero carbon solar saves 17-23% C clawback
- Flatten annual performance to minimise winter backup
  - ☐ Positional approaches: steep S facing
  - ☐ Trade summer excess for some winter gain as in Austria
- Maximise response to hot water demand
  - ☐ Non-selective coatings perform best here.

© Solartwin 2009

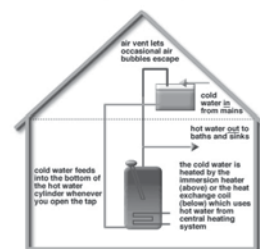
## Cylinder Training

1. Low Pressure Vented
2. Direct vs Indirect
3. Twin Coil
4. Thermal Stores
5. Pressurised Systems
6. Combi Systems

## 1. Low Pressure Vented System

### Basic Plumbing

for a normal low pressure hot water system - no solar



## 2. Direct vs. Indirect Heating

Direct heating means heating water directly:

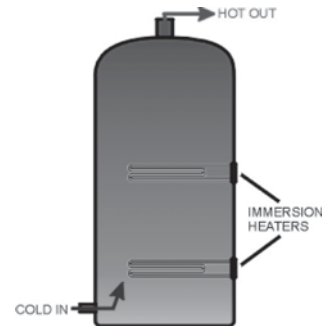
- By immersion heater
- By solar panel

Indirect heating means heating via heat exchanger

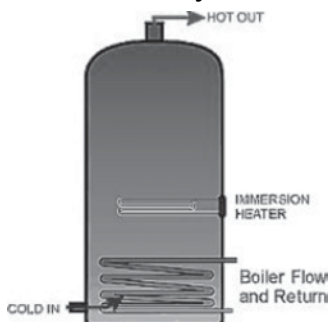
- By a coil
  - Boiler, solar coil, Aga, Rayburn, back-boiler

© Solartwin 2009

### Direct Cylinder



### Indirect Cylinder



### Direct vs. Indirect Heating

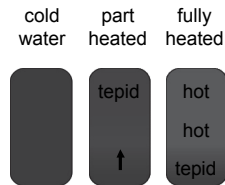
Issue:	Indirect <i>Mainly old solar</i>	Direct <i>Solartwin, usually</i>
+ Replacement cylinder	Always required	Often not required
0 or - Hardness control	Less often	May be needed
+ Effect on panel temperatures / losses	Med-high temps, increasing losses	Low-med temps, with lower thermal losses
+ Is the whole cylinder heated	No, typically only the upper 75-80% is heated	Yes, 95-100% is heated, in effect, right to the bottom
+ Stratified storage	Low	Yes, this is valuable
+ Simplicity	No, fairly complex	Yes, simple.

© Solartwin 2009

### Mixed or stratified storage?

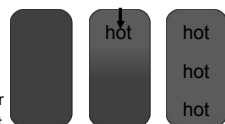
Mixed: how indirect solar delivers heat

- Via a heat exchanger at the bottom of the cylinder
- As a result, almost the whole cylinder heats up gradually
- This tends to provide only tepid water at noon due to mixing



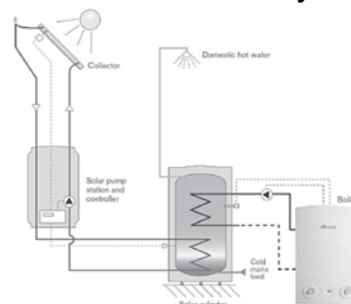
Stratified: how direct solar delivers hot water

- Direct to the top of the cylinder
- Where it floats (stratifies) on cooler water
- Hot water is more likely at the hot taps at noon.



© Solartwin 2009

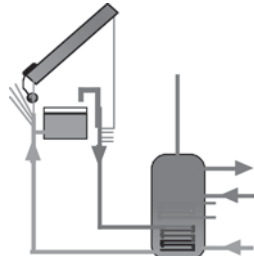
## 3. Twin Coil Solar Cylinder





## Indirect twin coil solar cylinder installation (schematic)

- Kingsmead Primary School
  - 4 panels in parallel
- Solar cylinder
  - 750l twin coil
  - Pumped secondary HW return
- Headers
  - Mini Solartwin header shown
  - Main cold header not shown.

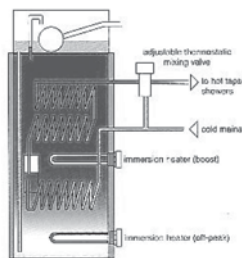


© Solartwin 2009



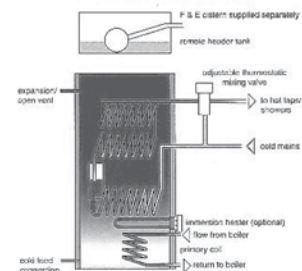
## 4. Direct Thermal Store

### TORRENT DIRECT



## Indirect Thermal Store

### TORRENT INDIRECT



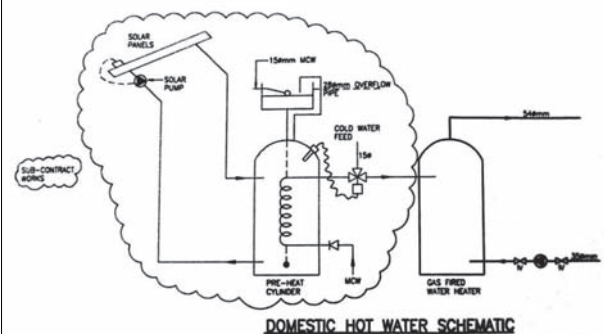
## Low Pressure Vented Heat Store

(with separate metal header in the loft)



© Solartwin 2009

## Low pressure vented heat store



4 Panels on  
Wistaston Green  
Primary School +  
heat store pre-  
heating to Andrews  
Water Heater.



## 5. Pressurised Systems

- We rarely fit to these cylinders
- G3 plumbing & design approval needed
- Suggest only possible with thermal store
  - ☐ Replace with thermal store (preferred)
  - ☐ OR Pre-heat incoming water

## 6. Combi Systems

- Launching a product this month
  - ☐ Take customers details and advise them
- Custom thermal store in development
- Pre-heats 100% solar dedicated cylinder
- Manual fill & drain
- Combi preferably, ☐ Solar Ready ☐
  - Able to be fed with 50 C hot water
  - Advise customers to fit only solar ready if considering a replacement
  - Bypass valve will allow mixing down to combi's max inlet temperature.

solartwin.com

What plumbing / cylinder design will I use?

Plumbing	Mostly used in <input type="checkbox"/>	+ Pros	- Cons
<b>Direct low pressure vented cylinder</b>	• 80% plus of domestic retrofit installations. • Some new build domestic.	✓ Can keep your cylinder, ✓ Great stratification, ✓ Best value.	• Needs robust hardness control.
<b>Indirect low pressure vented cylinder</b>	• Hard water areas where homeowner rejects a softener. • Social homes with hard water.	✓ Maybe fit this where a solar cylinder is pre-fitted.	• Usually needs a new solar cylinder. • Less stratification.
<b>Low pressure vented heat store (header can either be integral or remote)</b>	• Non-domestic applications. • Supposed solar space heating applications, (caution!) • Some new build domestic. • Pre-feeds, including to combis, • Social homes with hard water.	✓ High pressure water supply. ✓ Can use geothermal and fuels like wood. ✓ No hardness issues	• Requires appropriate large heat exchanger, blender valve & pressure vessel, • Should be run hotter at say 65C

© Solartwin 2009

solartwin.com

## Volumes of Water Storage

- Volume increases
  - ☐ As panel area increases
  - ☐ If indirect cys + heat stores: 30% larger
  - ☐ With irregular hot water use
- Cylinder
  - ☐ Retrofit - 120 litre recommended
  - ☐ New build 170 litre
  - ☐ 2 panels = 250 - 300 litres
- Thermal Store
  - ☐ Recommend dedicated solar volume of 70.5 litres min. / panel
  - ☐ Retrofit
    - 150 litre (>2m<sup>2</sup>) minimum
    - 190 litre (>3m<sup>2</sup>) recommended
  - ☐ New Build
    - 190 litre minimum

© Solartwin 2009

solartwin.com

## Photos

- How a cylinder should be left
- Spot the error



© Solartwin 2009

## Get best value from solar: **check backup heating temperature**

- Tweak temperature (& timing) of backup heating:
  - ☐ Cool water = energy gain
- Backup heating thermostat
  - ☐ Temperature is best set at 60C
  - ☐ Lower temps may be a Legionella risk
  - ☐ Higher temps always increase heat leakage losses
- Adjusting the timing is also important.

© Solartwin 2009

## Get Best Value

### - Adjust backup heating timing

- Default timing examples:
  - ☐ Continuously on 6am - 10 pm (wasteful)
  - ☐ Or say 2 times a day, eg 6-10 am, and 6-10 pm
  - ☐ But these start the day with lots of hot water in the cylinder
- Try changes such as:
  - ☐ Heat water to 60C for 1 hour after sun off the panel
  - ☐ Winter: on 6-7am and 5-9pm
  - ☐ Summer: on 6-9pm only
- In summer water sometimes reaches 60-85C
  - ☐ No backup needed then (thermostat should prevent it)

© Solartwin 2009

## Backup Heating Issues

All solar panels work best when incoming water is cool.  
This can be done by :-

- Dedicated solar volume in space (consider Legionella)
  - ☐ Solar pre-feed cylinder: large vols of potentially tepid water
  - ☐ Heat store pre-feed to continuously heated backup cylinder
    - low volume in heat exchanger minimises risk.
  - ☐ Twin coil cylinder: medium vols of potentially tepid water
- Dedicated solar volume in time
  - ☐ Time the backup heat to come on after sunset
  - ☐ Best when cylinder volume exceeds daily use.

© Solartwin 2009

## Five reasons to retain existing, sound cylinders

1. Dumping cylinders is avoided
2. Recycling cylinders is avoided (energy intensive)
3. CFC's in most old insulation foams are at less risk of release
  - o Global warmers / ozone depleters are best left in place
4. Scaled-up cylinders are rescued by softeners
  - ✓ Simply shifting scale is preferable to replacing cylinders
5. Retro-insulation is practical and effective
  - ✓ Use thick slip on jackets where needed.

*An assumption that a solar installation automatically needs a replacement cylinder may be mistaken.*

© Solartwin 2009

# Solartwin Specification

© Solartwin 2009

## You get 2 boxes

- The big box
  - ☐ Panel
  - ☐ Brackets
- The small box
  - ☐ 30m of pipe
  - ☐ PV panel
  - ☐ Pump
  - ☐ Solar controller & leads
  - ☐ Fittings
  - ☐ Documentation.



© Solartwin 2009

## solartwin.com

# Solartwin's Specification Questions

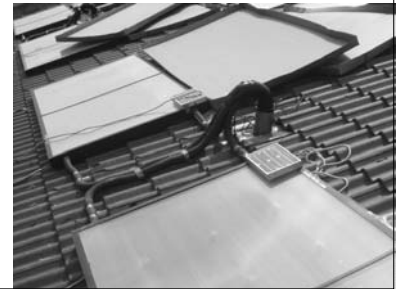
- How big and how heavy is the main panel?
- Why have you chosen these materials?
- How does the pump work?
- What are the pipes like?
- How much energy is delivered?
- Are the CO<sub>2</sub> savings significant?



## solartwin.com

# How Big is the Solartwin Panel?

- L x B x H
  - 2.465m x 1.265m x 80mm deep
  - (Approx 2.5m x 1.3m)
  - Looks big on the ground, smaller on the roof!
  - Fitted, it normally projects less than 100mm above the roof
  - Often treated as permitted development by UK planners
- Areas
  - Its footprint with frame is 3.25 sq m.
  - The aperture to the sun is 2.82 sq m
- Lightweight,
  - At 31 kg (empty) or 33 kg (full)
  - Rarely requires UK building control.



## solartwin.com

# What is the Solartwin Panel Made of?

- The main metal
  - mainly hydro-electrically made aluminium (lower environmental impact)
- External screws / bolts
  - are stainless steel (for durability)
- The absorber coatings are a special type of black
- Double glazing
  - UV-stable polycarbonate.
  - double, rather than single glazing optimises winter performance
- Insulation
  - pentane-blown rigid foam
  - zero ozone depletion potential.

© Solartwin 2009

## solartwin.com

# Panel Pressures

- 3 Bar approx burst pressure - lower than pipes and pump for safety reasons.
- 2.25 Bar - factory tested to this
- 1.5 Bar max rating
- To be used at +/- 0.5 Bar for reasons of pump pressures and PED
- *This means 5m above or below the water surface level in the header tank.*

© Solartwin 2009

## solartwin.com

# Special Panels

### Normal:

- Landscape
- RH or LH pipe exits
- Black frame
- One central glazing bar

### Specials

- Orientations other than landscape
  - Portrait or diagonal
- Any shape or size
  - Also sell 1/4 and 1/25 size demo panels
- Other variations
  - Double piped panel for small flats in pairs
  - Vary positions of pipe exits, eg both bottom edge
  - Vary frame colour from black
  - 3 glazing bars instead of 1 for conservation areas.

© Solartwin 2009

## solartwin.com

# Specials - other than varying the panels themselves

- Thermostatic blender valves (TBV) - always offered
- Multiple panels rather than just one
  - Always plumbed in parallel
  - Much larger cylinders
  - Issues of marginal cost-benefit
- Plumbing variations other than LP vented
  - Indirect panel on LP twin coil cylinder with mini header
  - Heat store options plus TBV for general HP water or combis
  - HP cylinders?
- Pool heating rather than domestic hot water heating
  - *Each day 35 litres of pool water is replaced per swimmer in some pools*
  - Most efficient: heat incoming cold main
  - Next efficient: heat pool itself
  - Least efficient: heat showers.

© Solartwin 2009

## Bournville Trust - Chocolate Panels



© Solartwin 2009

## Panel Spacings in Multiple Installations

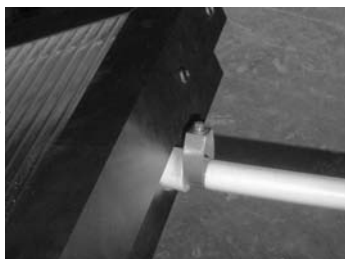
- Normal nominal landscape panel:
  - 2.5 m L-R
  - 1.3 m Up-Down
- Generous allowances - add the following spacings:
  - 0.5 m L-R to allow for pipe entries
  - 0.3 m Up-Down to allow for attachment
- So allow a footprint per panel of
  - 3.0 m L-R
  - 1.6 m Up-Down
- These can be reduced by careful design, however!

© Solartwin 2009

## Flexible silicone rubber pipes.

*Properties*

- highly flexible = freeze-tolerant
- corrosion-resistant
- extreme temperature tolerance range is: -50C to +250C!
- *used, for hygiene reasons, for milk pipes in dairies.*



© Solartwin 2009

## Flexible silicone rubber pipes.

*Regulatory conformity.*

- Material for food contact:
  - European Extraction Testing Regs 90/129/EC (BGVV XXI)
  - USA FDA 21 CFR 177.2600
- Material also meets UK-WRAS for hot and cold water for extrusion as a pipe
- And the pipe meets BS 6920 in its extruded form
- Silicone rubber is a safe, durable and robust material.



## Flexible silicone rubber pipes.

*Air entrainment*

- Panels don't air lock because pipe leading out of the panel has a 6mm internal diameter
- Narrowness entrains (carries) air bubbles away if released while water is heated in the panel
- So NO vent or air release valves needed on panel.



## Solartwin PV &amp; Pump



- Photovoltaic panel
  - 5 Watt rating
  - 12 Volt (peak)
  - crystalline silicon technology
  - mounted coplanar with the main panel
- Pump (head)
  - Positive displacement / diaphragm
  - Two valves in it stop reverse thermosyphon at night
  - Third safety bypass valve also protects against frozen by day conditions
- Pump (motor)
  - brushless DC motor; very long life
  - self-regulating; variable speed.

© Solartwin 2009

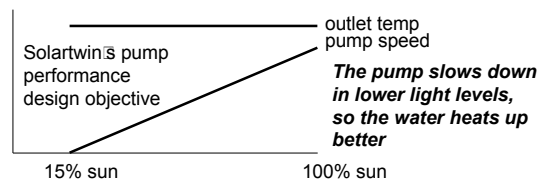
- PV pumping is zero carbon
- It's a myth that you need a fast pump
- There are good reasons to pump slowly
  - Variable speed is inherently better than on-off pumping.

© Solartwin 2009

### How do Solartwin's PV & pump work together:

PV and pump operate together, along with the silicone pipe and panel fluid dynamics

- Pump starts at slightly under 15% sun
- Near linear dose response sunlight to flow rate
- Peak flow rate approx 40 litres / hour.



© Solartwin 2009

## CO2 / Energy / Environment

© Solartwin 2009



© Solartwin 2009

Is 100% solar pumping environmentally worthwhile?

Data from DTI report on 8 solar water heating systems / CO2 budgets.

- Q: What is the average CO<sub>2</sub> clawback from using mains powered pumps and controllers?
  - 17% clawback: flat plate solar panels
  - 23% clawback: evacuated tube solar
  - 0% clawback: Solartwin's zero carbon technology
- Summary:
  - Old solar - up to 23% CO<sub>2</sub> savings lost

[illegible]

✓100% solar pumping is significantly more sustainable

© Solartwin 2009

- ✓ Look at the big picture
- ✓ Simplify where possible
- ✓ Beautify where possible
- ✓ Optimise health and safety
- ✓ Go for quality
- ✓ Design in reliability
- ✓ Long life is essential
- ✓ Minimise the component count
- ✓ Minimise their interactions
- ✓ Over-specify for innovations
- ✓ Minimise installation time
- ✓ Minimise installer skill needs
- ✓ Minimise installer hassle
- ✓ Minimise running costs
- ✓ Minimise call-backs
- ✓ Optimise for the environment
- ✓ Look at life cycle: cradle to grave
- ✓ Focus on global warming / CO<sub>2</sub>
- ✓ Minimise embodied carbon
- ✓ Minimise CO<sub>2</sub> input/output ratio
- ✓ Minimise transport impacts
- ✓ Minimise damage in transit
- ✓ Go for long term satisfaction
- ✓ Get ahead in terms of compliance
- ✓ Optimise long term cost-benefits
- ✓ Keep on improving & innovating.

Questions ????

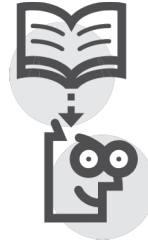


## Taking the Customer's Perspective

### Read the survey

- Look at the photos
- First impressions!
  - ☐ The 3 (plus) initial calls with customer really matter.
  - ☐ You are the face of Solartwin and your own business.
- CALL 1 - Within 24h of you knowing, that you will be their installer, always call,
  - ☐ Hello, Mrs Smith, I'm Fred Jones your installer, How are you? I'm looking forward to meeting you / installing your Solartwin. I'm calling to introduce myself.
- CALL 2 - As soon as diary is ready (this may be on the first call)
  - ☐ Are you free all day on ☐? Will you be able to let me in at xx am, weather permitting? (How do we sort out residents: parking, or survey details etc?)
  - ☐ Confirm the survey details
  - ☐ Will the house / new roof / new plumbing (etc) be ready for me to come?
  - ☐ Will you be there after 2 pm so I can show you your installation, answer your questions and collect your balance cheque?
  - ☐ Here's my mobile number just in case.
- CALL 3 - Day before, reconfirm: customer, weather, site, water & funds etc are all ready.

## Be prepared (Baden Powell)



Every person must read up in advance on:

- How to install!
  - ☐ please don't ever work it out on the day
  - ☐ nor expect one single colleague to do so either!
- The customer
  - ☐ Who they are / expectations
  - ☐ Any special personal requirements?
- The installation
  - ☐ Read the specification in full
  - ☐ Tools and parts etc needed

(All this before arriving on or before time)

© Solartwin 2008

## Installing Solartwin

1. Preliminaries
2. Prepare to start the job
3. Roof work
4. Internal plumbing & wiring
5. Commissioning
6. Post-commission checklist
7. Clear up
8. Sign off & documentation including photos
9. Afterwards

© Solartwin 2009

## 1. Installation - Preliminaries on Arrival



- With client
  - ☐ ID & reconfirm job
- Site checks
  - ☐ Survey accurate?
  - ☐ Specification?
  - ☐ Water on?
  - ☐ Weather safe?
  - ☐ Access, H&S&E?
- Parts checks
  - ☐ Tools?
  - ☐ Components all here?
- Preparations
  - ☐ Lay dust sheets inside
  - ☐ Roof access outside
  - ☐ Power supplies (any LV).

© Solartwin 2008

## 2. Prepare to Start Job

See Method Statement

© Solartwin 2009

## 3. Roof Working



### 3. External Installation - Panel Fixing



- Find the rafters
  - ☐ Strengthen if necessary
  - ☐ Mark on roof
  - ☐ Drill holes
- Fix the two brackets
  - ☐ Lower then upper
  - ☐ Flash roof bolts
- Panel
  - ☐ Raise & position
  - ☐ 3 screws per bracket end
- Pipe exits
  - ☐ Must not foul rafters
  - ☐ Pipe connections
  - ☐ Sleeving and insulation
  - ☐ Flashing/weathertight
- (NB scaffold shown is incomplete)

© Solartwin 2008

### 3. External Installation - PV Fixing



- PV fixing
  - ☐ 2 brackets and screws
  - ☐ Least and last shaded
  - ☐ Cable routing very secure.

© Solartwin 2008

### 4. Internal Plumbing & Wiring



© Solartwin 2009

### 4. Internals - tees, pipes, pump, cables, leccy

- Disconnect services
  - ☐ Gas / Leccy all off
  - ☐ Drain down to top of cyl
- Hot tee
  - ☐ Bubbles must escape upwards, ie there must be a rising run to vent to release air
  - ☐ Close to cyl as poss
- Cold tee
  - ☐ Gravitational water filter
  - ☐ Not facing downwards
  - ☐ 1m+ above cold cyl inlet
  - ☐ No cold tap draw-offs between it and cylinder
- *Never put gate valves etc on tees: steam explosion risk that the panel could burst in full sun.*

© Solartwin 2008

### 4. Internals - tees, **pipes**, pump, cables, leccy

- Solartwin pipes
  - ☐ Cut a bit long, not too short
  - ☐ Tee into copper not plastic pipes
  - ☐ Label ends hot and cold
  - ☐ Hep2O sleeve and blobbing
- Pipe insulation
  - ☐ To Bldg Regs part L (ie 2m from cyl)
  - ☐ Insulate hot and cold throughout
  - ☐ Tape all insulation joints with insulation tape.

© Solartwin 2008



© Solartwin 2008

#### 4. Internal Installation

- tees, pipes, **pump**, cables

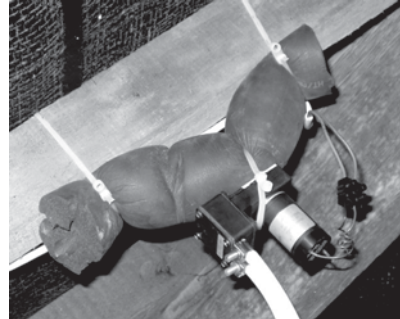
- Pump

- ☐ On the cold water pipe
- ☐ Height 0-120mm above cold water level in CWT
- ☐ Appropriate anti-vibration mounting, pipe protection
- ☐ Spigots point downwards
- ☐ +/- Polarity correct
- ☐ Half connect it
- ☐ Do not hang pipes & cables from it: support them please.



solartwin.com

#### Preferred Pump Mount on Soft Foam Insulation



© Solartwin 2008

solartwin.com

#### Internals - tees, pipes, pump, **cables. leccy**

- Controller and sensors

- ☐ Connect electrically and thermally
- ☐ Leave showing one temp only

- Clip / secure remaining

- ☐ Cables (roll up and support tidily)
- ☐ Pipes / insulation
- ☐ Labels on cylinder

- Before commissioning

- ☐ Double check what you have done so far
- ☐ Then refill cold tank to a low level only (if it is dirty, clean it out first).

© Solartwin 2008

solartwin.com

#### 7. Final Clearing Up

1. Pack away tools
2. Tidy site - recycle
3. Leave site cleaner than when arrived
4. Re-inspect for watertightness & correct operation

© Solartwin 2009

solartwin.com

#### 8. Sign Off & Documentation - Photos

- Photograph all work
- Use good quality digital camera
- Preferably around 4MB
- Check photos on site
- Post photos on Picassa

© Solartwin 2009

solartwin.com

#### 8. Cont. - Photos

1. Scaffold / ground / panel



© Solartwin 2009

## 8. Cont. - Photos

### 2. Whole panel / penetrations



© Solartwin 2009

## 8. Cont. - Photos

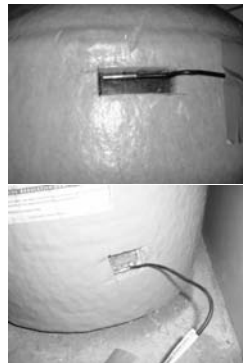
### 3. Sensor on rear of panel



© Solartwin 2009

## 8. Cont. - Photos

### 4. Cylinder & Sensors



© Solartwin 2009

## 8. Cont. - Photos

### 5. Top & Bottom Tees



© Solartwin 2009

## 8. Cont. - Photos

### 6. Header Tank



© Solartwin 2009

## 8. Cont. - Photos

### 7. Pipes Entering Voids



© Solartwin 2009

## 8. Cont. - Photos

### 8. Header Showing Pump



© Solartwin 2009

## 8. Cont. - Photos

### 9. Rafters - Wide Shot



© Solartwin 2009

## 8. Cont. - Photos

### 10. Loft Hatch



© Solartwin 2009

## 8. Cont. - Photos

### 11. Cylinder Plus Label



© Solartwin 2009

## 8. Cont. - Photos

12. Controller
13. All additional work
  - softeners
  - blender valves
  - etc.



© Solartwin 2009

## 9. Afterwards

1. Tell Solartwin job is complete / feedback
2. Pay cheque in
  - at Co-op Bank
  - or post to Solartwin
3. Post photos on Picassa
4. Send documentation to Solartwin
  - Copy of warranty / commissioning certificate
  - Signed, dated commissioning check-list
  - Any Legionella issues / solutions
  - Paying in slip (customer no. + sum paid in)
  - Invoice

© Solartwin 2009

## Solartwin zero carbon controller

1

© Solartwin 2007

### Zero carbon delivery for the wider solar thermal market:

- PV powered solar controller
- For solar water heating systems
- A generic multi-platform product
- Zero carbonises existing low carbon solar thermal products
- PV to pump matching service
- Delivery now.



© Solartwin 2007

## Basic Concept

- Advanced High quality, reliable, no fuss PV or DC powered solar controller in a simple rectangular white box
- Uses an integral microprocessor
- Uses 3 sensors (PT1000 sensor for panel)
- Temperature display can be top of cylinder temp (default) or all three.
- All controls are safely inside the box ensures that settings are not changed inadvertently.
- Diagnostics can display problems such as sensor disconnection
- Simple to install.
- Delivered pre-programmed.

3

© Solartwin 2007

## Electrical summary

- Suitable for 18 and 36 cell PV Nominally 11-21V open circuit voltage up to 20W this can be increased if necessary.
- Alternative option for low voltage DV power supply operation.
- Electricity store via supercapacitors, with 500,000 charge discharge cycles (not rechargable batteries, which only last for about 600 cycles).
- Charges supercapacitors in early morning daylight when thermal panel is most likely to be cool and when there is usually not enough PV power to start the pump.
- Day / night mode detection logic reduces power consumption by increasing sensor interrogation time at night.
- With no power input, has over 30 hrs display backup time and permanent program backup time.

4

© Solartwin 2007

## Logic summary

- **Primary Logic**
  - Differential control
  - ON DT of 4-15C
  - OFF DT = from 2 deg below ON DT to 2 deg
  - Pump off overrun time can be set between 0 sec and 300 sec

### Secondary logic

- What to do at high cylinder temperatures? 3 options are
  1. Pump on (please always use this with Solartwin)
  2. Pump off (for most conventional solar thermal)
  3. Pump remains differential (this may occasionally be used with conventional solar thermal)
- The temperature to implement secondary logic can be selected between 65 and 85C

5

© Solartwin 2007

## The basics: controller operation

For PV or low voltage DC solar heating systems including Solartwin.

- It makes solar panels operate efficiently and safely,
- Low or even zero operating carbon impact.

It shows you the water temperature near the top of your hot water cylinder.

Behind the scenes it controls whether the pump is on or off

With two special ways of working

1. differential control
2. occasional heat export

Here is a brief explanation of each.

6

© Solartwin 2007



## The basics: controller operation

1. Most of the time the controller is doing **differential control**.

This compares the temperature of (Tp-Tb)

- the **top** of the solar panel with
- the **bottom** of the hot water cylinder

and it switches the pump on or off to gain energy in the hot water cylinder.

- 2/ However, when the top of the hot water cylinder (Ta) goes over a preset high temperature, such as 65 degrees C

**heat export** control takes over in order to reduce the risk of scalding.

- Here, the pump keeps on pumping until the water at the top of the cylinder falls below the preset temperature.
- Then it reverts back to differential control.

7

© Solartwin 2007

## How to install

- mount the controller box where the user wants it and can see it easily
- mount the controller box itself on to something solid like a wall
- connect and route five cables to it, 2 for power and 3 for sensors
- fix the three temperature sensors in exactly the right positions

### Mount your controller just right

1. Inspect that the controller is in good condition.
2. Decide where to mount it so the user will see the display front of it easily.
3. Mount the back plate on wall or a flat vertical surface.
4. Work out where all of your cable runs will go.
  - 15 meters cable run to the sensor on the panel (25m available)
  - 3 meters to the cylinder sensors.
5. Open the controller via the two small screws on the front on the controller.
6. Screw the back plate to the wall.

8

© Solartwin 2007

## How to install

Get your 5 cable runs perfect

2 power cables.

- Power in from PV
- Power out to Pump

3 sensor cables:

- Panel sensor - Tp
- Top of cylinder sensor - Ta
- Bottom of cylinder sensor - Tb

Sensor cables are labelled at both ends.

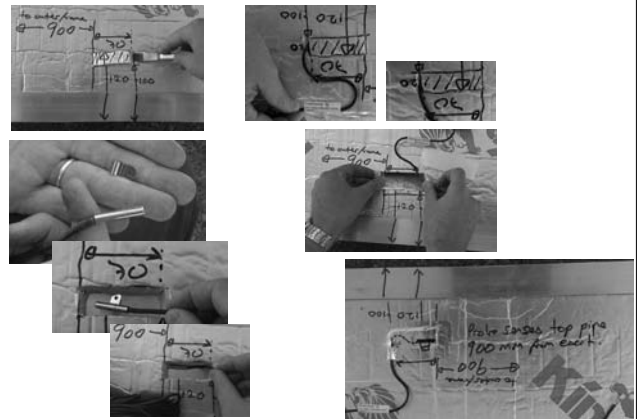
They are the same as the labels on the circuit board.

**•Charge the controller up and press its reset button with all cables connected. It will not work until you have done this.**

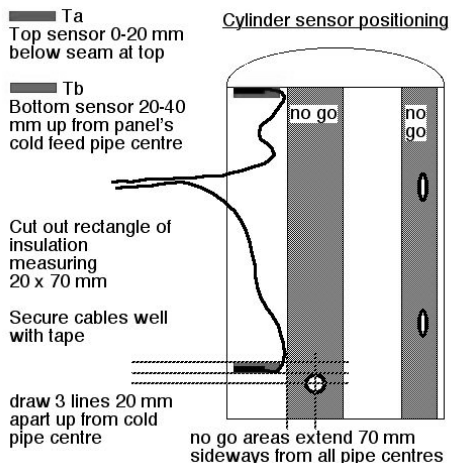
9

© Solartwin 2007

### Installing the panel sensor



### Installing the cylinder sensors



## Fitting 3 sensors - where?

- **sensor Tp? (panel sensor)**
  - On metal absorber at back of the upper row of pipe of solar panel, in an unshaded area.
  - Working from the top corner of the panel where the hot pipe exits, mark out a 20 x 70mm horizontal rectangle on the back of the panel.
  - Rectangle should run (a) 900-970 mm from the left or right edge where the hot pipe exits pipe and (b) 100-120 mm down from the top edge of the panel. It may already be marked or cut out on your panel.
- **sensor Ta? (cylinder upper sensor)**
  - On or close to the seam where the dome which is the top of the cylinder joins the main body of the cylinder.
- **sensor Tb? (cylinder lower sensor)**
  - 20-40mm above the midline of the pipe which is the cold feed to the panel.

Make sure that Ta and Tb are at least 70mm away, sideways, from the nearest edge of any pipe's insulation cutaway, including that of the cold pipe.

© Solartwin 2007

## Remember before commissioning

- Charge the controller (With PV as long as it takes, or 9-12V battery 20 mins.)
- Are the PV and Pump connections all OK with just 1 pump wire left to connect?
- Get your sensors just right...

13

© Solartwin 2007

## Check sensors before commissioning

1. that each sensor is really secure and will not come loose if pulled.
2. that each sensor is not just poked end-on into the insulation (and not just their ends, for example)
3. that they are really touching all the way along their length, the metal of what they must sense
4. that good sound insulation is securely replaced over the sensor
5. that the sensing pockets, if cut into insulation, are fully insulated and taped over with the correct tape, with no water or air entry possible
6. that all the sensors cables plugged in the correct sockets on the unit
7. that they are fully plugged in and not just partly plugged in
8. that you have not swapped any sensors over with each other by mistake.

14

© Solartwin 2007

## Usual default settings

- Pump overrun 30 sec after off.
- Start differential 4C
- Stop differential 2C
- Heat export chosen to be ON (never change this with Solartwin!)
- Heat export starts at 65C (raise to say 70 / 75C for heat stores). Please ask us how.

15

© Solartwin 2007

## Surveying & Specifying Solartwin



Case study: Dr Lawn's new all timber house where he installed a ground source heat pump and two Solartwin panels with a 30% Scottish grant.

© Solartwin 2009

## Grants

- Solar Keymark
- LCBP Phase 1 - Product Listed
- LCBP Phase 1 - Installations - application pending

### Examples of what grant inspectors check:



- Compliance with
  - ☐ Grant technical criteria
  - ☐ Installation instructions
  - ☐ Water & Building Regs / Part L
  - ☐ Domestic Heating Compliance Guide
- Correct
  - ☐ Plumbing, piping, sleeving insulation
  - ☐ Insulate within 1m of cylinder
  - ☐ Dedicated solar vol 70.5 litres
  - ☐ Thermostatic blender valve
  - ☐ Boiler interlock present
  - ☐ Cylinder insulation
- Plus
  - ☐ Documentation
  - ☐ Customer satisfaction
  - ☐ Company behaviour.

© Solartwin 2009

## Surveying & Specifying Solartwin

An accurate, comprehensive home survey will:

- Establish whether solar is feasible
- Identify design option(s)
- Provide a specification(s) for the customer's needs
- Estimate performance
- Enable costings to be accurate
- Give you a full tools and parts list
- Identify roof access options
- Cover all significant health, safety & envt aspects.



## The Solar Survey



- Feasibility, design options, specifications, performance, costs, tools, roof access, health, safety, environment.

© Solartwin 2009

## Inner city mid-terrace, west facing, gutter mounted



solartwin.com

## Suburban semi, SW facing with a hipped roof and a gutter mount



solartwin.com

## Is Solartwin feasible for my property? 1 of 5

- Panel position
  - ☐ Yes, if *mainly unshaded, roughly towards the sun.*
  - ☐ South, southwest or southeast roofs are ideal.
  - ☐ Even E or W roofs offer 75-85% of peak performance
  - ☐ Most roof pitches are suitable
  - ☐ Landscape or portrait - will it fit?
- Mounting
  - Pitched roof
  - A-frame on flat roof
  - Ground mount on A-frame
  - Wall mount

© Solartwin 2009

solartwin.com

## Is Solartwin feasible for my property? 2 of 5

- Plumbing
  - ☐ Easily, if you have a *traditional low pressure vented hot water system:* Hot water cylinder, with its cold tank above, usually in the attic.
  - ☐ *Thermal stores* are an easy fit, too.
  - ☐ Solutions for high pressure hot cylinders or combination boilers may be feasible
  - ☐ Are proposed pipe runs accessible?
- Heights & PED
  - ☐ Yes, if there'll be *under 5 m* height (up or down) between water level in cold tank and the panel's midline.
  - ☐ Usually OK in most homes.
  - ☐ Are the roof and the loft accessible?

© Solartwin 2009

solartwin.com

## Is Solartwin feasible for my property? 3 of 5

- Hot water demand
  - ☐ Ideal is 365 days a year with peak in summer
  - ☐ Look at usage patterns - base or peak load?
- Cylinder volume
  - ☐ Yes, if cylinder holds over *80 litres*
  - ☐ Preferably at least 120 l.
  - ☐ Recommend higher vols for intermittent occupancy.

© Solartwin 2009

solartwin.com

## Is Solartwin feasible for my property? 4 of 5

- Solartwin is normally viewed as a roof window by planners
  - ☐ Panel projects 100 mm
  - ☐ 100mm projection = usually permitted development
- Planning consent may be needed for
  - ☐ Listed buildings,
  - ☐ conservation area properties
  - ☐ national parks *etc.*
- Health, Safety and Environmental issues include
  - ☐ Legionella minimisation
  - ☐ Roof access
  - ☐ Working in the loft
  - ☐ Nesting birds / bat licenses.

© Solartwin 2009

solartwin.com

## Is Solartwin feasible for my property? 5 of 5

### System Sizing

- Head count - usually 1 panel for 1-4 people
- *Maybe drop to 3 people if:*
  - ☐ There is a hot water circulating loop - since this dumps heat.
  - ☐ There is a power shower - since this uses hot water very fast.
  - ☐ Other high demand - eg invalids needing twice daily bathing
- Sizing for domestic installations is simple  
**Nearly all homes need just one panel.**

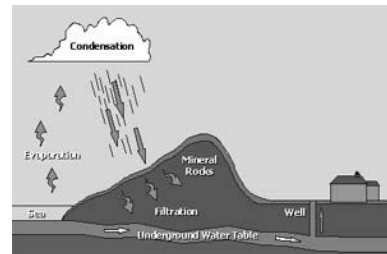
© Solartwin 2009

## Hardness Control



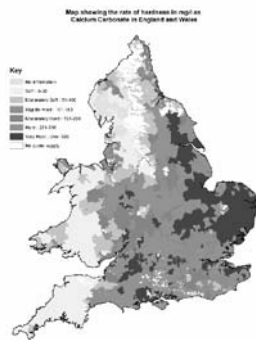
© Solartwin 2009

## Limescale comes from rocks



© Solartwin 2009

## England / Wales Hardness



© Solartwin 2009

## Hardness Control - Prevent Before Cure

- Don't expose to the panel to continually replaced hard water
- How hard your water is affects what you use to control limescale
- 0 - 100 ppm  $\text{CaCO}_3$  - no control needed
- 100 - 200 ppm  $\text{CaCO}_3$  - Chelation
  - ☐ Fernox LSP - polyphosphate dosing
  - ☐ Surround calcium ions with an ion which stops them taking part in the chemical reaction which causes hardness to form
- 100 ppm  $\text{CaCO}_3$  + use an ion exchange water softener
  - ☐ Swap calcium for sodium which does not form scale
  - ☐ Ion exchange water softener (a good solution)
- Thermal store
- DO NOT - Promote scale formation / gadgets
  - ☐ Physical water conditioners (the resultant particles block the panel's narrow low flow pipes and must never be used)
- Remove the calcium
  - ☐ Distil the water (far too costly)
  - ☐ Use reverse osmosis (far too costly).

© Solartwin 2009

## Water hardness: main issues

- What are its effects?
- How does hardness chemistry work?
- Does hardness vary a lot?
- Can hardness affect Solartwin?
- How is hardness controlled, if it needs to be? ☐

© Solartwin 2009

## Water hardness: effects

### Effects of limescale in homes

1. Blockage: Pipe / cylinder / shower head
2. Porous substrate for bacteria to grow in
3. High soap and detergent use / poor soap lathering / unsightly scum
4. Rough sheets & clothes which wear out faster
5. Extra cleaning needed for bath / shower / sink
6. High water heating bills: encrusted heat exchanger = energy inefficiency.

© Solartwin 2009

## Water hardness: chemistry

- Limescale chemistry and behaviour
  - $\text{CaCO}_3$  = calcium carbonate = limestone = calcite/aragonite
  - Dissolves from chalk and limestone into water
  - Heating elements over 60°C cause scale formation
- Limescale deposits can be removed (you are NOT stuck with them!)
  - quickly by acid
  - gradually by soft water.

© Solartwin 2009

## Water hardness varies by place and time

- Hardness comes from dissolved rocks:
  - Chalky groundwater is hard
  - Surface water is usually soft
- Time. Hardness may also vary over a year. It may be higher in late summer when more groundwater is pumped as reservoirs run dry.
- So use PEAK figures when considering hardness control.
- Typical hardness in different places (ppm  $\text{CaCO}_3$ )
  - 400 Kent
  - 300 London
  - 200-300 Surrey
  - 100-200 Newcastle on Tyne
  - 100-250 West Midlands
  - Under 100 much of Scotland and Wales, higher in coal seam areas
  - Phone the water company with your postcode

© Solartwin 2009

## How Hardness Affects Solartwin

- Is hardness control required? Yes usually
  - Our panels heat up to over 60°C
  - High temperatures promote limescale - causes blockages
- How is hardness measured?
  - We refer to ppm  $\text{CaCO}_3$  parts per million calcium carbonate
  - Not calcium alone!
  - 13 different hardness units exist, most are convertible
  - (100  $\text{CaCO}_3$  ppm = 7 degrees Clark).

© Solartwin 2009

## Chemical hardness control is simple (polyphosphates / ion exchange softener thresholds)

ppm $\text{CaCO}_3$	Is control needed?	PP dosing? (Fernox SCLSP)	Ion Exch Water Softener?
0-99	no	no	no
100-199	yes, a choice	either yes	or yes
200 up	yes	no	yes

*Table assumes the WA gives a single hardness figure.*

- Reduce thresholds by 20% (ie 200 becomes 160) for
  - intermittently occupied properties: higher temps = higher scaling risk
  - Fortic cylinders: higher temps from being smaller and also Fernox SCLSP degrades to a degree in warm water in attached Fortic header.

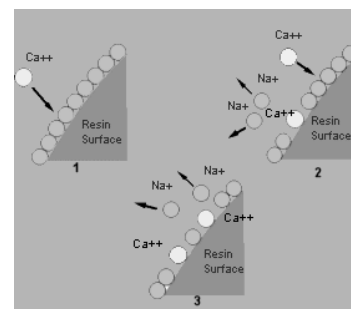
© Solartwin 2009

## Ion Exchange Water Softener: How it Works

- Calcium ions - swap - with sodium from salt.
- Add salt as crystals / tablets / blocks.
- Result is baking soda in the water + no limescale.
- The exchange takes place on the surface of tiny beads of ion exchange resin in a resin tank.
- The resin regenerates with sodium every few days.
- During regeneration calcium chloride is drained off as the resin dumps its calcium.
- This regeneration usually takes place at night.

© Solartwin 2009

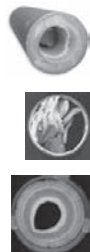
## How ion exchange works



© Solartwin 2009

## solartwin.com Ion Exchange Water Softener: Benefits

- Less scale
- Reduced *Legionella* risk
- Greater boiler efficiency
- Reduced eczema claims by some people, anecdotal, not proven.



© Solartwin 2009

## solartwin.com Ion exchange water softener: surveying

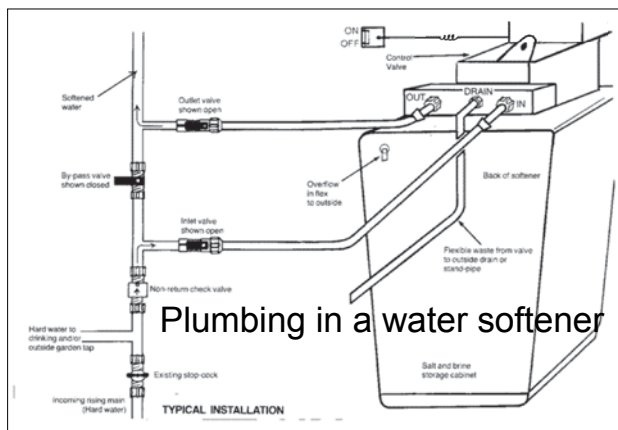
Attached to the softener are

1. Usually a low voltage power cable attached to a transformer plug
2. Mains water in (hard in)
3. Mains water out (soft out)
4. Drain hose (calcium chloride waste)
5. Overflow hose (emergency only)

Requirements include:

1. Intercept the cold main after the stop cock
2. Allow an unsoftened drinking water supply
3. Soften the supply to the header tank and hot cylinder
4. Connect into a waste pipe
5. Have a power supply (usually)
6. Be on the ground floor (usually)
7. May need a pressure reducing valve (only if water is very high pressure)
8. Need a space to fit it into (dimensions vary) usually under a draining board
9. Must be on an outside wall or be able to overflow through one.
10. Not have lead pipes downstream
11. Not be in a freeze-prone location.

© Solartwin 2009



## solartwin.com Ion exchange water softener: five items connect in / out

5 items in / out	Connection	Function	When used
Cable (usually)	From 12V transformer plug	Powers clock / valves	All the time
Mains water in	In from the street	Hard water in	99% of time
Mains water out	Out to the house	Soft water out	99% of time
Drain pipe	Out to a drain (not soakaway)	Calcium chloride solution out	1% of time
Overflow	Drain or out the wall	Prevents floods if all else fails	Hopefully never

© Solartwin 2009

## solartwin.com Ion exchange water softener: its three main parts

Part	Function	Comments	Spec issues
EITHER Valve + timer	Regenerates at pre-set <b>time intervals</b>	Reliable, mains electric powered	Cheap and cheerful
OR Valve + water meter	Regenerates on a pre-set <b>water volume</b>	Possibly a bit less reliable, may or may not be mains powered	Use if on a water meter or high spender
Main cabinet	Holds the salt and brine	Fill with a salt scoop through a hole in the lid	Big = fewer refills Small = neat
Resin tank	Exchanges Ca ions for Na ions	Usually 1 tank. 2 can do 100% soft all the time	10 litre base 14 l larger etc

© Solartwin 2009

## solartwin.com Ion exchange softener: install it - summary

- Tell the water co you will fit it
- Cross-check our survey
- Close stopcock and drain down
- Add softener downstream from this after:
  - ☐ Drinking water
  - ☐ Garden water
- Connect power supply if needed
- Calibrate the softener - for no of people & hardness.

© Solartwin 2009



## Correct hardness control is essential (1 of 2)

- Never use these methods for hardness control in direct Solartwins, even when combined with an appropriate method (incomplete list)
  - ☐ Physical hardness control / seed crystal makers, eg
  - ☐ Magnets, Electromagnetics, Radio, Electronics, Ionics
  - ☐ Ultrasonics, water shockers, long range vibrators
  - ☐ The latest great amazing foolproof costly budget gadget
  - ☐ Magic, including 100% guaranteed magic with a money back warranty.
- Warranty is invalid for incorrect hardness methods or thresholds.

## Correct hardness control is essential (2 of 2)

If any other than IEWS or LSP used before installing a direct Solartwin then an IEWS is essential

- For indirect installation
  - ☐ any hardness is OK
  - ☐ Use Fernox F1 in the solar part of the indirect circuit
  - ☐ Either a solar cylinder or thermal store

## Legionella

## Legionella Risk Assessment

- This needs to be recorded in writing
- Record any changes / improvements made
- Refer to Code of Practice: ACOP L8
- ALL businesses must comply with L8
  - ☐ Includes rentals and housing associations
- CIBSE provides one day training seminars
- Prevention is better than cure.

*Legionella Pneumophila*

- Start with clean incoming water and keep it clean
  - ☐ Risk assess non-mains water and treat if required
  - ☐ Header tanks must have lids fitted and be insulated to keep a low average temperature
  - ☐ Avoid multiple header tanks
  - ☐ Water header tanks may warm up in sites such as schools in summer. Drain off, clean and refill before term starts.
- Limescale presents a large surface area of substrate for bacterial and amoebal growth
  - ☐ Use ion exchange water softeners where appropriate
  - ☐ Lower cost ☐ seeding devices are not appropriate

*Legionella Pneumophila*

- Solar preheat or twin coil cylinders may not be heated to the bottom for months at a time
- Designing out the risk is preferable
  - ☐ Heat from (or to) the bottom (with back-up heating - timed)
  - ☐ Or use destratification pumps
- Minimise water volumes that may not reach high temps
  - ☐ Consider heat stores as pre-feed to calorifiers
  - ☐ Water volumes in HEXs may be 1-5% of total heat store volume and they are rapidly and regularly swept
  - ☐ Especially important in places such as medical sites where users may be immunosuppressed.

## Legionella Pneumophila

- Potentially tepid pipe runs
  - ☐ Minimise risk - make them as short and low volume as possible
  - ☐ Assess pipes for trace heating, especially if not continually swept
  - ☐ Avoid dead legs!
  - ☐ Don't forget vent pipes
- Hot water to services must always be hot enough
  - ☐ Design boiler and coil to ensure a fast enough recovery time
  - ☐ Time the backup heating correctly
  - ☐ Set the backup temperature correctly.

© Solartwin 2009

## Solartwin Users Guide

Questions answered include:

1. How do I get best value from my Solartwin panel?
2. What about maintenance, holidays and power cuts? ☐

© Solartwin 2009

## Solartwin User Guide

- *get the best value from your Solartwin!*

1. Have good insulation
2. Know how to boost energy yield - theory
3. Time hot water use - if you can
4. Maintenance
5. Holidays
6. Power cuts
7. Moving house

© Solartwin 2009

## Insulation - add plenty !

- Insulation is cost-effective and easy to fit
- **Cylinder**
  - ☐ Slip-on jackets cost £10
  - ☐ Don't thermally insulate the immersion cable for fire safety
- **Hot pipes**
  - ☐ Lag these, especially vent pipe (including in the loft)
  - ☐ Recommend lag all pipes between cylinder and hot taps
  - ☐ Lagging should be at *least* as thick as the pipe it covers
  - ☐ Lag at least a metre from the cylinder - **compulsory**
- See Bldg Regs part L, on energy efficiency - available on the web
- Benefits may come close to having a solar panel fitted!

© Solartwin 2009

## What actually heats up the panel?

- Radiation from the sun heats it up = is absorbed
  - ☐ 55% **visible** light radiation - we can see this
  - ☐ 45% **infrared** radiation - we can feel but not see it
  - ☐ (Ultraviolet is a small % of solar radiation: not used)
- The panel is highly insulated, and double glazed
  - ☐ So air temperature contributes little to performance
- Logarithmic perception of light
  - ☐ Our eyes and brain see light as being **half** as bright when it actually is about **10 times** dimmer
  - ☐ We can confirm this with a light meter

© Solartwin 2009

## What boosts energy yield of a panel?

- Energy yield of all solar panels
  - + Increases with sunlight
  - + Increases as panel's shadow increases
  - ☐ Decreases slightly when cooled by evaporation or wind
  - ☐ Decreases as the panel heats up compared to outside
- Largest yields when
  - ☐ No clouds
  - ☐ Sun is square on to panel
  - ☐ Weather is dry and still (low influence)
  - ☐ Water is cold
- This last point means that
  - ☐ Try to keep the bottom of the cylinder cool when the sun shines.

© Solartwin 2009

## Get best value from your solar panel by **timing hot water use**

- Can you **use hot water by day**?
  - ☐ Put washing machine / dishwasher on at lunch, if they are hot fill
  - ☐ Let cylinder refill with cool water in time for a solar reheat
  - ☐ Use hot water immediately it is collected to cut energy losses by 10-50% (Insulation is less than 100% efficient)
- Try to use more hot water more on sunny days
- Not everyone can achieve solar lifestyle behaviour!

© Solartwin 2009

## Low Maintenance

- Inspect inside & outside & do pump pipe pinch test
  - ☐ 1d and 1w after installation
  - ☐ After holidays, storms, plumbing changes
- Hardness control if required
- Main panel internal pipes - flush out every 6-7 y
- Cleaning - rarely safe or worthwhile
  - ☐ PV, rain usually shifts bird droppings.
  - ☐ Steeper than 15 degrees, glazing is largely self-cleaning.

© Solartwin 2009

## Going on Holiday?



- **Never** switch off the pump
- **You may** switch off backup heating
- **Maybe** leave the airing cupboard door open in order to keep the damp off the house
- **No** need for neighbours to dump hot water
- **Always** heat water to 60C for 1 hr before using hot water, on your return
- **Self-regulating** Solartwin usually stabilises at up to 85C in summer.

© Solartwin 2009

## Mains Power Cut?

- Solartwin is an off-grid technology
- It just works as usual during a power cut
- Controller box is PV powered
- Does not boil during a mains power cut

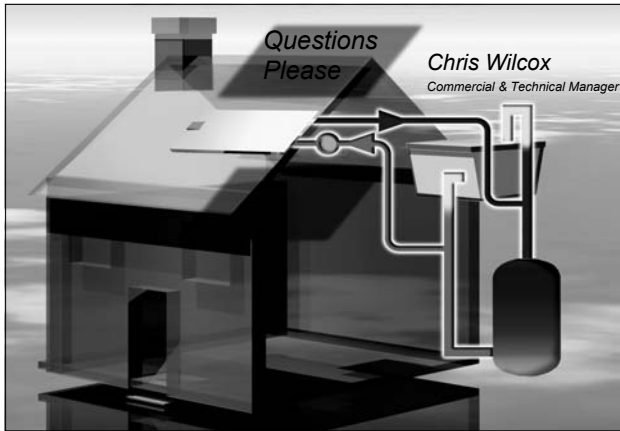
© Solartwin 2009

## Moving House?

- People in UK stay in a house on average 7 yrs before moving
- Simple to move for DIYers
  - ☐ Just disconnect and remove it
  - ☐ Load it in the van
  - ☐ Refit it
- The warranty is portable.

© Solartwin 2009







# Brochure



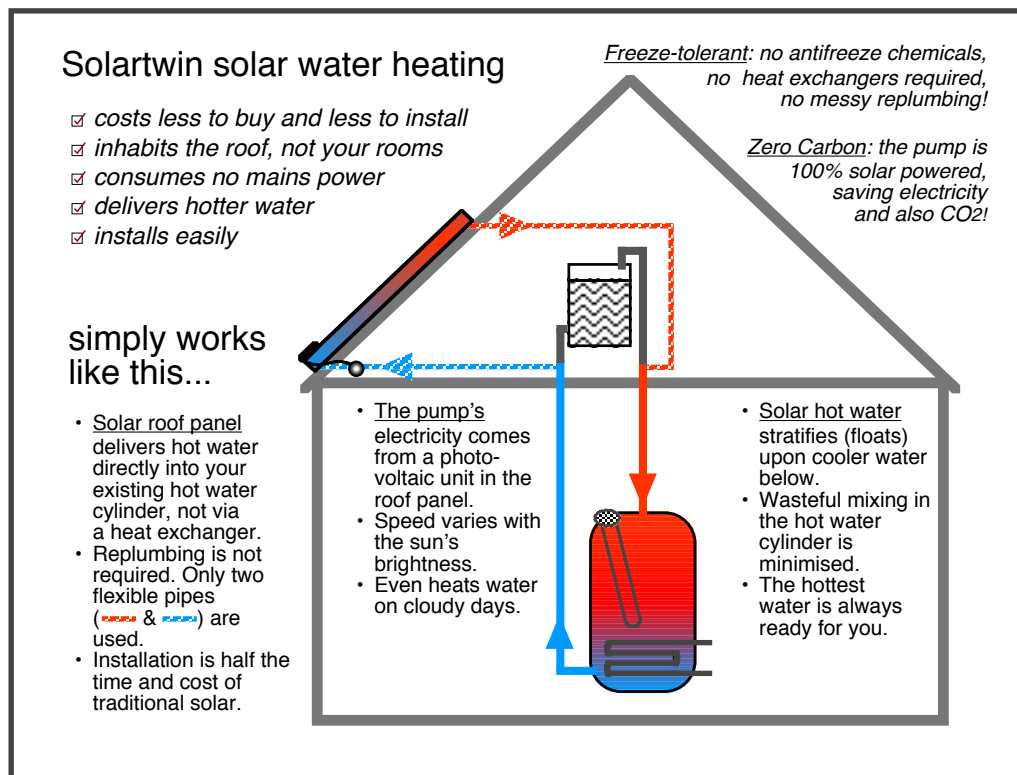




# Solartwin.com



*Zero carbon solar hot water systems for washing & bathing*



***Simple solar water heating solutions at last!***

***Also available with water softeners.***

***if sunbeams were weapons of war, we would have had solar energy long ago***

George Porter, The Observer August 1973



Renewable Energy Association Member, British Photovoltaic Association PV-UK Member, Association for Environment Conscious Building Member



Solar Keymark Certified, ISO 9001 Registered



***email: [hi@solartwin.com](mailto:hi@solartwin.com)***

***web: [www.solartwin.com](http://www.solartwin.com)***

***instant phone quotes, feasibility checks and inquiries - call now UK 01244 403 407***

# Solartwin *the best quality, convenience and design under the sun*

## ✓ *High performance zero carbon solar hot water at a brilliant price...*

- Solartwin usually takes less than a day to fit, minimising disruption.
- And it's simpler than traditional solar.



- Being a zero carbon technology, you don't pay mains electric bills, to run your solar panels, thanks to Solartwin's 100% solar pump. Solartwin=heat+electricity.
- Solartwin often needs less top-up heating than traditional solar, thanks to more hot and less tepid water.
- Solartwin does not need to have its antifreeze replaced by an engineer every few years, since it uses no antifreeze.

*Rapid fitting, less top-up heating & solar powered pumping = real value!*

## ✓ *Simple, technically elegant, double award winning new technology*

Solartwin's design *maximises* reliability, simplicity, environmental benefits and hot water delivery while *minimising* capital and running costs.

Invented at Napier University, Edinburgh, Solartwin won a DTI Smart Award for its innovative freeze-tolerant technology. In 2003 it won again - for commercial success.

## ✓ *How does Solartwin work?*

Inside Solartwin's patented black heat absorber are flexible water channels.

- Double glazing in front lets the sun's heat & light in and makes them very hot.
- Daylight runs an "intelligent" variable speed solar electric pump.
- This pumps cold water, via a narrow pipe, from the bottom of your existing hot water cylinder into the panel. Here, the water heats up.
- Thanks to the pump, your solar hot water then delivers itself, direct, to the top of the cylinder. That's it!

## ✓ *Classic good looks*

Solartwin's matt black frame looks like a big, but slim roof window. Optional glazing bars can be of value in conservation areas. We also offer bespoke frame colour options.

## ✓ *Reliable, proven, robust, safe, low maintenance, 5 yr warranty*

A five year performance warranty comes with Solartwin. Comprising very few parts and made in UK under ISO 9002 quality management, Solartwin is intrinsically reliable. It uses no antifreeze chemicals and frees you from safety concerns about highly pressurised piping, mains voltages and large smashable glass panels or tubes. Robust yet flexible pipes made from silicone rubber give bacteriological safety, as do high water temperatures. Electric power cuts do *not* make Solartwin need repressurisation by an engineer.

Going on holiday? Solartwin is self-regulating, so you don't need to invite neighbours in for baths. You can even turn off the main stopcock if you want. Moving house? Simply un-install and re-install: your warranty is portable!

## ✓ *Installs so easily*

Solartwin is for existing homes or new build projects. Two people can fit a standard Solartwin in under a day. With so few components, Solartwin halves the workload and disruption of traditional solar. Do it yourself or ask us to install. Either way, you save.



Traditional solar needs three full skills in the fitting team: roof working, advanced plumbing and mains electrics. Solartwin does not require the last of these skills. Bolt the lightweight Solartwin panel to the roof. Pass 2 flexible microbore pipes and a cable indoors. Much of the rest happens in the attic, keeping your house tidy. Plumbing is easier than fitting a washing machine: two microbore pipes "tee" into existing pipes. You often don't need a space-consuming and costly new cylinder, nor vent pipes, nor a pressure vessel. And no mains wiring at all!

## ✓ *Why zero carbon solar?*

Do you want to reduce your dependence upon the energy utilities or start future-proofing from rising energy prices?

100% solar electric pumping eliminates the typical 20% environmental penalty associated with using mains electricity to run solar heating pumps and controls.

A UK government-funded study<sup>1</sup> of eight solar water heating systems confirmed what has long been suspected: that the environmental benefits of solar can be substantially improved by eliminating mains electricity.

Flat plate solar heating systems negated an average of 17% of their potential global warming benefits (i.e. CO2 savings) by using mains electricity. For partial-vacuum tubes, their loss averaged even higher, at 23%. In other words, if you run *mains-powered* solar for ten years, its electricity consumption deletes its CO2 saving by about two years.

Solartwin's environment-centred "zero carbon" design *specifies* a solar electric pump. So your CO2 savings *won't* retreat two steps after advancing ten.

We aim for Solartwin to be the world's most sustainable form of pumped solar.

## ✓ *Our technology & ways of working are simple and environmental*

1. goodbye to antifreeze chemicals
2. keep your cylinder: waste less
3. uses "green" hydro-aluminium
4. lightweight: less embodied energy
5. hotter water = less topup heat
6. energy-efficient microbore pipes
7. phone, not car surveys save CO2
8. we offer only zero carbon solar
9. totally off-grid, 100% solar pump!
10. Solartwin keeps it simple...

## ✓ *Freeze-tolerant technology for both performance and simplicity*

Solartwin's flexible thermally conductive pipes actually *freeze solid* in winter *without cracking*. In sun, they thaw out fast. This "Holy Grail" of solar makes Solartwin unique, by:

- **Eliminating most of the** controllers, plumbing, antifreeze, unreliability & maintenance inherent in traditional solar.

- **Usually delivering hotter water** whether it is sunny or overcast, and earlier in the day. Why? Because of Solartwin's variable speed single pass pumping, special panel coatings, no heat exchangers and stratified (top down) hot water storage. More about these innovations later...

<sup>1</sup>Side by side testing of eight solar water heating systems 2001 DTI/Pub URN 01/1292

*Zero carbon solar from Solartwin - it's only natural!*

Want a free phone quotation? Just call UK 01244 403 407 email: [hi@solartwin.com](mailto:hi@solartwin.com) web: [www.solartwin.com](http://www.solartwin.com)

© Solar Twin Ltd 50 Watergate St Chester CH1 2LA, UK



# Solartwin *answers your solar energy questions*

## Is Solartwin OK for my property?

□ Yes, if you can *face the panel mainly unshaded, roughly towards the sun*. South, southwest or southeast roofs are ideal. Even east or west roofs usually offer 75-85% of peak performance.

□ Easily, if you have a *traditional low pressure vented hot water system*. This means a hot water cylinder, with its cold tank above, usually in the attic. *Thermal stores* are an easy fit, too.

□ Yes, if, height-wise, there'll be *under 5 metres* height (up or down) between the water level in the cold tank and the panel's midline. OK in most homes.

□ Yes, if your hot water cylinder holds over *80 litres*. Listed buildings, conservation area properties, national parks *etc.*, may need consent: Solartwin is normally viewed as a roof window by planners.

## How many Solartwins do I need?

In UK/Ireland *one* 2.8 sqm panel is the usual number in homes of 1-4 people.

## Need I control water hardness?

Control for 'direct' Solartwins is uncomplicated. First phone the water company for 'parts per million calcium carbonate' (also called 'ppm CaCO<sub>3</sub>'). If they quote 'typical' or 'average' (not maximum) figures, allow 20% tolerance i.e. add 20% to their figure.

• If hardness ever exceeds 200 ppm CaCO<sub>3</sub> (*very hard water*) use *either* an ion-exchange (salt-regenerated) water softener *or* an 'indirect' Solartwin. We supply and fit softeners. Please call.

• At 100 - 199 (maximum) ppm CaCO<sub>3</sub>, you can use Fernox Superconcentrate Limescale Preventer. Your first little bag of crystals on a string is free. Simply hang it in the cold tank. Replace it twice a year. A free 6-monthly postcard reminds you. Fernox SLP is food grade. It costs about £10 from DIY shops. *Or* you can use an ion-exchange water softener *or* an 'indirect' system.

• Under 100 ppm, and with 'indirect' Solartwins, use no hardness control.

All other water hardness treatments or conditioners, including electromagnetic, magnetic, electronic, physical or ultrasonic methods must not be used. The above 100/200 ppm maximum thresholds are reduced to 80/160ppm respectively for all 'fortic' type hot water cylinders as well as irregularly used hot water systems, such as in holiday homes.

## High pressure plumbing?

Solutions for high pressure hot cylinders or combination boilers may be feasible. Please call us.

## Who uses Solartwin?

Want to do something *significantly* positive for the environment? Or do you use costly fuels, or live 'off-grid'? Homeowners, self-builders, pool owners, farmers, businesses and housing associations (eg. Bournville, Berwickshire, Perthshire, South Yorkshire, Habinteg and Mosscafe) use Solartwin.

## Is the sun OK in UK or Ireland?

Yes! (Spain can use smaller panels.) Specifically designed for Scotland, Solartwin also performs superbly in hot countries. It typically gives 30-70% of a home's hot water a year and works in response to variable sunlight levels. Meteorologists say the June sun offers 6 times more energy than December's. All solar needs top-up heat (eg gas, wood, oil, electric), most in winter.

## Hotter water, how?

• **Variable speed pumping** is more accurate than traditional on-off control. Solartwin measures and adjusts to daylight as dull as 10-20%, so water stays longer in the panel, heating up *better*.

• **Solartwin's panel coatings** maximise heat gain up to around 70C, while usually giving boil-protection when you are away. Harvesting 95% (+/- 3%) of ordinary daylight *plus* non-visible infrared, our panel coatings don't need hot days nor bright days to catch energy effectively.

• **No heat exchangers.** Indirect solar heats water via a heat exchanger at the *bottom of a costly new cylinder*. But heat exchangers impose system inefficiencies: they rely on cooling in order to operate. Some partially evacuated tube systems have *second* heat exchangers on the roof.

• **Top down heat.** Solartwin delivers heated water *direct to the top your existing cylinder*, maximising temperature by floating (stratifying) it, unmixed, on cooler water below. So when you open your tap, Solartwin hot water arrives, *first*. And it gets hot *earlier* in the day.

## What about other uses of solar, apart from washing and bathing?

**Solar central heating** It's cold in winter and at night because of the lack of sunlight. Unless you want radiators at full blast on sunny summer days, solar washing & bathing offers at least 2-3 times better value.

One Solartwin delivers around 5 times more energy than the same sum spent on a *solar electric* (photovoltaic) array.

## Third generation specification.

A standard Solartwin installation supersedes traditional solar in several ways. It gives direct solar water heating from a patented, freeze tolerant, double glazed flat plate with a variable low speed photovoltaic circulation, using no heat exchanger. Water is the heat transfer fluid. (Older solar designs use indirect antifreeze circuits, heat exchangers, mains powered control, high power pumps plus collectors such as metal back-piped flat plates or partial-vacuum tubes.) Over 80% of our panel is easily recyclable.

**How big is the panel?** It usually looks big on the ground and smaller on the roof! The main Solartwin water heating panel measures 2.465m x 1.265m x 80mm deep. (approx 8' 5" x 4' 5" x 3"). Fitted, it normally projects less than 100mm above the roof, so it is often treated as 'permitted development' by UK planners. Its 'footprint' with frame is 3.25 sq m. The 'aperture' to the sun is 2.82 sq m. Lightweight, weighing 31 kg (empty) or 33 kg (full) it rarely requires UK building control.

**What is it made of?** The main metal is mainly hydro-electrically made aluminium, with a lower environmental impact than aluminium made using fossil fuel. For durability, external screws / bolts are stainless steel. The absorber coatings are black. Double glazing is UV-stable polycarbonate. Double, rather than single glazing optimises performance in winter and in windy sites. Insulation is zero-ODP pentane-blown rigid foam.

**And the pump?** The 12 volt (peak) photovoltaic panel powers a self-regulating, variable speed, long life brushless DC motor. This drives Solartwin's positive displacement pump. Valves in it stop 'reverse thermosyphon' at night, and a bypass valve protects against 'frozen by day' conditions.

**Flexible pipes.** Solartwin's freeze-tolerant, corrosion-resistant pipes are made of silicone rubber. Its extreme temperature tolerance range is: -50C to +250C! This silicone is also used, for hygiene reasons, for milk pipes in dairies. Its material conforms to the requirements of UK-WRAS for hot water and European Extraction Testing Regs 90/129/EC (BGVV XXI) for food contact, and USA FDA 21 CFR 177.2600 for food contact.

**How big is Solartwin's output?** Solartwin typically heats a normal 120 litre cylinder to 50-60C on a sunny March or Sept. day (It can reach 60C in summer). Independently tested, Solartwin *delivered* 1000 kWh (3.6 GJ) of energy as hot water a year, in the central UK. It *saves* far more bought-in energy. Peak output is 1.6 kW, similar to an immersion heater.

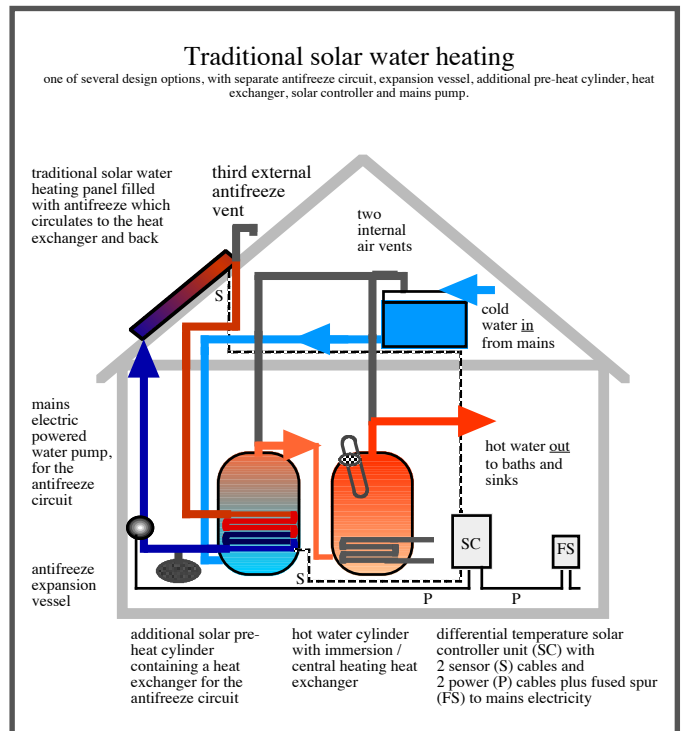
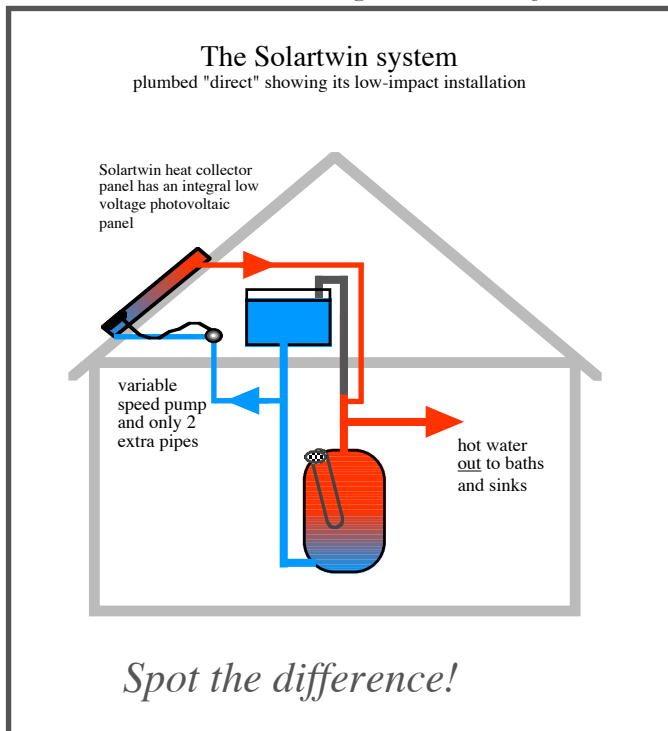
## Yes, Solartwin cuts global warming!

'Carbon is the new currency' says John Cartwright, Environmental Scientist at Chester University. Independent research shows that Solartwin can cut your yearly carbon dioxide emissions by a **quarter of a tonne** if your water heating fuel is mains gas. If other fossil fuels, or electricity are saved then yearly saving can be up to **a tonne or more!**

*Solartwin - energy systems designed with you and our environment at heart...*

*Other questions? Call: UK 01244 403 407 email: hi@solartwin.com © Solar Twin Ltd Solartwin is fun!*

# Solartwin *brings the cost of the sun down to earth*



## Solartwin ☐ hot prices

Published prices mean you know what to expect. A standard direct Solartwin installation in mainland UK usually costs only £3499, inclusive of VAT at the reduced 5% ☐fuel☐rate, if surveyed by phone.

A standard installation takes no more than a day, is on a pitched roof on a one storey house with a loft hatch giving access to the void behind where the panel will be fixed, with roof access requiring only ladders or tower scaffolding, where an appropriate low pressure vented hot water system is in place and where we can use existing hot cylinder(s), which should be large enough, usually over 110 litres, and in good condition, when we eco-survey your home.

## Self-installing?

Call for prices and information. We also make specials for pools, boats, caravans. Or unglazed, odd shaped and ☐vertical☐ panels.

We don't hard sell, nor operate ☐show houses☐ But if you ☐like to contact an existing Solartwin user we can usually put you in touch. Please call!

Working Solartwins are on view at Heeley City Farm, Richards Road, Sheffield, England; The Mill on the Fleet, Gatehouse of Fleet, Scotland; The Hydroponicum, Achiltibuie, Scotland. We give free educational material to teachers, lecturers and trainers. Please ask! We can also lend you demonstration panels and offer expert speakers for conferences and events.

To check your home is suitable, and whether we can install at the standard price, take one of our surveys, with a fixed price installation quote *including* VAT.

## Short phone eco-survey

This is your simplest, quickest, and best value option.

99% of homes are fine for our unique, quick eco-survey - just a few easy questions. During your call we may even take a quick look at your roof, using an aerial photograph, if one is available. You normally get a fixed price quotation immediately, reconfirmed in writing / by email. No-one visits or disturbs your privacy. We can normally offer a Solartwin user contact too. Call 01244 403407

Occasionally, for complex roofs / plumbing please post / email (jpeg or gif files to hi@solartwin.com) at least 6 pix:

1. Long distance outside shots of suitable **roof(s)**, including the **ground** needed to place scaffolding or ladders on.
2. Your **hot water cylinder**, usually in the airing cupboard, ideally showing the pipes around it.
3. Your **cold water tank** (usually in the attic), showing the pipes going in and out of it.
4. A wide shot in the loft of **underneath where the panel might fit** so we can see the rafters.
5. A shot of the **loft hatch** and ladder, if any. If not, a shot of where a new hatch needs to be.
6. Any **other** photographs you think may be relevant, such as alternative positions for the panel.

Please use a flash for inside shots and label each picture with your name, address & phone number. Architects ☐ plans, sketches or drawings are helpful too. We will phone you and give you a decision on suitability. Plus a fixed price written quotation - and a local Solartwin user contact if you wish.

## Traditional paid survey visit

If an eco-survey is really not practical (and it nearly always is) please ask Solartwin to come and survey your home. If you request this, there will normally be a charge.

*Please call now on 01244 403 407*

© Solar Twin Ltd 50 Watergate St Chester CH1 2LA UK email: hi@solartwin.com web: www.solartwin.com

# Solartwin *brings the cost of the sun down to earth*

## 1 My Solartwin choice is

### **Solartwin system, professionally installed**

- **from only £3499 inclusive (£3332.38 ex VAT at 5%)**



Usual one storey installation price at 10% eco-survey discount. 2.8 sqm (nom. aperture) standard direct Solartwin installation + 5yr warranty. Two storeys from £3699, with eco-survey. You may need to use a water softener. Our trained, considerate installers usually do everything in a day. Costs are quoted, not estimated, based on a survey. UK mainland del *included*. For ecosurveys, call: 01244 403 407

### **Or self-install Solartwin system kit**

- **just £2543.70 ex works (£2211.91 ex VAT at 15%)**



The full kit: roof panel (2.8 sqm nom. aperture) roof mounting brackets, 30m of microbore silicone pipe, fittings, tees, pump, PV panel with cable, thermometer, installation guide, user guide, 5yr warranty. Price *excludes* delivery. UK mainland delivery costs £99 inc VAT. We can quote for delivery to almost anywhere in the world - please just call us.

#### **Kit delivery option for DIY kit (free for installations)**

- **You arrange kit delivery for me, please quote** ☐
- **or I sort kit delivery / collection, no charge** ☐

Solartwin ☐ wide range of options include

#### **Water softeners fitted from £800**



#### **or Softener kits (incl UK mainland del £ please call)**



Ion-exchange water softeners (eg: 10-litre resin tank & 12 volt time clock) reduce limescale and scum. Soft water uses less washing powder and soap. Clothes and sheets feel softer - last longer - they aren't washed with little bits of grit. Softeners mean fuel economy because limescale inhibits the boiler's heat transfer in your hot cylinder. Warranty: 1y for DIY kits, 2y installed. Prices are quoted, (not estimated). Call for solutions.

#### **Thermostatic blender valves fitted from £300**



Water heated by solar may reach 80C or occasionally be even hotter. If children or elderly people will use the water we recommend a thermostatic blender valve to limit it to say 60C.

#### **Your bespoke frame colour from £300**



☐ Any colour as long as it's black ☐ is no longer our thing!

#### **Three decorative glazing bars only £99**



3 bars (not one) for ☐ ye olde roofoe windowe ☐ appearance.

#### **A-frame mount for walls / flat roof / ground.**

Frame weighs approx 20-30 kg depending on design and tilt.

- **£500 prof. installed (£476.19 ex VAT 5%)** ☐
- **£400 self-install kit (£340.43 ex VAT 17.5%)** ☐

## 2 My contact details are

Name \_\_\_\_\_

Phone \_\_\_\_\_

(Mobile) \_\_\_\_\_

(Fax) \_\_\_\_\_

(email) \_\_\_\_\_

May we email you about Solartwin products or services?

Yes ☐

Full address and postcode (postcode needed for delivery)

\_\_\_\_\_

\_\_\_\_\_

Address / contacts for installation / delivery if different.

\_\_\_\_\_

\_\_\_\_\_

## 3 Dates When do you want your Solartwin system?

We ☐ call to confirm details.

- **I want my system as soon as possible (asap)** ☐

- **I would prefer it to arrive on / around (later)** ☐

(please suggest dates) \_\_\_\_\_

## 4 Payment I enclose a deposit of:

£ \_\_\_\_\_ against a total of: £ \_\_\_\_\_

This sum in Pounds Sterling is payable to Solar Twin Ltd. It comprises £599 deposit per Solartwin system (plus, if chosen, £49 deposit per glazing bar set and full payment for A-frames). For installations, I agree to pay the balance to the installer in full on the day of completion of installation. I have a seven working day cooling off period, after which my installation may start. If I cancel an installation, I will cancel in writing to the address below. If I cancel within seven working days of the date of order, a full refund will be made. I agree that a 10% total order value deduction applies if my cancellation happens eight or more working days from the date of order. For self-install purchases, I have a cooling off period starting from the date of order to seven days after delivery, during which I am entitled to a full refund, less delivery and collection charges, if charged. (I may return the goods undamaged to the original despatch point at my own expense if chosen.) I agree to pay the balance plus delivery, if selected, in full, to clear at least 5 working days before despatch.

Signature \_\_\_\_\_

Date \_\_\_\_/\_\_\_\_/\_\_\_\_ (optional: pipe exits: Right / Left / Either)

Any queries about ordering? Please call UK 01244 403 407 now.

**Please call now on 01244 403 407**

© Solar Twin Ltd 50 Watergate St Chester CH1 2LA UK email: hi@solartwin.com web: www.solartwin.com



# Solartwin *the zero carbon solution for solar water heating*

## Solartwin users say:

*John Stonell, Castle Douglas: "We were impressed by the simplicity of the design and operation."*

*A. M., Belfast: ☐I am besotted with my panels. I keep running upstairs to look at the thermometer!! So you can tell future clients an additional benefit... is that they will keep members of the household fit!!*

*Dr MacG, Perth ☐23 December 2004 - My Solartwin was happily whirling away in the bright winter sunshine yesterday morning at around 11 o'clock.☐*

*P. T. in Clevedon:☐..you could tell they were very experienced in your product. It was a pleasure to have workmen in our house who were very polite and efficient. I would like to thank you for all the help you have given to us and for the installers whom we could not fault. If the system proves to be as good as your service and the installers, then we have a brilliant product that is going to last for a very long time. If I can recommend anyone to have a solar system it will most certainly be Solartwin.☐Many Thanks.*

*Andrew Coker, Oxfordshire: ☐My family has been the beneficiaries of Solartwin hot water for the past three years and we cannot speak highly enough about the company and its equipment. Even in the middle of the winter the pump gets triggered and our tank fills with warm water. Living in an isolated spot with bottled gas as our energy source the cost of heating the water was astronomical and a year round expense. Now however we turn off the gas for three to four months in the summer and enjoy enough hot water for all our washing needs. We have never needed any service or help since installation and recommend Solartwin both for its technology and helpful and friendly service☐*

*Bryon Bird, Surrey: ☐My Solartwin system was installed recently and has been providing plenty of hot water without any input from the immersion heater or gas central heating. The late spell of hot weather confirms the survey predictions regarding heat collection. I have enjoyed showering in 'sunshine' and relish the prospect of my reduced fuel bill. My advanced investment in this luxury seems to be psychologically blocked. This is very convenient.*

*The installation was carried out cleanly and efficiently. I have no reservations in recommending it. I am presently boring my neighbours and family by frequently extolling it's virtues. This must be part of the same psychological effect☐*



## Solartwin way ahead - DTI data

Thanks to UK's Freedom of Information Act we can finally reveal DTI data on grant aided solar. It shows that Solartwin customers gave **85% of Solartwin installers the best score of "very helpful"**. The figure for non-Solartwin installers was 9% lower, at 76%. In addition, Solartwin was 25% less likely to have problems after installation, than other solar heating technologies.

## Solartwin makes sense now

**Starting to quit the carbon economy** has never made better sense. Solartwin's challenge is to shrink your carbon footprint and cut your energy bills more cost-effectively than traditional solar. The UK plans a 20% cut in CO2 and other global warming gases, but climatologists say real sustainability needs over 70%. You can help to close this gap using clean, renewable solar energy.

**Solartwin gives you the fun and satisfaction of solar hot water:** saving energy, money and the environment in one go. Solar can also extend your boiler's life, since it is used less, and raise the SAP energy rating of your home and boost your property's value!

**Zero carbon solar heating technology.** Most other solar water heating systems consume mains electricity. This negates about 20% of their CO2 savings. But Solartwin's solar electric pump is zero carbon.

## When we ask for one word...

to describe Solartwin, our customers usually use one of these: **Efficient, Friendly, Helpful, Hot, Futuristic, Practical, Unobtrusive, Economical, Brilliant, Ten out of Ten.**

# Zero carbon solar makes sense!

*Can we give you a quote or feasibility check - free of charge? Call 01244 403 407*

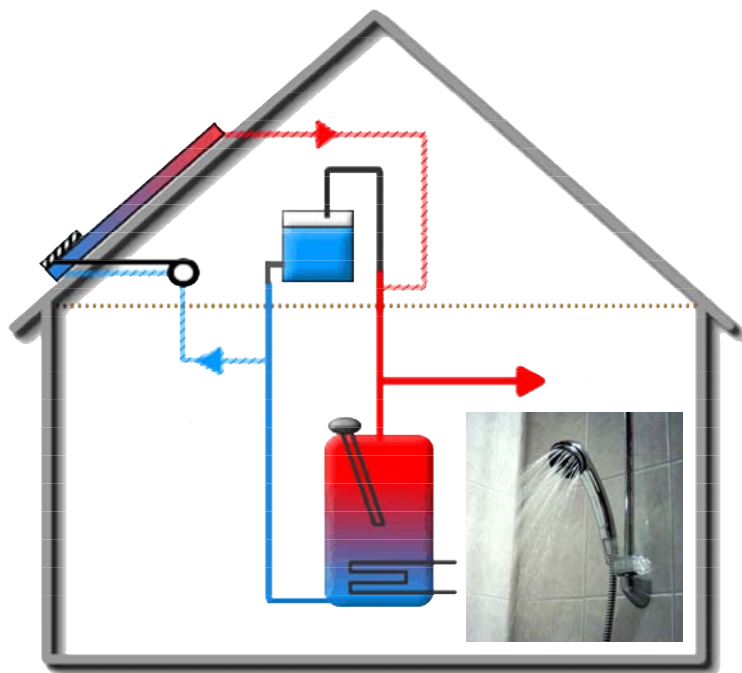
# Installation Method Statement







## Installation Method Statement



- Can heat tap water directly
- Freeze-tolerant panel
- No glycol
- Safe low voltage
- PV drives variable speed pump
- Only 2 extra pipes
- Stratified storage of hot water maximises efficiency
- Simple to install

## Zero Carbon, Solar Pumped Solar Hot Water



REA Renewable Energy Association Member and Association for Environment Conscious Building Member



Solar Keymark certified | ISO 9001 registered



VAT no: 752 9027 26 Solar Twin Ltd, Company number: 3750291 Registered address: 9 Abbey Square, Chester, CH1 2HU UK

## ***Contents:***

1. Introducing Solartwin
2. Before you start
3. Site requirements
4. Preliminaries before the job starts
5. Prepare to start the job(if appropriate)
6. Roof working
7. Internal plumbing and wiring
8. Commissioning
9. Post-commissioning checks
10. Final clearing up
11. Installation, signing off and documentation
12. After leaving the installation.
13. Revisits
14. Finally;
- Appendix 1 Standards and Documents Included
- Appendix 2 Equipment and Materials
- Appendix 3 Hardness Control
- Appendix 4 Cylinder Notice
- Appendix 5 Solartwin Variation
- Appendix 6 Pressure Drops and Multiple Panels
- Appendix 7 Amendments



## 1. Introducing Solartwin

Solartwin is a reliable, quickly fitted and affordable solar water heating system. It is based on a Scottish engineer's sudden insight on how to avoid the problem of frozen pipes bursting in winter - by just letting them freeze - flexibly!

Invented and patented by Kerr MacGregor at Napier University, Edinburgh, and developed in conjunction with Solar Twin Ltd, his innovation exploits recent advances in materials science.

Kerr identified highly flexible, thermally conductive pipes to accommodate the problem that water expands when it freezes. This 'freeze-tolerance' eliminates, at a stroke, any need for inefficient heat exchangers and antifreezes, and the numerous costly and power-draining control peripherals normally associated with conventional solar water heating.



Solartwin's unique pumping system uses a low-speed, single pass, water flow through the panel, rather than less efficient fast multiple passes. With not one, but two surface coatings on different parts of the absorber, selective and matt, total system efficiency and, crucially, cost-effectiveness are boosted still further.

In addition, all of the parasitic mains electricity consumption normally associated with pumps, 24 hour solar controller circuitry and various other peripherals is completely eliminated by using a dedicated low power, variable speed, *solar* powered pump. Based on new high torque, rare-earth magnet technology, it is powered totally from a small, off-grid photovoltaic module.

Solartwin usually takes less than a day to install! Typical total job duration is 5 - 10 person hours, eg 2 people for up to 5 hours each. Its name comes from combining both solar *thermal* and solar *electricity* into one system. Made in the UK, most of the aluminium it contains is bought from Norway because there it can be made with hydro-electricity, rather than conventional fossil fuel power.

REA Renewable Energy Association Member and Association for Environment Conscious Building Member



Solar Keymark certified | ISO 9001 registered



VAT no: 752 9027 26 Solar Twin Ltd, Company number: 3750291 Registered address: 9 Abbey Square, Chester, CH1 2HU UK

## 2. Before You Start

*Please read the whole of this document before you start.*

*This is an example of a typical method statement for installing a Solartwin solar hot water panel on a one or two storey domestic home, where there is already a low pressure vented hot water cylinder in place which does not need to be replaced. Your installation may differ.*

**WARNING.** Only install your panel if you and all the people working with you are competent to do so, and only after you have assessed all risks, and either eliminated them or reduced them to safe levels.

**CAUTION 1** There is a boiling risk, which is fully avoidable. Simply shade the main panel until after connecting all plumbing and wiring. A useful shade is the box in which it was packed. Use strong ropes to secure it against wind.

**CAUTION 2.** There is a slight risk of burst, which, again, is fully avoidable. Never close off both pipes of the panel either by folding them or by using bungs, valves, etc. At least one (preferably both) of its inlet and outlet pipes must be open to the air at all times, or it may burst due to boiling if placed in strong sunlight.

**NOTE 1:** If the panel is to be left empty, or without the pump running, in full sun for more than 5 sunny days in total, please drain and shade it, to limit internal temperatures.

**NOTE 2:** To allow Solartwin's peak temperature control function to operate correctly, the Solartwin panel is never to be installed on a solar tracker. Install it instead in a fixed plane such as on a roof, wall or fixed position A-frame.

**NOTE 3:** Please carry out all commissioning checks and signing off procedures that are given towards the end.

**NOTE 4:** Please ring your local Water Authority **before you start** to ask for a hardness figure for Calcium Carbonate in ppm (parts per million). If you get two figures, use the higher one. If you get one figure, add 20%. With this maximum figure, refer to Appendix 3 to see what, hardness control, if any, is required.

**NOTE 5:** Check that the header/expansion tank is in good working condition and has adequate volume and expansion capacity. In particular, it must conform to water bylaw regulations, be fully insulated and have a cover. If any of these conditions are not satisfied, decommission the system if it is unsafe. Any non-conformances must be advised to the client, in writing, detailing which elements must be upgraded..

**NOTE 6:** All installations require a detailed photo diary in order to obtain a full 5 year warranty. These should be taken as the installation progresses, not at the end. details of photos required are given in Section 11.

### 3. Site Requirements

#### 3.1. General

Carry out all duties in a professional, conscientious, responsible, healthy and safe manner. All operatives shall be experienced and trained in their respective trades and will be fully familiar with the correct method of installation of the Solartwin System so that both short-term as well as long-term installation work and product warranties are in no way compromised.

#### 3.2. Responsibilities

- 3.2.1. Site supervision - MAIN contractor.
- 3.2.2. First Aid responsibility to be provided on site.
- 3.2.3. Reporting of accidents and responsibilities supplied on site with own company logging.
- 3.2.4. Technical guidance if required from the Solartwin office.

#### 3.3. Materials, tools and equipment including selected PPE equipment

Item	Where used
Overalls	Generally
Safety Boots	Generally
Gloves	Handling scaffold and materials
Hard hat	Generally
Dust mask	Loft areas
Disposable overalls	Loft areas
Hand wipes	Before breaks, with glues and generally
Waterproof clothing	Outdoor rain protection

Tools and equipment lists vary from job to job.

3.3.1. General Personal Protective Equipment to be supplied and used is shown above. You may want to list further relevant items.

3.3.2. General Tools and equipment ☐ equipment is normally all provided by the subcontractor.

- 3.3.2.1. All tools and equipment shall be fit for purpose and regularly checked and maintained in accordance with Health & Safety Guidelines.
- 3.3.2.2. All on-site electrical equipment shall be low voltage battery operated under 36 Volts DC or 110 Volts AC provided by an approved mains transformer or generator supply. Electrical equipment must not be used in damp or wet conditions. All non-cordless electrical equipment must be PAT tested.
- 3.3.2.3. All access equipment including ladders and scaffold must be correctly erected, well maintained and regularly inspected. Ladders will only be used as a means of access and not as a working platform for the purposes of installing a Solartwin system. Where appropriate, a safe working platform such as an SGB Youngman system approved to HD1004 Class 3 shall be hired from a reputable hire company. At all times, installers must comply with legal requirements for working at heights.

#### 3.4. General materials

- 3.4.1 All materials used shall be specified by the system manufacturer and used / installed with manufacturer's instructions. (See Appendix 2 for guidance on tools required)
- 3.4.2 Where necessary a COSHH assessment will be undertaken and all operatives instructed in and supplied with relevant information on safe methods of use and storage.
- 3.4.3 In transit, all components and materials will be carefully stored in company vehicles in order to minimise the possibility of damage in transit.



#### **4. Preliminaries Before the Job Starts** (0.5-1 person hour)

- 4.1. Arrive on site and introduce yourselves.
- 4.2. Note down the 4 serial numbers on the warranty - panel, pump, PV and controller
- 4.3. Pre-survey issues:
  - 4.3.1. Carry out a weather-risk assessment. Postpone the roof work if unsafe.
  - 4.3.2. Examine the site conditions fully for all other aspects of health and safety.
  - 4.3.3. Examine the condition of the roof and photograph. Make the customer aware of any damage such as broken tiles - before any work has started.
  - 4.3.4. Check installation feasibility and the accuracy of any earlier surveys including checking proposed panel elevation, pitches and also orientations using a compass with corrections for magnetic deviation. Also check inside the property to determine if the loft is free from obstruction. Check pipe routes and any obstacles or difficulties that may arise.
  - 4.3.5. Check that the header/expansion tank is in good working condition and has adequate volume and expansion capacity. If not, decommission the system and advise the client, give a written warning statement that the tank requires replacement
- 4.4. Carry out and record a Legionella Risk Assessment and implement any required outcomes.
- 4.5. Check that if an ion exchange softener is being installed, that there will be no lead pipes downstream of the softener since there is a toxicity risk from these.
- 4.6. Critically inspect scaffolding if supplied to eaves level / access equipment / harnessed running roof line if all to be supplied by main contractor.
- 4.7. Fully brief occupants (if any) of work to be carried out detailing, when, where, including access and all health and safety implications of the installation relevant to them.

#### **5. Prepare to Start the Job, if Appropriate** (0.5-1 person hour)

- 5.1. Carry out all appropriate onsite health and safety site measures including cordoning off the working area.
- 5.2. Unload panels, equipment and tools.
- 5.3. Check every single thing that you will need. Preparation now will save time later.
  - 5.3.1. Assemble and check the conditions, and presence of the required tools and parts before you start.
  - 5.3.2. Make sure that all tools and parts are appropriate and all are available before starting.
  - 5.3.3. Tick all Solartwin components off on the parts list one by one and identify each carefully.
  - 5.3.4. If items are missing or damaged report this immediately.
- 5.4. Lay dust sheets on all internal surfaces requiring protection including carpets and vulnerable hard floors.
- 5.5. Gain access to loft via suitable ladder, temporary ladder or working platforms, and check positions of cylinders and header / expansion tanks against survey data. Remove and lay ladders flat in a place where they will not obstruct access if unattended.
- 5.6. Measure the exact size of your panel from top to bottom where the support rails attach, and record this measurement.
- 5.7. If necessary, strengthen rafters (or timbers or other structures) used for securing the panel, for example by adding noggins between rafters or adding thicker timbers alongside them.



## 6. Roof Working (1-3 person hours)

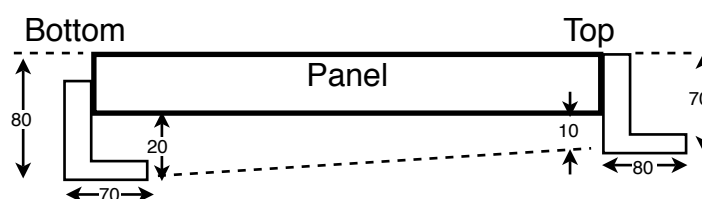
Required competence **MUST** include safe working at heights and on roof. Two people are required, but only one needs be on the roof.

### 6.1. Panel location while on the ground

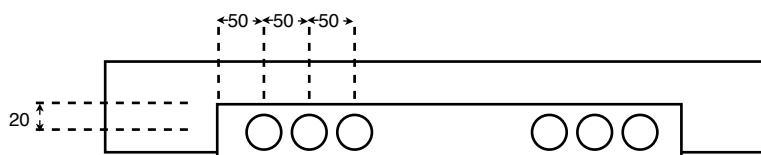
- 6.1.1. Reassess if necessary / decide exactly where on the roof your panel is to go.
- 6.1.2. Reconfirm this position with customer if appropriate.
- 6.1.3. Make sure that the lowest part of the thermal panel will be no more than 5m below the highest point of vent pipe of the header / expansion tank to which the panel is attached.
- 6.1.4. Make sure that the highest part of the thermal panel will be no more than 5m above the water level of the header / expansion tank to which the panel is attached.

### 6.2. Pre-drill the roof brackets.

- 6.2.1. Whilst on the ground, both top and bottom roof brackets should be pre-drilled so that work to fix the panel to the brackets on the roof is minimized. Do not pre-drill holes for fixing the brackets to the rafters.
- 6.2.2. Each bracket should be placed on the frame, in turn, as shown, and six holes of 3.5 mm diameter should be drilled through bracket and panel. These holes should go right through the panel frame. Do not drill more than 20 mm into the panel, as the frame insulation is 25 mm thick. If the drill bit penetrates right through the insulation, you will deliver dust inside the panel.



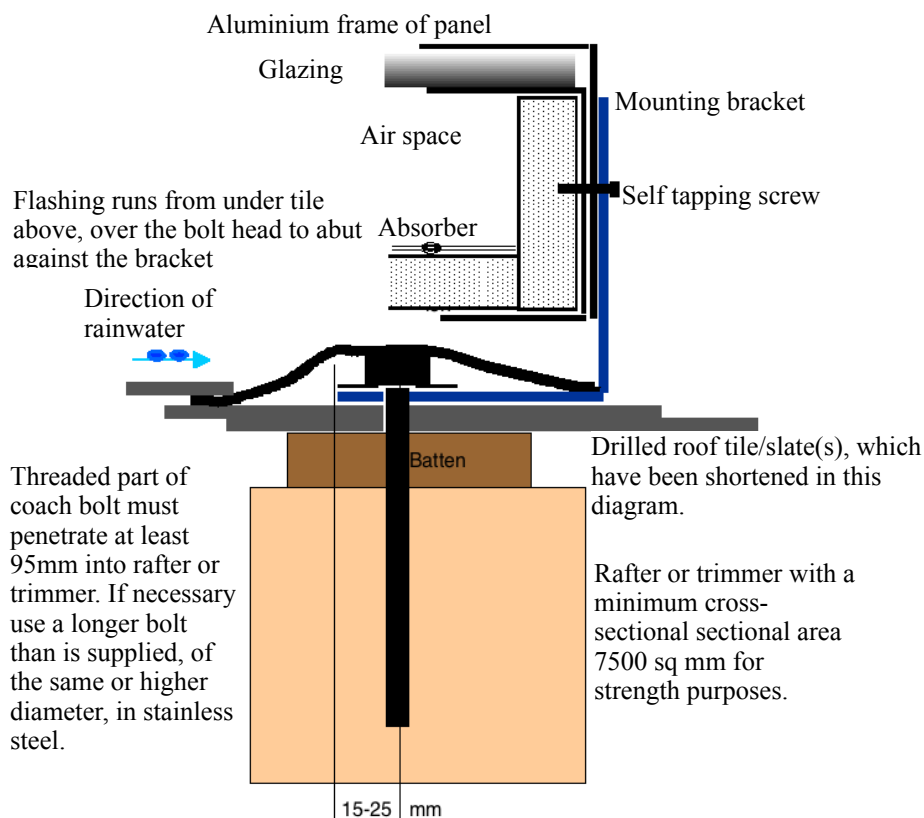
The gaps of 20 mm and 10 mm to the roof are necessary so that dirt particles can roll out below the panel, and not get caught. Strips of timber or roof batten make good spacers.



**View of Top Long Edge of Panel**

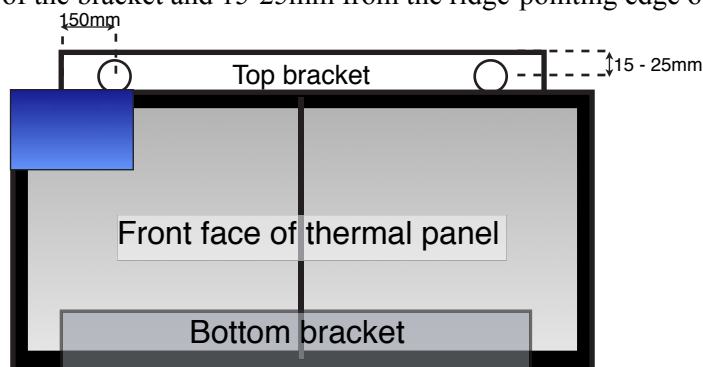
- 6.2.3. Once the six holes through the bracket and panel have been drilled for each bracket, a 4 mm drill should be used through the brackets only, to provide clearance holes for the screws. Do not assemble brackets to the panel before the panel is raised on to the roof.
- 6.3. Fit panel temperature sensor to the back of the thermal panel as per controller manual.
- 6.4. Roof access
  - 6.4.1. Carefully erect the roof access equipment according to its instructions, having first provided a level base from which to set this up.
  - 6.4.2. Use undamaged and robust timbers and levellers where needed.
  - 6.4.3. Include erection of guardrails and toe boards and stabilisers as appropriate.
  - 6.4.4. Where installations exceed one day and where appropriate, remove all access equipment at the end of the day and store it in a secure place and re-erect it the next day.

- 6.5. Lifting and storage at height
  - 6.5.1. Safely raise tools, brackets and fixings required for the roof work.
  - 6.5.2. Store them in tied-on or otherwise well secured roof buckets, or toolbags or tool belts as appropriate.
- 6.6. Check that the rafters are strong enough. If you are not sure, ask a structural engineer to attend / calculate for you. In general a rafter or trimmer in good condition should have a minimum cross-sectional area of 7500 sq mm if it is to support the panel. If any rafter does not satisfy this requirement, then either securely fix/add a perpendicular trimmer between two rafters or thicken the rafter with timber which meets this requirement.
- 6.7. Find the rafters or noggins you intend to fix the brackets onto. This detective work can involve a variety of tricks including:
  - 6.7.1. Feeling for rafters under slates using a long thin metal trowel
  - 6.7.2. Remove a tile in the area of the rafter nearest both ends of the bracket and locate the exact fixing position by feeling through the roofing felt.
  - 6.7.3. Looking under the eaves to see where the lower ends of the rafters are, if they are visible.
  - 6.7.4. Measuring the positions of rafters in the attic from a reference point such as a chimney breast inside the attic and then transferring the measurements onto the roof.
- 6.8. Mark both edges of all possibly relevant rafters on the roof using chalk.
- 6.9. Decide which rafters you will fix to. Use the widest spacing possible allowing for 20mm no-drill area at the edge of the roof brackets. For example it is better to span four rafters than three.
- 6.10. Secure the lower bracket to roof using drills and coach bolts as follows:
  - 6.10.1. In summary, mount the lower bracket, and position the panel over it before marking and drilling the position of the upper bracket which also faces upwards. (Using a hole cutter is usually easier than using a drill to make holes.) You will use two coach bolts and washers to secure each mounting bracket to a rafter or trimmer. Space the coach screws as wide apart as possible, by spanning as many rafters as possible. The lower leg of each bracket must point up the roof. The coach bolts must be 15-25mm down from the upper edge of the bracket. Seal thoroughly by flashing over the bolt head and using silicone sealant at each drilled layer. The following diagram is not to scale.



**NB** Seal liberally with silicone sealant in the hole, and under and over the bolt head. Use a blow torch, or similar to dry tiles, if wet, before applying the silicone.

- 6.10.2. Hold the lower support bracket on the roof in the required position.
- 6.10.3. Use a spirit level to level the top edge of the bracket to within 1 degree of horizontal. This is because the pipe runs in the panel must run within 2 degrees of horizontal in order to prevent air bubbles from collecting.
- 6.10.4. Face the 80 mm (not the 70 mm) leg of the lower bracket perpendicular to the roof, ie towards the panel to minimise any leaf trap effect. This way any objects getting in at the top of the panels can fall out the wider gap at the bottom instead of lodging between the panel and the roof.
- 6.10.5. The panel may be mounted from 10 deg off horizontal to 90 deg (ie vertical). Different angles offer different performance over the year. Note that at panel tilt angles shallower than 15 deg off horizontal, the cleaning action of rain diminishes significantly.
- 6.10.6. Drill guide holes through the tiles into the rafters for the coach bolts.
- 6.10.7. Measure the distance between the holes and drill the support bracket accordingly (on the shorter side of the angle for the lower bracket). Make sure that the leg of the bracket points up the roof and that each of the two holes is drilled within 150mm of the end of the bracket and 15-25mm from the ridge-pointing edge of the bracket.



- 6.10.8. Apply silicone sealant in and around the hole on each of tiles that have been drilled.
- 6.10.9. Apply a smaller dab to the washers and slide them onto the coach bolts.
- 6.10.10. Now screw in the coach bolts into the rafters using a socket or ratchet spanner.
- 6.10.11. Apply silicone sealant around all bolt heads.
- 6.11. Secure the upper bracket to the roof.
  - 6.11.1. Measure centres for coach bolt penetration (as measured before) 1265 mm upwards from the lower bracket to obtain the correct bolt centre position for the upper bracket.
  - 6.11.2. Now attach the upper bracket using the coach bolts. This time, face the 70 mm (not the 80 mm) leg of the upper bracket perpendicular to the roof, ie towards the panel to minimise leaf trap effect.
- 6.12. Apply secure flashings over all coach bolts.
- 6.13. Check that all coach bolts are secure and weather-tight before the next step.
- 6.14. Raise the panel safely to the roof (30-40 kg typical panel weight depending on its exact specification such as the number of glazing bars) - responsibility of principal contractor.
- 6.15. Position the panel securely abutting the brackets, top and bottom. At this stage, before you put the 12 securing screws in, it can still slide from side to side. Note that the lower edge of the panel has drillings, which act as drain holes. Always fit this lower edge facing downwards, never facing upwards.
- 6.16. Work out and drill your pipe and cable entries **before** securing the panel to the brackets!
  - 6.16.1. Remember there are six or eight holes in the roof to consider.
    - 4 for roof bolts.
    - 2 for pipes
    - 2 for PV and temperature cables, if a route cannot be found without making an extra hole.

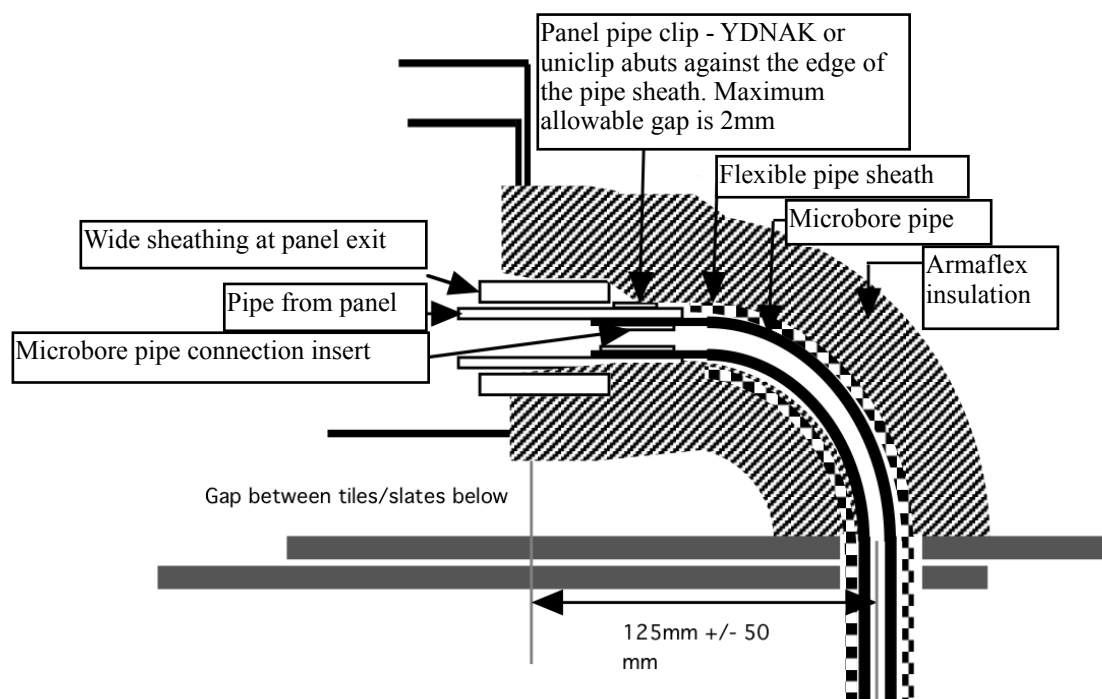
- 6.16.2. Decide where your pipe entry holes will be **BEFORE** attaching the panel to the brackets, otherwise they may foul a rafter on the way through if you don't plan ahead. You may need to slide the panel left and right a bit order to facilitate easy pipe exits before adding the 12 screws to attach it to the roof brackets.
- 6.16.3. Decide where you will drill for the pipes and cables.
- 6.16.4. Drill 2 holes opposite the pipe exits of the panel which will be able to accommodate the black corrugated pipe sheathing. Make a neat hole in the felt below the hole.
- 6.16.5. Finish off this job when you have secured the panel to the roof brackets.
- 6.17. Secure the panel to the roof brackets.
  - 6.17.1. Fix the panel securely to the rails using the self tapping screws provided.
- 6.18. Waterproof the pipe and cable entries **after** securing the panel to the brackets.
- 6.19. Use the two screws provided to attach the PV to an appropriate corner of the main panel

### Photovoltaic (PV) Panel



- 6.19.1. Where is most appropriate? Typically the **least** and **last** shaded corners of the main panel. It is important to minimise shading from trees, chimneys etc, particularly between 1000 H-1800 H (sun time). If the PV panel has to be shaded for a time, the pump will pump more slowly or it may even stop. So position it to be shaded out late rather than early in the day.
- 6.19.2. Bear in mind that bird droppings could foul the PV panel - so positioning it under an aerial where birds may rest is not recommended!

6.20. Now complete the pipe entries through the roof. The following diagram is not to scale:



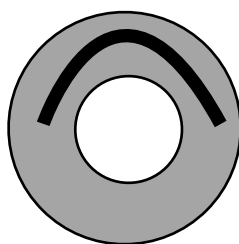
- 6.20.1. Cut the two narrower pipes exiting from the panel so that each protrudes 20-30mm longer than the wide pipe sheath.
- 6.20.2. Cut the black corrugated protective sleeving into three equal lengths, trimming any rough edges.
- 6.21. Start fitting the upper (hot) microbore pipe (from the 30m roll of silicone tube).
  - 6.21.1. Insert one of the brass inserts into the end of the flexible silicone hose.
  - 6.21.2. Put one of the black flexible corrugated sleeving pieces inside the shaped insulation piece (the Armaflex HT).
  - 6.21.3. Find the hot (upper) length of silicone microbore hose and put it inside the above assembly.
  - 6.21.4. Insert the end of the hose, complete with brass insert, into the panel hose and secure using one of the supplied YDNAK clips around the panel hose.



**Pliers holding YDNAK.**

- 6.21.5. Thread the other end of the hose through the hole in the tile and make sure that it goes through the felt. This is where some sellotape and wire from a coat hanger can help as you thread it through. Do not damage the pipe.
- 6.21.6. Cut a piece of Armaflex (HT, UV resistant) foam pipe insulation to length and angle the cuts so that there is a good fit, both to the roof and to the panel edge. It is important to get clean straight cut against the tile/slate.

- 6.21.7. Repeat this procedure for the lower (cold) hose. You should now have two pipes going through the roof. Each will be sheathed in corrugated sheathing. Over that will be Armaflex foam insulation. The silicone pipe will be shielded from light and it will be securely connected to the panel inlet or outlet pipe.
- 6.22. If pipes are to be led across the roof rather than go through it near the panel, it is important not to allow any pipe leverage at the point where it enters the the panel since this flexing may damage the pipe from the panel. Any unsupported length of pipe between where it exits the panel and its first point of fixing must not exceed 200mm.
- 6.23. Next, push the cable from the PV panel through the roof, using the last section of protective sleeving, and then through the roof. Again, seal up appropriately and with silicone sealant. Make sure the PV cable on the roof is very secure so that it will not be loosened or damaged by wind - over many years
- 6.24. Watertightness: Apply roofing grade silicone sealant around all holes in the roof and seal the insulation to the side of the panel with silicone. The silicone sealant used around the pipe entry holes should fill all available space, make good contact with all surfaces and its top surface should be raised above the tile/slate surface to deflect the water flow around the black corrugated sleeve, as it goes through the tile/slate. An additional bead of silicone sealant should also be added around the top half of the cut face of the Armaflex HT.



**Cross-section of Armaflex**

- This will also deflect the rainwater. Alternatively use lead slates if appropriate to the design of the roof for watertightness at roof penetrations. Appropriate proprietary or flashed pipe entry methods may also be used, if watertight.
- 6.25. Connect any appropriate lightning protection if required by local weather conditions and regulations.

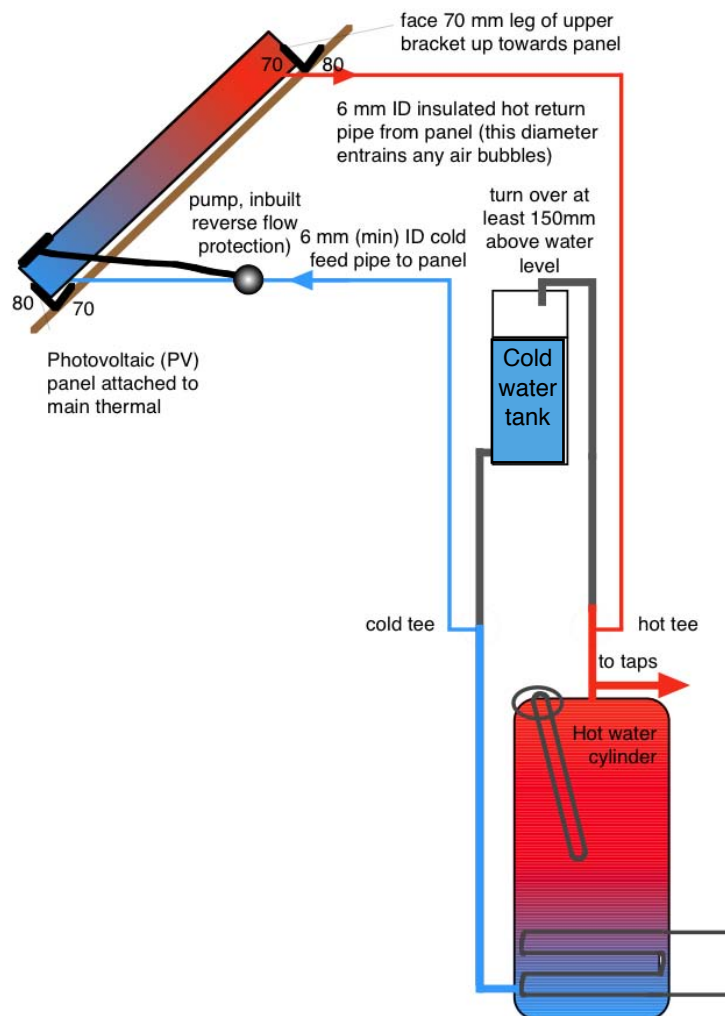
Inspect all work closely and descend.



## 7. Internal Plumbing and Wiring (1-3 person hours)

Operative must be competent in plumbing and hot water safety but CORGI is not normally required.  
Hint: label all pipe ends blue for cold side.

**A Typical Vented Cylinder System**  
(Thermostatic blender valve plumbing has been omitted for clarity.  
Details are explained and shown diagrammatically in 7.13)



- 7.1. Do not paint the silicone pipes. Do not apply any adhesives to them apart from silicones. Builders roofing sealant or mastic must not contact the pipes unless it is silicone based.
- 7.2. Lengths. Total microbore pipe run length in both directions must not exceed 30 m. If total runs are to be longer, up to 50m maximum, use 15 mm copper pipe for the cold feed to the panel where it runs in freeze protected areas. Use our microbore pipe, where possible, since its lower area and volume reduces dead leg/heat losses. Note: When copper pipe has to be used, it should gently rise in the direction of the water flow to avoid air-locks/bubbles becoming entrained.



- 7.3. It is essential to sheathe all silicone pipes against physical damage and light. Water regulations require this as well as it being important to do. The silicone pipes must be routed through Hep2O or similar robust external sheathing pipe in order to protect silicone pipe against physical damage from rodents or abrasion due to movement over time. Ensure that entry points of the silicone pipe into the Hep2O pipe are smooth and cannot cause abrasion damage. Apply a blob of silicone rubber to cover every place where the silicone pipe enters any sheathing. This will protect it from possible abrasion. This also applies to any point where silicone pipe may be prone to abrasion where it enters a hole. If there is any chance that the silicone may work loose or move before it sets, such as due to vibration because the system is already in operation, tape over it with insulation tape or similar tape to hold it in place until it sets.
- 7.4. HINT! Occasionally the water hammer from the pump may cause the silicone pipe to "slap" against the inside of the Hep2O. This noise can be solved by tensioning it slightly as it travels through the pipe by pumping the pipe by up to 1% longer than its resting length and securing at both ends of the Hep2O with silicone sealant (and tape until it sets).
- 7.5. Secure pipes correctly. Where silicone pipes are sheathed, use the spacing required according to the stiffer material - for example Hep2O. Should, for an exceptional reason the silicone pipes have to run unsheathed, and only where there is no risk of physical damage whatever, we recommend *maximum* clipping intervals of 0.5m on vertical runs and 0.3m on horizontal runs.
- 7.6. Seal all holes inside the loft at pipe and cable entry points. If there is a significant void between the tiles and the felt/inside of loft, the silicone should be sheathed in Hep2O and insulated as far as possible. Rodent attack may occur otherwise

Photo of rigid sheathing over silicone microbore pipe before insulation is added. Afterwards the sheathing was slid closer to the tee, the entry point to the sheathing was "blobbed" with silicone. Then the pipes were insulated and secured.



- 7.7. Insulation. The only insulation we provide is a small length of high performance UV-resistant Armaflex insulation, for use on the roof.
  - 7.7.1. Externally, both pipes must have insulation which doubles as UV sheathing on the outside, such as Armaflex HT. Minimise freeze-exposed external lengths where possible.
  - 7.7.2. For internal work, use Armaflex HT to insulate the Hep2O and other pipe sheathing. All internal pipework should be insulated wherever possible.
  - 7.7.3. Tape the butted joints of the insulation over the hot pipe together with heat resistant tape. Attach the insulation to rafters using the nail hole zip ties. Do not use normal pipe clips within 2m of the pump.
  - 7.7.4. All 10mm silicone rubber pipes should be insulated with a material of thermal conductivity of not more than 0.045W/m.K and thickness at least that of the pipe diameter. (Scotland) or Max 7.23 W/m (Rest of UK)
  - 7.7.5. Never put pipes of two different temperatures inside the same piece of insulation!

- 7.8. Before you start working with the existing plumbing.
  - 7.8.1. Switch off the boiler and its controls.
  - 7.8.2. Drain down the whole header / expansion tank. Drain down its connected cold and hot water system to an appropriate level. This is usually at least 100mm below any lowest intended teeing in point. You may not need to drain down the whole cylinder.
- 7.9. Teeing in.
  - 7.9.1. The two compression tees will draw water out of the bottom of the cylinder and replace it, heated, at the top.
  - 7.9.2. Tee in to a low pressure vented cylinder only.
  - 7.9.3. Minimise heat loss by minimising the length of copper pipe runs. You can normally do this fitting both pipe tees fairly close to the hot water cylinder, for example 50-500mm above it.
  - 7.9.4. Use 22 mm compression tee fittings with 22 mm or 3/4 inch olives. Our supplied reducers will fit our 6 mm (internal diameter) silicone rubber hoses using the supplied YDNAK clips to hold the rubber tube onto the fitting. Support pipes at least every 30cm if running horizontal and every 50cm if vertical.
  - 7.9.5. **No plastic pipes whatever!** If any pipes or fittings connecting the cylinder to the header / expansion tank, including the vent pipe are made of plastics they must be replaced by copper pipes. Tee only into copper pipes.
  - 7.9.6. In social housing applications we usually recommend teeing-in in the loft if this is possible, since this will eliminate all extra piping from the airing cupboard.
- 7.10. Cold tee from bottom of cylinder to pump.
  - 7.10.1. Fit the cold pipe tee on the cooler side onto a copper pipe and be sure that there are no cold water distribution tees in between it and the cylinder. There must be no tees or valves between the solartwin cold tee and the cylinder. In particular, make sure that the cold tee is not drawing hot water past any tees that feed any other part of the house or those cold taps may experience a warm pulse
  - 7.10.2. The tee must be on the cold feed from the header / expansion tank to the cylinder to allow pipe flushing into the cylinder to take place when taps are opened.
  - 7.10.3. When fitting this cold tee, if possible point the small diameter exit upwards (ideally) or sideways, but never downwards. Upwards positioning reduces the possibility of particulates entering the Solartwin system.
  - 7.10.4. In addition, for the same reason, make sure that if possible, the tee is positioned at or above shoulder level of the cylinder. If you need to tee in lower, do not tee in lower than 0.3 m above the base of the cylinder or the wider pipe's gravitational water particle filter will not function. Teeing in too low could result in the pump and panel accumulating debris which could otherwise be filtered out.
  - 7.10.5. Make sure that the hose connecting the cold water tee to the pump is at least 2 m long and has at least a 90 degree turn in it, since its elasticity stops waterborne transmitted vibration from the valves in the pump from reaching the main pipework of the house (see section 7.12 for more details).
  - 7.10.6. Also, position the cold tee so that it will not allow vertical convective heating to the header tank to occur. In other words, tee in not too close to the header tank.



Renewable Energy Association Member and Association for Environment Conscious Building Member



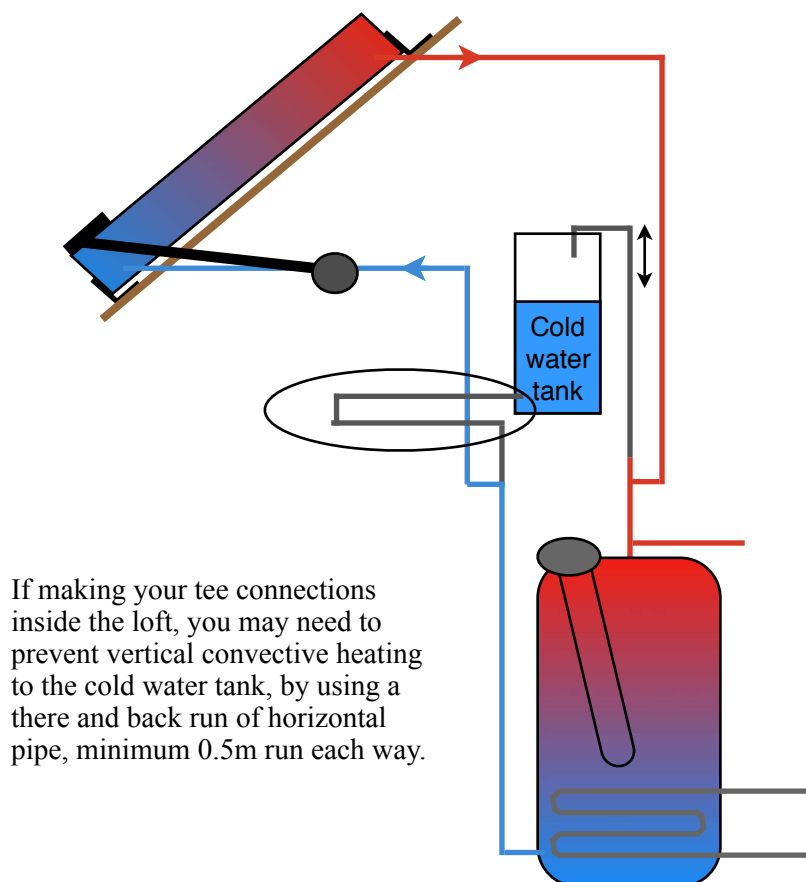
Solar Keymark certified | ISO 9001 registered



VAT no: 752 9027 26 Solar Twin Ltd, Company number: 3750291 Registered address: 9 Abbey Square, Chester, CH1 2HU UK

### Loft Tee Connection

(Thermostatic blender valve plumbing has been omitted for clarity.  
Details are explained and shown diagrammatically in 7.13)



#### 7.11 Hot tee from top of panel to vent pipe.



#### Hot tee without sleeving and insulation, before they are added

REA Renewable Energy Association Member and Association for Environment Conscious Building Member



Solar Keymark certified | ISO 9001 registered



VAT no: 752 9027 26 Solar Twin Ltd, Company number: 3750291 Registered address: 9 Abbey Square, Chester, CH1 2HU UK

7.11.1. The hot microbore pipe leaving the panel must tee in to a copper (not plastic) vent pipe which is:

- At least 120mm below the water level of the header / expansion tank
- No more than 5m below the highest point of the vent pipe of the header / expansion tank.
- No more than 9 m below the top of the main panel.

7.11.2. The vent pipe must have at least 150 mm turn-over height above cold water level, to prevent possible pump-over.

7.11.3 When installing a Thermostatic Blender Valve, you must tee off the vent before installing. Installing in-line with the vent is dangerous as the valve could block the vent.

## 7.12. Pump Mounting

7.12.1. Inspect that the pump is in good condition before installation



7.12.2. The pump is not user-serviceable. It should not be opened, in any circumstances as this would invalidate the warranty and could compromise water tightness.

7.12.3. Mount the pump in a freeze protected area (wherever possible) on the cold feed side to the panel as shown:



7.12.4. Allow 30-60mm cable slack between where the electrical wires leave the pump and their first attachment point. Since the pump is mounted flexibly, the wires must not be under tension or they may pull out. The photo above shows a correct example.

- 7.12.5. Wires and spigots must point downwards.
- 7.12.6. The level of the pump should be 0-120 mm above the usual water level of the water level of header / expansion tank, not below it. The lower limit must always be no lower than the water level of the tank. If necessary this upper limit can be raised to 1m, however this may cause difficulties in priming the system.
- 7.12.7. Mount the pump with a strong nylon zip tie around its rectangular crank case attached to the middle (+/-50mm) of a 300-400 mm piece of Armaflex insulation, the two ends of which are then attached to a firm support.
- 7.12.8. Neither this zip tie nor the pump should touch anything else other than the Armaflex.
- 7.12.9. Attach the Armaflex to a solid and non-resonating support. Plasterboard is not suitable as an attachment point, while rafters usually are. The zip ties should be 70-100mm from the end of the Armaflex. This mount offers the best protection against vibration.
- 7.12.10. Connect the pipes, the ends of which must be cut square and cleanly. Do not attempt to adjust the tensions of YDNAK pipe connectors. They have been factory-pre-tensioned and must not be altered. YDNAKS can only be used once.
- 7.12.11. Do not apply thermal insulation to the motor of the pump: it needs circulating air and an operating temperature below 40C. Pipes up to 5m from the pump may vibrate in normal operation, so ensure that they do not abrade against nearby surfaces. Insulating as close as possible to the pipes on each side of the pump is recommended.
- 7.12.12. Be sure not to allow any possible abrasion where pipes may vibrate against surfaces near the pump.
- 7.12.13. Do not allow unclipped lengths of cable to hang off the pump. Attach them securely. The insulated silicone tubes coming from the pump should point vertically downwards and hang in a gentle loop, which is important to minimize vibration and strain on the pipe.
- 7.12.14. Route and clip all cables securely throughout the property. Cables must run separately from pipes and must not be clipped together with them.
- 7.12.15. Initially, connect one, but not both of the PV wires to the pump. You will connect the second when you commission the system.
- 7.12.16. Make sure that the Solartwin pipes within 2-5 m of the pump are not attached directly to surfaces, but that the insulation around them is attached to surfaces instead. This is in order to reduce vibration transmission from the pipes to the surface.
- 7.13. Thermostatic blender valve installation (compulsory for all installations within the scope of the Microgeneration Certification Scheme [1] i.e. all domestic installations and installations up to 45 kW)
  - 7.13.1. Install the new cold tee that feeds for the blender valve, between the cold Solartwin tee and the header tank. Do not fit it between the cold Solartwin tee and the cylinder, since this water may be warm on occasions.
  - 7.13.2. Make sure that the pipe from the cold blender valve tee to the blender valve never flows upwards. Only sideways and downwards is allowed. Keep it as short as possible, ideally no longer than 1.5 times pipe diameters. These constraints are for Legionella safety reasons, as the cold pipe feeding the valve may not be used for several months at a time, becoming a dead leg, especially in winter. Water regulations require that dead legs should be eliminated if possible, but if not possible, they should be kept as short as possible.
  - 7.13.3. In addition you should allow a minimum distance of 150 mm (preferably at least 500 mm) between the cold Solartwin tee and the blender valve tee. This will reduce unwanted heat reaching the blender valve.
  - 7.13.4. Insulate any feed pipe to the blender valve if it goes through the loft.
  - 7.13.5. Never obstruct the vent pipe. This is dangerous, could cause a blockage and contrary to Building Regulations. In particular, never install the blender valve inline with the vent pipe. Tee off the vent pipe instead.



Renewable Energy Association Member and Association for Environment Conscious Building Member



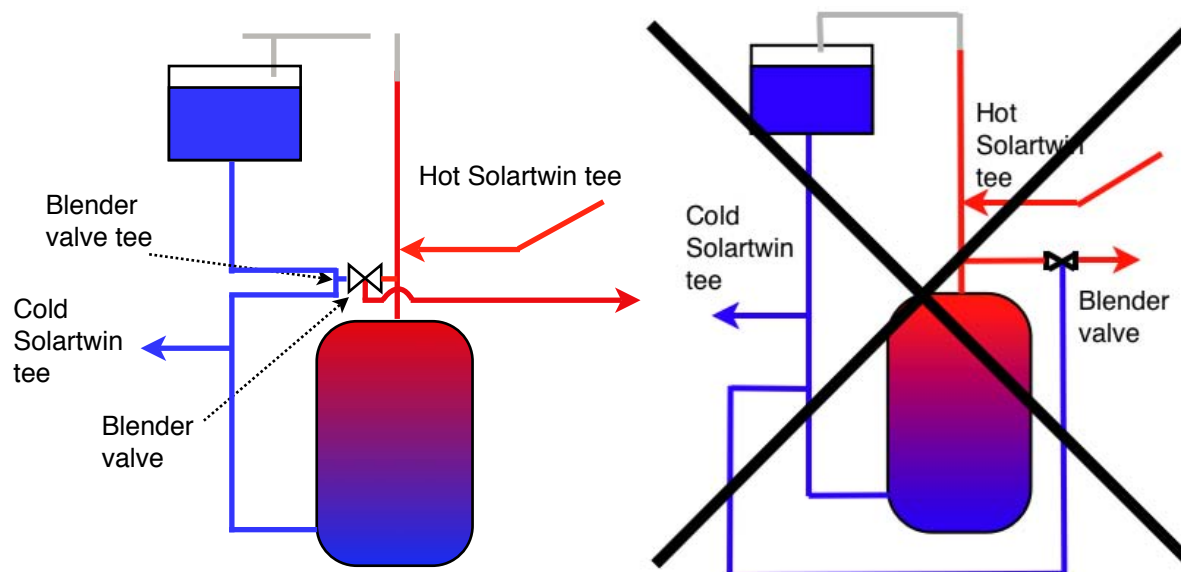
Solar Keymark certified | ISO 9001 registered



VAT no: 752 9027 26 Solar Twin Ltd, Company number: 3750291 Registered address: 9 Abbey Square, Chester, CH1 2HU UK



7.13.6. Set the blender valve to 60C and lock it. Blender valves should be at 60C on all cylinders, including thermal stores.



Correct Blender Valve Installation

Incorrect Blender Valve Installation

The above diagrams show the correct and incorrect cold tee positions for the thermostatic blender valve. On the left, the blender valve tee is correctly positioned above the cold Solartwin tee; on the right, the tee is positioned below the cold Solartwin tee. Under no circumstances should this set-up be used as it is a Legionella risk.

- 7.14. Make sure that there are no potential air locks in the vent pipe. Occasionally due to incorrect plumbing work there may be a downward instead of upward run on a horizontal part of the vent pipe. This must be corrected to an upward run or the hot return from the panel may pump over the vent pipe.
- 7.15. Insulate all copper pipes around cylinder as this is a requirement to comply with Part L of Building Regulations on new cylinders, where installed.
- 7.16. Install the solar controller as per separate method statement.
- 7.17. Switch on water supply. Refill header / expansion tank and hot water cylinder.
  - 7.17.1. Once at pressure, check for leaks.
  - 7.17.2. Correct if necessary.
  - 7.17.3. Add Fernox Limescale Preventer, only if appropriate, to the cold water header tank. (see users guide) **Do not add it to the expansion tank on an indirect system.**
  - 7.17.4. Never use antifreeze, or similar, in the solar circuit through the panel. This is because it is not needed, and it is too viscous, especially when cold. In indirect systems, use only a corrosion inhibitor (again no antifreeze) such as Fernox MB1 or Fernox F1, in the solar circuit.
  - 7.17.5. Open every single hot and cold tap in the property, one by one, to check for airlocks. All must flow satisfactorily.
- 7.18. Switch on electrics and boiler controls when safe to do so.



## 8. **Commissioning** (0.5-1 person hour)

- 8.1. There is usually no need to bleed or vent the system. Just connect the pump to the photovoltaic panel. On a sunny day, the controller charges in 5-10 minutes. Once this becomes operational the system primes and fills in 5-10 mins! If there is no direct sun on the PV, run a 9V battery pack such as from a rechargeable drill across pump for 10 + mins to prime the system as follows...
- 8.2. Before or after commissioning, as appropriate, connect the power from the controller to the pump, using correct connectors and check that there is no risk of short circuit or accidental disconnection.
- 8.3. In either case, check the vent pipe for escaping bubbles, which will escape at a rate of about 0.4 to 1 litre a minute. This check may be visual or auditory or both. (For example, listen for the bubbling noises at the pipe, or watch for escaping air by carefully placing a soap bubble/film over the end of it and watching it blow, provided that contamination of the cold water tank is prevented.) If, on rare occasions, water pumps out of the vent pipe, this may be because the vent pipe has a place in it where it does not run continually upwards. This may need to be corrected.
- 8.4. When air stops escaping from the vent, the system is primed.
- 8.5. There is no need to calibrate the dose-response of the flow against sunlight levels. This has been pre-specified for the panel supplied.



**9. Post-Commissioning Checks** (0.5-1 person hours)

This is aimed to help you produce the perfect installation! Please go through these one by one, tick each as it is confirmed (or write a deviation explanation) and then send a copy to Solartwin unless it is a DIY installation.

**You, the installer should complete this section on site.**

**Customer no and name** \_\_\_\_\_

**Date post-commissioning checks completed** \_\_\_\_\_ **by**  
**(installer)**

**Property address and postcode**

**9.1. General**

- 9.1.1. Confirm that both Solartwin tees/connections are fitted to a low pressure vented domestic hot water system.

**9.2. Thermal panel.**

- 9.2.1. Confirm that the panel serial number is logged on the warranty
- 9.2.2. Confirm that the lowest part of the thermal panel will be no more than 5m below the highest point of vent pipe of the header / expansion tank to which the panel is attached
- 9.2.3. Confirm that the highest part of the thermal panel will be no more than 5m above the water level of the header / expansion tank to which the panel is attached.
- 9.2.4. Confirm that the panel is positioned with deliberately minimised shading, for maximised performance

**9.3. PV panel**

- 9.3.1. Confirm that the PV serial number is logged on the warranty.
- 9.3.2. Confirm that the PV is securely fitted
- 9.3.3. Confirm that it is in the plane of the main panel, and located normally in the least and last shaded position so that boiling and overheat risks are minimised. Position away from TV aerials and overhead wires so that the risk of bird dropping contamination / cutout is very low. Such contamination will not normally cause failure and should self-clean in time.

**9.4. Pump**

- 9.4.1. Confirm that the pump serial number is logged on the warranty
- 9.4.2. Confirm that the pump is fitted in a freeze protected area wherever possible
- 9.4.3. Check that the pump mounting is secure and robust
- 9.4.4. Check that pump wiring is with the correct polarity and that the wires to it have adequate slack in them.
- 9.4.5. Gently tug the wires to the pump's connector to check they are secure.
- 9.4.6. Check the pump is pumping in the right direction - from bottom of cylinder to bottom of panel.
- 9.4.7. Check the pump's operation at full power (may need battery pack) and listen to check there is no excessive noise / vibration
- 9.4.8. Check that neither the pump nor pipes vibrate nor abrade against nearby surfaces during pump operation
- 9.4.9. Perform the pipe squeeze test when the pump is running and the system is primed. Squeeze shut the inlet pipe - the pump note should change, usually the pump will race (as it cavitates). Squeeze shut outlet pipes - pump note should change again, usually a lower / slower note (this is bypass valve test) .
- 9.4.10. Check that the pump height is 0-120 mm above the water level of the header / expansion tank.
- 9.4.11. Check that the pump has at least 2m length of pipe between it and the cylinder and that this pipe turns at least 90 degrees to minimise vibration transmission.

**9.5. Cold tee to pump checks**

- 9.5.1. Note the pipe size where cold tee fits (15/22/28 mm etc)
- 9.5.2. Check that the cold tee is not pointing downwards but that it is either horizontal or, preferably pointing upwards.
- 9.5.3. Check that the cold tee is not drawing hot water past any tees which feed any other part of the house or those cold taps may experience a warm pulse.
- 9.5.4. Check that the cold tee is at least 300mm above the base of the cylinder.

**9.6. Hot tee from panel checks**

- 9.6.1. Note the pipe size where hot tee fits (15/22/28 mm etc)
- 9.6.2. Check that the hot tee is at least 120mm below the water level of the header / expansion tank
- 9.6.3. Check that the hot tee is no more than 9m below the top of the panel.
- 9.6.4. Check that the hot tee and all parts of the hot silicone pipes are no more than 5m below the highest point of the vent pipe which overhangs the header / expansion tank to which the panel is connected
- 9.6.5. Check that the hot tee normally connects to the vertical vent pipe itself, or that if attached to a horizontal run that bubbles will run up in the direction of the vent pipe and not back towards the cylinder. You may need to use a spirit level for this on any near-horizontal pipe runs. If the water filled pipes from the vent pipe of the cylinder to the vent are not continually running upwards the vent pipe will airlock and water is likely to pump over the vent pipe

**9.7. Cables**

- 9.7.1. Check all cables are clipped or tied and secured correctly and that cables on the roof are particularly secure
- 9.7.2. Confirm that they cannot be confused with mains cables.

**9.8. Watertightness**

- 9.8.1. Pressure test for leaks as Water Regulations require
- 9.8.2. Inspect system for operation and drips and check no damp spots or condensation on roof and at other pipe routes including penetrations through roof or walls, joints, unions, glands and seals etc

**9.9. Cold water header or expansion tank**

- 9.9.1. Check that the header / expansion tank is refilled and that the levels are correct and there is no overflow from overflow pipe
- 9.9.2. Check that the header / expansion tank covers are in place and secure and are not liable to degrade, (for example, chipboard is an inappropriate material for a cold tank cover)
- 9.9.3. Check that the positions and heights and materials of venting arrangements are correct.
- 9.9.4. Check that there are no obstructions or risk of obstructions to the venting arrangements of the hot water cylinder and thereby the panel

**9.10. Roof work**

- 9.10.1. Check that roof fixings are firm and undamaged or well repaired if damaged
- 9.10.2. Check that pipe penetrations, external seals and weatherings are all sound
- 9.10.3. Check for broken slates, tiles etc and replace them
- 9.10.4. Check that gutters etc are not damaged or blocked with building debris and that any flashing into it has not been disturbed

**9.11. Pipe runs**

- 9.11.1. Check that all pipes are sheathed first by Hep20 or similar sleeving and then in insulation. Check that all places where the silicone pipe enters or exits sleeving that it is secured in place with a blob of silicone and cannot slip about or abrade.  
If there is any chance that the silicone may work loose or move before it sets, such as due to vibration because the system is already in operation, the blob at the entry pint must be taped over with insulation tape or similar tape to hold it in place until it sets.
- 9.11.2. Check that pipes are adequately secured and are supported via their insulation and not directly onto surfaces to minimise vibration transmission
- 9.11.3. Check that all silicone pipes are protected from physical damage, usually by routing through a rigid pipe as described earlier.

- 9.11.4. Check that pipe insulation is high temperature grade, in place and secured at junctions and corners and that the insulation coverage on the hot pipe run is continuous, wherever practicable between the cylinder and panel. On the cold pipe run the insulation should also be continuous.
- 9.11.5. Whether or not the cylinder was replaced, check that pipes are insulated to Part L of Building regs.
- 9.11.6. Check that the vent pipe is insulated for the whole of its length where this is practicable.

#### **9.12. Boiler function and control**

- 9.12.1. Check that the boiler is functioning and can heat water to 60C minimum
- 9.12.2. Check that a boiler interlock exists and operates - using a cylinder stat which is fitted and set to an appropriate temperature. Not too hot - suggest 60C.

#### **9.13. Cylinder**

- 9.13.1. Check that the cylinder label(s) is/are attached and visible in all installations. Include the decommissioning instructions here: please attach them securely to the cylinder, for example in a clear plastic pocket.
- 9.13.2. Check that the cylinder insulation has been made up to 60mm thick and that it is fitted correctly and snugly and that it is properly closed at the top of the cylinder.

#### **9.14. Thermostatic blender valve**, if fitted for water leaving cylinder (rather than a valve located close to the taps).

- 9.14.1. Check that thermostatic blender valve, if fitted, is set to customer's chosen temperature, which must be over 60C
- 9.14.2. Check that the blender valve control knob is locked correctly and that its cover is securely replaced
- 9.14.3. Check that the cold feed to the valve will always contain cold water and not water which may be fully or partially heated by solar. Compared to the position of the cold Solartwin tee, this feed for the cold supply to the thermostatic blender valve must be at least 1m towards to header tank. It must never be on the cylinder side of the tee.

#### **9.15. Limescale control**

- 9.15.1. Check the limescale control method, if needed, is in place and functioning.
- 9.15.2. If an ion exchange softener is used, check that there are no lead pipes downstream of it.

#### **9.16. Legionella**, summary of the most pertinent actions

- 9.16.1. Check there are no dead legs in the cold or hot water plumbing. If there are any, these must be closed off.
- 9.16.2. Check that the header tank contains clean water and that any significant sediment has been removed.
- 9.16.3. Check that the header tank has a sound lid and that this is on the header tank with no gaps so that the header tank is fully covered. The tank must be fully insulated.
- 9.16.4. Reconfirm that the boiler stat and thermostatic blender valve if any are set to 60C or higher
- 9.16.5. Heat the cylinder to 60-65 C using the backup heating before allowing hot water to be used. Since plumbing of any kind can disturb legionella bacteria and move these bacteria into the cylinder high temperatures will be needed to kill these.
- 9.16.6. Make a written confirmation above that you have done these checks which are required by law and which must, by law, be retained by us if you have installed for us.

### **10. Final Clearing Up** (0.5-1 person hours)

- 10.1. Pack away all tools and equipment.
- 10.2. Tidy site and recycle all waste where possible.
- 10.3. Leave the site at least as clean as, and preferably cleaner than when you arrived.
- 10.4. Carefully remove dust sheets and clean all surfaces requiring cleaning.
- 10.5. Final re-inspect system for correct operation and watertightness.

**11. Installation Signing off and Documentation.** (0.5-1 person hour)

Only do this when you have fully commissioned the system and have fulfilled all the above checks.

- 11.1. Show the customer all work carried out and remedy any outstanding installation issues.
- 11.2. Explain users guide including adjusting timing backup heating to evening where possible, and any maintenance if required.
- 11.3. Give the customer plenty of time to ask you questions and please answer them fully.
- 11.4. Collect balance payment if appropriate and check this is the correct sum.
- 11.5. Only if a new cylinder or hot water store was fitted,
  - 11.5.1. Complete and sign and date its commissioning certificate.
  - 11.5.2. Attach a copy of the cylinder label to the certificate or transcribe the label details if necessary.
- 11.6. For the solar installation,
  - 11.6.1. Complete and sign and date the commissioning certificate / warranty in triplicate for the solar installation.
  - 11.6.2. Make sure that the following are filled in please,
    - 11.6.2.1. Solartwin panel serial number.
    - 11.6.2.2. Pump serial number.
    - 11.6.2.3. PV panel serial number.
    - 11.6.2.4 Controller serial number.
  - 11.6.3. Ask the customer to countersign all three commissioning certificate warranty sheets.
- 11.7. Sign and date the cylinder warranty if it is supplied and give to customer.
- 11.8. Deliver the following documents in a waterproof envelope near the hot water cylinder if the customer agrees to this.
  - 11.8.1. Copies of the signed commissioning certificate(s) / warranty- one for the grants refund and the other for the customer's own records. One of these certificates will have a grants claim envelope attached.
  - 11.8.2. User guide.
  - 11.8.3. Decommissioning instructions.
  - 11.8.4. Installations instructions and method statement and parts list.
  - 11.8.5. Fernox replacement cards and sticker to customer only if appropriate (this is found inside the Fernox box which comes in the kit)
  - 11.8.6. Make and deliver any additional recommendations in writing as appropriate.

11.9. **Checklist** that all photos are taken:

Installer name: \_\_\_\_\_

Customer no and name \_\_\_\_\_

Confirmation of all photos present, by Solartwin \_\_\_\_\_

On date \_\_\_\_\_



Take 6-12 digital photographs, clearly showing all visible parts of the installation within 7 days of installation or commissioning. Each photo should be identifiable (eg "Jones 1234 roof") and include:

11.9.1. Long distance outside shot(s) of the **roof(s)** or other mounting surface with the panel mounted on it including the **ground** used to place scaffolding or access upon.



11.9.2. Close up shot of the **whole of the collector** showing the pipes going into and out of it, roof penetrations by pipes and the PV unit. This may require more than one photo



11.9.3. The **hot water cylinder**, ideally showing the pipes around it, plus how the temperature sensor is attached.





11.9.4. Close ups of the hot and cold Solartwin **tees** and any surrounding pipes.



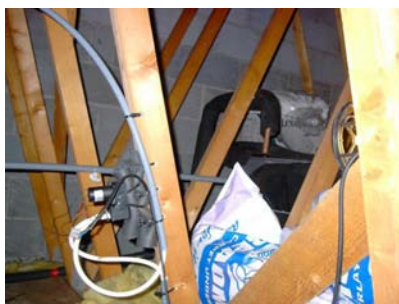
11.9.5. The **cold water / expansion tank**, showing pipes going in and out of it



11.9.6. All visible **solar pipe runs**, showing, if appropriate, where they enter voids.



11.9.7. The **pump and its mounting**, showing, if possible, its position in relation to the header / expansion tank.



11.9.8. A wide shot in the loft of **underneath where the panel fits** so we can see the rafters or any strengthening work.



11.9.9. A shot of the **loft hatch** and ladder, if any.



11.9.10. Views of all **additional plumbing or other work** if carried out such as softeners, thermostatic blender valves, header / expansion tanks & associated work including pipework

11.9.11. Close up shot of cylinder label secured to cylinder.



11.9.12. Picture of controller installed (and working if possible)



11.9.13. ANY non-standard installation techniques (that have been impossible to avoid) should be photographed in full.

11.10. When fully completed, sign off when leaving the site, if site safety regulations require this.

## **12. After Leaving the Installation**

- 12.1. Please confirm that you have completed the job successfully to Solartwin, with any relevant feedback.
- 12.2. Please email the photos to Solartwin.
- 12.3. Send to Solar Twin Ltd in a Solartwin freepost envelope.
  - 12.3.1. The Solartwin copy of the warranty / commissioning certificate(s).
  - 12.3.2. The signed and dated commissioning check list and any Legionella risk issues and solutions.
  - 12.3.3. If appropriate, tear-off stub of the paying in slip - and please write on it the:
    - Customer number
    - Sum paid in
- 12.4. If appropriate, send to the Co-op bank in a Co-op freepost envelope:
  - Cheque for balance payment.
  - Paying in slip.

**Solartwin to complete this commissioning counterchecks section with reference to the photos / other info**

EITHER Reconfirming full compliance \_\_\_\_\_ (sign)

On date \_\_\_\_\_

OR

List of deviations found and changes to be made and date for completion.

On date \_\_\_\_\_

\_\_\_\_\_ (sign)

### 13. Revisits

In the unlikely event that either the photographs taken were not satisfactory, or there is a new customer issue that requires a revisit, the following conditions apply:

- All remedial work must be photographed in full to the satisfaction of Solar Twin.
- Any equipment modified or installed should be photographed.
- If in doubt, photograph it.

All photographs must be digital photographs taken on a good quality camera. It is highly unlikely that mobile phone cameras will give sufficient clarity to be acceptable so they should not be used.

### 14. Finally

Thank you for installing Solartwin. We are constantly trying to improve our methods, so any suggestions you may have are welcome. These can be sent to us by any of the means given below:

Solar Twin Ltd  
50 Watergate Street  
Chester, CH1 2LA, UK  
tel: 01244 403407  
fax: 01244 403654  
email: [info@solartwin.com](mailto:info@solartwin.com)

## **Appendix 1**

### ***Standards and Documents included***

#### **1.1. Standards include:**

- 1.1.1. BS 5918: 1989, Domestic hot water systems
- 1.1.2. BS 6785 : 1986, Domestic solar swimming pools systems
- 1.1.3. 2000 ACOP&G L8 The control of Legionella bacteria in water systems
- 1.1.4. DD ENV 12977-1 (Drafts)
- 1.1.5. DD ENV 12977-2 (Drafts)
- 1.1.6. DD ENV 12977-3 (Drafts)
- 1.1.7. BS EN 12975-1(British Standards)
- 1.1.8. BS EN 12975-2 (British Standards)
- 1.1.9. BS 12976-2 (British Standards)
- 1.1.10. BS 12976-1 (British Standards)

#### **1.2. Enforceable legislation includes:**

- 1.2.1. Building Regulations 2001 Part L1
- 1.2.2. Local water bylaws
- 1.2.3. The water supply (water fittings) Regulations 1999
- 1.2.4. Health & safety at Work Act (HSW) 1974
- 1.2.5. Management Health & safety at Work (MHSWR) 1999
- 1.2.6. Construction (Health, Safety & Welfare) 1996
- 1.2.7. Construction Regulations 1989
- 1.2.8. Construction Design and Management (CDM) 1994
- 1.2.9. Lifting operations and Equipment (LOLER) 1998
- 1.2.10. Manual handling operations 1992
- 1.2.11. Provision and Use of Work Equipment (PUWER) 1998
- 1.2.12. The Workplace (Health, Safety and Welfare) 1992
- 1.2.13. Working at Heights HSE Handbook
- 1.2.14. Health and Safety (First Aid) Regulations 1981
- 1.2.15. Reporting of Injuries, Diseases and Dangerous Occurrences Regulations
- 1.2.16. (RIDDOR) 1995 Noise at Work Regulations 1989 Electricity at Work
- 1.2.17. 1989 Control of Substances Hazardous to Health Regulations
- 1.2.18. (COSHH) 1994 Personal Protective equipment at work 1992



Renewable Energy Association Member and Association for Environment Conscious Building Member



Solar Keymark certified | ISO 9001 registered



VAT no: 752 9027 26 Solar Twin Ltd, Company number: 3750291 Registered address: 9 Abbey Square, Chester, CH1 2HU UK

## **Appendix 2**

### ***Equipment and materials***

This is still an incomplete list, but we hope it will be of some help.

#### notes:

E = essential D = desired

Appropriate access equipment such as scaffolding

**Please note that using ladders alone for roof access is unsafe and is illegal and can result in prosecution / enforcement action by HSE.**

- E •Ladders suggested
- E •3 way combination step ladder
- E •3 x 3.5 m ladder 7.2 m extended
- E •4.3 m extending roof ladder 7.6 m extended
- E •2.9 m extending roof ladder 4.6 m extended
- E •Harness + 1.5 m Lanyard
- E •Hand jammer (ascension)
- E •Rope - 10-12mm thick x 30 m long (adequate for fall arrest)
- E •Drill SDS with adapter chuck-110v + 20m ext or min. 24 V cordless
- D •Combination spanners - 10,13,17,19mm 12" adjustable up to 34 mm
- E •Sockets + wrench - 10,13,17,19mm
- E •Screwdrivers - flat, posidrive, Phillips (various sizes), terminal
- E •Stanley knife + blades (retractable)
- E •Wood saw - suitable for joists
- E •Hacksaw - 300 mm + 24t blades
- E •Claw hammer
- E •Drill bits
  - wood flat up to 16 mm
  - metal various up to 13 mm including 4mm (with at least one spare)
  - for drilling aluminium for panel/bracket holes
  - masonry, SDS 5.5, 6, 8, 10, 16mm 160mm long
  - 6mm 210 mm long
  - 10, 16 mm 450 mm long (walls)
- E •Pliers - side-cutters, electrical, and locking(mole grips)
- E •Inspection lamp + extension lead 20 ft(loft)
- E •Pipe cutters 15mm, 22mm roll around - ones with small clearance are best
- E •Spirit level (pocket size)
- E •Dust sheets (from door to loft-approx 20m )
- E •Mastic gun for silicone sealant
- E •Tape measure 5m
- E •4.5" Grinder, cutting discs (for roof tiles)
- E •Tool belt
- E •2 roof buckets of different colours if possible (with angled base approx 30 degree)
- E •kneeling /walking boards (to span joists in loft - approx 1.2m x 0.5m)
- E •magnetic compass with a flat edge or GPS
- D •detachable rope cover 1m for protection at ridge
- D •indelible marker pen/pencil
- D •wire brush
- D •deburring tool for pipe sheathing



## **Materials to be Supplied by Installer/DIYer**

- D •Chalk (for marking out)
- E •Roll of lead flashing - 300 mm wide
- E •0.5 tube Silicone sealant - roof grade low modulus (eg Dow Corning 797 black or clear)
- D •Electrical PVC Insulation tape - black + blue for marking hot and cold pipes

### **Materials - mainly for internal work (in addition to parts supplied in kit)**

- E •30m roll of pexapipe or Hep2O for pipe sheathing
- E •Electric cable roll of 2 core rated at 24V 0.5 amp min. red+black, if PV cable is too short
- Electrical terminal connector 2 amp screw connections to enable 2 wires to be connected to wires
- D •Screw to hold this to a joist
- Olives (4 off) 3/4 inch imperial(for older pipe/ Imperial)
- E •Pipe insulation - internal high temperature grade such as Armaflex HT
- 22mm int diameter for most water pipes (for internal)
- 15mm int dia for plastic sheathing

## **Appendix 3**

### ***Hardness control***

What you need to do will depend on whether your installation is direct (heating the contents of the cylinder directly in the panel) or indirect, through a heat exchanger coil. It is very important to do your hardness control correctly. It is usually also easy to do.

<p>Solartwin performance and warranty requirements in relation to hardness.</p> <p>These apply to standard directly plumbed installations at different maximum water hardnesses as described below.</p> <p>Note: we refer to parts per million calcium carbonate below, however other units can also be used.</p>	<b>Chemical item</b>	CaCO <sub>3</sub>	Ca or Ca <sup>2+</sup>	CaCO <sub>3</sub> or Ca or Ca <sup>2+</sup>	-
	<b>Also known as</b>	Calcium carbonate (note: WITH the word carbonate!)	Calcium or calcium ion (note: WITHOUT the word carbonate!)	Calcium carbonate or calcium or calcium ion	-
	<b>Units, summary</b>	ppm (or mg/l)	ppm (or mg/l)	mmol/l	-
	<b>Units, in full</b>	Parts per million (or milligrammes per litre)	Parts per million (or milligrammes per litre)	Millimoles per litre	English (or clark) degrees of hardness
So what must be done..?	(description/factor)	1	0.4	0.01	0.07
<p>0-99 (max) ppm CaCO<sub>3</sub> NO Water hardness treatment To be done Here</p>	Very soft	0	0	0	0
	Very soft	25	10	0.25	1.8
	Soft	50	20	0.5	3.5
	Mod soft	75	30	0.75	5.3
	Mod soft	99	39.6	0.99	6.9
<p>100-199 (max) ppm CaCO<sub>3</sub> either Fernox superconcentrate Limescale Preventer OR Ion exchange water softener required</p>	Slightly hard	100	40	1	7
	Mod hard	150	60	1.5	10.5
	Hard	199	79.6	1.99	13.9
<p>If EVER over 200ppm CaCO<sub>3</sub> Ion exchange Water softener required</p>	Hard	200	80	2	14
	Hard	240	96	2.4	16.8
	Very hard	300	120	3	21
	Very hard	400	160	4	28
	Extra hard	500	200	5	35

Direct Systems hardness control

If you are installing a Solartwin which is directly plumbed, please read the next section carefully and comply with it fully. Otherwise please skip to the section called Hardness control in indirect Solartwin installations

What is a direct installation?

A direct installation is usually where water going through the panel is the same water which later comes out of the hot tap, or other hot water supply. It is where new water is regularly passed through a panel in a way which may lead to limescale deposition. About 80% of domestic Solartwin installations are direct installations. The rest will be indirect of some form or another.

Get accurate water hardness figure please.

Hardness information is usually obtainable free from the local water supplier. Just phone the number on your water supply bill, and have the address and postcode of the property concerned ready.

Water supply data is likely to be more accurate than one-off on-site testing. Do NOT rely on one-off site testing. This is almost always inaccurate.

If you are given a high-low range by the water company, always base your hardness control decision on the higher of the two figures.

Please do not confuse different but similar sounding terms, for example make sure that parts per million calcium are not treated the same as parts per million calcium carbonate since the first figure is only 40% of the second! If in doubt ask the water company to put their figures in writing with clear units given.

Only use the appropriate hardness control solutions from the above table.

Never use electromagnetic water conditioners such as magnets or any electronic water descaling/conditioning systems or any physical water shocking systems such as ultrasonics on any water going into Solartwin. Their use will invalidate your warranty. Their use may lead to your panel bursting.

For intermittently used properties or for type cylinders reduce the 100/200 hardness thresholds by 20% to 80/160ppm.

**Appendix 4 Cylinder Notice**

**THIS PAGE MUST BE AFFIXED TO THE HOT WATER CYLINDER WHICH THE  
SOLARTWIN IS HEATING  
WARNING**

**This hot water cylinder is directly connected to a Solartwin solar water heating panel.**

**Please read on, about working on a water system connected to Solartwin...**

The cold header tank is also connected to this hot water cylinder. If you drain this hot water cylinder down, or drain the header tank, or if you work near the Solartwin pipes and connected pipes while it is drained down, or if you refill it, please read right to the end of this document before you start:

Draining down the cylinder, for example if replacing a hot water cylinder.

You can simply drain the cylinder while letting the panel drain itself using the pump. But beware of hot water or steam. The Solartwin pump should normally not be disconnected during the drain down process itself. Instead it should be allowed to keep running so that it will pump some or all of the water out of the collector. If possible avoid disconnecting the pump unless the collector will be left drained for more than a week until it boils dry. The pump can run dry for up to a week. It is low voltage and runs on solar electricity with a maximum voltage of 21 Volts DC and a maximum power consumption of 5 Watts. The collector is not harmed by being left dry and hot in the sun.

Working with Solartwin drained down requires important thermal safety precautions

Even after the solar water collector has been drained, residual hot water or steam may still come out, sometimes in sudden bursts, for hours or days afterwards, particularly in bright or sunny weather. Pipes connected to the collector may get very hot, up to 100C. The solar collector always needs to be open vented from at least one side and preferably two. Never close off any of the pipes to or from the collector, even for a brief period. Doing so is dangerous and may cause high pressure steam to build up with the possibility of bursting and serious water or steam burns.

Recommissioning Solartwin is normally easy

Solartwin is a relatively robust technology, and the pump usually primes and recommissions itself immediately on filling the cylinder / header tank or expansion tank.

When refilling the cylinder, please take care that it is filled with clean water and ensure that particles are not carried into the solar water heating system's (narrower 6mm) pipework, because they might block it. After refilling the cylinder, always check, by listening to it, that the low voltage solar pump is working. If the sunlight levels are too low for it to operate attach a 9-15 volt DC battery or power pack if necessary, observing the correct polarity.

Once it has pumped for at least 20 minutes check that it is primed and really pumping water by pinching the pipes on either side, in turn, shutting off the flow for no more than ten seconds. If the note of the pump changes noticeably with one or both pinching actions, then it is correctly primed. Occasionally the note may not change. In this case the pump needs to be primed - lower it below the water level of the cold tank so that cold water enters it.

When working on the water system, and in particular when refilling the collector by day, please note that the panel's internal surfaces may well be over 100C and that the hottest part is the upper 40% which might occasionally be as hot as 190C. This means that steam may emerge from the vent pipe for a short period if it is refilled during sunlight. This is normal. However, do not touch the vent pipe and keep away from the end of the vent pipe until all risk of scald or burn has ceased.

## **THIS PAGE MUST BE AFFIXED TO THE HOT WATER CYLINDER WHICH THE SOLARTWIN IS HEATING**

### Decommissioning Solartwin - on its own

**Normally**, draining down the hot water cylinder first, and then decommissioning a pumped / boiled dry Solartwin system afterwards, is by far the best and safest method of decommissioning. If you want to disconnect or decommission Solartwin without doing draining down first, it is best to do so at night or when sunlight levels on the panel are below 20% of peak - in other words, when the sky in front of it is heavily overcast or it is raining and there are no gaps in the clouds.

(Very rarely, the system may need to be decommissioned at short notice during sunlight. This decommission should be chosen only when there is **absolutely no alternative** because there will inevitably be significant risk of burns from hot water or steam. We stress that the following method is **not recommended** because it involves these risks. We are including it only because it is likely to be safer than having no instructions whatsoever)

**For an emergency daytime decommission which is normally not advisable**, you will need 2 buckets, preferably with handles, 5-15 metres of strong string, 2 pencils or similar bung devices, and a pair of scissors. Plus you will need to protect yourself well, particularly your hands, eyes and face against possible steam burns or soaking from very hot water. Identify the solartwin silicone rubber pipes to and from the panel correctly. Plan what you will do. Take the top off the cold water tank (if it is nearby) in case you need a cold water plunge for a burn.

1/ When you are fully prepared, disconnect the low voltage power to the pump. For example cut one single wire of the pump. Cut it so there will be an end left to reconnect.

2/ Within 1 minute of this, at arms length, cut the inlet (usually colder) pipe to the panel. Bung the end which goes to the cylinder (unless it is above the level of the header / expansion tank, in which it will not flow) and leave the panel end open. Secure this end with string so that any hot water coming from it is caught by one of the buckets.



3/ Immediately afterwards, and within 3 minutes, again at arms length, cut the other pipe, which carries the hot water from the top of the panel to the top of the cylinder. It is likely to be hotter than the other pipe. Once again, bung the end which goes to the cylinder (unless it is above the water level of the header / expansion tank, in which it will not flow) and leave the panel end open. Again secure this end with string so that any hot water coming from it is caught in a bucket. The panel and piping typically contain approx 3-10 litres of water.

Technical support is available - **phone 01244 403404** Monday to Friday from 10am to 6pm

If you observe the above points, you should have a problem-free recommissioning of the Solartwin solar water heating system. However, if you are unsure, or need additional information, please call. Solartwin is relatively new and easy technology and we are here to help to explain it. Technical support is normal available from Monday to Friday from 10 am to 6 pm. We supply technical information for installers at: [www.solartwin.com](http://www.solartwin.com)

### End of product / component life issues.

This section is a summary. We have not addressed every issue in full here. Please avoid landfilling or incinerating this product as one unit at the end of its life. Recycle or reuse its component materials if possible. The main component of Solartwin by weight is recyclable aluminium. The foam insulation is CFC free and is also HCFC free and does not need to be degassed (unlike some older refrigerator insulation). The silicone rubber pipes and hoses are currently not recyclable at the date of printing. The polycarbonate glazing can usually be recycled. Please recycle electrical and electronic components appropriately. If disassembling the panel, take due care. For example, wear a fine particle dust mask if the insulation is damaged or has become abraded. Avoid injury from sharp edges and do not disassemble it in direct sunlight (this casts a hazy or sharp edged shadow) because of risk of high temperature burns.

 Renewable Energy Association Member and Association for Environment Conscious Building Member 



Solar Keymark certified | ISO 9001 registered



VAT no: 752 9027 26 Solar Twin Ltd, Company number: 3750291 Registered address: 9 Abbey Square, Chester, CH1 2HU UK

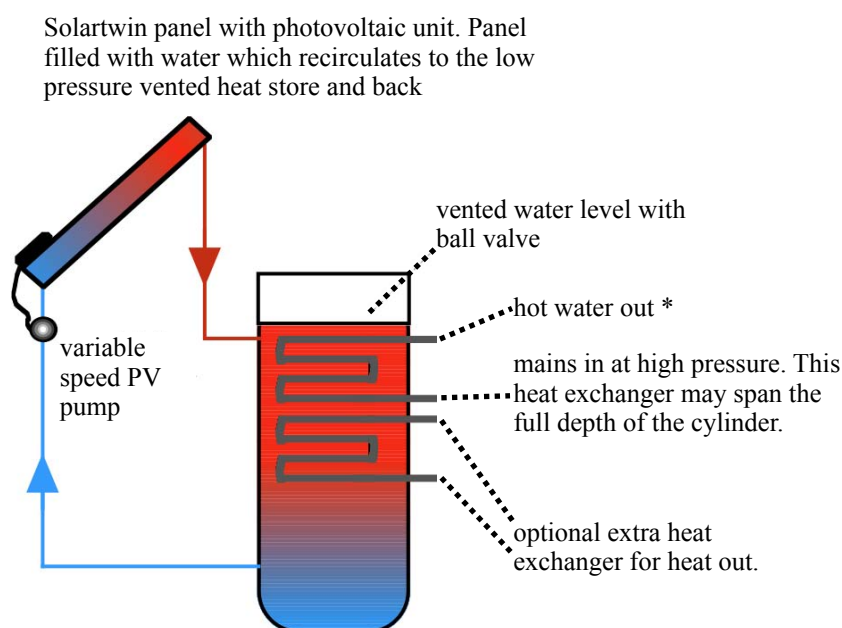
## **Appendix 5**

### ***One Variation on Standard Solartwin Plumbing***

#### **Solartwin heat store plumbing (Thermal Store)**

showing solar heat store application

This may be free standing as a hot water supply. Alternatively, its output may be top-up heated, so that it pre-feeds another water heating system such as a combi boiler or high pressure cylinder. A thermostatic blender valve is required at \* to prevent high temperature spikes, for example, if this pre-feeds a solar-ready combi boiler. (Thermostatic blender valve plumbing has been omitted for clarity. Details are explained and shown diagrammatically in 7.13)



Various additional heat sources may sometimes be applied to the heat store, including electric immersion or low pressure hot water (direct or indirect such as from a conventional boiler or wood stove etc.) Use Fernox MB1 Protector (NOT superconcentrate limescale preventer!) or similar at 4% in the Solartwin circuit.



# Appendix 6 Pressure drops and Multiple panels

## Maximum pressure drop.

Although this is not relevant to most installations, because we have pre-specified most or all of the associated components, for the purposes of European certification we are required to state a maximum allowable pressure drop across the panel in normal operation, so here it is: the maximum allowable pressure drop across the collector in normal operation is 0.2 Bar. This equates to a water flow of approx 200 litres per hour at 20C. In fact a domestic Solartwin collector normally runs at a maximum flow rate of 0.7 litres per minute. This is approximately 40 litres per hour: it creates a pressure drop across the panel itself of only around 0.02 bar.

## Parallel not series!

Always plumb multiple Solartwin panels in parallel, never in series. The apertures in the system, including pipe diameters, have been carefully selected to potentially accommodate steam from *one* panel boiling, should it do so, but not for *more* than one in series. That is why all panels must be plumbed in parallel in all installations.



## Use the correct flow and return pipes.

So even in multiple panel installations you must use the normal 6mm (internal diameter) silicone microbore pipe for all connections to the panels and pumps provided that the total pipe run, to panel and back is no longer than 30m..

If the total return distance is over 30m total you can replace the cold (Inlet) pipe with copper of 10-12 mm internal diameter, but only in freeze protected areas. Never increase the diameter of the hot (outlet) pipe with any other pipe since it *must* be 6mm internal diameter in order to entrain air bubbles out of the system. Never substitute another pipe on the hot side: always use the microbore silicone pipe for the hot side, until it reaches a vertical run of vent pipe of the appropriate diameter.

## What internal pipe diameter should the vent pipe be?

Large enough to accommodate steam if all the panels boiled at once. Rather than give a formula, we have calculated this to make life easy for installers, so please follow the table overleaf. It shows pipe sizing for arrays of up to 80 panels (224 sqm) Please note that the figures are for the *internal* diameter. Remember to allow for this when choosing the external diameter of a pipe, which may be larger. If you are fitting bigger arrays than 80 panels, please call us for vent pipe dimensioning.

 Renewable Energy Association Member and Association for Environment Conscious Building Member 



Solar Keymark certified | ISO 9001 registered



VAT no: 752 9027 26 Solar Twin Ltd, Company number: 3750291 Registered address: 9 Abbey Square, Chester, CH1 2HU UK

Selection table: vent pipe diameter.		vent internal diameter, mm	
Area, sqm of panels, nominal	no of panels used	minimum mm	preferred mm
2.8	1	12	19
5.6	2	13	19
8.4	3	14	19
11.2	4	15	19
14	5	17	21
16.8	6	18	23
19.6	7	20	25
22.4	8	21	27
25.2	9	23	29
28	10	24	30
33.6	12	26	33
42	15	29	37
56	20	34	42
70	25	38	48
84	30	41	52
112	40	47	60
140	50	53	67
168	60	58	74
196	70	63	79
224	80	67	85

# Appendix 7 Amendments

Version	Date	Amendments
2009a	14 Jan 2009	Thermostatic mixing valve details added
2009b	4 Feb 2009	Removed two Solartwin plumbing variations Clarifications on thermostatic mixing valves added

# The Zero Carbon Controller V14b

**Draft** product and installation manual

This draft expires on 22 June 09. Please check at [solartwin.com](http://solartwin.com) for updates.

## Contents

Overview of specification

Trying out the Solartwin Zero Carbon Controller

Introduction

Retrofitting the controller

How to Install

Final checks before commissioning

More technical detail



# The Zero Carbon Controller V14b

## **Draft** product and installation manual

This draft expires on 22 June 09. Please check at [solartwin.com](http://solartwin.com) for updates.

### **Overview of specification**

subject to change as part of our policy of continuous improvement:

### **Concept**

- Advanced High quality, reliable, no fuss PV or DC powered solar controller in a simple rectangular white box
- Uses an integral microprocessor
- Uses 3 sensors (PT1000 sensor for panel)
- Temperature display can be top of cylinder temp (default) or all three.
- All controls are safely inside the box ensures that settings are not changed inadvertently.
- Diagnostics can display problems such as sensor disconnection
- Simple to install.
- Delivered pre-programmed.

### **Electrical**

- Switches up to 1A DC. Has internal self-resetting overload protection.
- Suitable for 18 and 36 cell PV☐ Nominally 11-21V open circuit voltage up to 20W this can be increased if necessary.
- Alternative option for low voltage DV power supply operation.
- Electricity store via supercapacitors, with 500,000 charge discharge cycles, not rechargable batteries, which only last for about 600 cycles.
- Charges the supercapacitors in early morning daylight when thermal panel is most likely to be cool and when there is usually not enough PV power to start the pump.
- Day / night mode detection logic reduces power consumption by increasing sensor interrogation time at night.
- Even with no power available has over 30 hrs display backup time and over 7 days program backup time.

## The Zero Carbon Controller V14b

### **Draft** product and installation manual

This draft expires on 22 June 09. Please check at [solartwin.com](http://solartwin.com) for updates.

#### **Primary Logic**

- Differential control
- ON DT of 4-15C
- OFF DT = from 2 deg below ON DT to 2 deg
- Pump off overrun time can be set between 0 sec and 300 sec

#### **Secondary logic**

- What to do at high cylinder temperatures? □3 options are
  1. Pump on (please always use this with Solartwin)
  2. Pump off (for most conventional solar thermal)
  3. Pump remains differential (this may occasionally be used with conventional solar thermal)
- The temperature to implement secondary logic can be selected between 65 and 85C

The appropriate primary and secondary logic settings for your system will normally be preset into the controller.



# The Zero Carbon Controller V14b

## **Draft** product and installation manual

This draft expires on 22 June 09. Please check at [solartwin.com](http://solartwin.com) for updates.

## Introduction

Congratulations on buying your Zero Carbon Controller.

This is a differential temperature controller which can be used for controlling a variety of photovoltaic or low voltage DC solar heating systems including Solartwin. It makes your solar panel operate efficiently and safely, with very low or even zero operating carbon impact.

As a user, it lets you see the water temperature near the top of your hot water cylinder. This temperature will usually be similar to that which will come out of your taps unless you have long pipe runs to the taps or a thermostatic blender valve installed, in which case the tap temperatures may be lower.

But behind the scenes it is doing a lot more than just displaying temperature. It controls whether the pump is on or off, using two special ways of working. These are called **differential control** and **occasional heat export**. Here is a brief explanation of each.

Most of the time the controller is doing **differential control**. Here, it compares the temperature of the top of the solar panel with the bottom of the hot water cylinder and it switches the pump on or off accordingly.

For example, when the solar panel is slightly hotter than the stored water in the cylinder, the controller switches the pump on. Provided there is enough solar electricity available, it then pumps hot water from the panel into the top of the hot water cylinder, so you can use it when you need to.

Later, when the stored water is hotter than the solar panel, the pump normally turns off since the panel would otherwise cool the stored water.

However, when the top of the hot water cylinder goes over a preset high temperature, such as 65 degrees C, **heat export** control takes over in order to reduce the risk of scalding. Here, the pump keeps on pumping until the water at the top of the cylinder falls below the preset temperature. Then it reverts back to differential control.

Being innovative, your Solartwin Zero Carbon Controller does not require mains power, because its electricity comes from a solar electric (photovoltaic) panel.

Thank you for choosing the Solartwin Zero Carbon Controller!

# The Zero Carbon Controller V14b

## **Draft** product and installation manual

This draft expires on 22 June 09. Please check at [solartwin.com](http://solartwin.com) for updates.

### Trying out the Solartwin Zero Carbon Controller

You may find it interesting to do a trial installation of the sensors, the PV and the pump to see how the controller works. To do this, first charge up the supercapacitor energy store in the controller for 20-40 minutes using a 9-12V battery or the PV in the sun.

To see it work you will need to connect five things: the three sensors, the pump (please note that the dedicated Solartwin pump can run dry, but others such as the Ecocirc are not able to) and the PV.

Heat up and cool down the sensors. Please do not moisten or immerse them in hot and cold water to change their temperatures. Water can damage them. Please don't use a flame such as a cigarette lighter either, as overheating will damage them permanently. We find that a good source of heat can be a warm hand or a teapot with a tea cosy or a cloth wrapped around it, while a good source of coolness is a teapot filled with cold water or ice. You can then tuck your sensor under the tea cosy! At night time, you can use a 9-12 volt battery instead of a PV. Enjoy!

### Retrofitting the controller

Some hints on retrofitting your controller to an existing Solartwin DIY installation with a 36 cell PV and a round motor pump.

- Some very early Solartwins used aluminium tape to shade the PV a little. Please remove this carefully. If there is no shading then be sure to remove all shunt resistors. There is usually one at the rear of the PV. It usually has coloured stripes on it. If you don't remove it, the pump may run a little too slowly. There may also be other shunt resistors in the circuit, sometimes close to the pump, if you are using certain types of cylinders such as heat stores or if you have hard to control backup water heating such as an AGA. Remove all shunt resistors please. Just cut them away with pliers, cutting both ends if you cannot disconnect them easily.
- Do not mix and match Solartwin pumps and PV's. Only use the original pump and PV (ie 36 cell PV with pump with a round bodied motor) unless we specify otherwise.
- The back of the panel will be extremely hot, even up to 150C if the day is sunny. Please shade the panel for at least 60 minutes before working on it. Be safe with heat and height!
- Please refer the latest Solartwin system installation method statement on our website [www.solartwin.com](http://www.solartwin.com)
- The main benefit of the controller will be in installations with hard to control backup heating such as AGAS and wood fires or with thermal stores. For these we suggest that you may want to raise the heat export temperature threshold from 65C to slightly higher, and to add a thermostatic blender valve set at 60-65C at the top of the cylinder for thermal safety.

## The Zero Carbon Controller V14b

### **Draft** product and installation manual

This draft expires on 22 June 09. Please check at [solartwin.com](http://solartwin.com) for updates.

## How to install your Zero Carbon Solar Controller

On a new installation, there are several things to do.

Please read ahead before you start and plan ahead carefully.

*In summary you need to*

- *mount the controller to be visible and where the user will want it to be*
- *mount the controller box itself on to something solid like a wall*
- *connect and route five cables to it, 2 for power and 3 for sensors*
- *fix the three temperature sensors in exactly the right positions*
- ***Charge the controller up and press its reset button with all cables connected. It will not work until you have done this.***

*to be sure that your controller will work correctly.*

Mount your controller just right

1. Inspect that the controller is in good condition before installation.
2. Decide where to mount it.
3. Make sure that the user will see the display front of it easily.
4. Mount the back plate on a wall or a flat vertical surface, away from direct moisture, such as on the outside of an airing cupboard.
5. Make sure it will be on a flat vertical surface within 12 meters cable run of the sensor on the panel and 3 meters of the cylinder sensors.
6. Work out where all of your cable runs will go.
7. Open the controller via the two small screws on the front on the controller.
8. Use screws in the holes in the back of the case to fix the back plate to the wall.

Get your cable runs perfect

The controller is equipped with 5 cables. Two are power cables. These are:

- Power in from PV
- Power out to Pump

The other three are sensor cables:

- Panel sensor - TP
- Top of cylinder sensor - TA
- Bottom of cylinder sensor - TB

You will see that the cables are labelled and that the labels are the same as the labels on the controller's circuit board

# The Zero Carbon Controller V14b

## **Draft** product and installation manual

This draft expires on 22 June 09. Please check at [solartwin.com](http://solartwin.com) for updates.

Route and clip all cables securely throughout the property. Run the cables separately from pipes and mains power cables, making sure that they are 50mm away from them. But you can run cables on the outside of pipe runs if there is good thermal insulation between the cables and the pipes.

### Power connection.

Be safe with electricity and do not take risks. Double check that your power supply is a DC supply that will not peak above 24 Volts. There is a record of a lethal electric shock as low as 32V, while around 50V is the voltage above which a risk of lethal shock starts to become significant. So it is strongly advisable to turn off the power or completely shade the PV while making connections. Make sure that your hands are completely dry when you connect the power. Sweaty or wet hands can conduct electricity far better than dry hands.

Connect both PV wires to the controller. Observe the correct polarity which is normally black to black and red to red, When new, the controller can take 20-30 minutes to charge itself up from the PV in full sun. It may take longer in partial sun, so don't worry if its sunny and it does not come on straight away. If you can, connect the controller up to the PV and place PV in the sun before you start installing it. It is usually charged enough ten minutes *after* the display comes on.

Initially only connect one wire to the pump. This will stop it from running. You will connect the second when you commission the system.

### Power checks. Please check

1. that all of your clamped cable connections are sound by pulling gently on each of the four wires.
2. that no loose cable strands are lying about because they could cause short circuits
3. that you have got your + and - polarities completely right

## **Position your sensors accurately.**

The controller uses three temperature sensors. They sense the cylinder and solar panel temperatures at intervals, usually every 30-60 seconds by day, and less often at night.

You must position and install each sensor completely correctly for the controller to function properly. Put them fully in contact with what they need to measure and make sure that they are fully insulated to protect them from being influenced by the ambient temperature, with no air draughts or water ingress. Don't expose the sensors or the control box to moisture or condensation as this might damage them. Do not extend the sensor cables,

## The Zero Carbon Controller V14b

### **Draft** product and installation manual

This draft expires on 22 June 09. Please check at [solartwin.com](http://solartwin.com) for updates.

so make sure that the control box is close enough to all points where temperatures need to be measured.

Here is how to thermally connect the three sensors in a typical Solartwin installation.

How to thermally connect and route the cable for the panel sensor (Tp):

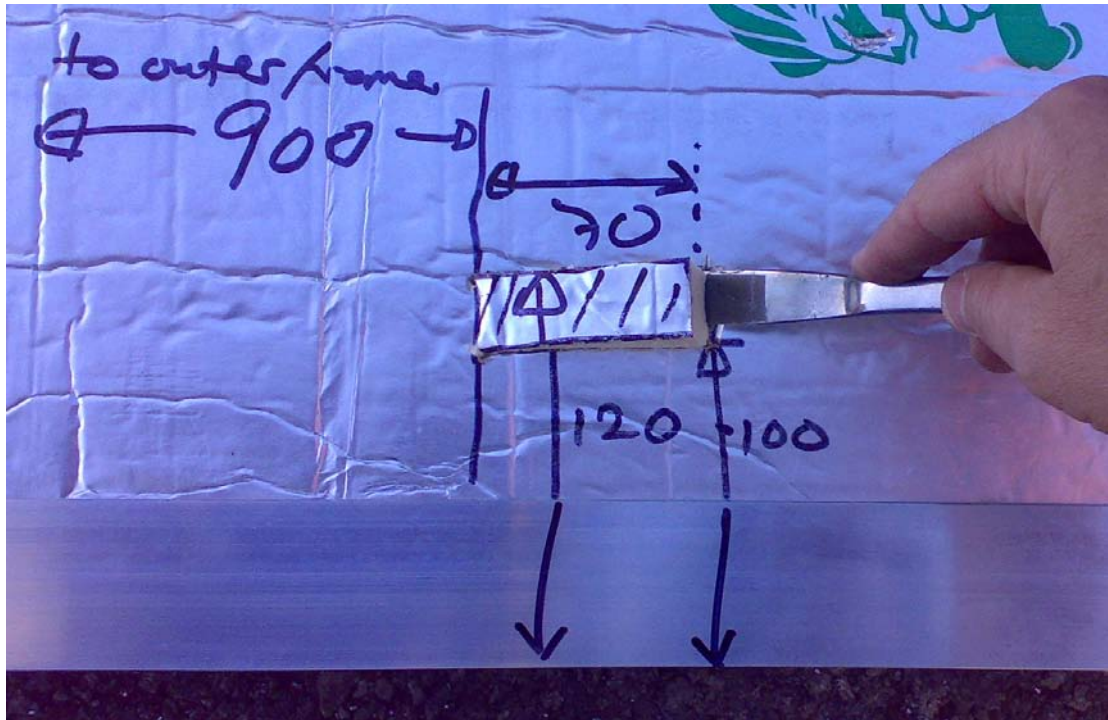
1. First identify it correctly. It is labelled Tp. Its 12 m silicone cable is the softest and longest of the three sensor cables.
2. The metal sensor needs to be attached **along its full length** to the metal absorber at the back of the upper row of the pipe of the solar panel, in an unshaded area. Where is the best unshaded area?
3. Working from the top corner of the panel where the hot pipe exits, mark out a 20 x 70mm horizontal rectangle on the back of the panel.
4. This rectangle should run; (a) 900-970 mm from the left or right edge where the hot pipe exits pipe and; (b) 100-120 mm down from the top edge of the panel. It may already be marked or cut out on your panel. If it has been cut out already then remove the low tack tape which is holding it in place and proceed to point 7 below. Otherwise just read on.
5. Using a round fronted knife (not a sharp pointed knife, which might cut the aluminium absorber itself), gently cut out the marked-out 20 mm x 70 mm rectangle of insulation from the back of the solar panel.
6. Keep this cutout of insulation carefully. You will need to reinsert it later.
7. You will find a sheet of insulation behind where the insulation was. This is the back of the solar thermal absorber. If this sheet has some silicone glue on it, scrape this away.
8. Put a steel P clip over the middle of the metal part of the sensor.
9. Insert the long flange of the P clip which is now attached to the sensor between the aluminium and the remaining insulation.
10. Then reinsert the cutout piece of insulation back in its original position.
11. Route the cable of the sensor downwards to prevent water ingress.
12. Now use aluminium tape to stick the the cutout back in. Make it overlap by at least 20mm all round the hole.
13. The hole should be completely airtight and watertight by now. If it is not, then apply more tape. Make sure that the cable of the sensor is well secured and that it will not pull out over time.
14. Feed the cable through the roof. One way to do this is to find a gap under a tile or slate. Do not run these cables next to any pipes and make sure that they penetrate the roof via a different place from pipes.
15. Now route the cable through the property, to the controller, being careful not to damage the cable or bend it. Coil up any spare cable in a discreet place. Clip the cable as you go.
16. Connect the small white plug on the other end of the cable to the connected to the solar controller socket marked Tp.



## The Zero Carbon Controller V14b

**Draft** product and installation manual

This draft expires on 22 June 09. Please check at [solartwin.com](http://solartwin.com) for updates.



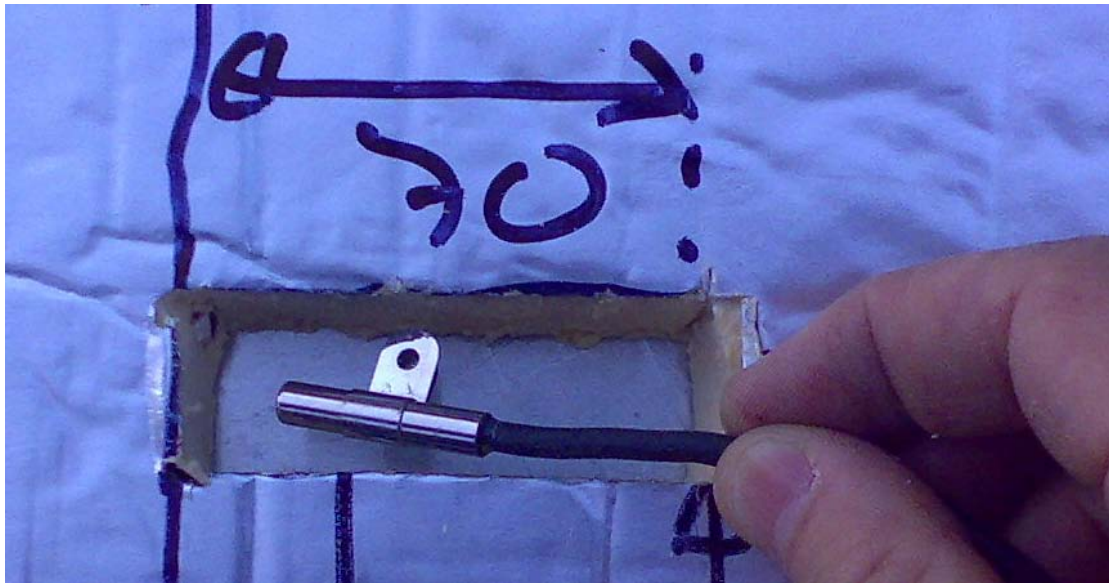
These pictures show the cutout in the rear of the panel and the sensor before the clip is added.



## The Zero Carbon Controller V14b

### **Draft** product and installation manual

This draft expires on 22 June 09. Please check at [solartwin.com](http://solartwin.com) for updates.

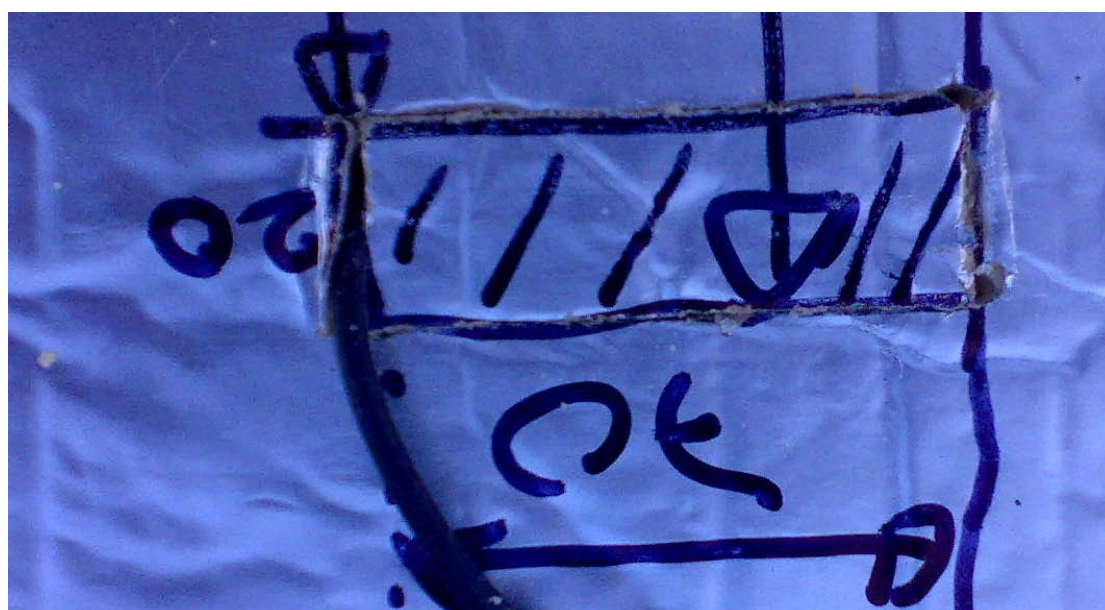
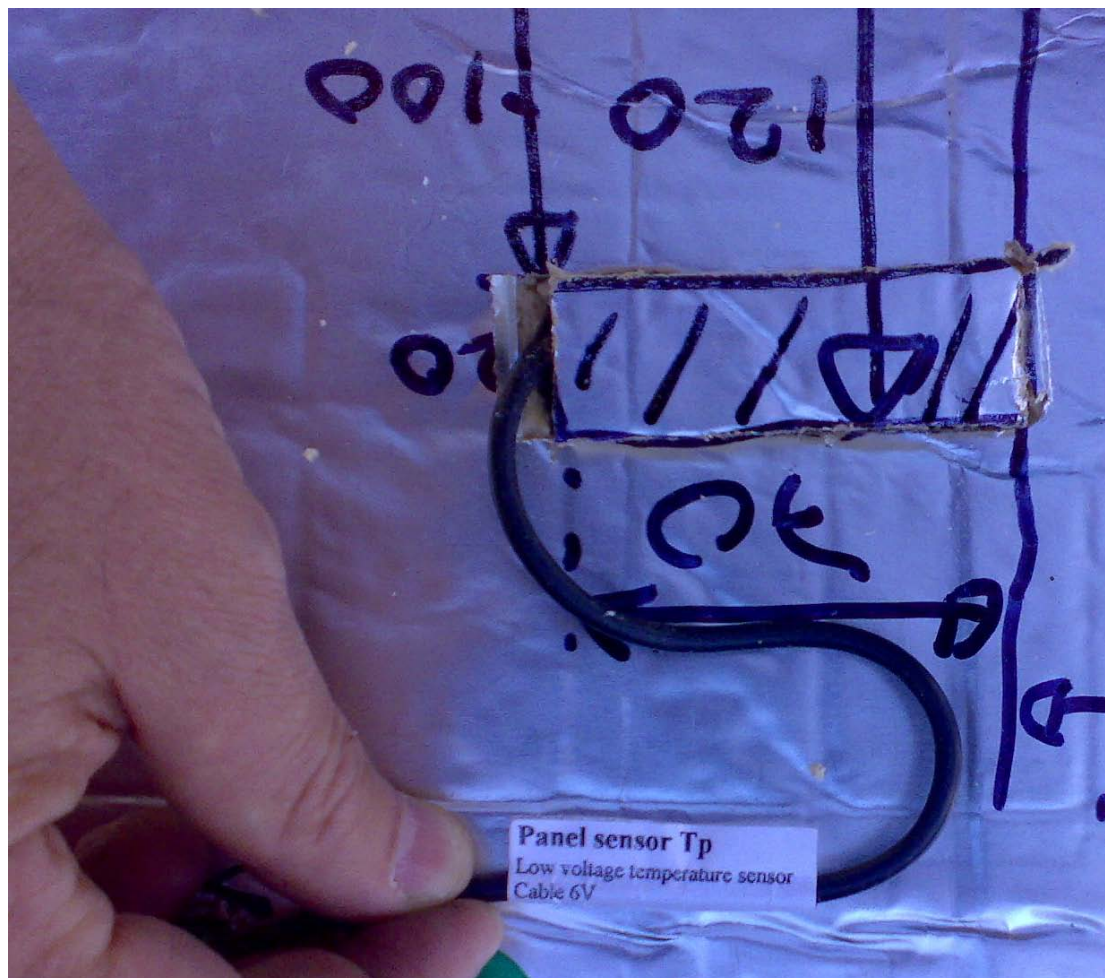


These pictures show the sensor being inserted so that it is in good thermal contact with the panel.

## The Zero Carbon Controller V14b

**Draft** product and installation manual

This draft expires on 22 June 09. Please check at [solartwin.com](http://solartwin.com) for updates.



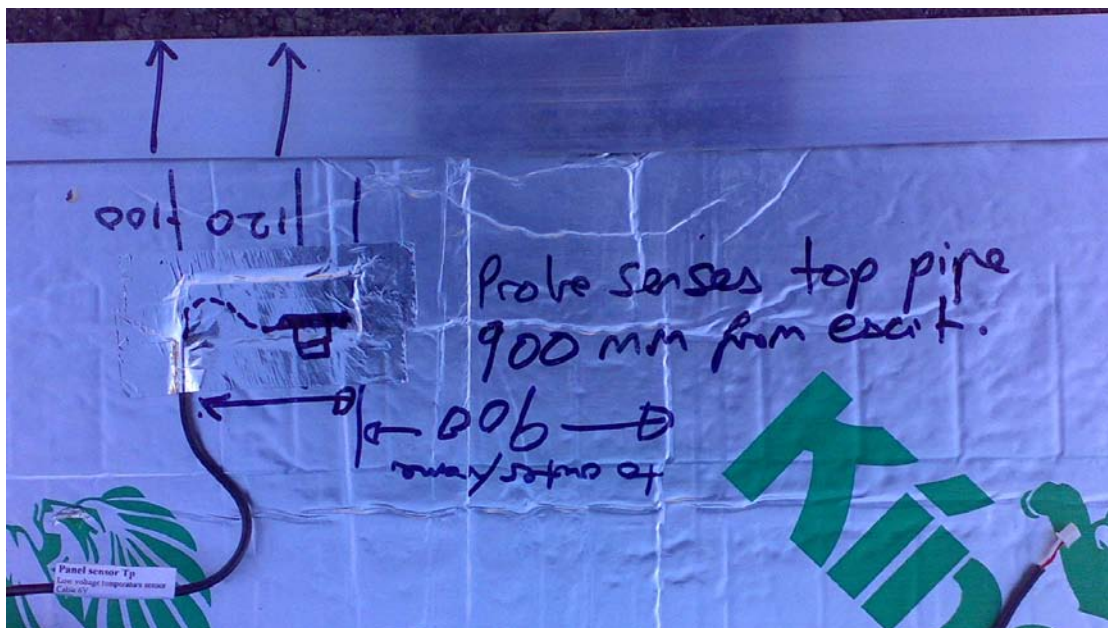
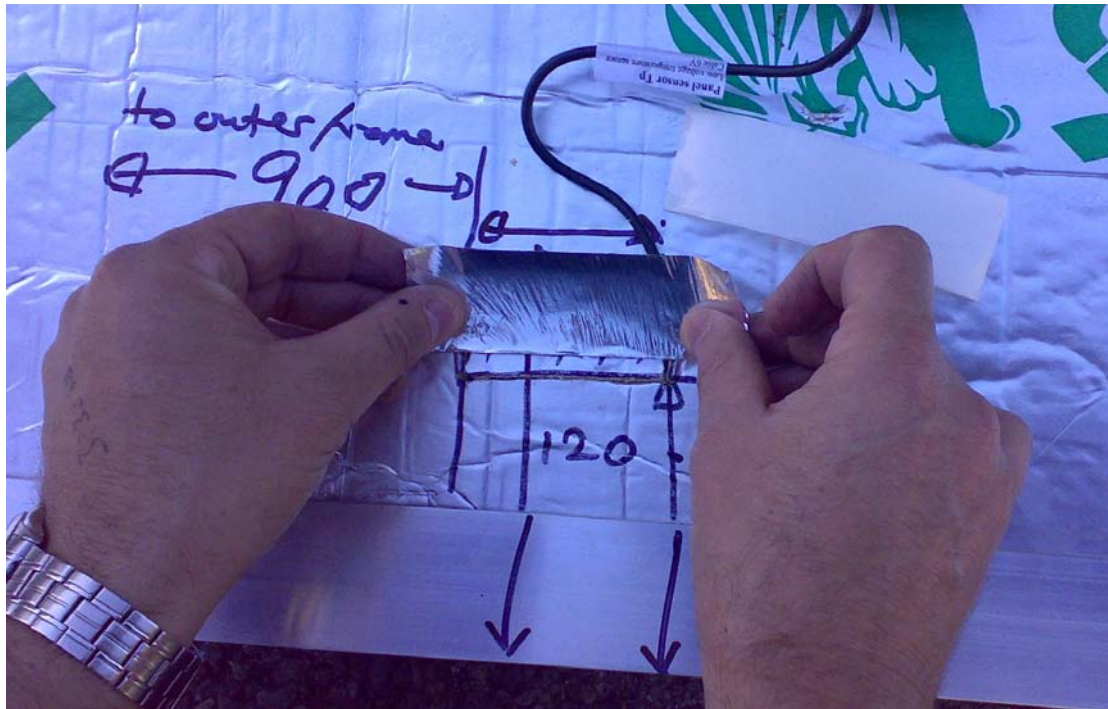
The cable points downwards



## The Zero Carbon Controller V14b

### **Draft** product and installation manual

This draft expires on 22 June 09. Please check at [solartwin.com](http://solartwin.com) for updates.



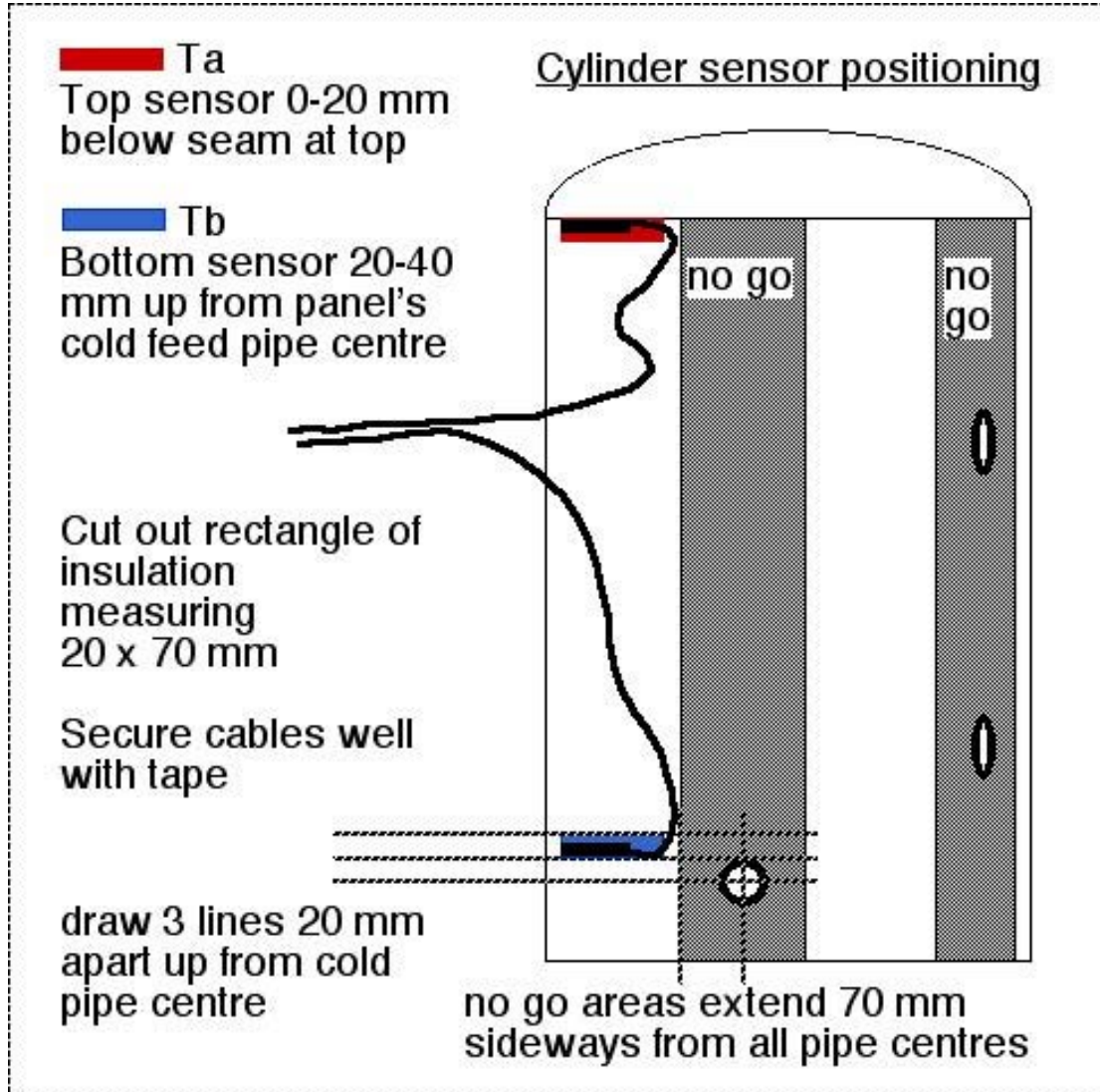
Taping over the cutout so that it is airtight and secure.

## The Zero Carbon Controller V14b

### **Draft** product and installation manual

This draft expires on 22 June 09. Please check at [solartwin.com](http://solartwin.com) for updates.

Next, thermally connect and route the cable for the two cylinder sensors (Ta and Tb) as shown below.



1. There are 2 different sensors for the cylinder. The one that goes near the the top is Ta. The one that goes near the bottom is Tb.
2. Thermally connect them in the same way as for the solar panel sensor. Cut out a 20 x 70mm chunk of insulation and insert the long flange of the P clip of the sensor underneath this. Then replace the cut-out and tape it on in an airtight way as before. make sure the sensor will not come loose by attaching its cable to the cylinder as well.
3. PLEASE NOTE: When fitted, it is important the sensors are not influenced by any pipes or immersion heater bosses attached to the cylinder no matter how far above or below the sensors they may be. This is because bosses and pipes act as heating or cooling points causing warm water to rise or cool water to fall below them. You must

## The Zero Carbon Controller V14b

### **Draft** product and installation manual

This draft expires on 22 June 09. Please check at [solartwin.com](http://solartwin.com) for updates.

not intercept these subtle rising or falling temperature currents with the sensors, because they may then not represent the average temperature of the cylinder at the particular height that you attach them. The easiest way to make sure is to make sure that the sensors are located sideways at least 70mm around the cylinder away from existing pipes, bosses, or other un-insulated areas.

4. **Exactly where do I fit sensor Ta?** On or close to the seam where the dome which is the top of the cylinder joins the main body of the cylinder.
5. **Exactly where do I fit sensor Tb?** At a height which is 20-40mm above the midline of the pipe which is the cold feed to the panel. (Do make sure that it is at least 70mm away, sideways, from the nearest edge of any pipe's insulation cutaway, including that of the cold pipe.)
6. Again route, clip and connect them to the controller, making sure that any spare coiled cable is secure not just now, but over time.

If you mix any sensors around (eg if you swap Ta with Tb) the controller will malfunction. Be very careful about this please.

## The Zero Carbon Controller V14b

### **Draft** product and installation manual

This draft expires on 22 June 09. Please check at [solartwin.com](http://solartwin.com) for updates.

Final checks before commissioning.

Check...

1. that each sensor will not come loose if it were pulled, but that it is really secure.
2. that each sensor is not just poked end-on into the insulation and that the sensors (and not just their ends, for example)
3. That they are really touching all the way along their length, the metal of what they must sense
4. that good sound insulation is present and securely replaced over the sensor
5. that the sensing pockets, if cut into insulation, are fully insulated and taped over with the correct tape, with no draughts or water or air entry possible
6. that all cables are secure and not dangling, and can not become snagged or trapped on anything.
7. that all the sensors cables plugged in the correct sockets on the unit
8. that they are fully plugged in and not just partly plugged in

Your solar controller installation is now complete.

1. Press the reset button inside the controller.
2. If it is charged up, then the spanner and the error messages on the screen will now disappear.
3. Screw the controller back together if all your cables are connected to it.



# The Zero Carbon Controller V14b

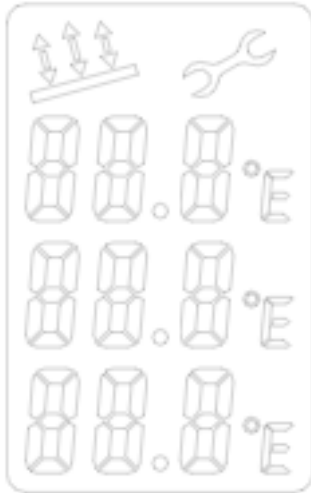
## **Draft** product and installation manual

This draft expires on 22 June 09. Please check at [solartwin.com](http://solartwin.com) for updates.

### More technical detail

#### Outside the controller.

First, take a look at the display. If every part of the display is lit up at once, this is what it would look like.



This section now shows you all the things that it can tell you about. Starting from top left.

The panel symbol is the angled bar. This can show four different things about how it is or is not saving you energy.



Panel not in use. You will see just the panel only with no arrows when the pump is switched off. The main time that you will see this when there is not enough sunlight to heat the panel hotter than the water at the bottom of the cylinder. It sometimes shows when the controller is charging in the morning.



Panel importing heat.

You will see this, with the arrows pointing inwards, when the panel is capable of saving you energy: when it is hotter than the water in the bottom of your hot water cylinder. Remember that the system can be importing heat but actually cooling the top of the cylinder. For example, take a day when the water leaving the panel is at 50C, the top of the cylinder is at 65C and the bottom of

## The Zero Carbon Controller V14b

### **Draft** product and installation manual

This draft expires on 22 June 09. Please check at [solartwin.com](http://solartwin.com) for updates.

it is at 35C. At this time the top of the cylinder will cool a bit but useful energy is still being delivered because 50C is warmer than 35C.



Panel exporting heat.

You will only see this with the arrows pointing outwards, if the top of the cylinder is particularly hot (say over 65C) and when water from the panel, which is also cooler than the water at the bottom of the cylinder, is being used to cool it down. This might happen on hot sunny days in summer when not much hot water has been used.



System running without full control.

You will not normally see this unless you have a fault with a sensor. If it is not corrected, over a year, the system will run a bit less effectively, typically delivering between about 1% to 10% less energy over a year.



This spanner is the error symbol. You might see this if there a problem such as not enough power, in the electrical energy store, or a fault in the circuit board. In addition, it can tell you if a particular temperature sensor has a problem and what that problem is.

## The Zero Carbon Controller V14b

### **Draft** product and installation manual

This draft expires on 22 June 09. Please check at [solartwin.com](http://solartwin.com) for updates.

## What if I have longer pipes than usual?

Because long pipes lose more heat than short pipes, there may be a small adjustment to make on the temperature differences at which the pump starts and stops, compared to the temperature at the bottom of the cylinder. These temperatures are called the stop and start differential. There may also be adjustments to be made to the pump overrun time.

Do these adjustments really matter? Not a lot. Neither of these adjustments, to differentials or to overrun time are as important in low volume pipe technologies such as used by Solartwin, as they are with large pipes solar panels, so, if you want, you can ignore this section without much loss of energy.

The following figures are for Solartwin installations in mainland UK and Ireland. First calculate the combined there and back length in an unheated area such as in a loft with insulation on the floor or on the roof. Then add on half of the total pipe run length in heated areas.

TOTAL length (ie there and back added together) of unheated pipes (eg in lofts and on roofs PLUS HALF the length of heated pipes (eg in the airing cupboard and in heated rooms)	Prn Suggested pump overrun time setting in seconds	on.t Suggested start difference (over the bottom of cylinder temperature). on.t degrees C	of.t Suggested stop difference (over the bottom of cylinder temperature) in degrees C
up to 10m	30-90 sec	4C	2C
10.1 to 15m	120 sec	6C	3C
15.1 to 20m	180 sec	8C	4C
20.1 to 25m	240 sec	10C	5C
25.1 to 30m	300 sec	12C	6C

Note that these are typical minimum temperatures.

You can use higher differential temperatures (both start and stop) where they are available, but raising them will usually drop system efficiency, by increasing water temperatures only slightly at the expense of noticeably smaller volumes heated.

But you should use higher temperatures where the pipes are exposed to more than usual heat loss, for example where for reasons that cannot be controlled,

## The Zero Carbon Controller V14b

### **Draft** product and installation manual

This draft expires on 22 June 09. Please check at [solartwin.com](http://solartwin.com) for updates.

they pass through a wall with less than the usual level of insulation. Conversely, you can use slightly lower temperatures if the pipes are super-insulated. (To be specific, if you use insulation which is better insulated than that which gives a 7.5 W/m heat loss at temperature difference of 45C then you should operate the system below the differentials given in the table. Most insulation suppliers will be able to give you their figure if you speak with their technical help desk.)

Setting the pump overrun function is not critical. Leaving at 30 sec will make very little difference to system performance but since it is available you might want to use it. Increasing the differential allows the pump to empty out the panel more after the stop differential is reached.

Whatever you do, make sure that with Solartwin, you leave the Hi? menu with ☐On☒selected. If you don't your panel could be invalidated as the system must pump hot water at high temperatures and the pump must not be off.

## The Zero Carbon Controller V14b

### **Draft** product and installation manual

This draft expires on 22 June 09. Please check at [solartwin.com](http://solartwin.com) for updates.

### **Some problem solving.**



This section is about what the display's fault messages show and what they mean. A spanner will show if there is a fault with the power supply or the sensors)



this means there is no electrical power to the controller's microprocessor, its little computer, even in its power store. It is usually because either the controller has not been charged up or because it has run down in very low light levels over a period of several days. The cause of this might be the PV panel being disconnected and therefore needing to be reconnected.

## The Zero Carbon Controller V14b

### **Draft** product and installation manual

This draft expires on 22 June 09. Please check at [solartwin.com](http://solartwin.com) for updates.

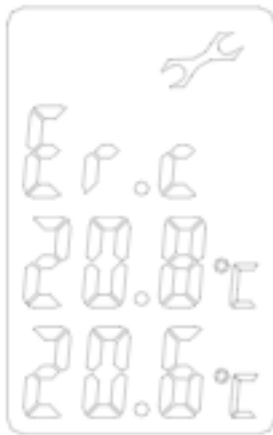
Temp sensors. repeat from above.... caused by it being disconnected (open circuited) or its wires are short circuited.

How do I read these and what do I do to sort them out?

There are three possible faults, on each of the three lines. Here are some examples:

\*\*\* need to add the double arrows issue... as appropriate!!

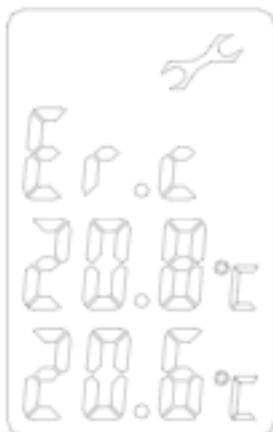
!!! perhaps ask \*\*\* to run as the default: if errors: this is what to do with the pump...



Pon - ON

Poff - OFF

Diff - ? OFF





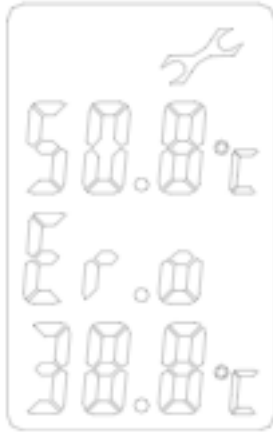
## The Zero Carbon Controller V14b

### **Draft** product and installation manual

This draft expires on 22 June 09. Please check at [solartwin.com](http://solartwin.com) for updates.

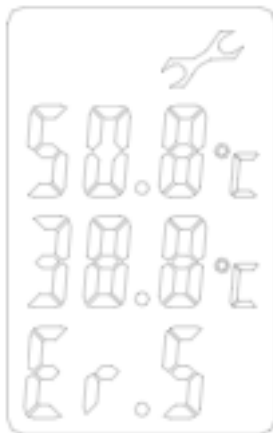
Er.c on the top line says that the panel sensor has a circuit fault. This

Action: First checking that the connections of the sensor are secure. If this does not fix the problem, please contact us.



Er.o on the middle line says that the sensor at the top of the cylinder has an open circuit fault, which usually means that it is disconnected.

Action: Reconnect the sensor if it is disconnected.



Er.S on the lower line says that the sensor at the bottom of the cylinder is short circuited.

Action: Remove the short circuit.

The controller display shows nothing at all.

Probably there is a power disconnection.

Action: Investigate and reconnect it.

# The Zero Carbon Controller V14b

## **Draft** product and installation manual

This draft expires on 22 June 09. Please check at [solartwin.com](http://solartwin.com) for updates.

## Components

3 temperature input sensors

D = 6mm. L = 30mm

Temperature Range : -30C ~ +200C in panel and 0C to 105C on cylinder

2. Temperature Sampling Time : 30 Sec by day but slower by night

4. Sensor Accuracy : +/- 0.5C

3. System resolution : +/- 0.1C (-19.9C~ +99.9C), +/-1 C (higher range

4. Sensor types

a) TP Sensor : PT1000 ( -30C ~ +200C ), silicone coated 12m / 15m black or yellow coated

b) TA Sensor : 103AT2 ( 0 C ~ +110C ), PVC wire coaxial black or red coated

c) TB Sensor : 103AT2 ( 0 C ~ +110C ), PVC wire coaxial black or blue coated blue

PV External Power 18 - 36 Cell PV, 5-30W, all within these total constraints, max 24V DC AND max 1.7A, whichever is lower.

Pump Control Output ON/OFF. (Variable speed comes from PV output).

Memory with Power Saving Design

Housing materials: Main box is ABS.

Display window is polycarbonate.

Environmental temperature:

Of storage when not being used -30C ~ +60C

Of operation of the controller box when it is in use -15C ~ +50C

Dimensions of housing approx 146 x 82 x 40-60 mm deep.

Programme input via 3 buttons which are inside the box

Energy storage 2 x 50F supercapacitor. (500,000 recharge cycles typical)

Switch is a mosfet max 60V 3.7A peak 25A

Self-resetting fuse max current is 1.5A-1.8A polyswitch.

IC 4-24V normal, or temporarily (under 1 sec) at 40V

### **CE Compliance: Electromagnetic Directive / WEE / RoHS**

Warning electrostatic discharge can damage the components

Mount internally not externally to a building

Lay cables separate from others and from pipes

## The Zero Carbon Controller V14b

### **Draft** product and installation manual

This draft expires on 22 June 09. Please check at [solartwin.com](http://solartwin.com) for updates.

### **Engineer access to programs**

1. press all three buttons 10 sec (this will show all three temperatures)
2. press + and □ buttons 30 sec (this enters the menu)
3. program by choosing / pump overrun time / on diff / off diff / high temp response / high temp threshold temperature (use +/-/set buttons)
4. press all three buttons 10 sec (this will show one temperature).

## Supplementary info



## ENVIRONMENTAL POLICY

Our commitment & aims We aim to help our customers cut their energy use and cut global warming sustainably and cost-effectively. We respect both people and the environment. We aim to create a sustainable and injury free environment through a constructively critical culture of health, safety and environmental protection.

Beyond the minimum We view the environment holistically, not just in a human perspective, and we will seek to protect it and enhance it. We aim to comply with or exceed the requirements of all relevant health, safety and environmental laws and codes of practice. We will interact constructively with legislators and regulators.

Impacts matter We accept that all personal and business activities may impact negatively, positively, or both, on the environment. We seek to eliminate or minimise negative impacts while promoting and maximising the positive ones.

Our principles of operation We will seek to anticipate and prevent problems, rather than cure them after creating them. We will strive to continually improve, reduce our use of resources, plan ahead, reuse or recycle materials where possible, be energy efficient, minimise waste, and take a life cycle approach to product development. We will integrate health, safety and environmental good practice into all strategic planning as well as into the day to day operation of all parts of the business.

### Concerning travel

Travel need reduction. We will minimise the need for travel where it is reasonable to do so by the use of teleworking, teleconferencing and other means.

Travel impact reduction. Where transport is required, we will promote more sustainable forms. This means promoting walking and cycling over public transport and shared car travel, with solo car travel as a low priority and air travel as the lowest.

Travel mode incentives for a level playing field. We will normally pay the same rate per mile for business travel irrespective of whether it is by walking, cycling, car travel and public transport, except where tickets for public transport cost less. This rate will normally be the Inland Revenue's approved rate for cycling (20p / mile from 5/4/01).

Our supply chain We will inform our main suppliers and contractors of our environmental policy, we will seek to influence them positively and to monitor their environmental performance. We actively prefer to choose suppliers from countries committed to the Kyoto Accord on reducing global warming.

Internationalism We will not seek to cross borders in order to evade local HSE controls or regulations. Where we operate abroad we will apply uniformly high standards, according to UK or higher, even if local standards may be lower or non-existent.

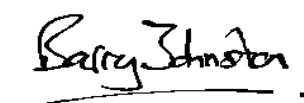
Management systems An appropriate environmental management system such as ISO 14001 or EMAS will be established to implement this policy when turnover exceeds £5 million or when staff numbers exceed eight, whichever is the sooner.

Product stewardship A formal investigation of the cradle to grave life cycle analysis of our main products is taking place. This will be reviewed annually.

Community benefits Within commercial constraints, we will share health, safety and environmental good practice with other businesses and the community. We will seek to earn public trust by consulting and operating openly and positively. We will seek to promote environmental awareness and to enhance the environments where we live and work.

Resources Appropriate resources will be available to implement this policy. Appropriate education, awareness and training will take place to achieve its aims, both within the company and in relation to our main suppliers and contractors.

This policy is approved by:

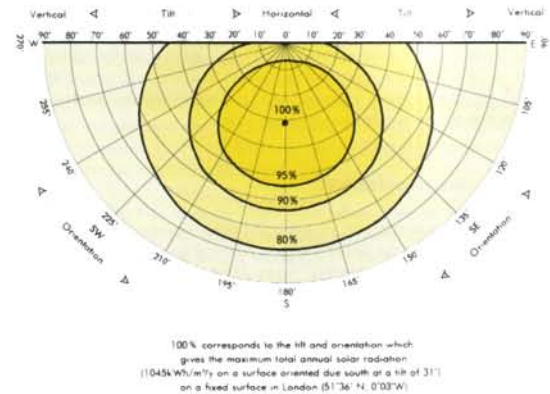


Barry Johnston, Managing Director

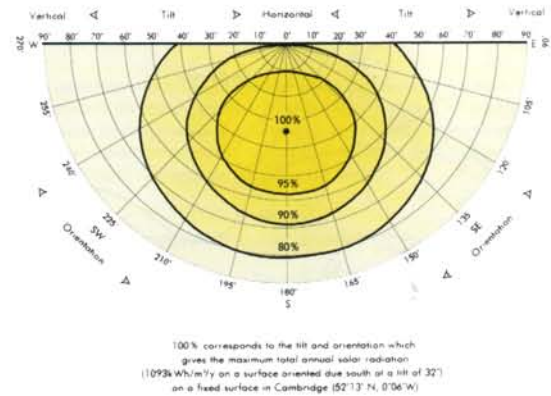


# Metoffice Data - UK Yearly irradiation maps

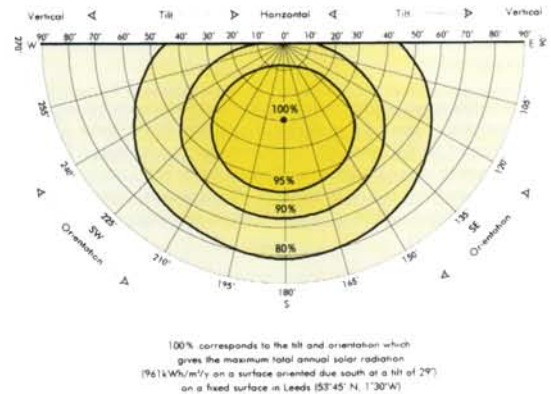
Yearly irradiation map for London



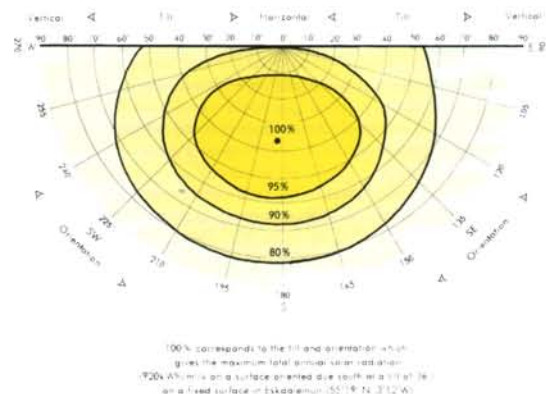
Yearly irradiation map for Cambridge

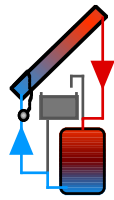


Yearly irradiation map for Leeds



Yearly irradiation map for Eskdalemuir





# Solartwin

*affordable solar water heating*

Solar Twin Ltd  
2nd Floor, 50 Watergate Street  
Chester, CH1 2LA, UK  
tel: 01244 403407  
fax: 01244 403654  
email: barry@solartwin.com

## ***Savings and payback*** ***using solar hot water systems: some thoughts***

Let me reiterate a few points

- Savings and payback are very different. Savings are less complex to calculate because:
  - **Savings are about money** - fuel savings minus all expenses and are usually considered per year. I have named below nine (!) possible variable as inputs to this calculation.
  - **Payback is about time** - how long before the buyer breaks even, so four more variables, often with assumptions, may get put into the equation, bringing their total to thirteen, so there is even more scope for error.(Nevertheless such calculations can still be useful.)
- Valuations can be internal or external or both
  - Internal valuations look only at the financial payback to the customer, not to wider social or environmental issues. This primer looks only at the financial balance sheet, not at the environmental one.
  - External valuation looks at how the environment benefits and how this might be translatable into money terms
  - Social (or total environmental best value) payback combines both of these on the same balance sheet, thus paying back faster. I have ignored these social payback issues in this paper. Including them would dramatically shorten payback.

## Some of the variables in savings (rather than payback) calculations follow

1. The energy net saving calculations is energy the bought fuel displacement potential minus any energy used. It is important to consider:
  - 1.1. The *estimate of the energy delivered by the system* as hot water at the taps (not just by the panels, which will be higher) Units are usually kWh per year. 800-1200 kWh for a 2.8 sq m Solartwin is within our expected range for most of UK.
  - 1.2. The *total energy efficiency of the hot water system*, such as a boiler, at producing hot water. (This is not merely its combustion efficiency!) This may be a percentage in the range 35%-60%<sup>1</sup> if a gas boiler is used, but closer to 70% with electric immersion heating if it has typical storage and distribution losses. Bear in mind that many gas and oil boilers tend to operate at low efficiency when working below their peak rated load - which is what tends to happen when they are heating only water for washing and bathing in summer. It is also important to factor in the fact that reducing the use of a boiler often means slightly lower electricity bills as well as gas/oil bills since it will be pumping (and maybe also using flue fans) less.
  - 1.3. Dividing the first figure by the second gives the fuel displacement potential in kWh of solar. This can be calculated by dividing the system (not panel) delivery of the solar water heating system in terms of hot water production at the cylinder divided by the efficiency of the hot water system at producing hot water if fuels such as gas or oil are displaced. Whether this efficiency figure is chosen to be 35% (as in Sutherlands tables for hot water *at the taps* rather than at the cylinder) or a higher figure, can have a huge bearing on the final environmental and cost effectiveness figure for solar. So this fuel displacement potential is usually far, far higher than the estimate of the energy delivered by the system.
  - 1.4. However this displaced energy figure probably needs to be reduced by a *usability fraction*. Not all homes are occupied 365 days a year. And even they were, perhaps not all of the energy in the solar hot water would be used. So this percentage will rarely be 100%. Perhaps it might be 90%?
2. Now convert this displaced energy figure into money.
  - 2.1. This calculation depends on the *fuels displaced and tariff(s)* at which they are bought. For example a fuel displacement potential of say 2500 kWh of low cost mains gas displaced at say 2p a kWh is worth £50. But with bottled gas the figure may be over £100.
  - 2.2. A further reduction needs to be applied to this figure for alternative systems other than Solartwin because of the cost of the *energy used by parasitic mains powered equipment: such as the pump, controller motorised valve, etc.* It is important to deduct rather than ignore the energy and fuel use impacts of the parasitic electricity use of other systems since their usage can be significant and may well exceed 5% of the claimed cost-benefits of a 2 square metre tube system and over 20% of its environmental benefits. In general:
    - 2.2.1. Mains electric solar circulating pumps run at around 30-90 W for an average of a few hours a day. You may need estimate or calculate the cost of running one. (You may also want to reduce this figure a bit, since some of their energy probably ends up in the solar hot water. On the other hand, large uninsulated metal pumps can act as heat dumps.)
    - 2.2.1. Controllers run at around 3-10 W, usually 24 hours a day. Use the figure inclusive of the transformers they use at 230 V, not just the low voltage transformed figure. Deduct this cost along with any pump running cost.

<sup>1</sup> 35% is the usual hot water delivery efficiency given for standard UK domestic gas fired water heating systems. See Sutherlands Tables, sometimes available at Energy Efficiency Advice Centres.

- 2.3. Further reductions to any remaining savings may need to be applied due to
  - 2.3.1. *maintenance charges*, and
  - 2.3.2. *costs of antifreeze*
  - 2.3.3. all or part of the cost operating water *hardness control* systems if relevant, unless their use is regarded as a general benefit rather than cost
- 2.4. On the other hand, if a boiler is being used less as a result of having solar, a *boiler life extension* of say £10 can be added to the figure. After all, if a boiler is being used, say 20% less, it may be reasonable to expect it to require less maintenance and to last rather longer. Say a £1000 boiler was normally expected to last 12 years, but were instead to last 14 years because of solar, then the annual write-off of the capital sum of £1000 would be reduced from £83 to £71. So a further saving of £12 can thus be attributed to having solar.

3. The *cost of the finance* is also extremely important.

- 3.1. If the money spent were invested or in a bank account or elsewhere, how much might it be earning there?
- 3.2. If the panel is bought using borrowed money, at what rate of interest?
- 3.3. This gives you a negative cost of finance figure to set against your savings.

4. Now tot these numbers up to get a final figure for savings/losses. (Now also tot up how many assumptions you have made!)

Variables are shown in italics above! Some will be known accurately, others will need to be estimated. That calculation was only about possible savings in one year, not payback.

**Payback** is another multi-input time calculation based on the above money figure, plus even more data. All factors need to be considered. These include:

1. Capital/revenue issues.

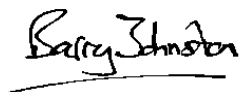
- 1.1. *Initial cost* (Say £2599)
- 1.2. The sum if any, of this which *adds to the capital value* of the home if it were to be sold (Say £1000)
- 1.3. The difference between these is the net capital balance to be repaid via a payback calculation. Include the deduction above unless the owner thinks that solar payback must, uniquely, happen twice! (In this example £1599)

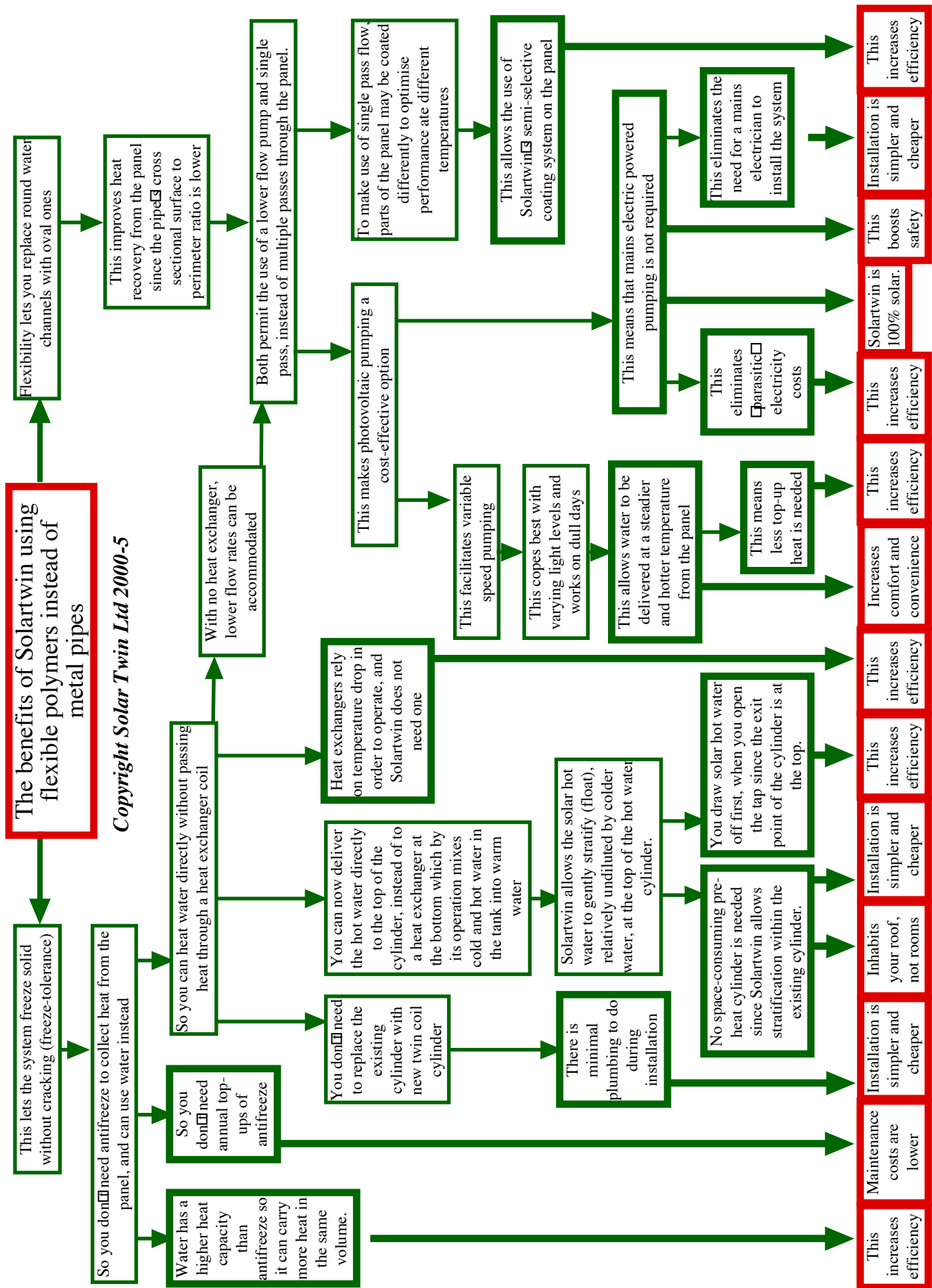
2. The fuel price inflator issues.

- 2.1. Estimate an *annual percentage price rise* (or drop) for the fuel(s) which you are displacing by using solar.
- 2.2. Decide whether to apply a *simple or compound interest* to these price changes.
- 2.3. Now calculate the actual payback horizon calculation in years: divide the net capital balance to be repaid each successive year by the previously calculated savings (with an annual fuel price inflator built in), to calculate what is the break-even threshold to your particular solar water heating system.

This will give you an estimate of how many years (if ever) the solar hot water system might pay itself back. After this period an accountant considers you to be profiting from the sun. Our ambition is to be well ahead in terms of price-performance (since this is the main reason why people don't buy solar) and thus to grow the UK solar market.

Regards,







## ***Get the best out of your Solartwin!***

Solartwin is uniquely simple. Using no mains power, it heats water direct, without antifreeze.

Getting the best out of Solartwin simply involves thinking about three areas:

- how you **use hot water**,
- adjusting your **backup heating** and
- **keeping heat in** using insulation.

One thing that is not unique to Solartwin is to bear in mind that all solar water heating systems work most efficiently when the water going into the panel is as cool as possible.

1/ If you can actually do so, try to **use your solar hot water** when it's most immediately available: **by day** and on **sunny days**.

2/ If you can **use hot water by day**, then do. Can you use the washing machine or dishwasher at lunch time or early afternoon? This way the cylinder can refill with cool water in time for a solar reheat. Using the water immediately also minimises heat losses due to hot water cylinder insulation being less than 100% efficient.

3/ If you are able to use hot water more on **days when it's particularly sunny**, then please do. Not everybody can manage a solar lifestyle, where the washing machine waits for a bright day, however! (Drying clothes outdoors on sunny days is a second, simple, use of solar.)

Solartwin rarely boils in normal use - its unique panel coatings emit excess heat at high temperatures. However, on sunny days or if you use little or no hot water for more than 24 hours, water may become hotter than normal. Unless you have a temperature limiting valve fitted, please take care about a possible scalding risk.

2/ Try optimising your **backup water heating** - in terms of thermostat **temperatures** as well **timing**: when they switch on and off.

- Thermostats control the **temperature** to which the backup water heating system heats your cylinder, by controlling at what temperature it switches on and off. Backup heating includes gas and oil boilers and electric immersion heaters. Back boilers generally don't have thermostats, and, although, most can't have them added, one compensation is that they tend to be used most when the sun is least strong.

Setting your hot water thermostat over 60C wastes energy - too low lets bacteria grow. Adjust it to 60 if it is safe to do. For bacteriological safety (even if you don't have solar) please heat your cylinder to at least 60C for an hour every day, preferably in the evening, after the sun has heated it as much as it can.

- Fine-tune your backup **timing**, to further optimise performance. If you don't have a separate timer for hot water, you may want to fit one. If you use off-peak electricity, then the time(s) you heat water may not all be chosen by you, so this section may not fully apply.

Many homes have a timer or programmer. This controls when the backup water heating system comes on and off. Take control of it! Two principles are: 1/ give the cylinder enough backup heat to provide the hot water that you need, but not far more than this, and 2/ use the timer to allow the sun to heat cool water by day.

First, the basics on timing. Unless you have to, don't leave the backup heating on 24 hours a day, particularly in summer: it's often wasteful.

- Most timers work by turning the water heating on 2 or 3 times a day for an hour or more: first in the **morning**, sometimes at **lunch** and finally again in the **evening**. You can tweak this...

For **mornings**, minimise the duration of the backup heating to provide enough hot water for your usual needs, but no more. And, if possible, turn the timer off **before** you actually start using hot water. This way the water at the bottom of cylinder, at least, will be cool for the sun. If you can do without any morning heat, even better.

Try to avoid **lunch** time backup heating. It's best to use solar on its own by day. If necessary allow a short burst of 10-30 minutes backup heat.

For **evenings**, please time backup water heating to bring the water up to 60C **for one hour, after** the sun has done its job and to go off **before** the adults in the house take their baths: so the cylinder is cool-ish overnight. After a good solar day, your backup heating may not come on at all, even if the timer tells it to (when the thermostat finds that the water is already over 60C).

3/ Insulate very well! This **keeps the heat inside** your **cylinder** and **hot pipes**. Insulation is available from DIY shops and plumbers' merchants. It's cost-effective and easy to fit..

Current solar grants require at least 60 mm thickness of insulation on your hot **cylinder**. Slip-jackets cost £5-15. But don't thermally insulate the immersion cable for fire safety.

Lag all **hot pipes** as well, especially the vent pipe (lag it even in the loft) and pipes between the cylinder and hot taps. All lagging should be at **least** as thick as the pipe it covers, and should run at least a metre from the cylinder.

ST/UG/001/09



## Maintaining your Soltartwin

Maintaining Soltartwin is easy. It involves intermittent **inspection** checks and, for some users, water **hardness control** and only occasionally panel **cleaning**. (We have separate instructions on decommissioning Soltartwin, if, say, you need to do any hot water re-plumbing.)

A/ Do **inspection** checks both **inside** and outside the **house** on the following occasions:

1. Within 24 hours of your installation being completed.
2. One week after your installation is completed.
3. On returning from being away from home for over a week.
4. After you have work done on your plumbing, roof or loft, and after severe storms.

Routinely do these checks at the above times - and least once a year.

• **Inside** the house, check all visible components including pipes and fittings including pump and roof penetrations for drips, leaks and any signs of damage or degradation. The pipes may vibrate, particularly near the pump. Inspect them for any signs of abrasion or damage; call us if there is. By day, when the sun casts a clear-edged shadow, listen to the pump to check it's working. Briefly pinch the pipes shut on either side of it in turn. If the note of the pump changes, it is pumping OK. Check regularly (particularly in Autumn) for rodents in voids and roof spaces, take steps to remove these and keep controlled, if evidence found.

• **Outside** the house check any easily visible parts of the panel and its fixings to the roof for being secure, general condition, drips, or leaks or any other signs of damage or degradation. Binoculars might be useful here.

B/ **Water hardness control**: If you have a Direct Soltartwin (ie the water from your hot tap has been heated directly in the solar panel) it is important to make a simple annual check on your water hardness. Phone the water company (or check on the internet) for parts per million calcium carbonate (or ppm CaCO<sub>3</sub>). If they quote typical or average (not maximum) figures, rather than a range, please allow 20% tolerance i.e. add 20% to their figure.

• If your hardness ever exceeds 200 ppm CaCO<sub>3</sub> use either an ion-exchange (salt-regenerated) water softener or an Indirect Soltartwin. We supply / fit softeners. Please call.

• At 100 - 199 (maximum) ppm CaCO<sub>3</sub>, you can use Fernox Superconcentrate Limescale Preventer. Your first little bag of crystals on a string is free. Simply hang it in the cold tank and replace twice a year. Fernox SLP is food grade. It costs about £10 from DIY shops. Or you can use an ion-exchange water softener or an Indirect system.

• Under 100 ppm, and with Indirect Soltartwins, no control is needed.

All other water hardness treatments or conditioners, including electromagnetic, magnetic, electronic, physical or ultrasonic methods must not be used to treat water which goes into the Soltartwin pipes, pump or panel. They are likely to damage your system and using them invalidates your warranty. The above 200 ppm threshold is reduced to 160ppm for all Indirect type hot water cylinders as well as irregularly used hot water systems, such as in holiday homes.

**Thank you for being a Soltartwin user !**

ST/UG/001/09

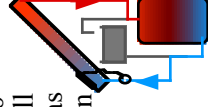
C/ Panel **external cleaning** is rarely required, unless the panel is flatter than 15 degrees from the horizontal or ground-mounted in a way that it gets splashed with dirt. Steeper than 15 degrees, rain usually cleans it satisfactorily. However, if the panel needs to be cleaned, for example if a large bird decorates the photovoltaic panel and if it is safe to do so, use a soft sponge and warm water containing mild soap or detergent. Please don't use solvents other than water, nor highly alkaline cleaners, nor ones which contain abrasives or grit..

Panel **internal cleaning** every 6-7 years. Disconnect and flush panel out with water at a maximum pressure of 1.5 Bar. Flush for at least 10 minutes from each end until the water leaving runs clear. Vinegar or proprietary limescale removers may be used at the correct dilutions according to the manufacturers instructions. Reconnect the panel. Replace the external HT Armaflex pipe insulation with new insulation.

**Going away? If you won't be using hot water for 2 days or more between March and September**, switch your backup water heating off until you return, to save energy and control overheating. Leaving the airing cupboard door open helps to keep the house dry. On your return, turn the boiler back on and heat the water up to at least 60C for an hour before you use it.

**Controller** Your soltartwin controller is preset and contains no serviceable parts, please do not remove the front cover, doing so may result in invalidating your system warranty.

Solar Twin Ltd, 2nd Fl., 50 Watergate St  
Chester, CH1 2AH, UK tel: 01244 403 404  
fax: 01244 403 654  
email: feedback@soltartwin.com.



# Solartwin solar water heating system

## *commissioning certificate and five year limited performance & components warranty*

1. This warranty is valid in UK and Ireland only unless specifically extended to elsewhere in writing. It applies to domestic retail purchases only. This warranty is only valid after we have received and approved a comprehensive set of photographs which clearly show full compliance with correct installation practice including full compliance with our written installation method statement or an agreed written modification of it.
2. This warranty covers the event of failure or significant non-performance of the Solartwin solar water heating system or its component parts and extends for five (5) years from the date of purchase, with the following exceptions. Water softeners are covered for two (2) years if we install them and one (1) year if bought as kits only.
3. Should such an event occur, we undertake either to repair or to replace, as Solar Twin Ltd regard as appropriate, with an equivalent or identical component or system.
4. Compensation for any consequent loss or any other loss such as in relation to system downtime is excluded from this warranty.

5. The following maximum water hardness control conditions of the supply water to the hot water system if plumbed as a direct rather than indirect system must be fully met:

- 5.1 where the supply water contains a total hardness which ever exceeds 200 parts per million (ppm) calcium carbonate, an ion-exchange (sometimes called salt regenerative) water softener must be used and must be specified, installed, used and maintained correctly on the water feed to the hot water system.
- 5.2 where the total hardness of the supply water is 100 ppm or above while also always being below 200 ppm calcium carbonate, then either of the following two options must be specified, installed, used and maintained correctly. These two options are EITHER an ion-exchange (sometimes called salt regenerative) water softener OR a phosphosilicate / hexametaphosphate water dosage system such as Fernox Superconcentrate Limescale Preventer.
- 5.3 where the total hardness of the supply water is always below 100 ppm, then no water treatment is necessary.
- 5.4 the above 100 ppm and 200 ppm thresholds are reduced to 80 ppm and 160 ppm respectively for all "fortic" type hot water cylinders as well as irregularly used hot water systems, such as in holiday homes.
- 5.5 all other water hardness treatments or conditioners, including electromagnetic, magnetic, electronic, physical or ultrasonic methods must not be used

6. This warranty does not apply if the system or any component of it:

- 6.1 is not used or installed in full compliance with our warranty conditions, specifications or instructions
- 6.2 has been subject to unauthorised modifications or servicing
- 6.3 shows evidence of negligence, wilful or malicious damage or damage unrelated to normal use
- 6.4 is significantly damaged by living things including biting insects and rodents
- 6.5 is not attached to a permanent residential dwelling or a permanent outbuilding of one
- 6.6 has been installed more than three times (ie, three, but not four relocations of the system are acceptable under the warranty)
- 6.7 is only aesthetically but not functionally changed from its original condition
7. Evidence of date of purchase and date of commissioning is required when making a warranty claim.
8. Your Solartwin controller is preset and contains no serviceable parts. Please do not remove the front cover, doing so may invalidate your system warranty.
9. This warranty is transferable to a new purchaser or occupier of a property in which Solartwin is installed provided that Solar Twin Ltd is notified in writing at the above address within 6 months of the change of ownership or occupancy.
10. Nothing in this warranty diminishes, or is intended to diminish, in any way, your statutory rights, which we uphold fully. English Law applies to this warranty.

Date the system was commissioned / delivered \_\_\_\_\_

Warranty : \_\_\_\_\_

PV Serial No : \_\_\_\_\_ Controller Serial No : \_\_\_\_\_

Serial nos: Panel \_\_\_\_\_ Pump \_\_\_\_\_

Customer record number \_\_\_\_\_ Installation number \_\_\_\_\_

Customer Name \_\_\_\_\_

Installation address \_\_\_\_\_

**Installer**

Signed : \_\_\_\_\_

Print Name: \_\_\_\_\_

**Customer**

Signed : \_\_\_\_\_

Print Name: \_\_\_\_\_

Solar Twin Ltd: 2nd Floor, 50 Watergate Street, Chester, CH1 2LA, UK  
tel: 01244 403407 fax: 01244 403654 email: warranty@solartwin.com

date of printing 15/6/2009 © Solar Twin Ltd, Company no: 3750291 Registered address: 9 Abbey Square, Chester, CH1 2HU UK.

***Thank you for choosing Solartwin!***

**ORIGINAL FOR CUSTOMER - TO BE KEPT BY CUSTOMER**

ST/WCC/001/09



## Legionella Control International Ltd

info@legionellacontrol.com

Tel: +44 161 877 0586

### **REPORT ON THE LEGIONELLA COMPLIANCE OF THE SOLARTWIN SOLAR PUMPED HOT WATER HEATING SYSTEM**

#### **INTRODUCTION**

Legionella Control International Limited, referred to from hence forth as LCI, have been commissioned by Solar Twin Limited to establish the level of compliance of their direct solar heating system with the HSE guidance note "Legionnaires Disease, The control of legionella bacteria in water systems, Approved Code of Practice and Guidance" referred to from hence forth as L8. This report will consider the product compliance with the key elements of L8 and make reference to a number of "Solar Industry" guides and application papers.

It is recognised that in general L8 does not apply to domestic owner occupied dwellings, however, solar heating systems are increasingly being installed in semi commercial enterprises and also in tenanted dwellings, under such circumstances L8 does apply for the protection of such tenants and landlords have a legal obligation under the Health & Safety at Work Act 1974 and also to the Control of Substances Hazardous to Health Regulations 2002 to protect the health and well being of their tenants. It must also be considered that owner occupied homes of today could be the tenanted homes of tomorrow and as such all properties should be considered as relevant.

It must be noted that LCI are not design or thermal efficiency engineers and as such our comments will be restricted to those pertinent to legionella growth and compliance issues.

#### **LEGIONELLA CONTROL INTERNATIONAL LIMITED**

LCI is a consultancy practice dedicated to all matters and legislation relating to the safe, and L8 compliant, operation of water systems. LCI is staffed by a team of professional water treatment chemists with an aggregate experience of over 150 years who have "grown up" with the introduction of legislation, firstly in 1988 with HSG70 and latterly with the introduction, in 2001, of the current legislative document L8.

We also have two additional associate consultants, one of whom was a co-author of L8 and the second who is a former Senior Inspector with the Health and Safety Executive specialising in legionella investigative projects. The writer of this report, Richard Berry, has thirty years of experience in the industry and is a Senior Consultant with LCI.

#### **SOLAR HEATING SYSTEMS**

There would appear to be two main methods of delivering the energy of the sun to generate hot water for either bathing or heating purposes. Firstly there is the Solar Twin system which is referred to as "direct" heating and as such the water that is directly heated in the solar panel is passed into the hot water distribution system for end use. Secondly there is the "non-direct" system which takes

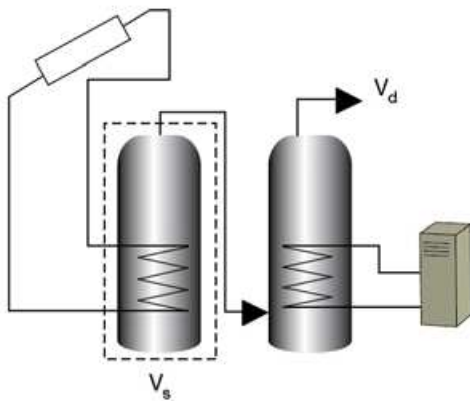
## Legionella Control International Ltd

info@legionellacontrol.com

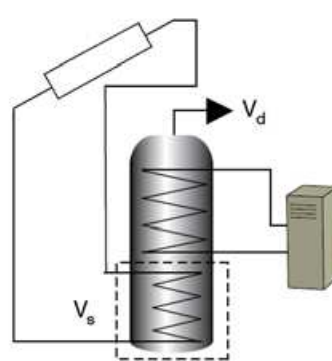
Tel: +44 161 877 0586

water from the solar panels and passes this through a heat exchanger coil located inside of the hot water storage cylinder, often referred to as the twin coil system.

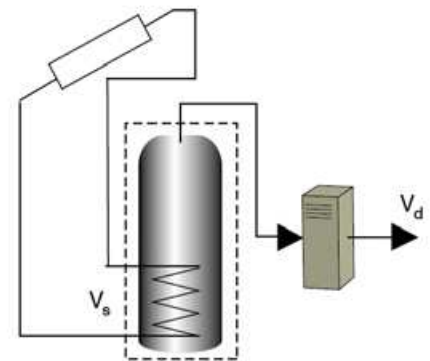
In addition there are thermal store systems and also twin cylinder systems which have a solar pre-heat cylinder. In the case of the thermal store, solar energy heats the body of the store and heat is extracted by a mains cold water coil, in these cases if the body of the coil is heated to greater than 60°C for one hour per day then L8 compliance would be achieved. The Solar Twin system is actually heated to 65°C thus allowing for some temperature drop across the heat exchanger. The following diagrams give an indication of the types of system available:



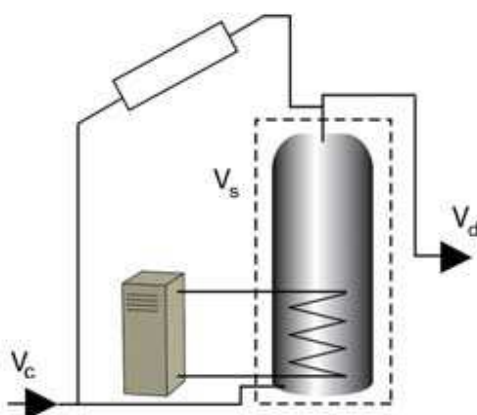
a) With separate solar cylinder



b) With a twin-coil cylinder



c) Combi boiler



d) Direct solar heating



## Legionella Control International Ltd

info@legionellacontrol.com

Tel: +44 161 877 0586

There are various pieces of literature which seem to favour the twin coil systems suggesting problems such as freezing of the water in the collector panel and also the potential for lime scale to form in the collector panel in hard water areas. Both of these issues have been considered and engineered out of the Solar Twin system.

From a legionella point of view freezing is not deemed to be an issue: at freezing temperatures there will be no proliferation, and any legionella that may be present will remain dormant. Freezing will not be an engineering issue to the Solar Twin system as silicone rubber, with suitable expansion properties, has been selected to transport the water from the panel to the hot water cylinder so there will not be any leakage issues which could cause stagnation in any part of the collector system.

It is well documented that lime scale deposits (predominantly calcium carbonate) can shelter legionella bacteria and that proliferation may be exacerbated. Solar Twin have considered this issue and recommend the installation of a water softener when calcium carbonate levels are greater than 200ppm  $\text{CaCO}_3$  and that a polyphosphate should be added to the water in conditions where the water hardness is between 100 - 200ppm  $\text{CaCO}_3$ . Both of these recommendations will control calcium deposition under such conditions. At levels of calcium carbonate less than 100ppm deposition is unlikely to give cause for concern.

### **DEDICATED SOLAR VOLUME**

This element of the design of the solar heating systems comes up in many of the guidance documents, being referenced in Domestic Heating Compliance Guide, issued by the Office of the Deputy Prime Minister May 2006, SAP 2005 rev2 The Government's Standard Assessment Procedure for Energy Rating of Dwellings and the Energy Saving Trust Consultation Draft document Solar Thermal Heating System Specifications and also cross referenced in MIS 3001: Issue 1.2 February 2008 to the Domestic Heating Compliance Guide. These documents seem to have been solely dedicated to energy issues relating to solar heating systems but in doing so have paid insufficient attention to the requirements of legionella risk management and in particular the recommendations in the HSE guidance note L8.

As stated in the introduction of this report LCI are not energy consultants and thus cannot comment on whether this is for energy saving purposes, but from a legionella proliferation point of view to have such a large volume of water sitting below the secondary heating coil has to be seen as a serious flaw in design, as on days where the solar gain is limited, this volume of water is unlikely to achieve the L8 recommended temperature of  $60^{\circ}\text{C}$  and thus may pose a threat of legionella proliferation. This problem will be exacerbated with the use of a pre heat cylinder as the overall stored volume will be nearer to two days and thus falls significantly outside of the L8 recommendations for stored water.

The recommendations for the size of this dedicated solar volume range from 25 litres per  $\text{m}^2$  of collector panel area to 50 litres per  $\text{m}^2$  of collector panel area and thus is most likely to give a hot water storage cylinder of greater than 24 hours capacity which contradicts the recommendations of



## Legionella Control International Ltd

info@legionellacontrol.com

Tel: +44 161 877 0586

L8 which clearly recommend that water storage is less than 24 hours. There is a suggestion that the twin coil system is of a ~~safer~~ design. We cannot accept this suggestion for the reasons stated above and in addition we believe that there may be circumstances, ie high demand, when 60°C could not be achieved. This in our opinion justifies the design and decision of Solar Twin to avoid twin coil systems having a dedicated solar volume unless it can be guaranteed that the entire cylinder contents will heat to 60°C for at least one hour per day. Solar Twin define this as a dedicated solar volume in time.

The Solar Twin system, however, has a secondary heating coil located at the base of the storage cylinder which is actuated, in the evening, for one hour per day and thus ensures the entire hot water storage cylinder is heated to 60°C for the one hour period. With this design the Solar Twin system, in theory, has no ~~dedicated solar volume~~ and thus fails to comply with the documents cited above. From a legionella perspective ~~this decision of non-compliance has no credibility and we see no reason for the direct system to be deemed to be non-compliant.~~

### **AREAS OF POTENTIAL STAGNATION**

There is one area of the Solar Twin system which may theoretically be subject to stagnation, this is the small volume of water in the pipe work and within the silicone rubber tubing within the collector panel (total approximately three litres) which during extended periods of low solar intensity may not see any movement. However, in the unlikely event that this volume of water does remain static it is highly probable that the water will be of such a low temperature, ie less than 20°C, that no legionella proliferation would occur. The fact that water is drawn from the base of the hot water storage cylinder, ie the point at which fresh cold water also enters the cylinder, suggests that extended periods of no flow are highly unlikely and thus deemed to be of very low or negligible risk. It may be worth considering the use of a data logger to demonstrate this highly improbable effect.

There is, in some cases, the issue of blending valves, often referred to as thermostatic mixing valves, (TMVs). TMVs are a common means of preventing scalding by blending very hot water with cold water. Where taps or other outlets are very close downstream, the usual temperature range for the blended water is 39 – 43°C. As these are the typical delivery temperatures, it is appropriate that L8 guidance states that ideally a single TMV should not be used for multiple outlets, that a single valve on the outlet from a cylinder is not ideal and should be avoided if possible and that the pipe work containing blended water should be kept as short as possible.

However, with solar, the cylinder contents could be unusually hot and thus a TMV would be installed at the cylinder outlet to reduce the temperatures to just over 60°C. While it is accepted that delivering water at greater than 60°C will reduce (but not eliminate) the risk from scalding while also complying with the L8 Code of Practice, there is a potentially significant upstream Legionella risk to consider and minimise: this relates to the cold water supply pipe which at times of low solar intensity might see little flow and thus would create a stagnant dead leg. In such circumstances if TMVs are installed in order to prevent the hazard of scalding they could generate an even greater problem of legionella proliferation. When TMVs are installed they should be fitted so as to minimise

## Legionella Control International Ltd

info@legionellacontrol.com

Tel: +44 161 877 0586

the length of the cold water supply pipe as far as is practical, ideally no more than 1.5 pipe diameters away from the cold feed tee-off point.

### MATERIALS OF CONSTRUCTION

Many synthetic materials, due to high carbon content, are able to support growth of a range of biological agents, including legionella. Solar Twin Limited have subjected all materials used in the construction of their equipment to an independent laboratory who have certified that all components satisfy the criteria set out in **BS6920: Part 1:2000 [Specification] and thus comply with the requirements of the Water Regulations Advisory Scheme Test of Effect on Water Quality (BS6920:2000): Odour & Flavour of Water/Growth of Aquatic Microorganisms/High Temperature Tests**. The selection of non-biodegradable components, especially the silicon rubber, is clearly of value in minimising the potential for bacterial growth within solar hot water systems and is a key element of the ACoP.

### TRADITIONAL NON SOLAR HOT WATER SYSTEMS

A conventional domestic dwelling hot water system is, in modern times, linked to the domestic central heating system which typically would, for the normal family setting, operate no more than twice per day, often early morning and late afternoon/early evening. In such circumstances there will be variability in the temperature of the stored hot water. The use of solar heated water is considered to be no different to that which has been the UK practice for many years and thus is deemed to pose no greater risk of legionellosis to those more traditional methods of hot water generation provided that storage of hot water is held at a temperature of at least 60°C for a period of a minimum of one hour once per day.

### CONCLUSION

The Solar Twin design, and overall application concept, has taken great account of the dangers posed by the proliferation of legionella bacteria in hot water systems and thus offers significant safety improvements compared to the designs of the more traditional twin tank and/or twin coil systems. When operated as per the manufacturers' instructions we believe that the Solar Twin system takes full account of the design and operating principles of the L8 Approved Code of Practice and Guidance.

J R Berry  
Senior Consultant  
Legionella Control International  
27<sup>th</sup> November 2008



## Case Studies





## Case Study: Ashton Hayes Primary School, Cheshire

### Client:



Ashton Hayes is a village located just outside Chester which introduced a carbon neutral project in January 2006. The aim is to encourage the community to consider how their actions impact on climate change and to see how simple changes can make a big difference. The village is aiming to become carbon neutral. Part of the education process includes the involvement of the primary school and Solar Twin, together with Cheshire County Council have installed a solar thermal panel to provide hot water for the cleaner.

The panel is located at the school entrance and the installation incorporates an interpretation board with a digital thermometer read out allowing the children to understand how the solar thermal technology operates and to monitor the output as part of project work.

### The installation.

The installation comprised:

- South facing facade mounted panel with left hand pipe exits
- 5 Watt PV panel and low voltage pump
- Installation of an open vented hot water cylinder
- Installation of electric immersion element and 24hr timer



The panel is located in an area providing maximum exposure to sunlight without any shadows, whilst enabling the school children to see the collector plate up close. The lower bracket was fitted to the wall using wall anchor bolts with a 20mm gap left behind the panel to allow debris to clear. The upper bracket was then fastened to the wall and secured with wall anchor bolts and the panel was then fitted between the two brackets.

Silicone rubber flow & return pipe work was passed through Hep2O conduit and then insulated in Armaflex HT pipe insulation.

The new open-vented hot water cylinder and header tank were installed in the adjacent cleaners cupboard. As the water quality in Ashton Hayes is very good the Solartwin system is connected directly onto the hot water cylinder, circulating the water the maintenance staff are actually using through the collector and back again. An immersion element is installed on a timer to ensure the cylinder is heated above 60C across the winter months.

### Education use

We have installed an interpretation board below the collector, which not only describes how solar thermal works but also displays the temperature within the hot water cylinder via pv powered digital thermometers. The thermometers are located at the top and bottom of the store to enable the children to monitor the water temp before and after the water flows through the panel. The children's findings are then logged and discussed as a group with teaching staff.



### Ashton Hayes primary school Renewable Energy Technology Datasheet:

Renewable energy type: Solar thermal  
Application: Domestic hot water  
Number of collectors: 1  
Orientation: South  
Angle of tilt: 90 degrees  
Collector total aperture: 2.8 sqm  
Panel type: freeze-tolerant

Pump type: 24V variable speed  
Power supply: 5 Watt PV cell (x1)  
Calorifiers: 120 litre vented cylinder (x1)  
Backup fuel: Mains electric  
Global warming target: save 1000 kg CO<sub>2</sub> p.a.  
Manufactured in: England

### Partner:







## Case Study: Bournville Trust, Shenley Redevelopment, Birmingham

The Shenley redevelopment project utilised part of the original Bournville estate and involved the demolition of unsuitable, energy inefficient three storey blocks of flats. The initial phase of the redevelopment was completed in early 2005 and provided the community with 54 new homes, shops and a large medical centre, in a landscaped environment.

We were approached by Bournville Village Trust in 2003 who asked us to design a suitable solar water heating system, which would also be eligible for a Clear Skies Community grant. 16 properties were designated to have solar thermal installations, each of which houses a minimum of 5 tenants.

### The installation.

Panels were fixed above existing tiled roof surface on a mixture of two & three storey properties. Panels were painted to match the chocolate coloured roof tiles.

CHN construction, the mechanical and electrical contractor for the project, carried out the installation of the Solartwin systems. Their engineers and management staff attended a one day installation training course.



The collectors are connected to a Gledhill Boilermate open vented thermal store unit and direct SolarPod, which acts as a separate solar store below the primary heated Boilermate ensuring the coolest water is drawn up into the panels. The thermal stores provide mains pressure hot water to the taps.

### Performance

The panels are mounted 45 degrees from horizontal. Each Solartwin system is generating approx. 1000kwh per annum (net) to the taps. As mains gas is the primary heating fuel being displaced, the total CO<sub>2</sub> saving for the 16 solar systems at Shenley will be approx. 4000kg/annum.

#### Client:



Solar Twin Ltd  
2nd Floor  
50 Watergate street  
Chester  
CH1 2LA

01244 403 407  
trade@solartwin.com  
www.solartwin.com

#### Main Contractor:



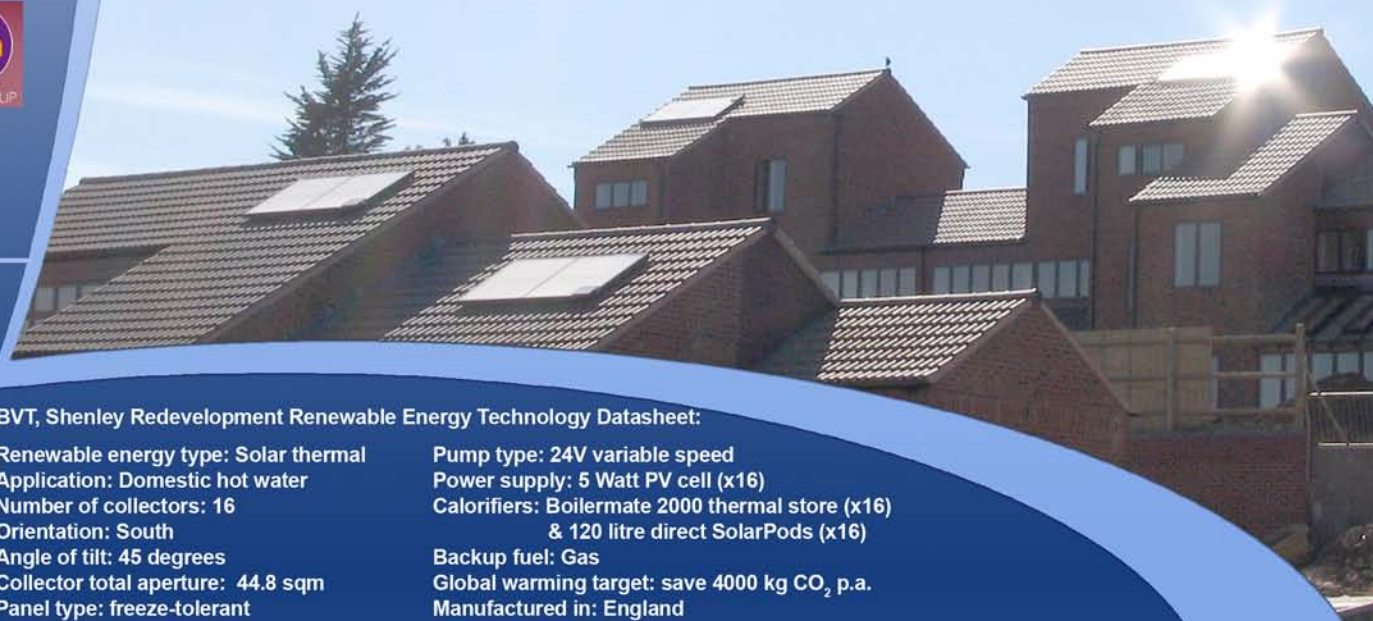
#### M&E Contractor:



#### BVT, Shenley Redevelopment Renewable Energy Technology Datasheet:

Renewable energy type: Solar thermal  
Application: Domestic hot water  
Number of collectors: 16  
Orientation: South  
Angle of tilt: 45 degrees  
Collector total aperture: 44.8 sqm  
Panel type: freeze-tolerant

Pump type: 24V variable speed  
Power supply: 5 Watt PV cell (x16)  
Calorifiers: Boilermate 2000 thermal store (x16)  
& 120 litre direct SolarPods (x16)  
Backup fuel: Gas  
Global warming target: save 4000 kg CO<sub>2</sub> p.a.  
Manufactured in: England







## Case Study: Burnley Youth Theatre, Burnley, Lancashire

Client:



Designed specifically for young people, Burnley Youth Theatre was developed with funding from a number of different contributors including the NW Development Agency, Arts Council England Lottery, the Lancashire Environmental Fund and Lancashire County Council. The project has been shortlisted for the Community Benefit category of RICS Awards 2006.

Solar Twin were approached by the architectural consultancy manager to provide solar thermal panels for integration into the building to preheat to the primary domestic hot water calorifier.

### The installation

4 Solartwin panels were fixed to wall mounted A frames set at 45 degrees from horizontal. The 4 collectors each have their own solar pumping station and connect to an 800 litre thermal store. Solar Twin pipework was run to and from the store through soil pipe, within Armaflex HT pipe insulation.

The connection to the thermal store was direct rather than through a heat exchanger, providing a number of advantages, including:

- Stratified delivery of hot water to the top of the cylinder
- Mains pressure hot water at flow rates comparable to un-vented cylinders but without the annual maintenance requirement and associated costs.



### Performance & Grants

The panels are mounted at 45 degrees facing South. The 45 degree angle increases winter collection, and there is some reflective gain from the light coloured flat roof surface in front of the collectors. With each Solartwin panel generating approximately 1000kwh per annum, at the point of delivery, totalling 1000 kg/annum in saved CO<sub>2</sub>.

We helped the client win a Clear Skies community grant which provided 50% match funding towards the cost of the Solartwin installation.

M & E Contractor:



#### Burnley Youth Theatre Renewable Energy Technology Datasheet:

Renewable energy type: Solar thermal  
Application: Domestic hot water  
Number of collectors: 4  
Orientation: South  
Angle of tilt: 45 degrees on A frames  
Collector total aperture: 11.2 sqm  
Panel type: freeze-tolerant

Pump type: 24V variable speed  
Power supply: 5 Watt PV cell (x4)  
Calorifiers: 800 litre preheat thermal store (x1)  
Backup fuel: Gas  
Global warming target: save 1000 kg CO<sub>2</sub> p.a.  
Manufactured in: England





## Case Study: Kingsmead Primary School, Cheshire

### Client:



*Schools and homes use lots of hot water for washing and bathing. The sun, even in Britain's climate can deliver 30-70% of this energy. At Kingsmead Primary School, four large roof-mounted Solartwin panels pre-heat the schools hot water for washing and bathing.*

Uniquely simple to install in homes, Solartwin is used all over the UK. Solar Twin Ltd now installs roughly 10% of all UK solar water heating panels, using an award winning solar water heating technology. Homes, schools and pools all over the UK benefit from Solartwin's solar water heating installations.

Compared to previous forms of solar, Solartwin is uniquely simple to fit in both schools and homes. Its 100% solar electric water pumping system improves its environmental footprint by not requiring any mains electricity.

This innovation is crucial to cutting global warming and helps to meet energy targets more easily, with less 'energy drawback'.

"Being a parent and having been a teacher myself, I'm delighted that the next generation of Cheshire children will be learning in a sustainable environment, thanks to Solartwin" says Managing Director, Barry Johnston.

Other Solartwin Schools projects in Cheshire are:

Wistaston Green Primary School - Main Building  
Beeston Outdoor Education Centre - Laundry Block  
Chester Catholic High School - Science Classroom for the Future



### Main contractor :



### M&E Contractor :



### Consulting Engineers :



### Kingsmead primary school Renewable Energy Technology Datasheet:

Renewable energy type: Solar thermal  
Application: Domestic hot water  
Number of collectors: 4  
Orientation: South  
Angle of tilt: 45 degrees  
Collector total aperture: 11.2 sqm  
Panel type: freeze-tolerant

Pump type: 24V variable speed  
Power supply: 5 Watt PV cell (x4)  
Calorifiers: 750 litre twin coil indirect (x1)  
Backup fuel: 1/ Biomass 2/ Mains gas  
Global warming target: save 1000 kg CO<sub>2</sub> p.a.  
Manufactured in: England







## Case Study: Maes y Ffynnon, Cerrigydrudion, Conwy

### Client:



Solar Twin were approached Salem Myer Simpson in July 2005 on behalf of Conwy County Council. The council were interested in integrating solar thermal to sheltered housing in the county as part of an improvement programme. Six properties had been identified as a pilot project.

### The installation.

The buildings are of standard construction and consist of 3 pairs of semi-detached, single storey bungalows. Roof pitch was at approximately 40 degrees and of a construction allowing panels to be fitted directly onto the roof using our standard procedure as outlined in our method statement. Panels were mounted to the most southerly aspect of each property and within 2 metres of the header tank. Pumps were mounted underneath the panels in the roof void and in line with the water level in the header tanks.

Internal pipework was through the roof void to the airing cupboard, directly below the header tank and connected directly to the existing hot water cylinder. Water hardness levels were confirmed with Welsh Water and were of a level where no water hardness control measures were required.



### Performance

The panels are mounted at 40 degrees, and face between south east and south west. Each Solartwin panel generates approximately 900kWh per annum.

The main metal is mainly hydro-electrically made aluminium, with a lower environmental impact than aluminium made using fossil fuel. For durability, external screws / bolts are stainless steel. The absorber coatings are black. Double glazing is UV-stable polycarbonate. Double, rather than single glazing optimises performance in winter and in windy sites. Insulation is zero-ODP pentane-blown rigid foam.

### Main Contractor:



### Maes y Ffynnon, Cerrigydrudion Technology Datasheet:

Renewable energy type: Solar thermal  
Application: Domestic hot water  
Number of collectors: 6 (1 per household)  
Orientation: South  
Angle of tilt: 40 degrees  
Collector total aperture: 16.8 sqm

Pump type: 24V variable speed  
Power supply: 5 Watt PV cell (x6)  
Backup fuel: Oil  
Global warming target: save 6000 kg CO<sub>2</sub> p.a.  
Manufactured in: England  
Panel type: freeze-tolerant





## Case Study: Sawston Medical Centre

### Client:



Solar Twin Ltd  
2nd Floor  
50 Watergate street  
Chester  
CH1 2LA

01244 403 407  
trade@solartwin.com  
www.solartwin.com

### Main Contractor:



### M&E Contractor:



### Consulting Engineers:



Sawston Medical Centre has been built on a brownfield site, to replace a decaying structure where the medical practice has been based for a number of years, located within the heart of the village of Sawston.

The consultant engineers Mansfield Ravenhall were appointed to design a self-sustainable building securing the practice's energy supply, by having the building create its own energy. The ambitious project incorporates a number of renewable technologies including solar thermal, solar PV & a ground source heat pump system.

At Sawston, Solartwin provided a complete Turnkey solution from initial design through to onsite project management.

Solartwin together with Mansfield Ravenhall, calculated that the total domestic hot water (DHW) demand for the new medical centre would be approx. 82,000 kWh/pa. After consulting the client we opted to design a solar water heating system that would contribute a 30% solar fraction of the total DHW usage in the centre, which equated to 24 PV pumped Solartwin systems (67.2 sqm), delivering approx. 24,000 kWh/pa

We installed two 1800 litre thermal storage calorifiers, designed to preheat the mains cold water feed to a gas fired Andrews Water Heater. Each calorifier has 12 Solartwin collectors connected directly to it, with panels being easily isolated in banks of 3, without the need to decommission the entire array if maintenance is required. The project M&E contractor, Mowlem, have installed a Legionella pump set on a timer which purges the thermal store coils to ensure the system is operating within NHS and HSE standards.



The 24 Solartwin panels were fixed to the roof using the InterSole system, this spreads the load of the collectors across timber battens below the HDPE plastic sheets. Our silicone rubber microbore pipes are ducted in soil pipes, keeping flow and returns separate. Ducts penetrate through 300mm cowlings at the upper most point of the array and are sealed to avoid water penetrating into the structure.

The Solartwin system at Sawston Medical Centre contributes a CO<sub>2</sub> reduction of 6 tonnes per annum. As the Solartwin system uses PV powered pumps, there is no CO<sub>2</sub> claw-back, which is found in mains electricity pumped systems, usually negating CO<sub>2</sub> savings by approx. 20%.

### Sawston Medical Centre Renewable Energy Technology Datasheet:

Renewable energy type: Solar thermal  
Application: Domestic hot water  
Number of collectors: 24  
Orientation: South West  
Angle of tilt: 20 degrees  
Collector total aperture: 67.2 sqm  
Panel type: freeze-tolerant

Pump type: 24V variable speed  
Power supply: 5 Watt PV cell (x24)  
Calorifiers: 1800 litre thermal store (x2)  
Backup fuel: Gas  
Target annual solar fraction: 30%  
Global warming target: save 6000 kg CO<sub>2</sub> p.a.  
Manufactured in: England





## Case Study: Seldown Eco-Village

### Client:



The Seldown Eco-village in Poole Dorset is being developed by Western Challenge Housing Group. The original design allowed for solar collection by including roofs at 30 degrees, facing due south, but cost constraints meant that at the tendering stage solar thermal was not included. Shortly before going on site, Solartwin made a presentation to Western Challenge, who were impressed by the simplicity and surprised at the modest cost of Solartwin. They asked for six systems to be installed on the upper floor of two blocks of one and two bedroomed flats.

### Simple plumbing

We connected the Solartwins directly on to open vented thermal stores, which in a new build situation have a number of advantages.

The Solartwin's will deliver hot water to the top of the the cylinder as would usually be the case with a standard open-vented domestic hot water system.

Solartwin also provides mains pressure hot water at flow rates comparable with combination boilers or unvented cylinders, but without the expense of annual maintenance.

As the water in the cylinder that the panel is circulating is not going out to the taps, we were able to overcome water hardness by treating it with Fernox MB-1 Scale Inhibitor, mixed to 4% of total storage volume.



### Special roof mounting

Solartwin worked closely with the roofing and main contractors to design a bespoke mounting system, which the roofing contractor could integrate into the polymeric roof covering without affecting the integrity of the roof surface. Structural engineer's calculations showed that a Solartwin panel raised 150mm above the roof would produce wind loadings well within the limits of the timber frame and insulation construction.

### Main Contractor:

**ROK**

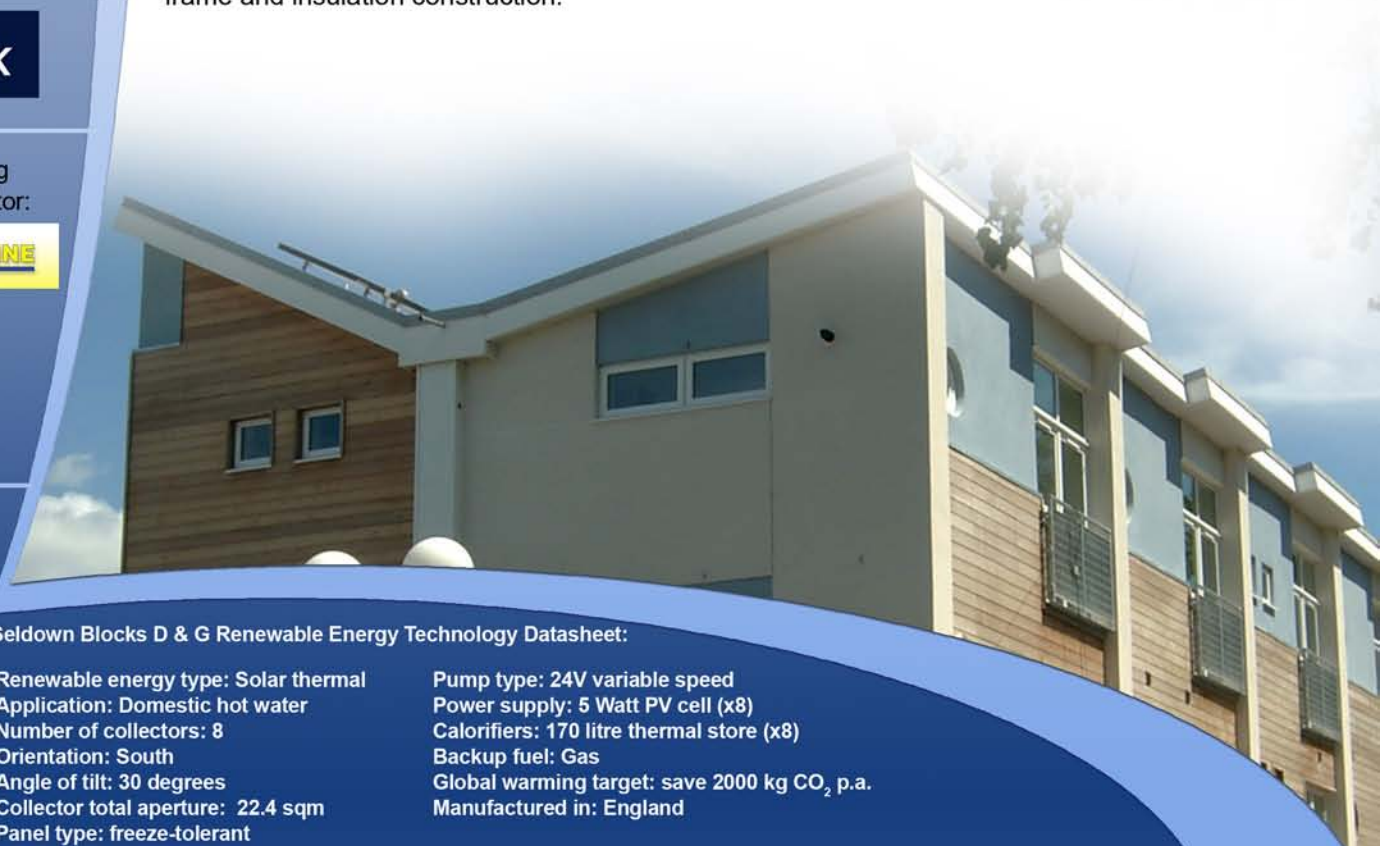
### Roofing Contractor:

**ROOFLINE**

### Seldown Blocks D & G Renewable Energy Technology Datasheet:

Renewable energy type: Solar thermal  
Application: Domestic hot water  
Number of collectors: 8  
Orientation: South  
Angle of tilt: 30 degrees  
Collector total aperture: 22.4 sqm  
Panel type: freeze-tolerant

Pump type: 24V variable speed  
Power supply: 5 Watt PV cell (x8)  
Calorifiers: 170 litre thermal store (x8)  
Backup fuel: Gas  
Global warming target: save 2000 kg CO<sub>2</sub> p.a.  
Manufactured in: England







## Case Study: 10% Renewables, Sydenham Road, Croydon

Client:

**Wates**

Ruskin Homes approached Solartwin in October 2004, about a block of 41 flats they proposed to build, a mixed development of private units for sale, and social housing for London and Quadrant Housing Association. Croydon Council were one of the first to require that on larger housing developments, 10% of all energy used in the properties should come from renewable sources.

Solar thermal is widely recognised as the most cost effective of renewable energy sources .

Ruskin Homes were able to calculate the typical energy consumption of the apartments of this type. For Solartwin to provide 10% of the total energy demand, 12 systems would be required, 9 for private housing, three for the larger social housing units. Each system is expected to provide up to 70% of the hot water requirements across the year, and will reduce CO<sub>2</sub> emissions by 250kg annually.

Solar Twin Ltd  
2nd Floor  
50 Watergate street  
Chester  
CH1 2LA

01244 403 407  
trade@solartwin.com  
www.solartwin.com

### The installation

The building had already been designed with a large flat roofed area in the centre, with plenty of room for three rows of four panels. These were to be connected to flats on the fourth and fifth floors, with one system going to a third floor unit.

Solartwin approved installers have carried out the installation, working closely with Ruskin Homes, to co-ordinate the associated building and plumbing works. Work has been completed in several stages.



Solartwin supplied special leg mounts with spreader plates, that were mounted on the timber deck of the roof, then weathered into the roofing felt. We then fixed A frames to the bespoke supports with 'Z' clamps. Pipe runs have been enclosed in galvanised ducting across the roof, then run through floor and ceiling voids to airing cupboards, where the systems are connected to open vented thermal stores.

### Performance

The panels are mounted at 45 degrees, and facing almost due south. The 45 degree angle increases winter collection, whilst having minimal impact on useable summer solar collection. With each Solartwin panel generating 1000kwh per annum at the point of delivery, this equated to 2000 kwh per annum per system of displaced gas.

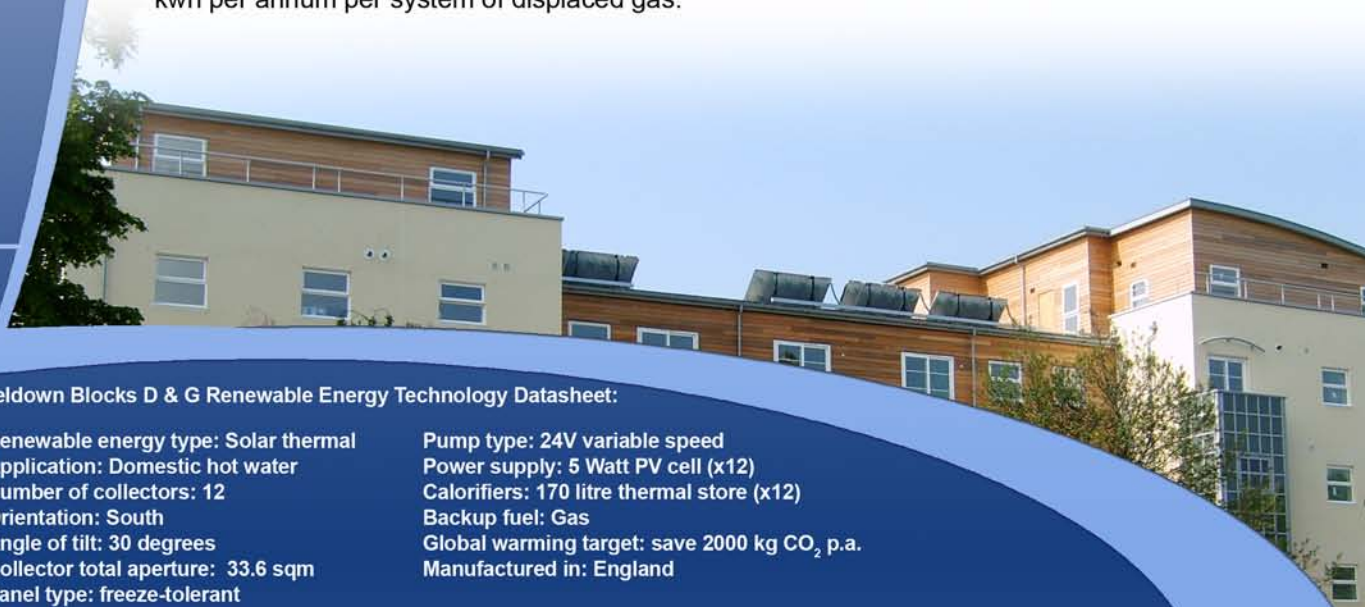
Main  
Contractor:

**Ruskin**  
HOMES

#### Seldown Blocks D & G Renewable Energy Technology Datasheet:

Renewable energy type: Solar thermal  
Application: Domestic hot water  
Number of collectors: 12  
Orientation: South  
Angle of tilt: 30 degrees  
Collector total aperture: 33.6 sqm  
Panel type: freeze-tolerant

Pump type: 24V variable speed  
Power supply: 5 Watt PV cell (x12)  
Calorifiers: 170 litre thermal store (x12)  
Backup fuel: Gas  
Global warming target: save 2000 kg CO<sub>2</sub> p.a.  
Manufactured in: England





## Case Study: The Catholic High School, Chester

The new Emmaus Building at The Chester Catholic High School has been built to accommodate the school's highly successful and expanding Sixth-form. Solartwin provided a complete turnkey solution from initial design through to onsite project management of the solar water heating system.

Client:



Liverpool based architects OMF Derek Cox designed the building to include such features as; sixth form accommodation on two floors including quiet rooms, seminar rooms, learning resource and a double height common room which is the focal point of the building. The common room doubles as a performance area for the school's Performing Arts Department which itself contains music, practice and rehearsal rooms, a recording studio and drama and dance studios.

Solartwin together with Paul Moy Associates, calculated that the total domestic hot water demand for the new sixth form centre would be approx. 8456 kWh/annum. This equates to approx. 675 litres of water heated from 10C to 65C for each day the building is occupied, roughly 200 days per year. The solartwin system is designed to contribute approx 50% of the buildings annual domestic hot water demand.



Solar Twin Ltd  
50 Watergate Street  
Chester  
CH1 2LA

01244 403 407  
info@solartwinprojects.com  
www.solartwinprojects.com

Due to the schools occupancy being generally low over the summer months, we designed the solar thermal system to be optimised for all-year performance. This involved positioning the Solartwin collectors at a fixed angle of 70 degrees from horizontal, which increases the systems performance during Winter/Spring/Autumn months when the sun is at its lowest on the horizon, whilst reducing the summer gain when building is least occupied.

To achieve the 70-degree fixed angle the Solartwin collectors needed to be fixed to angle frames. This raised the issues of wind-loading, as the Solartwin collectors would effectively act as sails, and how the framework would be fixed to the building structure.

We developed a solution with the design team, Read Construction (the principle contractor) and the roofing contractor which consists of 'top-hat' sections which are fixed into the standing seam roof structure. A steel channel sub-frame is built up off the sections which avoided any penetrations through the roof, or fixings onto the main steel structural steel frame that could have caused weathering issues. We ensured roof access and a walkway with man-safe system were installed as part of the framework to allow access for maintenance or inspection of the solar collectors. We have extended the framework to allow for a 4kWp photovoltaic system to be installed in future as funds become available.

We supplied and installed 6 no. 2.82m<sup>2</sup> (16.92m<sup>2</sup>) Solartwin flat plate freeze tolerant collectors which are connected direct and in parallel to a 1200 litre thermal storage calorifier, located in the plant room. The system is designed to preheat the mains cold water supply to a gas fired hot water calorifier. The Solartwin pumps and controls are photovoltaic powered meaning the solar thermal system does not consume any mains electricity in its operation.

Principal Contractor:



M&E Consultant:

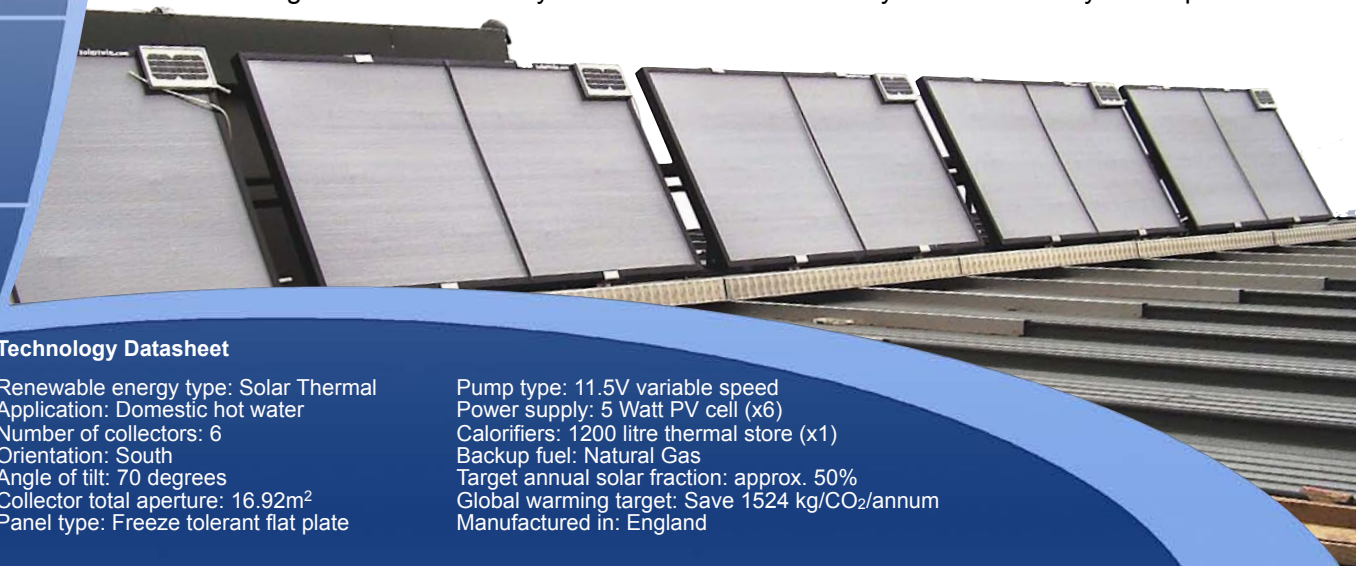


Architect:  
OMF Derek Cox

### Technology Datasheet

Renewable energy type: Solar Thermal  
Application: Domestic hot water  
Number of collectors: 6  
Orientation: South  
Angle of tilt: 70 degrees  
Collector total aperture: 16.92m<sup>2</sup>  
Panel type: Freeze tolerant flat plate

Pump type: 11.5V variable speed  
Power supply: 5 Watt PV cell (x6)  
Calorifiers: 1200 litre thermal store (x1)  
Backup fuel: Natural Gas  
Target annual solar fraction: approx. 50%  
Global warming target: Save 1524 kg/CO<sub>2</sub>/annum  
Manufactured in: England





Photos























**Name:** \_\_\_\_\_

**Q1. In general, how fully did this seminar meet your expectations?**

0 1 2 3 4 5 6 7 8 9 10  
not at all just met them 100%+ exceeded

**Q2. More specifically, please could you score the following details for us?**

**(a) Content / learning methods**

0 1 2 3 4 5 6 7 8 9 10  
bad / inappropriate satisfactory excellent / appropriate

**(b) Take home material (manual, CD, certificate etc)**

<u>0</u>	1	2	3	4	<u>5</u>	6	7	8	9	<u>10</u>
useless / inappropriate					satisfactory			useful / appropriate		

**(c) Venue / hospitality / food today**

0      1      2      3      4      5      6      7      8      9      10

really awful                          satisfactory                          excellent

***(d) Organisation, pre-booking info and how we handled your booking***

0 1 2 3 4 5 6 7 8 9 10  
unhelpful satisfactory excellent

**(e) Seminar speaker(s)**

0      1      2      3      4      5      6      7      8      9      10

really awful                          satisfactory                          excellent

(f) Other issues (please state which and rate) \_\_\_\_\_

0 1 2 3 4 5 6 7 8 9 10

***(g) How could this seminar have been better? (please could you answer overleaf)***

### Q3. Which are the best seminar days for you?

Monday | Tuesday | Wednesday | Thursday | Friday | Saturday | Sunday

#### Q4. If you'd like to attend future seminars, which would they be?

1. Solartwin for large scale projects (case studies)
2. The Solartwin concept and how Solartwin works (detailed technical content)
3. Solar in education (technical, plus educational aspects)
4. (Specifying solartwin in domestic applications - today's seminar)
5. Solar in social housing, what to do and not to do (general conceptual topics)
6. How to specify, integrate, install, commission Solartwin in large scale projects
7. Solar as a profitable growth area in an existing or new business
8. How to draft successful large scale solar grant applications
9. On-site mentoring schemes for trainee solar installers (practice, theory, techy)
10. Other topics: (please state which)

**Q5. After completing this seminar, how confident would you feel to install?**

<u>0</u>	1	2	3	4	<u>5</u>	6	7	8	9	<u>10</u>
un-confident					OK					confident

**Please turn over >**



Q6. My interest in re-selling Solartwin is...

0 1 2 3 4 5 6 7 8 9 10  
none probable immediate and in considerable numbers

Q7. My interest in installing Solartwin as a sub-contractor is...

0 1 2 3 4 5 6 7 8 9 10  
none probable certainly

Q8. My interest in specifying Solartwin to others is...

0 1 2 3 4 5 6 7 8 9 10  
none as one of several solar thermal products as the only solar thermal product

## Other comments...

---

---

---

---

## Referrals...

Name \_\_\_\_\_ Position \_\_\_\_\_

Phone \_\_\_\_\_ Fax \_\_\_\_\_ Email \_\_\_\_\_

Address \_\_\_\_\_

Name \_\_\_\_\_ Position \_\_\_\_\_

Phone \_\_\_\_\_ Fax \_\_\_\_\_ Email \_\_\_\_\_

Address \_\_\_\_\_

Name \_\_\_\_\_ Position \_\_\_\_\_

Phone \_\_\_\_\_ Fax \_\_\_\_\_ Email \_\_\_\_\_

Address \_\_\_\_\_

## Please freepost to...

Solar Twin Ltd, Freepost NWW7888A, Chester, CH1 2ZZ

Many thanks from the **Solartwin.com** team!



Solar Twin Ltd  
2nd Floor, 50 Watergate Street  
Chester,  
CH1 2LA



**Sales:** 0845 1300 137 (UK only)  
**or:** +44 (0) 1244 403 407

**Admin:** +44 (0) 1244 403 404  
**Fax:** +44 (0) 1244 403 654



For all the latest information  
visit our website at:  
[www.solartwin.com](http://www.solartwin.com)

email : [hi@solartwin.com](mailto:hi@solartwin.com)



Contact us...