Appendix - Island of Calm (IoC) Index (Adult-Equivalent Version)

(Functional definition, assumptions, and calculation details)

1) Functional definition (what the IoC holds constant)

The **Island of Calm (IoC)** is the minimum annual energy required to maintain a stable pocket of human order-**shelter, thermal stability, clean water, safe nourishment, usable light after sunset, and connection to the era's best-available knowledge and coordination network**-using the **technological frontier of that era**. It is a *frontier stability bundle*, not an "average" standard of living.

2) Why adult-equivalents (OECD modified scale)

Historical households differ in composition (adults vs children; extended family; staff living in/out). To avoid diluting fixed household overheads by raw headcount, this appendix reports "per person" using **adult-equivalents (AE)** via the **OECD modified equivalence scale**:

- 1.0 for the first adult
- 0.5 for the second adult
- 0.3 for each child

For the standard Island household (2 adults + 2 children), this implies:

AE = 1.0 + 0.5 + 0.3 + 0.3 = 2.1

We report both:

- **GJ per household-year (GJ/HH-yr)** and
- **GJ per adult-equivalent-year (GJ/AE-yr)**

IoC_AE(t) = IoC_HH(t) / AE

3) Model structure (overhead vs variable)

Total household IoC energy in year *t*:

IoC_HH(t) = E_heat(t) + E_light(t) + E_food,principals + E_food,support(t) + E_info(t)

Split into:
- **Household overhead:** E_heat + E_light + E_food,support + E_info

- **Variable (biology):** E_food,principals

and reported per AE by dividing totals by **2.1**.

4) Component assumptions (current implementation)

4.1 Thermal stability

Thermal energy uses the previously calibrated frontier trajectories for heat demand and heating efficiency/COP (open fireplaces → boilers → heat pumps), preserving the historical shape of the earlier IoC series while we improve denominators and explicitly account for information energy.

4.2 Lighting

Luminous service is held constant and converted to energy using frontier luminous efficacy (candles → gas → incandescent → fluorescent → LED).

4.3 Food (principals)

Food is **metabolic energy** only (not upstream agriculture). Standard household calories:

- Adults: 2500 kcal/day each
- Children: 1800 kcal/day each

So:

E_food,principals = 13.13 GJ/HH-yr

4.4 Food (support labour)

Support labour is represented as an era-dependent `servants_FTE(t)` term (people as infrastructure at the frontier). Each FTE is assigned 2800 kcal/day metabolic energy. This remains in the numerator.

4.5 Information & coordination (explicit; adult-only service)

The Island requires access to the era's best coordination network. In 1825 this includes clerks/couriers/horse relays and private intelligence networks; in modern years it is digital networks. This term is explicit as `info_GJ(t)` and treated as adult-only service. Anchor schedule (GJ/HH-yr): 1825=160.0, 1900=45.0, 1950=22.0, 2000=6.0, 2025=2.5.

5) Results table (household vs adult-equivalent; overhead vs variable)

Yr	Total (GJ/HH-yr)	Overhead (GJ/HH-yr)	Variable (GJ/HH-yr)	Total (GJ/AE-yr)	Overhead (GJ/AE-yr)	Variable (GJ/AE-yr)	Heat	Light	Food (principals)	Food (support)	Info	% pop
1825	3,163.97	3,150.83	13.13	1,506.65	1,500.40	6.25	2,700.00	205.31	13.13	85.52	160.00	0.00
1850	2,340.95	2,327.82	13.13	1,114.74	1,108.49	6.25	2,088.00	32.85	13.13	76.97	130.00	0.01
1875	1,725.70	1,712.56	13.13	821.76	815.51	6.25	1,540.80	21.90	13.13	59.86	90.00	0.01
1900	950.90	937.77	13.13	452.81	446.55	6.25	846.72	3.29	13.13	42.76	45.00	0.05
1925	455.80	442.66	13.13	217.05	210.79	6.25	384.48	2.53	13.13	25.66	30.00	0.20
1950	316.33	303.20	13.13	150.64	144.38	6.25	265.85	2.53	13.13	12.83	22.00	0.80
1960	271.66	258.53	13.13	129.36	123.11	6.25	231.43	0.55	13.13	8.55	18.00	1.20
1970	233.56	220.42	13.13	111.22	104.96	6.25	201.60	0.55	13.13	4.28	14.00	2.00
1980	201.32	188.19	13.13	95.87	89.61	6.25	175.50	0.55	13.13	2.14	10.00	3.50
1990	175.22	162.09	13.13	83.44	77.18	6.25	152.47	0.55	13.13	1.07	8.00	5.50
2000	152.11	138.98	13.13	72.43	66.18	6.25	132.00	0.55	13.13	0.43	6.00	8.00
2010	88.45	75.31	13.13	42.12	35.86	6.25	70.56	0.41	13.13	0.34	4.00	11.00
2020	53.79	40.66	13.13	25.62	19.36	6.25	37.15	0.25	13.13	0.26	3.00	14.00
2025	46.92	33.79	13.13	22.34	16.09	6.25	30.86	0.22	13.13	0.21	2.50	15.00

Island of Calm (IoC): Component Breakdown by Year (Stacked)
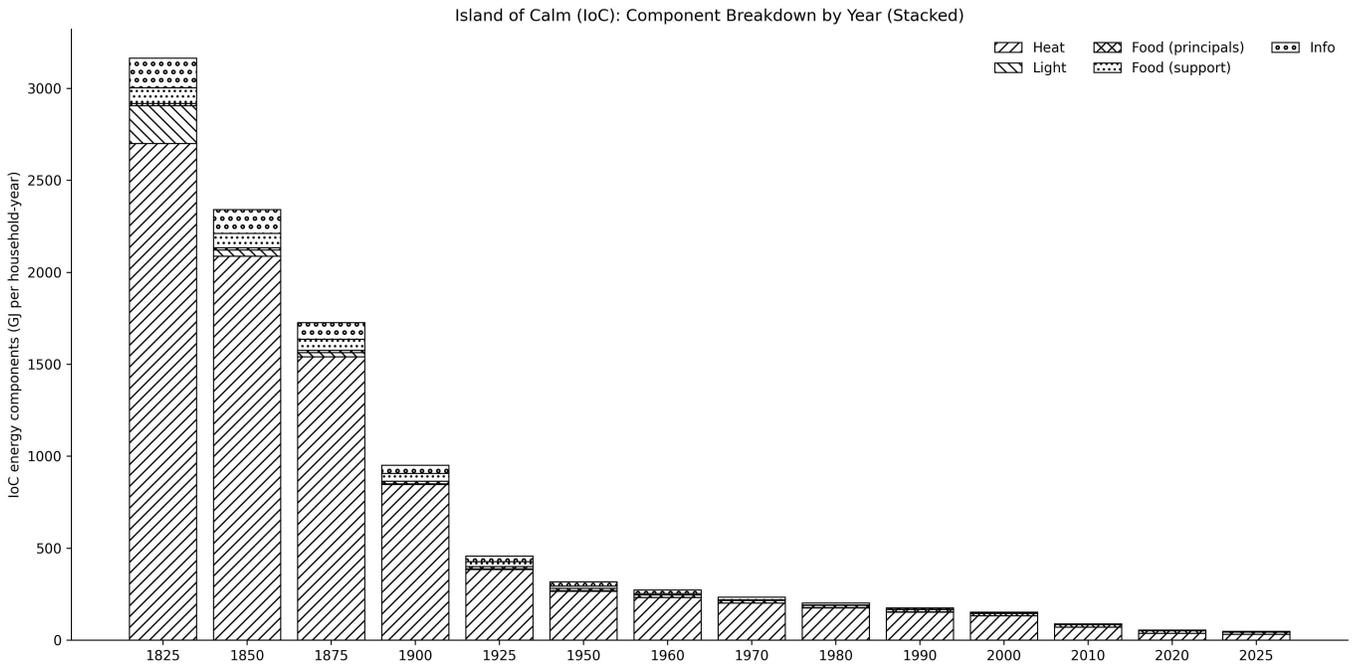
6) Notes and limitations

- This is a **frontier** metric, not an average.
- Food is metabolic; adding agricultural + logistics overhead is a straightforward extension.
- The RHS "% population" series is a stylised proxy for narrative context and is not used to compute IoC energy.

7) Reproducibility

CSV dataset: `IoC_index_per_adult_equivalent_1825_2025.csv`
Chart image: `IoC_chart_two_lines_per_AE_1825_2025_hi_res.png`