

RESUME EXPORT REPORT

Generated: 2026-01-10 21:23:00

1. Dataset Summary

Item	Value
Device	Unknown Device
Date Range	26/12/2025 - 10/01/2026
Total Rows	4,006
Start Time	26-12-2025 23:53:12
End Time	10-01-2026 00:47:41
Median Interval	300 seconds (5.0 min)

2. First 10 Rows

Timestamp	V (V)	A (A)	W (W)	kWh	Hz	PF
26-12-2025 23:53:12	223.20	0.119	25.10	3.9700	50.0	0.950
26-12-2025 23:58:12	224.60	0.120	25.40	3.9720	50.0	0.940
27-12-2025 00:03:13	223.70	0.107	22.70	3.9740	50.0	0.950
27-12-2025 00:08:12	222.60	0.108	22.90	3.9760	50.0	0.950
27-12-2025 00:13:12	225.10	0.095	20.70	3.9780	50.0	0.970
27-12-2025 00:18:13	224.60	0.094	20.60	3.9790	50.0	0.980
27-12-2025 00:23:12	222.90	0.095	20.60	3.9810	49.9	0.970
27-12-2025 00:28:12	223.90	0.094	20.50	3.9830	50.0	0.970
27-12-2025 00:33:13	223.60	0.095	20.70	3.9840	50.0	0.970
27-12-2025 00:38:13	222.40	0.095	20.60	3.9860	50.0	0.980

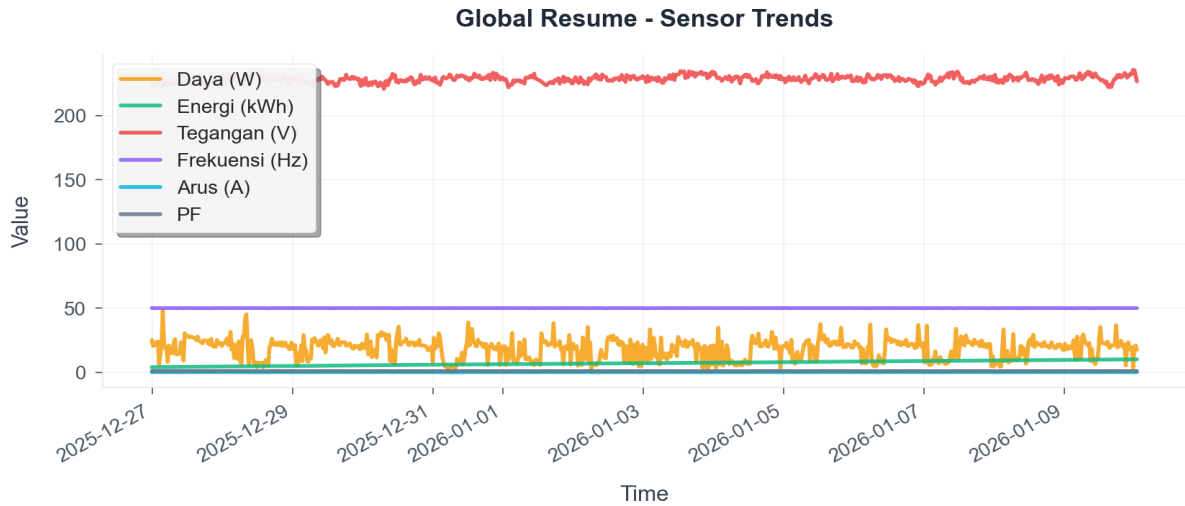
3. Last 10 Rows

Timestamp	V (V)	A (A)	W (W)	kWh	Hz	PF
10-01-2026 00:02:41	234.50	0.092	19.90	10.0740	50.0	0.920
10-01-2026 00:07:41	233.50	0.092	19.90	10.0750	49.9	0.930
10-01-2026 00:12:41	232.90	0.103	21.90	10.0770	50.0	0.910
10-01-2026 00:17:41	232.60	0.042	7.70	10.0790	50.0	0.790
10-01-2026 00:22:41	231.30	0.099	20.80	10.0800	50.0	0.910
10-01-2026 00:27:41	231.10	0.093	19.90	10.0810	50.0	0.930
10-01-2026 00:32:41	230.50	0.093	19.80	10.0830	50.0	0.920
10-01-2026 00:37:41	228.90	0.092	19.50	10.0850	50.0	0.930
10-01-2026 00:42:41	226.90	0.079	17.40	10.0860	50.0	0.970

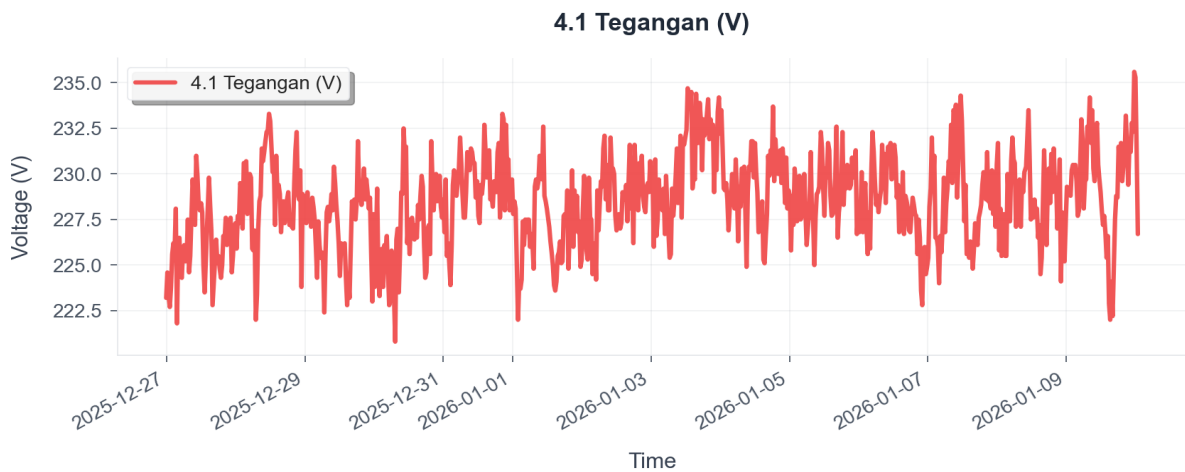
10-01-2026 00:47:41	226.70	0.079	17.50	10.0880	49.9	0.980
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4. Global Resume

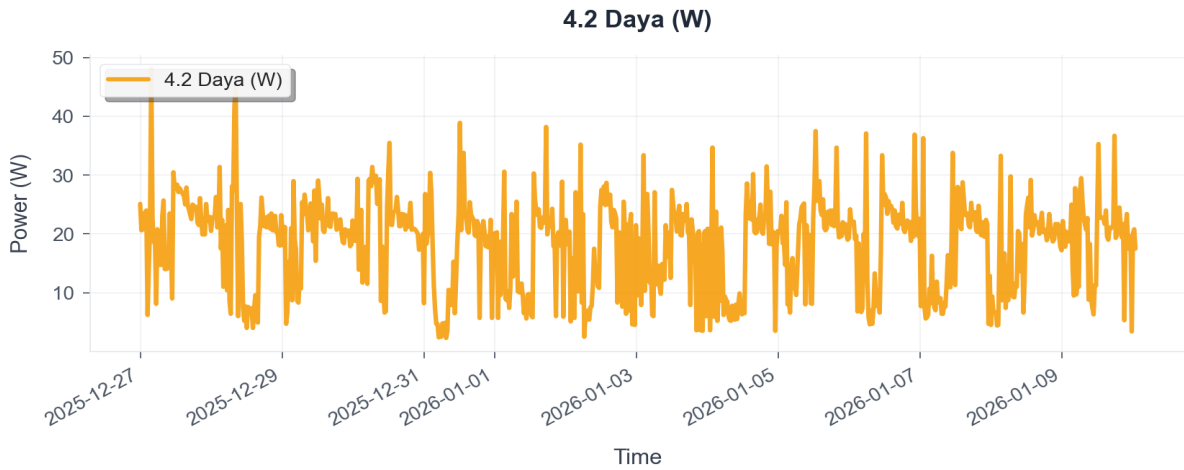
4.0 Overall



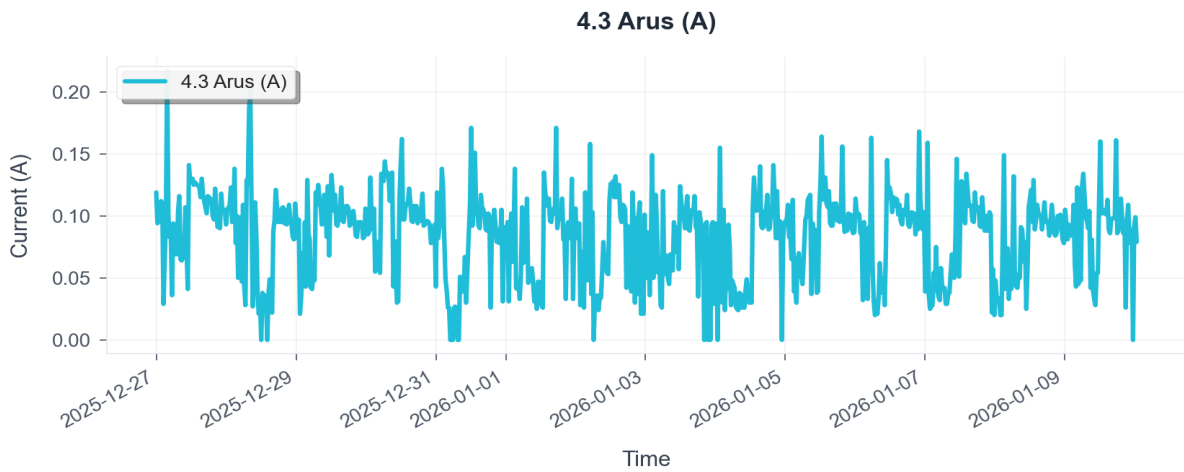
4.1 Tegangan (V)



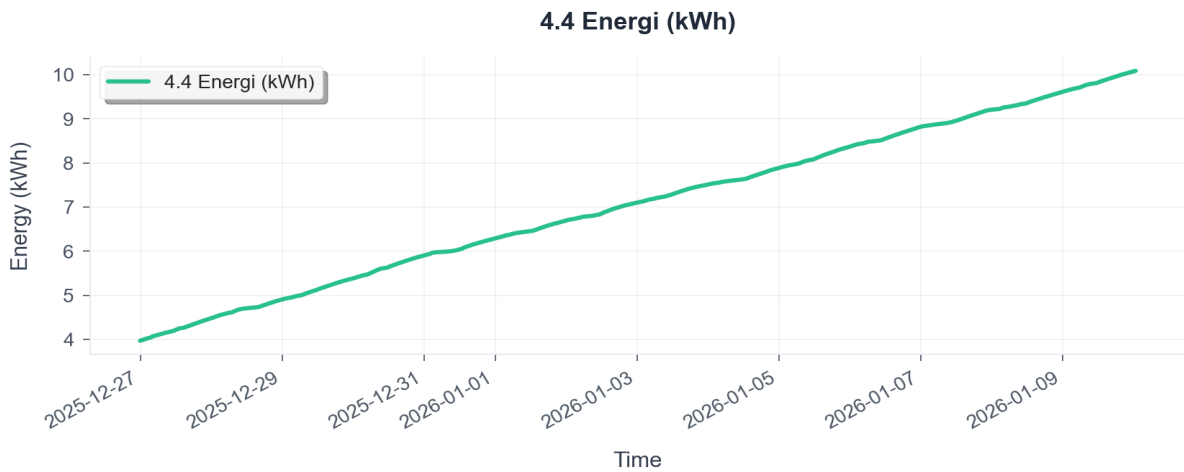
4.2 Daya (W)



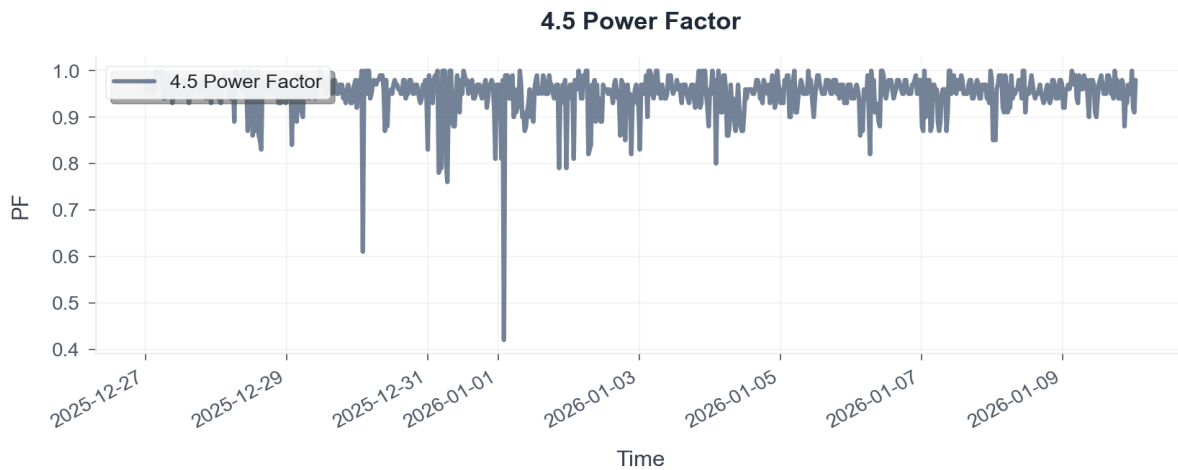
4.3 Arus (A)



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	06-01-2026 04:37:37	0.239	44.60	227.60	50.0	8.4450	0.820
2	08-01-2026 03:22:39	0.239	48.20	225.10	50.0	9.2430	0.900
3	01-01-2026 03:17:38	0.230	49.30	224.20	50.0	6.3520	0.960
4	27-12-2025 03:43:13	0.217	48.40	223.30	50.0	4.0560	1.000
5	27-12-2025 03:38:13	0.217	48.10	221.80	49.9	4.0520	1.000

4.7 Lowest Current Points (Arus)

Rank	Timestamp	A (A)	W (W)	V (V)	Hz	kWh	PF
1	02-01-2026 06:22:39	0.000	2.40	227.30	50.0	6.7830	1.000
2	30-12-2025 20:47:37	0.000	3.40	232.20	50.0	5.8440	1.000
3	30-12-2025 22:12:37	0.000	3.60	229.20	50.0	5.8710	1.000
4	31-12-2025 00:32:37	0.000	3.90	231.00	50.0	5.9150	1.000
5	02-01-2026 01:17:39	0.000	3.10	227.10	50.0	6.7160	1.000

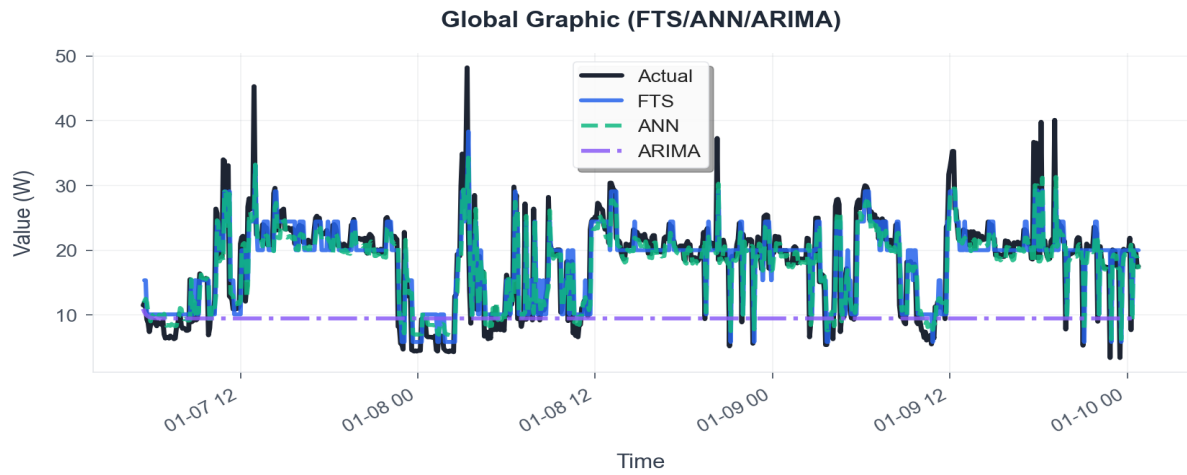
4.8 HOME Average Summary (Rata-rata)

Tanggal Awal	Tanggal Akhir	Jumlah Data	V_avg (V)	A_avg (A)	W_avg (W)	E (kWh)	Hz_avg	PF_avg
26/12/2025	10/01/2026	4,006	228.51	0.083	18.23	6.1180	50.0	0.950

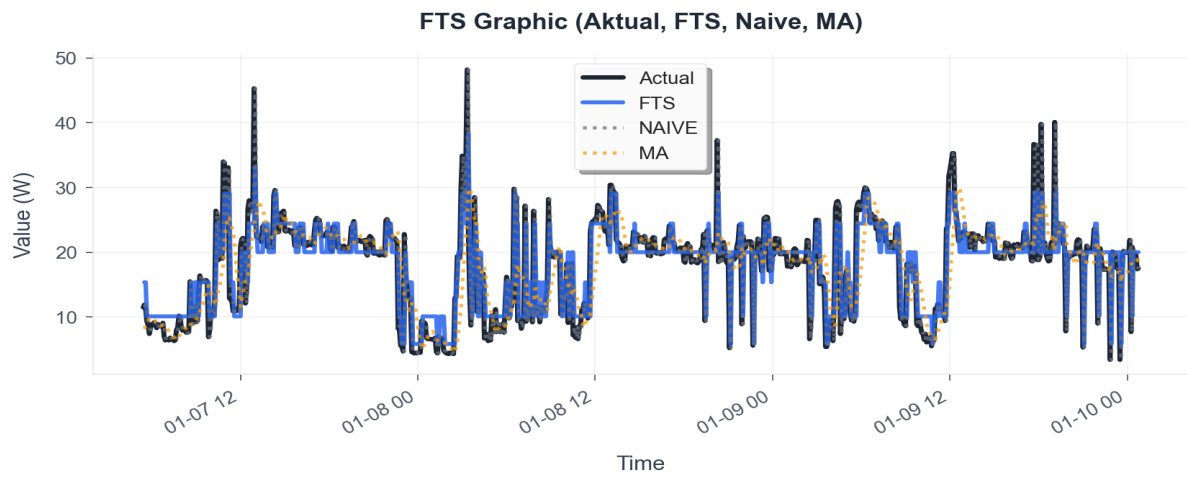
Energy method: **SENSOR_DELTA**

5. Resume Graphic (FTS/ANN/ARIMA)

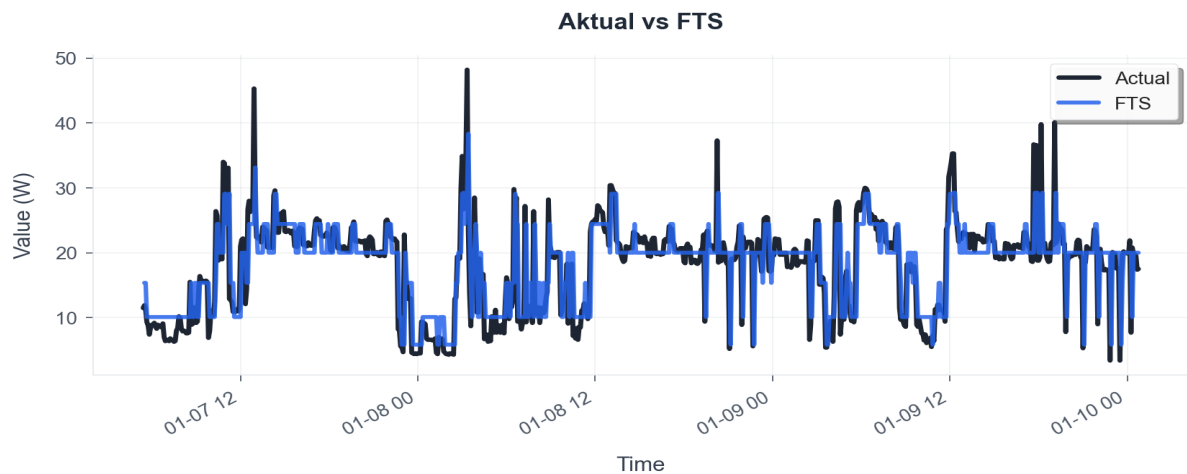
5.0 Global Graphic



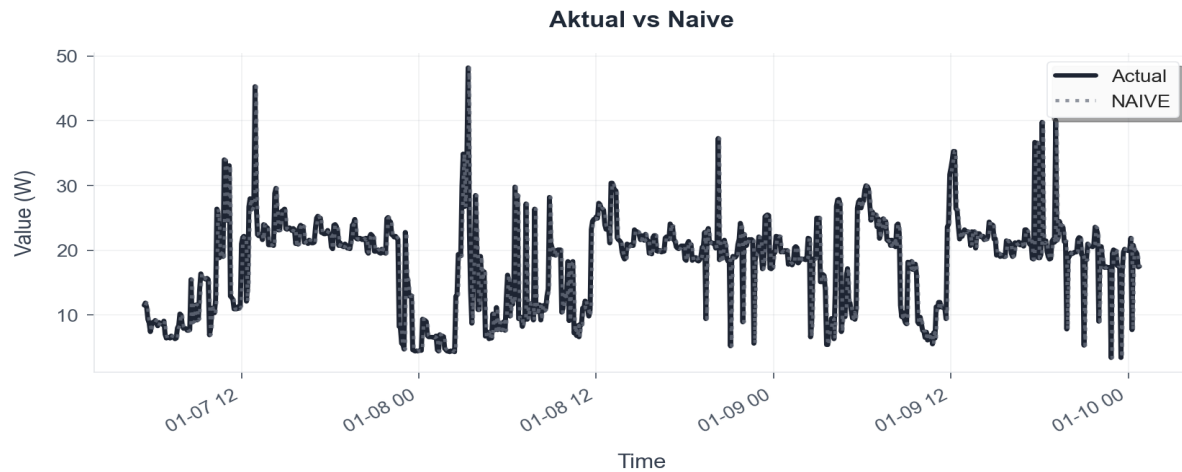
5.1 FTS Graphic



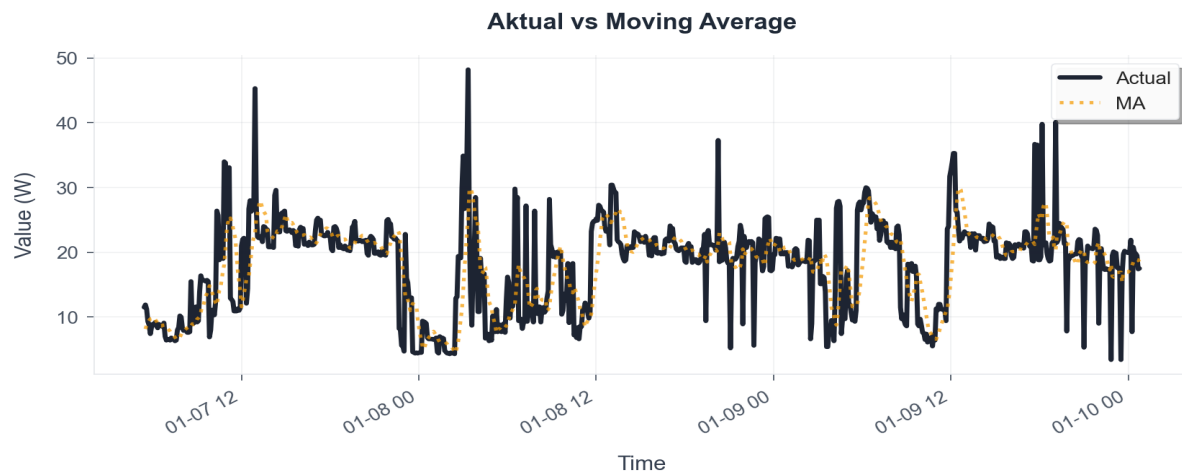
5.1.1 Grafik Aktual vs FTS



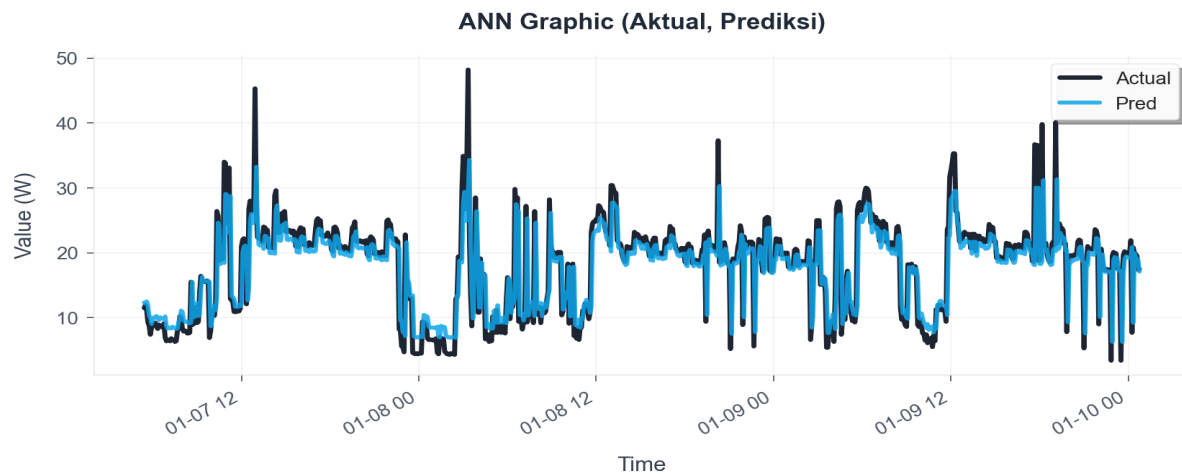
5.1.2 Grafik Aktual vs Naive



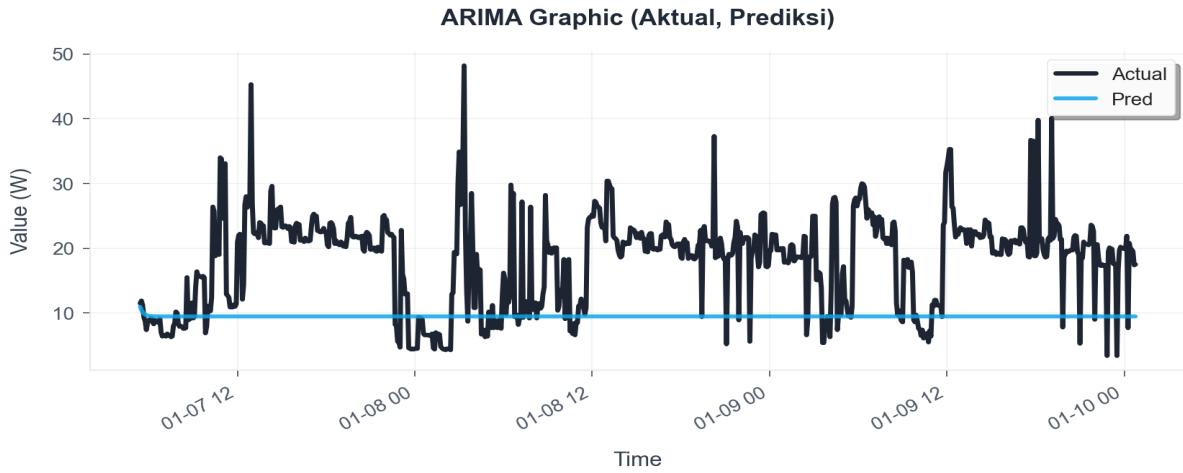
5.1.3 Grafik Aktual vs Moving Average



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: $\min(y)=2.3000$, $\max(y)=49.3000$, $span=47.0000$, $padPct=5.0\%$, $D_{min}=-0.0500$, $D_{max}=51.6500$

LaTeX Calculation Steps:

$$pad = 0.050 \times (49.3000 - 2.3000) = 2.3500$$

$$D_{min} = 2.3000 - 2.3500 = -0.0500$$

$$D_{max} = 49.3000 + 2.3500 = 51.6500$$

5.2 Partitioning (Equal-Width / Equal-Frequency)

Formula: $w = (D_{max} - D_{min}) / n$; $A_i = [D_{min} + (i-1)w, D_{min} + iw]$, $A_n = [D_{min} + (n-1)w, D_{max}]$.

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

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

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

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

Method=Equal Width, n=9, width=5.7444

LaTeX Calculation Steps:

$$w = \frac{51.6500 - -0.0500}{9} = 5.7444$$

$$A_1 = [-0.0500, 5.6944)$$

$$A_2 = [5.6944, 11.4389)$$

$$\vdots$$

$$A_9 = [45.9056, 51.6500]$$

ID	Lower	Upper	Midpoint
A1	-0.0500	5.6944	2.8222
A2	5.6944	11.4389	8.5667
A3	11.4389	17.1833	14.3111
A4	17.1833	22.9278	20.0556
A5	22.9278	28.6722	25.8000
A6	28.6722	34.4167	31.5444
A7	34.4167	40.1611	37.2889
A8	40.1611	45.9056	43.0333
A9	45.9056	51.6500	48.7778

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
26-12-2025 23:50:00	25.100	A5
26-12-2025 23:55:00	25.400	A5
27-12-2025 00:00:00	22.700	A4
27-12-2025 00:05:00	22.900	A4
27-12-2025 00:10:00	20.700	A4
27-12-2025 00:15:00	20.600	A4
27-12-2025 00:20:00	20.600	A4
27-12-2025 00:25:00	20.500	A4
27-12-2025 00:30:00	20.700	A4
27-12-2025 00:35:00	20.600	A4

5.4 Fuzzy Logical Relationship (FLR)

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

$$A_i \rightarrow A_j$$

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

No	Relation
1	A5 -> A5
2	A5 -> A4
3	A4 -> A4
4	A4 -> A4
5	A4 -> A4
6	A4 -> A4
7	A4 -> A4
8	A4 -> A4
9	A4 -> A4
10	A4 -> A4

... 3224 relasi lainnya ...

5.5 Fuzzy Logical Relationship Group (FLRG)

Formula: $A_i \rightarrow \{A_j\}$ dengan $\text{support} = \text{count}(A_i \rightarrow A_j) / \text{total}(A_i)$.

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

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

Group	Next States (Support)
A1	A1 (67.0%), A2 (22.7%), A4 (7.2%), A3 (2.1%), A5 (1.0%)
A2	A2 (75.3%), A4 (8.2%), A3 (8.1%), A1 (5.9%), A5 (2.2%), A6 (0.2%), A8 (0.2%)
A3	A3 (53.0%), A2 (18.8%), A4 (16.7%), A5 (9.8%), A6 (0.9%), A1 (0.9%)
A4	A4 (79.8%), A5 (10.0%), A2 (4.1%), A3 (2.7%), A1 (1.4%), A6 (1.2%), A7 (0.5%), A8 (0.2%)
A5	A5 (72.3%), A4 (17.8%), A6 (3.5%), A2 (2.3%), A3 (2.0%), A1 (0.7%), A8 (0.7%), A7 (0.5%), A9 (0.3%)
A6	A6 (55.6%), A5 (24.1%), A4 (7.4%), A7 (4.6%), A9 (1.9%), A8 (1.9%), A2 (1.9%), A3 (1.9%), A1 (0.9%)
A7	A7 (36.0%), A4 (20.0%), A5 (20.0%), A3 (12.0%), A9 (4.0%), A6 (4.0%), A8 (4.0%)
A8	A8 (38.9%), A5 (38.9%), A6 (5.6%), A4 (5.6%), A3 (5.6%), A9 (5.6%)
A9	A9 (45.5%), A5 (27.3%), A6 (18.2%), A7 (9.1%)

5.6 Forecasting (Cheng Method)

Formula: $\hat{y}_{t+1} = \text{sum}(\text{support} * \text{midpoint})$. Fallback: $\hat{y}_{t+1} = \text{midpoint}(A_i)$.

$$\hat{y}_{t+1} = \sum_j \text{support}(L_t \rightarrow A_j) \text{mid}_j$$

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

t	Timestamp	Actual (W)	Pred (W)
2	07-01-2026 05:30:00	11.900	15.367
3	07-01-2026 05:35:00	11.200	15.367
4	07-01-2026 05:40:00	9.300	10.101
5	07-01-2026 05:45:00	8.800	10.101
6	07-01-2026 05:50:00	7.400	10.101
7	07-01-2026 05:55:00	8.500	10.101
8	07-01-2026 06:00:00	8.900	10.101
9	07-01-2026 06:05:00	8.900	10.101
10	07-01-2026 06:10:00	9.200	10.101
11	07-01-2026 06:15:00	8.600	10.101

LaTeX Calculation Example:

Example calculation for $t = 1$:

$$\hat{y}_{t+1} = \sum_j \text{support}(L_t \rightarrow A_j) \times \text{mid}_j$$

$$\hat{y}_1 = - W$$

(detailed FLRG lookup omitted for brevity)

5.7 Evaluation Metrics

Formula: $MAE = \text{mean}(|y - \hat{y}|)$, $RMSE = \sqrt{\text{mean}((y - \hat{y})^2)}$, $MAPE = \text{mean}(|(y - \hat{y})/y|) * 100$.

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

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

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

Metric	Value
MAE	2.7622
RMSE	4.4474
MAPE (%)	21.10

LaTeX Calculation Steps:

$$n = 809 \text{ (test samples)}$$

$$MAE = \frac{1}{809} \sum_{t=1}^{809} |Y_t - \hat{Y}_t| = 2.7622$$

$$RMSE = \sqrt{\frac{1}{809} \sum_{t=1}^{809} (Y_t - \hat{Y}_t)^2} = 4.4474$$

$$MAPE = \frac{100\%}{809} \sum_{t=1}^{809} \left| \frac{Y_t - \hat{Y}_t}{Y_t} \right| = 21.10\%$$

5.8 Baseline Models Comparison

Formula: Naive $\hat{y}_{t+1} = y_t$, Moving Average $\hat{y}_{t+1} = \text{mean}(y_{t-w+1}..y_t)$.

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

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

Model	MAE	RMSE	MAPE (%)
Naive	2.1666	4.6153	15.60
Moving Average	3.5029	5.3438	25.51

5.9 Sensitivity Analysis

Formula: Delta MAPE = MAPE_FTS - MAPE_Baseline.

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

Case	MAPE (%)	Delta (%)
n = 11	19.72	-1.38
method = equal-frequency	21.32	0.22
pad = 10%	21.91	0.81

7. Model Configuration

Model	Config Summary
FTS	n=9, 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	2.7622	4.4474	21.10	2
ANN	2.4910	4.2894	18.70	1
ARIMA	9.4604	11.1275	48.30	3

Best Model: ANN

9. Sensitivity Analysis

Case	MAPE (%)	Delta (%)
n = 11	19.72	-1.38
method = equal-frequency	21.32	0.22
pad = 10%	21.91	0.81

Best Case: n = 11

10. Auto-Generated Caption

Analisis perbandingan FTS Cheng, ANN, dan ARIMA pada Unknown Device periode 26/12/2025 - 10/01/2026 dengan 4006 titik data. FTS parameter n=9, method=equal-width, pad=5% memberi MAPE=21.10%. Model terbaik: ANN (MAPE=18.70%). Sensitivity menyarankan n = 11 (improve 1.38%).