

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 |

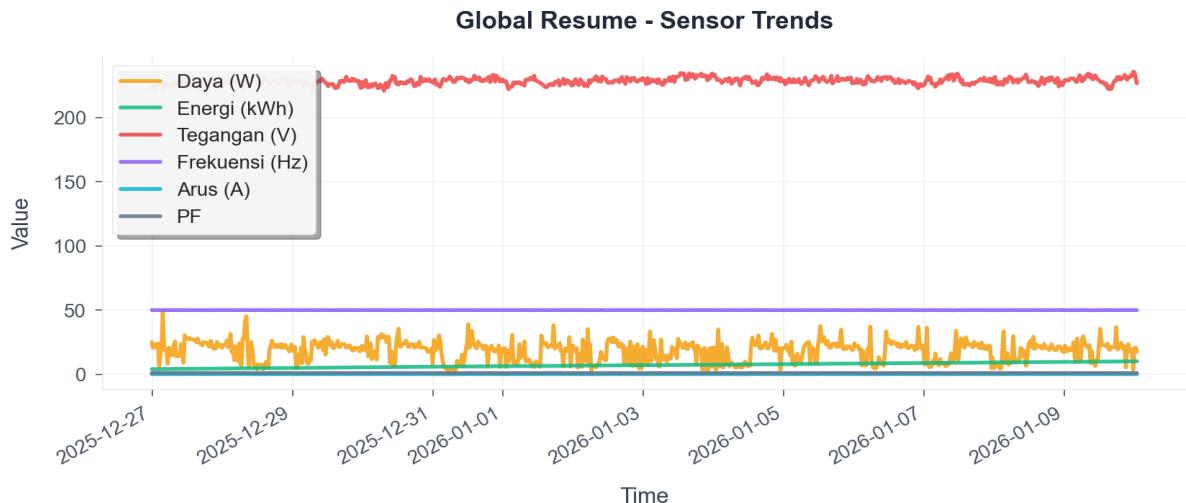
3. Last 10 Rows

| 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 |
|---------------------|--------|-------|-------|---------|------|-------|

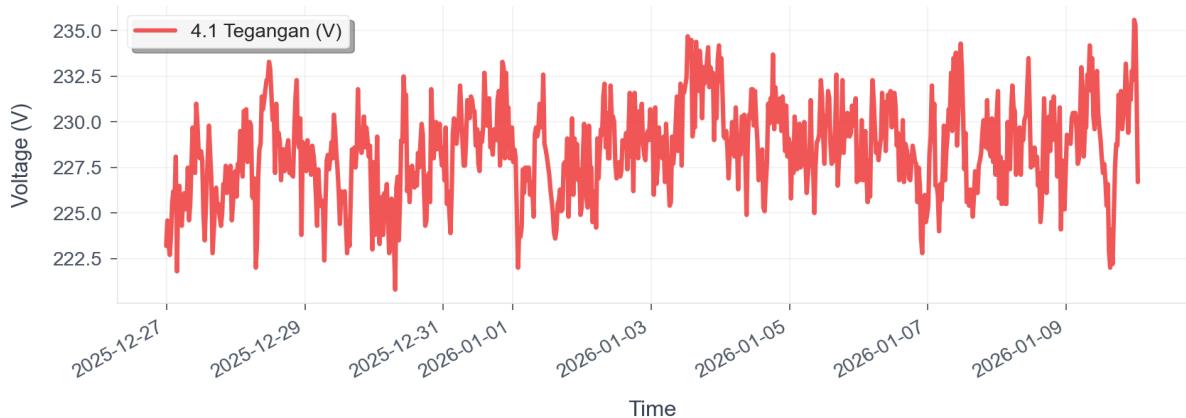
4. Global Resume

4.0 Overall



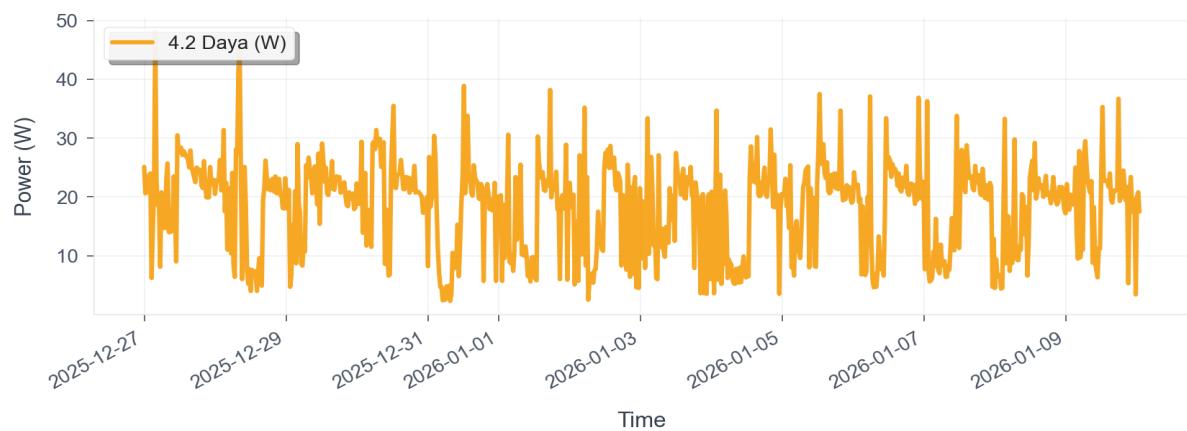
4.1 Tegangan (V)

4.1 Tegangan (V)

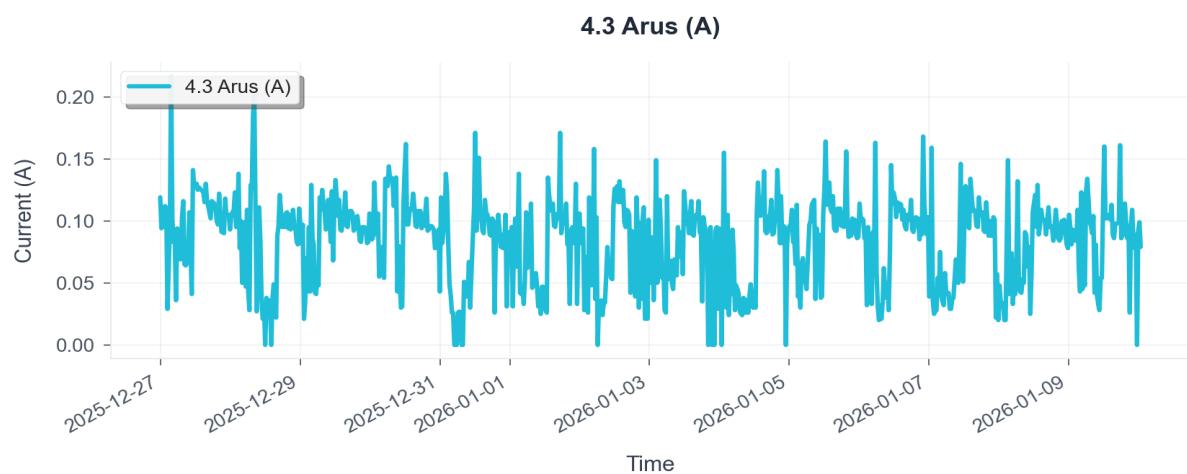


4.2 Daya (W)

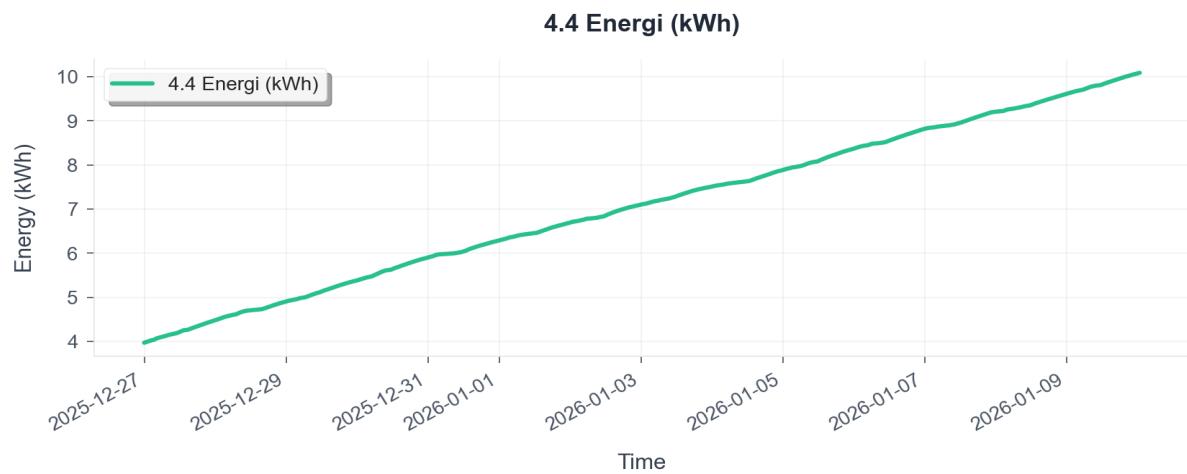
4.2 Daya (W)



4.3 Arus (A)

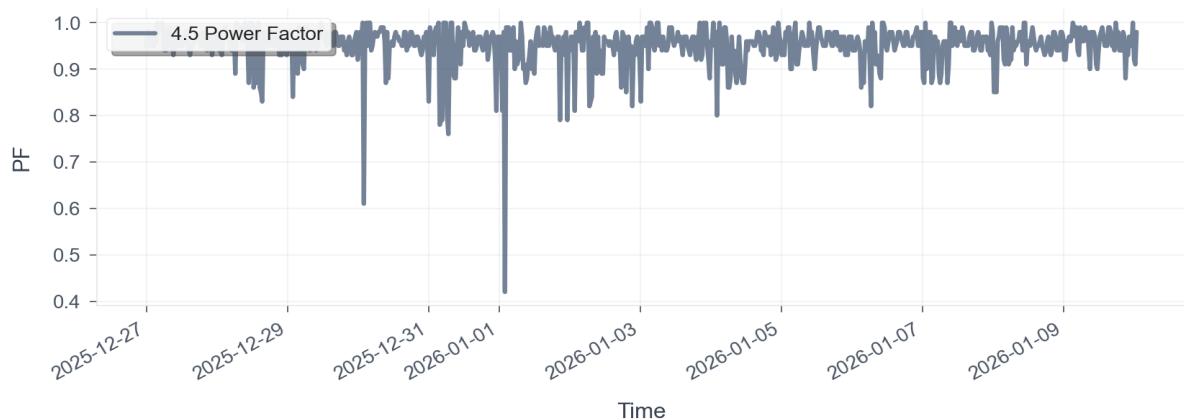


4.4 Energi (kWh)



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 | 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 |

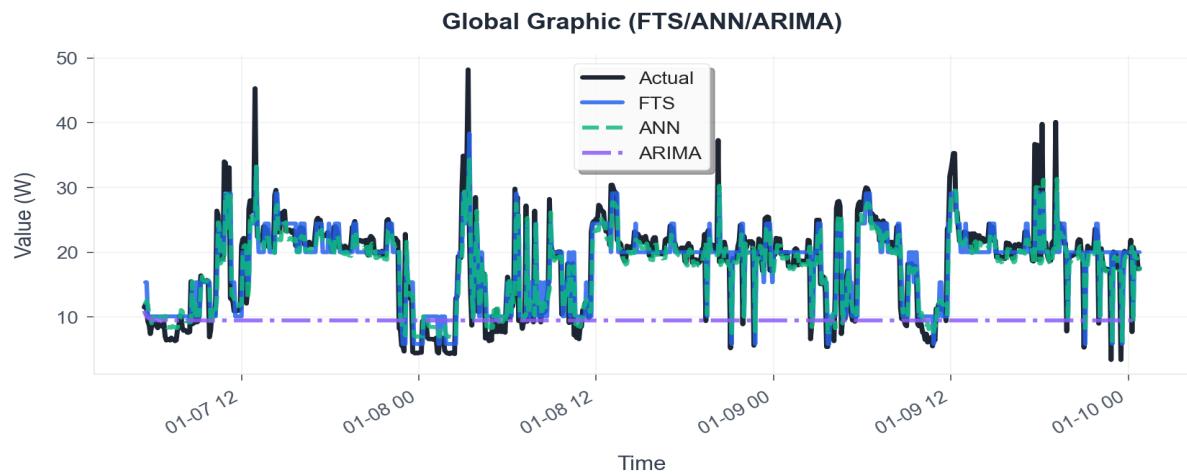
4.8 HOME Average Summary (Rata-rata)

| 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 |

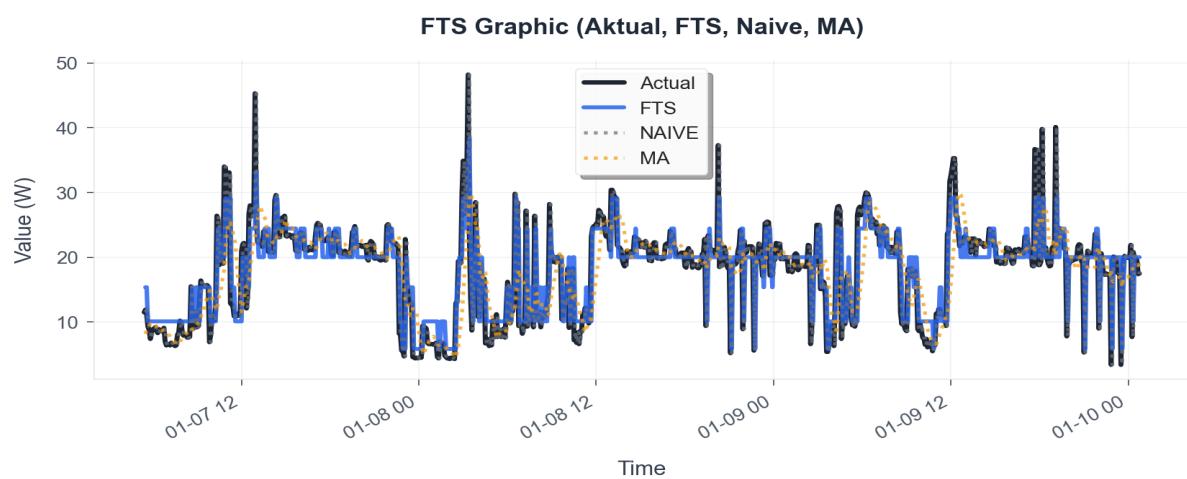
Energy method: **SENSOR_DELTA**

5. Resume Graphic (FTS/ANN/ARIMA)

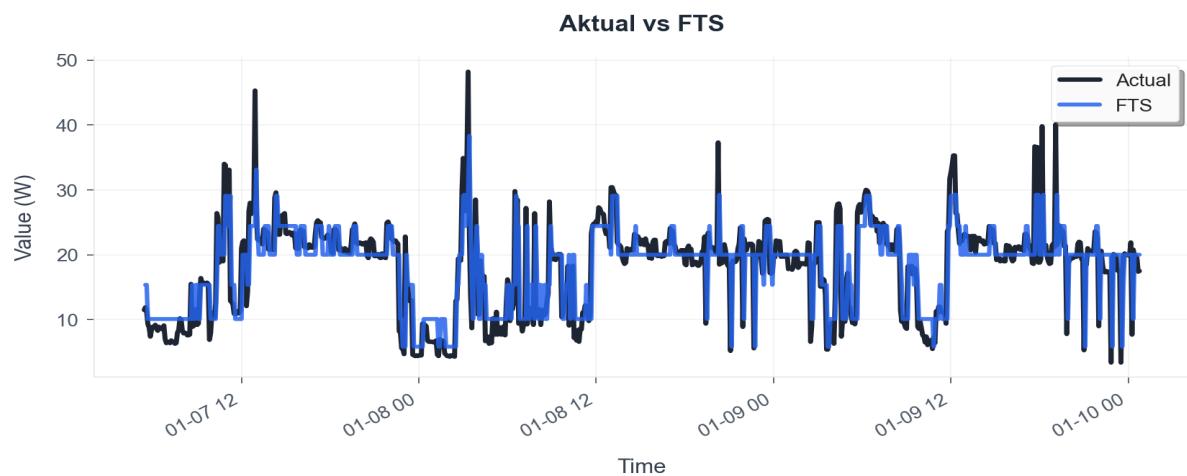
5.0 Global Graphic



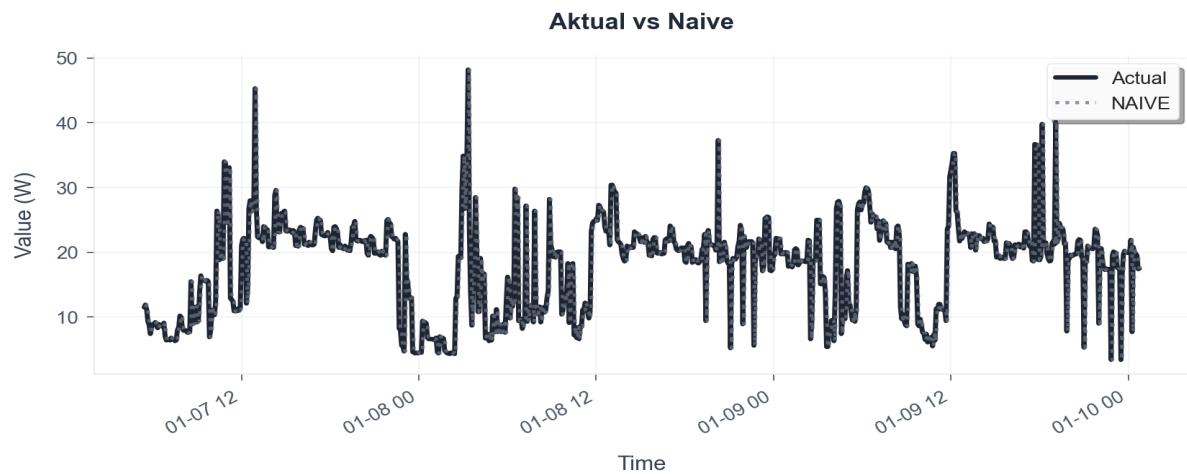
5.1 FTS Graphic



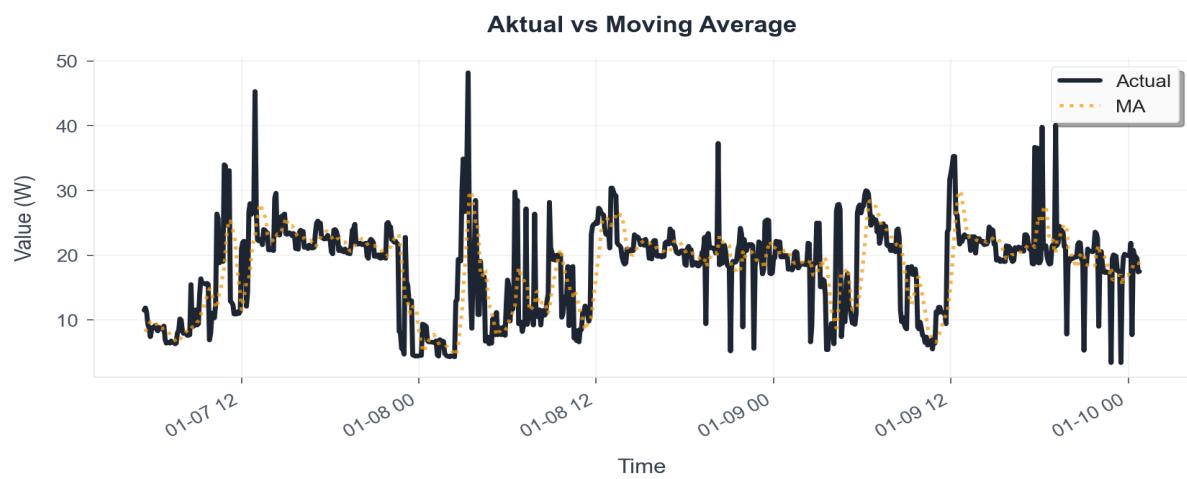
5.1.1 Grafik Aktual vs FTS



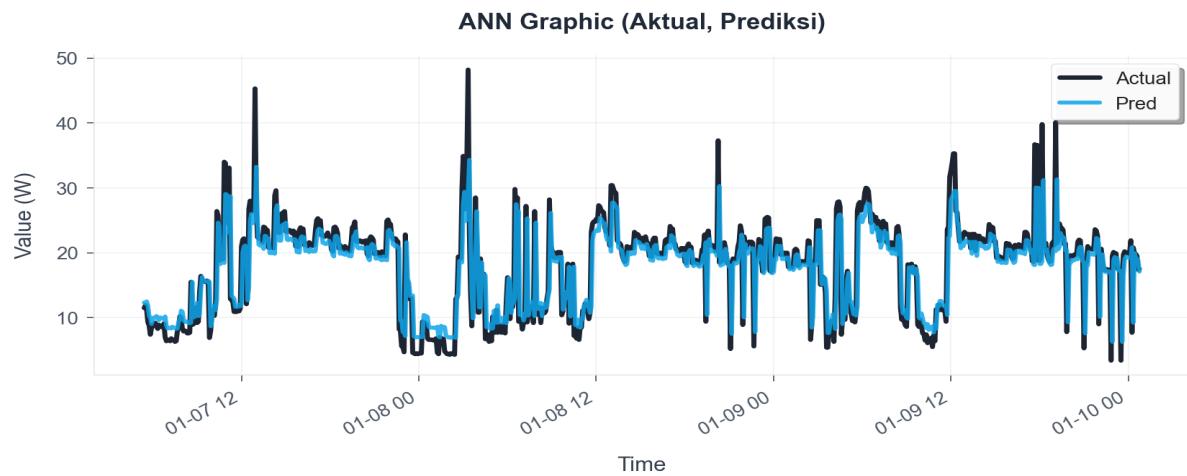
5.1.2 Grafik Aktual vs Naive



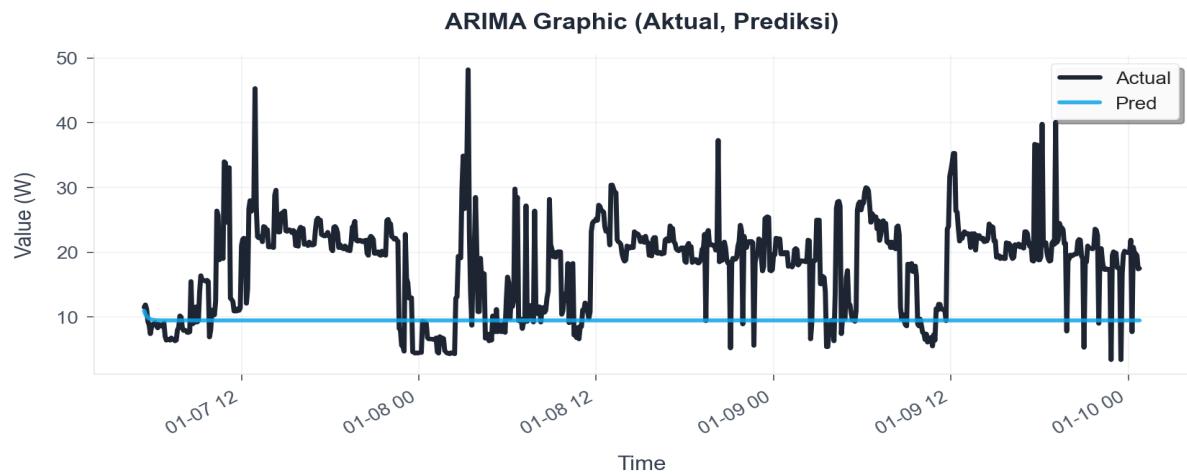
5.1.3 Grafik Aktual vs Moving Average



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

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

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

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

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

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 |
|---------------------|--------|-------|
| 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 | $A_5 \rightarrow A_5$ |
| 2 | $A_5 \rightarrow A_4$ |
| 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 | $A_4 \rightarrow A_4$ |
| 9 | $A_4 \rightarrow A_4$ |
| 10 | $A_4 \rightarrow A_4$ |

... 3224 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 (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: $y_{\text{hat}}(t+1) = \sum(\text{support} * \text{midpoint})$. 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 | 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 = $\text{mean}(|y - y_{\text{hat}}|)$, 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 | 2.7622 |
| 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 $y_hat(t+1) = y_t$, Moving Average $y_hat(t+1) = \text{mean}(y_{\{t-w+1}\dots y_t})$.

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

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

| 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%).