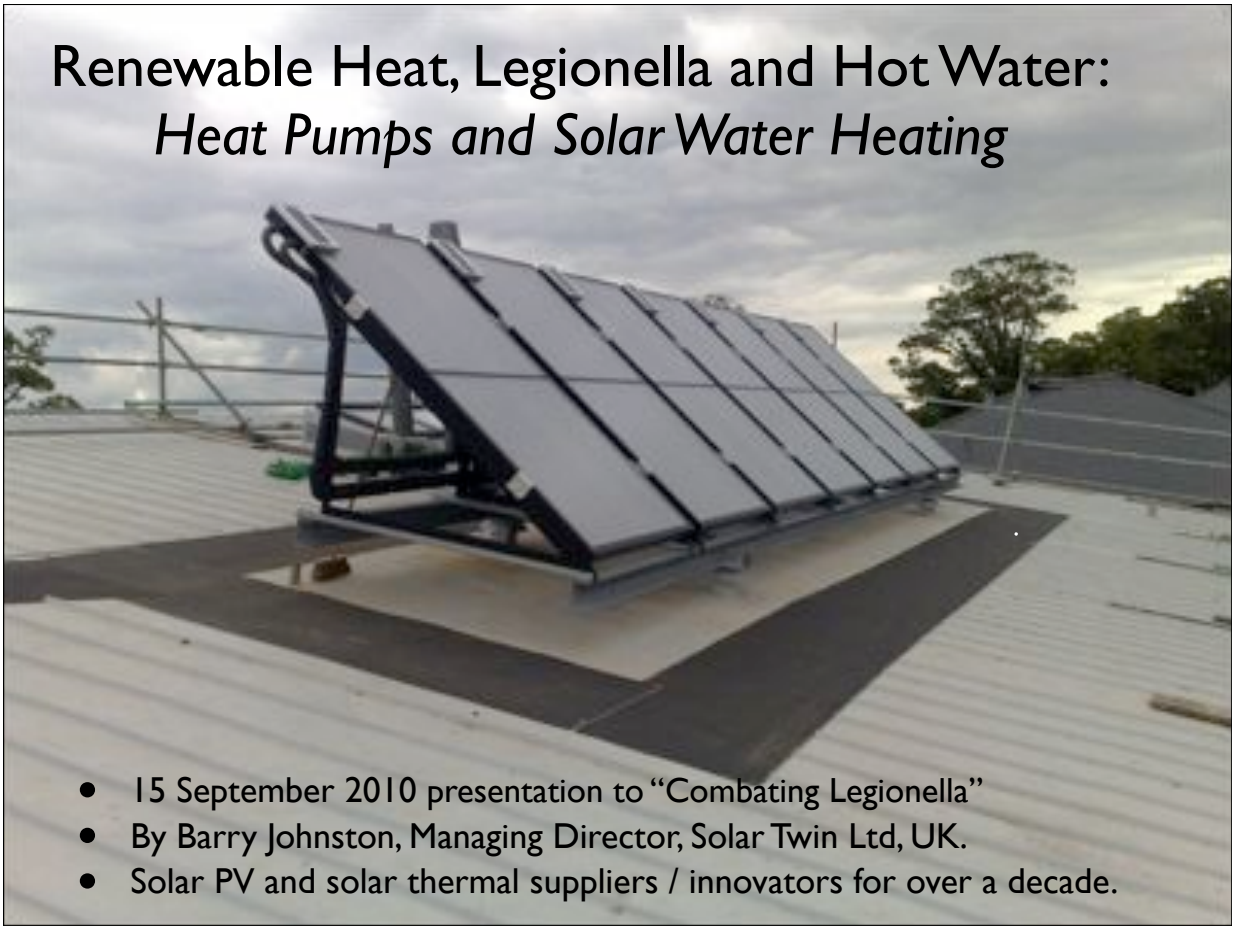
Renewable Heat, Legionella and Hot Water:
Heat Pumps and Solar Water Heating



- 15 September 2010 presentation to "Combating Legionella"
- By Barry Johnston, Managing Director, Solar Twin Ltd, UK.
- Solar PV and solar thermal suppliers / innovators for over a decade.

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Themes

1. Pressures for reducing water storage temperatures, in all applications, renewable energy or otherwise, are financial and environmental.
2. A historical "green exemption" from parts of L8 (or equivalents) today applies across Europe for solarthermal and geothermal water heating systems.
3. Across Europe such "exempt" installations are increasing rapidly.
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7. Example numerical risk assessment on installations outside strict L8 guidance.
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Thermodynamic realities: it saves energy (green or otherwise) to cut water storage temperatures.

You lose 25% less energy when, domestic hot water is stored at 50C (instead of 60C), assuming the air is at 20C.

- *This energy saving happens whether that energy is solar or not.*

Similarly, heating a cylinder to 60C once a day, instead of keeping it hot 24 hrs a day cuts storage energy losses by 25-50%.

- *Installing a solar water heating system saves about as much energy as this change to 24h heating to evening-only heating.*

Moving from 24h heating to evening-only heating.
Polysun simulation, 120 litre cylinder: no solar.

	Annual results 24/24	1/24
Syst. efficiency (Energy consumption / End energy)	0.34	0.41
Solar energy to the system	0	-0
Auxiliary energy to the system	2186	1535.7
Energy consumption	1564.1	1196
Energy deficit	65.6	405.1
End energy to the system (fuel and electricity)	4568.1	2896.7

This saves 37% of energy = 1762 kWh.
(Adding solar water heating saves 600-2000 kWh.)

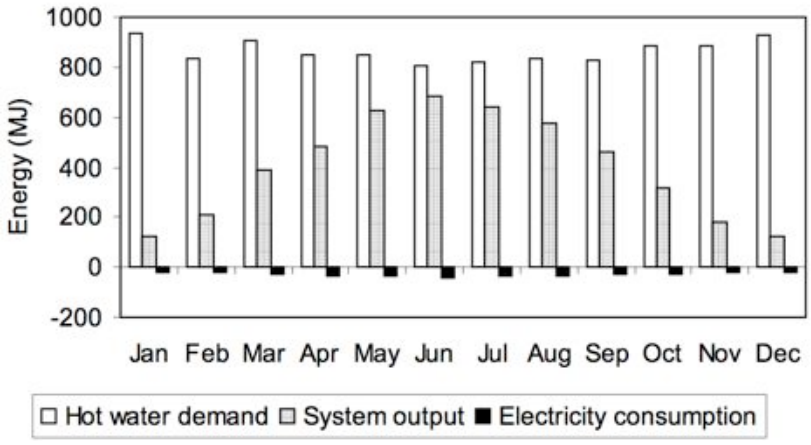
Conventional energy saved = environmental benefit.

- This green benefit happens - whether the conventional energy is saved - or replaced by green energy.
- So a renewables-only exemption from L8 is not logical.
- The foot-in-the-door: is there reason for a wider energy efficiency exemption?

Introducing Heat Pumps (HP) and Solar Water Heating (SWH).

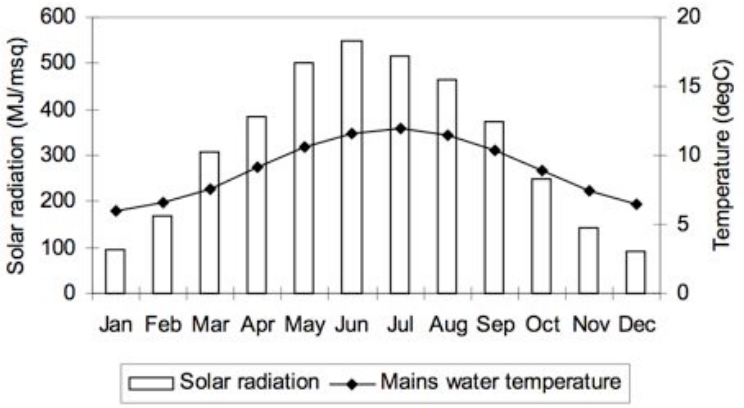
Technology	Is is really solar?	Under-floor / central heating?	Water heating?	Energy in-out ratio? (COP)	Variants	Typical energy storage media	Performance limitations
HP	yes	yes	yes	1:6 to1:1.5	Air or Ground source	Building fabric / water	Best where no gas grid. Low COP over 50C.
SWH	yes	usually no	yes	20 x to infinite	Mains or PV pumped	Water	30-70% solar fraction only.

Seasonal solarthermal performance



Source: side by side testing of eight solar water heating systems
DTI publication no: URN 01/1292. Research by The Energy Monitoring Company.

6:1 seasonality of solar supply



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Solarthermal and Heatpumps
examples of hot water applications

- Single family installations
  - Private homes
  - Social homes
- Multi-user installations
  - Residential: flats, care homes, prisons, hotels
  - Other: offices, fire stations, public toilets, farm / zoo handwashing sports: showers and pools, health centres

Three potential plumbing risk areas:

- Thermostatic blender valves on stores (eg avoid upward cold dead legs)
- External loop in direct solar systems (eg avoid organic polymers)
- Hot water storage / dedicated pre-heat (eg heat the full volume daily?)

Today's focus is

- Hot water storage / pre-heat in
  - *HP (scarce data)*
  - *SWH (more data)*

L8 has the same wording as: European Guidance

for the prevention and control of travel associated Legionnaires' disease

Hot water

The water can be heated by hot water or steam from a boiler which is passed through a coiled heat exchanger sited inside the hot water storage vessel - the [illegible] have been shown to have the lowest incidence of colonisation by Legionella. The storage water heater can also be heated by electricity or by means of an electric immersion heater.

In a hot water system, cold water enters at the base of the storage water heater with hot water rising from the top to the taps and appliances throughout the building. A control thermostat to regulate the supply of heat to the storage water heater is usually fitted near the base and should be adjusted so that the outlet water temperature is constant. The water temperature at the base of the storage water heater (i.e. under the heating coil) will usually be much cooler than the water temperature at the top. Arrangements should therefore be made to heat the whole water content of the storage water heater, including that at the base, to a temperature of 60°C for one hour each day. This period needs to coincide with the operation of boiler plant (or other storage water heater heat source) and is usually arranged during a period of low demand e.g. during the early hours of the morning. A shunt pump to move hot water from the top of the storage water heater to the base is one way of achieving this - in all cases the operation of the pump should be controlled by a time clock.

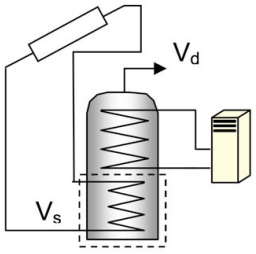
Alternatively, some storage water-heaters are fitted with coils extending to the base to promote convective mixing during heating. This mixing may not be required if using alternative treatment methodologies.

Ideally the storage water heater will have specific connections for the shunt pump return, as low down on the storage water heater as possible.

Dedicated solar volume in space (twin coil solar cylinder)

Does not comply with L8 Guidance Para 158 because:

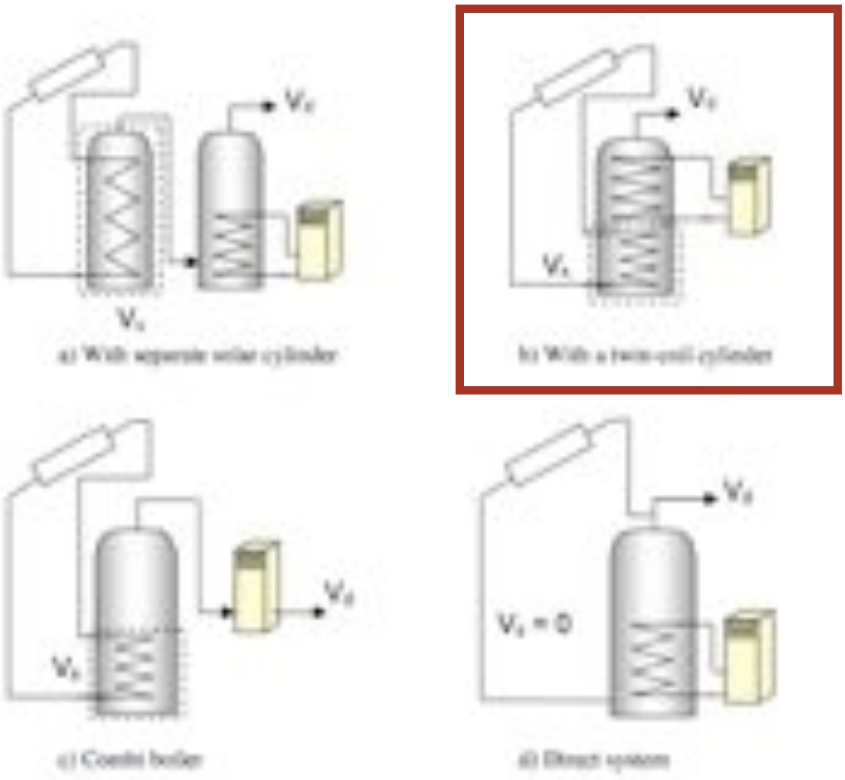
- The UK sun can not ensure heating to 60C every day
- And backup heater is not basal
- It is part-way up instead.



b) With a twin-coil cylinder

From:
DEFRA
SAP 2005
(Solar
Appendix)

Most solar installations are: Twin coil cylinders b).



Safety flagged up

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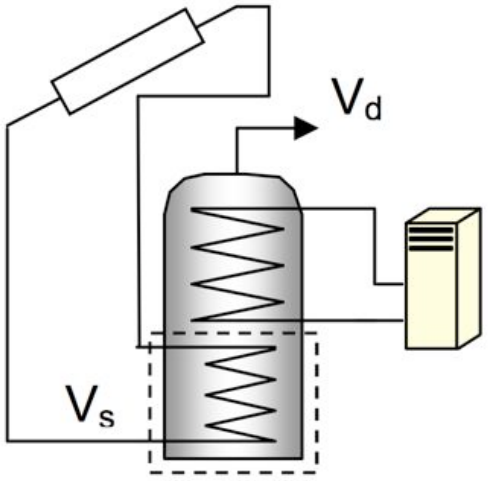
Solartwin.com

innovation in action

Over 80% of solarthermal installations in UK are like this.

Vs (- - - - -) is
"dedicated solar volume in space".

Is it a dedicated Legionella
volume x area x time
= risk as well?



b) With a twin-coil cylinder

zero carbon solar water heating

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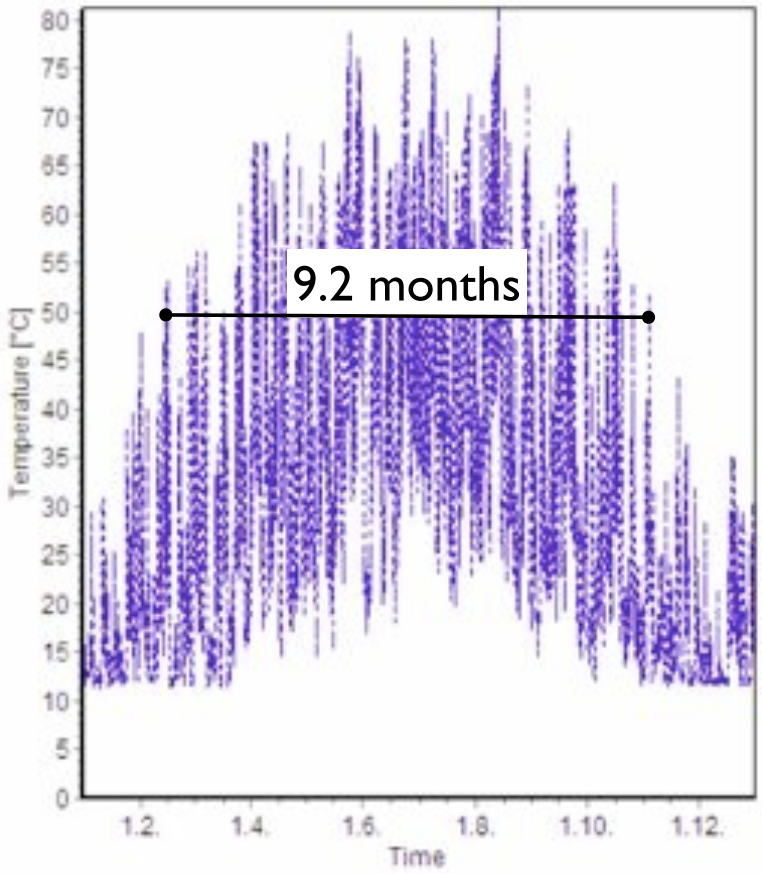
The temperature at the bottom of a solar cylinder in Denmark.

Timespan is a year.

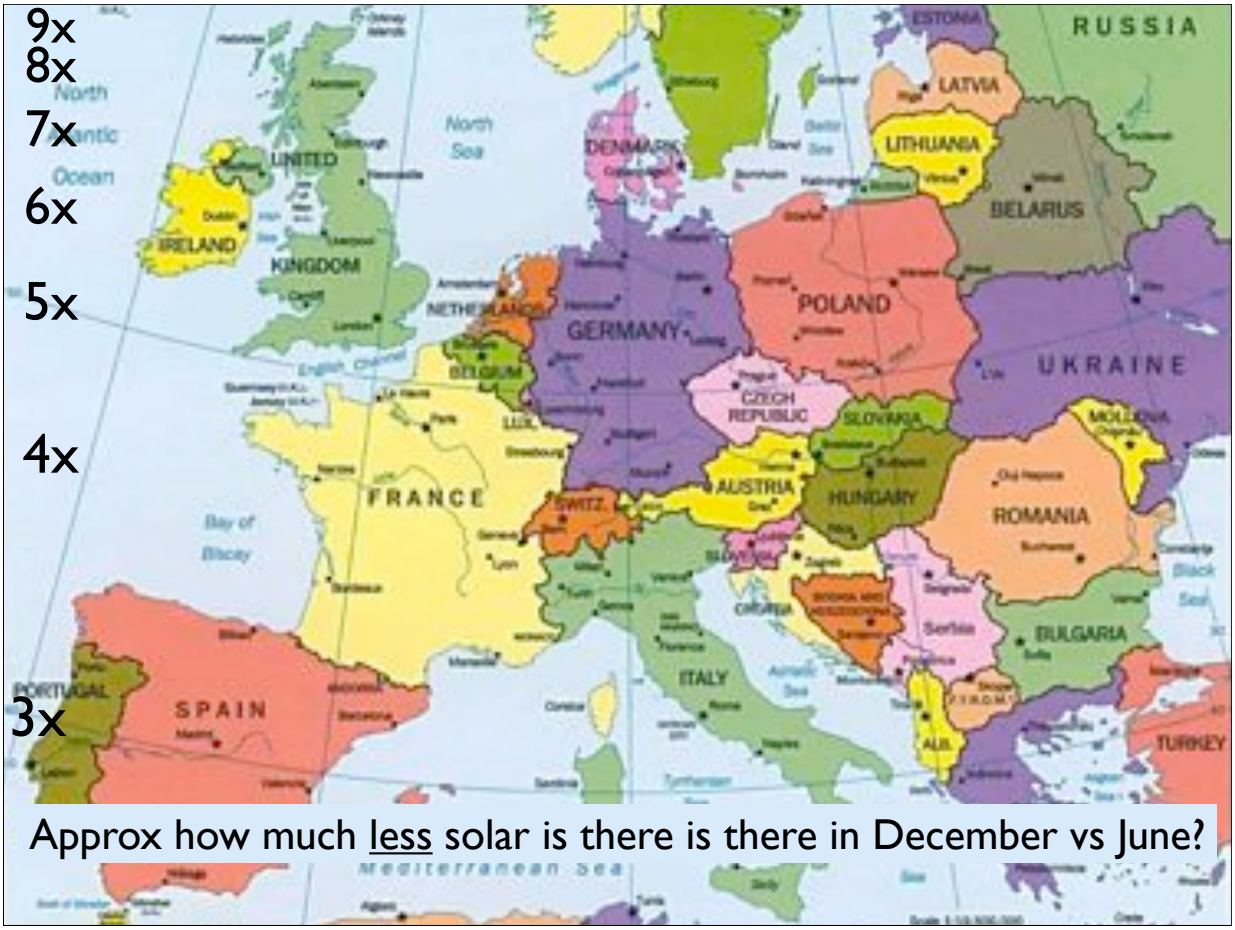
Nearly 3 months elapse without reaching 50C.

Source CEN Technical Committee 312 (Solar Thermal) 06/06/2007



17

9x
8x
7x
6x
5x
4x
3x



Approx how much less solar is there is there in December vs June?

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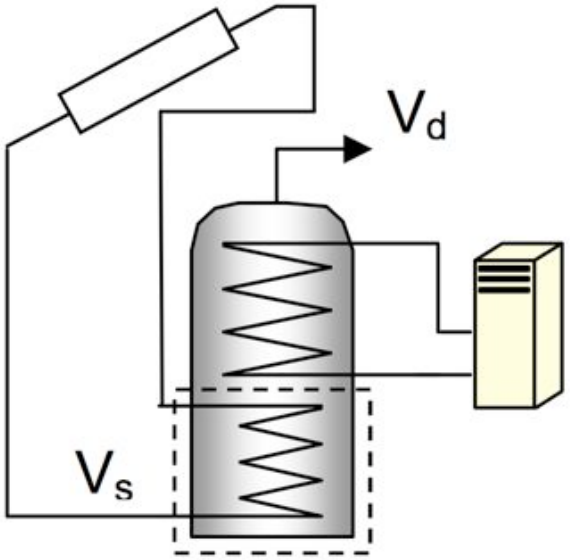
Vs = risk =

- **Larger <u>volume</u> to inhabit**
- **Larger <u>surface</u> area to inhabit**
- **More <u>time</u> to grow.**



b) With a twin-coil cylinder

Regarding solar hot water storage / pre-heat, Legionella bacteria need several factors including nutrients, temperatures under 50C, plus:

- **Volumes to inhabit**
- **Surface area to inhabit**
- **Time to grow.**

<u>Brief BS 8580 context:</u>

1. **Contamination**: header tank lids!
2. **Amplification**:
   - 2.1. typically 100 litres "dedicated solar **volume**",
   - 2.2. large **surfaces**, sometimes also limescale,
   - 2.3. **time**: not heated to 60C for about 3 months
   - 2.4. (often no shunt / destratifier pumps)
3. **Transmission & exposure**: aerosols from showers and spray taps.
4. **Host susceptibility**: retail age median 50y.

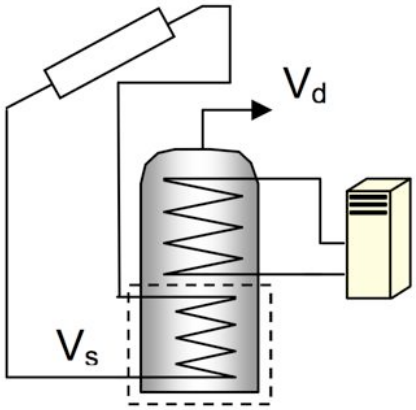
Para 158 in L8 "pack of four"

1. *heat to 60C*
2. *for >1 hour*
3. *every day*
4. *to the base of store.*

TCC's and L8 para 158's "pack of four"

1. *YES heat to 60C*
2. *YES for >1 hour*
3. *YES every day*
4. *NOT to the base of store.*

(Our policy is never to install these.)



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CEN Solar TC 312 Legionella paper

seeks exemption: to bypass the precautionary principle

Although positioned against heating to the base of the cylinder TC 312 "understand the precautionary principle of disease management".

But then seek to bypass it, asking for "special consideration of renewable energy pre-heating on the basis of national and European policies."

This bypass is sought on a questionable claim that "approx 50%" less solar energy would be gained if cylinders were heated to the base.

A recent paper by the author of this TC 312 paper Chris Laughton aiming to substantiate this 50% turned out to be flawed methodology. The real figure is in fact under 11% less energy gain (but potentially better costs-benefits).

CEN Solar TC 312 Legionella paper

claims heating to the base is "unnecessary" because...

"TC 312 sees no need for any recommendations for additional heating of the [dedicated] pre-heated part of a solar water heating system [ie to the base] to certain minimum temperatures."

They claim that the "solar pre-heated hot water will anyway pass through the back-up heated zone with the high temperature and be sterilised within short time [sic] at the correct temperature."

The above presumes that the heat is on all the time (ie 24 hrs a day)

It also presumes that the hot water draw off rate never exceeds the heat addition rate.

To achieve this you might need peak hot water flow limiters to be physically in place. These are often impractical , for example they would play havoc with most showers.

CEN Solar TC 312 Position

"special consideration" of solar is requested

if solar really deserves "special consideration",
then perhaps so does energy efficiency in general?

CEN TC 312's paper on Legionella (06/06/2007)
can be set aside.

- Its "Safe Hot Top" concept is not robust.
  (High water flow rates / what happens below it etc).
- "50% less solar performance" claim for alternatives is exaggerated.
  (More like 10% less. Some alternative designs are in fact cheaper.)
- **So no imperative to ignore the precautionary principle of safety.**

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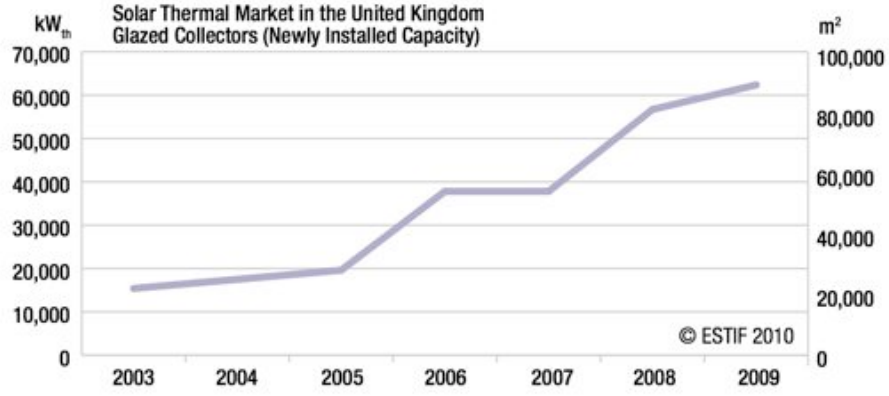
Europe solar thermal

UK: over 80% outside L8 guidance.



Ubiquitous L8-guidance **non**compliant documents in UK: Building regs.

- Building Regs part G (water)
- Building Regs part L (energy) refer to
  - Domestic heating compliance guide
  - Draft domestic Services compliance guide
  - SAP (DEFRA originated energy calcs).

More L8 guidance **non**compliant docs: UK, other than building regs.

- Microgeneration Certification Scheme (MCS) Solar thermal installer specification MIS 3001
- Energy Saving Trust Solar Guide CE 131 (referred to in part L and MCS)
- CIBSE Solar Heating Guide (referred to in part L and MCS)
- British Plumbing Education Council Solar Installers Manual.
- Energy Saving Trust / Building Research Establishment-drafted "solar best practice" series documents which said that the larger the dedicated solar volume the better the practice. (Now abandoned.)

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Are consumers kept informed?

- **European Standards: A member of CEN solar TC 312** seeks to repeat a procedurally-based boycott of new ideas in the Legionella debate In April 2010.

  (fat-finger TC 312 member in an email to several other members).

  - *"To my opinion we should not react directly to Johnston's email, but stick to our previous position that we do not enter in dialog with people that bypass their national mirror committee.*
  - *"I do not want to be involved in discussions that are not seriously based on physical and biological arguments, with people that only want to promote their own system. What do you mean?*
  - *"Does anybody know why ESTIF delegated to Johnston the task of dealing with this sensible issue? Does ESTIF know what could happen on this sensitive issue if Johnston's proposal would be agreed to by CEN/TC164/WG2?"*

Are consumers kept informed?

- **Solar grants / DTI / DECC / Building Research Establishment (BRE)**
  - BRE administered DTI grant approval of tens of thousands of grant aided installations for twin coil cylinders which are out of compliance with L8 guidance para 158.
  - When BRE were the the sole solar installer accreditation body for Low Carbon Buildings solar grants:
    - *We requested the "pack of four" ie heating to the base of a hot water cylinder to be allowed for grants but BRE refused to contract to accredit Solar Twin Ltd as a Microgeneration Scheme solar thermal installer when we requested performance assessment to be made in the context of safety, including Legionella.*

Are consumers kept informed?

- **Solar Trade Association**, February 2007 warns (and threatens):
  - *"The legionella issue is best left alone (for all members) as any mention of legionella and solar brings customer concerns out that are unjustified.*
  - *"...any mention of legionella will reduce total sales.*
  - *"Any mention of potentially negative perceptions that are unjustified such as electrical safety or legionella that is just not happening and I will take action."*

Are consumers being kept well informed of the **extent** of the Legionella debate?

- By subsidy / grant awarding bodies? - No.
- By the Solar Trade Association? - No.
- By the Consumer's Association? - No.

  (Which's Magazine's Solarthermal and Legionella article was pulled from publication in Spring 2009, apparently following industry pressure.)

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Small European Study

Found Legionella 6 x more common in solar homes.

- A Danish study found 50% of solar homes had Legionella.
- Non-solar homes had six times less, at 8%.
- Only 24 homes were studied, so a relatively small study.

Ref: Undersøgelse af legionella i solvarmebeholdere og i traditionelle beholdere. Civ.ing. Klaus Ellehauge, SolEnergiCentret, Energidivisionen. Civ.ing. Ph.D. Lene Bagh, Miljødivisionen. 1. udgave, 1. oplag 2001. Tryk og indbinding: Teknologisk Institut. Miljø- og Energiministeriet, Energistyrelsen. Amaliegade 44, 1256 København K, Danmark. J.nr.: 51181/00-0040. ISBN: 87-7756-650-5.

- Like UK, Denmark is a Northern European state.
- Other sampling studies have reported no increase with solar.

- Legionella apparently linked to solarthermal outside Europe

http://www.q-net.net.au/~legion/Legionnaires_Disease_England_Wales_1996.htm

*"Outbreak III The first outbreak of legionnaires' disease ever associated with the **Caribbean island of Antigua was detected in October 1996**.*

Two cases occurred in September and one in October 1996. All had stayed at a hotel complex in Mamora Bay. The PHLS and the Caribbean Epidemiology Centre (CAREC) were invited by the Ministry of Health of Antigua and Barbuda to carry out environmental and epidemiological investigations into the source and extent of the outbreak.

The hotel's sickness records showed that the incidence of respiratory illness was higher than expected among staff in August and among guests in September, suggesting that the outbreak had been triggered by a single event.

This event was found to be the installation in August of a solar powered hot water system at the hotel.

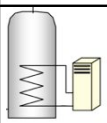
Thirty-one out of 54 hot and cold water samples from the hotel's water systems were positive for legionella and 19 of these contained L. pneumophila sg 1....

....A serological survey of 11 of the 35 hotel staff who reported a respiratory illness between August and November revealed two people who were retrospectively diagnosed as presumptive cases of legionnaires' disease with single high titres of antibody against legionella....

...Several national and international tour operators stopped sending guests to the hotel when the outbreak was identified in November and did not return to the hotel until December when all investigations and control measures were completed."

Simple risk index

Area x volume x time = simple risk index

Relative risk example calcs: Hard water: 250 ppm CaCO3 Simple risk index: Vol x Area x time Try your own figures or methodology.	Notes:	Wetted **area** (sq m) not reliably heated to 50C daily.			**Volume** not reliably heated to 50C every day. (litres) Assume there is typically an unheated volume at base of cyl of 15 litres (not thermal stores)	Usual max **time** between 100% water volume replacement (days) when in daily use.	Total **risk** index assuming: Risk = surfaces x Time x Volume	Percent of non-solar existing cylinder risk
		Cylinder wall, floor and heater / solar coils.	Limescale interstices.	**Total area.**				
Control / reference: Non solar existing 150 l cylinder.		**0.3**	**+ 1.5**	**= 1.8**				**100% (reference case)**
Twin coil conventional solar cylinder, 200 l.		**1**	**+ 1**	**= 2**				

Relative risk example calcs: Hard water: 250 ppm CaCO3 Simple risk index: Vol x Area x time Try your own figures or methodology.	Notes:	Wetted **area** (sq m) not reliably heated to 50C daily.			**Volume** not reliably heated to 50C every day. (litres)	Usual max **time** between 100% water volume replacement (days) when in daily use.	Total **risk** index assuming: Risk = surfaces x Time x Volume	Percent of non-solar existing cylinder risk
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Control / reference: Non solar existing 150 l cylinder.	heat almost to base apart from 0.3 sqm / 15 litres	0.3	1.5	1.8	X 15	X 1.2 =	32	**100% (reference case)**
Twin coil conventional solar cylinder, 200 l.	1/0 Base case. Internal surface 2 sqm	1	1	2	X 100	X 1.6 =	320	**988%**

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Control / reference: Non solar existing 150 l cylinder.	heat almost to base apart from 0.3 sqm / 15 litres	0.3	1.5	1.8	X 15	X 1.2 =	32	**100% (reference case)**
2 series cylinders with solar in the first, 2 x 100 litre.	1/0 Sizing assumes all cyls 0.6 m dia.	1.5	1	2.5	115	1.6	460	1,420%
Twin coil conventional solar cylinder, 200 l.	1/0 Base case. Internal surface 2 sqm	1	1	2	100	1.6	320	988%
Indirect solar retrofit to existing 150 l cylinder.	1/0 Retrofits heat almost to base apart from 0.3 sqm / 10 litres. Has a surface of 2.5 sqm	2.8	1.5	4.3	10	1.15	49	153%
Direct solar retrofit to existing 150 l cylinder. (Direct more often needs a softener)	0/0 with 1 sqm wetted ext loop surface, vol is 3 litres.	1.3	0.2	1.5	18	1.2	32	100%
Solar in thermal store, 200 litre.	0/1	0.5	0.1	0.6	5	0.5	2	5%

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courtprice

Courtprice Limited

RON BERRY
MANAGING DIRECTOR

iphe

Major plumbers insurance broker may not cover conventional solar cylinders

- Courtprice Ltd
- Broker to IPHE: Institute of Plumbing and Heating Engineering.
- Broker to thousands of plumbers.

Courtprice void insurance:

As I have pointed out to you, under the Public Liability section of all Contractors' policies the cover is accidental injury and you were also correct in my interpretation of the exclusion number 10 which is Defective Work. The resultant damage of defective work is always covered by Public and Products Liability policies but the actual rectification work of the defect is not.

There are wider implications here. Having spoken to various industry colleagues of many years standing, we are all under the impression that my comments do not just relate to solar installation but to any plumbing installation, where the engineer knows that it does not conform to current regulations or knowingly installs a system which could cause injury or damage. He is definitely in breach of various policy conditions, no more so than the duty of care condition which applies to all policies. This gives Underwriters the opportunity of voiding cover in the event of a claim and, given the current financial climate, I have no doubt in my own mind that such action would be taken by Underwriters to protect their position.

How is today's solar tradeoff risk level described?

- **About ten times higher risk**
  Simple risk assessment earlier.
- "**Highly likely to be creating a risk**"
  Dr Tom Makin Liverpool University Hosps report to WRAS.
- Conventional twin coil cylinders are a "**Serious flaw in design**" Legionella Control International. Consultants report to Solar Twin Ltd.
- Concern is **"Unjustified." "There has never been a case of Legionella anywhere in EU on a system with storage as low as 50C"** Solar Trade Association.

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Hot water storage falling outside L8 guidance.

a) Twin series cylinders with solar upstream

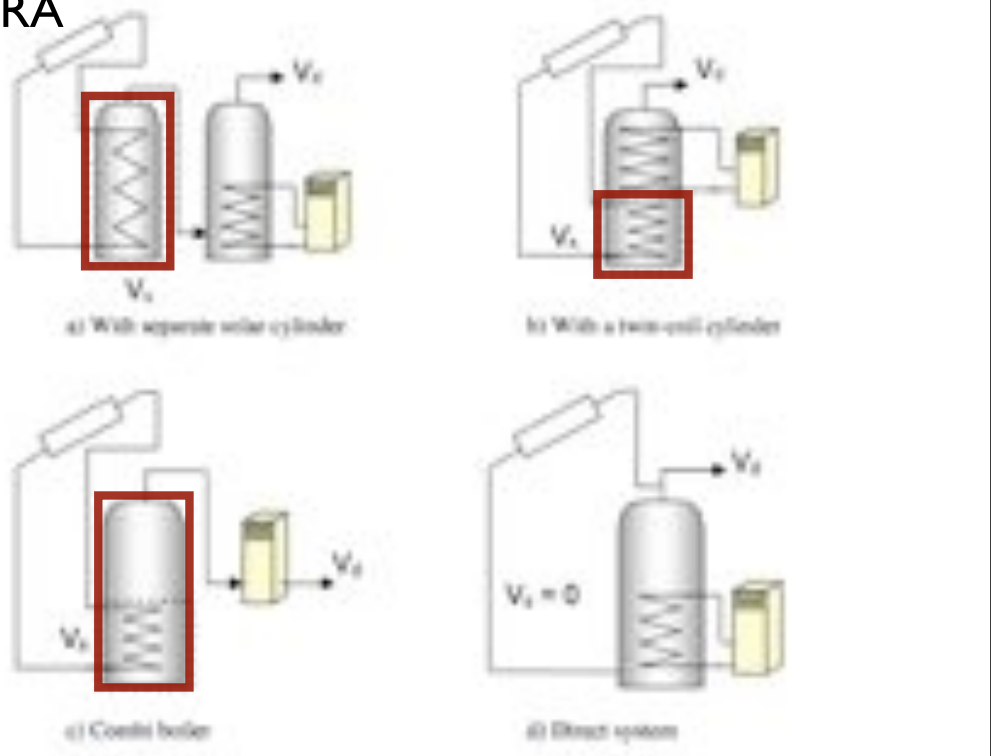
b) Twin coil cylinders (by far the most common)

c) Some combination boiler pre-feeds

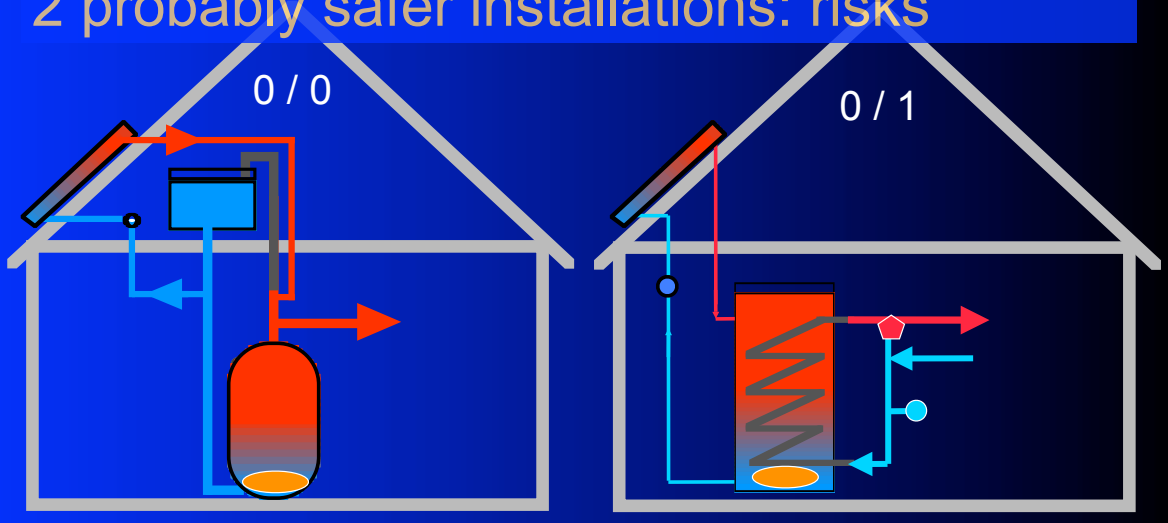
These three are usually only out of compliance if they have no destratification pump or other means of regular heating to the base.

Until Nov 2009 installers had to ignore L8 para 158 in order to gain Microgeneration Certification for Low Carbon Buildings grants of 10-50% project value.

From: DEFRA SAP 2005 (Solar Appendix)



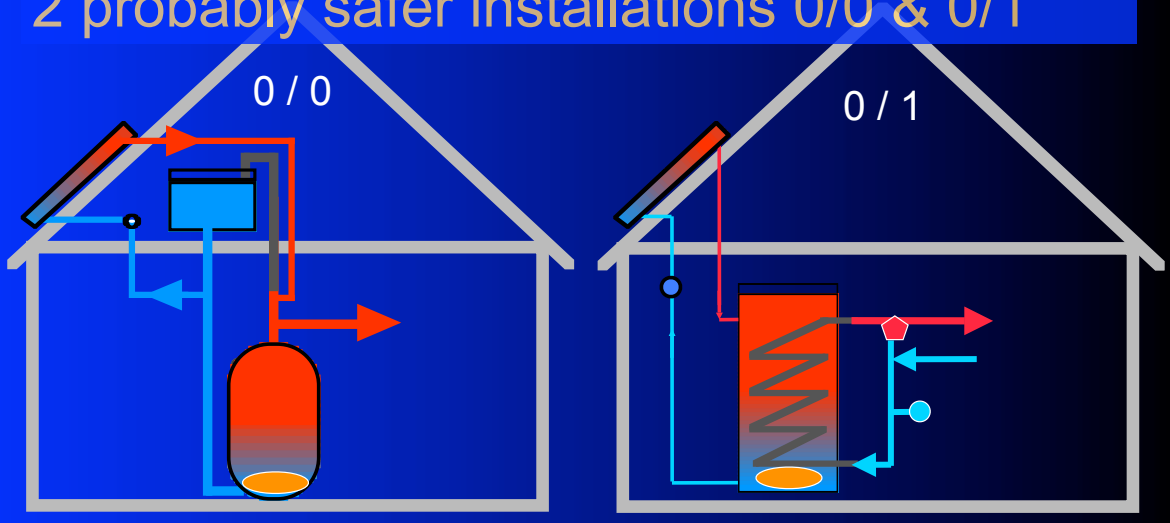
2 probably safer installations: risks



d). Direct conventional cylinder.
Retrofit or new cylinder.
(Blender valve not shown).
Backup heater at base.
= Dedicated solar vol. in time.

(not in SAP).
Thermal store.
Usually new installation.
Backup heater options:
base (shown) or raised
(with heat exch. also raised.)

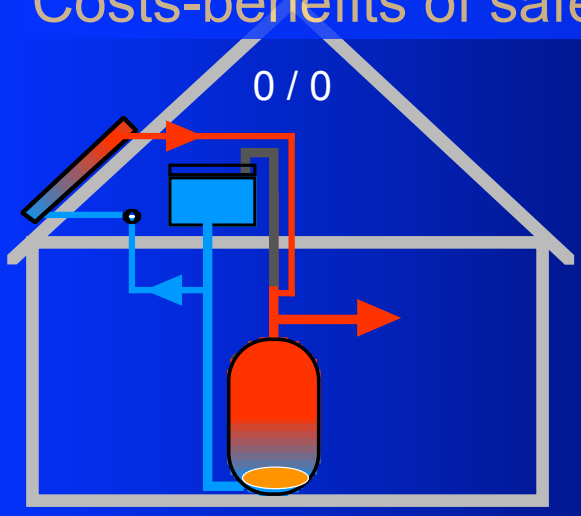
2 probably safer installations 0/0 & 0/1



d). Direct base-heat conventional cylinder. Indirect also used.
- Hard water needs ion exchange softener.
- Risk similar to conventional non-solar plumbing.

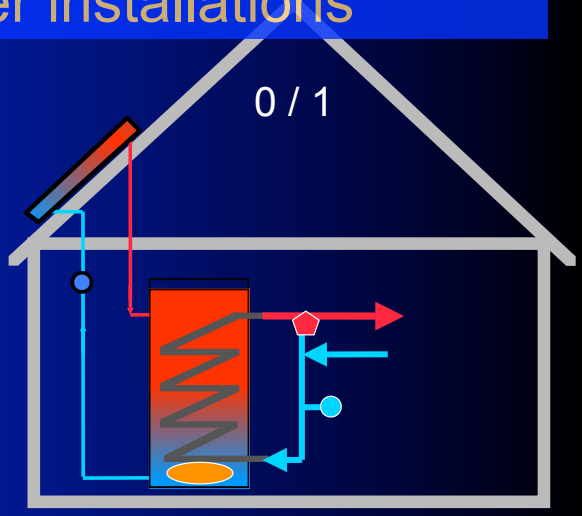
Thermal store.
Only about 5% of the risk.
- Low surface area
- Low volume of water
- Rapid water turnover.

Costs-benefits of safer installations



d). Direct conventional cylinder as a retrofit:

- Costs 20% less than TCC
- About 10% less energy.



Thermal store.

- Costs 20% more than TCC
- 0% - 30% more energy.

So...

Safer alternatives to conventional twin coil cylinders (TCC's) include:

- ***Heating to the base in evenings***

  Includes TCC's with destratification pumps

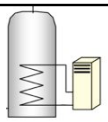
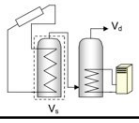
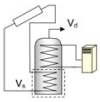
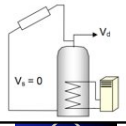
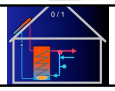
- ***Thermal stores with backup heating***

Both perform fine in energy and costs-benefits terms.

Themes

1. Pressures for reducing water storage temperatures, in all applications, renewable energy or otherwise, are financial and environmental.
2. A historical “green exemption” from parts of L8 (or equivalents) today applies across Europe for solarthermal and geothermal water heating systems.
3. Across Europe such “exempt” installations are increasing rapidly.
4. Most renewable heat consumers do not seem aware of any “exemption”.
5. How far (if at all) is it OK to permit a tradeoff between maximising energy conservation and risk?
6. Today, which areas (plumbing & backup heating control) fall outside L8 guidance?
7. Example numerical risk assessment on installations outside strict L8 guidance.
8. Moving forward: who has the final say? Industry, regulators, consumers...?

Area x volume x time = simple risk index

Relative risk example calcs: Hard water: 250 ppm CaCO3 Simple risk index: Vol x Area x time Try your own figures or methodology.	Notes:	Wetted **area** (sq m) not reliably heated to 50C daily.			**Volume** not reliably heated to 50C every day. (litres)	Usual max **time** between 100% water volume replacement (days) when in daily use.	Total **risk** index assuming: Risk = surfaces x Time x Volume	Percent of non-solar existing cylinder risk
		Cylinder wall, floor and heater / solar coils.	Limescale interstices.	**Total area.**	Assume there is typically an unheated volume at base of cyl of 15 litres (not thermal stores)			
Control / reference: Non solar existing 150 l cylinder.		**0.3**	**1.5**	**1.8**	**15**	**1.2**	**32**	**100% (reference case)**
2 series cylinders with solar in the first, 2 x 100 litre.		1.5	1	2.5	115	1.6	460	1,420%
Twin coil conventional solar cylinder, 200 l.		**1**	**1**	**2**	**100**	**1.6**	**320**	**988%**
Indirect solar retrofit to existing 150 l cylinder.		2.8	1.5	4.3	10	1.15	49	153%
Direct solar retrofit to existing 150 l cylinder. (Direct more often needs a softener)		1.3	0.2	1.5	18	1.2	32	100%
Solar in thermal store, 200 litre.		0.5	0.1	0.6	5	0.5	2	5%

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Relative risk example calcs: Hard water: 250 ppm CaCO3 Simple risk index: Vol x Area x time Try your own figures or methodology.	Notes:	Wetted **area** (sq m) not reliably heated to 50C daily.			**Volume** not reliably heated to 50C every day. (litres)	Usual max **time** between 100% water volume replacement (days) when in daily use.	Total **risk** index assuming: Risk = surfaces x Time x Volume	Percent of non-solar existing cylinder risk
		Cylinder wall, floor and heater / solar coils.	Limescale interstices.	**Total area.**	Assume there is typically an unheated volume at base of cyl of 15 litres (not thermal stores)			
Control / reference: Non solar existing 150 l cylinder.	heat almost to base apart from 0.3 sqm / 15 litres	**0.3**	**1.5**	**1.8**	**15**	**1.2**	**32**	**100% (reference case)**
2 series cylinders with solar in the first, 2 x 100 litre.	1/0 Sizing assumes all cyls 0.6 m dia.	**1.5**	**1**	**2.5**	**115**	**1.6**	**460**	**1,420%**
Twin coil conventional solar cylinder, 200 l.	1/0 Base case. Internal surface 2 sqm	**1**	**1**	**2**	**100**	**1.6**	**320**	**988%**
Indirect solar retrofit to existing 150 l cylinder.	1/0 Retrofits heat almost to base apart from 0.3 sqm / 10 litres. Has a surface of 2.5 sqm	**2.8**	**1.5**	**4.3**	**10**	**1.15**	**49**	**153%**
Direct solar retrofit to existing 150 l cylinder. (Direct more often needs a softener)	0/0 with 1 sqm wetted ext loop surface, vol is 3 litres.	**1.3**	**0.2**	**1.5**	**18**	**1.2**	**32**	**100%**
Solar in thermal store, 200 litre.	0/1	**0.5**	**0.1**	**0.6**	**5**	**0.5**	**2**	**5%**

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Themes

1. Pressures for reducing water storage temperatures, in all applications, renewable energy or otherwise, are financial and environmental.
2. A historical “green exemption” from parts of L8 (or equivalents) today applies across Europe for solarthermal and geothermal water heating systems.
3. Across Europe such “exempt” installations are increasing rapidly.
4. Most renewable heat consumers do not seem aware of any “exemption”.
5. How far (if at all) is it OK to permit a tradeoff between maximising energy conservation and risk?
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The final say?

- Please take any decision out of the political arena.
- Do we wait until a SWH / HP case happens?

Is there a chance of a Legionella iceberg?

- *UK aims to expand from about 100,000 solar thermal homes today*
- *To 7 million by 2020.*

  This is a 70 x increase.

- *Other European states are planning similarly.*
- *Are we planning ahead well enough?*

  We will NEVER have ALL the data.

But do we have enough data to act wisely?

Summary

1. Financial & environmental pressures for reducing water storage temperatures / setting L8 guidance aside are getting stronger.
2. "Green exemption" from parts of L8 (or their EU equivalents) today applies across Europe but only for solarthermal and geothermal water heating systems.
3. Across Europe "exempt" installations are increasing rapidly, with industry consent.
4. Most renewable heat consumers are probably unaware of this "exemption".
5. If today's tradeoff between maximising energy conservation and risk is OK, then perhaps this tradeoff should extend much wider than just renewable energy.
6. Over 80% of solarthermal and heatpump installations are outside L8 guidance.
7. Numerical risk assessment suggests risks are 10x higher than if no solar. Heating to the cylinder base / thermal stores are both viable alternatives.
8. Do we just wait? What next? Decision may need to be removed from industry's hands.

Thank you for your valuable attention.

Any questions?

15 September 2010 presentation to "Combating Legionella"

By Barry Johnston, Managing Director, Solar Twin Ltd, UK.

Solar PV and solar thermal suppliers / innovators for over a decade.