

RESUME EXPORT REPORT

Generated: 2026-01-11 20:42:35

1. Dataset Summary

Item	Value
Device	Unknown Device
Date Range	25/12/2025 - 09/01/2026
Total Rows	4,005
Start Time	25-12-2025 23:53:11
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
25-12-2025 23:53:11	227.70	0.085	18.70	3.5040	50.0	0.970
25-12-2025 23:58:12	226.40	0.086	18.90	3.5060	50.0	0.970
26-12-2025 00:03:11	222.50	0.085	18.60	3.5070	49.9	0.980
26-12-2025 00:08:11	223.00	0.085	18.60	3.5090	50.0	0.980
26-12-2025 00:13:12	227.10	0.086	19.00	3.5100	50.0	0.970
26-12-2025 00:18:12	227.80	0.086	18.90	3.5120	50.0	0.960
26-12-2025 00:23:11	222.90	0.086	18.70	3.5140	50.0	0.980
26-12-2025 00:28:12	224.00	0.099	21.50	3.5150	50.0	0.970
26-12-2025 00:33:11	226.60	0.029	6.40	3.5160	49.9	0.970
26-12-2025 00:38:12	226.00	0.046	8.90	3.5170	49.9	0.860

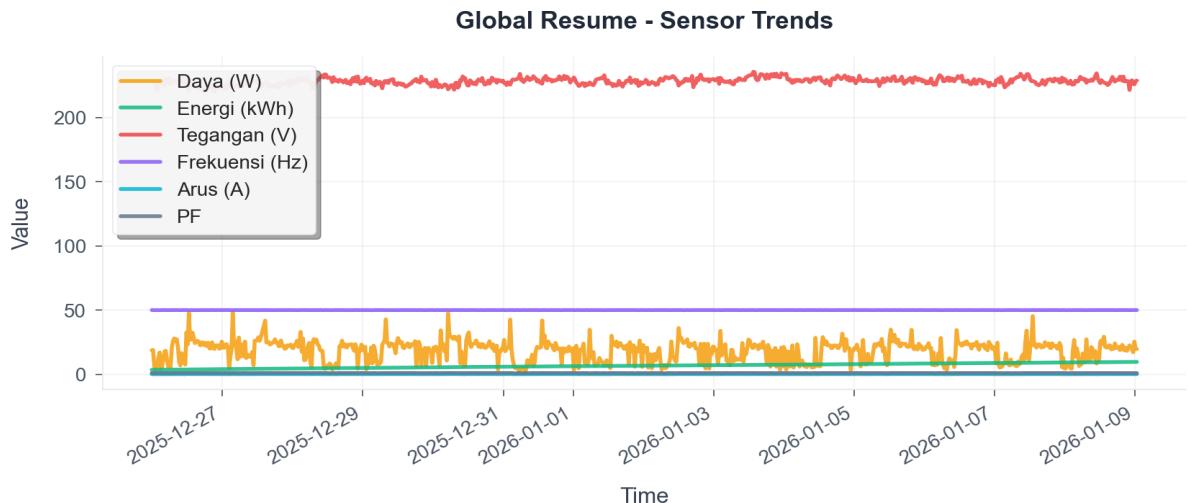
3. Last 10 Rows

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

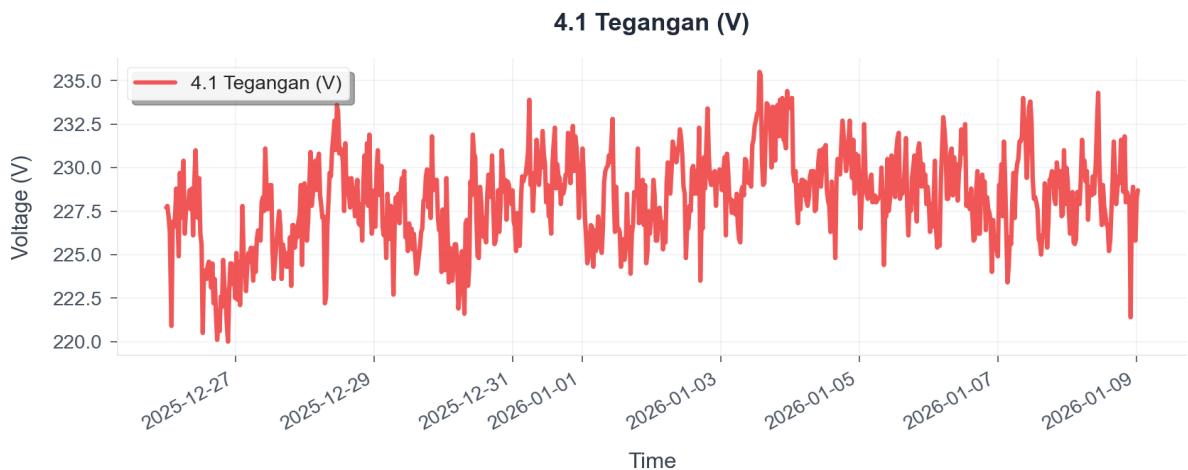
09-01-2026 00:52:40	228.50	0.093	19.70	9.6290	49.9	0.930
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4. Global Resume

4.0 Overall

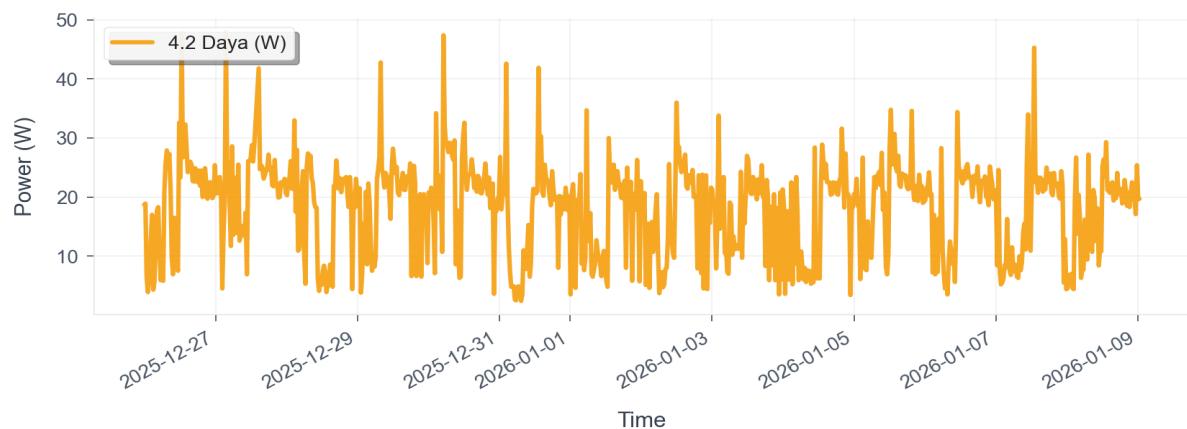


4.1 Tegangan (V)

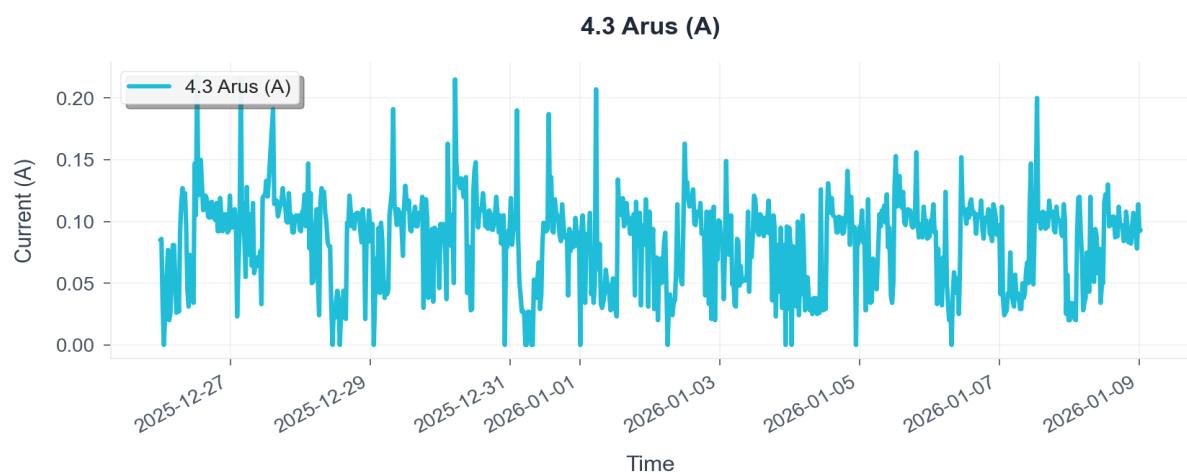


4.2 Daya (W)

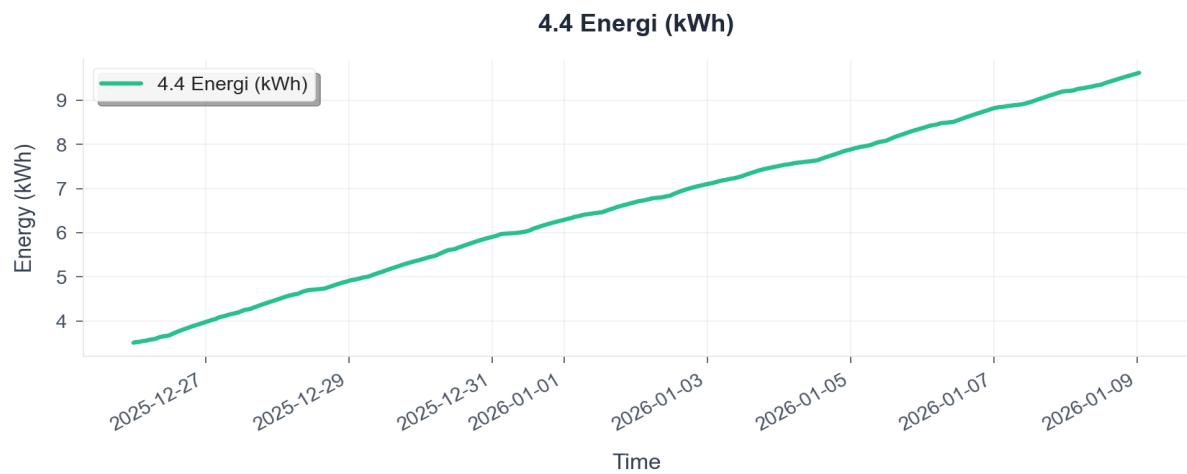
4.2 Daya (W)



4.3 Arus (A)

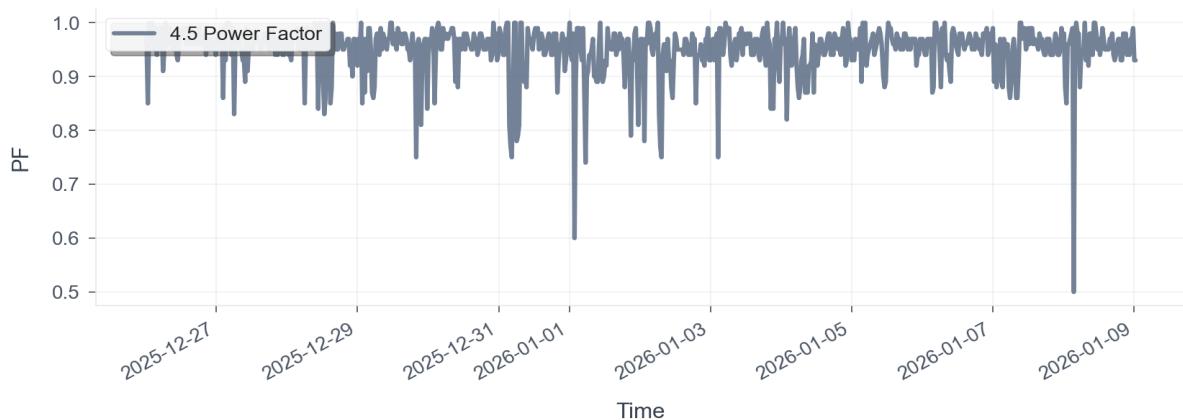


4.4 Energi (kWh)



4.5 Power Factor

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	26-12-2025 12:33:12	0.218	47.80	220.50	49.9	3.6930	0.990
5	27-12-2025 03:43:13	0.217	48.40	223.30	50.0	4.0560	1.000

4.7 Lowest Current Points (Arus)

Rank	Timestamp	A (A)	W (W)	V (V)	Hz	kWh	PF
1	02-01-2026 06:02:40	0.000	3.60	228.30	50.0	6.7820	1.000
2	04-01-2026 00:42:41	0.000	3.60	234.00	50.0	7.5210	1.000
3	04-01-2026 00:37:41	0.000	3.60	233.90	50.0	7.5210	1.000
4	03-01-2026 22:37:41	0.000	3.50	231.10	50.0	7.4890	1.000
5	03-01-2026 22:32:40	0.000	3.60	232.80	50.0	7.4880	1.000

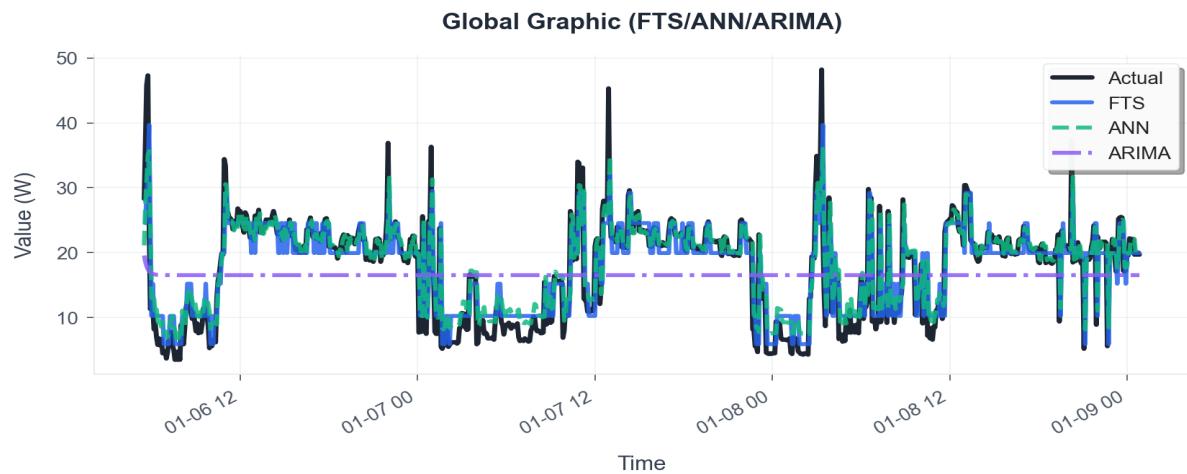
4.8 HOME Average Summary (Rata-rata)

Tanggal Awal	Tanggal Akhir	Jumlah Data	V_avg (V)	A_avg (A)	W_avg (W)	E (kWh)	Hz_avg	PF_avg
25/12/2025	09/01/2026	4,005	228.21	0.084	18.25	6.1250	50.0	0.951

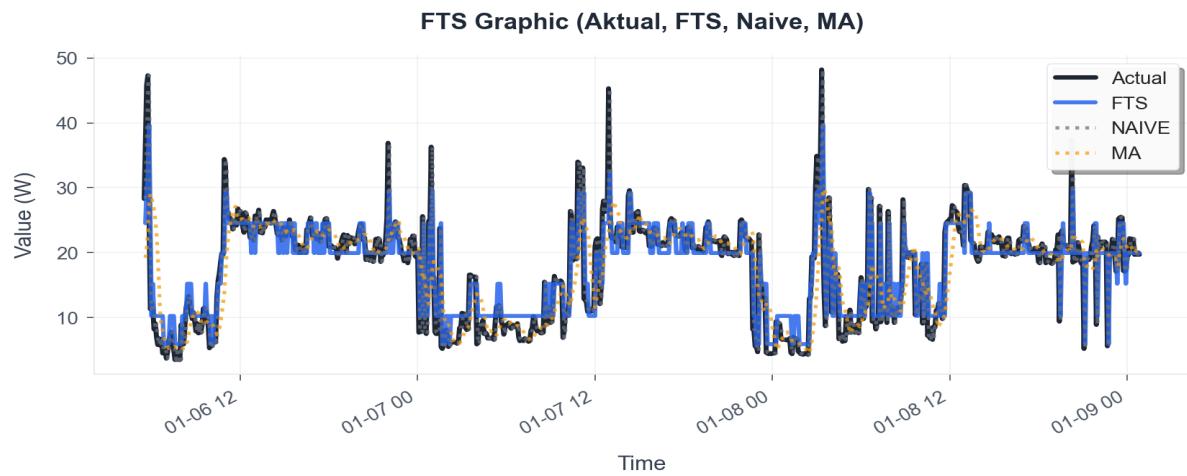
Energy method: **SENSOR_DELTA**

5. Resume Graphic (FTS/ANN/ARIMA)

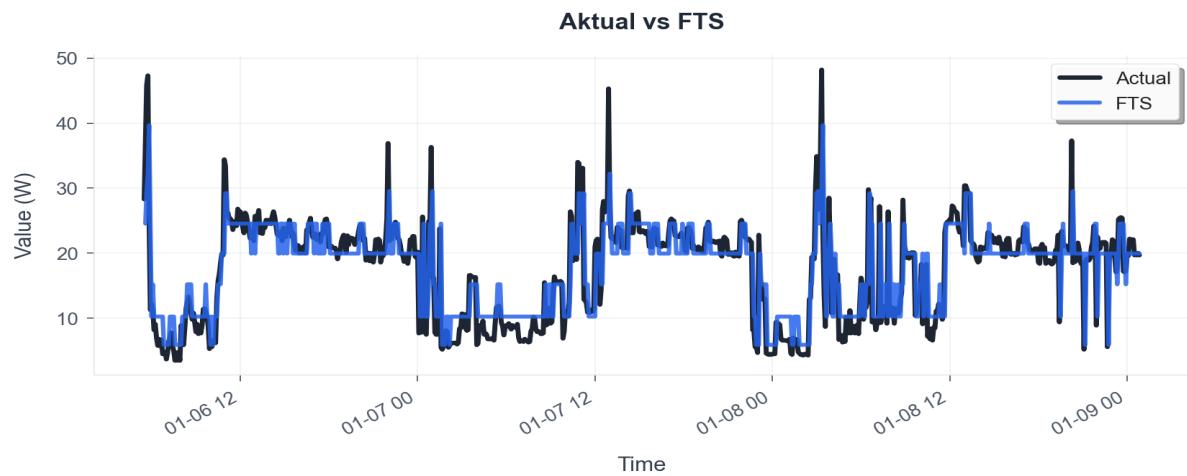
5.0 Global Graphic



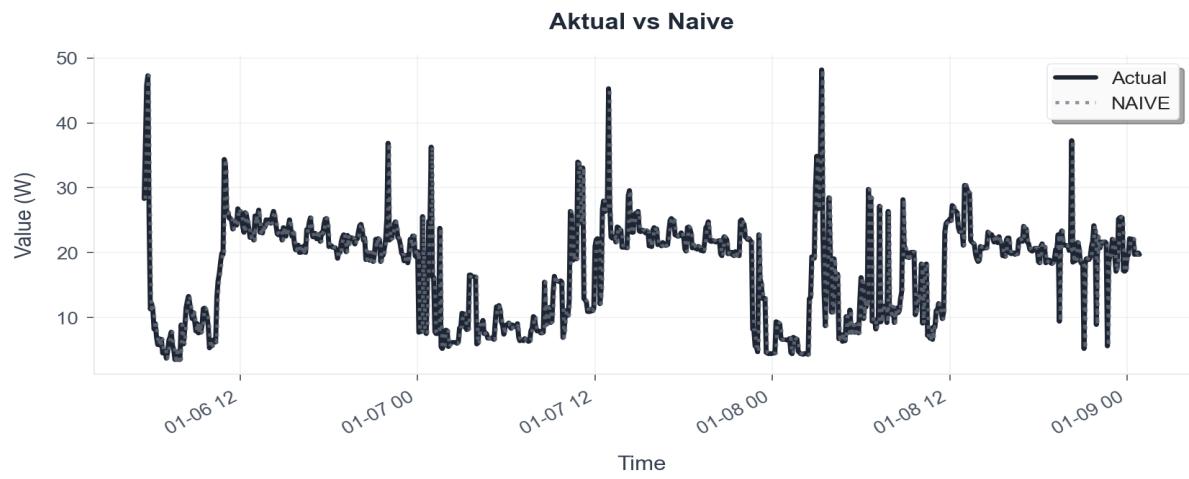
5.1 FTS Graphic



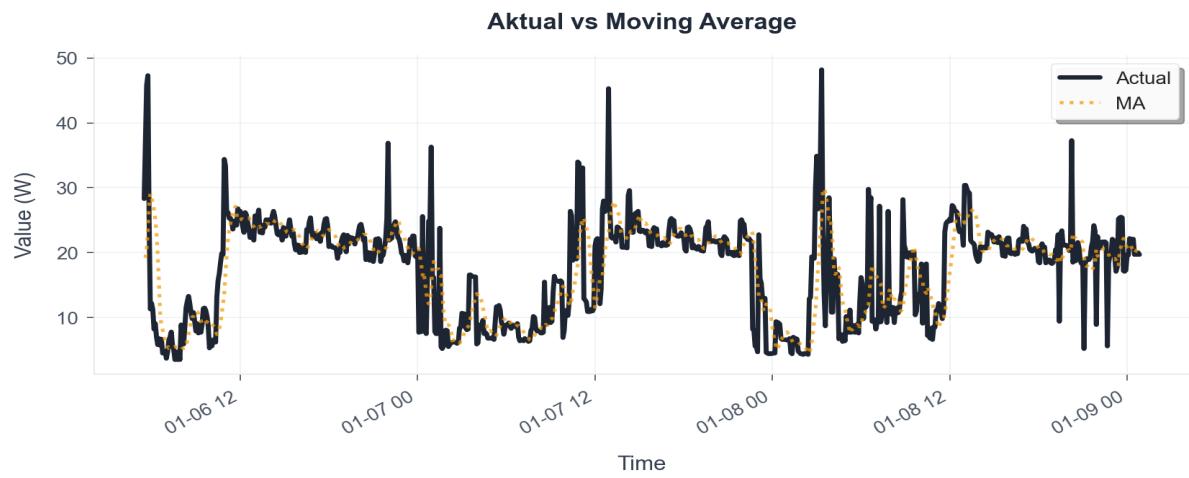
5.1.1 Grafik Aktual vs FTS



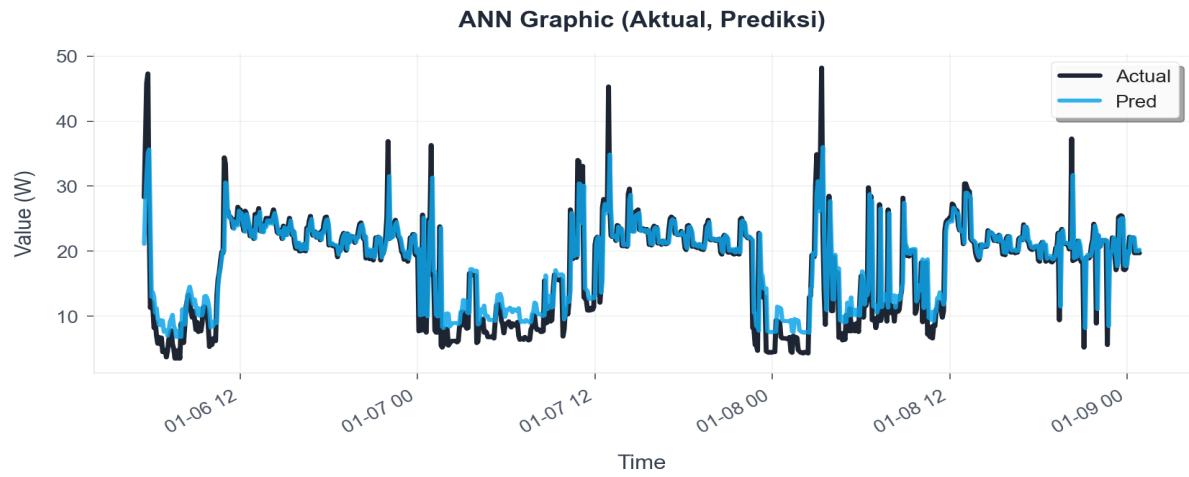
5.1.2 Grafik Aktual vs Naive



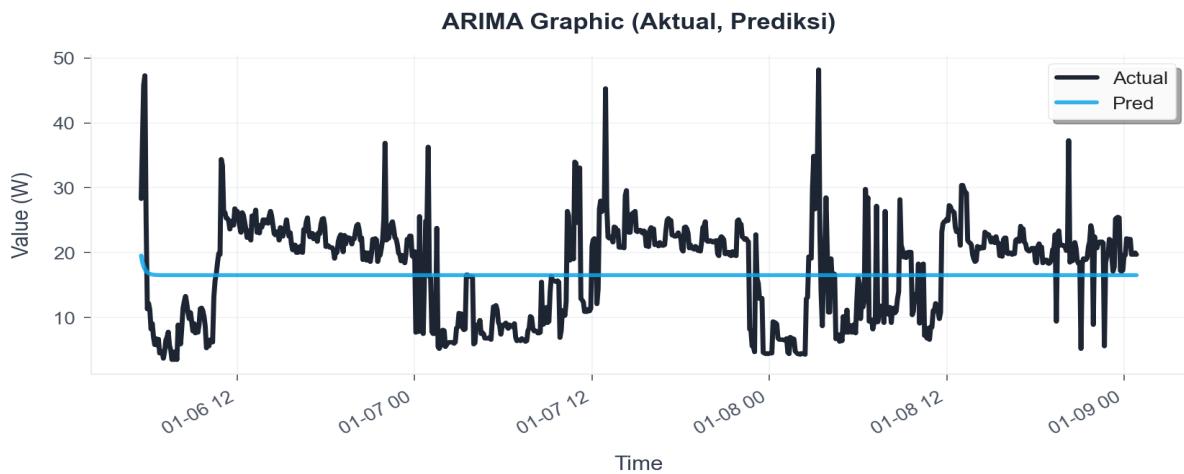
5.1.3 Grafik Aktual vs Moving Average



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

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

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

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

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

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

LaTeX Calculation Steps:

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

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

$$A_2 = [5.6944, 11.4389)$$

⋮

$$A_9 = [45.9056, 51.6500]$$

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
25-12-2025 23:50:00	18.700	A4
25-12-2025 23:55:00	18.900	A4
26-12-2025 00:00:00	18.600	A4
26-12-2025 00:05:00	18.600	A4
26-12-2025 00:10:00	19.000	A4
26-12-2025 00:15:00	18.900	A4
26-12-2025 00:20:00	18.700	A4
26-12-2025 00:25:00	21.500	A4
26-12-2025 00:30:00	6.400	A2
26-12-2025 00:35:00	8.900	A2

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	$A_4 \rightarrow A_4$
2	$A_4 \rightarrow A_4$
3	$A_4 \rightarrow A_4$
4	$A_4 \rightarrow A_4$
5	$A_4 \rightarrow A_4$
6	$A_4 \rightarrow A_4$
7	$A_4 \rightarrow A_4$
8	$A_4 \rightarrow A_2$
9	$A_2 \rightarrow A_2$
10	$A_2 \rightarrow A_2$

... 3225 relasi lainnya ...

5.5 Fuzzy Logical Relationship Group (FLRG)

Formula: $A_i \rightarrow \{A_j\}$ dengan 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 (66.7%), A2 (22.6%), A4 (7.5%), A3 (2.2%), A5 (1.1%)
A2	A2 (74.3%), A4 (8.8%), A3 (8.5%), A1 (5.6%), A5 (2.4%), A6 (0.2%), A8 (0.2%)
A3	A3 (53.1%), A2 (19.1%), A4 (16.6%), A5 (9.1%), A1 (1.2%), A6 (0.8%)
A4	A4 (80.0%), A5 (9.7%), A2 (4.3%), A3 (2.7%), A1 (1.5%), A6 (1.1%), A7 (0.5%), A8 (0.2%)
A5	A5 (73.1%), A4 (16.8%), A6 (4.1%), A3 (2.2%), A2 (2.1%), A8 (0.7%), A1 (0.5%), A9 (0.4%), A7 (0.1%)
A6	A6 (56.2%), A5 (24.8%), A4 (6.6%), A7 (5.0%), A9 (1.7%), A8 (1.7%), A2 (1.7%), A3 (1.7%), A1 (0.8%)
A7	A7 (39.1%), A5 (26.1%), A4 (17.4%), A3 (8.7%), A9 (4.3%), A6 (4.3%)
A8	A8 (41.2%), A5 (41.2%), A6 (5.9%), A4 (5.9%), A3 (5.9%)
A9	A9 (50.0%), A6 (25.0%), A5 (16.7%), A7 (8.3%)

5.6 Forecasting (Cheng Method)

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

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

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

t	Timestamp	Actual (W)	Pred (W)
2	06-01-2026 05:35:00	37.100	24.550
3	06-01-2026 05:40:00	45.800	29.546
4	06-01-2026 05:45:00	47.300	32.220
5	06-01-2026 05:50:00	25.100	39.682
6	06-01-2026 05:55:00	11.300	24.550
7	06-01-2026 06:00:00	12.200	10.254
8	06-01-2026 06:05:00	11.200	15.217
9	06-01-2026 06:10:00	8.200	10.254
10	06-01-2026 06:15:00	9.100	10.254
11	06-01-2026 06:20:00	7.000	10.254

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

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

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

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

Metric	Value
MAE	2.6702
RMSE	4.2446
MAPE (%)	21.48

LaTeX Calculation Steps:

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

$$MAE = \frac{1}{809} \sum_{t=1}^{809} |Y_t - \hat{Y}_t| = 2.6702$$

$$RMSE = \sqrt{\frac{1}{809} \sum_{t=1}^{809} (Y_t - \hat{Y}_t)^2} = 4.2446$$

$$MAPE = \frac{100\%}{809} \sum_{t=1}^{809} \left| \frac{Y_t - \hat{Y}_t}{Y_t} \right| = 21.48\%$$

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	2.0131	4.2727	14.29
Moving Average	3.3063	5.2362	25.42

5.9 Sensitivity Analysis

Formula: Delta MAPE = MAPE_FTS - MAPE_Baseline.

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

Case	MAPE (%)	Delta (%)
n = 11	20.09	-1.39
method = equal-frequency	20.58	-0.90
pad = 10%	22.60	1.12

7. Model Configuration

Model	Config Summary
FTS	n=9, method=Equal Width, pad=5%, split=80%
ANN	epoch=100, neuron=16, layers=1, lr=0.01
ARIMA	order=(1, 1, 1)

8. Performance Results

Model	MAE	RMSE	MAPE (%)	Rank
FTS	2.6702	4.2446	21.48	2
ANN	2.3712	4.0784	21.05	1
ARIMA	6.6565	7.5743	56.88	3

Best Model: ANN

9. Sensitivity Analysis

Case	MAPE (%)	Delta (%)
n = 11	20.09	-1.39
method = equal-frequency	20.58	-0.90
pad = 10%	22.60	1.12

Best Case: n = 11

10. Auto-Generated Caption

Analisis perbandingan FTS Cheng, ANN, dan ARIMA pada Unknown Device periode 25/12/2025 - 09/01/2026 dengan 4005 titik data. FTS parameter n=9, method=equal-width, pad=5% memberi MAPE=21.48%. Model terbaik: ANN (MAPE=21.05%). Sensitivity menyarankan n = 11 (improve 1.39%).