exergenics Beyond Optimisation

Harnessing the Power of Historical Data: Doing More With Less

20th August 2024

Agenda

- Retrocommissioning Efficiency Opportunity
- Data Collection, Validation & Normalisation
- Modelling & Simulation Approaches
- Optmisation Techniques
- Measurement & Verification

Retrocommissioning Efficiency Opportunity

Common Optimisation Strategies

- Temperature Resets
- Flow Resets
- Pressure Resets
- Chiller Seqencing
- Chiller Staging Setpoints
- Cooling Tower Staging

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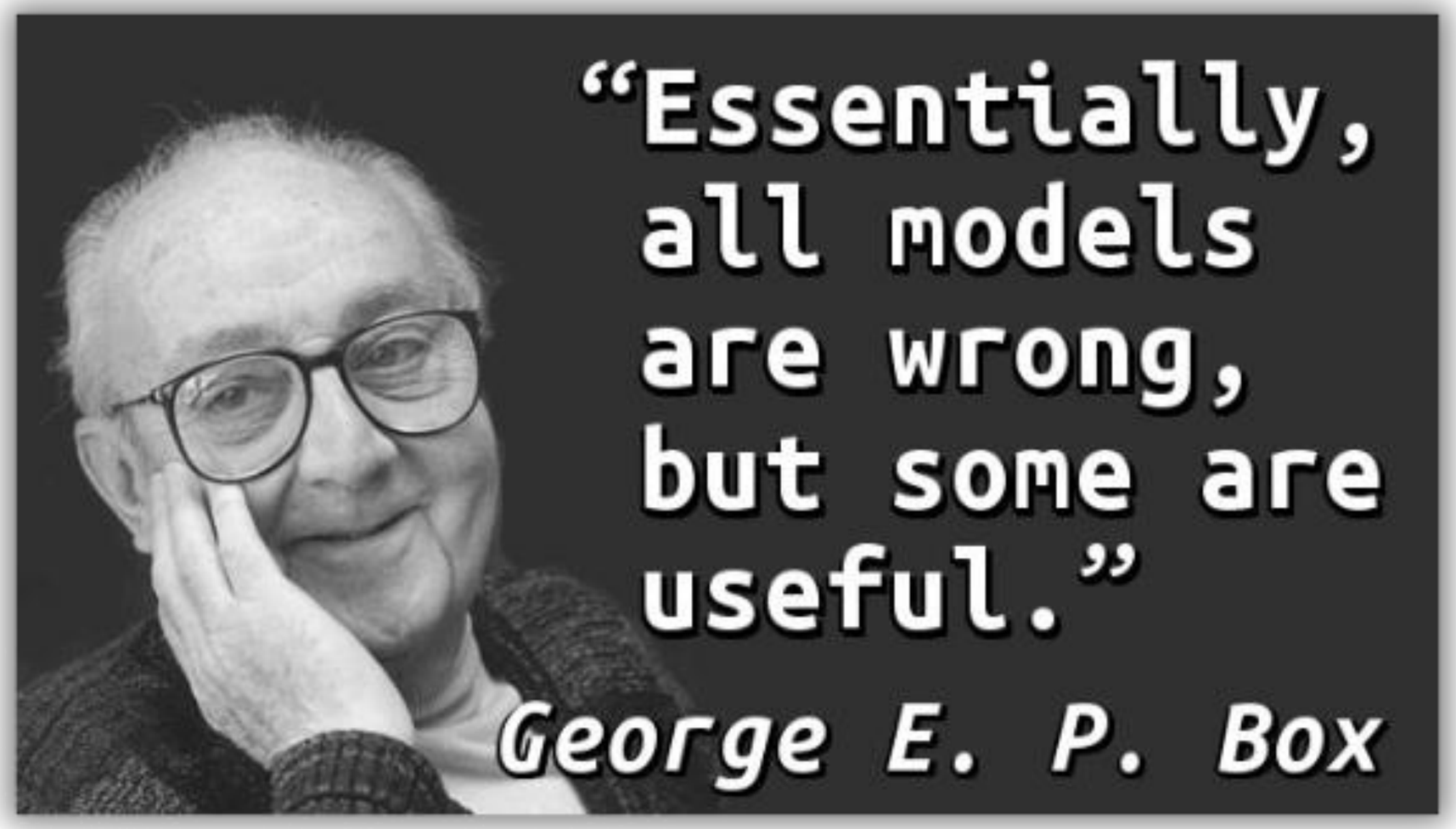
Optimisation Economics

- Chilled Water Plant Energy Reductions of 5-35%
- Retrocommissioning typical payback periods of 1-4 years
- Extension of equipment life can improve payback further

Modelling Golden Rule

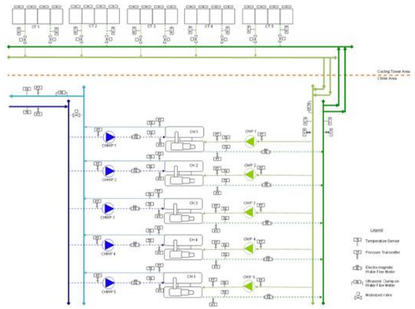


Data Collection, Validation & Normalisation

Design

Operational

Limits



	A	B	C	D	E	F	G	H
1	Time	CHWS	CHWR	CWS	CWR	CHWF	CDWF (L/s)	CH1 KW
2	1/1/2024 0:00	9.958	16.5	28.612	31.942	69.46	157.489	150.18
3	1/1/2024 0:01	9.973	16.5	28.62	31.938	69.073	157.387	151.16
4	1/1/2024 0:02	9.942	16.477	28.626	31.947	69.547	156.324	151.28
5	1/1/2024 0:03	9.919	16.483	28.632	31.957	68.451	157.121	151.28
6	1/1/2024 0:04	9.909	16.499	28.639	31.964	68.679	157.418	151.36
7	1/1/2024 0:05	9.924	16.502	28.642	31.961	68.625	156.976	151.41
8	1/1/2024 0:06	9.909	16.487	28.641	31.962	69.236	156.721	151.47
9	1/1/2024 0:07	9.913	16.479	28.642	31.962	69.04	156.166	150.53
10	1/1/2024 0:08	9.925	16.458	28.636	31.989	68.55	156.628	150.64
11	1/1/2024 0:09	9.916	16.453	28.633	31.953	68.792	156.501	147.54
12	1/1/2024 0:10	9.917	16.475	28.624	31.941	69.729	156.974	147.54
13	1/1/2024 0:11	9.93	16.479	28.613	31.951	67.946	155.839	148.34
14	1/1/2024 0:12	9.951	16.482	28.605	31.948	68.596	156.682	146.28
15	1/1/2024 0:13	9.969	16.488	28.602	31.909	64.995	155.612	146.56
16	1/1/2024 0:14	9.893	16.495	28.597	31.893	65.685	155.673	143.58
17	1/1/2024 0:15	9.901	16.488	28.585	31.87	65.598	156.558	143.58
18	1/1/2024 0:16	9.895	16.49	28.574	31.799	65.759	156.193	142.43
19	1/1/2024 0:17	9.897	16.491	28.568	31.776	67.314	156.247	141.52
20	1/1/2024 0:18	9.971	16.507	28.568	31.77	66.858	155.693	141.38
21	1/1/2024 0:19	10.012	16.522	28.573	31.777	66.478	155.998	143.27
22	1/1/2024 0:20	9.987	16.534	28.572	31.785	66.671	154.931	143.32
23	1/1/2024 0:21	9.988	16.573	28.563	31.816	66.318	155.396	143.34
24	1/1/2024 0:22	9.988	16.614	28.549	31.795	66.348	156.591	145.08
25	1/1/2024 0:23	9.975	16.649	28.536	31.808	65.609	156.278	145.05

& Max Flow rate of Cooling Tower

Cooling Tower	Min Flow rate (60%)	Max Flow rate (100%)
CT-T1E-01	57.6 l/s	96 l/s
CT-T1E-02	57.6 l/s	96l/s
CT-T1E-03	57.6 l/s	96l/s
CT-T1E-04	57.6 l/s	96l/s
CT-T1E-05	57.6 l/s	96l/s

Common Issues

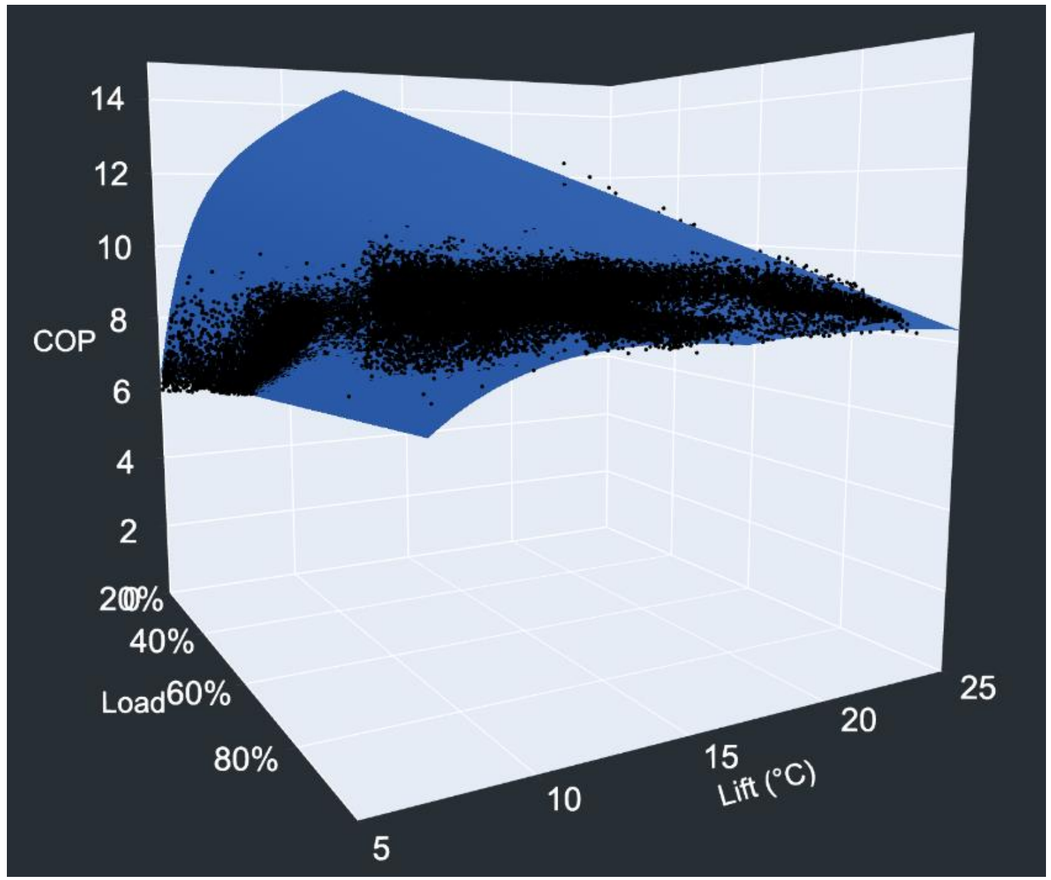
- Sensor calibration
- Network drops
- Naming conventions
- Timestamp mismatch

Modelling Tools

- Energy-mass balance
- Data backfill
- Naming convention (eg. Haystack)
- Nearest neighbour

Resource: AIRAH Big Data Guideline: https://airah.org.au/Common/Uploaded%20files/Resources/Best%20Practice%20Guidelines/Big%20Data%20Guideline.pdf

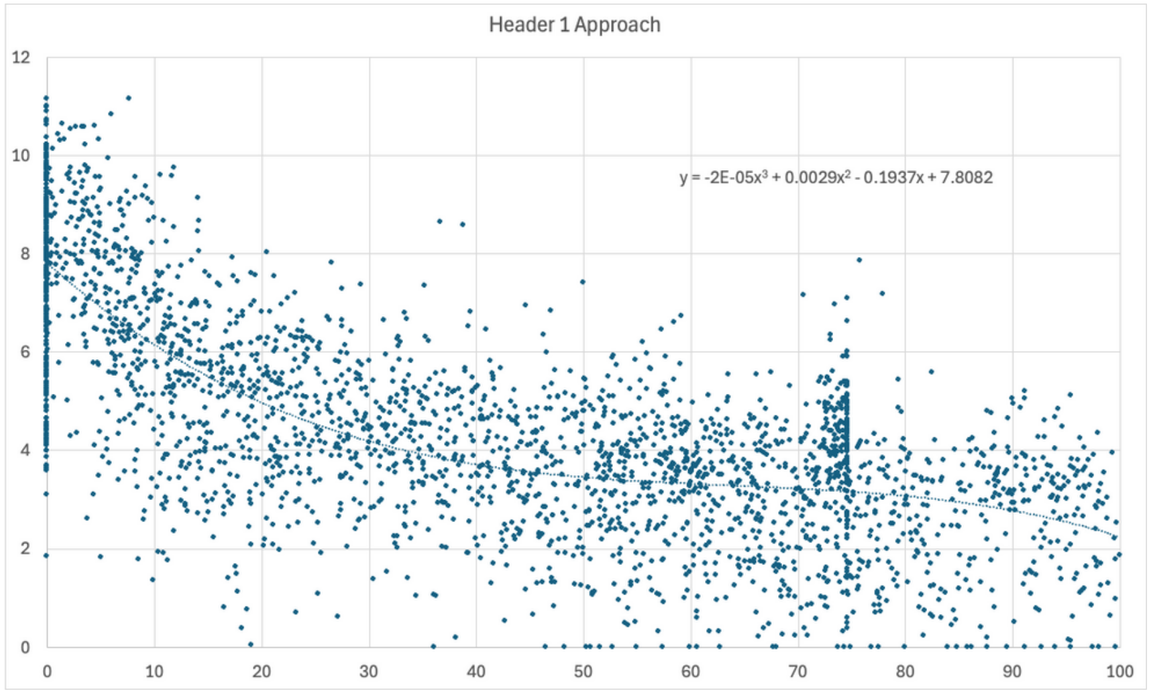
Modelling & Simulation Approachs



Modelling Tools

- Regression Analysis
- Model Predictive Control

Modelling & Simulation Approachs



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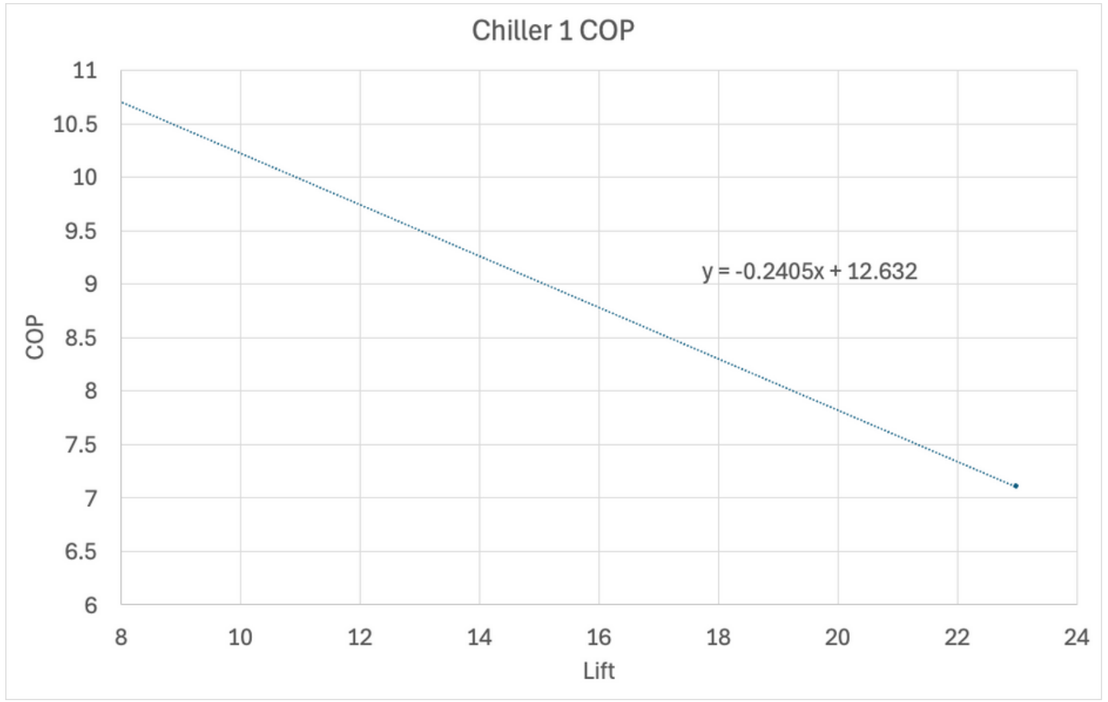
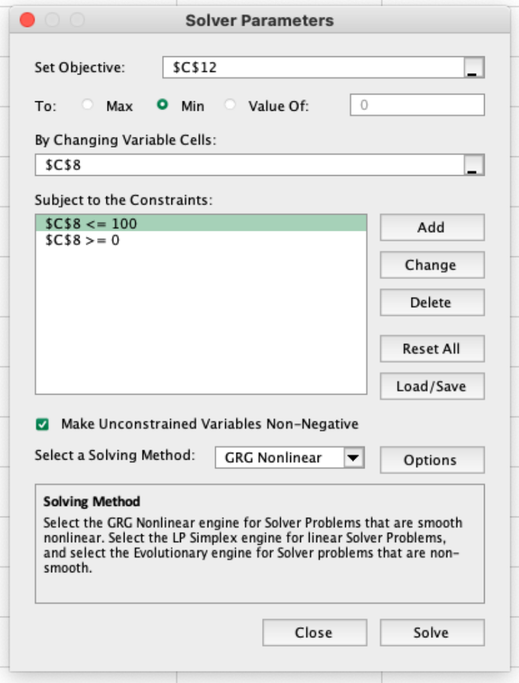


Optmisation Techniques

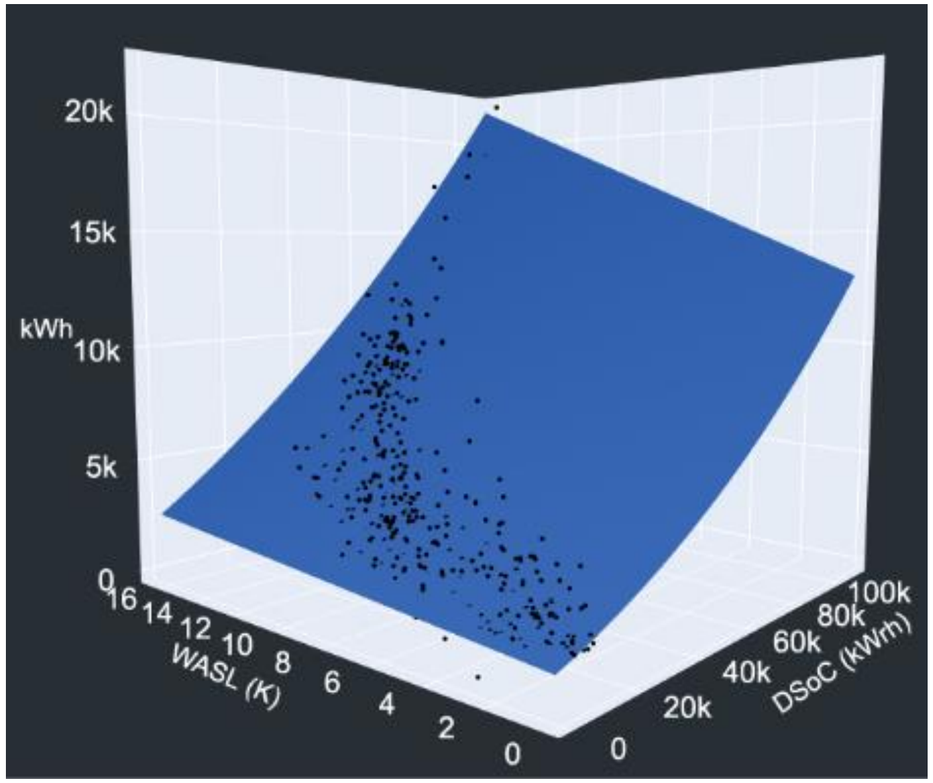
Modelling Tools

- Excel Solver
- Steepest Slope Optimisation
- Genetic Optimisation Alogrithms

Metric	Value	Units	Calculation
Chilled Water Temp Setpoint	6	Deg.C	Const
Wet Bulb Temperature	18	Deg.C	Const
Thermal Load	6000	kWr	Const
Condenser Range	4	Deg.C	Const
Approach SP	3.84	Deg.C	=-0.00002*C8^3 + 0.0029*C8^2+ - 0.1937*C8 + 7.8082
Fans Energy	36.66	kWe	[Optimised Variable]
Chiller Lift	19.84	Deg.C	=SUM(C4,C7)+C6-C3
Chiller Efficiency	7.86	COP	=-0.2405*C9+12.632
Chiller Energy	763.42	kWe	=C5/C10
Total Energy (Chiller & Fan)	800.08	kWe	=SUM(C11,C8) [Minimisation Target]

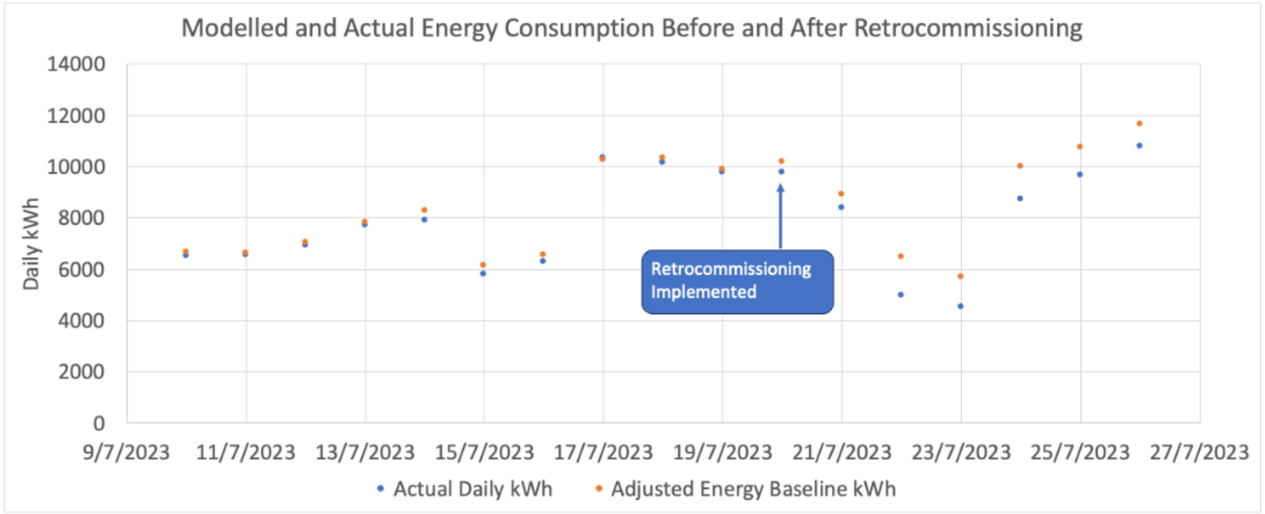


Measurement & Verification



Modelling Tools

- Multivariate Regression Analysis
- IPMVP Guidelines



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