

CASE STUDY 03 • EXAMPLE

Buried pipe – large heat leak (example)

A wetted pre-insulated hot-water line under paving reveals nothing from the surface – on a thermal image it shows as a warm band about 25 metres long. The example shows what a thermal camera can do, and what it cannot.

5.0 kW

loss on the 25 m wet section
(200 W/m, range 100–380 W/m)
estimate

≈ 48,000 kWh

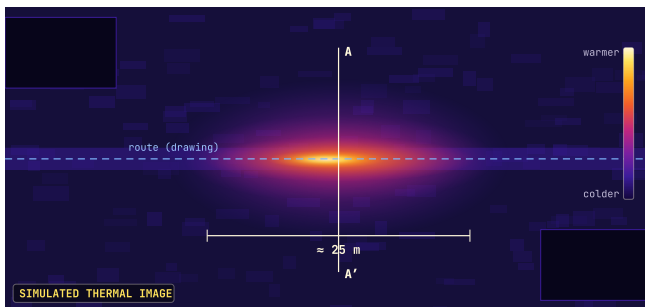
heat loss in one heating
season (at a 50 l/h leak)
estimate

2,100,000 HUF

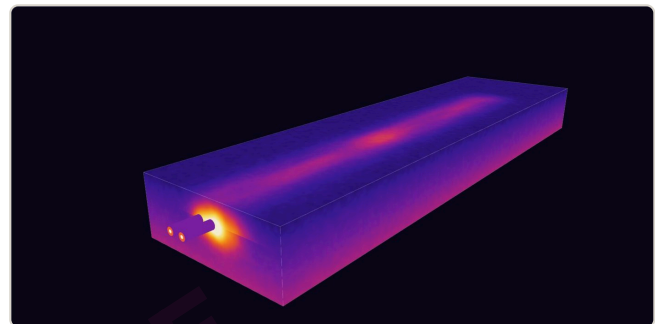
cost per heating season (HUF
1,200,000–2,900,000)
estimate

17 months

payback of the repair (6–61
months)
estimate



Simulated top-down thermal image (HőKép3D's own drawing, not a measurement): the blue dashed line is the route, A–A' marks the profile shown below.



Simulated 3D ground cut-away: the wet zone spreads around the pipe and towards the surface. Own simulation.

1 The make-up meter says it leaks – but where?

A pre-insulated (PUR) hot-water line runs under a paved area between two buildings at a 80 °C supply temperature. The make-up water meter shows more top-up than expected, but the location is unknown: the line runs under paving and nothing shows at the surface.

The leak is downstream of the heat meter, so the lost heat is billed one to one. Wet insulation also multiplies the heat emission.

Pipe pre-insulated (PUR) hot-water line

Supply 80 °C

Wetted section 25 m

Leak (main variant) 50 l/h

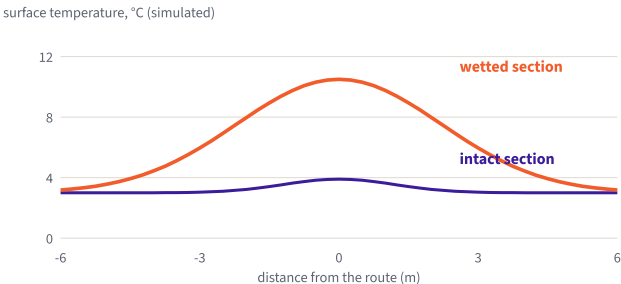
Operating hours 5,342 h/heating season

How we would measure

Timing: at night or before dawn, several hours after sunshine, on dry surfaces, in calm and preferably cool weather. **Top-down survey:** we cover the route by drone (where airspace and permits allow) or handheld camera and stitch a top-down heat map. **Matching the route:** a thermogram can hint at the route but does not replace a precise locate (e.g. a pipe locator). **Documenting:** temperature profile of the background, an intact and the suspect stretch, a visual photo, the surface material – emissivity differs by material.

EXAMPLE / ILLUSTRATION – Example – illustration built from open-licensed images and simulated data, not a real client.

2 The surface tells nothing – the thermogram does



Simulated surface-temperature profile along A–A' (HőKép3D's own drawing). On real images the contrast can be smaller: it depends on depth, paving and soil.

With intact insulation the surface above the line is barely warmer than its surroundings – which is why a thermal camera often hardly sees an intact pre-insulated line. Above the wetted section the anomaly is wider and far stronger.

Moisture spreads sideways and along the pipe in the trench, so the warm patch is larger than the defect itself: a thermogram marks out a stretch, not a point.

3 In numbers: from W/m to forints

The main variant: a 25 m wetted section, a 50 l/h leak, one heating season (5,342 hours). Every value is an estimate, rounded.

Step	Calculation	Result
Conduction loss	$200 \text{ W/m} \cdot 25 \text{ m} = 5.0 \text{ kW}; \times 5,342 \text{ h}$	$\approx 27,000 \text{ kWh/season}$
Make-up water	$50 \text{ l/h} \cdot 5,342 \text{ h}$	267 m^3
Heating the make-up	$1,163 \text{ kWh}/(\text{m}^3 \cdot \text{K}) \cdot 70 \text{ K} \approx 81 \text{ kWh/m}^3$	$\approx 22,000 \text{ kWh}$
Total	heat + make-up water ($\approx 400,000 \text{ HUF}$)	$\approx 48,000 \text{ kWh} \cdot 2,100,000 \text{ HUF}$

A Ljubljana district-heating study measured 200–380 W/m on wetted insulated lines; the example uses 200 W/m (central) with a 100–380 W/m range, the lower bound being an assumption. The heat price is a proxy based on a non-residential district-heat tariff (the local tariff may differ), the make-up water price is an assumption; October 2026 prices.

Leak	Make-up water	Heating the make-up	Cost, central (range)	Repair payback	5-year net
5 l/h	27 m^3	2,200 kWh	1,100,000 (590,000–1,400,000) HUF	33 mo.	2,400,000 HUF
50 l/h	270 m^3	22,000 kWh	2,100,000 (1,200,000–2,900,000) HUF	17 mo.	7,700,000 HUF
500 l/h	$2,700 \text{ m}^3$	220,000 kWh	13,000,000 (7,000,000–18,000,000) HUF	3 mo.	61,000,000 HUF

The conduction loss is the same in all three variants. With year-round operation (8,760 h) the 50 l/h variant costs 3,500,000 (1,900,000–4,800,000) HUF and pays back in 10 months. In a large district-heating network a closed-circuit water balance is reliable only above about 4 m³/h, so smaller leaks hide there; on a smaller private system the make-up meter is the first check and the thermal camera is for locating the leak.

4 From thermogram to repair

- 1. Water balance:** reading the make-up meter and checking the closed circuit confirms that a leak exists.
- 2. Pin down the location:** the thermogram marks out a stretch; the exact spot must be confirmed by acoustic leak detection, tracer gas or a trial excavation – carried out by your contractor.
- 3. Repair:** excavating, repairing or replacing the wet section, restoring insulation and paving. The example assumes 1,500,000–6,000,000 HUF, central 3,000,000 HUF.
- 4. Re-scan:** after the repair we re-scan under similar conditions; the thermogram shows whether the warm band is gone.

EXAMPLE / ILLUSTRATION – Example – illustration built from open-licensed images and simulated data, not a real client.

5 Payback – and the worst case

Item (50 l/h, heating season, net)	Central	Range
Loss per heating season	2,100,000 HUF	1,200,000–2,900,000 HUF
Repair	3,000,000 HUF	1,500,000–6,000,000 HUF
Pipe-run survey (minimum price)	90,000 HUF	–
Payback of the repair	17 months	6–61 months
5-year net result of the repair (flat prices)	7,700,000 HUF	–130,000 – 13,000,000 HUF

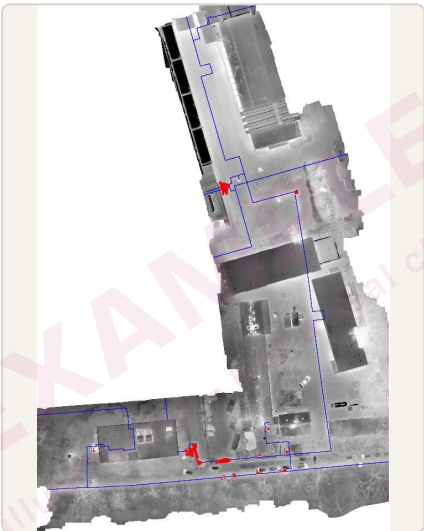
In the worst case (low conduction loss, high repair cost) the five-year result is slightly negative – which is why we give a range and why quotes are needed before the repair. Savings materialise only if the repair is carried out.

6 What it looks like in reality

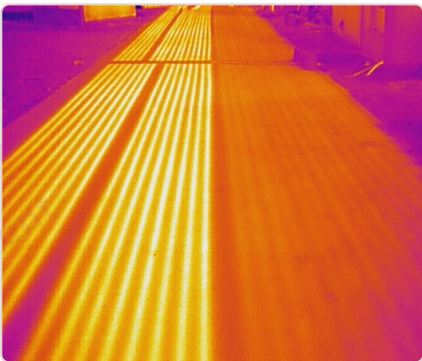
Real, open-licensed images – other sites, other conditions; not comparable with our example, they only show the phenomenon. The images are unmodified.



A. Sledz, J. Unger, C. Heipke, ISPRS Archives XLIII-B1-2020, Fig. 10, CC BY 4.0 – unmodified



A. Sledz, J. Unger, C. Heipke, ISPRS Archives XLIII-B1-2020, Fig. 11, CC BY 4.0 – unmodified



Saninfo1993, „Heated pavement”, Wikimedia Commons, CC BY-SA 4.0 – unmodified

UAV orthophotos (ISPRS, 2020): researchers at Leibniz University Hannover flew infrared orthophotos over district-heating networks; in the grayscale images warmer points are brighter, the blue line is the GIS route and red blobs are anomalies flagged by an algorithm – possible leaks. A thermal anomaly alone does not prove a leak: it needs verification. **Heated pavement:** intentional heating, not a leak; it shows how warm pipes under a surface appear on a thermogram.

EXAMPLE / ILLUSTRATION – Example – illustration built from open-licensed images and simulated data, not a real client.

Mike1024, „Pre-installation insulated underground pipes for district heating”, Wikimedia Commons, public domain – resized · Anatomy of a pre-insulated pipe: water in the foam multiplies the heat emission.



Abujoy, Wikimedia Commons, CC BY 4.0 – resized · In operation all of this runs below the paving – the camera sees only the effect that reaches the surface.

Limits. The camera sees only the surface temperature through the soil; a thermogram marks a stretch, not a point; thick snow, ice or wet surfaces can mask it; the exact spot needs another method; the numbers rest on a simulated example and model estimates.

Engineering thermal-imaging survey – not an accredited or certified inspection. It does not replace an energy performance certificate, a statutory energy audit, mandatory electrical-safety or fire-safety inspections; those are carried out by professionals authorised under Hungarian law. Figures are estimates, not guarantees.

Curious where heat escapes from your facility?

Request a quote: we survey at night, register the images on a 3D model and rank what to fix first. · hokep3d.hu · info@hokep3d.hu

Credits and sources

- A. Sledz, J. Unger, C. Heipke (Leibniz Universität Hannover) – „UAV-based thermal anomaly detection for distributed heating networks”, ISPRS Archives XLIII-B1-2020, 499–505, doi:10.5194/isprs-archives-XLIII-B1-2020-499-2020 – CC BY 4.0 – unmodified
- Saninfo1993 – „Heated pavement” – CC BY-SA 4.0, Wikimedia Commons – unmodified
- Mike1024 – „Pre-installation insulated underground pipes for district heating” – public domain, Wikimedia Commons – resized
- Abujoy – „Travaux d’installation du chauffage urbain à Rennes sur la rue de Fougères” – CC BY 4.0, Wikimedia Commons – resized
- The thermal images and the 3D cut-away: HőKép3D’s own simulation. Figures: HőKép3D worked example “D” (buried pipe), 9 October 2026, rounded to 2 significant digits; based on the Ljubljana district-heating study (200–380 W/m).