Thermal Imaging Training

Cambridge Carbon Footprint

Thu 14st December 2023, 7:00 - 8:30pm

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Thermal imaging

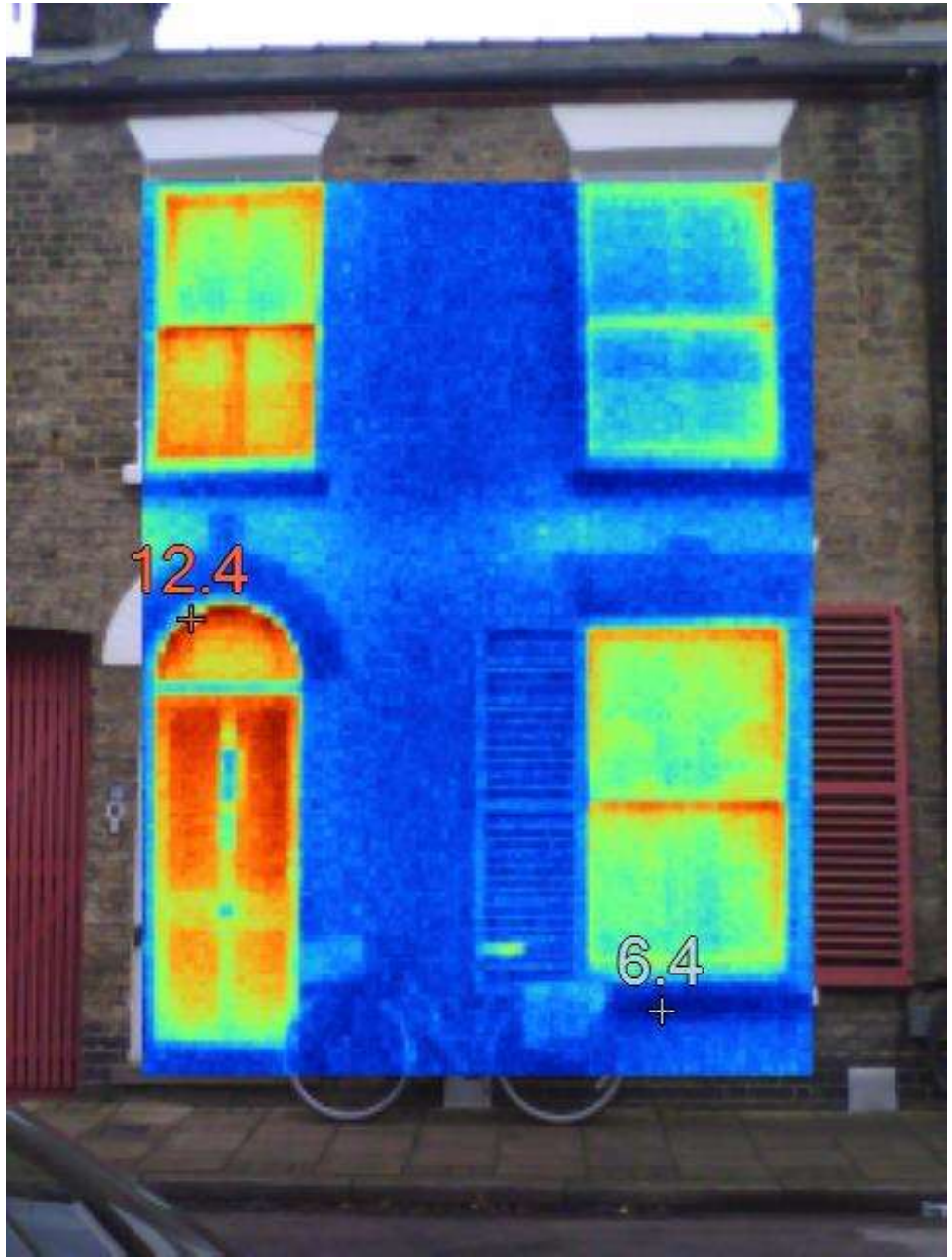
- get free training
- borrow a camera
- find heat leaks

See your home in a new light:

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

Training Sections

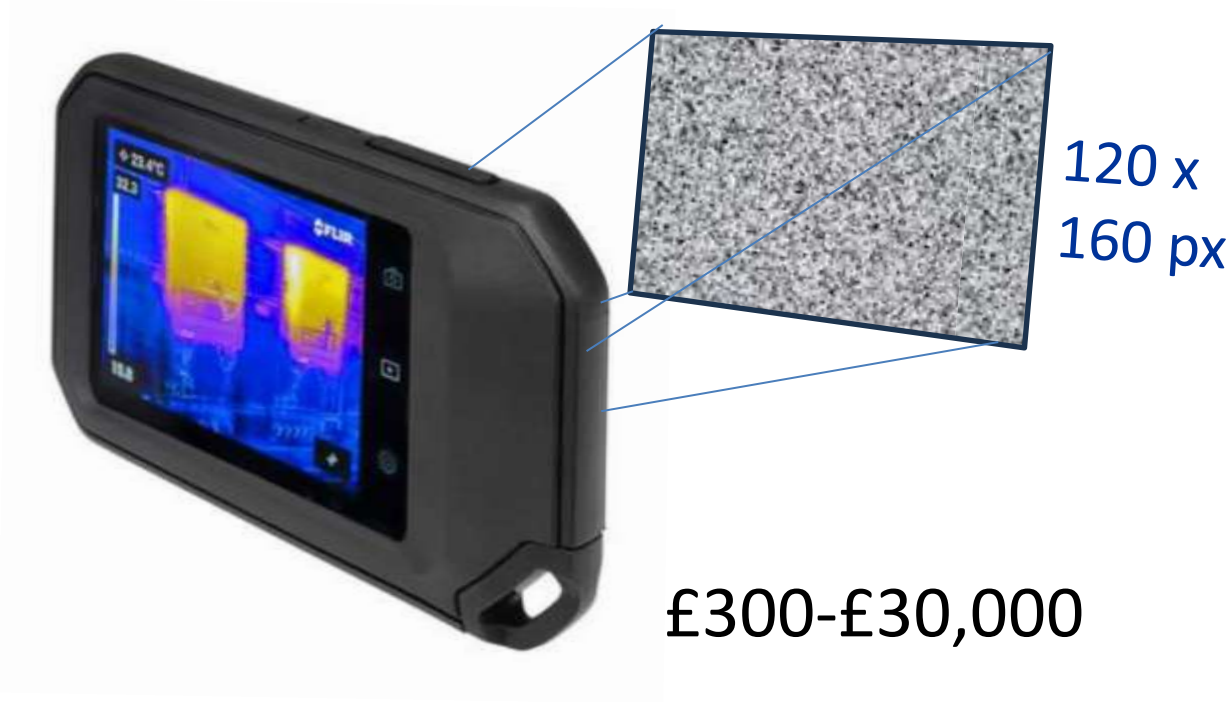
1. Uses of Thermal Imaging
2. Using a TI Camera
3. Interpreting Images: pitfalls
4. Borrowing a Camera
   - Questions after each



IR Thermometer

£20-£60

Thermal Camera



£300-£30,000

Both measure Infra-Red to show <u>surface</u> temperatures

Can show thermal effects of deeper structures, insulation, etc

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

Uses of TI

Insulation Problems

Looking up at top-floor ceiling

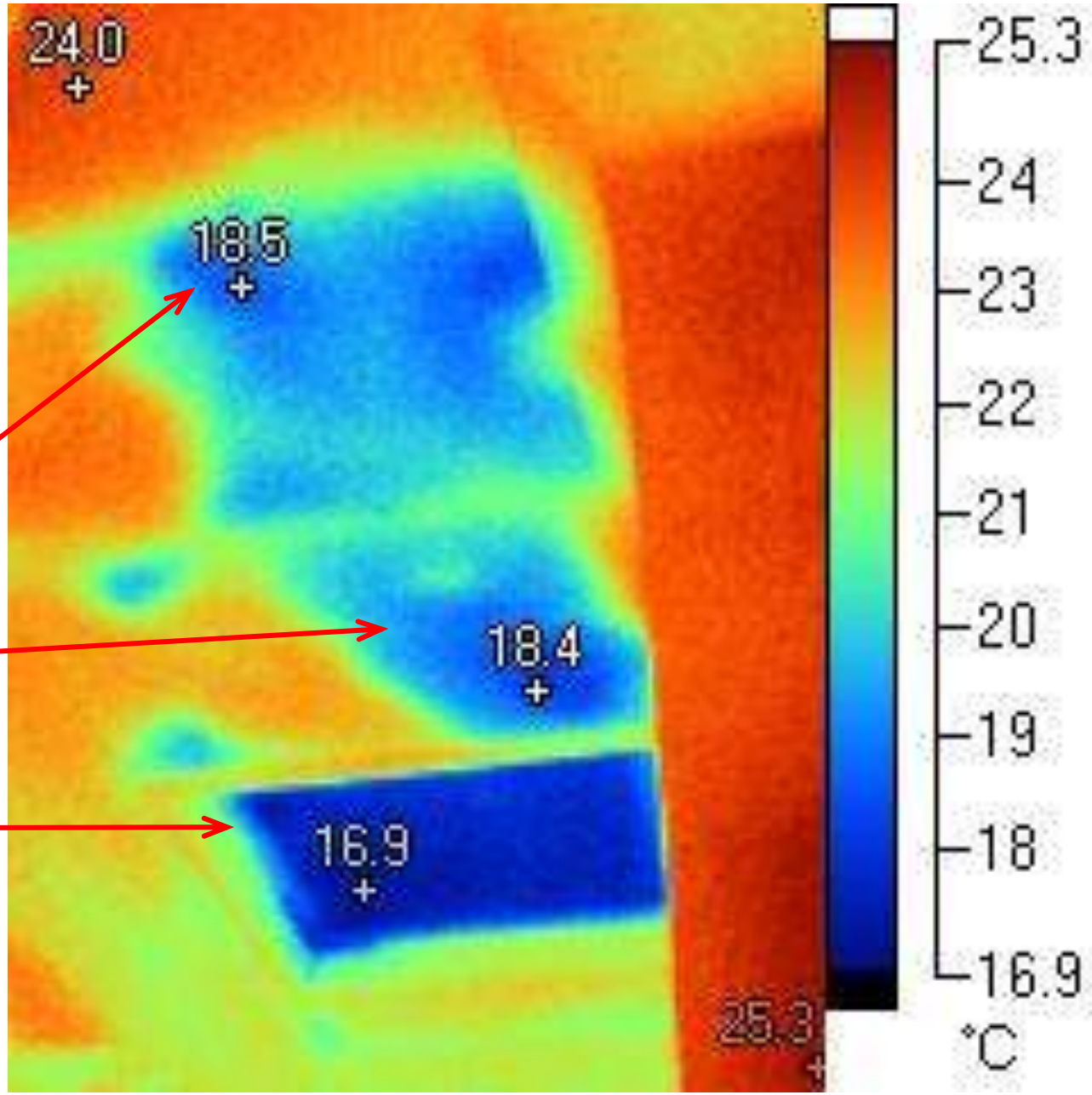
From inside: blue, cold = leaky

What are we seeing?

Loft insulation missing or thin

Poorly insulated loft hatch

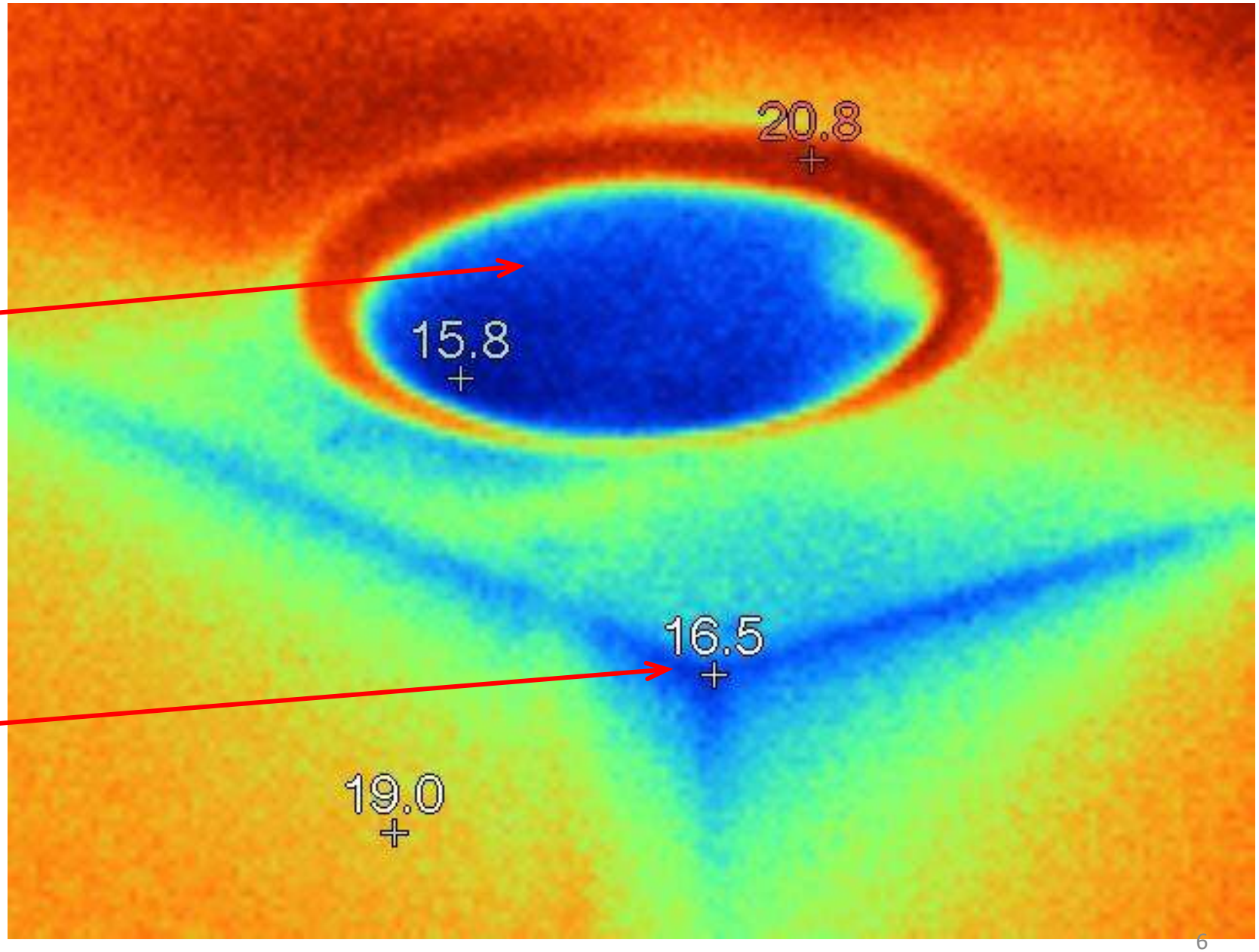
5°C difference is significant



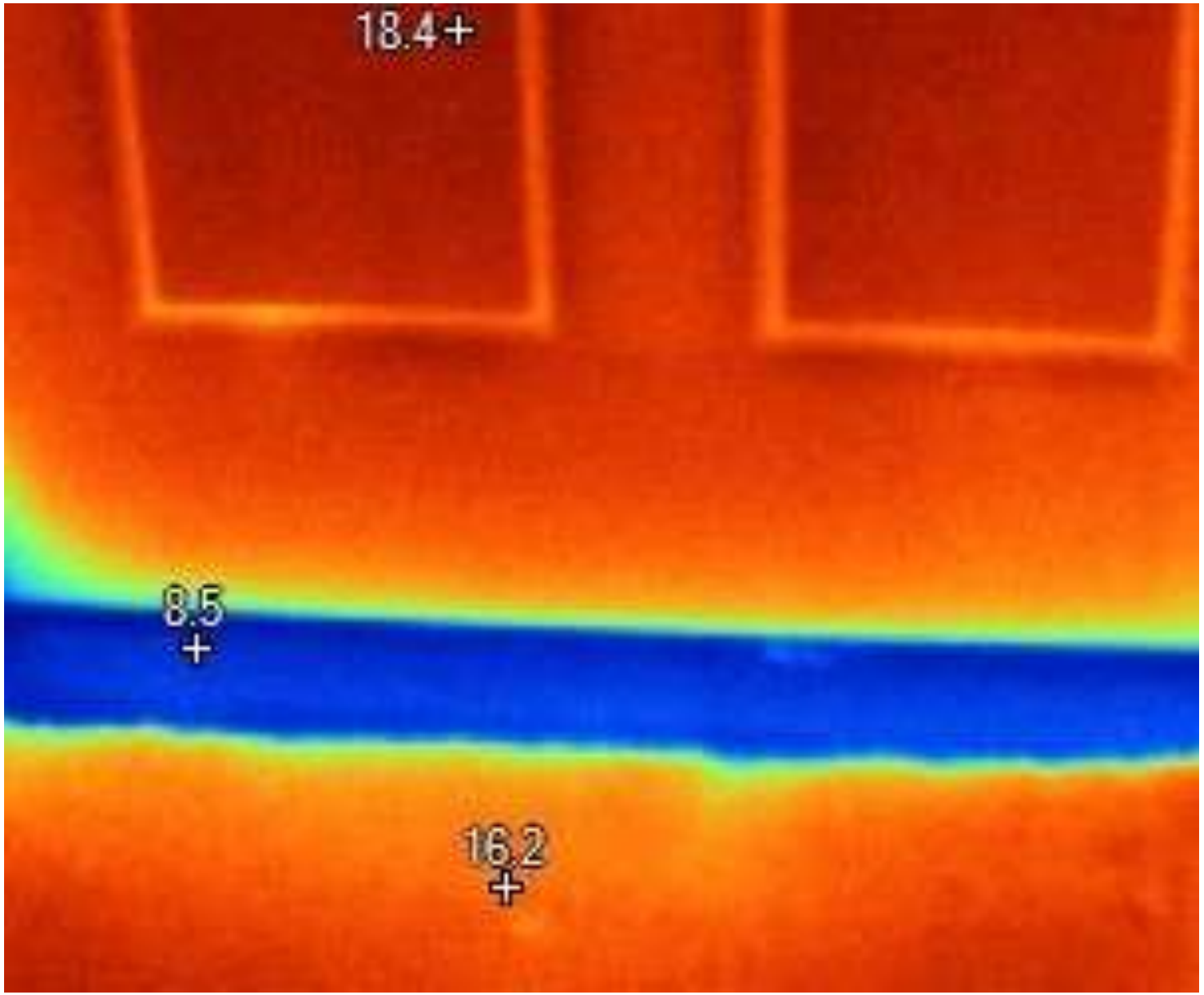
Another Ceiling

Light fitting with draught through wiring hole?

Cold Corner:
Not serious?



Cold Bridge - something conductive through the insulation

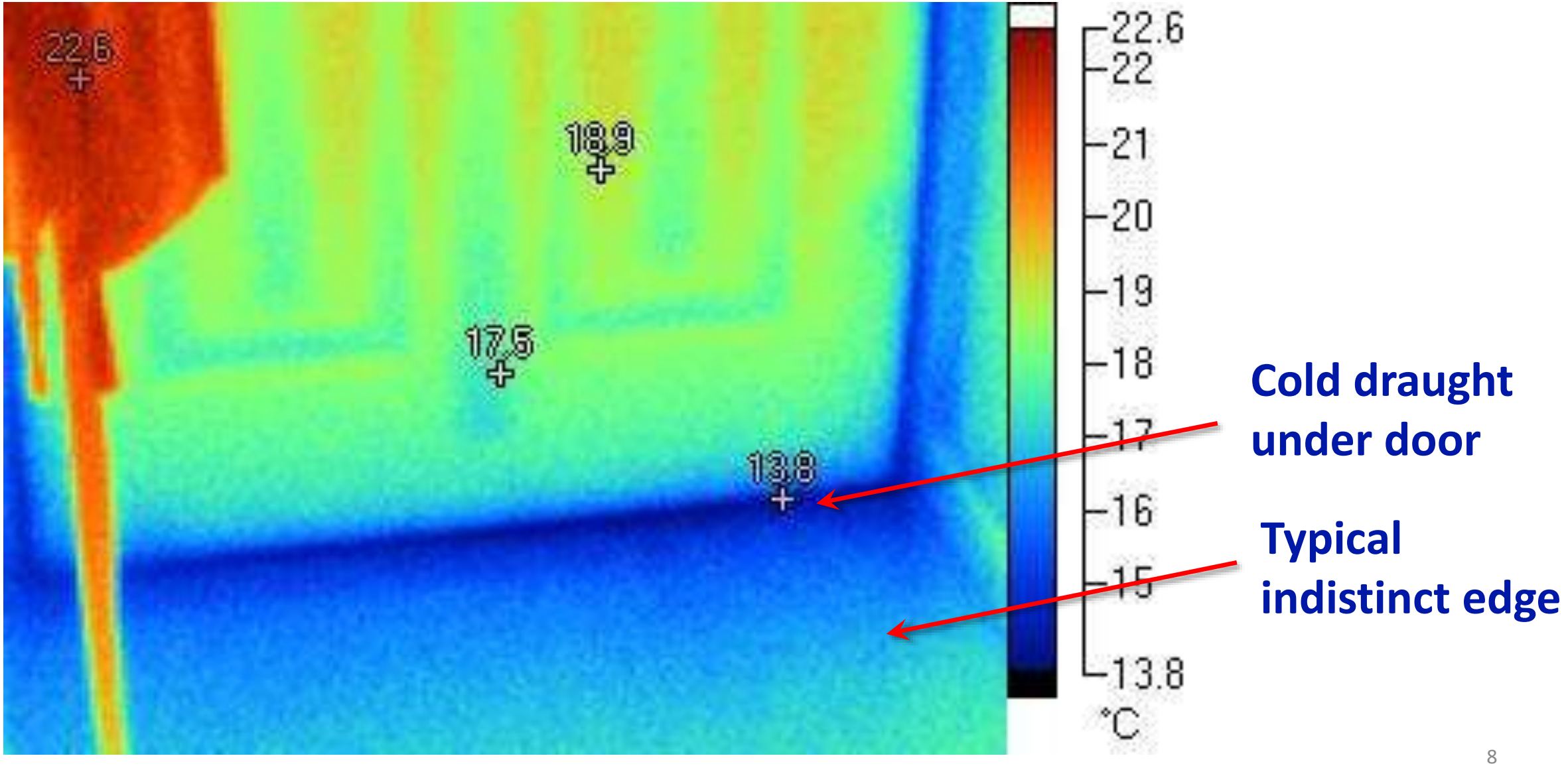


← **Front Door**

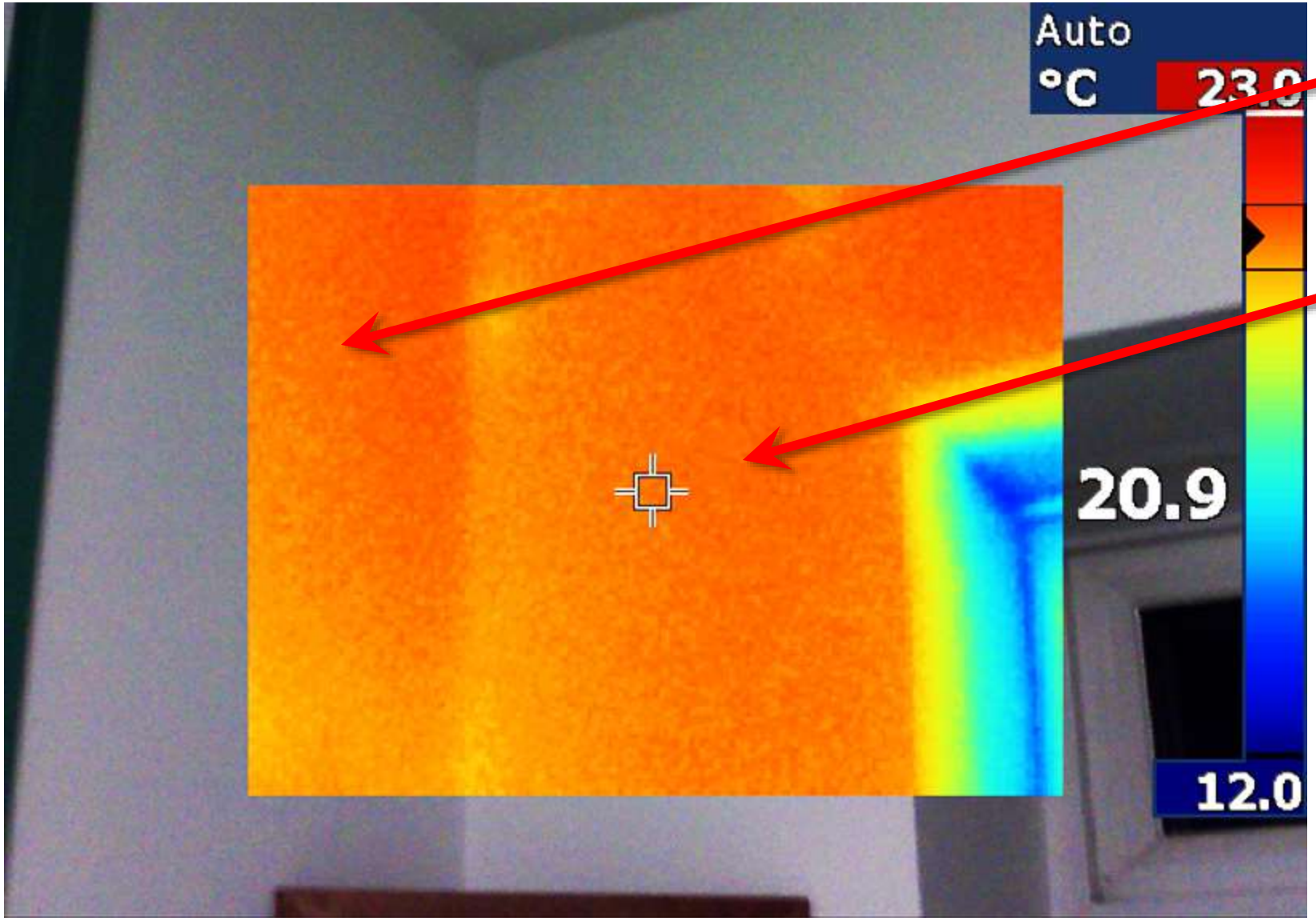
← **Stone Threshold**: Cold Bridge

← **Hall Carpet**

Draughts


22.6
18.9
17.5
13.8
22.6
22
21
20
19
18
17
16
15
13.8
°C
Cold draught under door
Typical indistinct edge

Checking insulation on External Walls

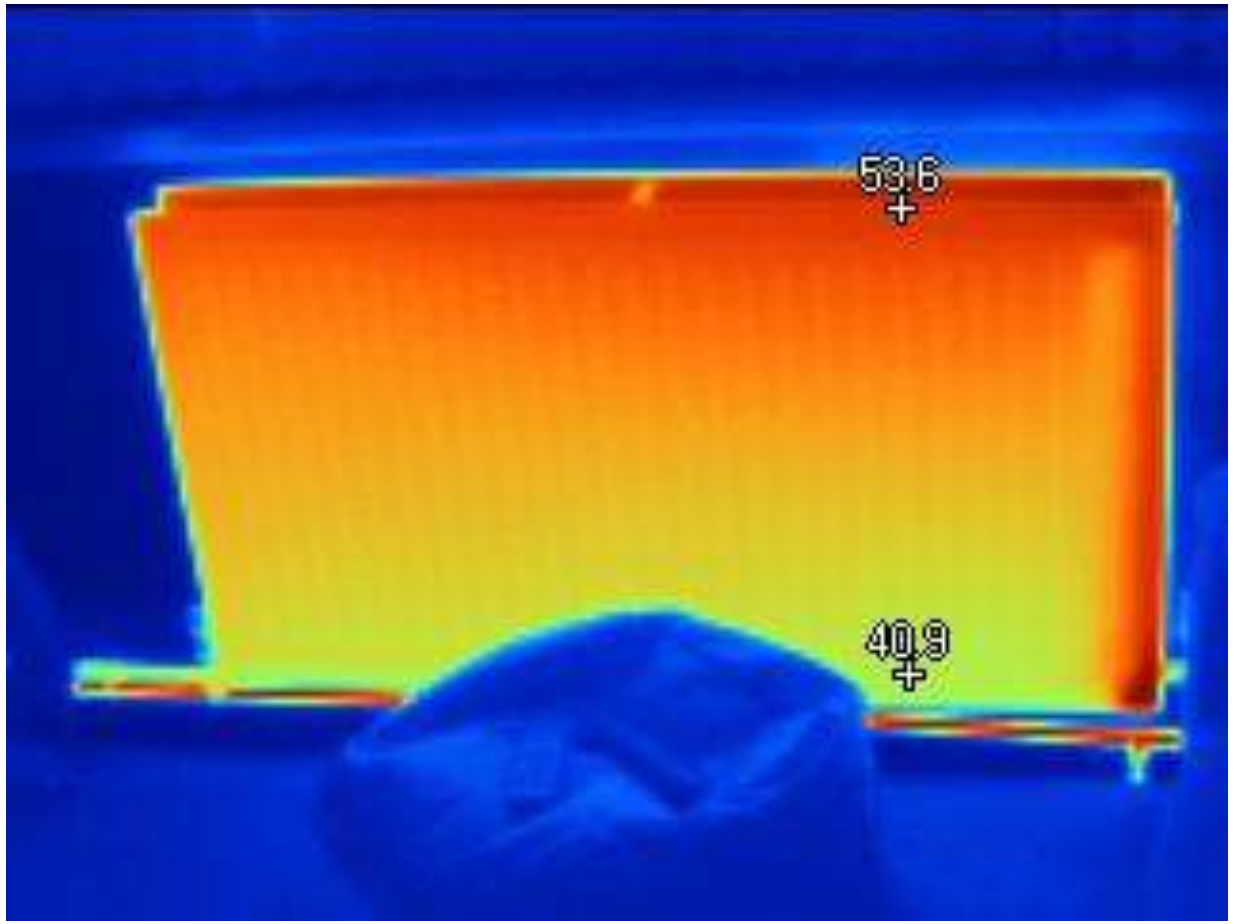


Internal wall - **warm** on the other side – should be room temperature.

Outside wall - **cold** on the other side – loses heat and will be colder.

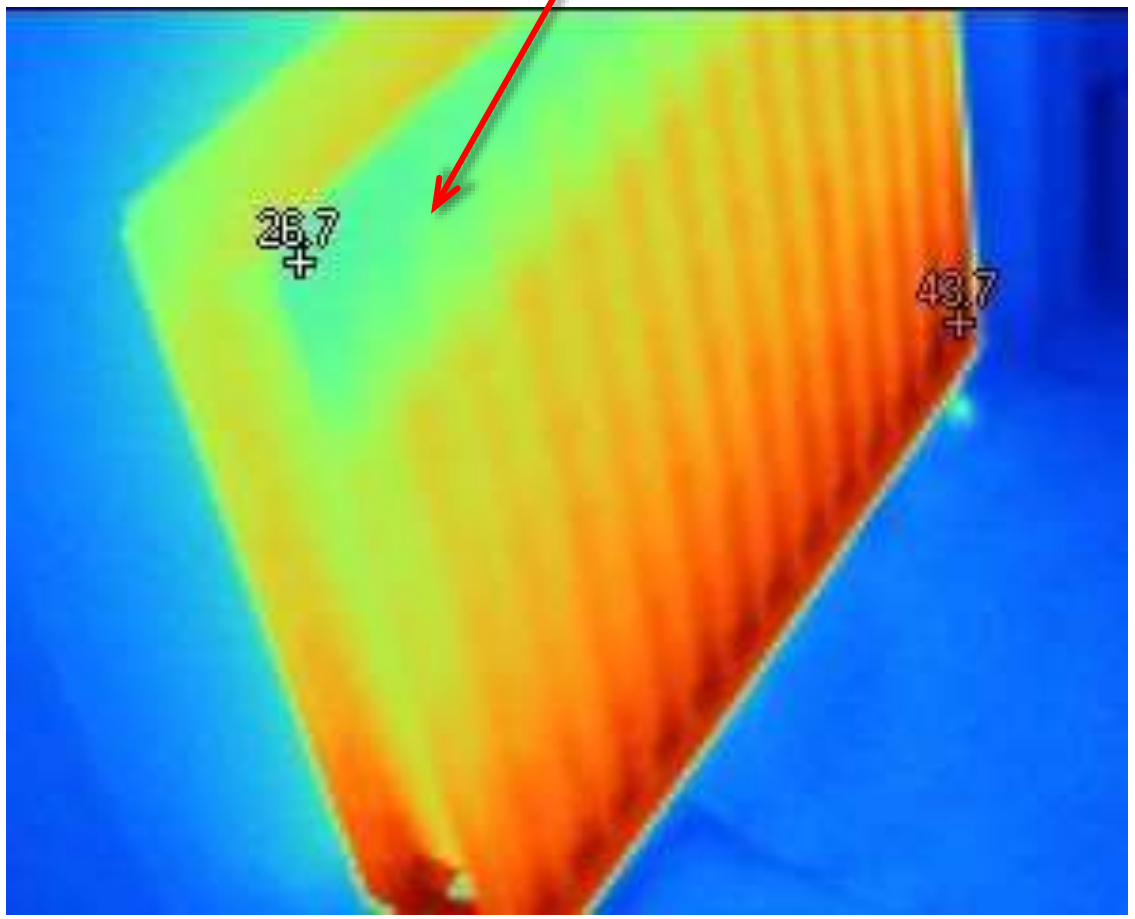
If the **external** wall is more than **1 or 2°C cooler** than the internal, then **better insulation** would be good.

Normal radiator



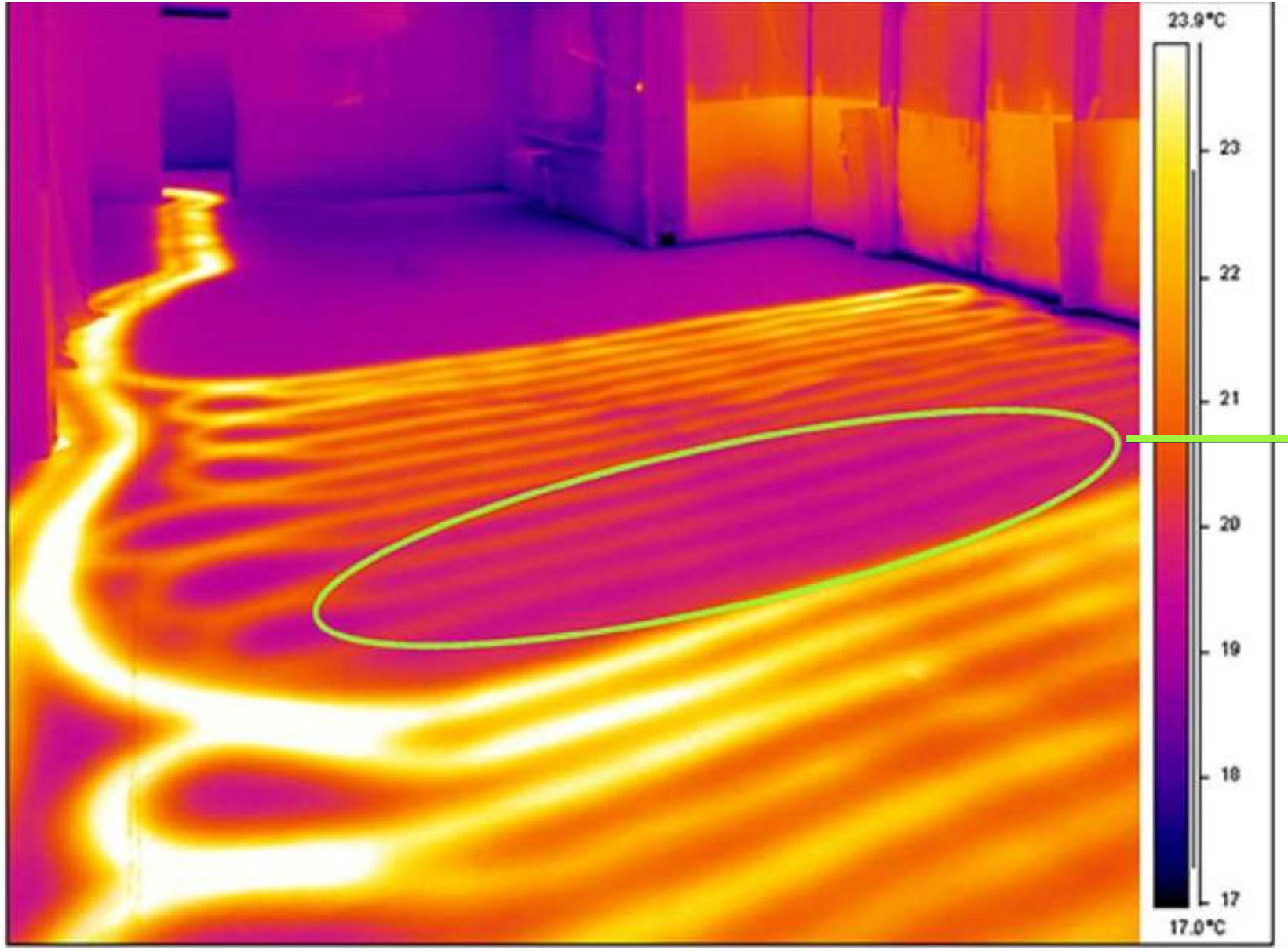
What's wrong?

Air in top of radiator



How to Bleed a Radiator

Under-floor Heating



No need to dig up the floor to check heat flow – the camera reveals all.

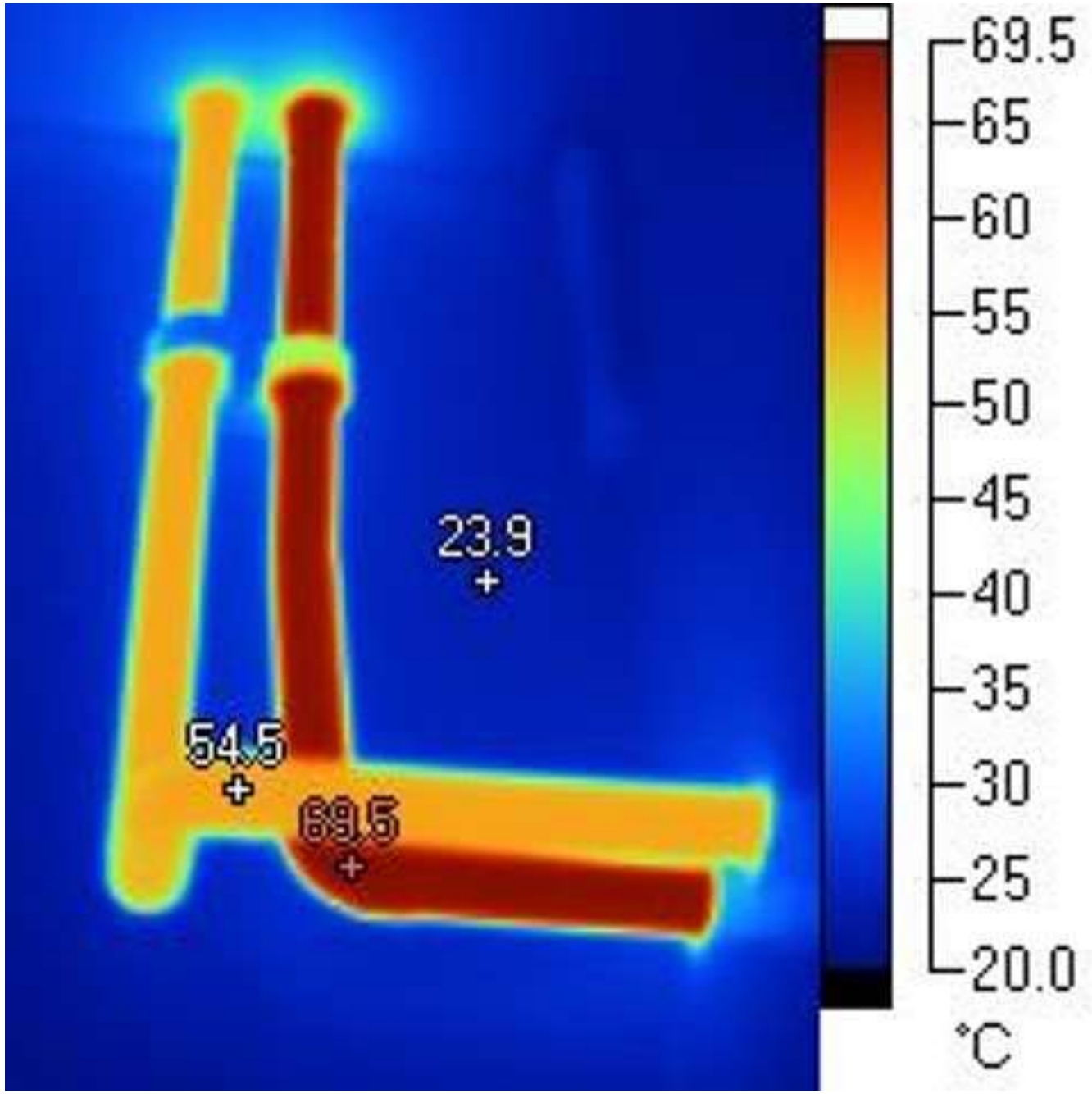
In this case one heating circuit gets progressively cooler near the end - probably restricted hot water flow.

Image from Red Current

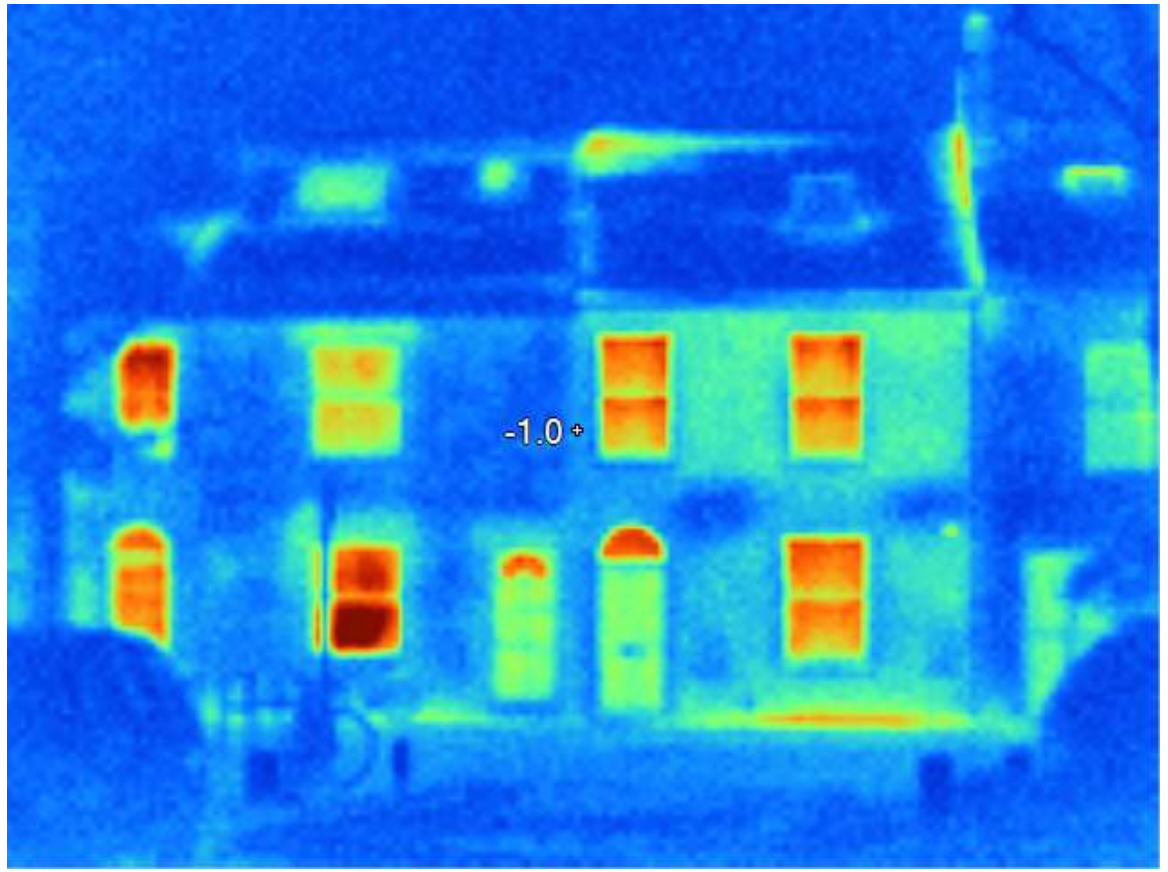
Hot Pipes

Heating pipes outside the thermal envelope need Insulation.

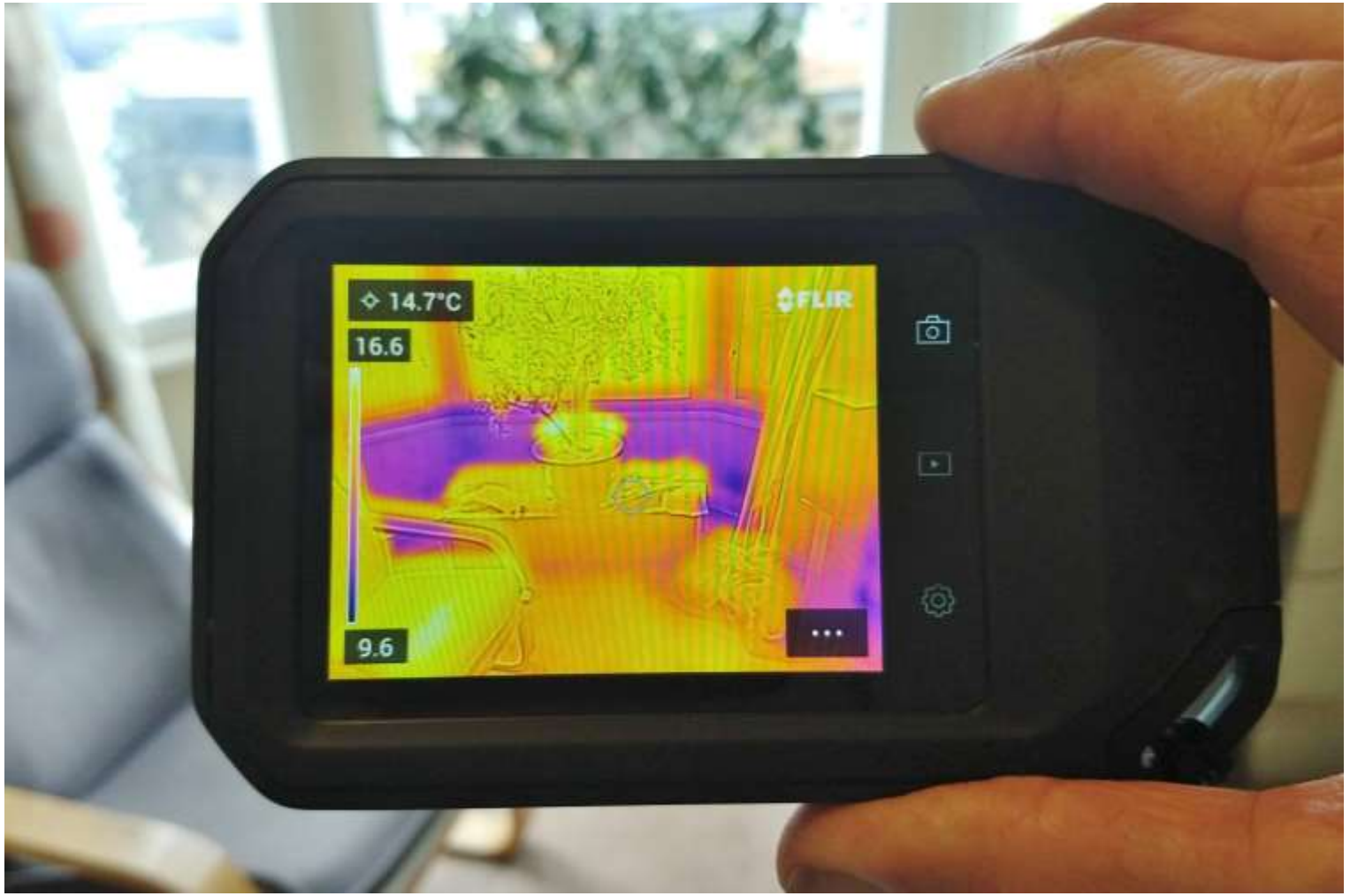
Hot water pipes always need insulation because they are hot in summer too when heat leakage is unwelcome.



Questions 1:
Uses of
Thermal Imaging



Section 2: Using the cameras



Thermal Cameras

Fluke TiR 105 (1)
160x120px

Manual Focus,
SD Card, Lens cap

Flir C2 (5)
80x60px

FLIR C3-x (1)
128x96 px

FLIR C5 (2)
160x120px

Touch screen,
USB connection

FLIR E40 (1)
160x120px

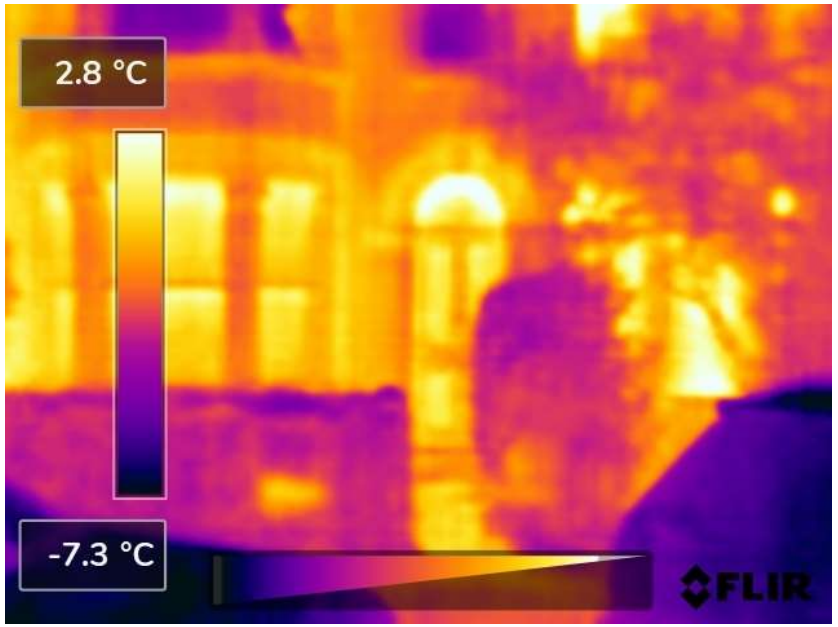
FLIR E4 (1)
80x60px

Hikmicro Pocket 2 (3)
256x192px

See Video & User manual for your camera

Please don't attempt to clean the lens

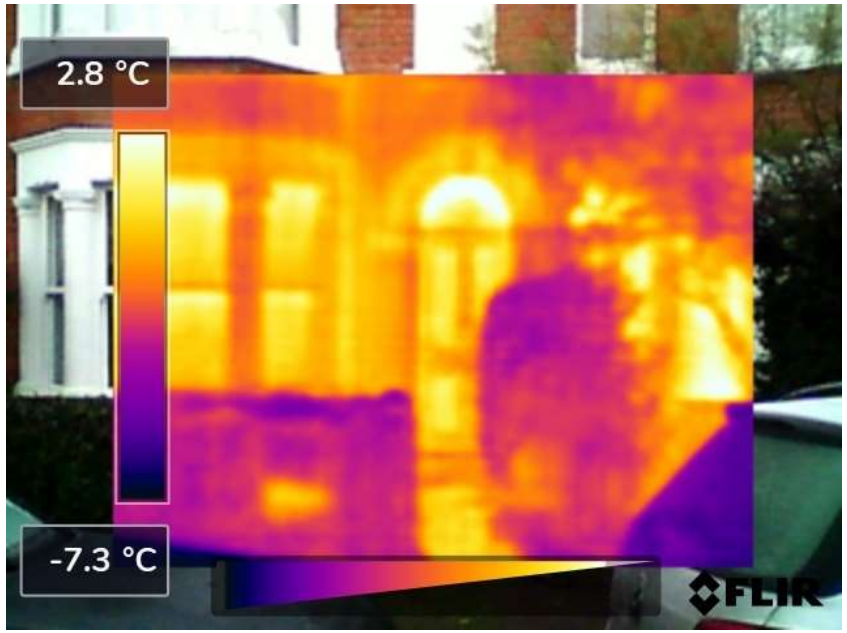
Picture modes



Thermal Only

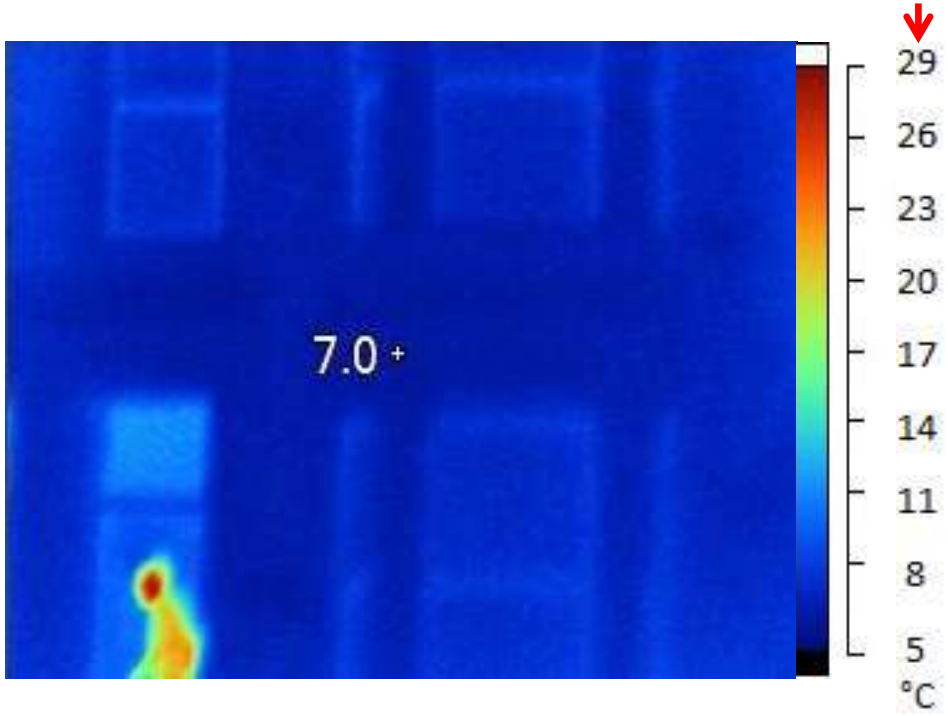
With MSX

not on Fluke Camera



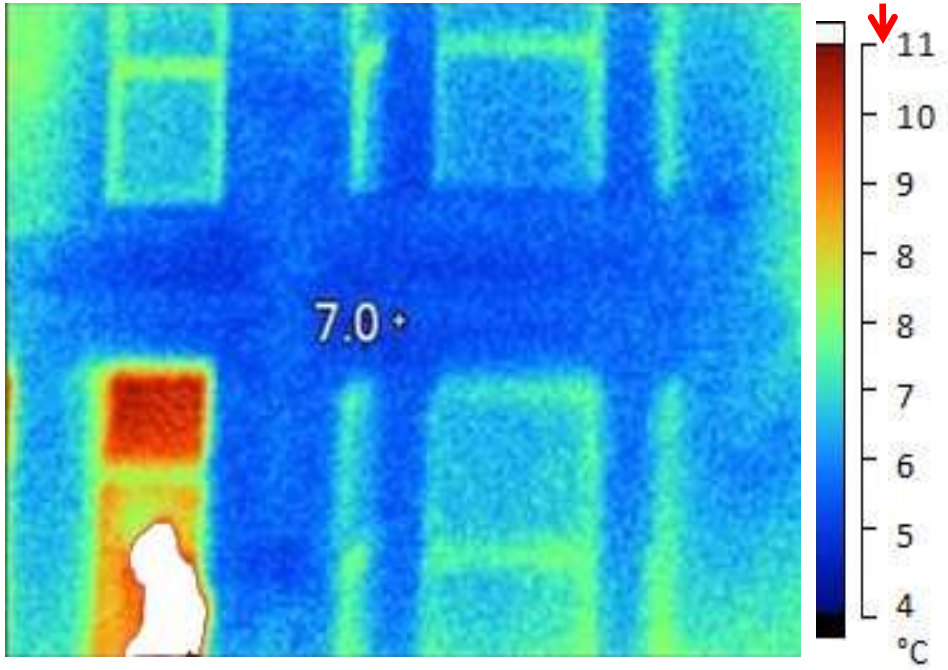
Picture-in-Picture

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

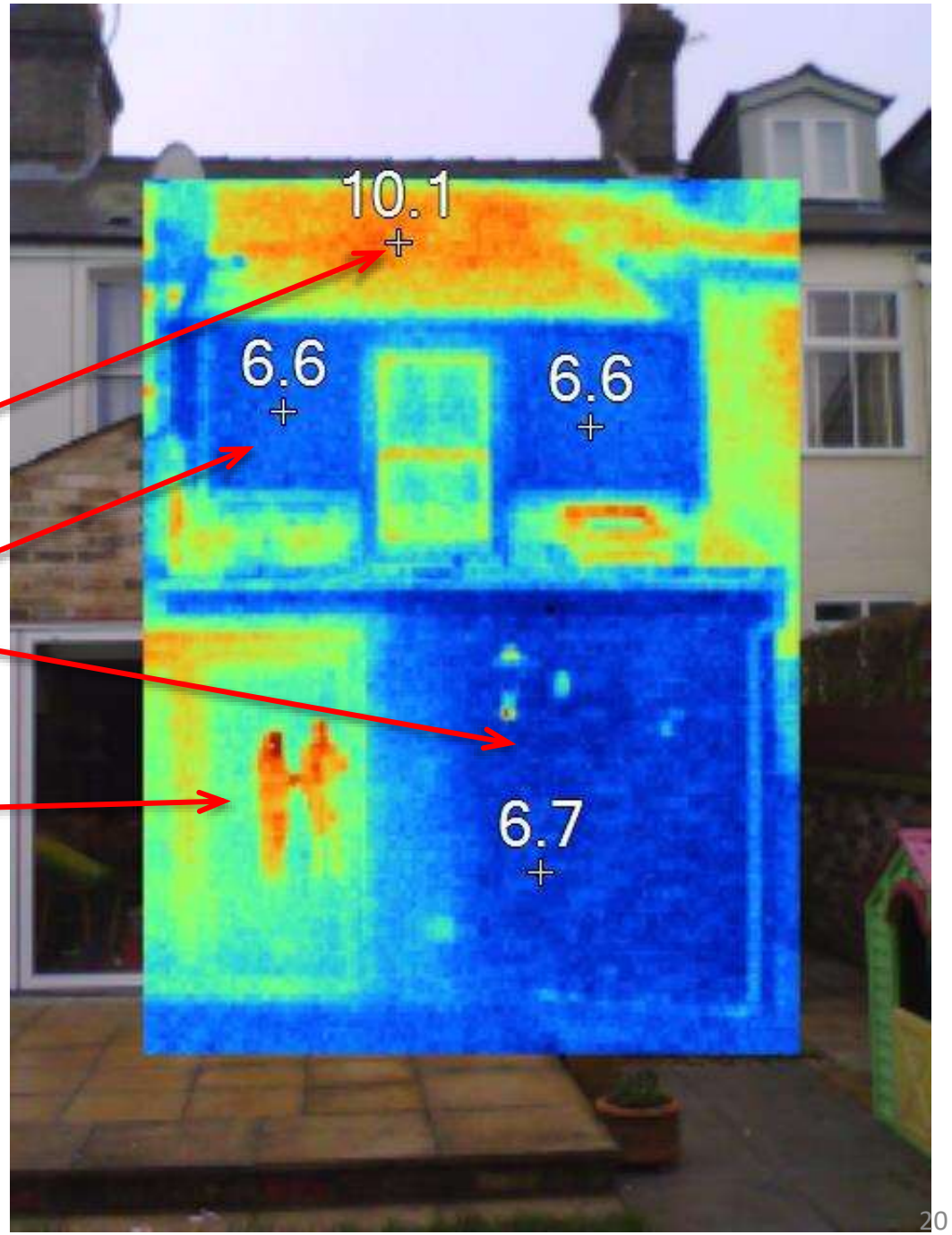
Viewing the outside

Hot = leaky

Warm: poor Loft Insulation

Cool: good Wall insulation

Reflections in glass



Draughts are usually easier to see from inside but this requires cold air flowing into the house. **Turn on extractors** to suck air in through all the draughty spots, regardless of wind direction**.**

House Survey - allow ~ 90 min

Preparation:

Choose a time when it's cold outside:

preferably >10°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:

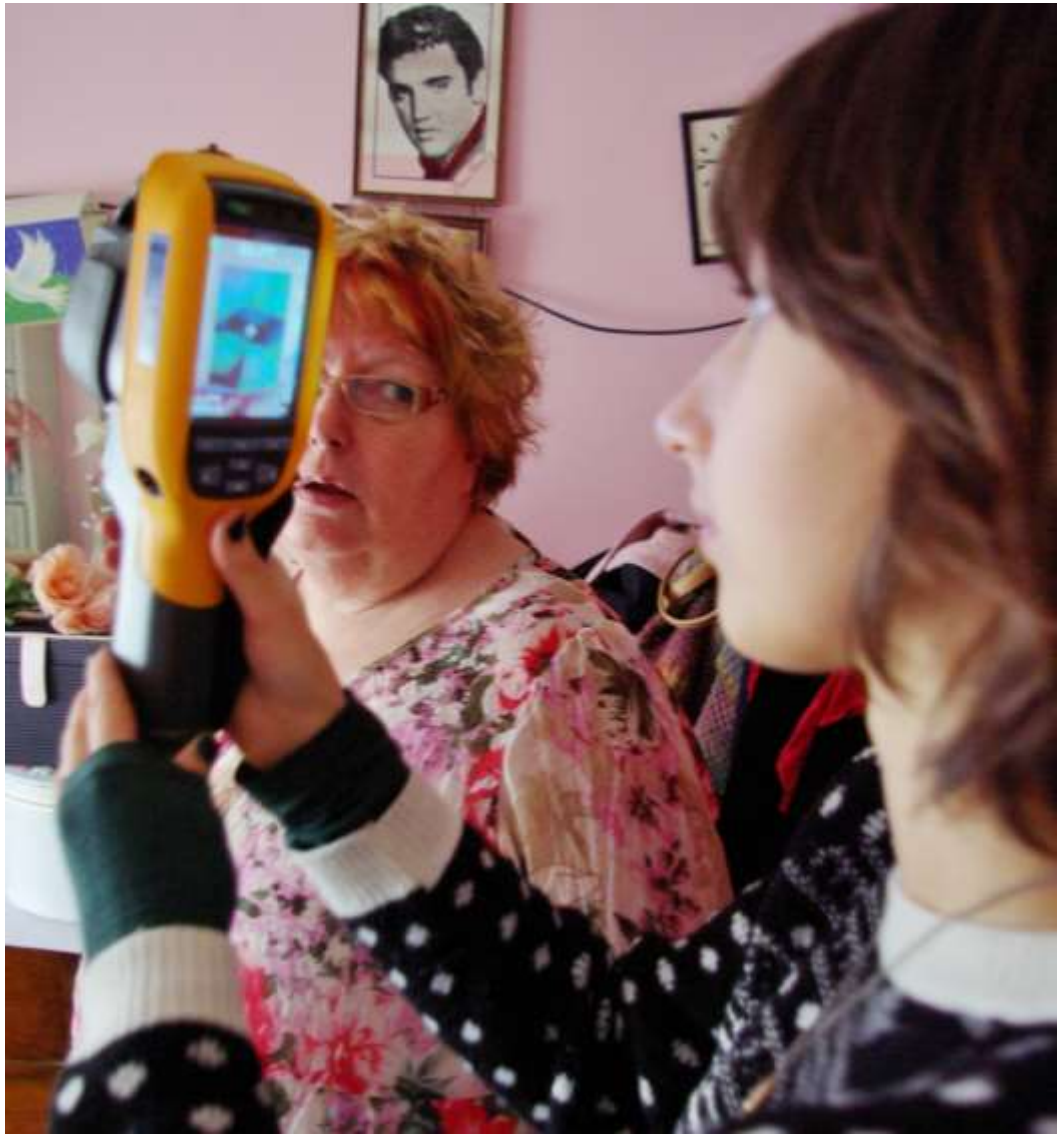
What is unexpectedly hot or cold? Why?

Investigate those places: distant and close

Make comparisons

Check from the outside too

Take plenty of images with notes



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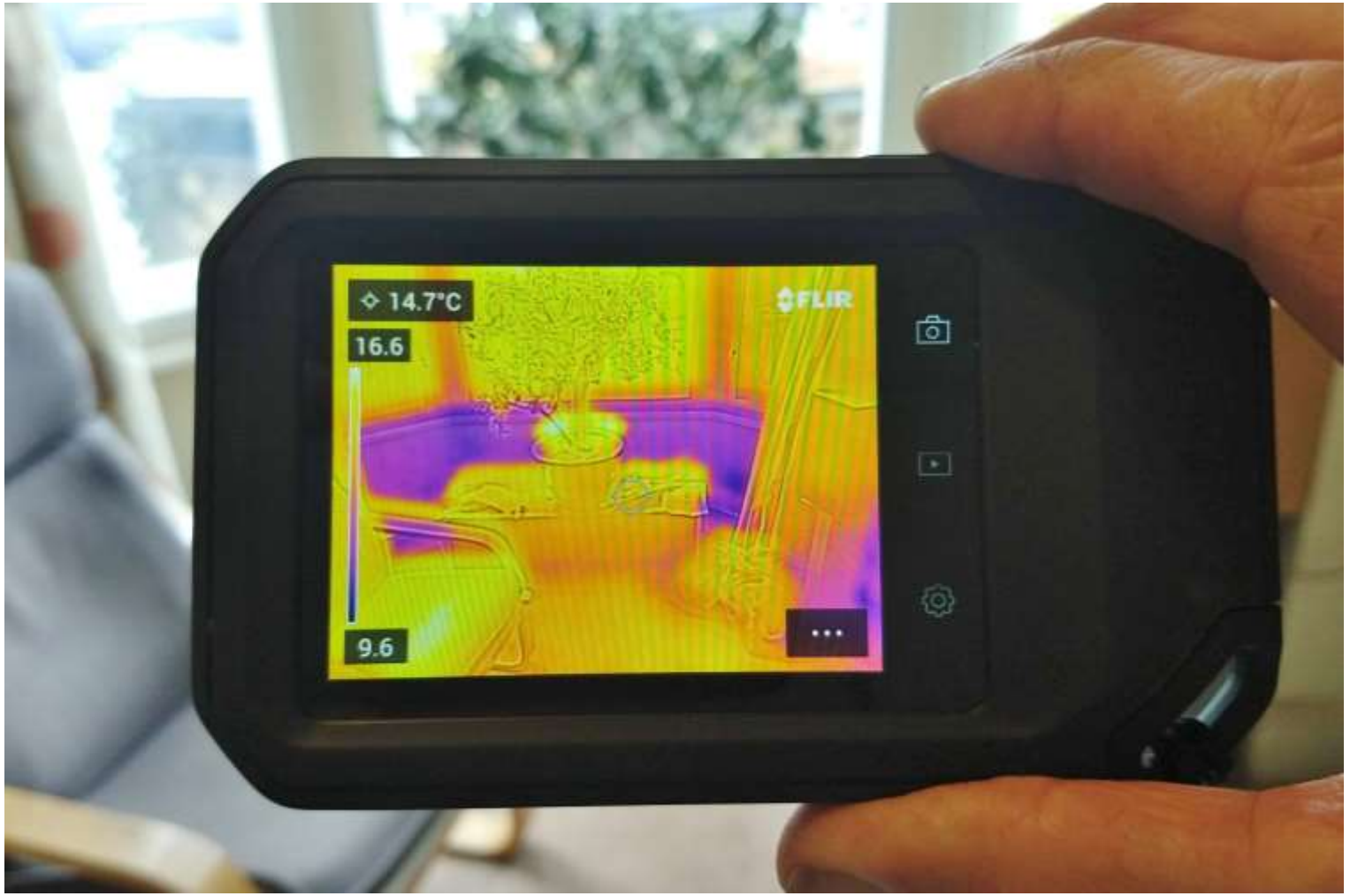
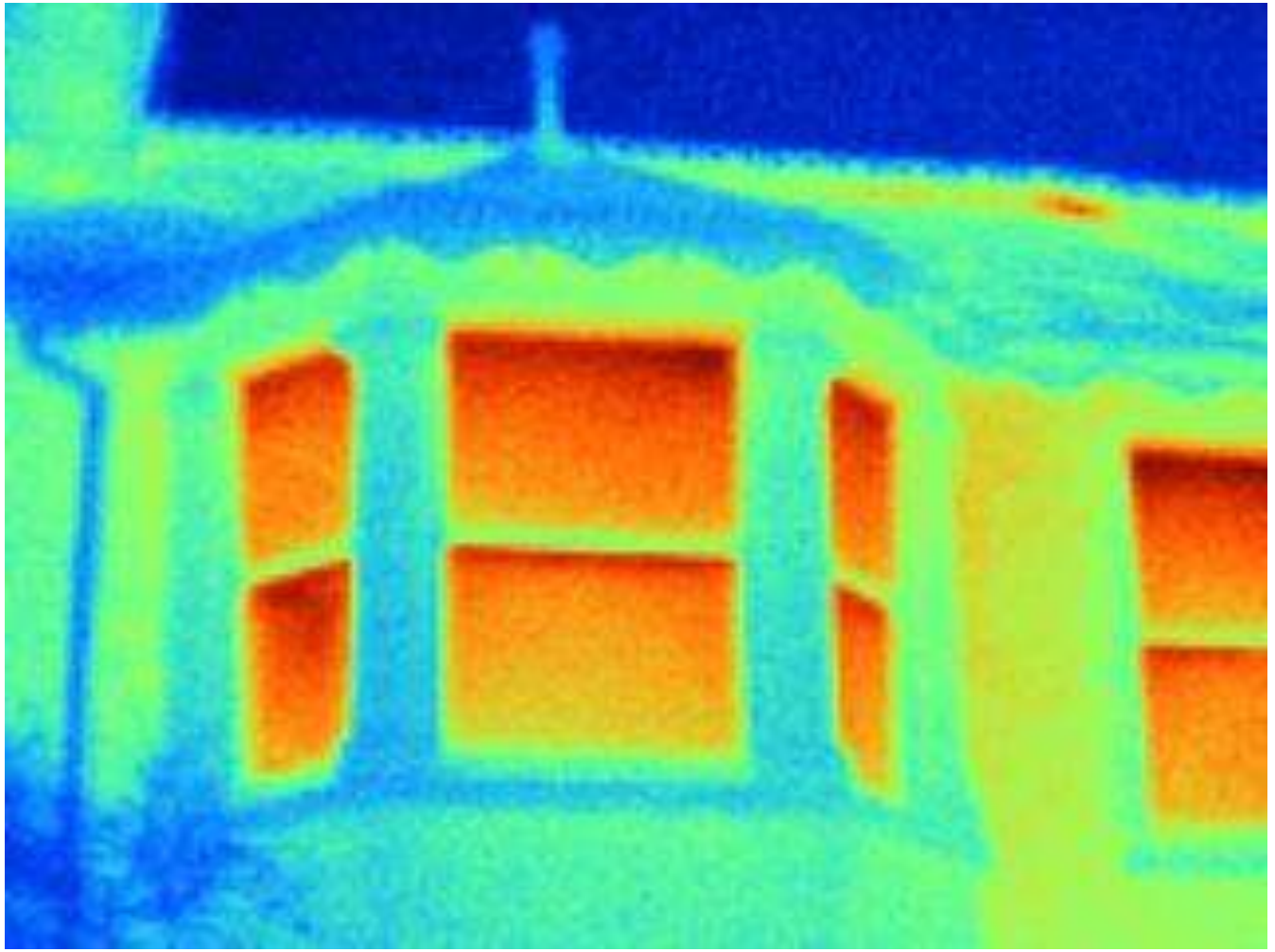


Section 3: Interpretating Images



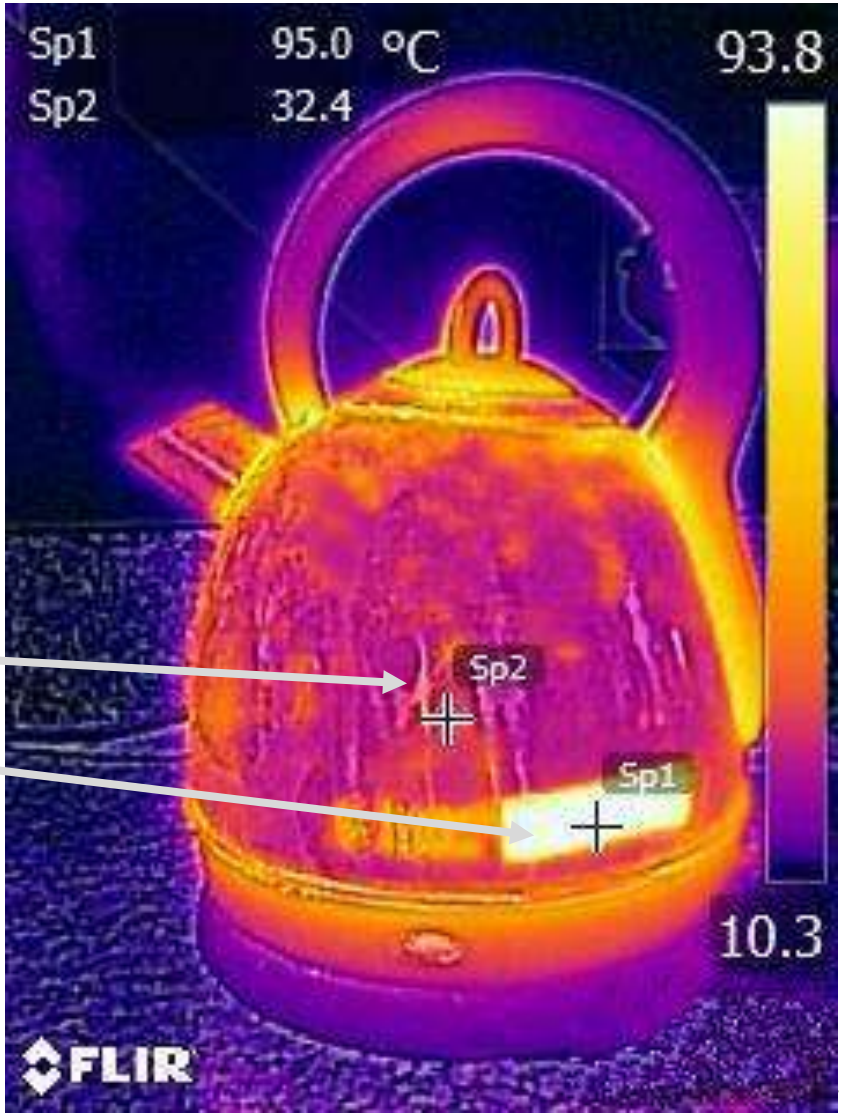
Reflections

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

Image from
https://www.spitzer.caltech.edu/image/sig08-005-hands-in-a-bag-black-and-white-visible-vs-infrared-light

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
  - Bare metal
  - Some glass
  - Some concrete

Why is the upper window so cold?

Sky - 60°C

Upper Window -12°C

Reflected Sky

Solid Brick Wall -8°C

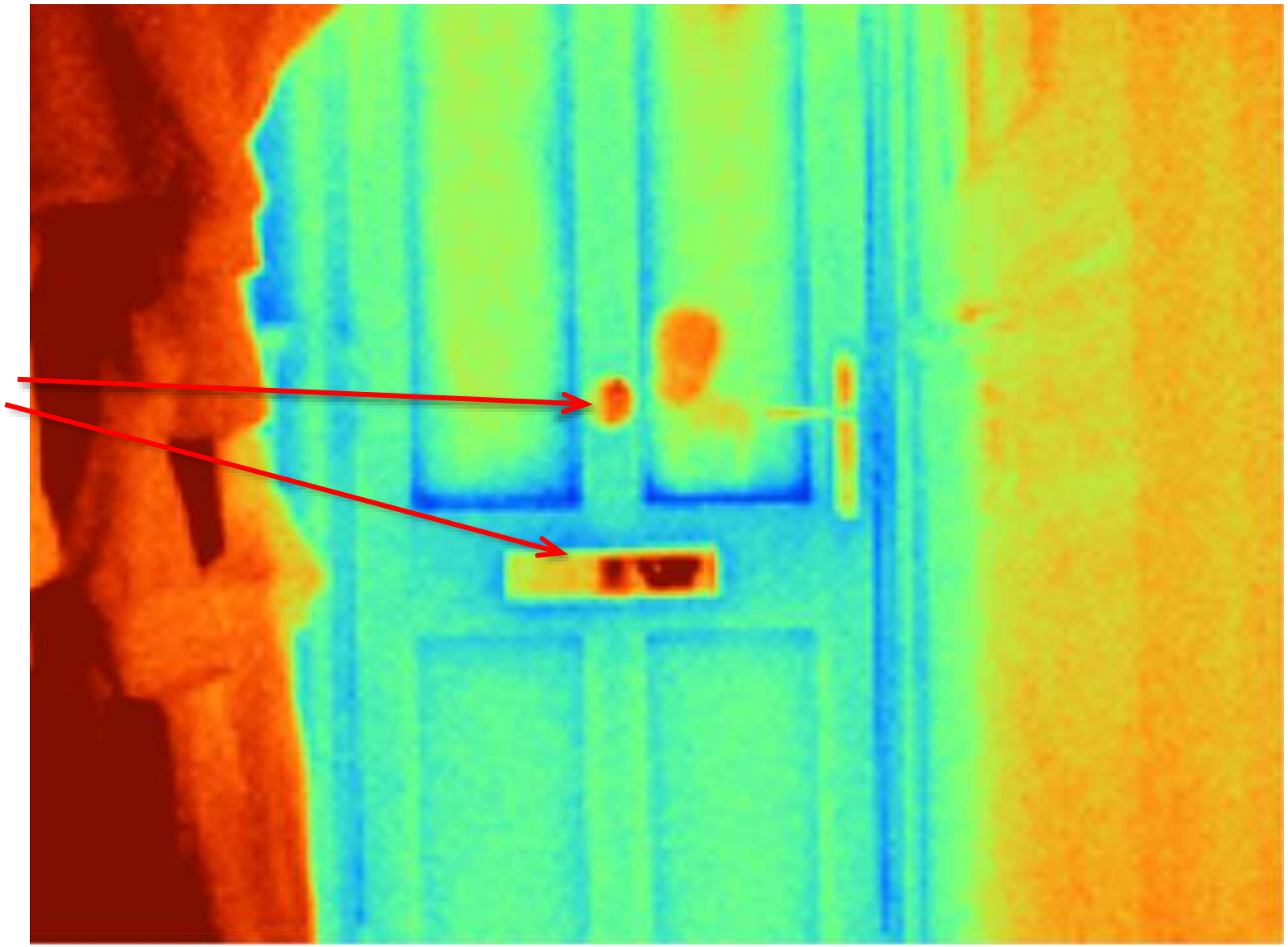
Lower Window -4°C

Reflected Warmer Building across street

What the hot spots on the letter box?

Temperature errors

Reflections



Why are the walls different temperatures?

Walls **will stay warm** for some time after sunset

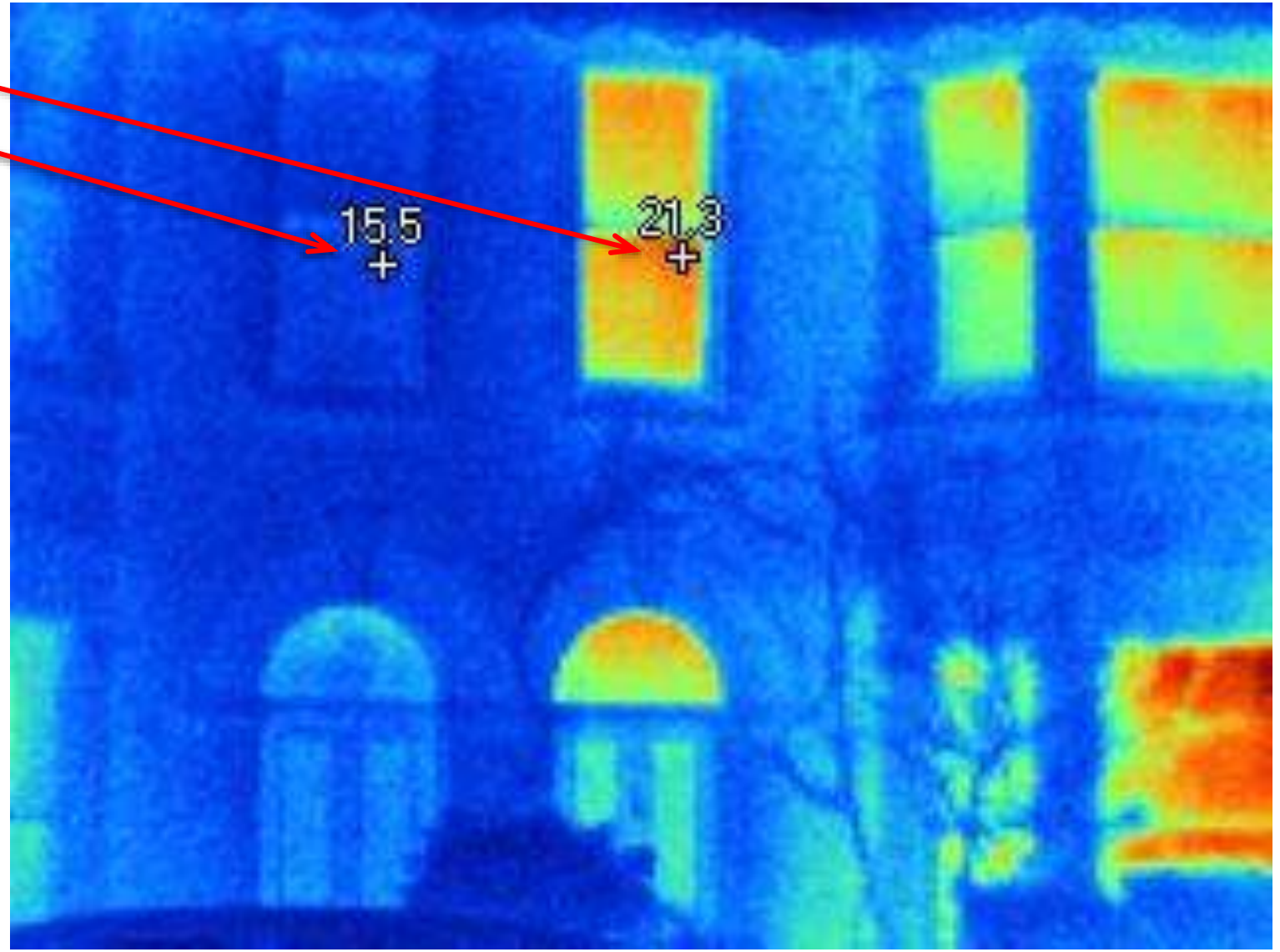
Why are the houses so different?

Why Different Temperatures?

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

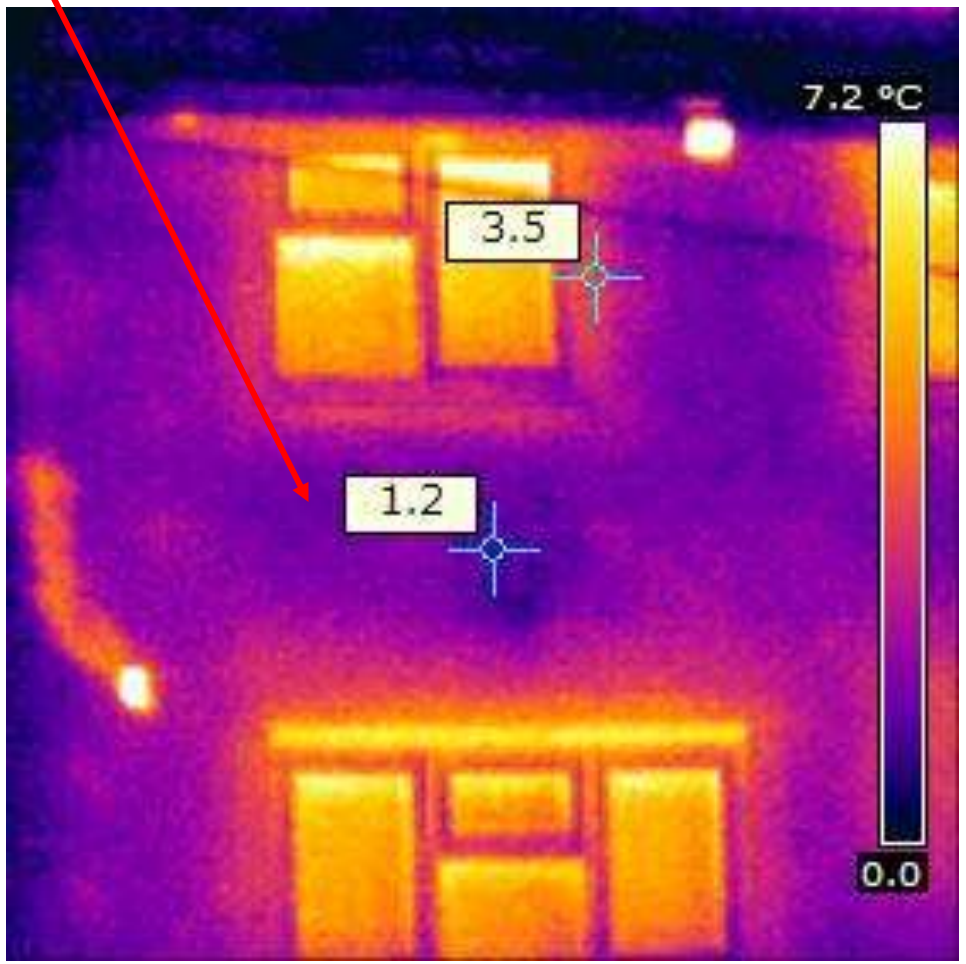
Neighbour had health problems needing warmth

More than technical issues



What Problems?

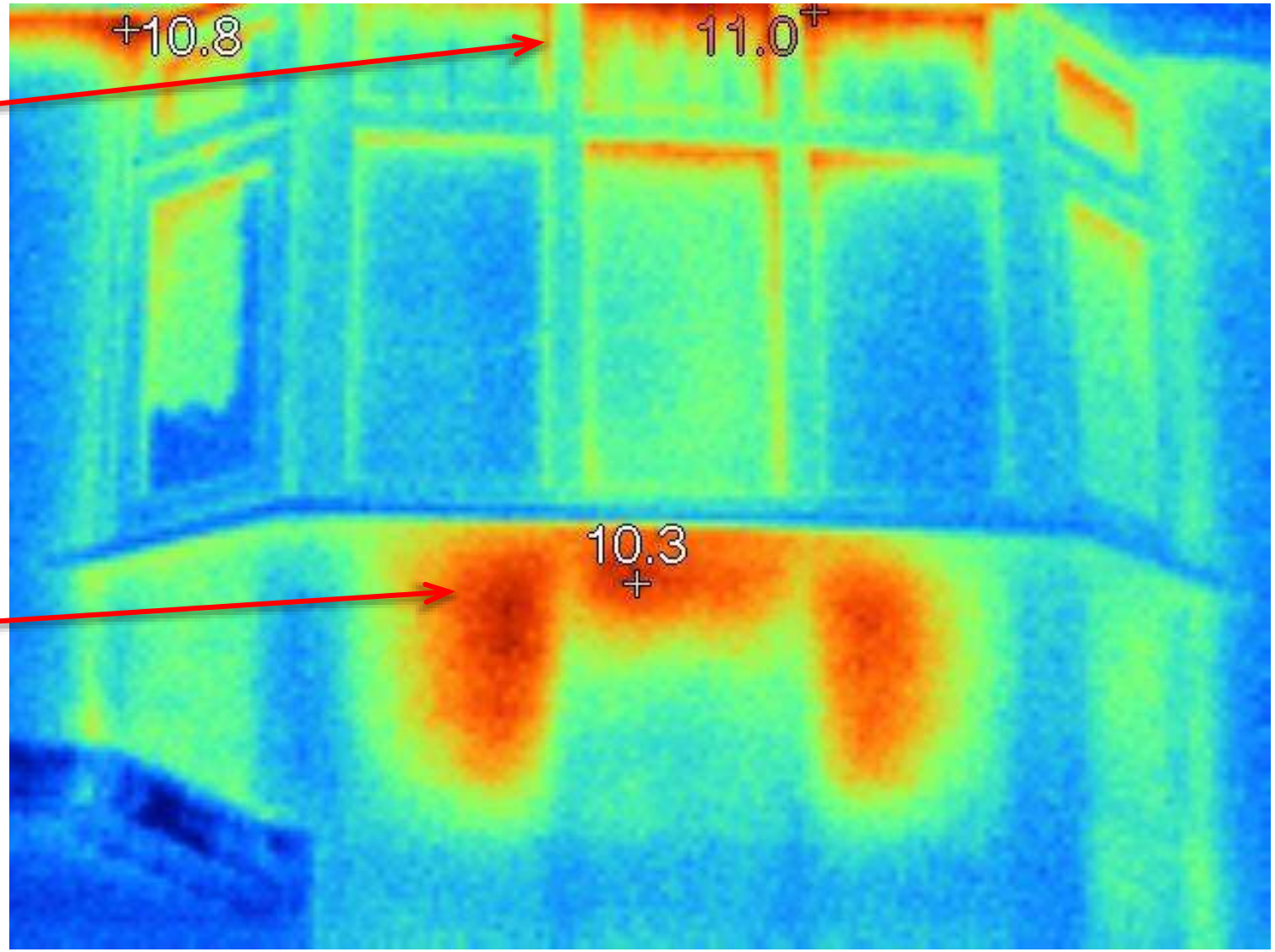
Why the difference in temperature below the windows



What Problems?

Draughty windows

Radiator inside
without reflective foil
(partly sludged up)



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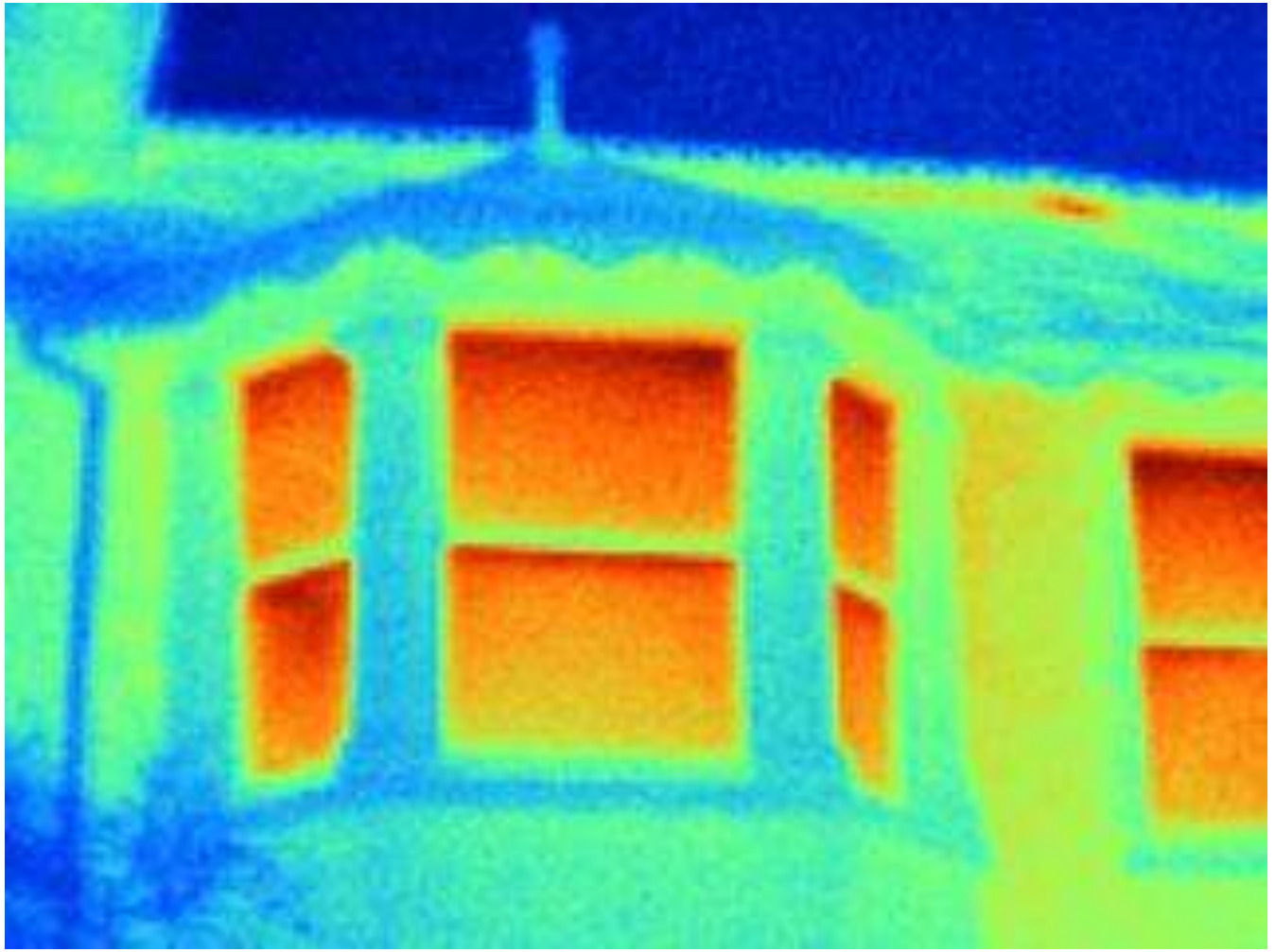


Section 4:
Booking etc

Borrowing a camera

First:

'Sign' **TI Camera Borrowing Agreement**:

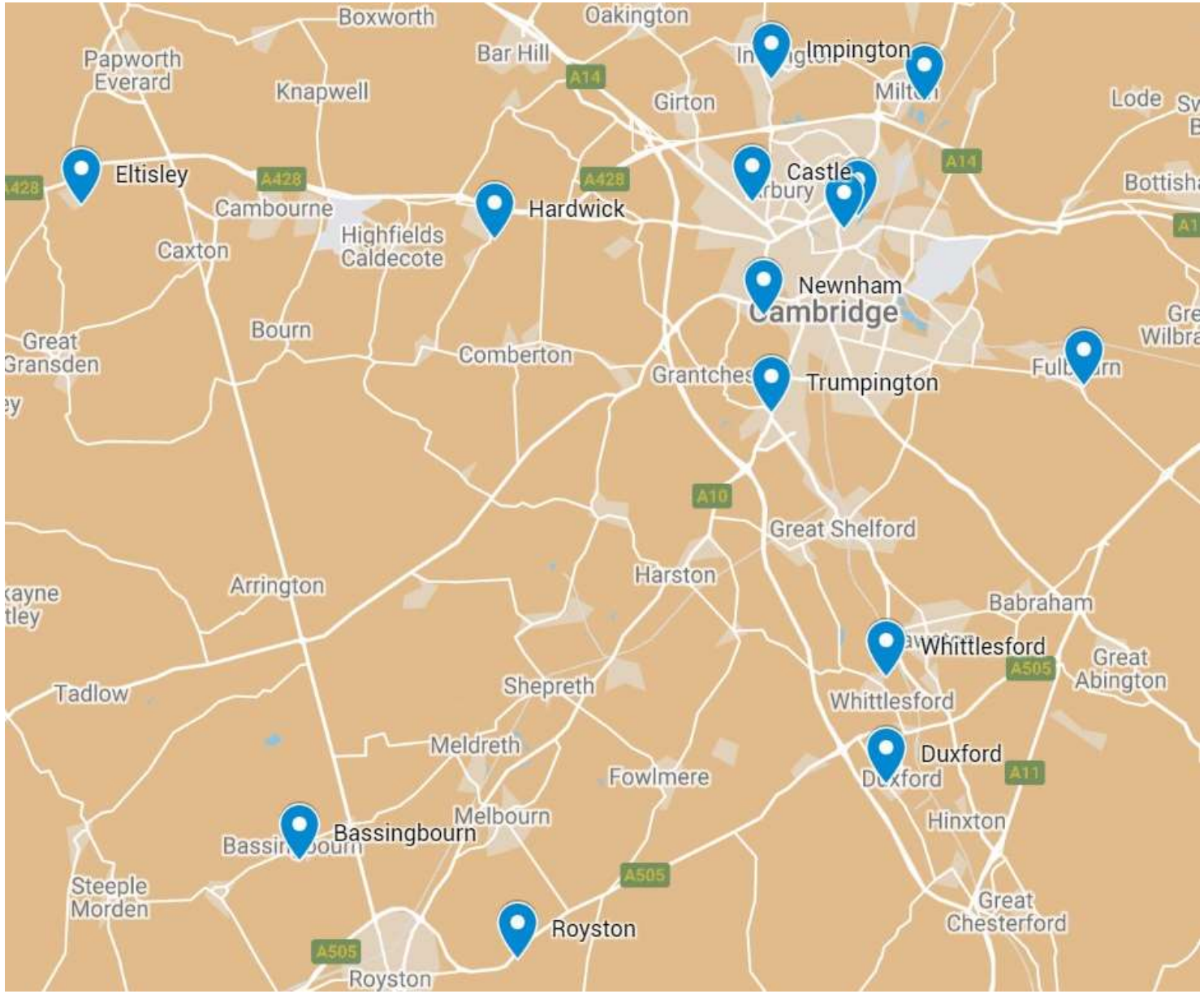
- Keep camera with you or in a locked place
  Don't lend it to anyone else
- Collect & return the camera as agreed
- After: fill Survey Record form for each building
  - Used to improve training and to measure our impact

A **donation** would be much appreciated

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	Camera
Bassingbourn	Flir C2
Cambridge, Castle	Tir 105
Cambridge, Chesterton 1	Flir C3-x
Cambridge, Chesterton 2 (Sentec)	Flir E4
Cambridge, Milton	Pocket 2
Cambridge, Newnham *	Flir e40
Cambridge, Trumpington (Bidwells)	Flir C5
Duxford	Pocket 2
Eltisley	Flir C2
Fulbourn	Pocket 2
Hardwick	Flir C2
Histon and Impington	Flir C2
Royston	Flir C5
Whittlesford	Flir C2

Book a Camera - after 8:30pm



Booking Calendar

Choose the Monday or Friday when you want to collect

Your booking in progress

Bassingbourn, Flir C2

November 2023 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			

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

Select a pickup time*:

2:30 PM – 3:00 PM

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: Host Details

Pickup address:

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:

cambridgecarbonfootprint.org/thermal-imaging

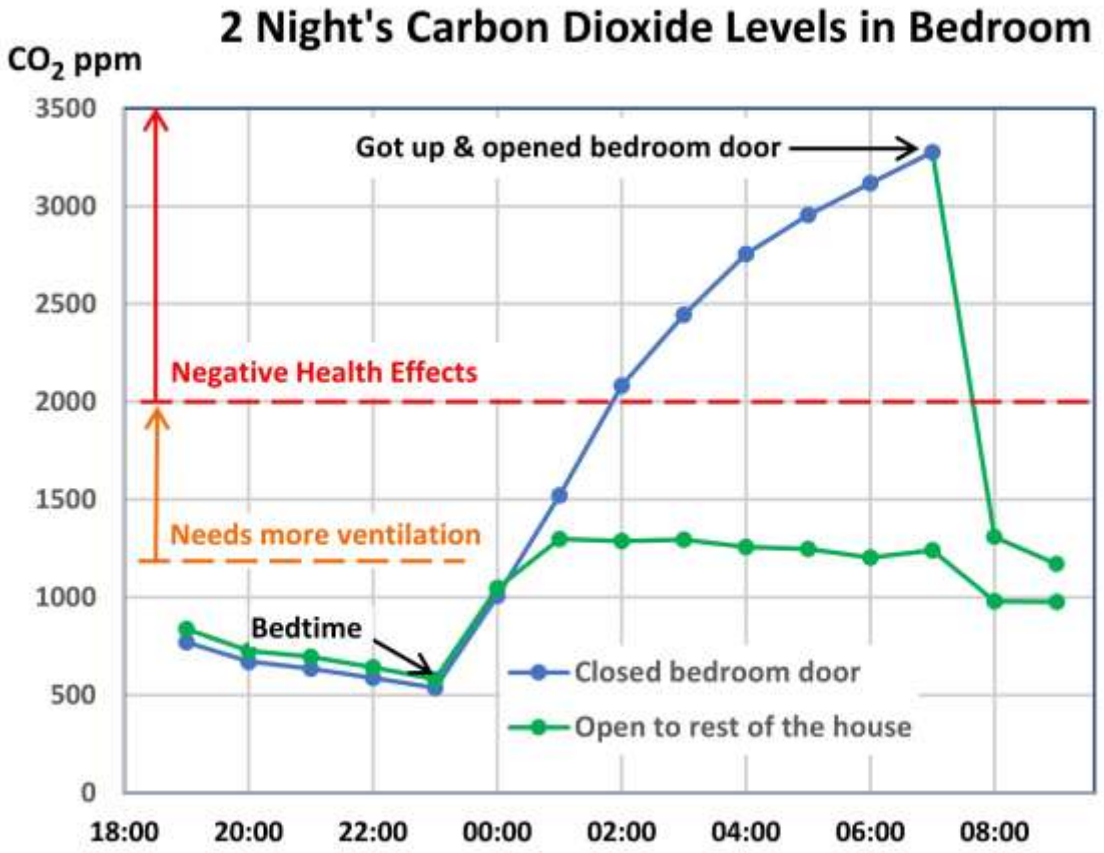
More TI Training: Mon 22nd January, Thu 29th February

Final Questions

Booking etc

CO_2 Monitor Loans check poorly ventilated rooms

Fri pm to Fri am loans. Online resources, no training needed



Good luck with your Thermal Imaging….

Cambridge Carbon Footprint

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

Plus - CO2 monitor booking

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