RESUME EXPORT REPORT

Generated: 2026-01-10 18:07:23

1. Dataset Summary

Item	Value
Device	Unknown Device
Date Range	27/12/2025 - 09/01/2026
Total Rows	3,454
Start Time	27-12-2025 23:52:34
End Time	09-01-2026 00:52:40
Median Interval	300 seconds (5.0 min)

2. First 10 Rows

Timestamp	V (V)	A (A)	W (W)	kWh	Hz	PF
27-12-2025 23:52:34	227.30	0.093	20.50	4.4800	50.0	0.970
27-12-2025 23:57:34	225.70	0.093	20.50	4.4810	50.0	0.980
28-12-2025 00:02:34	225.00	0.093	20.40	4.4830	50.0	0.970
28-12-2025 00:07:34	227.60	0.093	20.40	4.4850	50.0	0.960
28-12-2025 00:12:35	228.60	0.092	20.30	4.4860	49.9	0.970
28-12-2025 00:17:34	225.90	0.104	22.60	4.4880	50.0	0.960
28-12-2025 00:22:34	226.40	0.103	22.50	4.4900	50.0	0.960
28-12-2025 00:27:34	225.20	0.103	22.40	4.4920	50.0	0.970
28-12-2025 00:32:34	225.10	0.119	25.10	4.4940	50.0	0.940
28-12-2025 00:37:34	225.80	0.108	22.90	4.4960	50.0	0.940

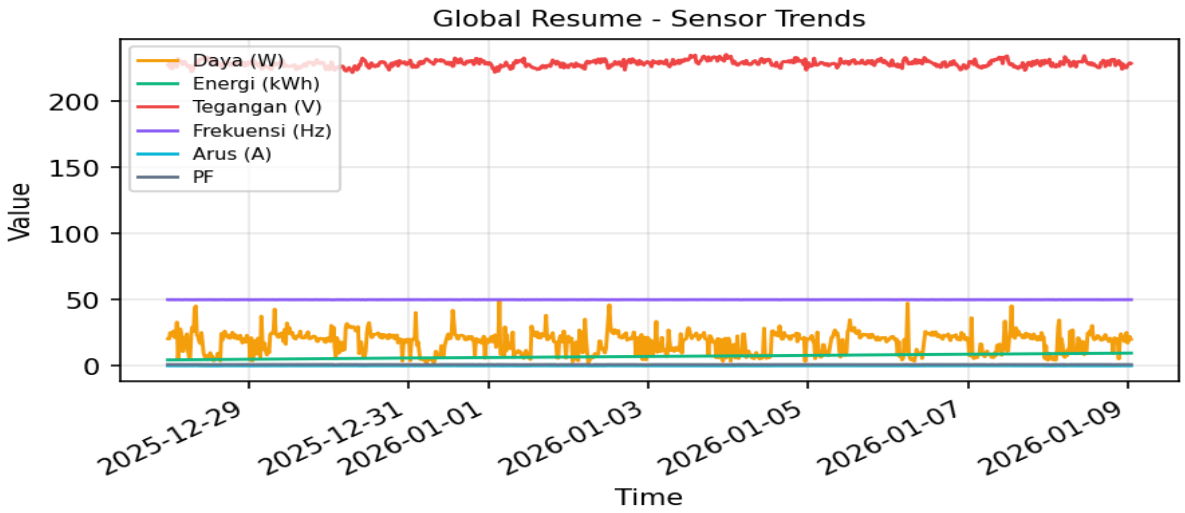
3. Last 10 Rows

Timestamp	V (V)	A (A)	W (W)	kWh	Hz	PF
09-01-2026 00:07:40	228.20	0.092	19.60	9.6130	50.0	0.930
09-01-2026 00:12:40	229.30	0.105	22.20	9.6150	49.9	0.920
09-01-2026 00:17:40	228.40	0.105	22.10	9.6170	50.0	0.920
09-01-2026 00:22:40	228.30	0.105	22.10	9.6190	50.0	0.920
09-01-2026 00:27:40	229.00	0.105	22.10	9.6210	50.0	0.920
09-01-2026 00:32:40	228.70	0.093	19.70	9.6220	50.0	0.930
09-01-2026 00:37:40	229.10	0.094	19.90	9.6240	50.0	0.920
09-01-2026 00:42:40	226.70	0.093	19.70	9.6260	50.0	0.930
09-01-2026 00:47:40	228.50	0.094	20.00	9.6270	50.0	0.930

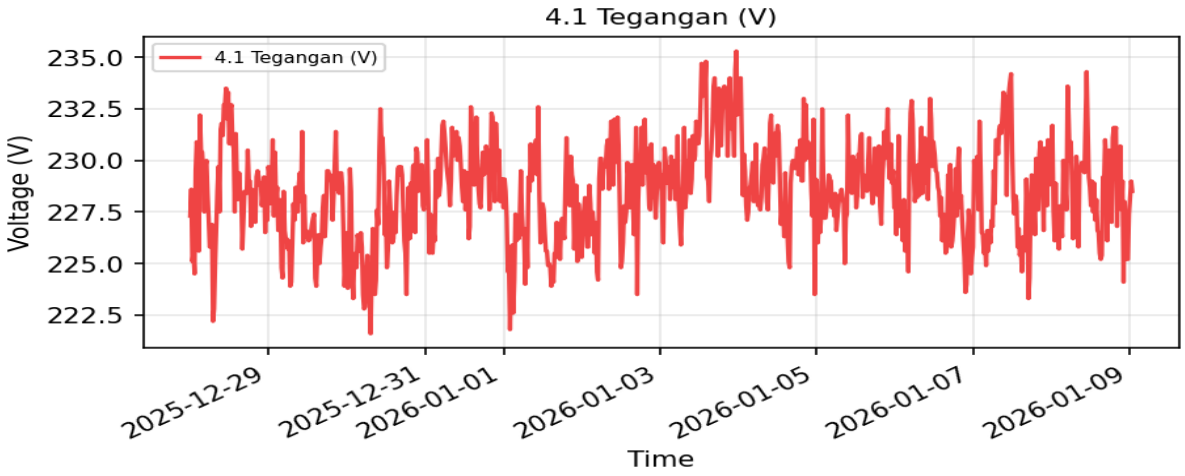
09-01-2026 00:52:40	228.50	0.093	19.70	9.6290	49.9	0.930

4. Global Resume

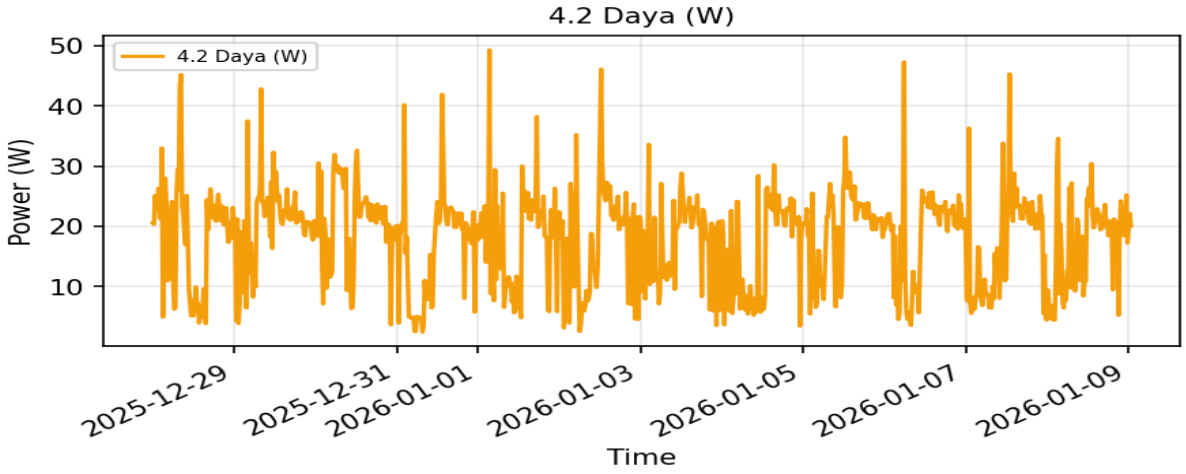
4.0 Overall



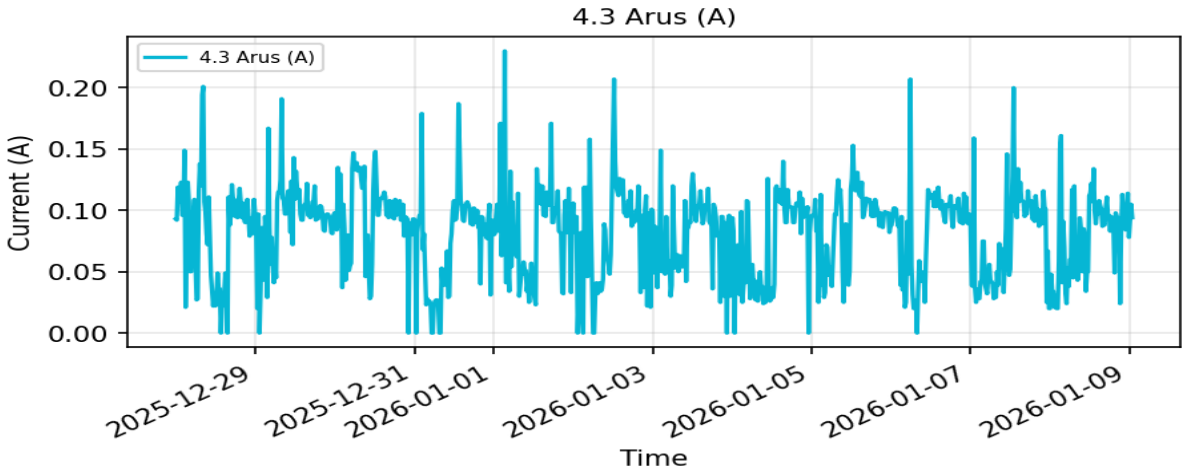
4.1 Tegangan (V)



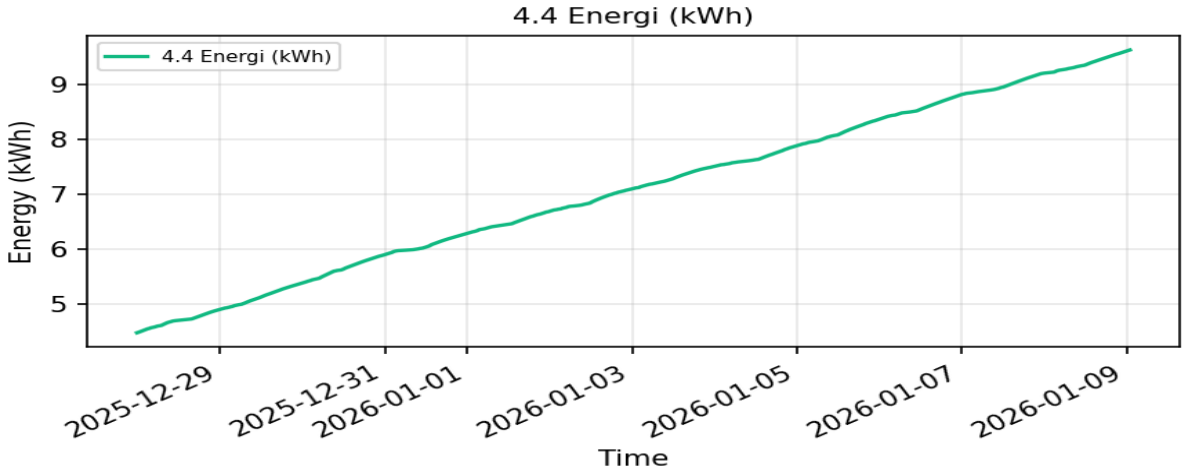
4.2 Daya (W)



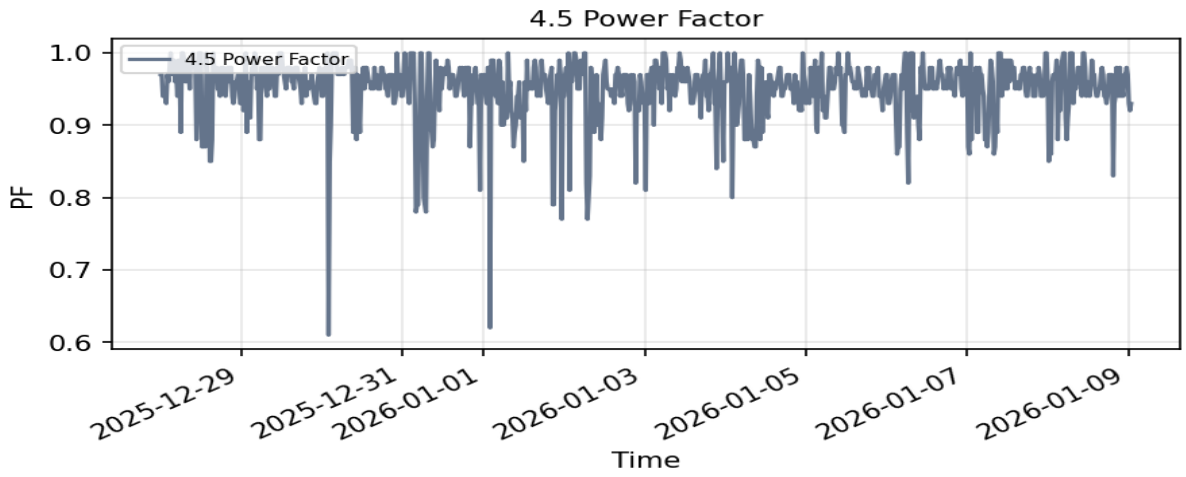
4.3 Arus (A)



4.4 Energi (kWh)



4.5 Power Factor



4.6 Highest Current Points (Arus)

Rank	Timestamp	A (A)	W (W)	V (V)	Hz	kWh	PF
1	08-01-2026 03:22:39	0.239	48.20	225.10	50.0	9.2430	0.900
2	06-01-2026 04:37:37	0.239	44.60	227.60	50.0	8.4450	0.820
3	01-01-2026 03:17:38	0.230	49.30	224.20	50.0	6.3520	0.960
4	30-12-2025 05:07:37	0.215	47.40	221.90	50.0	5.4810	0.990
5	30-12-2025 05:02:36	0.213	46.90	222.40	50.0	5.4770	0.990

4.7 Lowest Current Points (Arus)

Rank	Timestamp	A (A)	W (W)	V (V)	Hz	kWh	PF
1	30-12-2025 22:12:37	0.000	3.60	229.20	50.0	5.8710	1.000
2	31-12-2025 05:27:38	0.000	2.30	231.00	50.0	5.9800	1.000
3	28-12-2025 14:02:34	0.000	4.00	231.00	50.0	4.7190	1.000
4	28-12-2025 14:17:34	0.000	3.90	229.60	50.0	4.7200	1.000
5	31-12-2025 05:22:37	0.000	2.50	230.30	50.0	5.9800	1.000

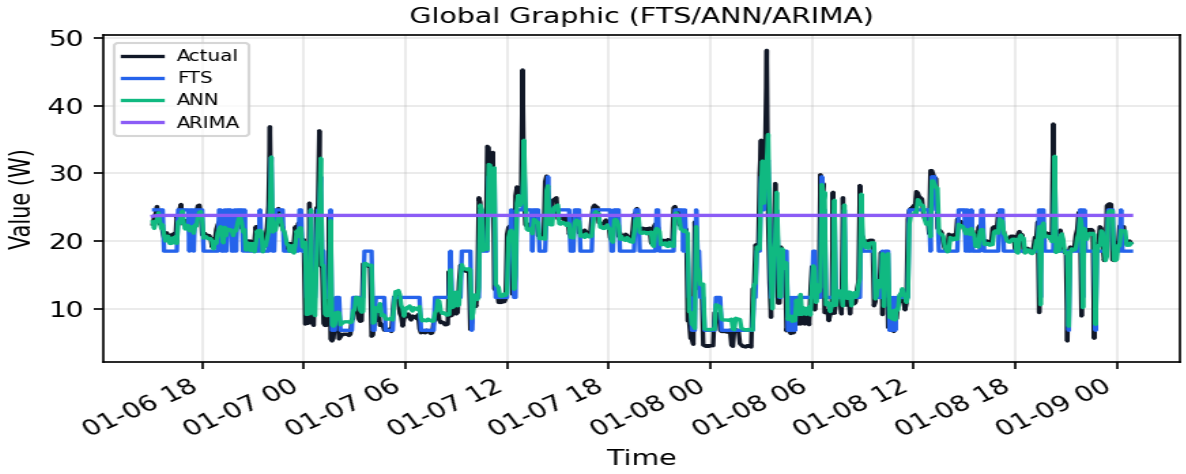
4.8 HOME Average Summary (Rata-rata)

Tanggal Awal	Tanggal Akhir	Jumlah Data	V_avg (V)	A_avg (A)	W_avg (W)	E (kWh)	Hz_avg	PF_avg
27/12/2025	09/01/2026	3,454	228.60	0.082	17.86	5.1490	50.0	0.949

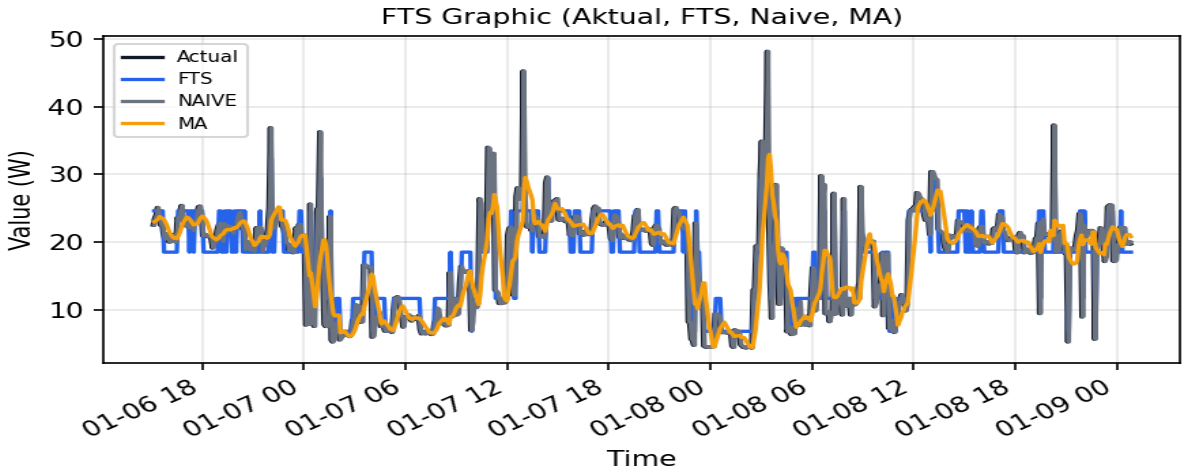
Energy method: **SENSOR_DELTA**

5. Resume Graphic (FTS/ANN/ARIMA)

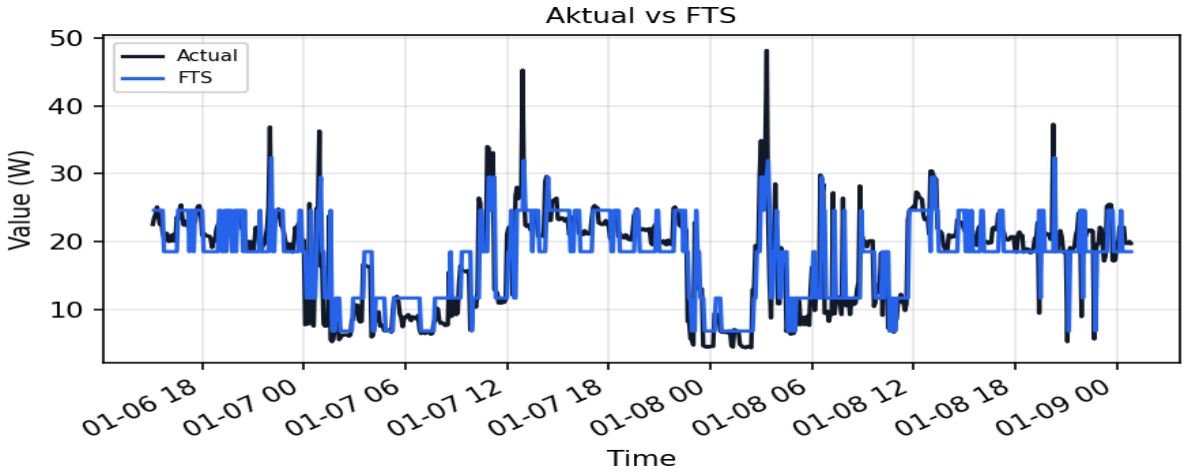
5.0 Global Graphic



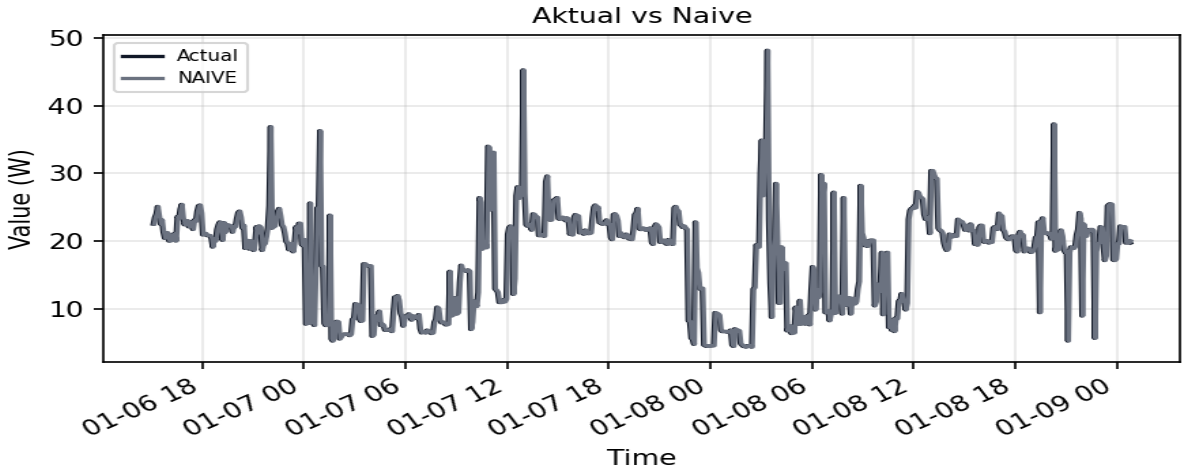
5.1 FTS Graphic



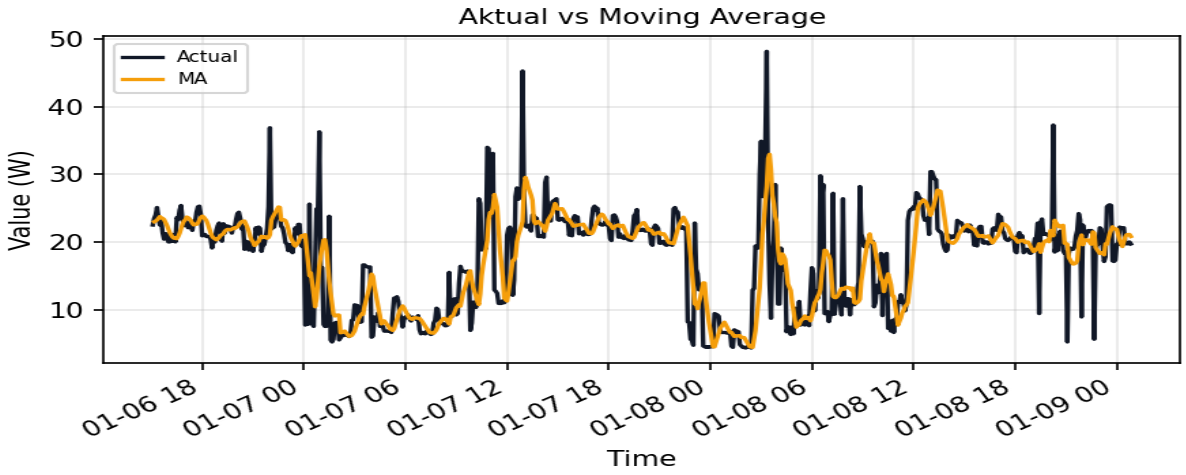
5.1.1 Grafik Aktual vs FTS



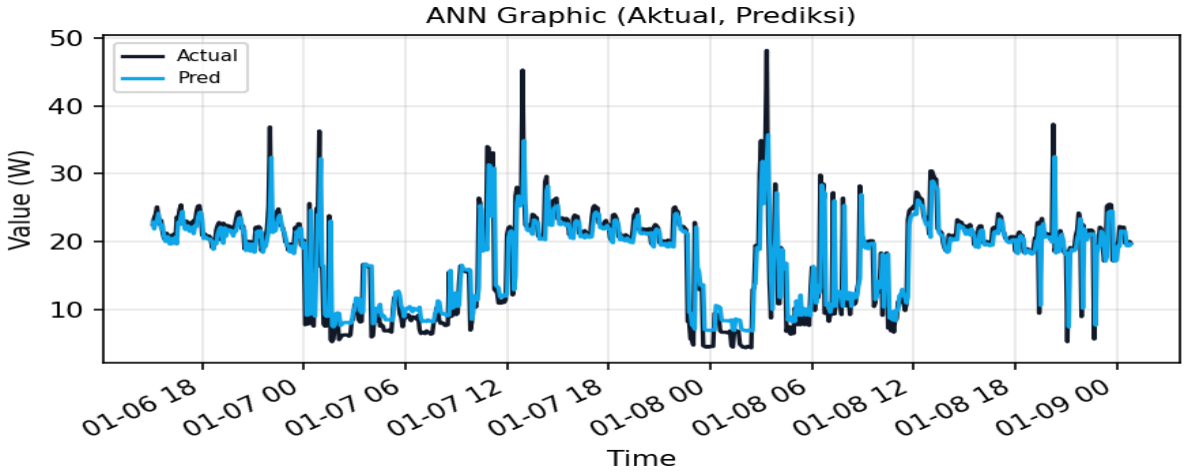
5.1.2 Grafik Aktual vs Naive



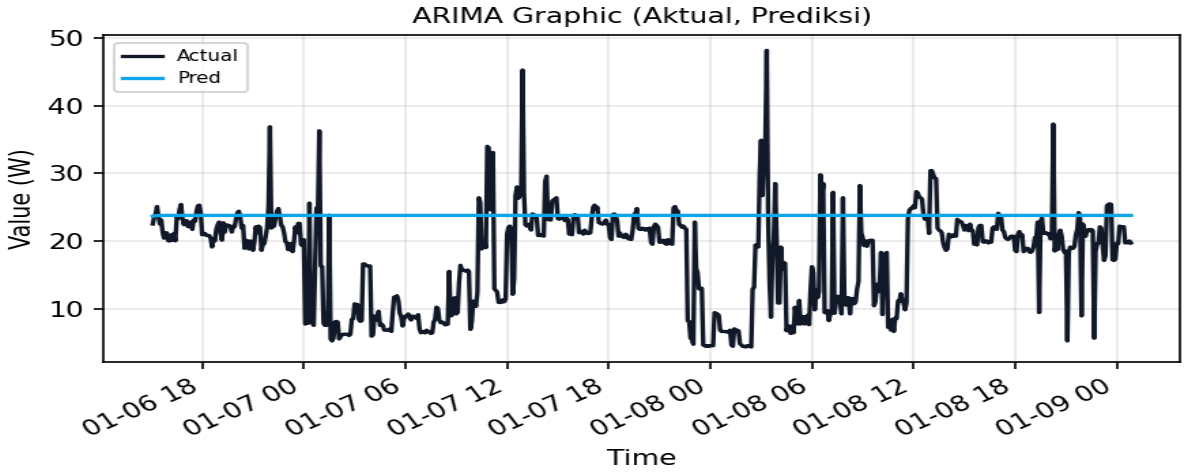
5.1.3 Grafik Aktual vs Moving Average



5.2 ANN Graphic



5.3 ARIMA Graphic



6. FTS Mathematical Documentation

5.1 Universe of Discourse (UoD)

Formula: D = [D_min, D_max], D_min = min(y) - pad, D_max = max(y) + pad, pad = padPct * (max(y) - min(y)).

$$D = [D_{min}, D_{max}]$$

$$D_{min} = \min(y) - pad$$

$$D_{max} = \max(y) + pad$$

$$pad = padPct \times (\max(y) - \min(y))$$

Calculation: min(y)=2.3000, max(y)=49.3000, span=47.0000, padPct=5.0%, D_min=-0.0500, D_max=51.6500

5.2 Partitioning (Equal-Width / Equal-Frequency)

Formula: w = (D_max - D_min) / n; A_i = [D_min + (i-1)w, D_min + i w), A_n = [D_min + (n-1)w, D_max].

$$w = \frac{D_{max} - D_{min}}{n}$$

$$A_i = [D_{min} + (i-1)w,\ D_{min} + iw)$$

$$A_n = [D_{min} + (n-1)w,\ D_{max}]$$

$$mid(A_i) = \frac{lo_i + hi_i}{2}$$

Method=Equal Width, n=7, width=7.3857

ID	Lower	Upper	Midpoint

A1	-0.0500	7.3357	3.6429
A2	7.3357	14.7214	11.0286
A3	14.7214	22.1071	18.4143
A4	22.1071	29.4929	25.8000
A5	29.4929	36.8786	33.1857
A6	36.8786	44.2643	40.5714
A7	44.2643	51.6500	47.9571

5.3 Fuzzification

Formula: L_t = A_i jika y_t berada pada interval [lo_i, hi_i).

$$L_t = A_i, \text{ jika } y_t \in [lo_i, hi_i)$$

Timestamp	W (W)	Label
27-12-2025 23:50:00	20.500	A3
27-12-2025 23:55:00	20.500	A3
28-12-2025 00:00:00	20.400	A3
28-12-2025 00:05:00	20.400	A3
28-12-2025 00:10:00	20.300	A3
28-12-2025 00:15:00	22.600	A4
28-12-2025 00:20:00	22.500	A4
28-12-2025 00:25:00	22.400	A4
28-12-2025 00:30:00	25.100	A4
28-12-2025 00:35:00	22.900	A4

5.4 Fuzzy Logical Relationship (FLR)

Formula: FLR = {(L_{t-1}, L_t)} atau A_i -> A_j.

$$A_i \rightarrow A_j$$

$$FLR = \{(L_{t-1}, L_t)\}$$

No	Relation
1	A3 -> A3
2	A3 -> A3
3	A3 -> A3
4	A3 -> A3
5	A3 -> A4
6	A4 -> A4

7	A4 -> A4
8	A4 -> A4
9	A4 -> A4
10	A4 -> A4

... 2764 relasi lainnya ...

5.5 Fuzzy Logical Relationship Group (FLRG)

Formula: A_i -> {A_j} dengan support = count(A_i->A_j) / total(A_i).

$$A_i \rightarrow \{A_{j_1}, A_{j_2}, \ldots\}$$

$$support(A_i \rightarrow A_j) = \frac{count(A_i \rightarrow A_j)}{\sum_j count(A_i \rightarrow A_j)}$$

Group	Next States (Support)
A1	A1 (72.4%), A2 (14.6%), A3 (11.3%), A4 (1.8%)
A2	A2 (75.3%), A1 (11.2%), A3 (8.5%), A4 (4.7%), A5 (0.2%), A7 (0.2%)
A3	A3 (79.5%), A4 (10.4%), A2 (4.3%), A1 (4.2%), A5 (1.2%), A6 (0.3%)
A4	A4 (79.8%), A3 (12.6%), A2 (2.6%), A5 (2.5%), A1 (1.4%), A6 (0.6%), A7 (0.6%)
A5	A5 (55.3%), A4 (27.6%), A3 (7.9%), A6 (3.9%), A2 (2.6%), A1 (1.3%), A7 (1.3%)
A6	A4 (33.3%), A6 (33.3%), A3 (16.7%), A7 (11.1%), A5 (5.6%)
A7	A4 (58.3%), A7 (25.0%), A6 (8.3%), A3 (8.3%)

5.6 Forecasting (Cheng Method)

Formula: y_hat(t+1) = sum(support * midpoint). Fallback: y_hat = midpoint(A_i).

$$\hat{y}_{t+1} = \sum_j support(L_t \rightarrow A_j)\, mid_j$$

$$\hat{y}_{t+1} = mid(L_t) \quad \text{(fallback)}$$

t	Timestamp	Actual (W)	Pred (W)
2	06-01-2026 15:10:00	23.500	24.598
3	06-01-2026 15:15:00	24.000	24.598
4	06-01-2026 15:20:00	25.100	24.598
5	06-01-2026 15:25:00	23.700	24.598
6	06-01-2026 15:30:00	22.500	24.598
7	06-01-2026 15:35:00	23.100	24.598
8	06-01-2026 15:40:00	21.300	24.598
9	06-01-2026 15:45:00	20.400	18.490
10	06-01-2026 15:50:00	21.200	18.490
11	06-01-2026 15:55:00	21.200	18.490

5.7 Evaluation Metrics

Formula: MAE = mean(|y - y_hat|), RMSE = sqrt(mean((y - y_hat)^2)), MAPE = mean(|(y - y_hat)/y|) * 100.

$$MAE = \frac{1}{n}\sum_{t=1}^{n}|Y_t - \hat{Y}_t|$$

$$RMSE = \sqrt{\frac{1}{n}\sum_{t=1}^{n}(Y_t - \hat{Y}_t)^2}$$

$$MAPE = \frac{100\%}{n}\sum_{t=1}^{n}\left|\frac{Y_t - \hat{Y}_t}{Y_t}\right|$$

Metric	Value
MAE	2.9997
RMSE	4.4824
MAPE (%)	21.86

5.8 Baseline Models Comparison

Formula: Naive y_hat(t+1) = y_t, Moving Average y_hat(t+1) = mean(y_{t-w+1}..y_t).

$$\hat{y}_{t+1} = y_t \quad \text{(Naive)}$$

$$\hat{y}_{t+1} = \frac{1}{w}\sum_{i=t-w+1}^{t} y_i \quad \text{(Moving Average)}$$

Model	MAE	RMSE	MAPE (%)
Naive	2.0418	4.3906	14.28
Moving Average	3.0488	4.7822	22.82

5.9 Sensitivity Analysis

Formula: Delta MAPE = MAPE_FTS - MAPE_Baseline.

$$\Delta MAPE = MAPE_{FTS} - MAPE_{Baseline}$$

Case	MAPE (%)	Delta (%)
method = equal-frequency	20.69	-1.16
n = 9	20.79	-1.07
pad = 10%	23.88	2.03

7. Model Configuration

Model	Config Summary
FTS	n=7, method=Equal Width, pad=5%, split=80%
ANN	epoch=90, neuron=10, layers=1, lr=0.01
ARIMA	order=(1, 1, 1)

8. Performance Results

Model	MAE	RMSE	MAPE (%)	Rank
FTS	2.9997	4.4824	21.86	2
ANN	2.2557	4.0970	17.79	1
ARIMA	7.1349	9.4654	77.20	3

Best Model: ANN

9. Sensitivity Analysis

Case	MAPE (%)	Delta (%)
method = equal-frequency	20.69	-1.16
n = 9	20.79	-1.07
pad = 10%	23.88	2.03

Best Case: method = equal-frequency

10. Auto-Generated Caption

Analisis perbandingan FTS Cheng, ANN, dan ARIMA pada Unknown Device periode 27/12/2025 - 09/01/2026 dengan 3454 titik data. FTS parameter n=7, method=equal-width, pad=5% memberi MAPE=21.86%. Model terbaik: ANN (MAPE=17.79%). Sensitivity menyarankan method = equal-frequency (improve 1.16%).