

# RESUME EXPORT REPORT

Generated: 2026-01-12 03:53:47

## 1. Dataset Summary

Item	Value
Device	Unknown Device
Date Range	27/12/2025 - 04/01/2026
Total Rows	2,137
Start Time	27-12-2025 23:52:34
End Time	04-01-2026 10:02:35
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

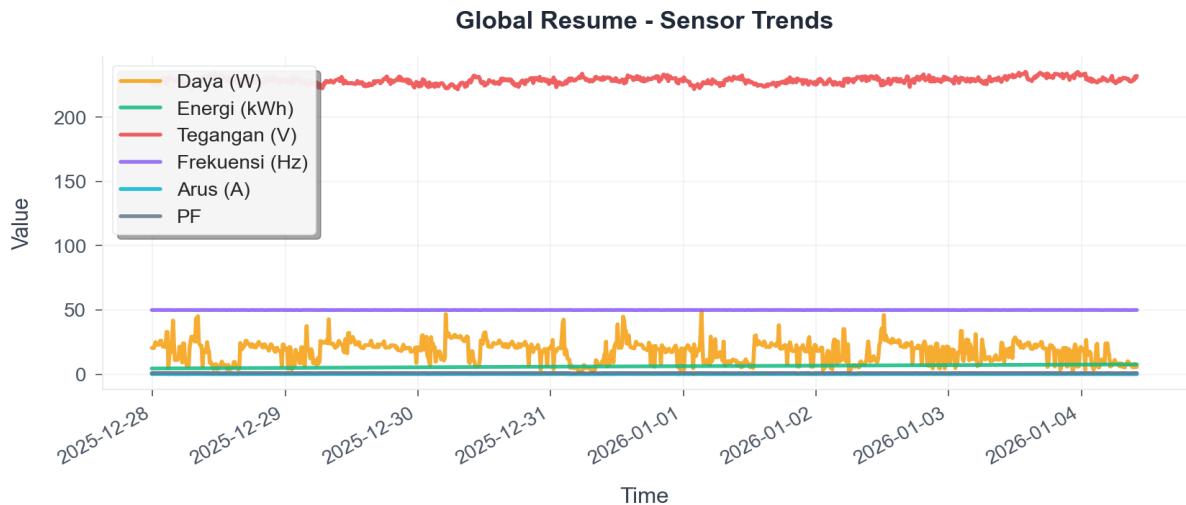
## 3. Last 10 Rows

Timestamp	V (V)	A (A)	W (W)	kWh	Hz	PF
04-01-2026 09:17:35	227.90	0.025	5.30	7.6070	50.0	0.930
04-01-2026 09:22:35	229.40	0.024	5.20	7.6080	50.0	0.940
04-01-2026 09:27:35	229.30	0.025	5.30	7.6080	50.0	0.920
04-01-2026 09:32:35	229.00	0.036	8.00	7.6080	50.0	0.970
04-01-2026 09:37:35	228.80	0.036	7.90	7.6090	50.0	0.960
04-01-2026 09:42:35	231.80	0.035	8.00	7.6100	50.0	0.990
04-01-2026 09:47:35	230.30	0.037	8.00	7.6100	50.0	0.940
04-01-2026 09:52:36	230.40	0.026	5.50	7.6110	50.0	0.920
04-01-2026 09:57:36	230.40	0.026	5.50	7.6110	50.0	0.920

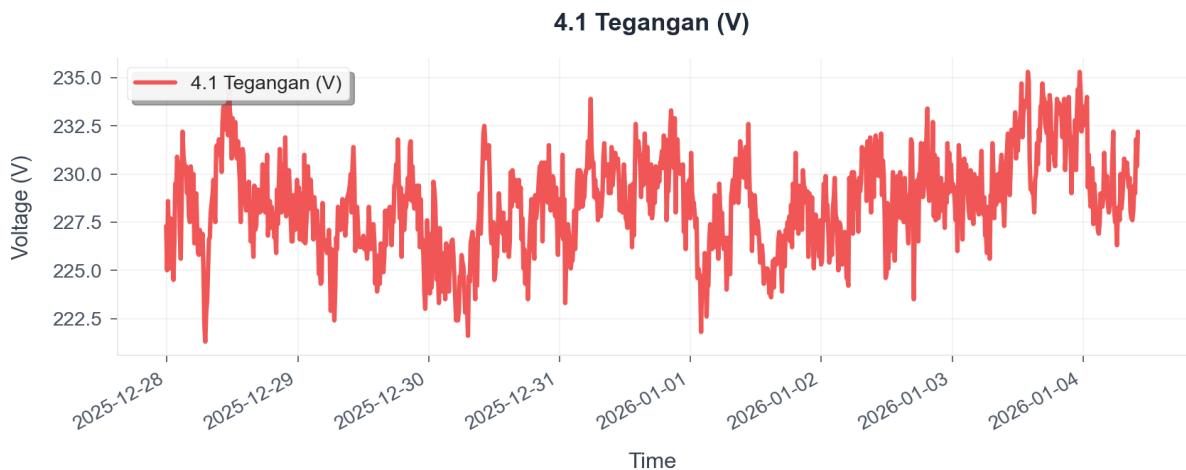
04-01-2026 10:02:35	232.20	0.025	5.70	7.6120	50.0	0.980
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## 4. Global Resume

### 4.0 Overall



### 4.1 Tegangan (V)

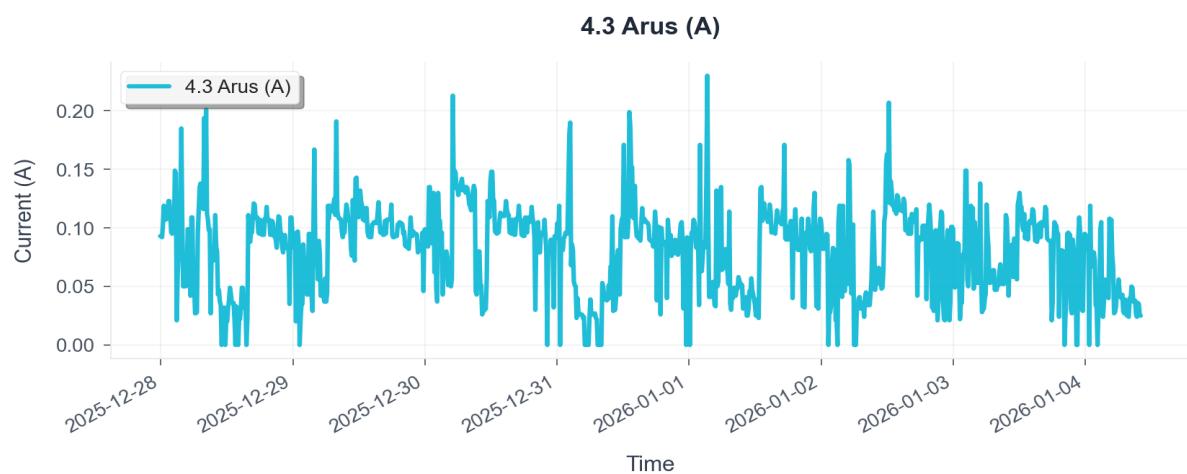


### 4.2 Daya (W)

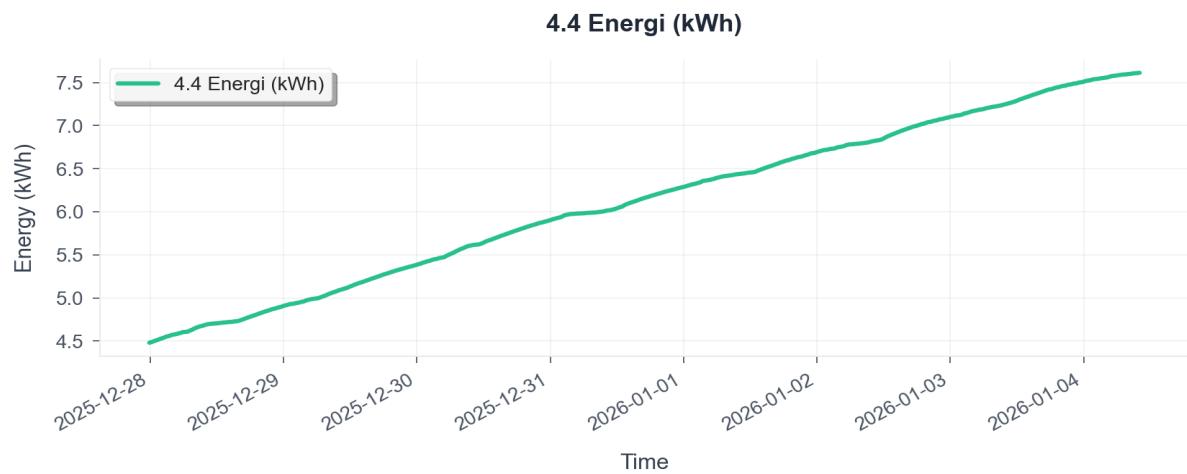
#### **4.2 Daya (W)**



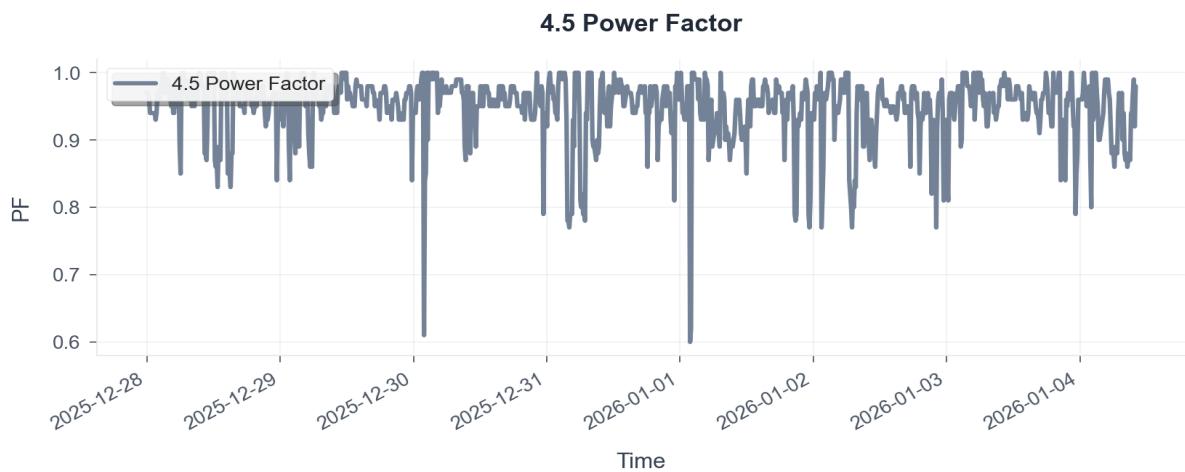
#### **4.3 Arus (A)**



#### **4.4 Energi (kWh)**



#### **4.5 Power Factor**



#### **4.6 Highest Current Points (Arus)**

Rank	Timestamp	A (A)	W (W)	V (V)	Hz	kWh	PF
1	01-01-2026 03:17:38	0.230	49.30	224.20	50.0	6.3520	0.960
2	30-12-2025 05:07:37	0.215	47.40	221.90	50.0	5.4810	0.990
3	30-12-2025 05:02:36	0.213	46.90	222.40	50.0	5.4770	0.990
4	30-12-2025 06:57:37	0.212	47.00	223.00	50.0	5.5380	0.990
5	02-01-2026 12:12:39	0.210	46.90	225.70	50.0	6.8580	0.990

#### **4.7 Lowest Current Points (Arus)**

Rank	Timestamp	A (A)	W (W)	V (V)	Hz	kWh	PF
1	02-01-2026 06:07:39	0.000	3.70	229.10	50.0	6.7820	1.000
2	31-12-2025 05:27:38	0.000	2.30	231.00	50.0	5.9800	1.000
3	31-12-2025 05:22:37	0.000	2.50	230.30	50.0	5.9800	1.000
4	31-12-2025 05:17:37	0.000	2.60	231.00	50.0	5.9800	1.000
5	31-12-2025 05:12:38	0.000	2.50	231.70	49.9	5.9800	1.000

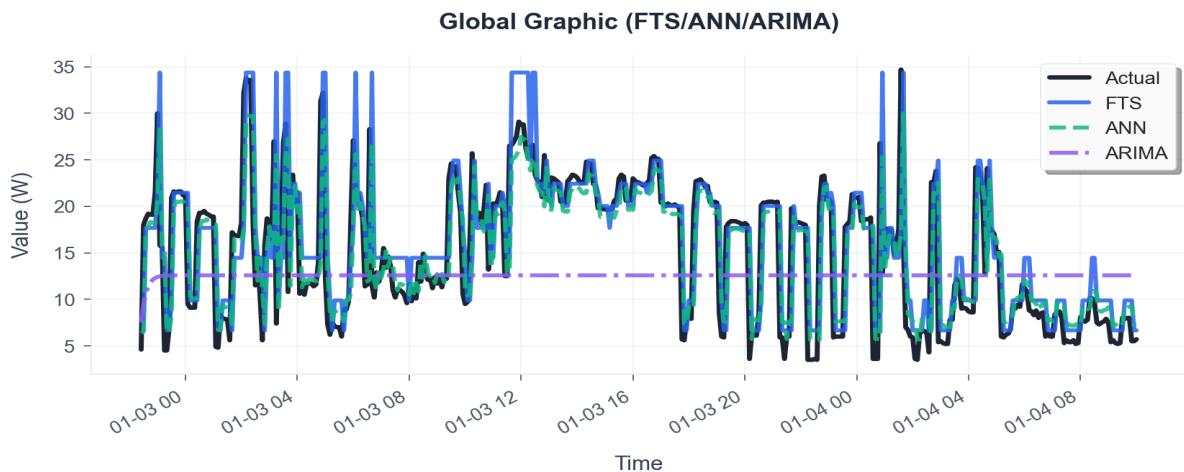
#### **4.8 HOME Average Summary (Rata-rata)**

Tanggal Awal	Tanggal Akhir	Jumlah Data	V_avg (V)	A_avg (A)	W_avg (W)	E (kWh)	Hz_avg	PF_avg
27/12/2025	04/01/2026	2,137	228.49	0.081	17.62	3.1320	50.0	0.948

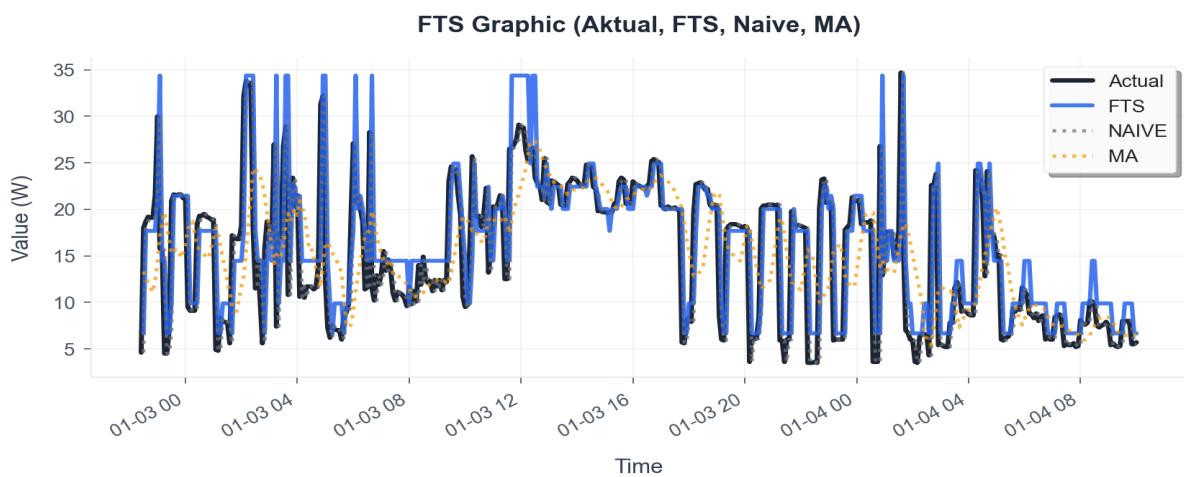
Energy method: **SENSOR\_DELTA**

### **5. Resume Graphic (FTS/ANN/ARIMA)**

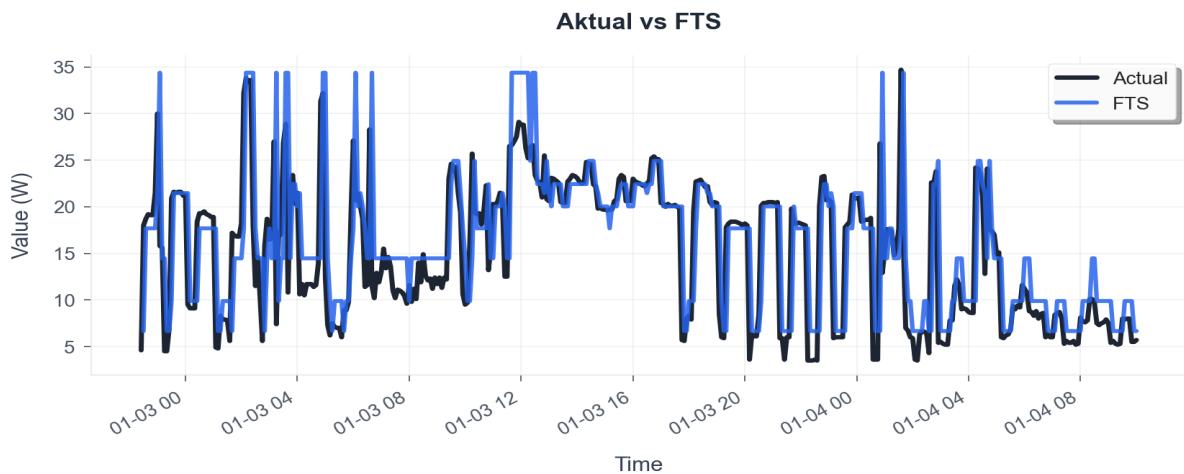
#### **5.0 Global Graphic**



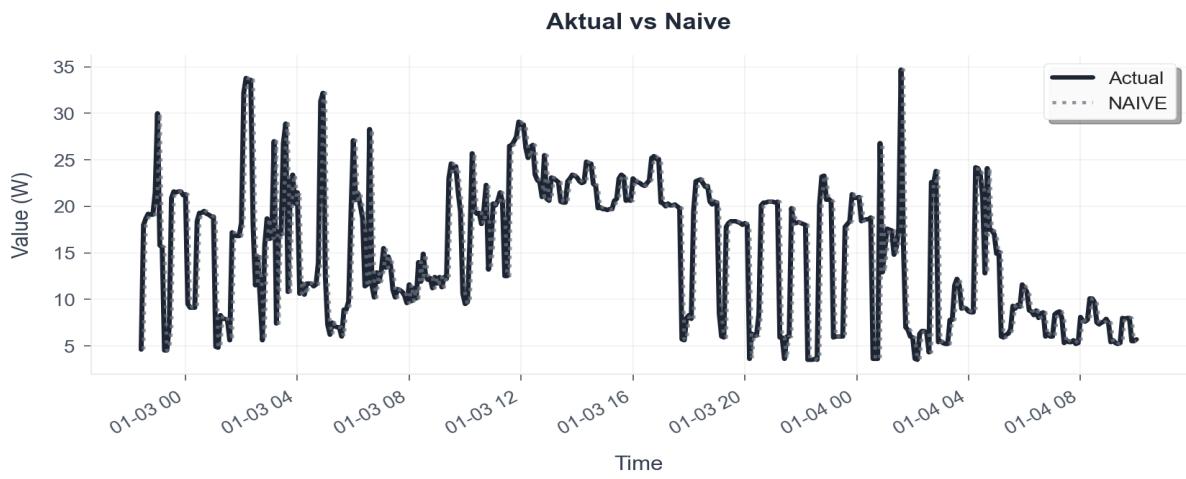
### 5.1 FTS Graphic



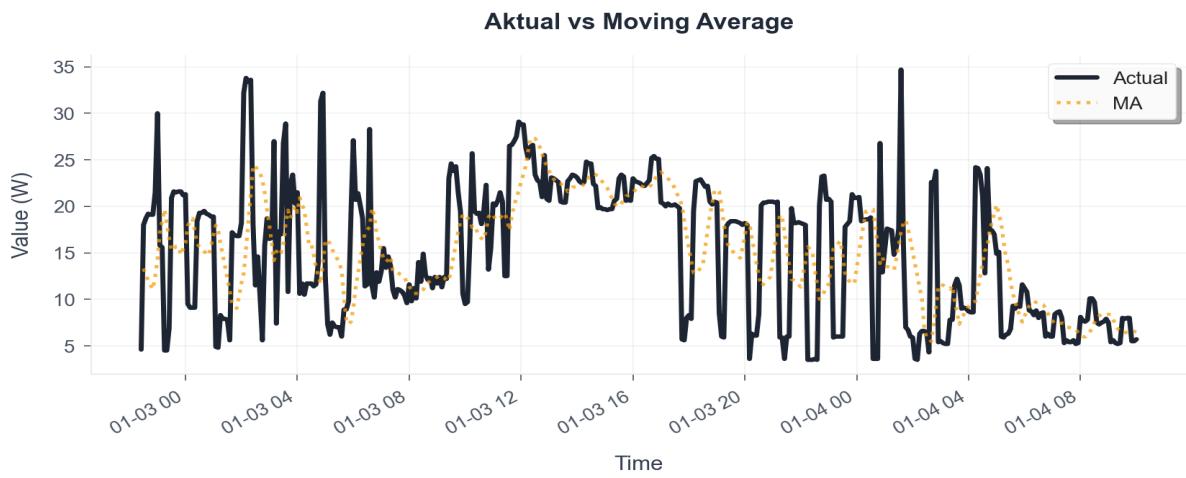
#### 5.1.1 Grafik Aktual vs FTS



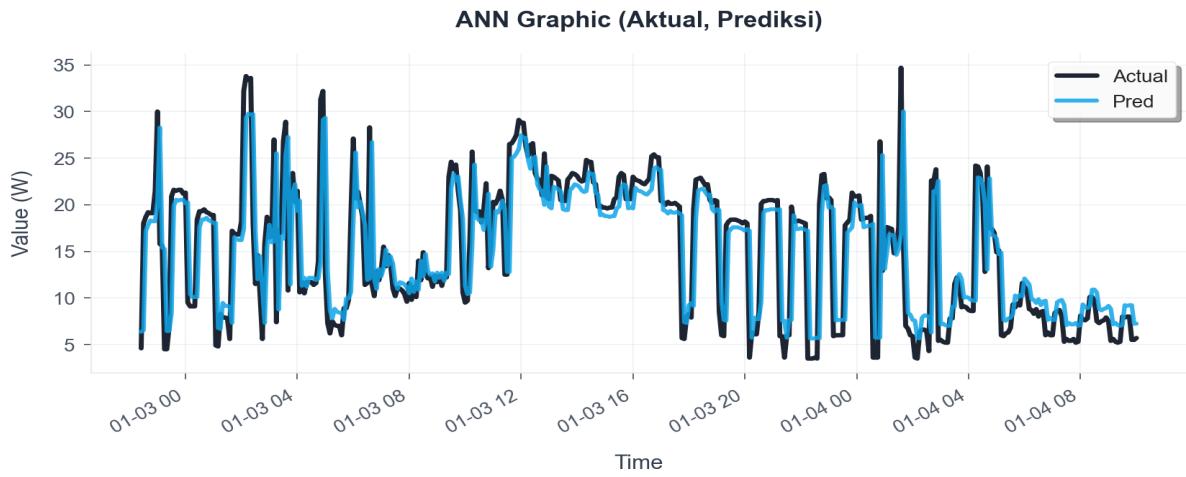
#### 5.1.2 Grafik Aktual vs Naive



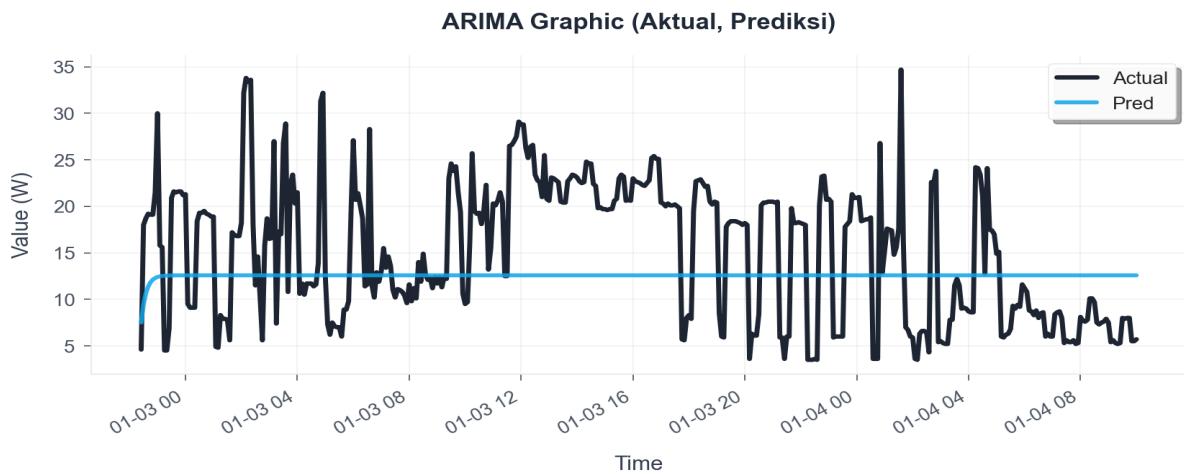
### 5.1.3 Grafik Aktual vs Moving Average



### 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-frequency, 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	6.6000	3.2750
A2	6.6000	9.8000	8.2000
A3	9.8000	17.5000	13.6500
A4	17.5000	19.7000	18.6000
A5	19.7000	20.8000	20.2500
A6	20.8000	22.3000	21.5500
A7	22.3000	23.5000	22.9000
A8	23.5000	25.8000	24.6500
A9	25.8000	51.6500	38.7250

### 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	A5
27-12-2025 23:55:00	20.500	A5
28-12-2025 00:00:00	20.400	A5
28-12-2025 00:05:00	20.400	A5
28-12-2025 00:10:00	20.300	A5
28-12-2025 00:15:00	22.600	A7
28-12-2025 00:20:00	22.500	A7
28-12-2025 00:25:00	22.400	A7
28-12-2025 00:30:00	25.100	A8
28-12-2025 00:35:00	22.900	A7

#### 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	$A_5 \rightarrow A_5$
3	$A_5 \rightarrow A_5$
4	$A_5 \rightarrow A_5$
5	$A_5 \rightarrow A_7$
6	$A_7 \rightarrow A_7$
7	$A_7 \rightarrow A_7$
8	$A_7 \rightarrow A_8$
9	$A_8 \rightarrow A_7$
10	$A_7 \rightarrow A_7$

... 1700 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 (66.1%), A2 (16.7%), A3 (5.4%), A5 (5.4%), A4 (3.2%), A6 (2.2%), A7 (1.1%)
A2	A2 (97.2%), A1 (16.6%), A3 (12.8%), A6 (4.3%), A4 (3.2%), A5 (2.7%), A7 (1.6%), A8 (1.1%), A9 (0.5%)
A3	A3 (83.4%), A2 (12.9%), A4 (10.8%), A1 (3.1%), A9 (2.6%), A8 (2.6%), A7 (2.1%), A5 (1.5%), A6 (1.0%)
A4	A4 (64.1%), A3 (9.4%), A5 (8.9%), A1 (7.3%), A6 (3.6%), A9 (3.1%), A2 (2.6%), A7 (0.5%), A8 (0.5%)
A5	A5 (60.3%), A4 (13.0%), A6 (8.7%), A7 (7.1%), A2 (3.3%), A9 (3.3%), A1 (2.7%), A3 (1.1%), A8 (0.5%)
A6	A6 (57.9%), A7 (11.1%), A5 (10.0%), A8 (10.0%), A4 (3.7%), A2 (2.6%), A9 (2.1%), A3 (1.6%), A1 (1.1%)
A7	A7 (56.4%), A8 (16.6%), A6 (11.6%), A5 (6.1%), A9 (2.8%), A3 (2.2%), A2 (2.2%), A1 (1.7%), A4 (0.6%)
A8	A8 (55.6%), A7 (16.2%), A9 (11.6%), A6 (9.1%), A3 (2.5%), A4 (1.5%), A5 (1.5%), A2 (1.5%), A1 (0.5%)
A9	A9 (47.4%), A8 (15.2%), A3 (2.5%), A6 (2.0%), A5 (2.0%), A7 (1.5%), A1 (1.0%), A4 (0.5%), A2 (0.5%)

## 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	02-01-2026 22:30:00	18.000	6.665
3	02-01-2026 22:35:00	18.700	17.684
4	02-01-2026 22:40:00	19.200	17.684
5	02-01-2026 22:45:00	19.100	17.684
6	02-01-2026 22:50:00	19.100	17.684
7	02-01-2026 22:55:00	21.500	17.684
8	02-01-2026 23:00:00	30.000	21.464
9	02-01-2026 23:05:00	15.800	34.385
10	02-01-2026 23:10:00	15.600	14.467
11	02-01-2026 23:15:00	4.500	14.467

### 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	3.3094
RMSE	5.5432
MAPE (%)	30.86

### LaTeX Calculation Steps:

$$n = 428 \text{ (test samples)}$$

$$MAE = \frac{1}{428} \sum_{t=1}^{428} |Y_t - \hat{Y}_t| = 3.3094$$

$$RMSE = \sqrt{\frac{1}{428} \sum_{t=1}^{428} (Y_t - \hat{Y}_t)^2} = 5.5432$$

$$MAPE = \frac{100\%}{428} \sum_{t=1}^{428} \left| \frac{Y_t - \hat{Y}_t}{Y_t} \right| = 30.86\%$$

### 5.8 Baseline Models Comparison

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

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

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

Model	MAE	RMSE	MAPE (%)
Naive	2.5272	5.1240	22.35
Moving Average	4.9935	6.6354	49.75

### 5.9 Sensitivity Analysis

Formula: Delta MAPE = MAPE\_FTS - MAPE\_Baseline.

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

Case	MAPE (%)	Delta (%)
pad = 10%	29.73	-1.13
n = 11	30.09	-0.77
method = equal-width	32.85	1.99

## 7. Model Configuration

Model	Config Summary
FTS	n=9, method=equal-frequency, 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	3.3094	5.5432	30.86	2
ANN	2.9029	4.8343	27.10	1
ARIMA	6.7084	7.7408	55.08	3

**Best Model:** ANN

## 9. Sensitivity Analysis

Case	MAPE (%)	Delta (%)
pad = 10%	29.73	-1.13
n = 11	30.09	-0.77
method = equal-width	32.85	1.99

**Best Case:** pad = 10%

## 10. Auto-Generated Caption

Analisis perbandingan FTS Cheng, ANN, dan ARIMA pada Unknown Device periode 27/12/2025 - 04/01/2026 dengan 2137 titik data. FTS parameter n=9, method=equal-frequency, pad=5% memberi MAPE=30.86%. Model terbaik: ANN (MAPE=27.10%). Sensitivity menyarankan pad = 10% (improve 1.13%).