SAFFRON WALDEN
COMMUNITY ENERGY

An Introduction to Thermal Imaging
+
Some Random Thoughts on Heat

Chris Dodge

Saffron Walden Community Energy

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About SWCE

- Established in 2021 with the aim of supporting the transition to zero-carbon energy locally.
- We're a Community Benefit Society
- Initial support from Essex County Council and Community Energy South
- Work primarily through volunteer input and grants funding

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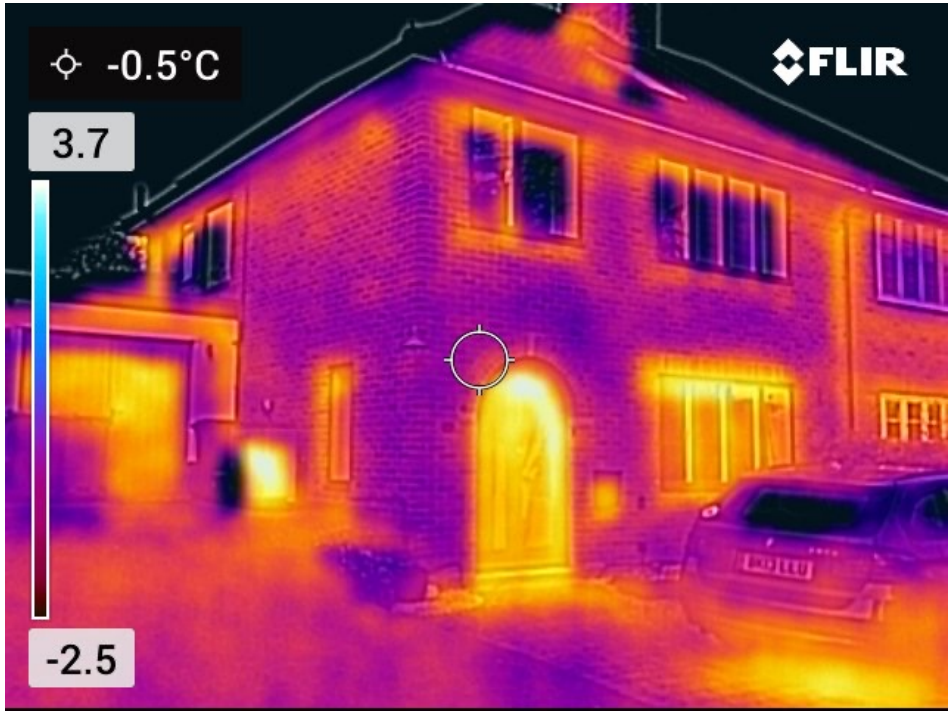
What is Thermal Imaging?

- Give yourself a sixth sense – see temperature variations
- Primarily qualitative
- Our aim:
  - See where heat may be leaking from home
  - Try and understand what's going on!
  - Basis for further investigation, fixing or retrofit



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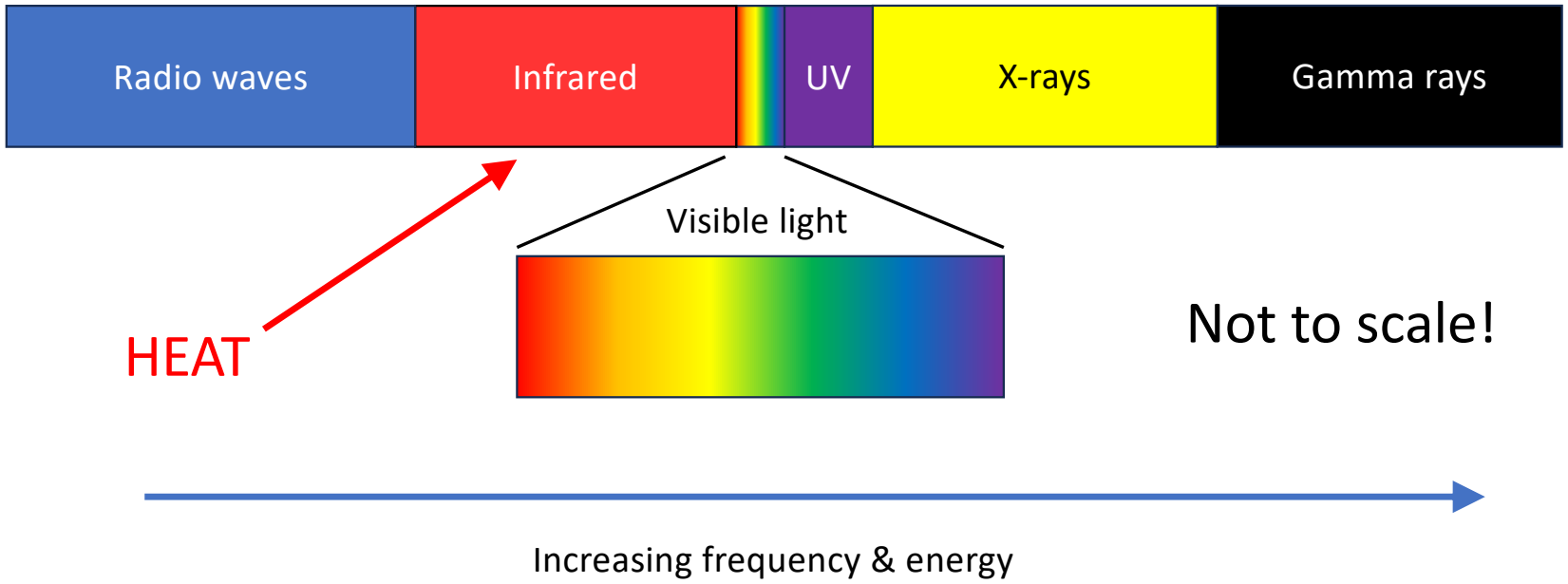
Science (Just a Little!)

The Electromagnetic Spectrum



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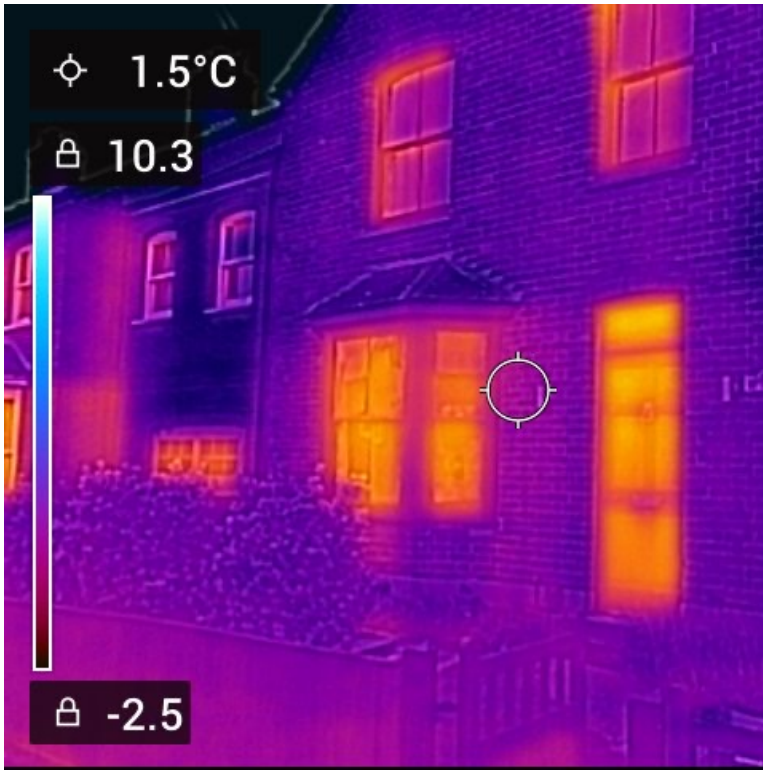
Thermal Cameras

- Shows surface temperature – not x-ray
  - Can reveal deeper structures
- Use a false colour map, for example
  - Orange/yellow = hot
  - Blue/black = cold
- Combines a visible image with a heat image
- Heat image is low resolution
- For example, the FLIR C5
  - 5-megapixel visible camera
  - 19,200 pixel (160 x 120) thermal image



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Imaging from the Outside

- Have at least 10°C temperature difference between inside and outside
- Should be dry and no strong winds
- Ideally daylight but avoid direct sunlight
- Allow heating to be on inside for a while
- Yellow & orange = bad.
- Blue & black = good.
- Simples! But various pitfalls.

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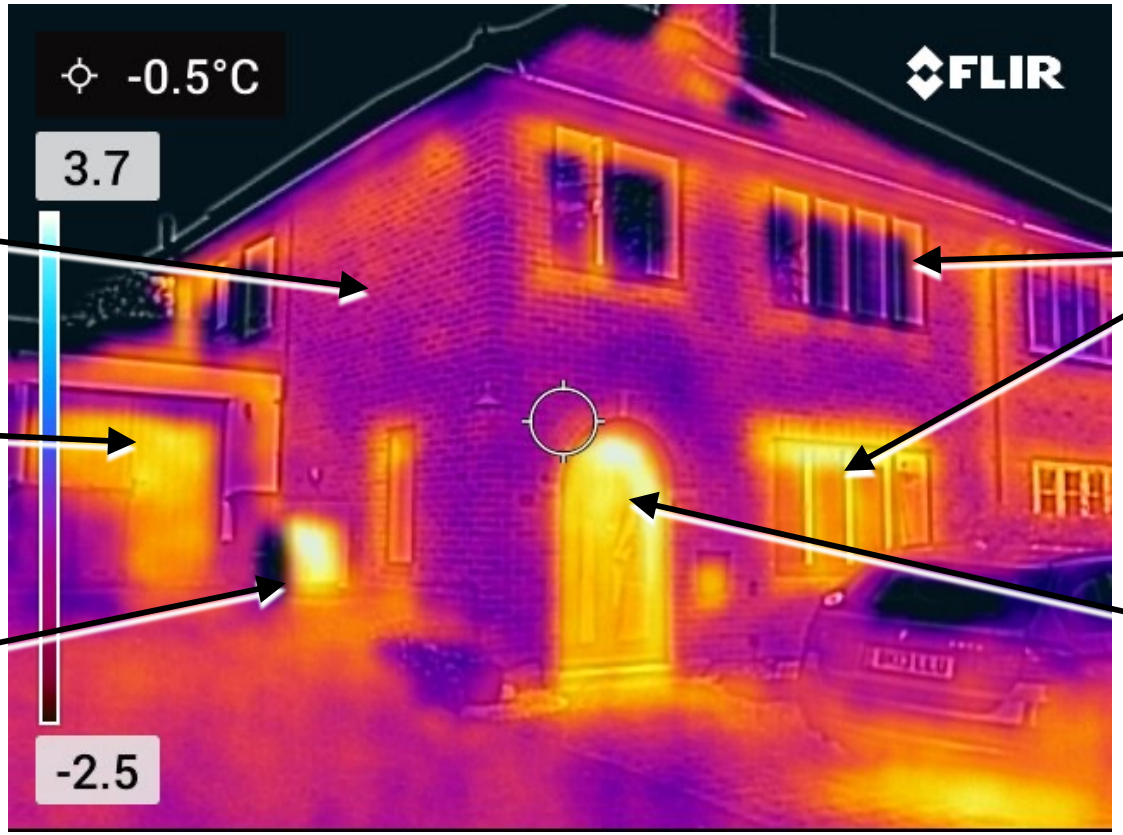
Typical Example

Patchy cavity wall insulation?

Workshop leaking heat

Heat pump - hot and cold



Windows warm and cold! What's going on??

Heat leaking from porch

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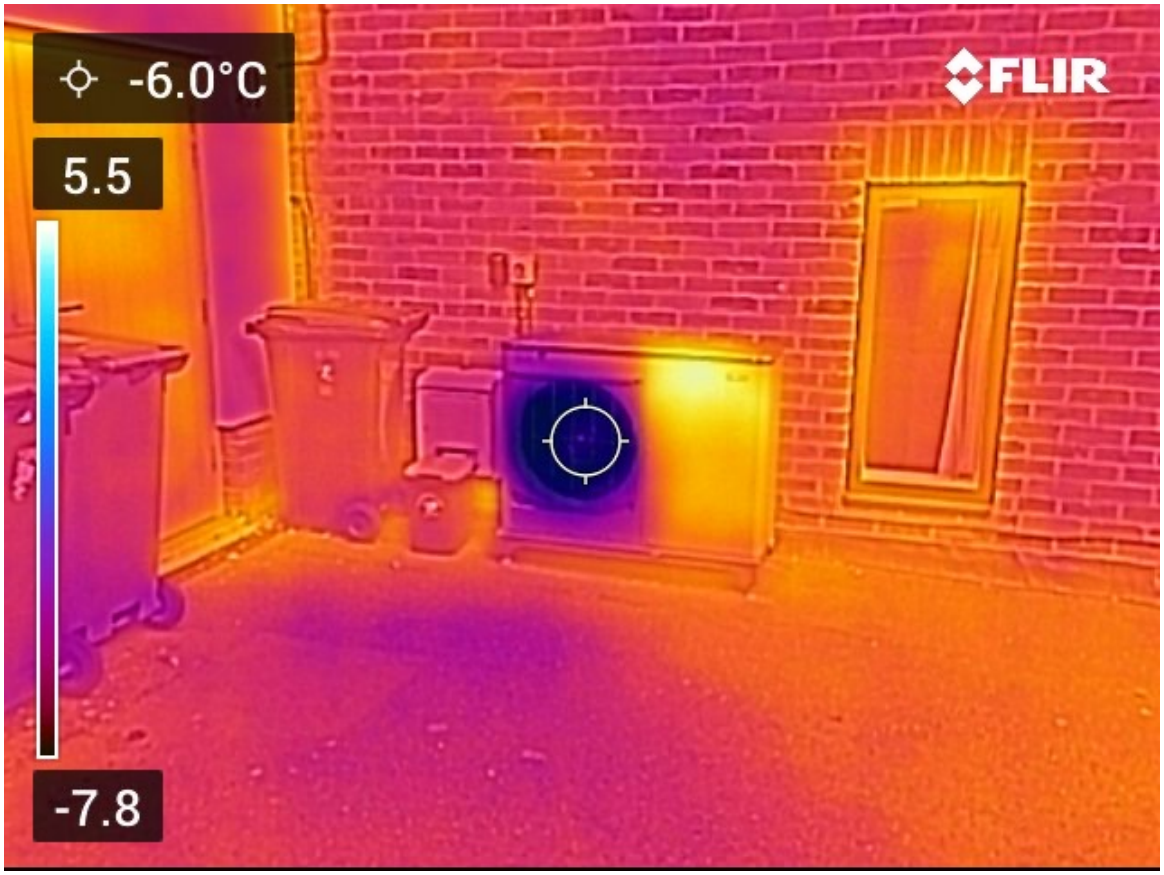
Checking out the Heat Pump



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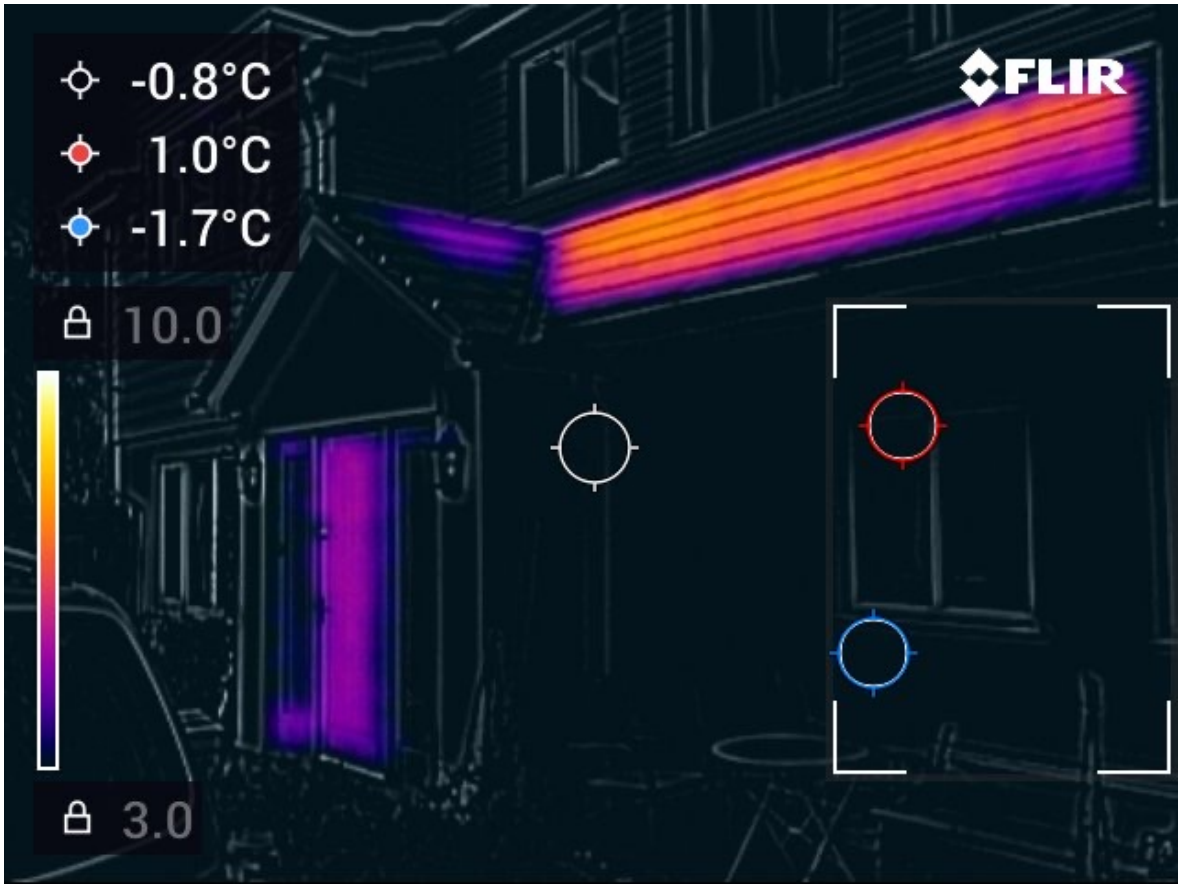

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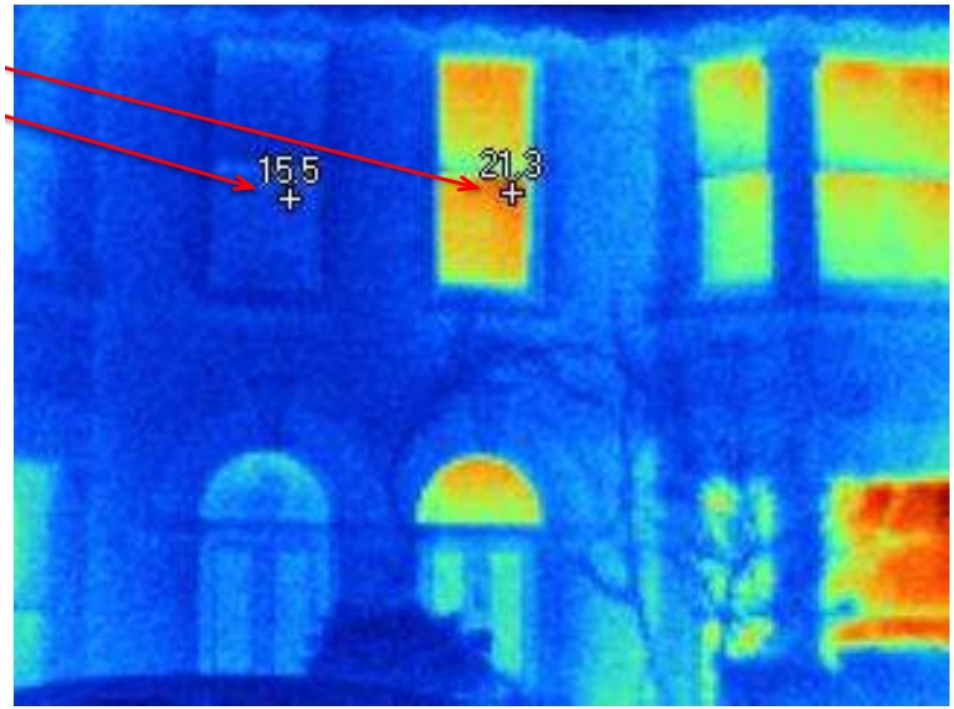
Is the House/Room Heated??

- Left: Low thermostat & secondary glazing

- Right: House kept a lot warmer

Thanks to Cambridge Carbon Footprint



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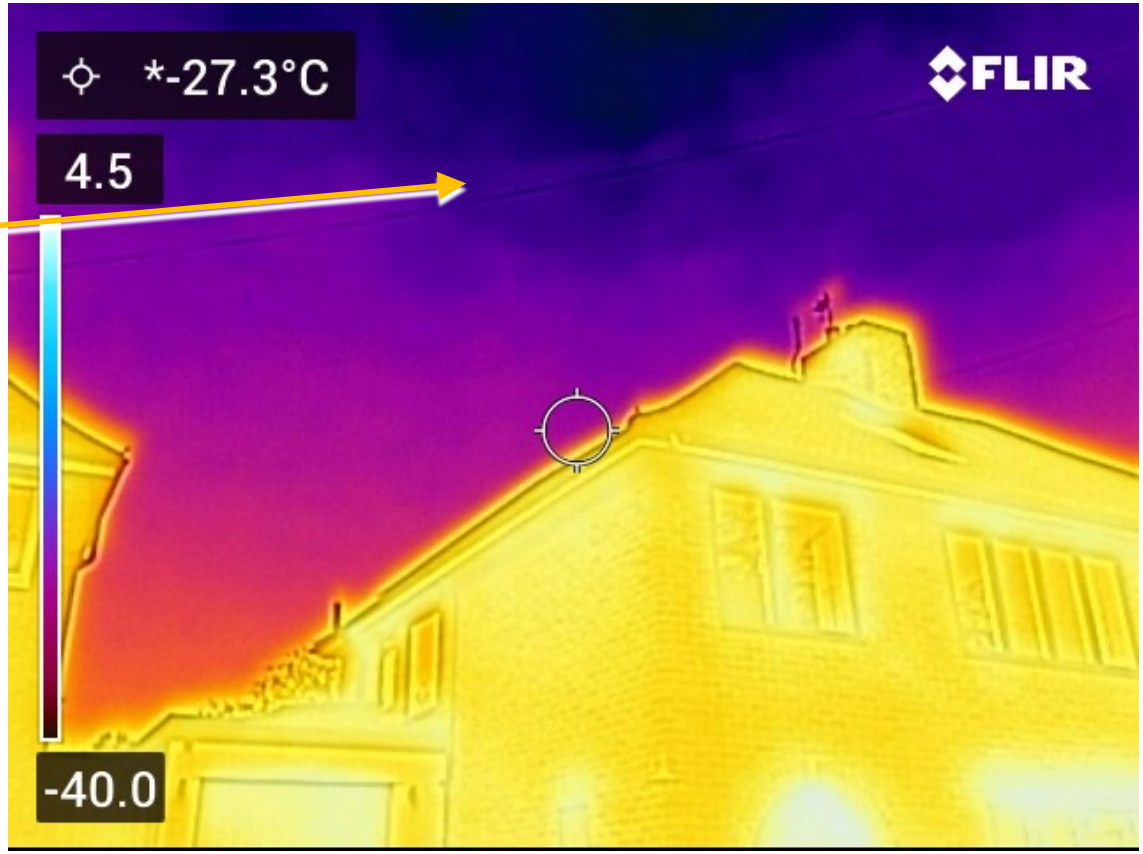
Care with Auto-Scaling

Measuring temperature of upper atmosphere

Poor temperature resolution in area of interest



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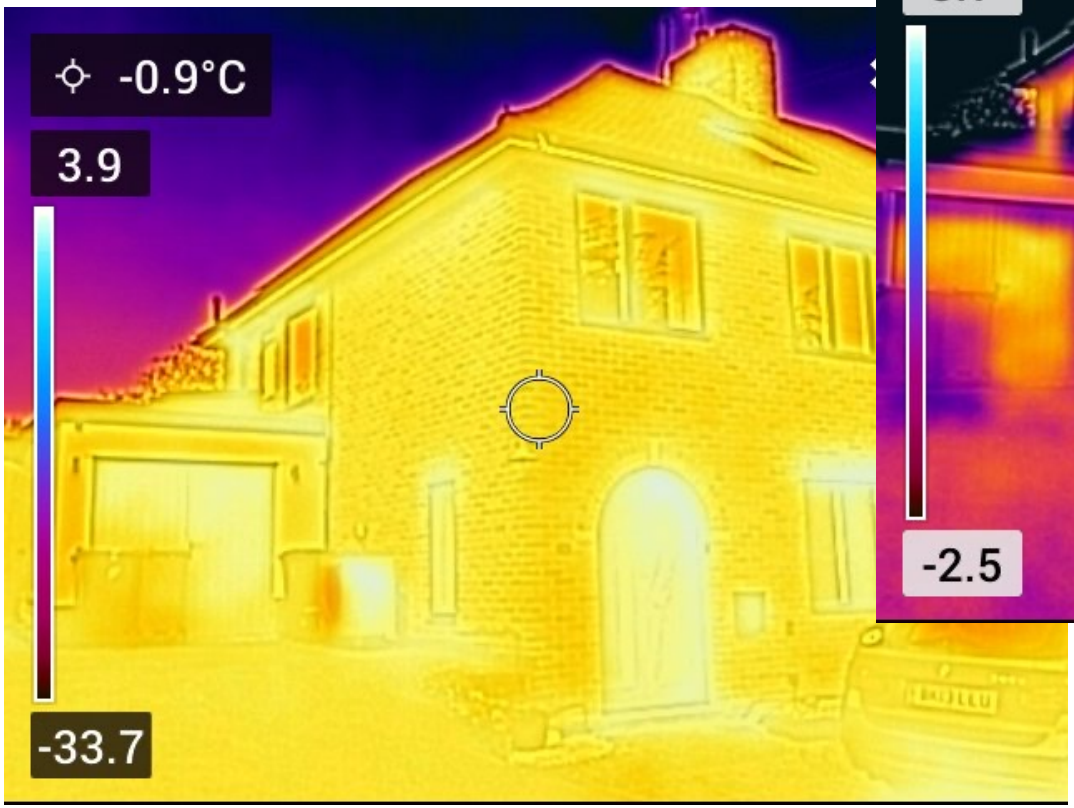

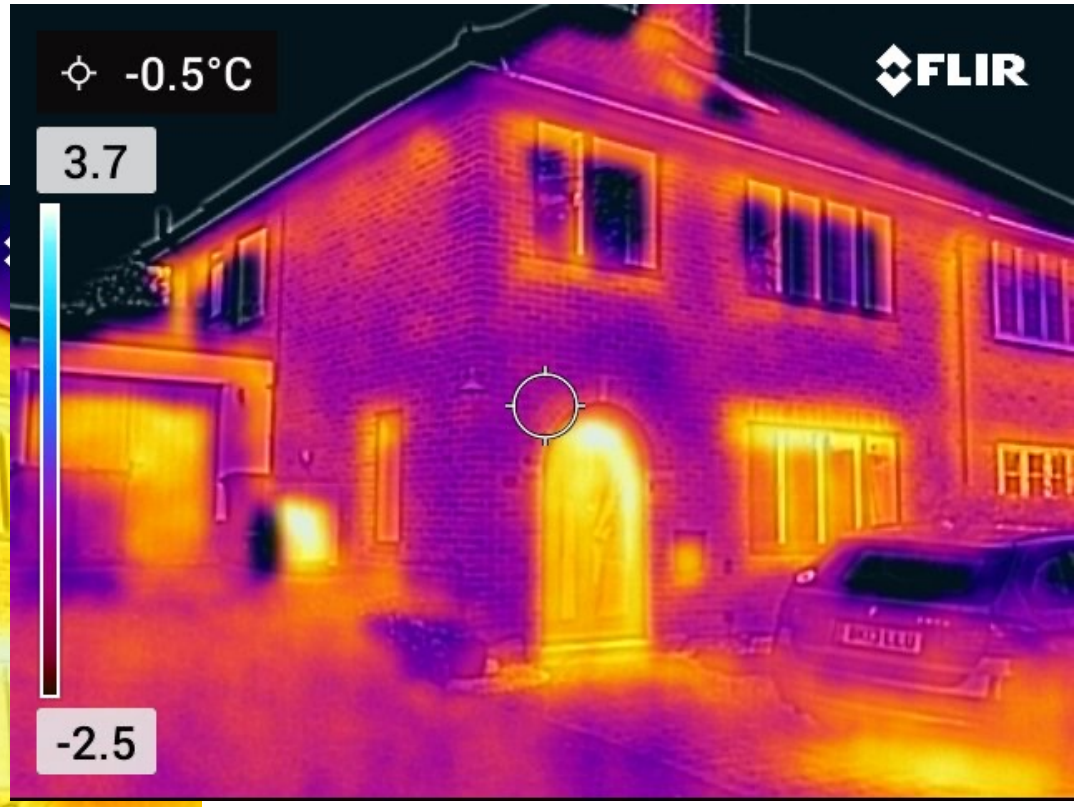

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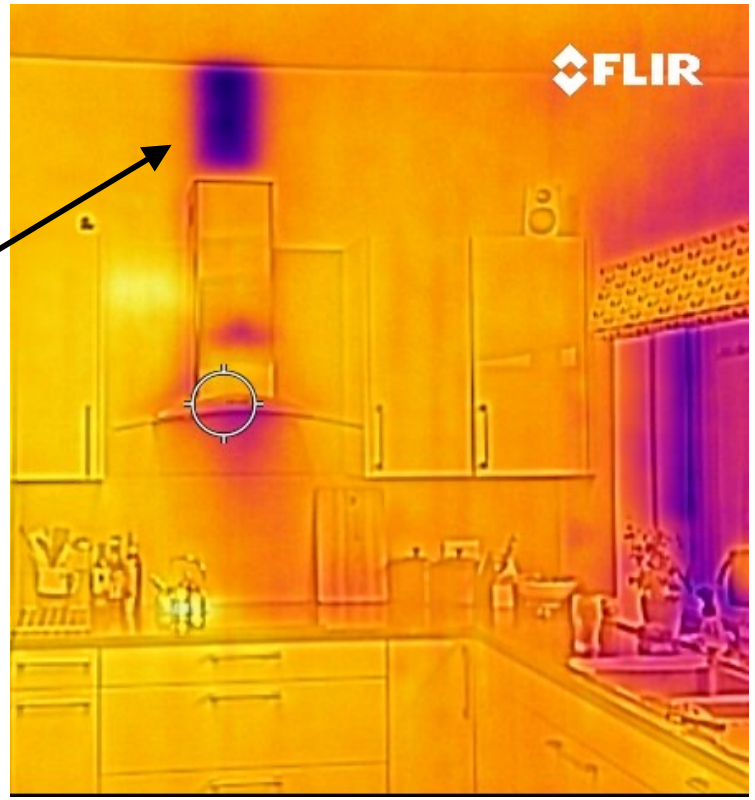
Imaging from the Inside

- Need the inside/outside temp difference
- Generally yellow & orange = good
- Generally blue & black = bad
- Understanding home construction useful
- Some pitfalls here as well



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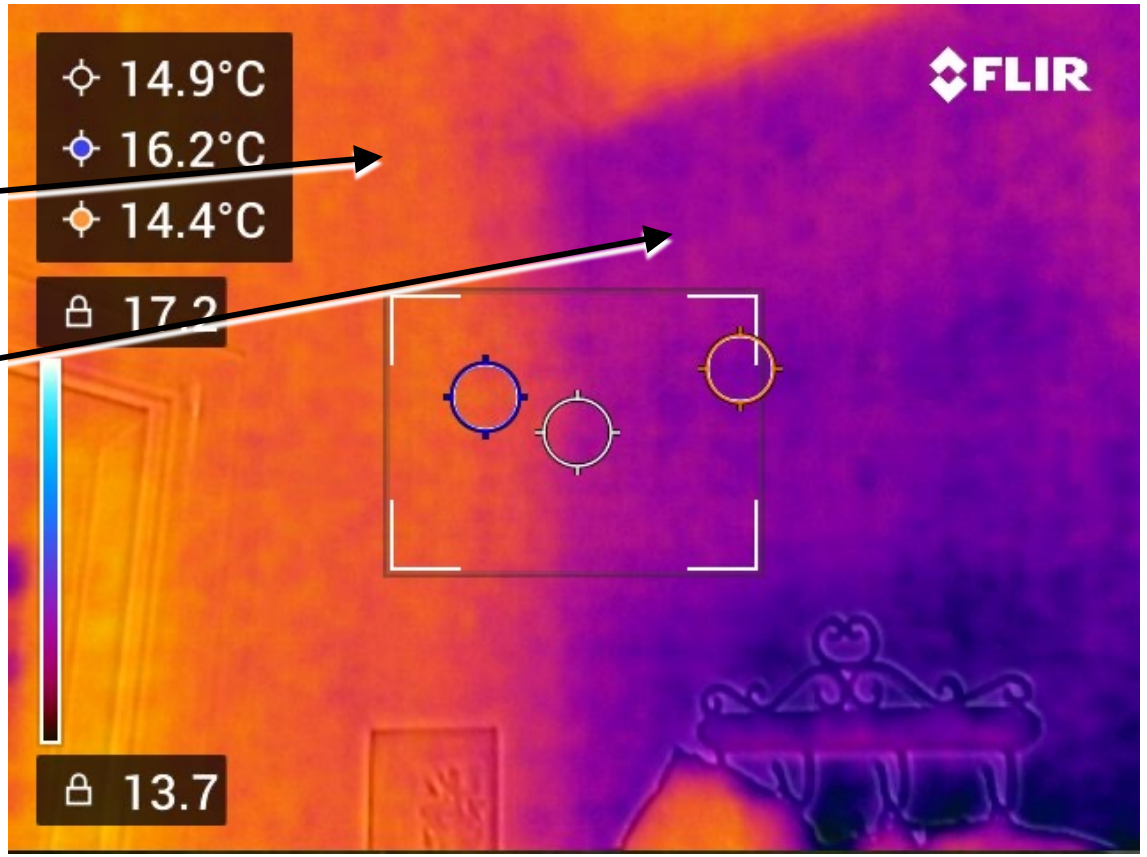
What's significant?

Inside wall

Outside wall

Outside wall cooler by 1 or 2°C than inside wall. Improved insulation would help



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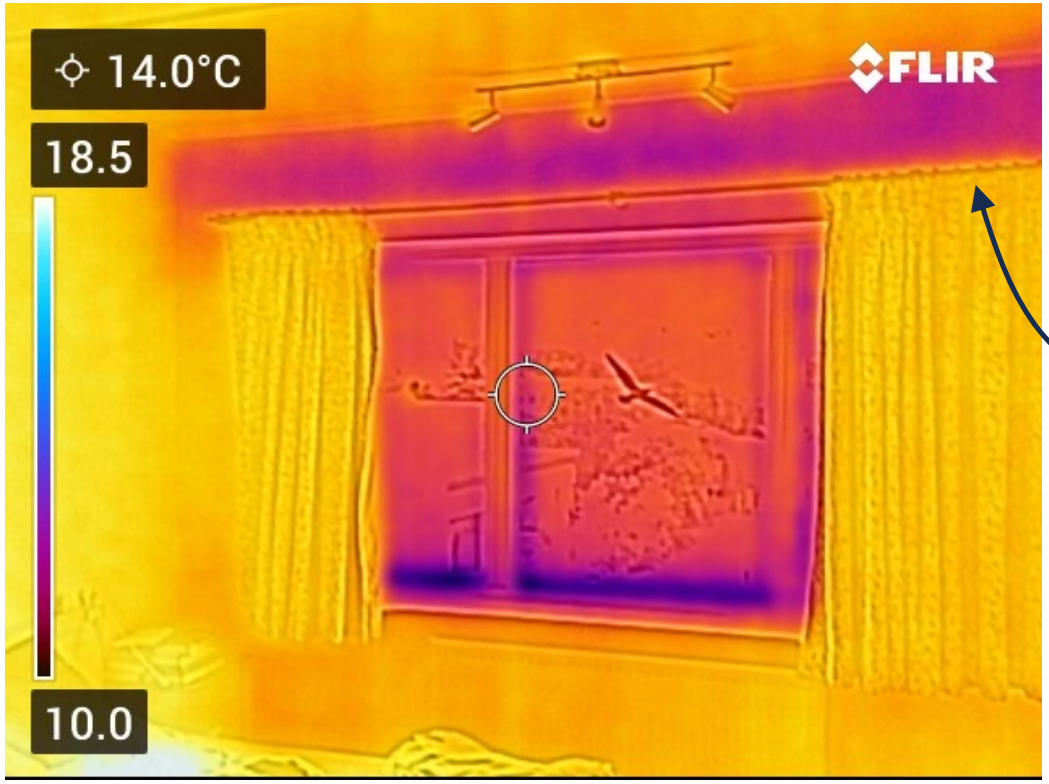
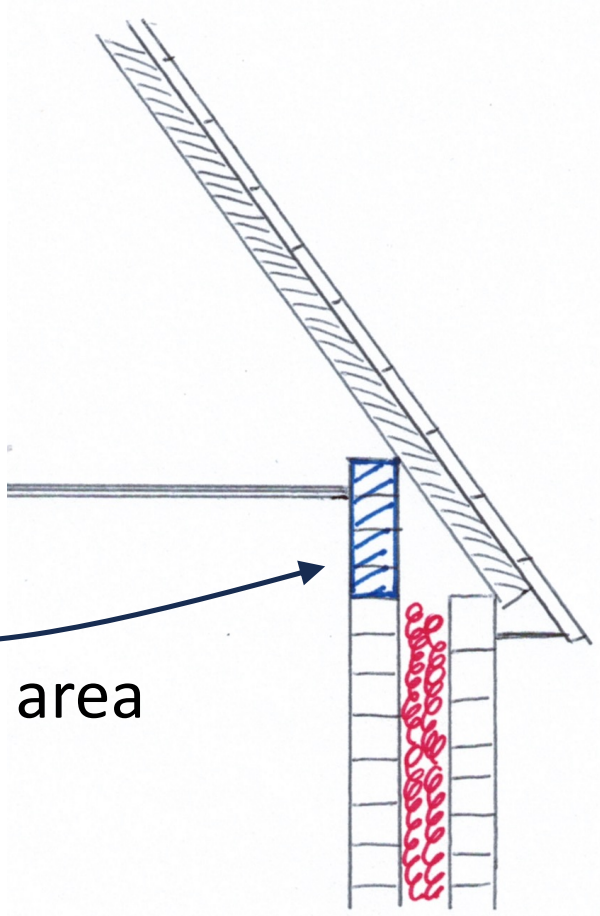
Understanding home construction can help





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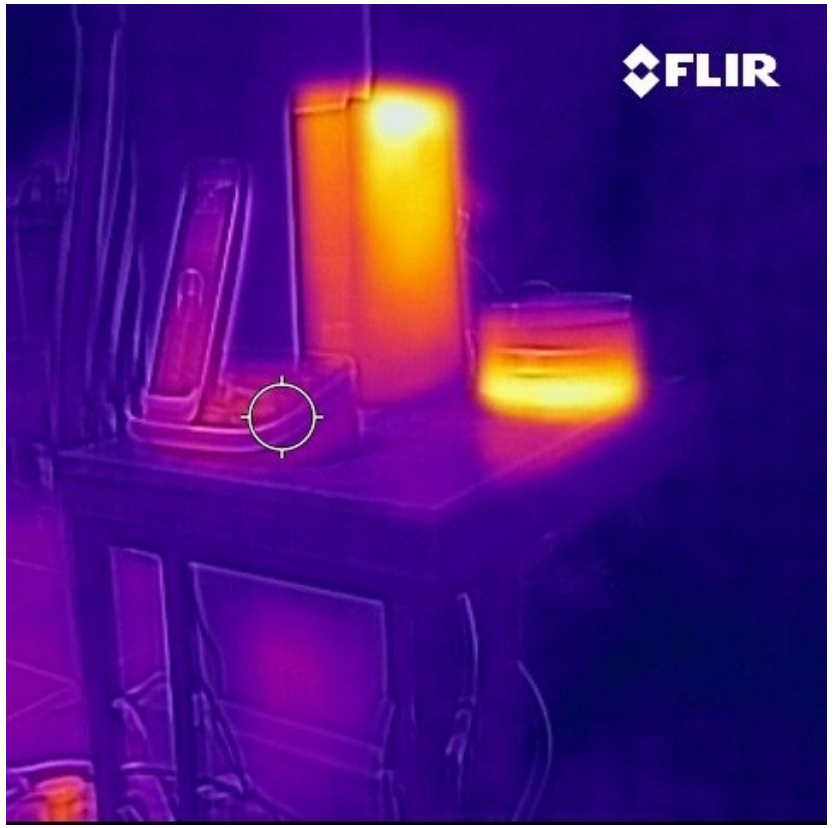
Check for wasted heat inside



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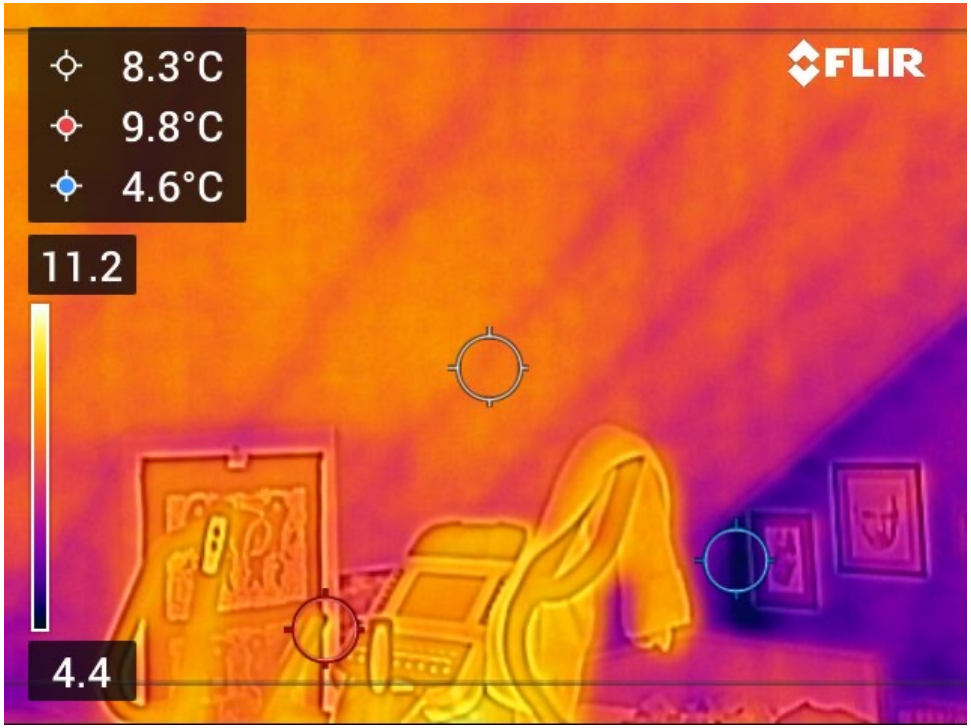
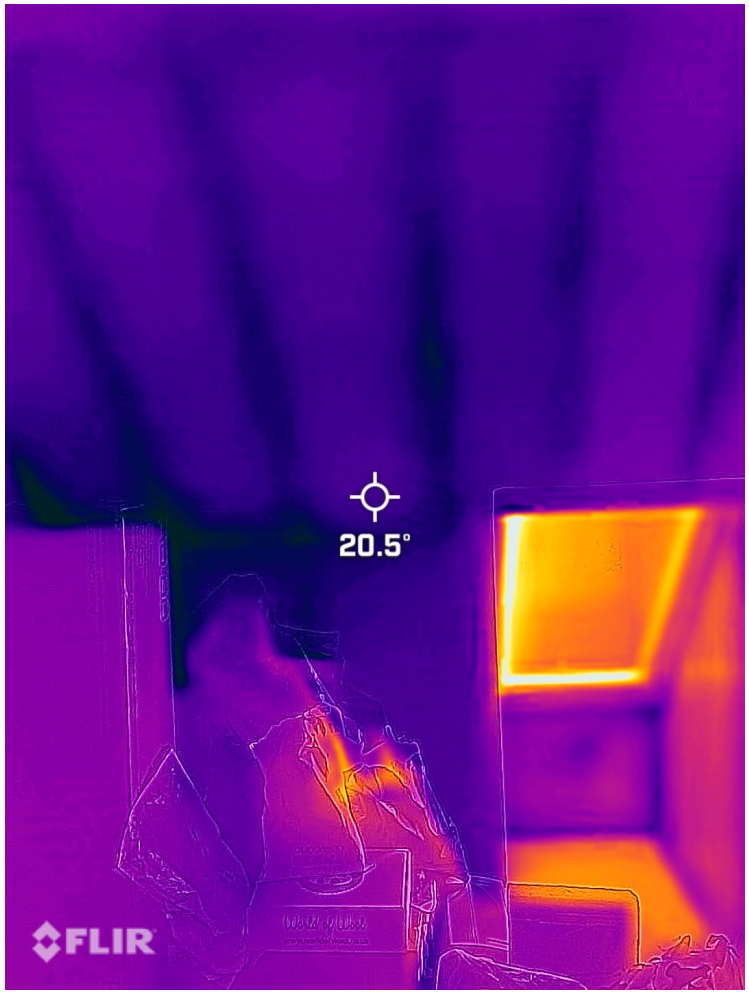
Poorly designed loft insulation





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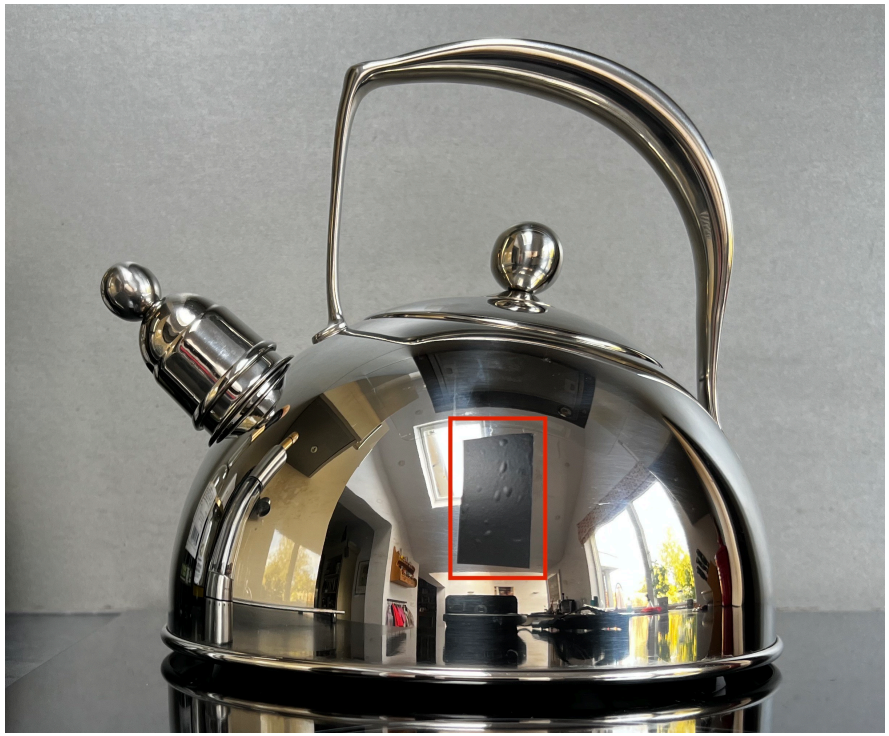
Emissivity

- Different materials radiate different amounts of heat
- With low emissivity, they will *appear* cooler in the camera
- Fortunately, we have a rule of thumb: If reflective then it is a bad radiator.



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Poor radiator design for heating:

- Minimal radiation
- Low surface area for conduction
- Often covered in towels

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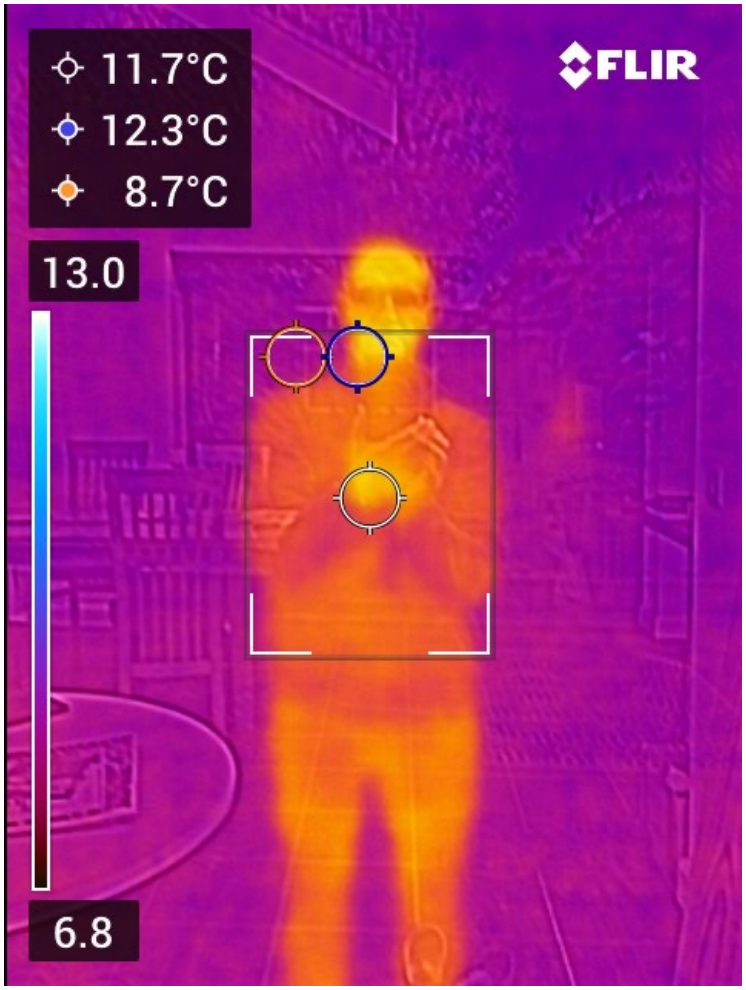
Windows – Can be awkward

- Glass will reflect some IR, so can be partially measuring reflection
- Newer glazing often has an IR reflective coating
- Use a piece of tape on glass to see actual temperature
- At an angle > 45° all light/IR reflected



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WARM

Single glazed windows

Almost facing us

COLD??

Angle: Probably reflecting sky temperature

Or: Is room unheated?

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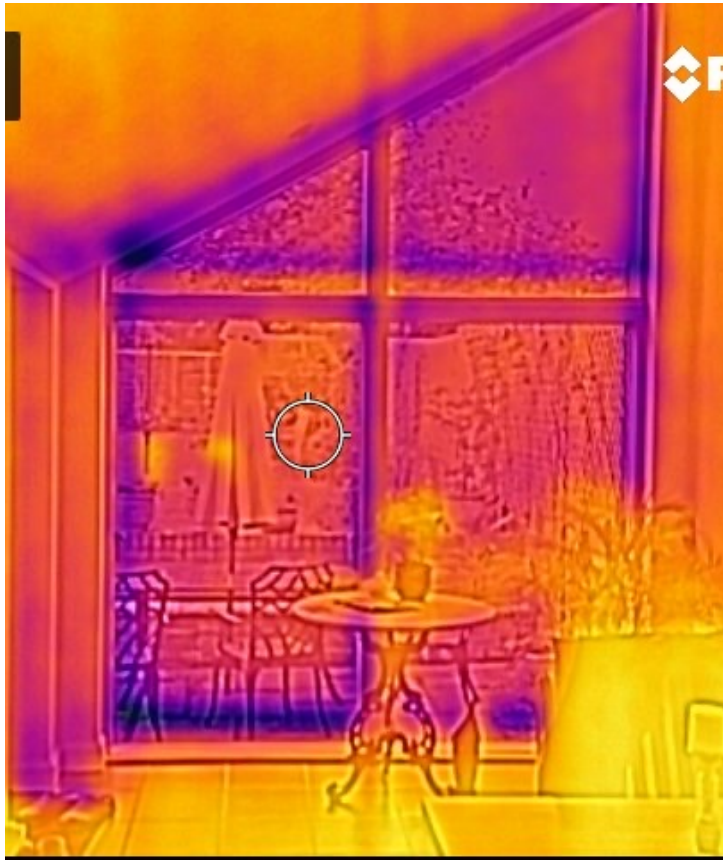
Windows – Usually look thermally poor



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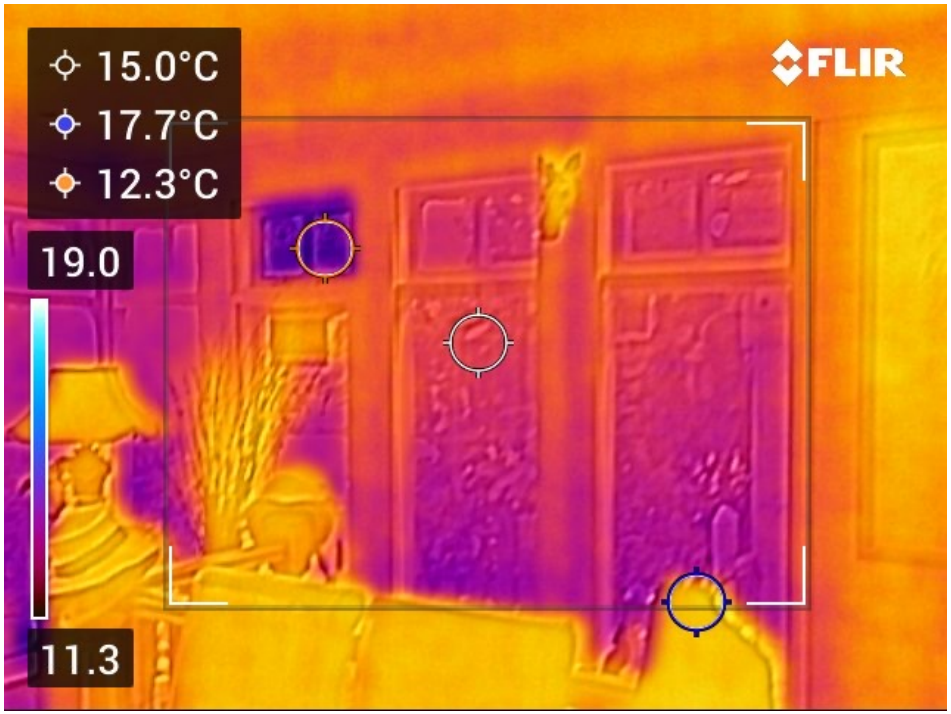
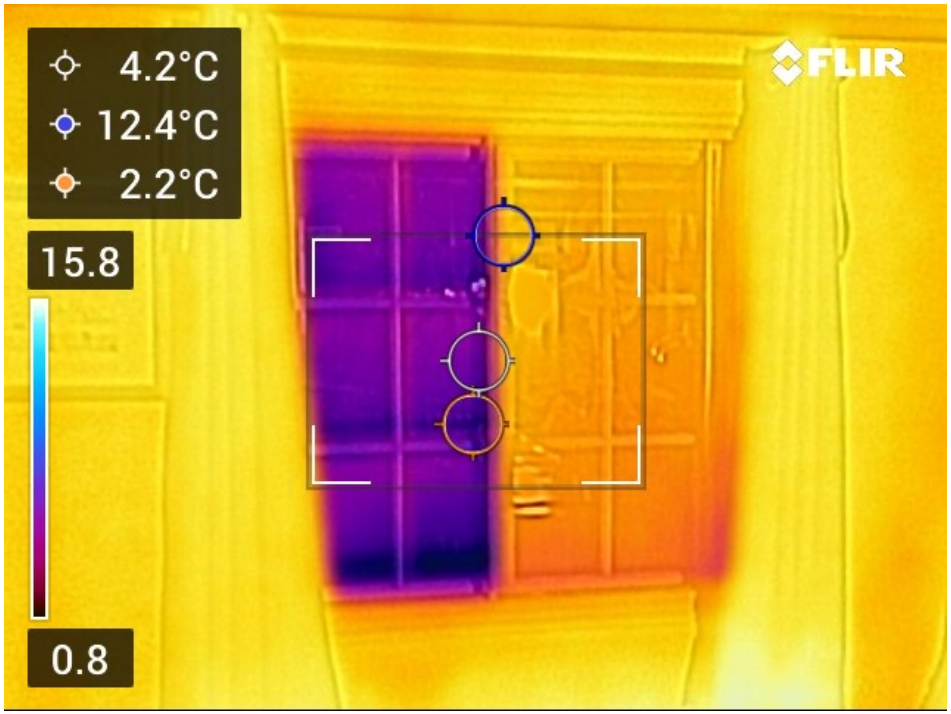
Single Glazing is not good!





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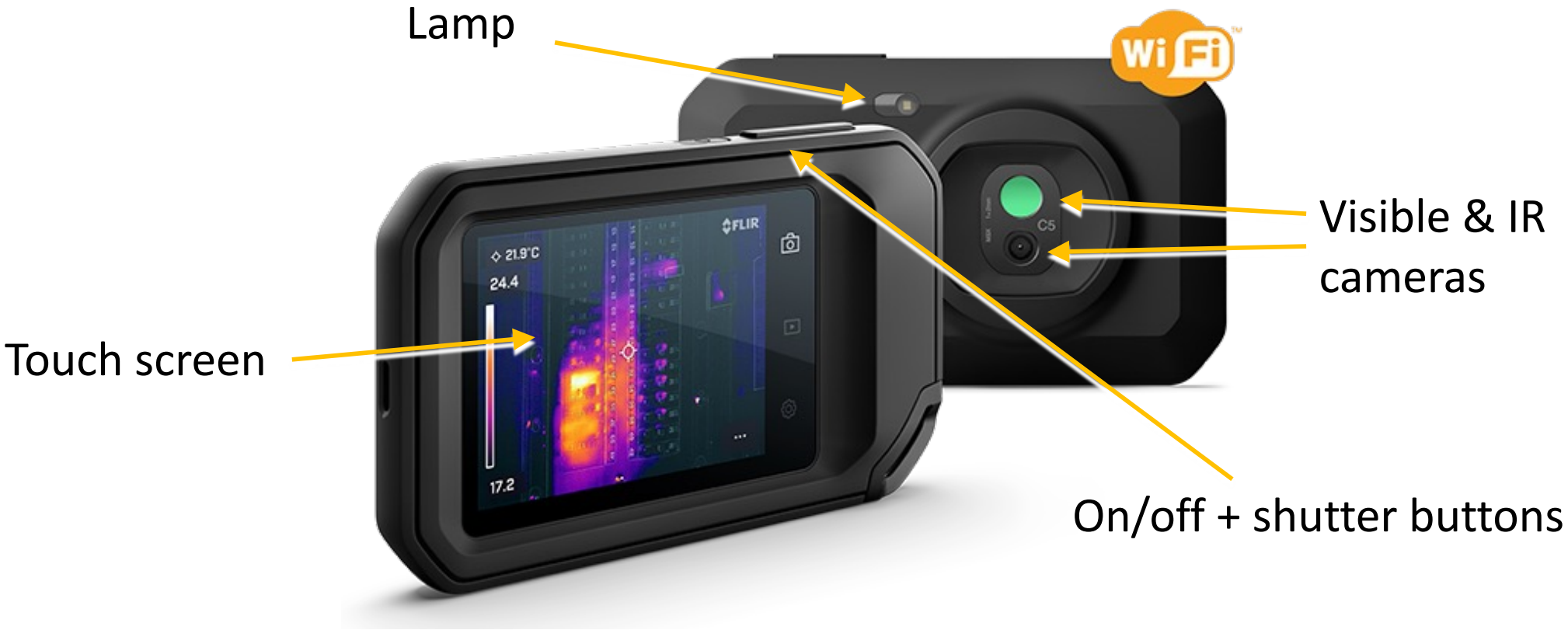
Using the Camera – FLIR C5 (& C3)



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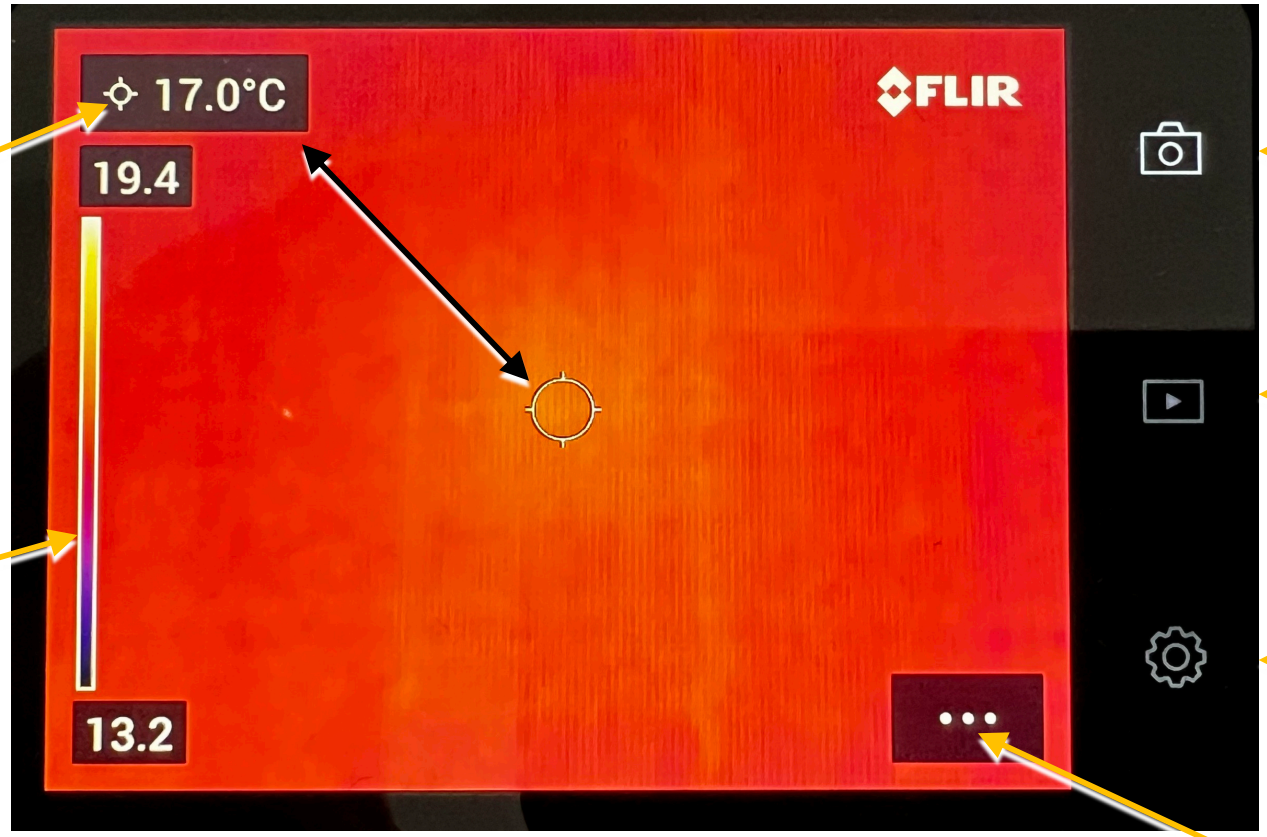

Centre spot temperature

Temperature scale

Live View

Gallery

Settings

Menu

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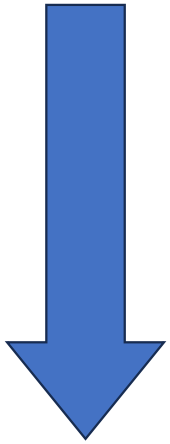
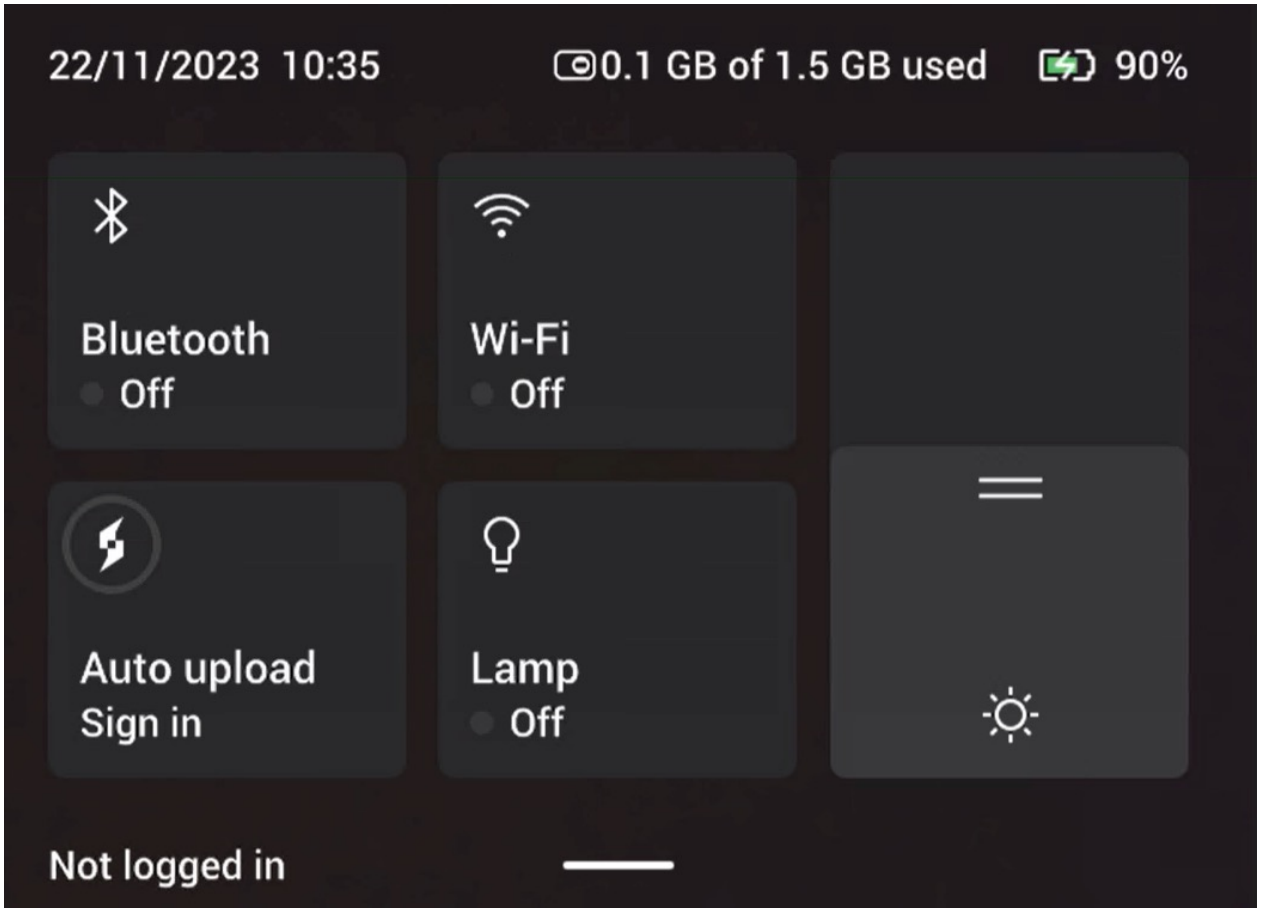
Swipe down





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The Menu

To make imaging as useful as possible

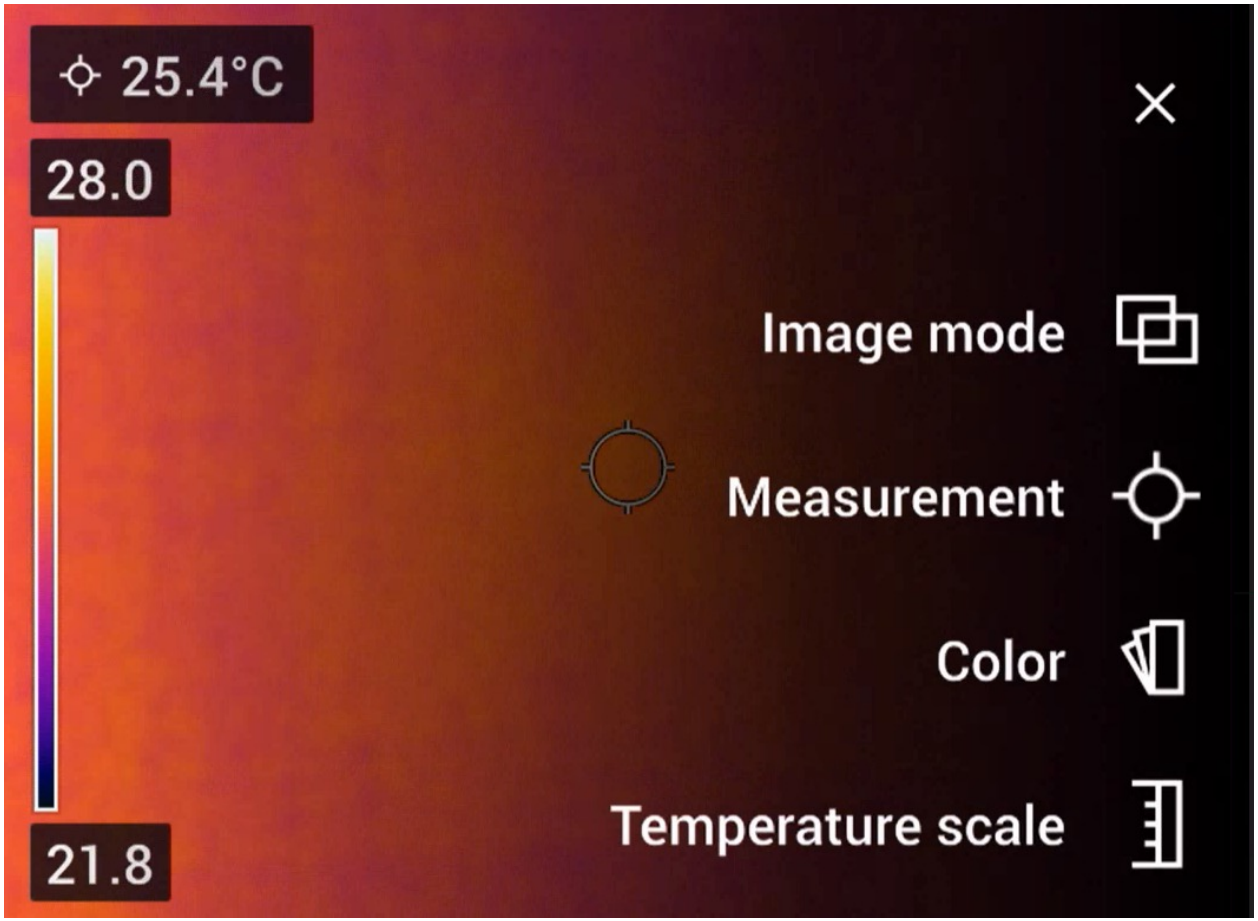

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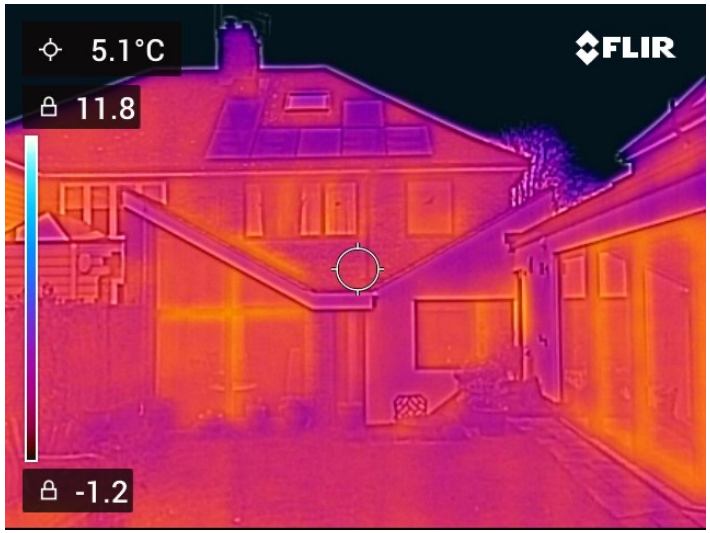
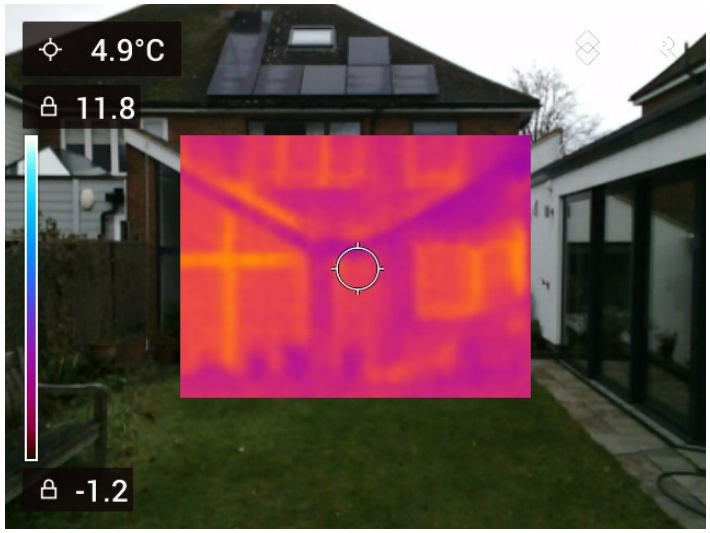
Image Mode





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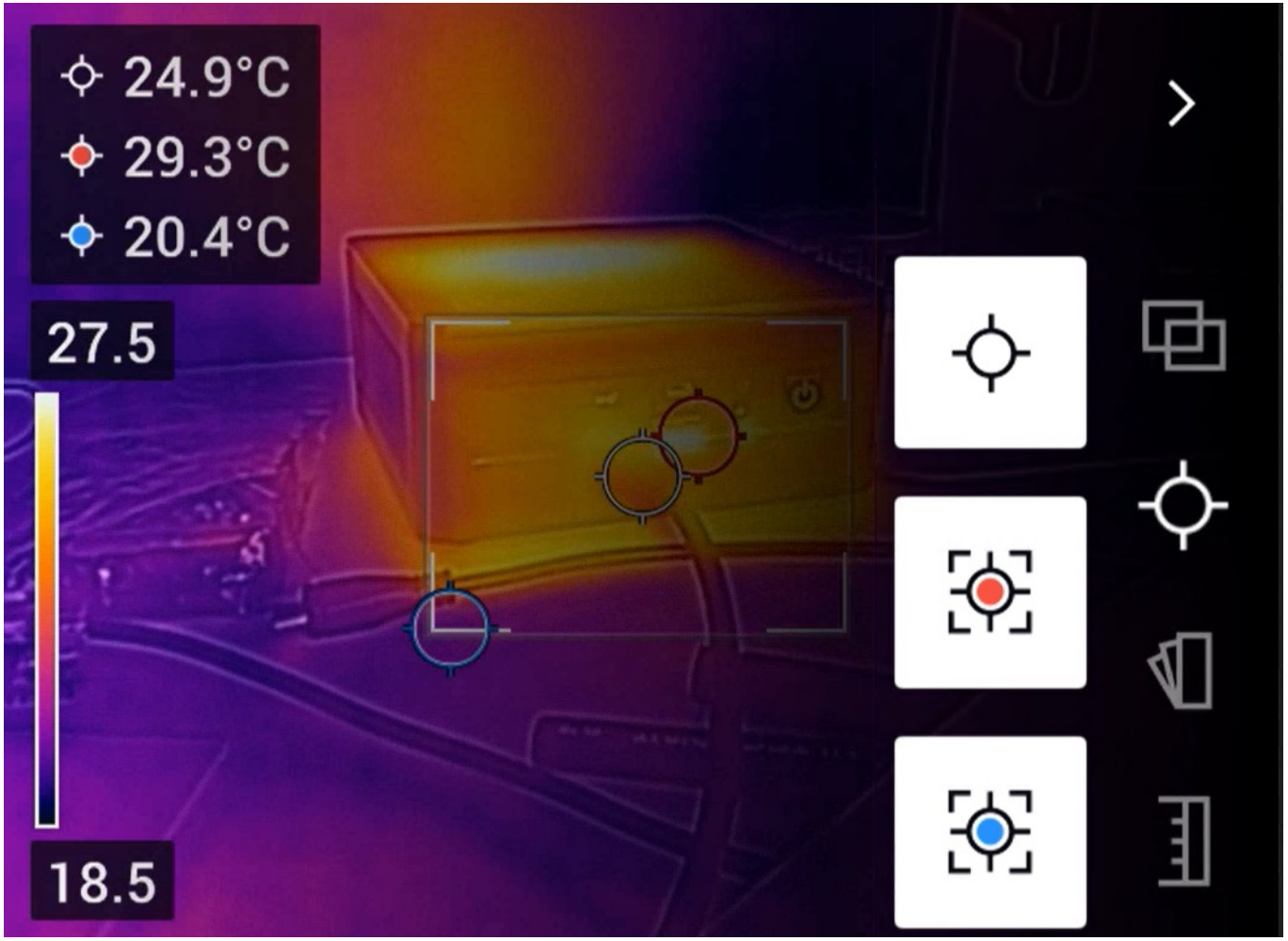
Measurements

- Centre point
- Max temperature in square
- Mini temperature in square



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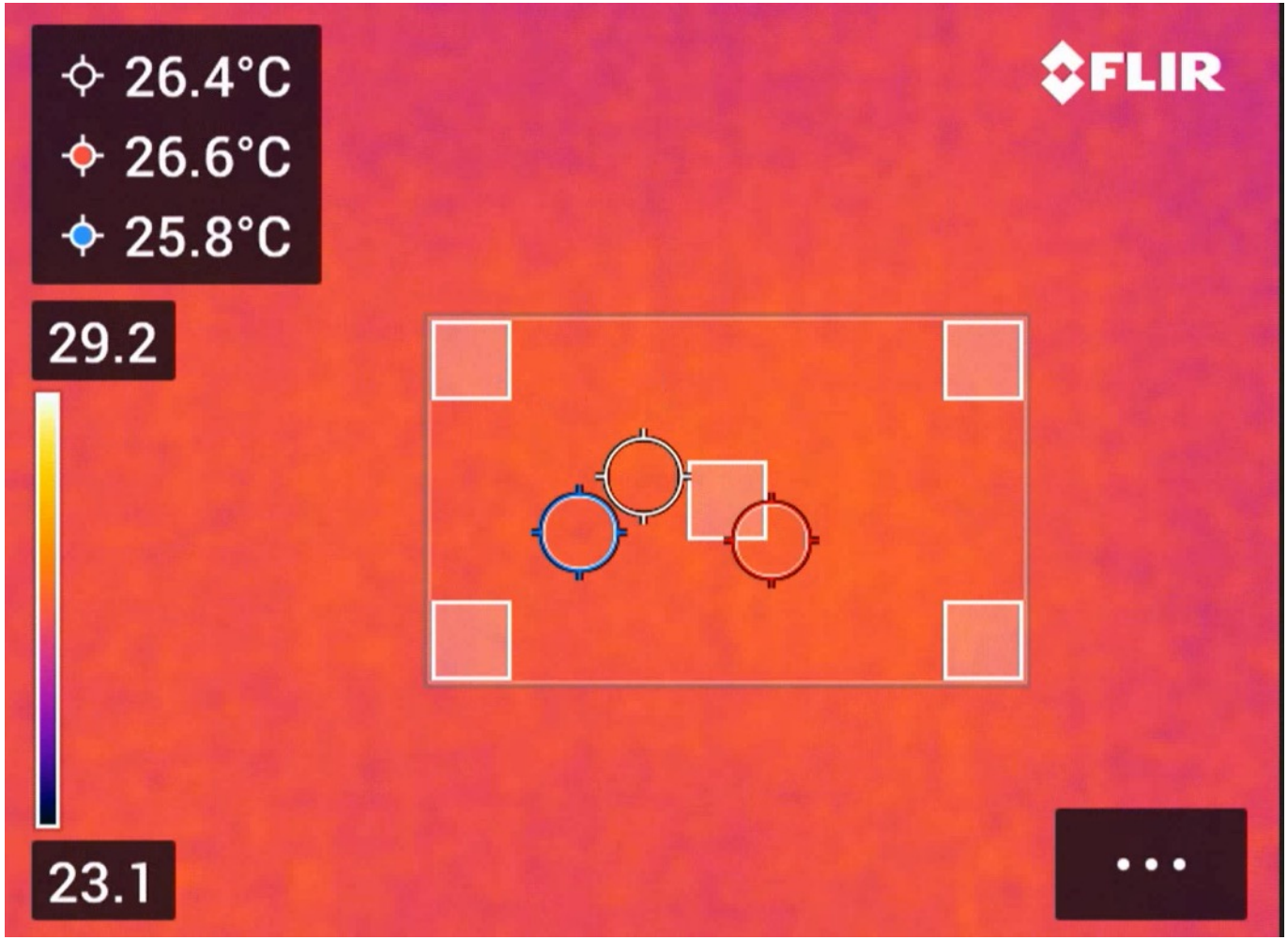
Adjust area of interest



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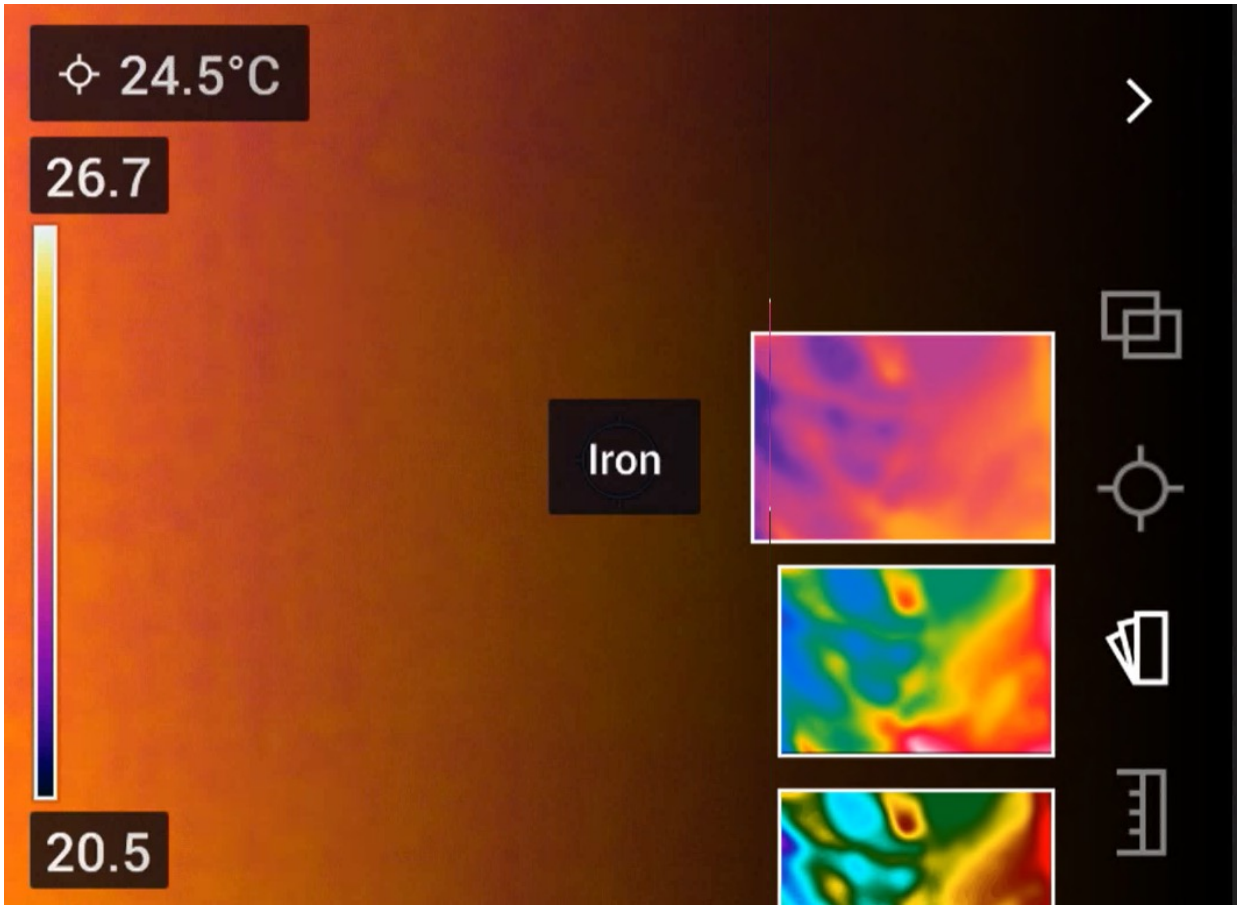
Colour Scale

- Changes how IR is represented
- Default is **Iron**



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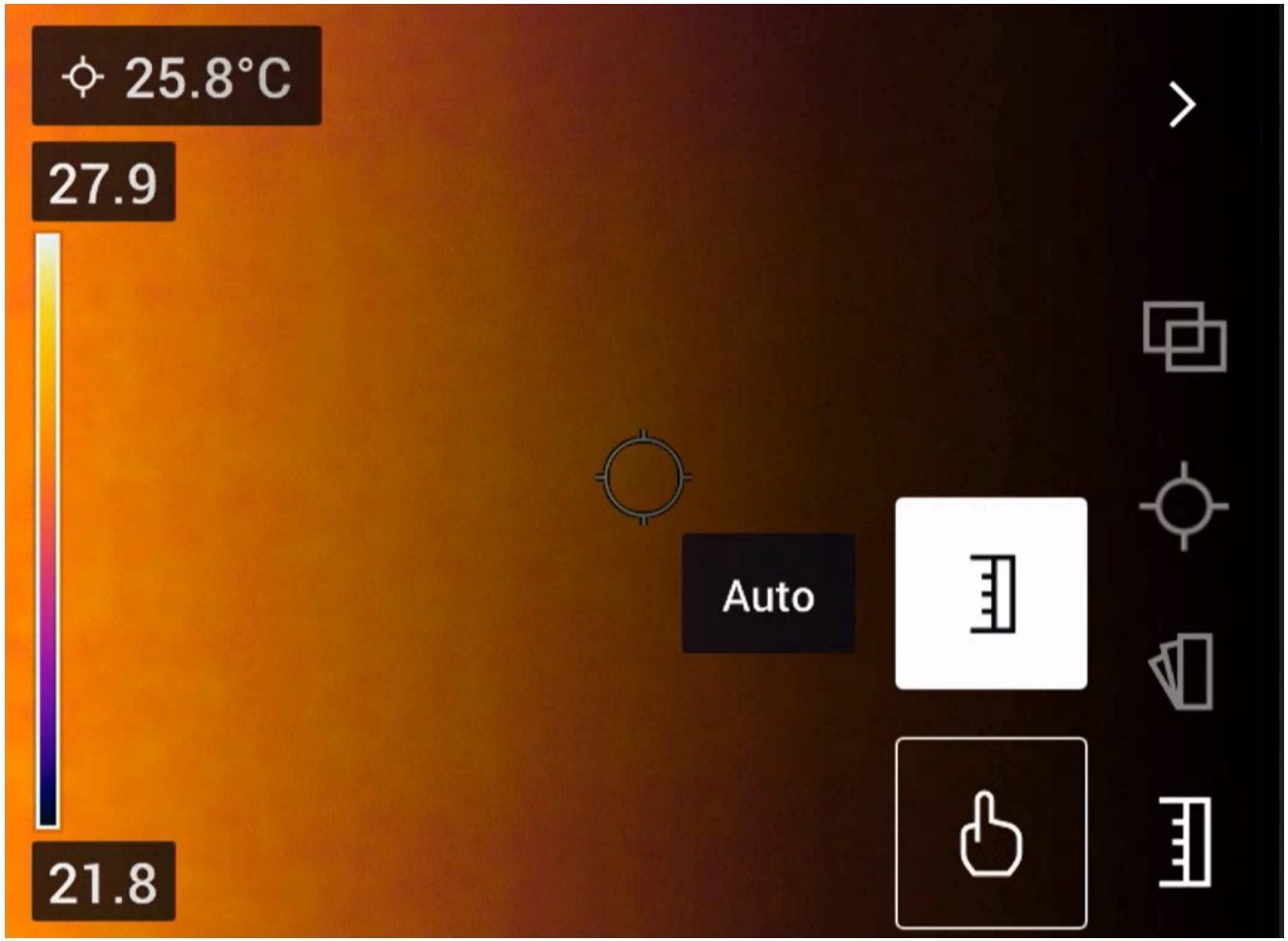
Temperature Scale

Can be useful to get most out of the camera



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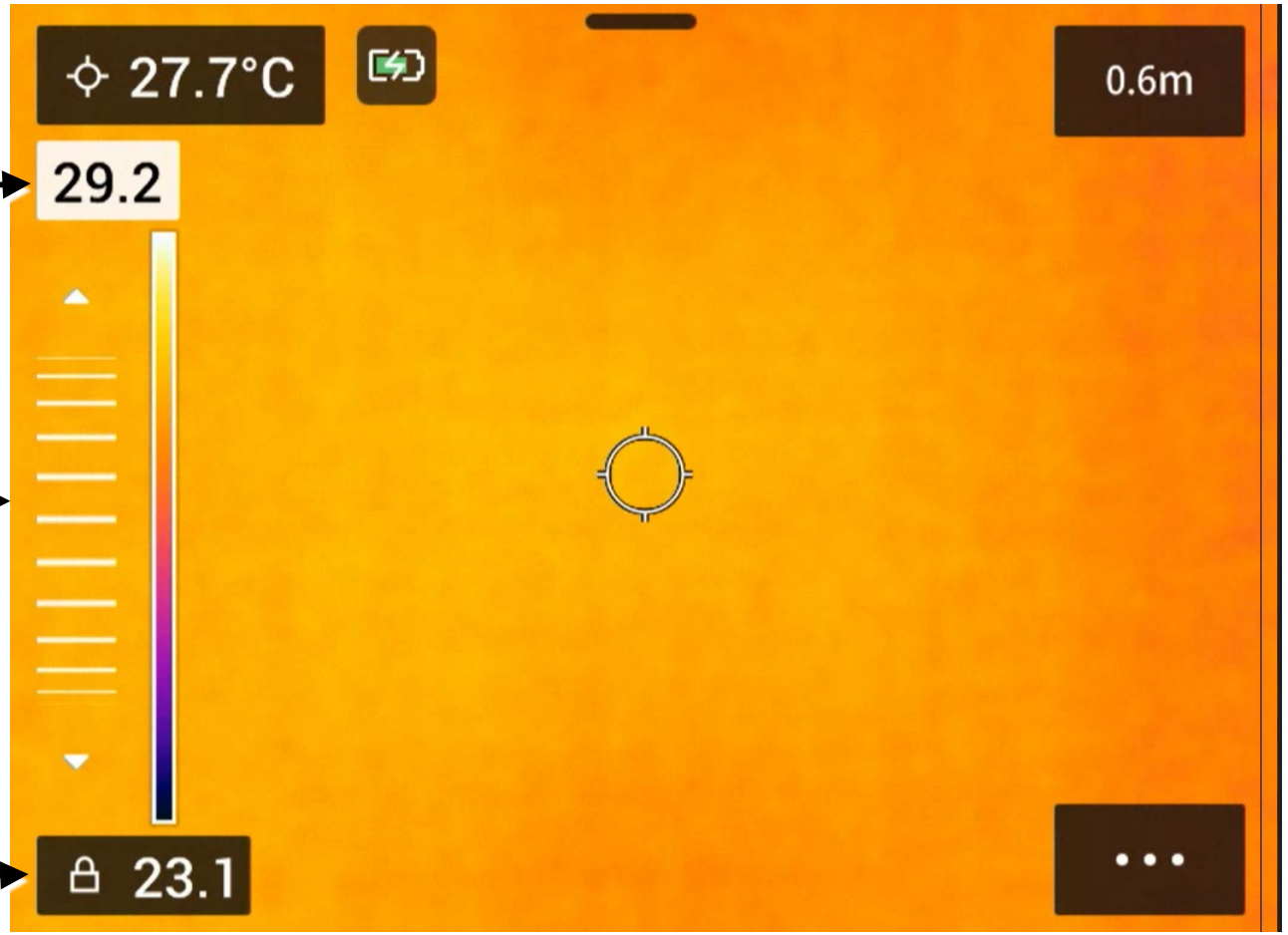

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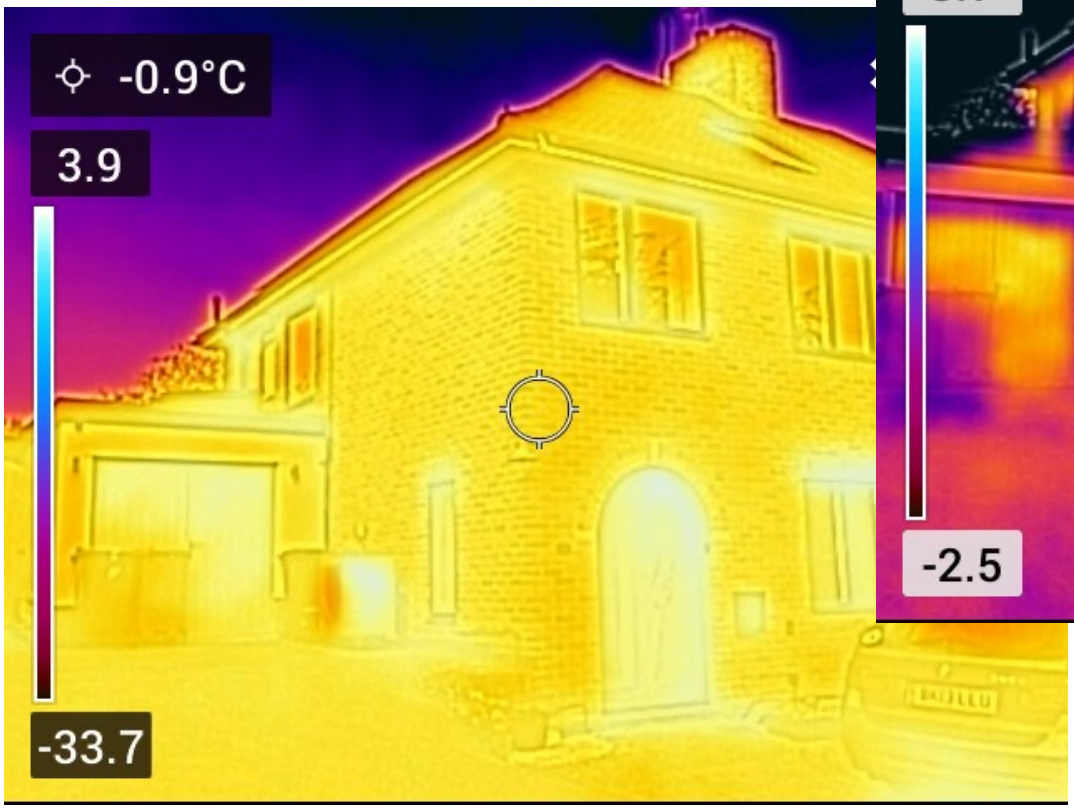

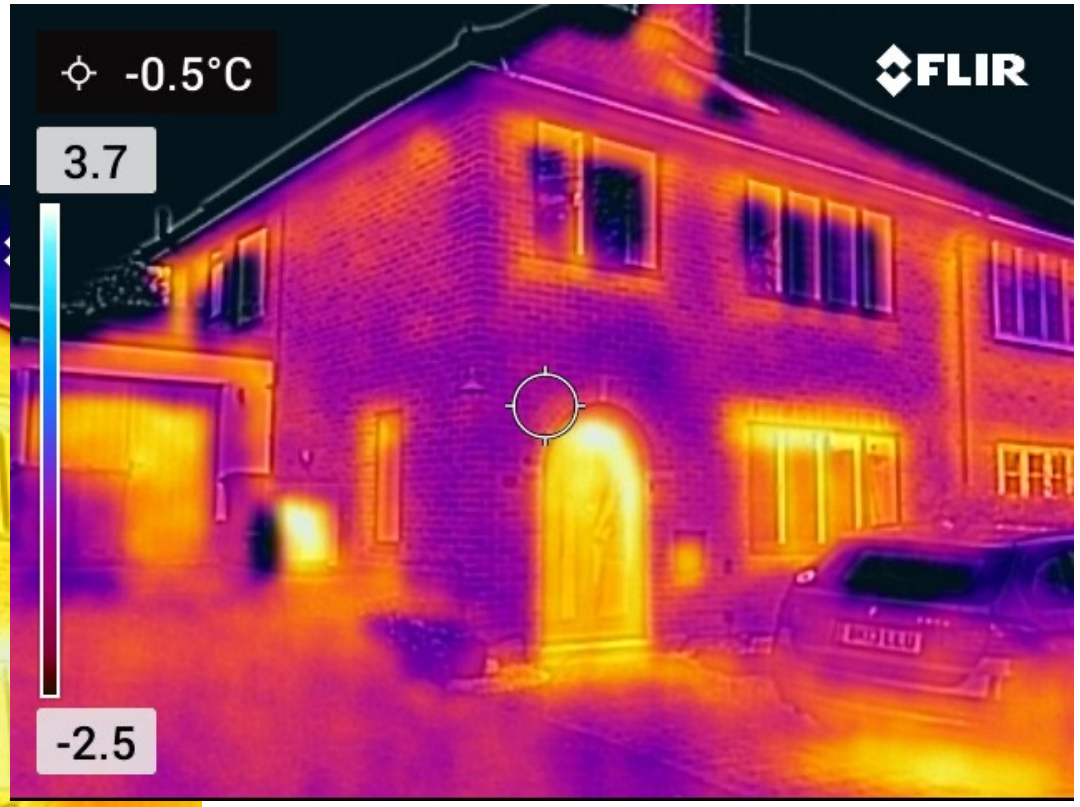

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Transferring Images

- Connect to PC via USB
- Windows: It should appear as “Flir Camera”
- Mac: Need the “Android File Transfer” app.