Irish Heat Split: data sources and estimation methodology

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Live site: causewaygt.github.io/irish-heatsplit · Repository: github.com/causewaygt/irish-heatsplit · Correspondence: contact@causewaygt.com

Abstract

The Irish Heat Split estimates the weekly heat balance of the island of Ireland – energy purchased, useful heat delivered, expenditure, indigenous share and emissions – for Northern Ireland, the Republic of Ireland and the island in aggregate, and publishes the estimates daily on a public tracker. Annual fuel-level anchors from national energy statistics [1,3] are distributed across the year by population-weighted heating degree days computed from ERA5 reanalysis [8,9]; the temperature-sensitive component of metered gas demand is estimated by segmented regression following the established gas-to-heat literature [5–7], with within-class (monthly) centring applied to remove seasonal confounding; oil, the island's largest heating fuel, is carried as an anchor-based estimate with a correspondingly wider uncertainty band, accompanied by daily price observation [15,16] which is expressly not treated as a demand feed. Delivered service is obtained from purchased energy through in-situ conversion efficiencies and field-calibrated seasonal performance factors [10]; the indigenous share of delivered heat follows the services-basis convention under which harvested ambient heat is wholly indigenous [24]. Counterfactual ("what-if") figures recompute the same accounting with one-fifth of delivered heat supplied by ground-source heat pumps and one-fifth of the cooling load moved to ground-coupled systems. Ground-source capacity accounting combines a bottom-up Northern Ireland register compiled by the authors with the WGC2026 country update for the Republic [12] and European market context [14]. All judgement figures are marked (†) and challengeable; the build pipeline, test suite and every anchor are public.

1 Conventions

- **Sourced versus estimated.** Every figure is either cited to a named public source or marked † as a Causeway Energies estimate. Daggered figures carry a stated basis in the repository and an open invitation to challenge.
- **Purchased energy versus delivered service.** Purchased (input) energy is fuel and electricity bought; delivered service is useful heat after conversion. The distinction is maintained throughout; bars on the tracker labelled "in" and "useful out" correspond to the two bases.
- **Two currencies.** Northern Ireland figures are computed in sterling, Republic figures in euro, and equivalences use the European Central Bank reference rate of the build day [19]; the two price axes of the oil ticker are locked through the same rate so that vertical position is directly comparable.
- **Sibling comparability.** The tracker is read beside its UK sibling. Any topline scoped differently between the two – cooling is the live example: this site's cold-economy census against the UK's comfort-scoped line – either shares a basis or carries an explicit scope note, and a standing regression test compares extensive quantities per capita against the UK anchors, flagging any ratio far from the population share that no real, nameable difference explains.
- **Terminology.** The estimator applied to the gas regression is described as within-class (monthly) centring – the within-transformation of panel econometrics; the

tracker's gas-panel label currently references the same computation under an older name, scheduled for alignment with this terminology.

2 Degree days

Daily heating degree days are computed as HDD = max(0, 15.5 − $\bar{T}$), where $\bar{T}$ is the population-weighted daily-mean two-metre temperature over seven stations (Dublin 0.40, Belfast 0.20, Cork 0.12, Galway 0.08, Limerick 0.08, Derry 0.06, Waterford 0.06†), from ERA5 reanalysis [8] retrieved through the Open-Meteo archive interface [9] (CC BY 4.0). Three series are maintained – island, Republic-weighted and Northern-Ireland-weighted – so that each jurisdiction's estimates are shaped by its own weather. The 15.5 °C base follows Met Éireann and SEAI practice. An hourly overheating-degree series (ODH_{26}: population-weighted degree-hours above 26 °C, from ERA5 hourly temperatures, trailing 60 days per run merged across runs) is collected alongside and shapes the comfort-cooling load in §9 once a season of it exists.

3 The oil anchor – the first hard question

Oil is the island's largest heating fuel – approximately 62% of Northern Ireland households [3,4] and 56.5% of Republic residential heat input [1] – and it has *no demand feed*: deliveries are untimetabled tanker drops into private tanks, unrecorded by any daily statistic. The tracker therefore estimates weekly oil heat from the annual anchor A_e shaped by degree days:

$$W_e = A_e \cdot [\ (1 - s)/52 \ + \ s \cdot H_v/H_\gamma\ ]$$

where s = 0.817 is the weather-driven (space-heat) share of annual demand and the flat term is hot water at 18.3% of annual input – the UK sibling's ECUK-derived DHW share, adopted † as the aligned convention of the July 2026 cross-calibration pending an SEAI-specific Irish split – with H_v the week's degree days and H_γ the trailing-year total. The same estimator shapes every unmetered fuel. Its uncertainty is materially wider than the gas estimate's: the anchor itself carries survey and balance uncertainty, the shaping fraction is a judgement, and no daily observation constrains the residual. Figure 1 illustrates the method with an indicative ±20%† band. The Consumer Council daily kerosene survey [16] and the EU Weekly Oil Bulletin with its 2005-onwards price history [15] provide a daily and weekly price pulse alongside the estimate; a price is not a quantity, and the methodology deliberately never treats it as one.

week of year

Figure 1. The oil-anchor estimator: an annual total distributed by weekly heating degree days over a non-weather base, with the indicative ±20%† band. Parameters are illustrative of the island series.

4 Gas-to-heat regression

Metered gas is the island's second heating fuel and its one daily-observed demand. Following the segmented-regression literature [5–7], daily distribution-level demand G is modelled as G = α + β·HDD + ε, where β identifies space heating and α the non-weather baseline. Pooled estimation of β is biased by covariates that co-move with winter – holidays, school terms, drifting baseload – so β is estimated after within-class (monthly) centring: demand and degree-day deviations from their own month's means,

$$\hat{\beta} = \Sigma\ \tilde{g}_i\tilde{h}_i\ /\ \Sigma\ \tilde{h}_i^2\ , \quad \tilde{g}_i = g_i - \bar{g}_{m(i)},\ \ \tilde{h}_i = h_i - \bar{h}_{m(i)}$$

On the current 204-day record the centred slope is 2.25 GWh per degree day against a pooled 4.03 – the pooled estimate carries nearly half its weight in seasonal confounding rather than weather response. Both estimates ship in the public data file; the centred figure

is displayed. Within-month variance explained is 0.66; this is variance explained, not demand explained; the residual standard error – the true daily uncertainty – is displayed beside the slope. A calibration disclosure publishes the regression-implied annual space heat against the anchor-implied figure with a 0.90–1.10 gate on every build, whether or not it passes; the two measures differ in scope (distribution-metered gas against the whole buildings-gas anchor) and the ratio quantifies exactly that difference. Figure 2 demonstrates the estimator on a synthetic record with an injected late-December demand suppression; the identical test ships in the repository and gates every release.

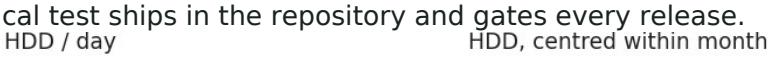

Figure 2. Left: a synthetic daily record with true slope 3.0 and a 30% holiday suppression (amber); pooled OLS drifts while the centred estimator holds the truth. Right: the same data after within-class centring. The test ships in the repository.

4.1 Feed provenance

Gas Networks Ireland data enters by two routes: the public gasconsumption interface, which serves rolling windows of roughly eight days by demand category (daily-metered, non-daily-metered, large daily-metered, power generation) and is walked backwards weekly to assemble a dense daily record; and the quarterly demand CSV published under CC BY 4.0 on data.gov.ie [17], which anchors the regression on a longer stable record. No LDZ/NTS separation of the British kind exists; the non-daily-metered category is used as the distribution-heat proxy. Whether unprefixed categories include Northern Ireland exit points is under verification; pending it, the regression is calibrated on the Republic-labelled series and the limitation is stated (§13).

5 Two jurisdictions, one island – the second hard question

Operationally the island is one system twice over – a single wholesale electricity market [18] and one gas network fed through Moffat – but statistically it is two regimes: SEAI/CSO for the Republic [1,20], DfE/NISRA for Northern Ireland [3,4]; CRU-supervised retail pricing in one jurisdiction, Consumer Council observation without a price cap in the other; two currencies. The methodology therefore computes every estimate per jurisdiction from that jurisdiction's anchors, tariffs and degree-day series, and defines the all-island figure as the sum, never the reverse; the property that the three views reconcile is enforced by automated test. Retail tariff anchors are the July 2026 standard-tariff pass (Northern Ireland electricity 32.5 p/kWh, gas 7.5 p/kWh; Republic 36 c/kWh and 11.5 c/kWh); time-of-use tariffs materially improve the heat-pump economics and are noted, not assumed. A July 2026 cross-calibration against the UK sibling confirmed the anchors at per-capita parity – island heat input 6.2 MWh per person against the UK’s 6.3 on the same input, buildings-only basis (ratio 0.98) – and aligned the weekly convention: both sites now shape space heat by degree days and carry hot water as a flat term (18.3% of annual), so weekly figures converge by construction; the previous 28% flat base had absorbed some space heat into the weather-independent term.

6 Delivered service and seasonal performance

Purchased fuel converts to delivered heat at in-situ efficiencies of 82%† (oil boilers) and 85%† (gas). Electric heat-pump routes use seasonal performance factors. The air-source factor is not taken from laboratory ratings: the demand-weighted outdoor source temperature falls out of the degree-day series itself – for heating days $T = 15.5 - HDD$, hence

$$T_s = 15.5 - \Sigma h_i^2 / \Sigma h_i$$

– and feeds a Carnot-fraction coefficient of performance (fraction 0.38†) at 45 °C† flow with a 0.90† defrost derate, blended on an energy-weighted harmonic basis with a 20%† hot-water share at 55 °C. The result, currently ≈2.74 for the Republic and ≈2.71 for Northern Ireland, is calibrated to the field-trial medians of the GB Electrification of Heat programme [10] and moves with the weather year. Ground-source systems are carried at SPF 4.0†, the design basis for engineered installations on a stable source [11]; the model makes the mechanism explicit – a stable source temperature is precisely what exempts ground-source performance from the climate ceiling that caps the air-source figure (Figure 3). The break-even SPF against untaxed Northern Ireland kerosene has ranged 3.1–3.6 through July 2026: across the observed price range, modelled air-source performance never clears it, and only ground-source-class performance is in contention.

Figure 3. The climate-modelled air-source SPF as a function of demand-weighted source temperature, the 2025/26 jurisdiction operating points, the July 2026 Northern Ireland break-even band, and the geothermal design basis above it.

7 Indigenous share

Each delivered unit of heat inherits the origin of its input on a services basis: imported oil delivers imported heat; grid electricity delivers heat indigenous in proportion to the jurisdiction's renewable share (Republic 41.3% [1]; Northern Ireland 46%†); and heat harvested from the ground or air by a heat pump is wholly indigenous, following national-balance convention for ambient energy [24]. This accounting is what moves the counterfactual: transferring one-fifth of delivered heat to ground-source, and one-fifth of the cooling load to ground-coupled systems, raises the island’s combined indigenous share of heat and cooling delivered from approximately 27% to 39% in a typical summer week – three-quarters of every transferred heat unit becomes locally harvested ambient heat, and the avoided cooling electricity is displaced by ambient rejection, indigenous by the same convention.

8 Electricity

The single electricity market simplifies the island relative to Britain: one day-ahead price feed [18] serves both jurisdictions in both currencies. System demand and all-island carbon intensity are retrieved from the EirGrid Smart Grid Dashboard interface [25], restored on 18 July 2026 after a nine-day declared outage following the dashboard redesign: quarter-hour actuals for the island and each jurisdiction are averaged to daily gigawatt-hours, with any day carrying fewer than 48 observed intervals excluded as incomplete, and history merged across runs. The carbon-intensity series (quarter-hour, daily means, same completeness rule) supplies the electricity emission factor as a trailing fourteen-day mean once at least seven days exist, replacing the 280 g/kWh† anchor with observed grid intensity – approximately 212 g/kWh in the July 2026 record – with the factor and its source published in the data file.

9 Cooling, waste heat and storage

The island's cooling analysis is a census of the cold economy, electricity basis: data centres at 22% of Republic demand (CSO [20], 29% projected by 2028) remain the largest single load, joined by the food-export cold chain (dairy, meat, cold storage, retail: 2.3 TWh†), pharmaceutical and industrial process cooling (0.8 TWh†), commercial comfort cooling and ventilation (1.0 TWh†) and Northern Ireland loads (1.2 TWh†) – approximately 12 TWh† in all. Heat rejection applies per-load factors: vapour-compression loads reject compressor work plus the heat they pump, so refrigeration rejects more heat than the electricity it draws; total rejection is approximately 19 TWh† a year, of order sixty percent of island

residential heat demand. Flat loads are spread evenly across the year; the comfort load is shaped by the live ODH_{26} record (a 30%† ventilation floor plus an overheating-shaped remainder) once at least sixty days of the series exist, and is treated flat with a stated note until then. The same census supplies the hero: weekly cooling electricity is the flat loads spread evenly plus the comfort load shaped as above, computed per jurisdiction. Delivered cooling service applies per-load factors (service per unit electricity: data centres ≈1.0†, whose service is heat removal, roughly their electricity; cold-chain and process 2.5†; comfort 3.0†; Northern Ireland blended 2.0†) – vapour-compression plant delivers a multiple of its electricity, so served heat-and-cooling can legitimately exceed purchased energy, and the balance between service and electricity is ambient rejection, indigenous by the convention of §7. Purchased energy, the bill and emissions follow electricity; the delivered figures, and both indigenous shares, follow service. These enter the headline figures and the counterfactual – in which one-fifth of the cooling load moves to ground-coupled systems at a 70%† electricity saving (free cooling and high-efficiency rejection), the avoided electricity counted as ambient and indigenous. In the July 2026 build week the island's cooling expenditure exceeds its heating expenditure by roughly three to one – the summer inversion the tracker now displays rather than omits. Heat demand follows the degree-day shape; with annual totals normalised, the stranded share is

$$S = \Sigma_i \max(0, 1/n - h_i/H)$$

– the fraction of a flat supply produced while demand runs beneath it – recomputed from the live record on every build. This is the quantitative case for underground thermal energy storage, whose Irish mirror is heating-dominated: more winter withdrawal than summer banking. Policy attribution is kept precise: the Heat Bill advanced by Cabinet in July 2026 establishes the district-heating framework; the obligation on facilities above 1 MW to assess and implement waste-heat recovery arises under Article 26 of the recast Energy Efficiency Directive [21]. A building comfort-deficit analysis remains deferred – Irish air-conditioning penetration is low and no British overheating anchors are imported – but its input series is now live: the ODH_{26} record accumulates daily toward it.

10 Ground-source capacity accounting

No single sourced total exists for island ground-source capacity, so the accounting is assembled from three named layers. Northern Ireland: a bottom-up register of every documented system above 60 kW – named, dated, statused, shipped in full within the public data file – totalling ≈0.6 MWth† confirmed, with 500–700† domestic units triangulated from MCS certification counts and a pre-certification-era estimate, and sub-threshold systems logged as documented exclusions. Republic: the WGC2026 country update [12] – 225 MWth, 20,128 systems, 293 GWh/yr, zero deep plants. Europe: comparator capacities from the country-update lineage cross-checked against the EGEC 2025 envelope [14], whose 2025 sales table (Ireland 1,409 units; Sweden 26,785) shows the island's gap widening in flow as well as stock; EGEC counts units sold where WGC counts capacity commissioned – different measures, both carried, not reconciled. The requirement side converts the counterfactual to hardware at 2,000† equivalent full-load hours: 20% of delivered buildings heat implies ≈2,530 MWth (Republic), ≈1,090 MWth (Northern Ireland), ≈3,620 MWth all-island, against 231.6 MWth† installed. Deep potential in the Permo-Triassic Sherwood Sandstone beneath Northern Ireland is established in Todd et al. [13]; the two regulatory regimes – the Northern Ireland licensing consultation with a register expected ~2027, and the Republic's framework under the 2023 policy statement [22] – are kept distinct.

11 Whole-economy anchors

The closing panel places heat beside transport and power across annual services, expenditure, imported energy and emissions. Republic final consumption (≈143 TWh) and emissions are sourced [1]; Northern Ireland totals and all allocations are Causeway derivations kept deliberately round and daggered; the import split allocates the 81.2%-imported share of 220.7 TWh primary energy from the Causeway island Sankey model (2024). The panel's ordering claims – heat rivals transport as the largest service, carries the smallest expenditure per delivered unit, and is therefore the service still dominated by fossil fuel – are enforced by automated test against the anchor set.

12 The weekly back-look

From pipeline 4.0.0 the tracker maintains a weekly history: complete calendar weeks (Monday to Sunday), each carrying the hero's combined heating-and-cooling figures and their counterfactual twins, appended or updated by week-ending date, frozen once they fall behind the two most recent weeks, and capped at sixty. Every week is priced at its own conditions, not today's: Northern Ireland kerosene at that week's Consumer Council survey mean; Republic heating oil at that week's Oil Bulletin observation; currency at the week's mean ECB reference rate (a ninety-day rate history is retained for this purpose); the electricity emission factor at the week's mean grid intensity where at least four days of the EirGrid series exist, the anchor otherwise, with the source recorded per entry; and tariffs through a period resolver whose rows were verified against regulator and supplier announcements before the first backfill – the April 2026 Firmus reduction and the three 1 July 2026 increases are period boundaries in the table, with pre-July rates back-derived from announced percentages (±≈1% derivation uncertainty, †). Because the weekly estimator is anchor-shaped by degree days, history depth is bounded by the price feeds, not the gas series: the record opens with the Consumer Council daily survey (26 February 2026) and reaches a full year in February 2027. The front-end exposes the history as one-, four-, twelve-week and twelve-month windows that re-total the headline figures (the indigenous share as a purchased-energy-weighted mean), with per-headline sparklines drawing the actual beside the counterfactual and shading the gap between them.

Bills throughout – live and historic – are sector-blended: services-sector gas and electricity, and the whole of the cooling census, are priced at non-domestic rates (†, pending Eurostat band prices nrg_pc_203/205, which publish on roughly a half-year lag), domestic shares at the standard domestic tariff, and counterfactual heat-pump electricity at the domestic share of delivered heat; oil is not blended, since the tanker market prices identically across sectors. In the absence of any regulated price cap the chosen tariffs carry a representativeness judgement the UK sibling's cap-based series does not – stated here and marked † in the anchors.

13 Validation and uncertainty

- Fifty-three synthetic tests gate every release: parser fixtures captured verbatim from live run logs; hand-calculated checks of every derivation; the injected-confound regression test of Figure 2; reconciliation of jurisdiction views to the island sum; the internal logic of the whole-economy anchors; freeze semantics of the weekly history (a perturbed input must leave frozen weeks byte-identical while repricing the live pair); and the sector blend's degenerate-settings equivalence – domestic shares of one with non-domestic rates equal to domestic must reproduce pure domestic pricing exactly, isolating refactor drift from intended change.
- Feeds are developed diagnostics-first: on first contact with an unknown format the pipeline logs the raw structure and continues, and parsers are written against that

evidence – a discipline that identified the price-history workbook's wide country-column layout before a wrong parser shipped.

- The calibration disclosure (§4) and residual-standard-error display ship in the current release; variance-explained statistics are labelled as such.
- History merges are snapshot-authoritative: current publications win conflicts with archived series, and series breaks are detected and logged.

14 Principal limitations

- The majority fuel is modelled, not metered: oil estimates carry a materially wider band than gas, and no daily observation constrains them.
- The gas regression identifies within-month weather response; genuine between-month structural signal is absorbed by the centring, so truth plausibly lies between the centred and pooled slopes.
- Carbon intensity awaits confirmation of its response shape from the restored EirGrid interface. The Great Britain oil comparison awaits confirmation that cache-circumvention measures defeat a content-delivery network observed serving archived 2021 pages to non-browser clients – a freshness gate rejects any fossil that slips through.
- The jurisdiction of unprefixed Gas Networks Ireland demand categories is unverified; the Northern Ireland domestic ground-source count awaits an MCS export check.
- Whole-economy expenditure and import allocations, the non-data-centre cooling-load anchors, the cooling service factors and the ground-coupled cooling saving are the softest layers and are scheduled for hardening on the autumn statistical cycle.
- Tariff representativeness: with no regulated cap, the bill series rests on a chosen standard tariff (†); blend shares and non-domestic rates are estimates pending the SEAI balance and Eurostat band prices, the latter on a half-year publication lag.
- Cooling is a cold-economy scope – wider than comfort-only national lines and declared as such on the hero; head-to-head cooling comparisons with the UK sibling are not valid without that caveat.
- Summer weeks carry near-zero degree days; small hero figures in June–August are the season, not a fault – the preceding winter's peak week required roughly eight times the energy of a July week.

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