

Thermal Imaging Training

Wed 1st November 2023, 7:00 - 8:30pm

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Thermal imaging

- get free training
- borrow a camera
- find heat leaks

See your home in a new light:

- understand thermal problems
and fix them
- *improve comfort*
- *cut bills & carbon emissions*



Training Sections

1. Uses of Thermal Imaging
2. Using a TI Camera
3. Interpreting Images: pitfalls
4. Borrowing a Camera
 - Questions after each

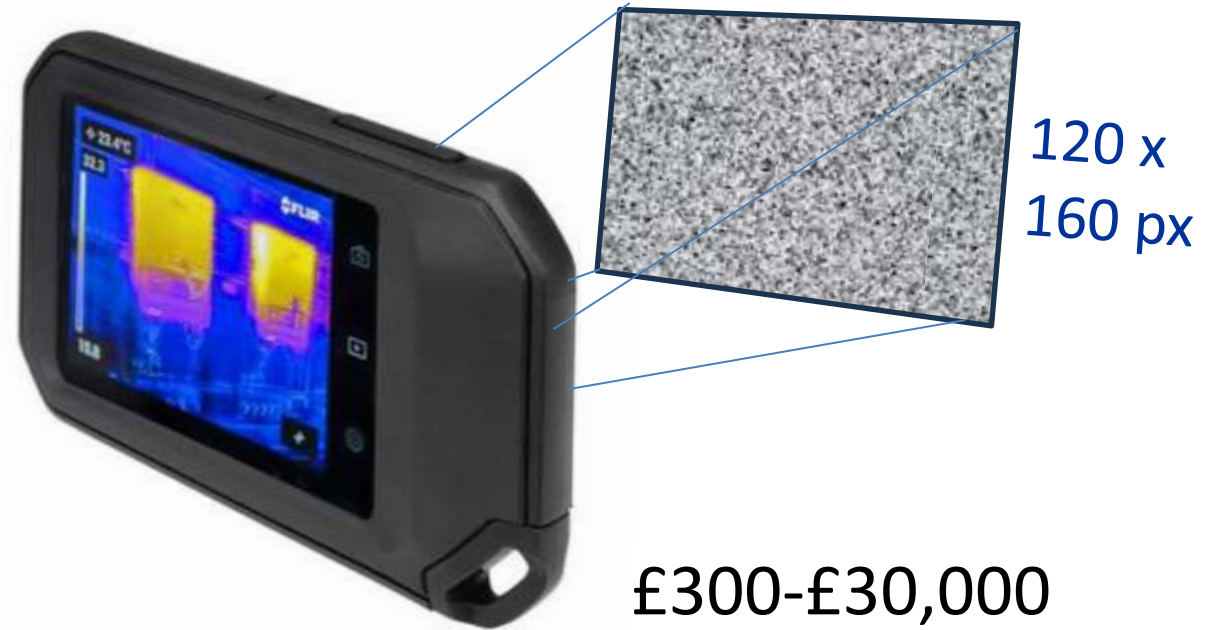


IR Thermometer



£20-£60

Thermal Camera



£300-£30,000

Both measure Infra-Red to show surface temperatures

Can show thermal effects of deeper structures, insulation, etc

White-hot objects emit light; all surfaces glow in Infra-Red, more so at higher temperatures

Uses of TI

Insulation Problems

Looking up at top-floor ceiling

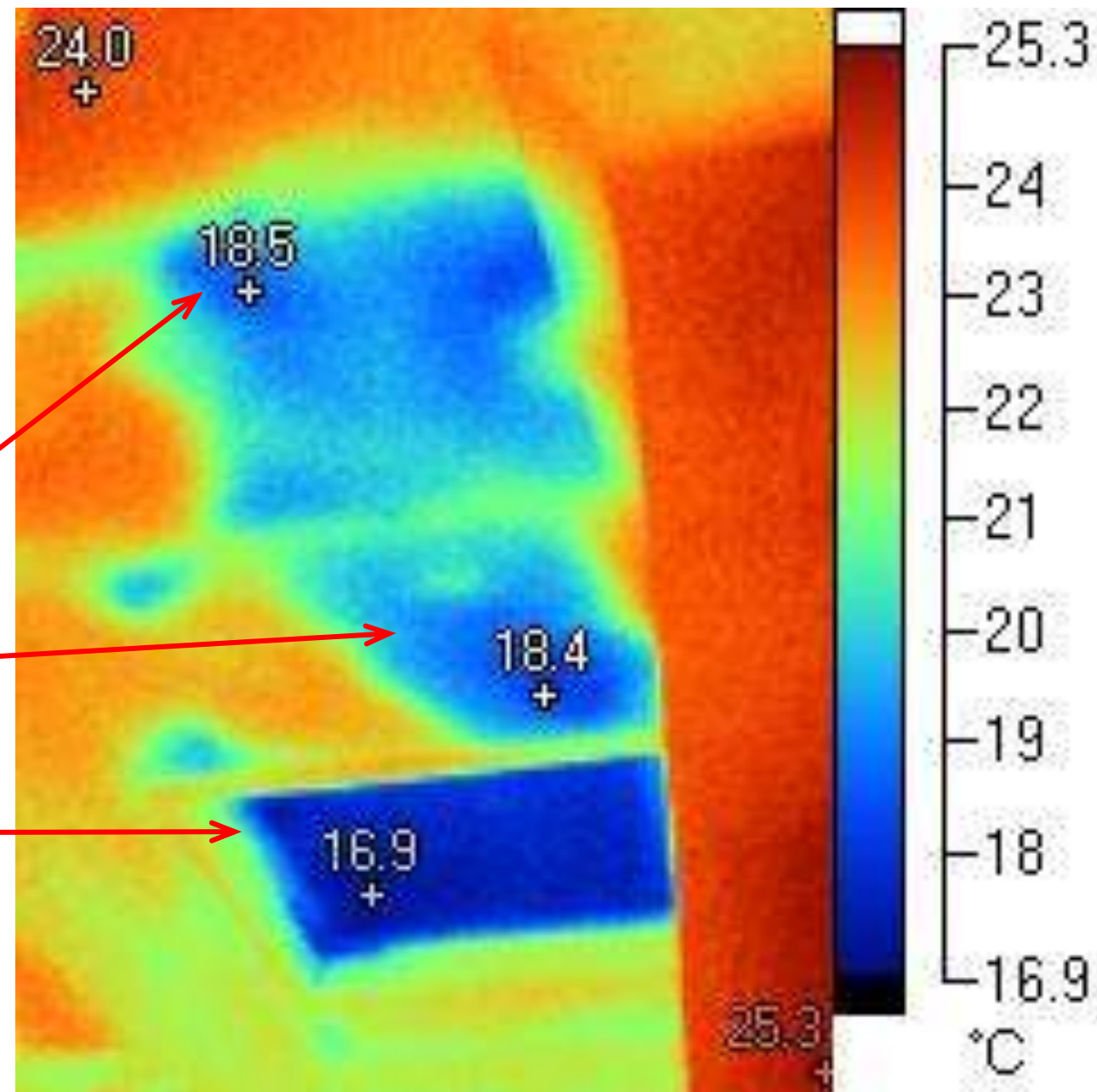
From inside: blue, cold = leaky

What are we seeing?

Loft insulation
missing or thin

Poorly insulated loft hatch

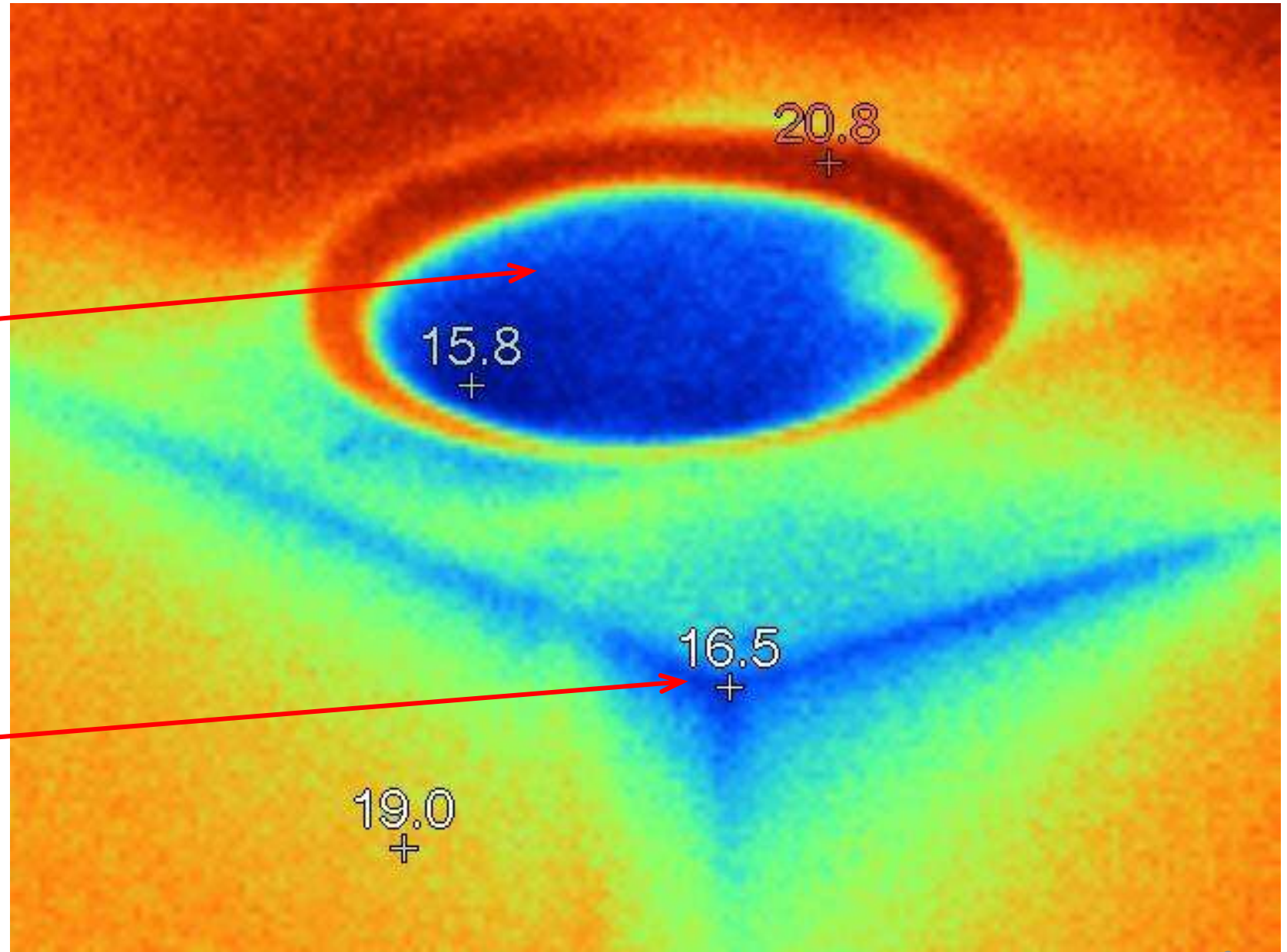
5°C difference is significant



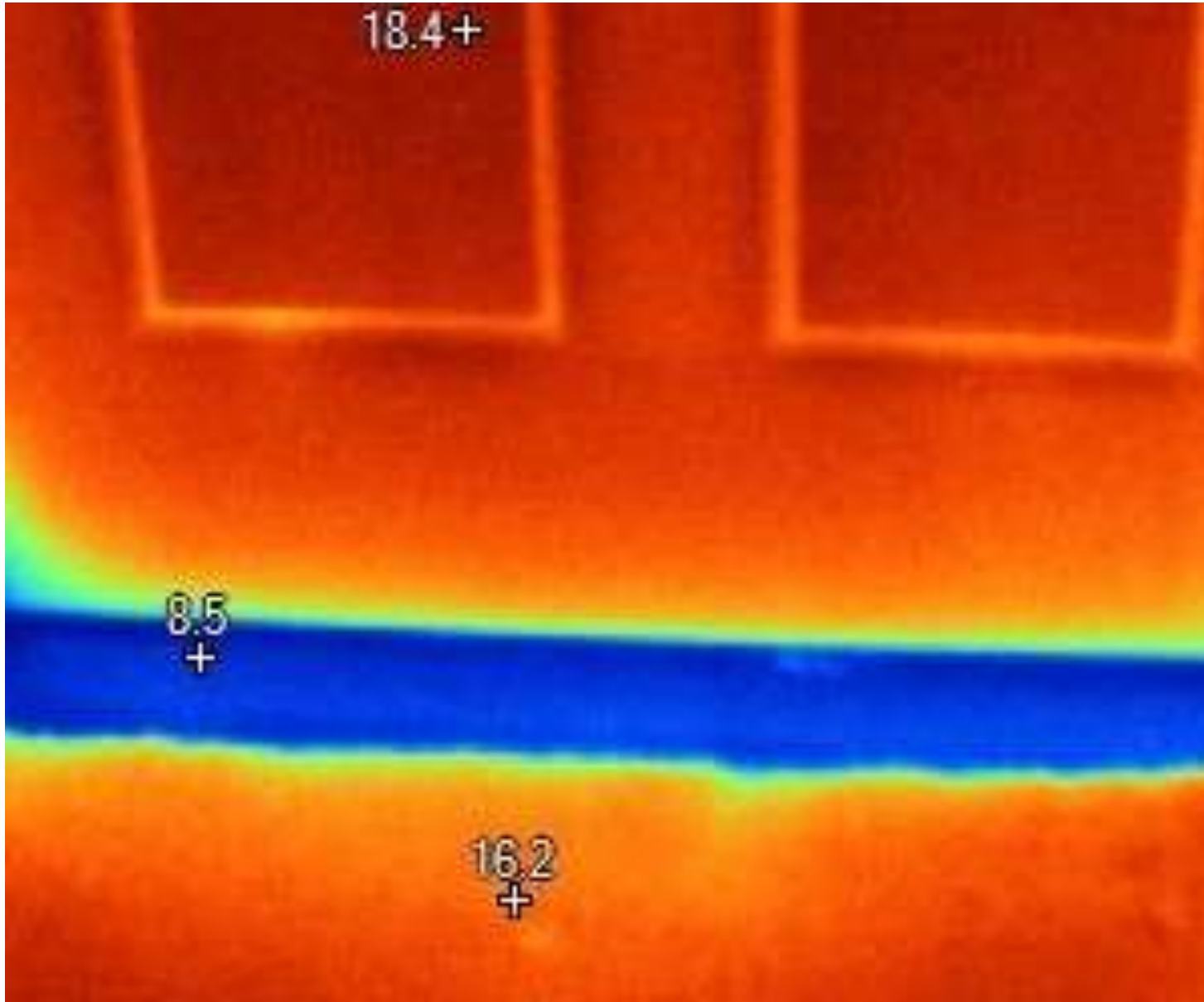
Another Ceiling

Light fitting with
draught through
wiring hole?

Cold Corner:
Not serious?



Cold Bridge - something conductive through the insulation

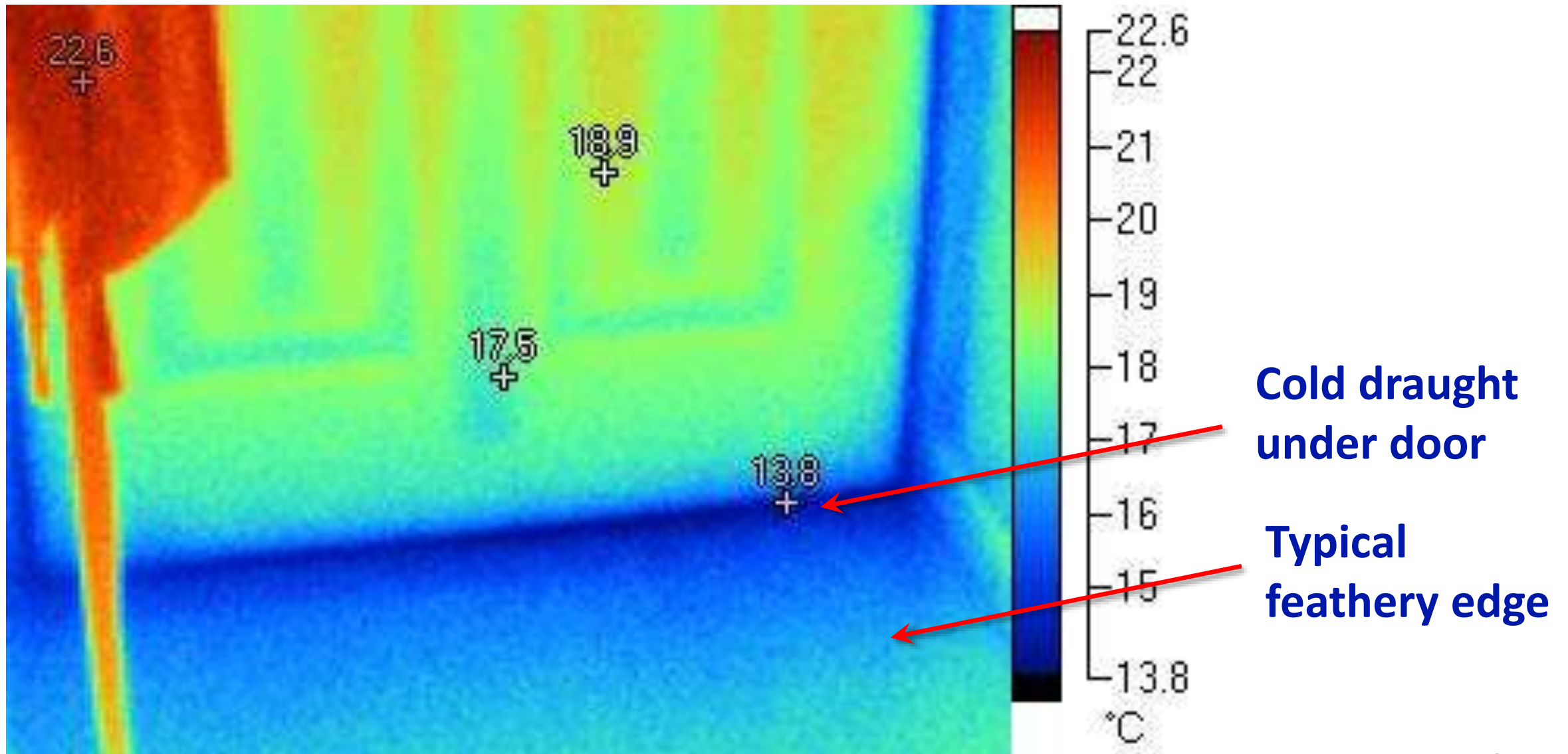


← **Front Door**

← **Stone Threshold:
Cold Bridge**

← **Hall Carpet**

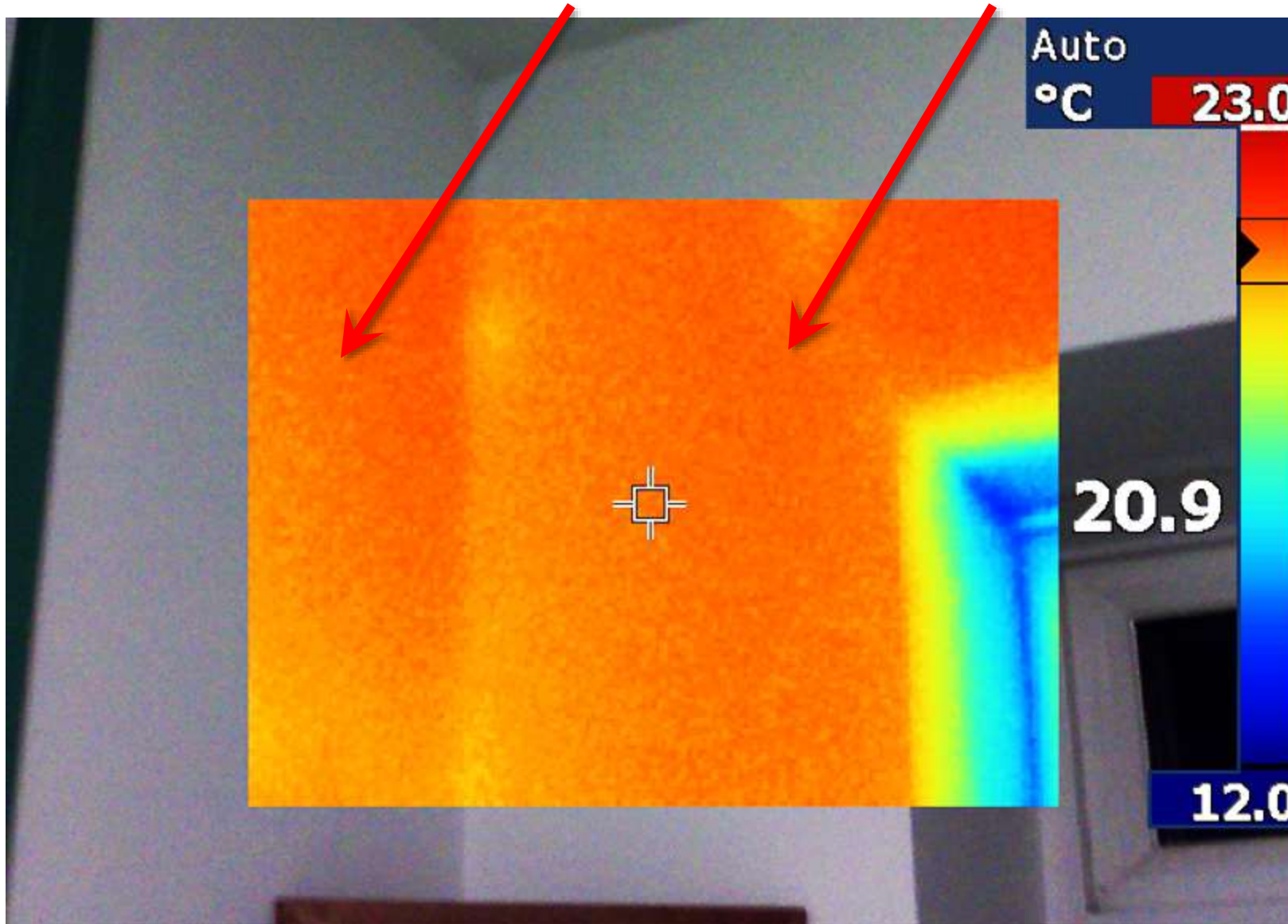
Draughts



Comparing Internal and External Walls

on the other side: a warm room

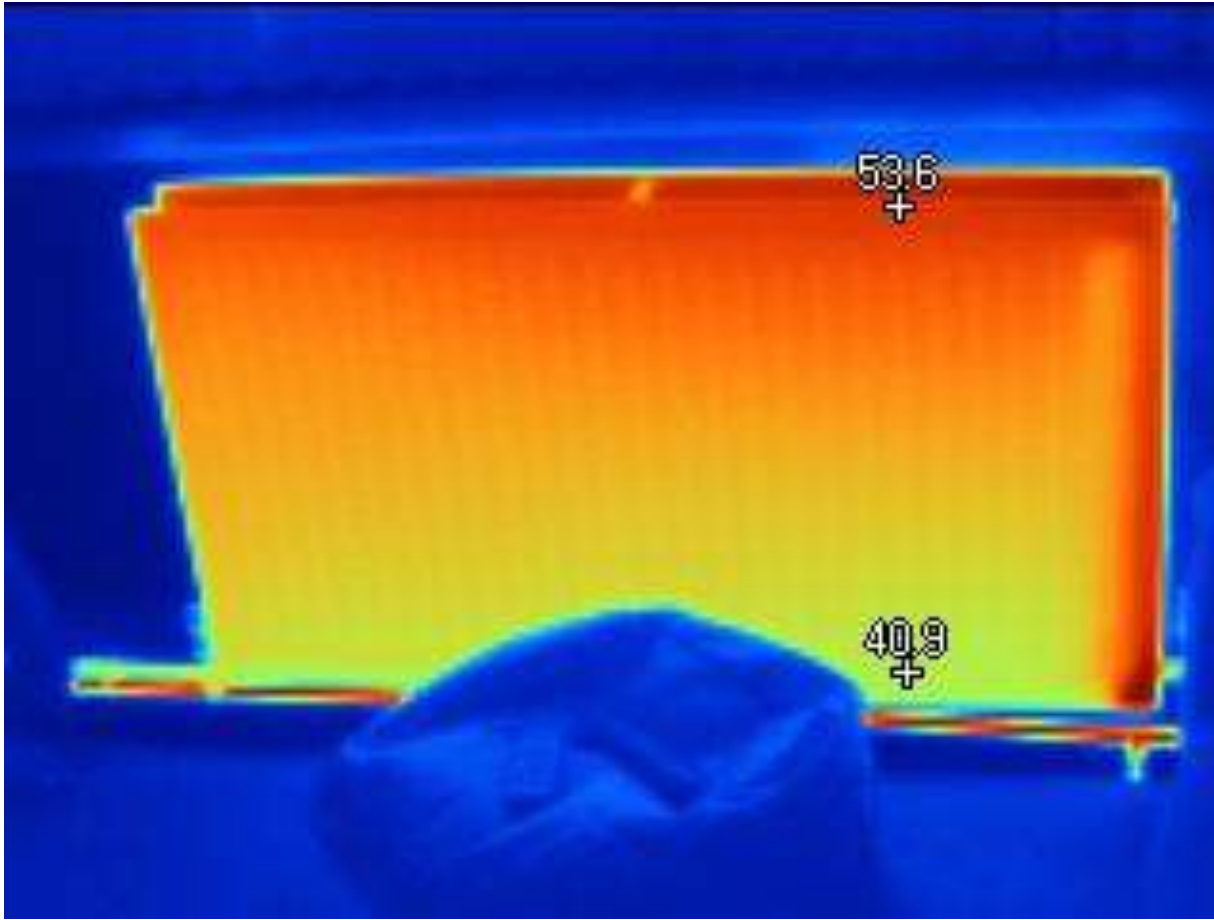
outside



They're the same temperature – great!

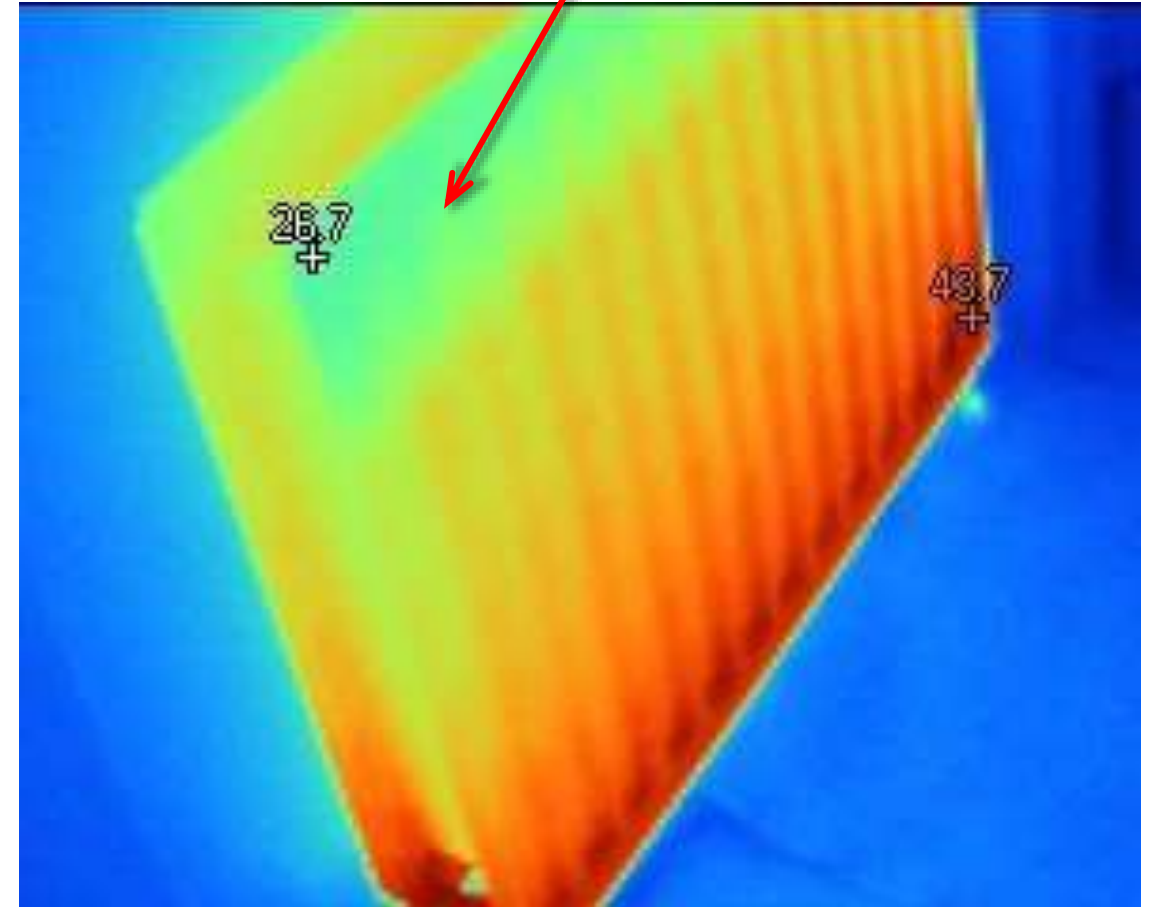
If external wall is more than 1 or 2°C cooler than the internal, then better insulation would be good.

Normal radiator



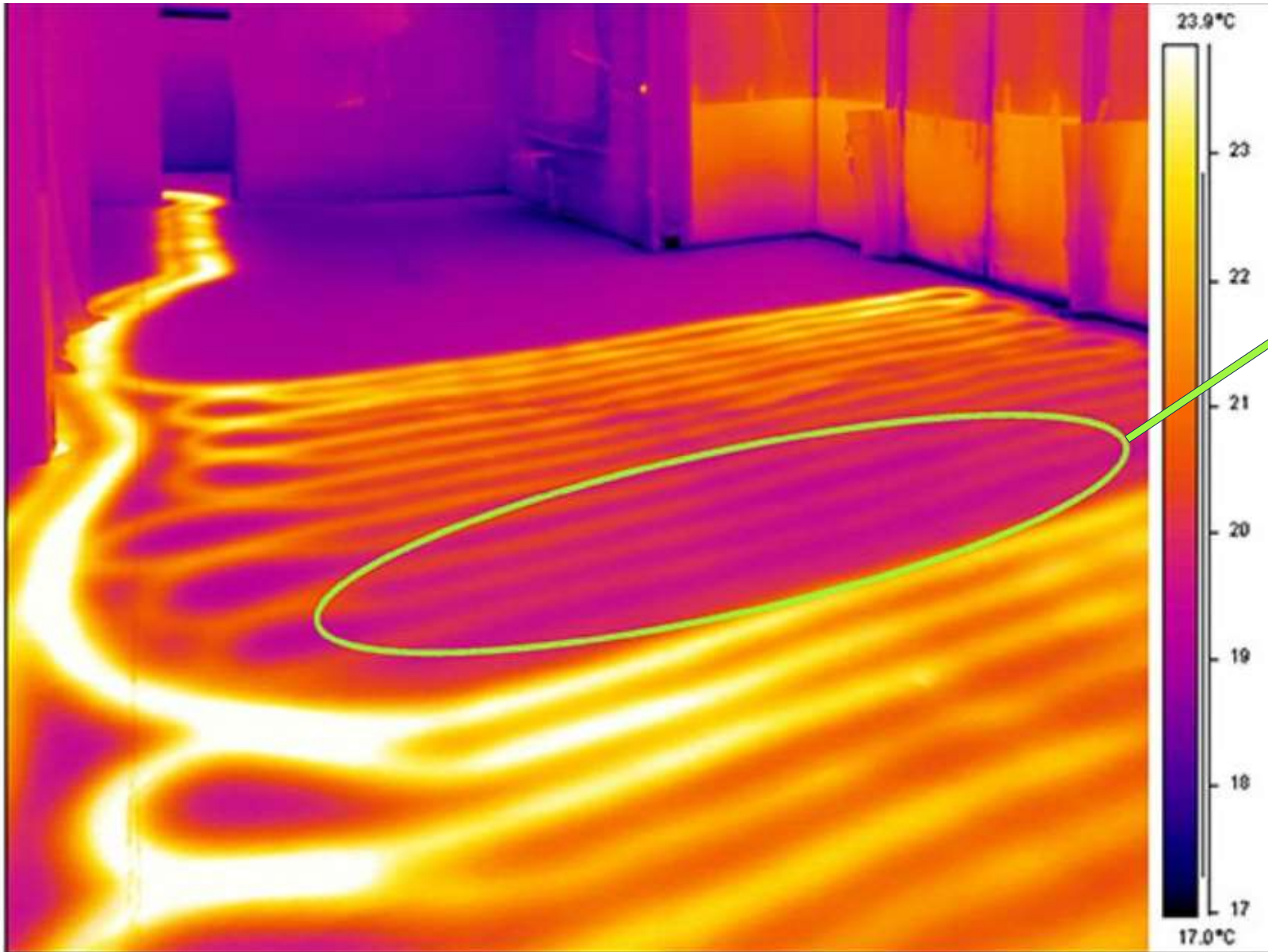
What's wrong?

Air in top of radiator



How to Bleed a Radiator

Under- floor Heating

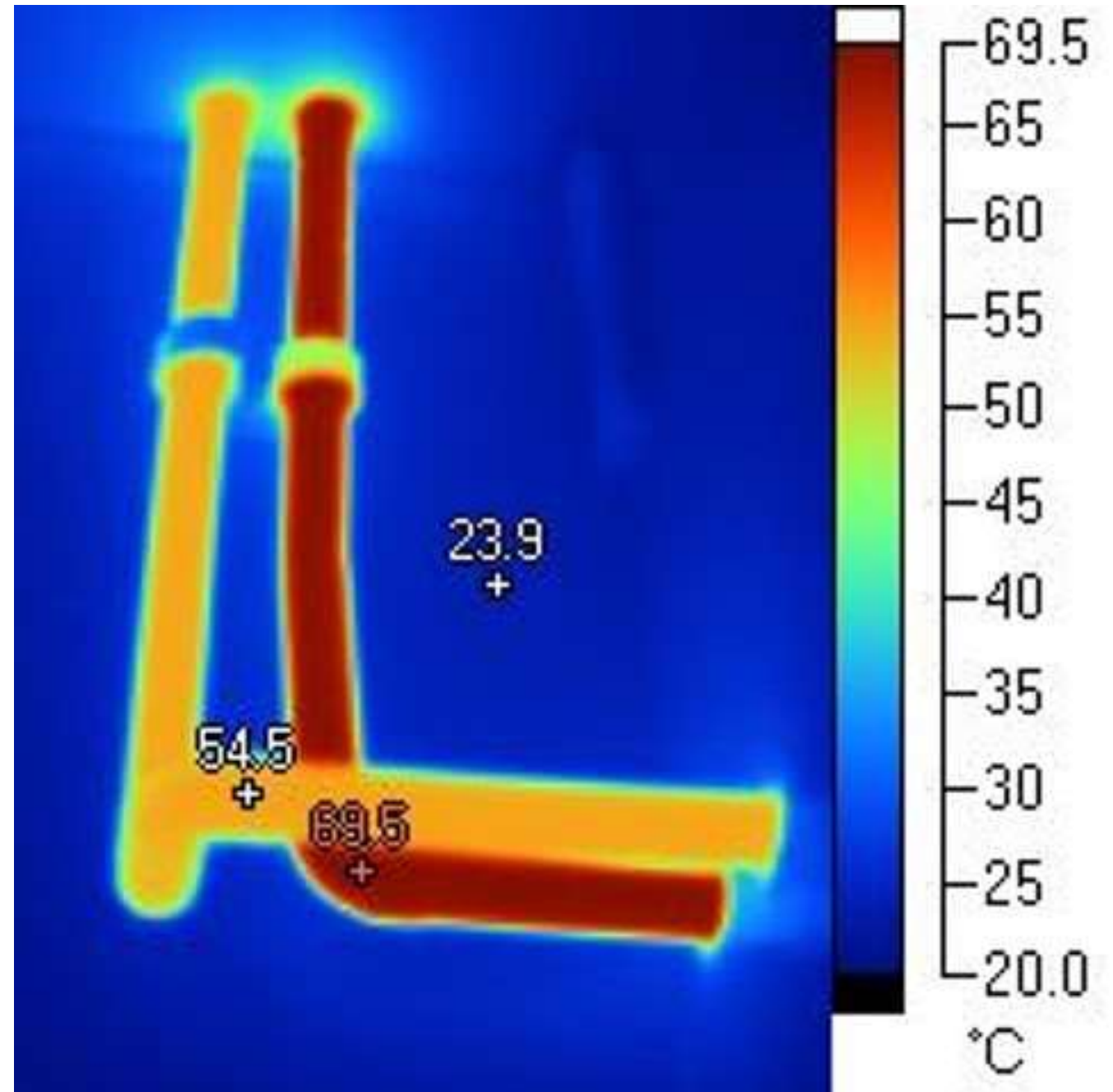


This heating circuit gets progressively cooler near the end. Probably restricted hot water flow.

Image from [Red Current](#)

Hot Pipes

Need Insulation
normally



Questions 1: Uses of Thermal Imaging



Ideal Conditions for Using a Camera

- Indoors $>10^{\circ}\text{C}$ warmer than out
- Enough light for visible images
- No direct sun, rain or strong winds



Thermal Cameras



Fluke TiR 105 (1)
160x120px

Manual Focus,
SD Card, Lens cap

Flir C2 (5) **FLIR C3-x (1)** **FLIR C5 (2)**
80x60px 128x96 px 160x120px



Touch screen,
USB connection

Hikmicro Pocket 2 (3)
256x192px

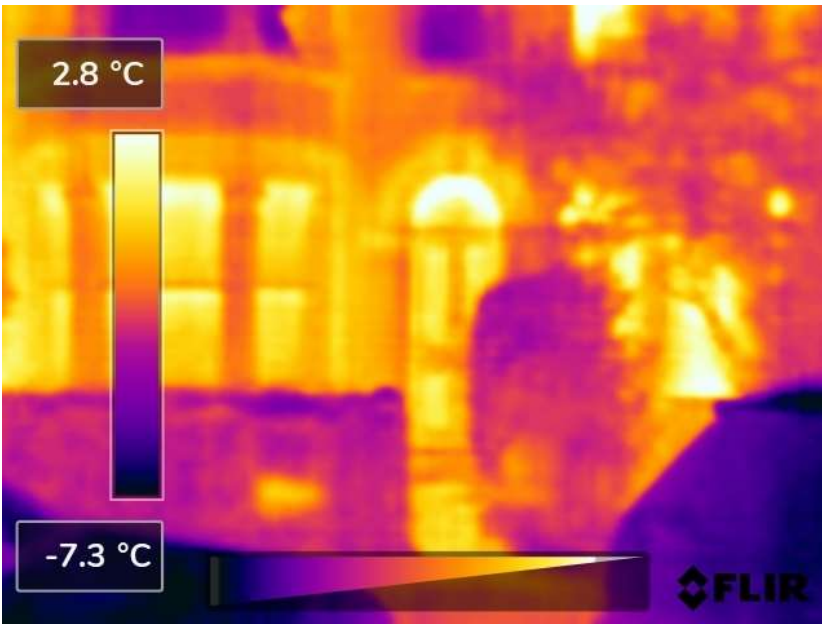


FLIR E40 (1)
160x120px

FLIR E4 (1)
80x60px

[See Video & User manual for your camera](#)

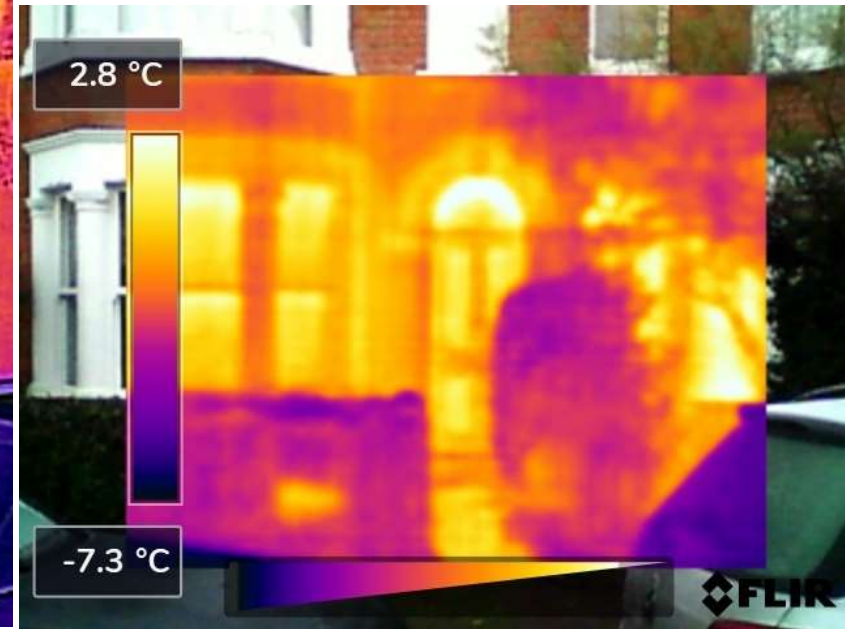
Picture modes



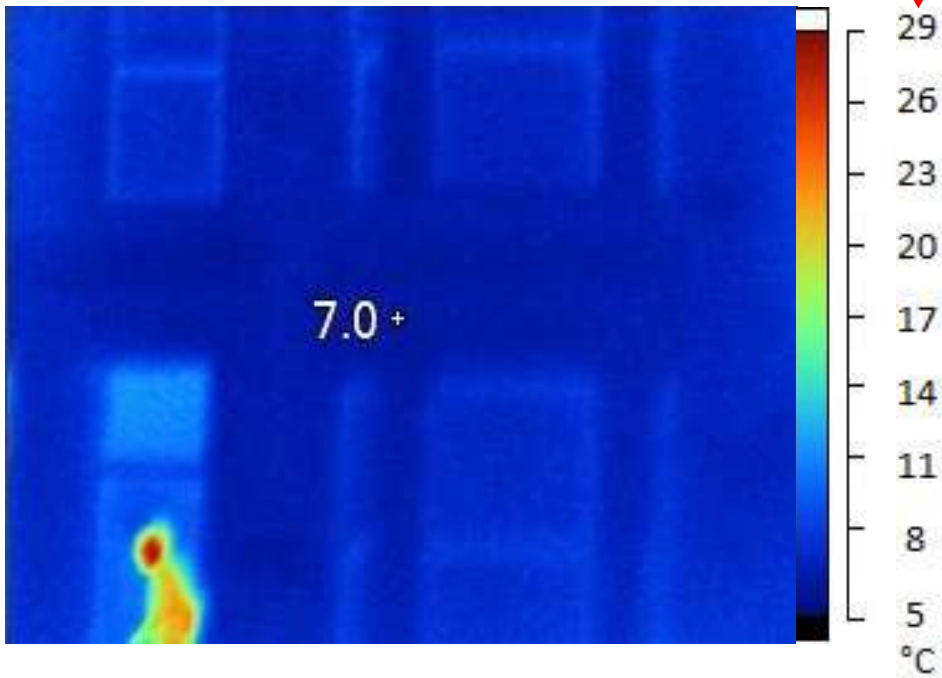
Thermal Only



With MSX
not on Fluke Camera



Picture-in-Picture

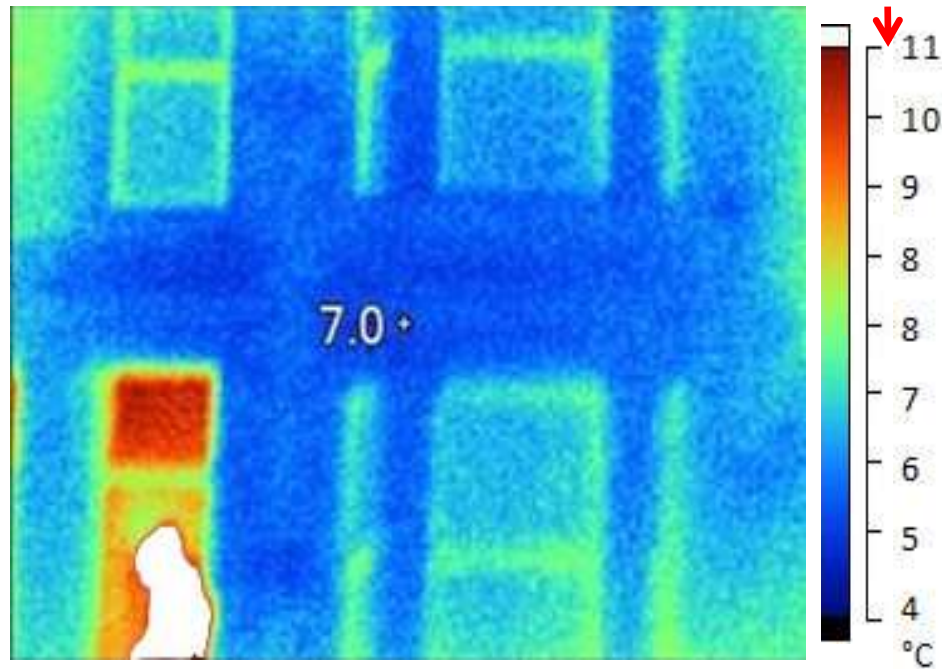


Colour –Temperature Scale

Auto

Constantly re-adjusts range to hottest and coldest temperatures in view

Colour <-> Temperature scale keeps changing



Manual/ Locked

locks the current temperature scale

*Useful for comparisons or
if temperature extremes are in view:
allows better temperature resolution*

Auto: colour range re-adjusts to cover hottest and coldest in view



Colours re-adjust
when cold sky
comes into view

Manual /Locked locks current colour vs temperature scale



Colours the same,
even when cold sky
comes into view

House Survey - allow ~ 90 min

Preparation:

Choose a time when it's cold outside:

preferably $>10^{\circ}\text{C}$ warmer inside than out
- if not, pre-heat the house for several hours

Ideally without sun, wind or rain

Check that the camera's charged & working

Survey:

Look all around every room:

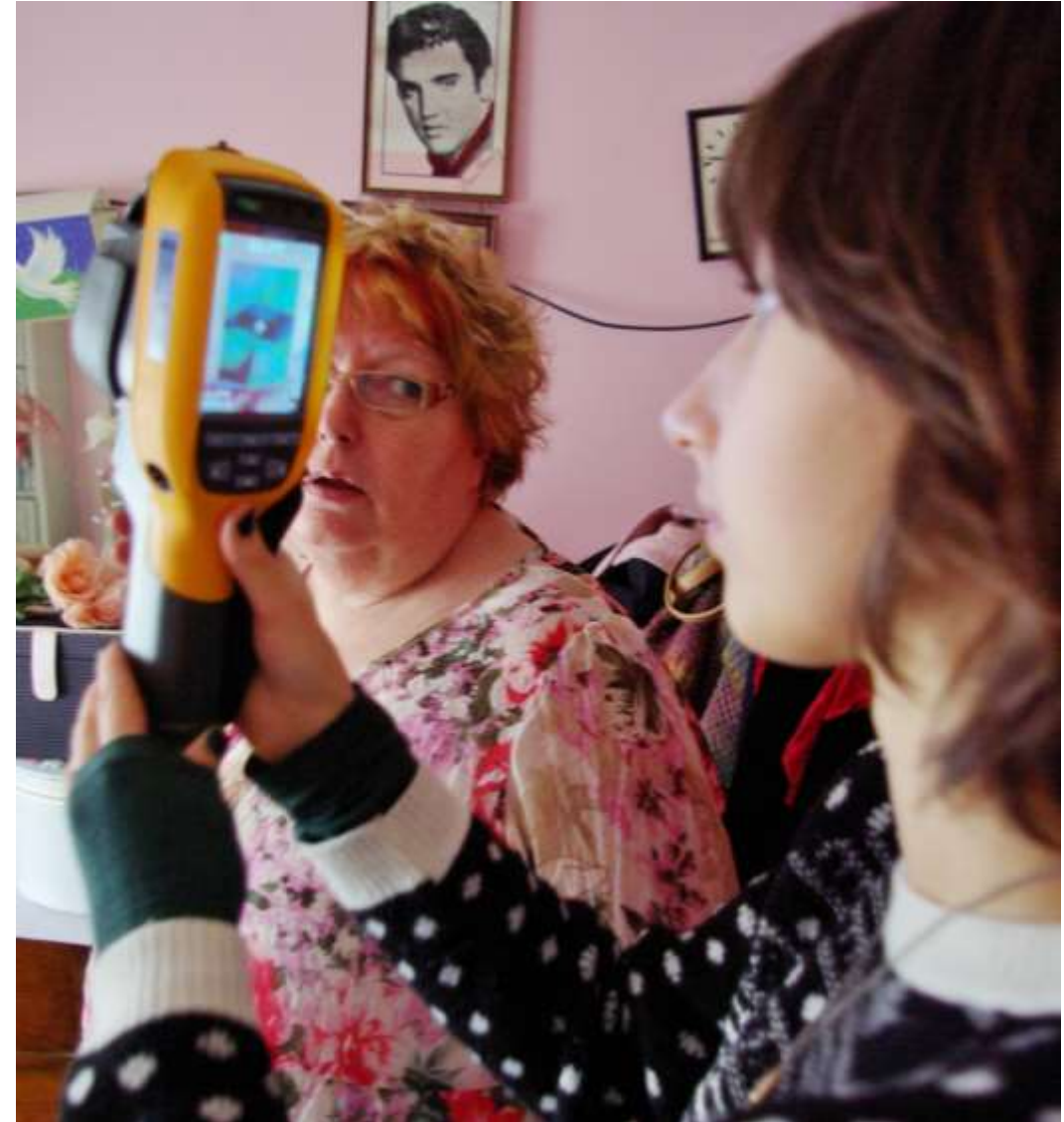
What is unexpectedly hot or cold? Why?

Investigate those places: distant and close

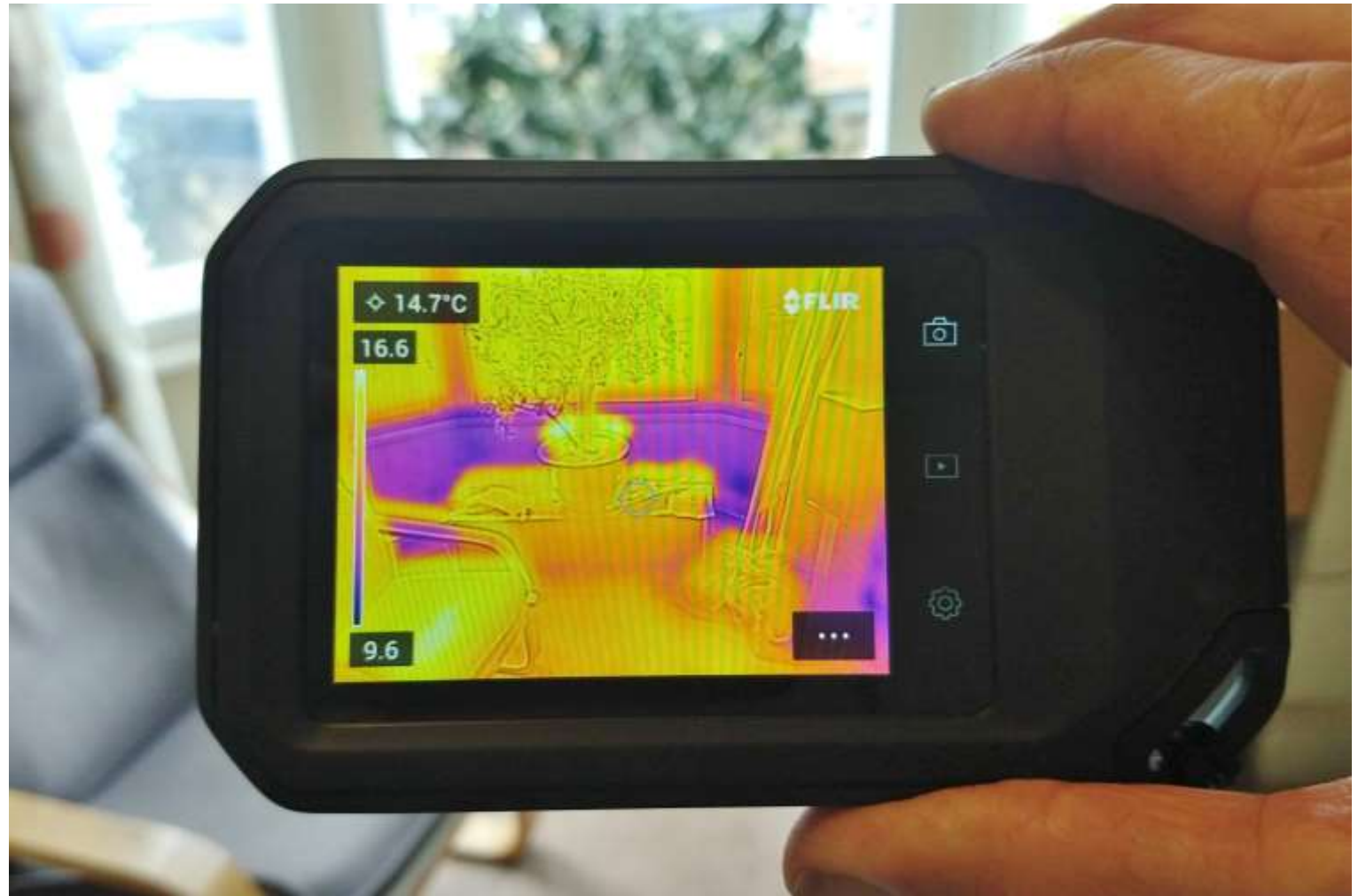
Make comparisons

Check from the outside too

Take plenty of images with notes



Questions 2: Using the cameras



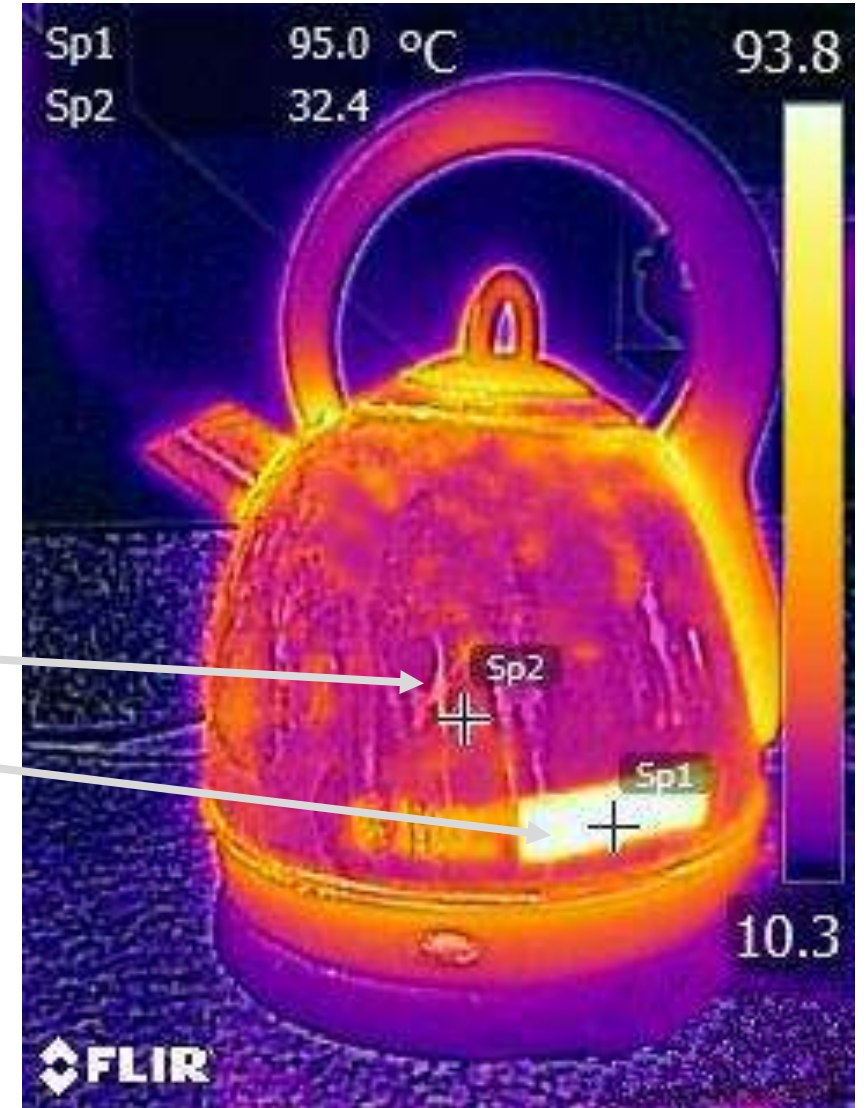
Reflections

When light hits a surface it can be reflected or absorbed. The same goes for IR radiation. Bare metal (and to a lesser extent concrete) reflects a lot so you get the wrong temperature.

Just boiled kettle

Bare metal reflects the surroundings – the temperature reading is too low.

Tape shows the true temperature.



Transparency

Materials can also be transparent.
How much depends on the
wavelength.

Glasses are transparent in visible light but
opaque/reflective in IR

Black bin liners are opaque/reflective in
visible but somewhat transparent in IR



Getting an accurate measure

- Most opaque materials are fine:
 - Most paint
 - Brick
 - Carpet ...
- For transparent or reflective materials, use black PVC tape to get an accurate measure
 - Some glass
 - Bare metal
 - Concrete

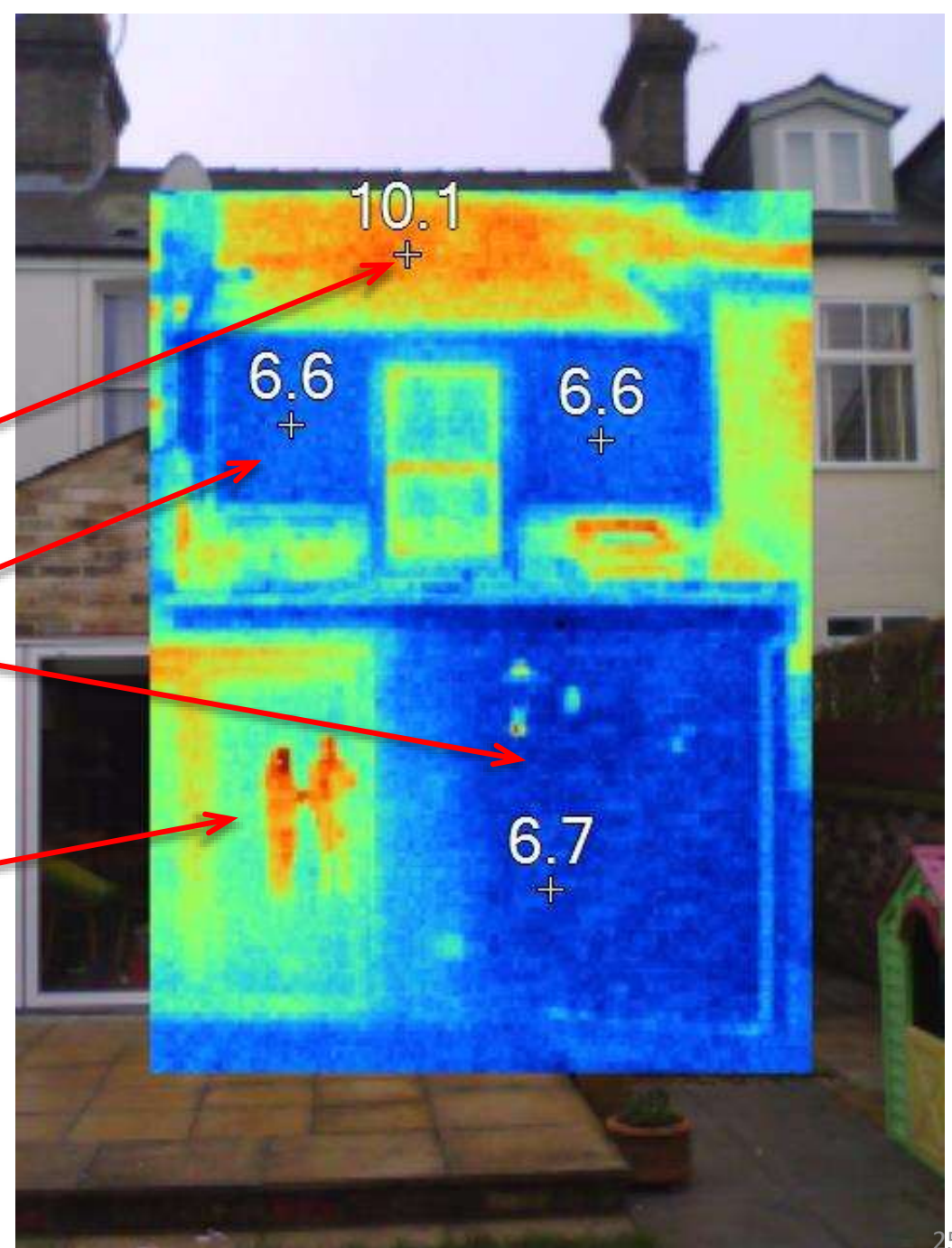
Gotchas 1

From outside: Hot = leaky

Warm: poor Loft Insulation

Cool: good Wall insulation

Reflections in glass



More Glass Reflections

Glass is more reflective in the Infra Red than for visible light

- Sky -60°C
 - Upper Window
Reflected Sky -12°C
 - Solid Brick Wall -8°C
 - Lower Window
Reflected Warmer Building across street -4°C
- Stick on PVC electrical tape
to measure glass temperature

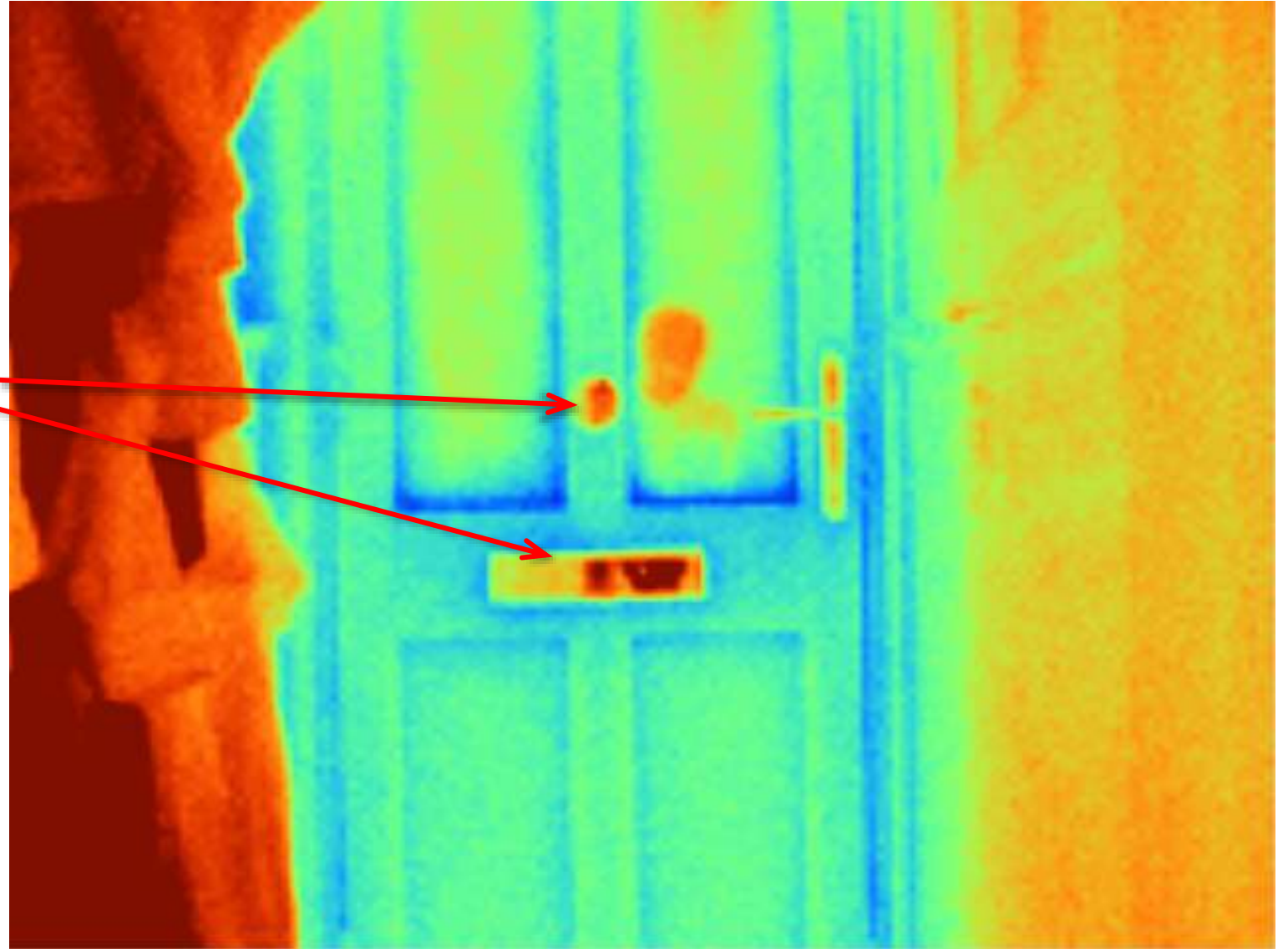


Gotchas 2

Shiny metal

Temperature errors

Reflections



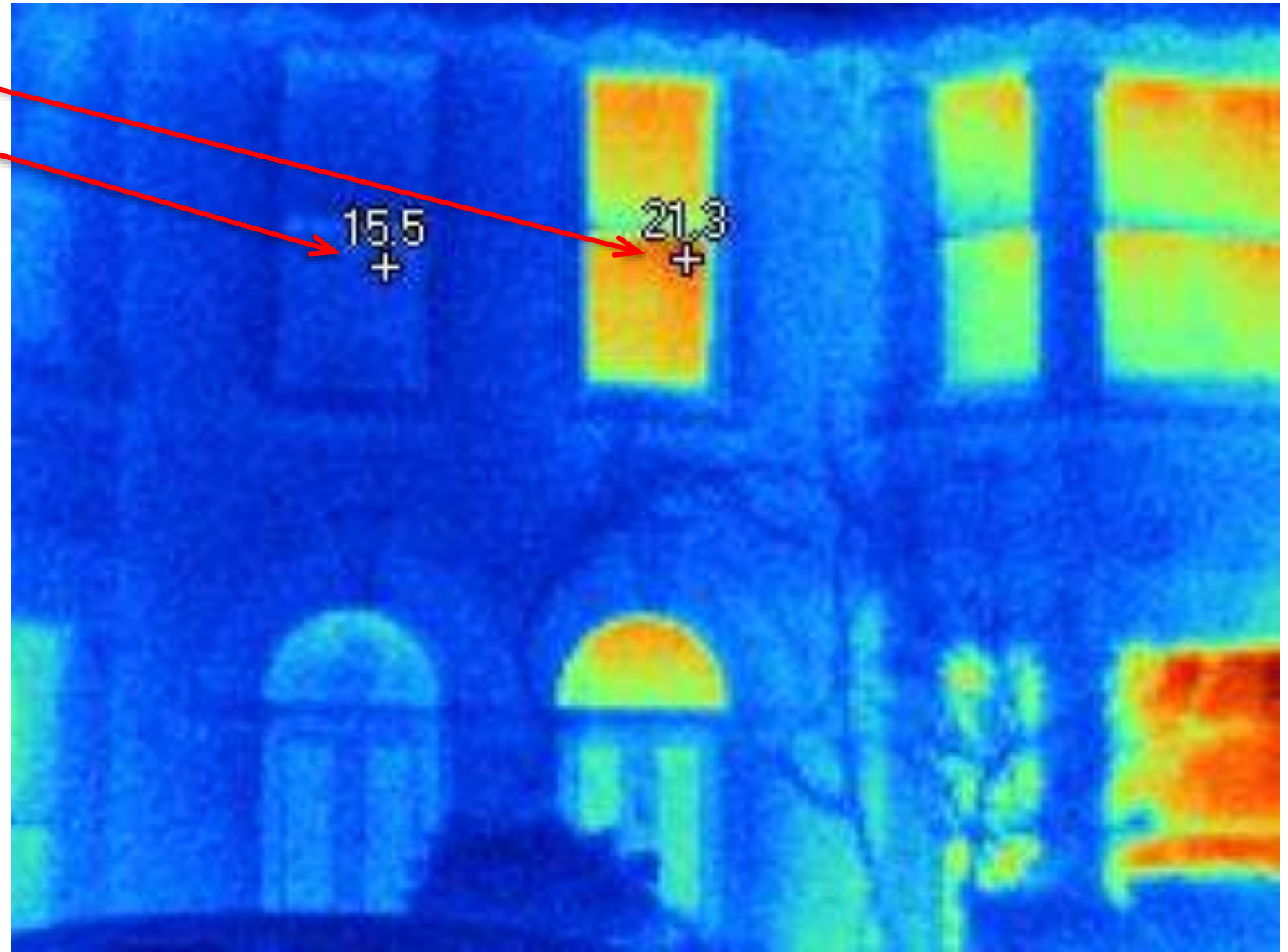
Gotchas 3 Why are the houses so different?

Why Different Temperatures?

Tom's house on left:
Low thermostat,
warm clothes,
secondary glazing
- improvements coming!

Neighbour had health
problems needing
warmth

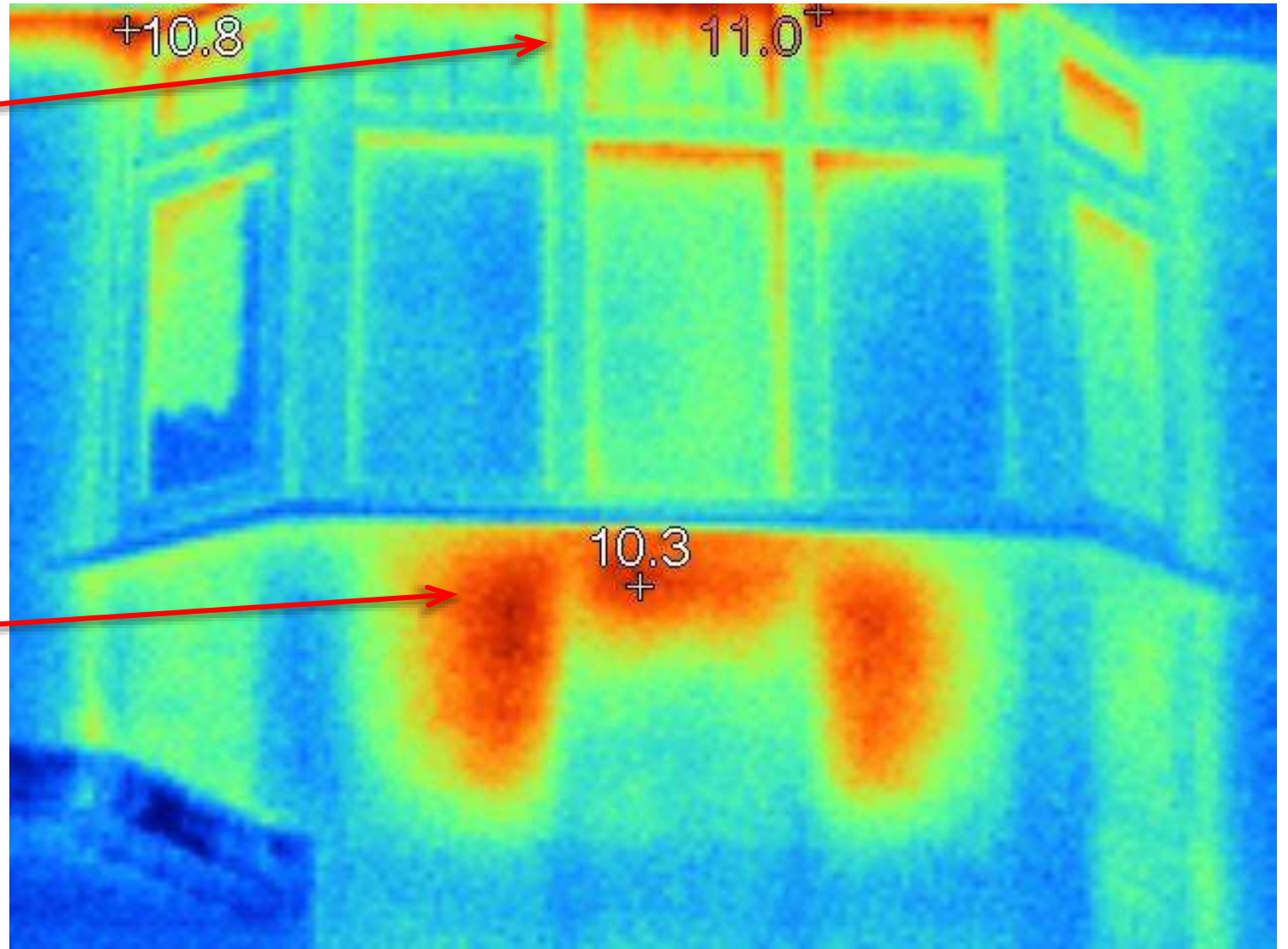
*More than technical
issues*



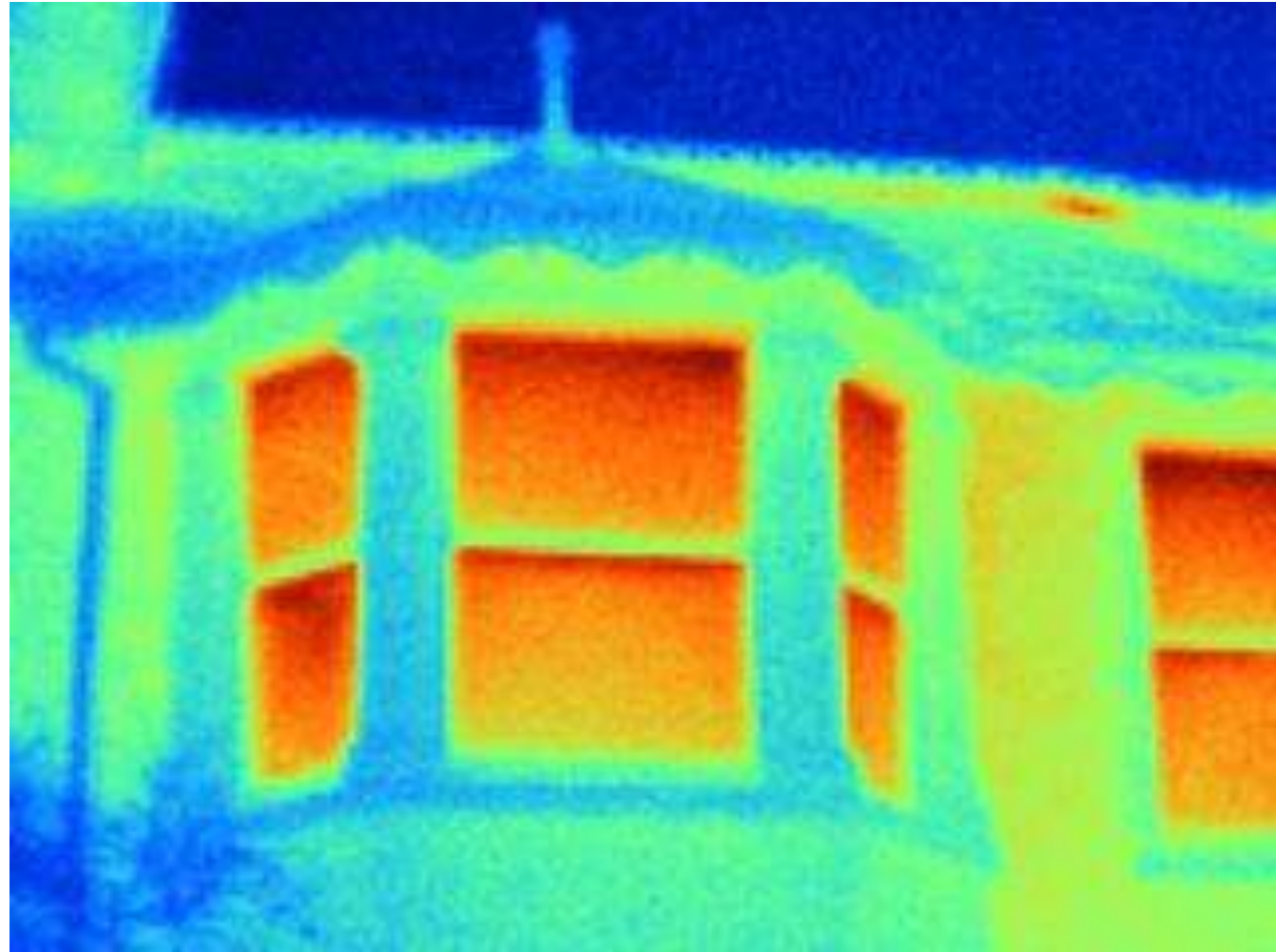
What Problems?

Draughty windows

Radiator inside
without reflective foil
(partly sludged up)



Questions 3: Interpretating Images



Borrowing a camera

First:



‘Sign’ [TI Camera Borrowing Agreement](#):

- Keep camera with you or in a locked place
Don't lend it to anyone else
- Collect & return the camera as agreed
- After: fill [Survey Record form](#) for each building

Normal Collection & Return times			
Weekdays		Weekend	
Collect	Return	Collect	Return
Monday	Friday	Friday	Monday
13:00-17:00	9:00-12:30	13:00-17:00	9:00-12:30

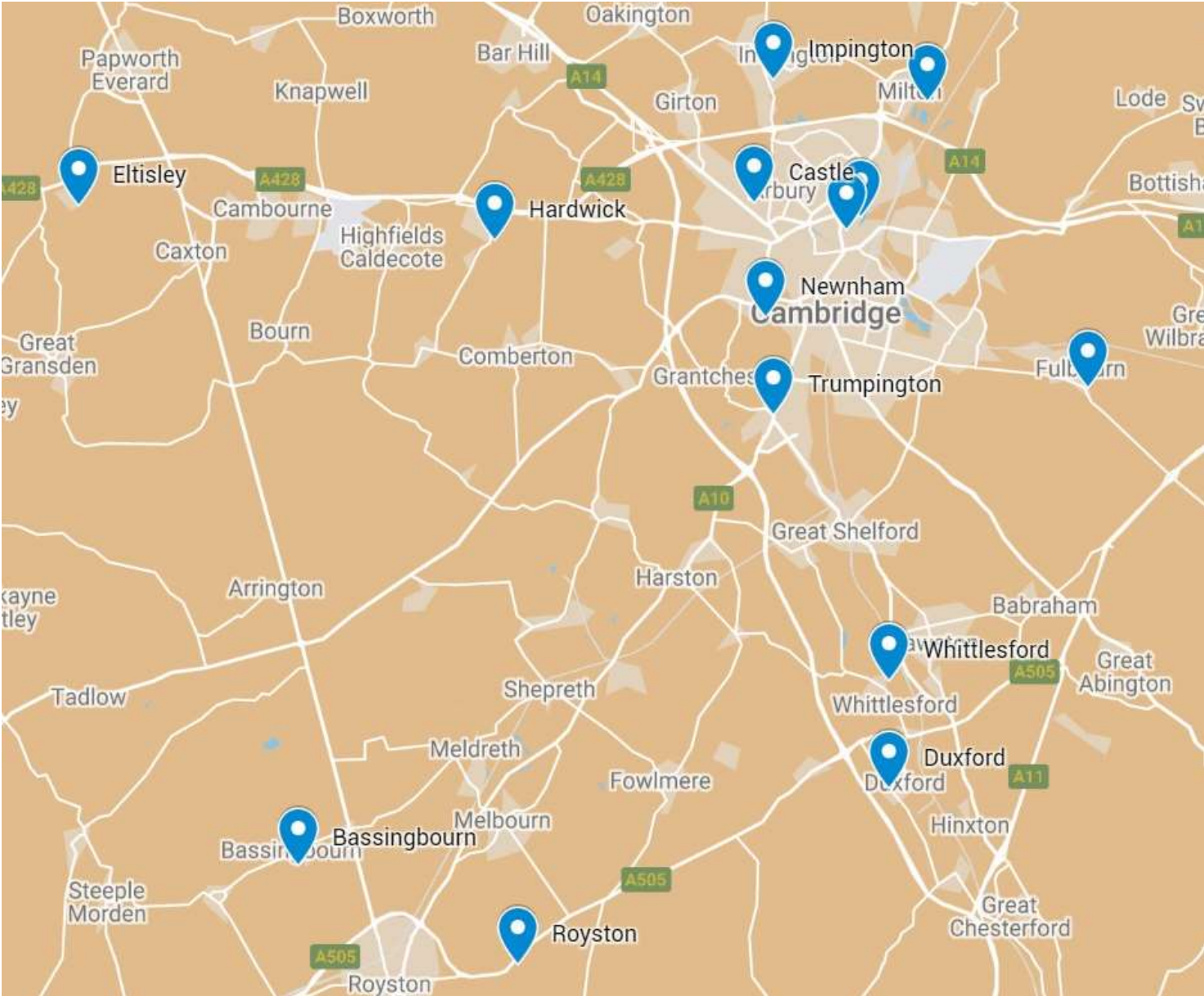
Location

Bassingbourn
 Cambridge, Castle
 Cambridge, Chesterton 1
 Cambridge, Chesterton 2 (Sentec)
 Cambridge, Milton
 Cambridge, Newnham *
 Cambridge, Trumpington (Bidwells)
 Duxford
 Eltisley
 Fulbourn
 Hardwick
 Histon and Impington
 Royston
 Whittlesford

Camera

Flir C2
 Tir 105
 Flir C3-x
 Flir E4
 Pocket 2
 Flir e40
 Flir C5
 Pocket 2
 Flir C2
 Pocket 2
 Flir C2
 Flir C2
 Flir C5
 Flir C2

Book a Camera - after 8:30pm



Booking Calendar

Choose the Monday or Friday when you want to collect

Your booking in progress

Select a pickup time*:

2:30 PM – 3:00 PM

Bassingbourn, Flir C2

November 2023

MO	TU	WE	TH	FR	SA	SU
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30			

December 2023

MO	TU	WE	TH	FR	SA	SU
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31



– Available



– Booked

First Name*:

Booking confirmation

Your booking has been confirmed

Booking

Item booked: Cambridge, Castle

Collection date: 6 November 2023 12:30 pm

Booker contact details: [Booker details](#)

Collection

Camera host:

Contact details:

Pickup address:

[Host Details](#)

Changing or cancelling your booking

Please let your volunteer camera host know if there are any changes to your pickup or drop off time, or use the links below links to:

- [Change the date of your booking](#)
- [Cancel your booking](#)

← email from 'CCF Bookings'

If you haven't received it within 1 hour of booking, check Spam.

If no sign, please email:

ticamera@cambridgecarbonfootprint.org

We'll confirm your booking details

Look out for an email from your camera host suggesting another pickup time

Keep them updated.

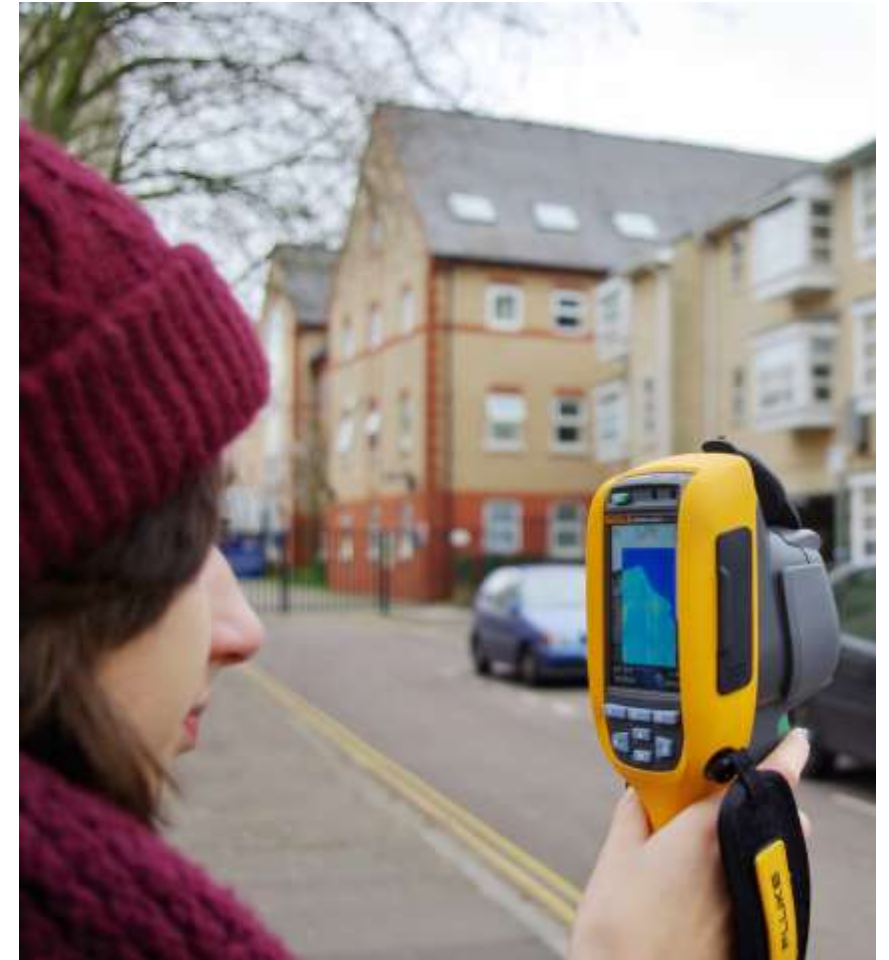
Collect & return at agreed times

Cambridge
**Carbon
Footprint**



CCF Thermal Imaging homepage
for info:

cambridgecarbonfootprint.org/thermal-imaging



Final Questions

Booking etc



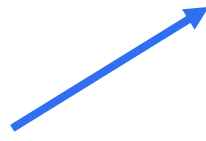
More TI Training sessions

Thu 14th December

Mon 22nd January

Thu 29th February

Other CCF Events eg:



Fulbourn Repair Cafe

Fulbourn Repair Cafe will be hosting another Cafe in November. Booking and other details to follow nearer the time.

Sat 4 Nov 2023, 2:00pm - 5:00pm

Fulbourn



From Ideas to Impact: Building a team and jumpstarting community climate action

Are you keen to get started on climate action in your community, but feeling stuck? This two-hour online workshop will cover everything you need to...

Wed 8 Nov 2023, 7:00pm - 9:00pm

Good luck with your Thermal Imaging....



Any [donations to Cambridge Carbon Footprint](#) welcome

Check where your home's leaking heat - & others?

More resources

- [Camera manuals and videos](#)
- [TI camera borrowing agreement](#)
- [Thermal image survey record form](#)
- [Slides from this presentation](#)
- [More thermal image examples](#)
- [Donation page](#)



House Survey - more details

Walls:

Cold patches on wall. Windows and doors
Temperature difference between internal and external walls
Draughts all round the frames. Also the letterbox

Ground Floors:

Cold patches (could mean water leakage).
Suspended floors: Hot pipes with poor insulation
Draughts between floorboards, Skirting boards

Upper ceilings/attic

Missing insulation, but should be none below a cold water tank
Loft hatch - draughts and missing insulation

Outside:

Draughts around windows, warm patches on the wall or roof
Roof insulation overall
Don't worry about heat leaking from vents under the floor

