

DAFTAR PUSTAKA

- Afra, S., Wahyudin, N., Vahlevi, R., Prayoga, H., & Prasetyo, N. D. 2020. Sistem Kontrol Pemanas Air Menggunakan Sensor Ultrasonik Dan Arduino Uno. *Power Elektronik: Jurnal Orang Elektro*, 9(2), 30-35.
- Ambarita, H., Siahaan, F., & Sihombing, H. V. 2020. PERFORMANSI PEMANAS AIR TENAGA SURYA DENGAN PENAMBAHAN SIRIP PADA PIPA KOLEKTOR. *Sprocket Journal of Mechanical Engineering*, 1(2), 57-64.
- Banne, M. S., & Marzuki, M. 2020. ANALISIS DAYA YANG DIHASILKAN OLEH SEL FOTOVOLTAIK 20 WP. *Jurnal Voering*, 5(1), 1-6.
- Butler, B. L. 2016. *U.S. Patent No. 9,518,759*. Washington, DC: U.S. Patent and Trademark Office.
- Dahliya, D., Samsurizal, S., & Pasra, N. 2021. Efisiensi Panel Surya Kapasitas 100 Wp Akibat Pengaruh Suhu Dan Kecepatan Angin. *Sutet*, 11(2), 71-80.
- Darwin, D., Panjaitan, A., & Suwarno, S. 2020. Analisa pengaruh Intesitas Sinar Matahari Terhadap Daya Keluaran Pada Sel fotovoltaik Jenis Monokristal. *Jurnal MESIL (Mesin Elektro Sipil)/Journal MESIL (Machine Electro Civil)*, 1(2), 99-106.
- Dewi, A. Y. 2013. Pemanfaatan energi surya sebagai suplai cadangan pada laboratorium elektro dasar di Institut Teknologi Padang. *Jurnal teknik elektro*, 2(3), 20-28.
- Dirja, I., Jihan, M. A., Mesin, P. T., & Pendahuluan, I. 2019. Rancang Bangun Pemanas Air (*Water heater*) dengan menggunakan Baterai Berbasis Arduino Pro Mini. *Jurnal INFOMATEK*, 21(2), 91-96.
- Fahrul, M. 2022. *RANCANG BANGUN DAN ANALISIS KINERJA SISTEM WATER HEATER BERBASIS SEL FOTOVOLTAIK= Design and Performance Analysis of Fotovoltaik Cell-Based Water heater System* (Doctoral dissertation, Universitas Hasanuddin).
- Harahap, P. 2020. Pengaruh temperatur permukaan panel surya terhadap daya yang dihasilkan dari berbagai jenis sel fotovoltaik. *RELE (Rekayasa Elektrikal dan Energi): Jurnal Teknik Elektro*, 2(2), 73-80.
- Hasan, H. 2012. perancangan pembangkit listrik tenaga surya di pulau Saugi. *Jurnal riset dan teknologi kelautan*, 10(2), 169-180.
- Hasbi Assiddiq, S., & Dinahkandy, I. 2018. Studi Pemanfaatan Energi Matahari Sebagai Sumber Energi Alternatif Terbaru Berbasis Sel Fotovoltaik Untuk Mengatasi Kebutuhan Listrik Rumah Sederhana di Daerah Terpencil. *Jurnal Teknik Mesin UNISKA*, 3(02), 2615-0867.

- Iqtimal, Z., Sara, I. D., & Syahrizal, S. 2018. Aplikasi sistem tenaga surya sebagai sumber tenaga listrik pompa air. *Jurnal Komputer, Informasi Teknologi, dan Elektro*, 3(1).
- Julian, B. R. 2023. Analisis Pengaruh Radiasi Matahari Dan Temperatur Terhadap Daya Keluaran Fotovoltaik Menggunakan SPSS. *Aceh Journal of Electrical Engineering and Technology*, 3(1), 14-18.
- Lubna, L., Sudarti, S., & Yushardi, Y. 2021. POTENSI ENERGI SURYA FOTOVOLTAIK SEBAGAI SUMBER ENERGI ALTERNATIF. *Pelita: Jurnal Penelitian dan Karya Ilmiah*, 21(1), 76-79.
- Muslim, S., Khotimah, K., & Azhiimah, A. N. 2020. Analisis Kritis Terhadap Perencanaan Pembangkit Listrik Tenaga Surya (Plts) Tipe Fotovoltaik (Pv) Sebagai Energi Alternatif Masa Depan. *Rang Teknik Journal*, 3(1), 119-130.
- Mustofa, Magga, R., & Arifin, Y. 2015. Desain Hybrid Panel Surya Tipe Monocrystalline dan Thermal Kolektor Fluida Air. *Jurnal IPTEK*, 19(2), 67-74.
- Ningsih, L. F., Sofyan, A. R., Giarno, G., Haryanto, D., Witoko, J. P., & Juarsa, M. (2018). Estimasi Perhitungan Kalor dan Laju Aliran Kalor Pada Untai FASSIP-02. *SIGMA EPSILON-Buletin Ilmiah Teknologi Keselamatan Reaktor Nuklir*, 22(1).
- Purwoto, B. H., Jatmiko, J., Fadilah, M. A., & Huda, I. F. 2018. Efisiensi penggunaan panel surya sebagai sumber energi alternatif. *Emitor: Jurnal Teknik Elektro*, 18(1), 10-14.
- Ramadani, R. 2020. *Studi Experimental Potensi Penyerapan Energi Matahari Sistem Fotovoltaik Di Wilayah Pegunungan Berastagi* (Doctoral dissertation).
- Rudiyanto, B., Rachmanita, R. E., & Budiprasojo, A. 2023. *Dasar-Dasar Pemasangan Panel Surya*. Unisma Press : Malang.
- Saputri, Y. A., Sa'diyah, K., & Yulianto, E. 2022. Analisis Efisiensi Heater pada Pengolahan Steam Unit 7 Pembangkit Listrik Tenaga Uap. *DISTILAT: Jurnal Teknologi Separasi*, 8(1), 54-63.
- Sariman, S., Agustina, S., Khori, M., & Bayusari, I. 2019. Analisa Efisiensi Pengaruh Parameter Cahaya Matahari Pada Fotovoltaik 100WP Jenis Polikristal, Monokristal dan Amorphous di Laboratorium Riset Teknologi Energi UNSRI Indralaya. *Applicable Innovation of Engineering and Science Research (AVoER)*, 363-368.
- Sitohang, M. 2019. *PERANCANGAN PEMBANGKIT LISTRIK TENAGA SURYA (PLTS) TERPUSAT OFF-GRID SYSTEM (Studi Kasus: Desa Tanjung Beringin, Kabupaten Kampar, Riau)* (Doctoral dissertation, Universitas Islam Negeri Sultan Syarif Kasim Riau).

- Tumangke, M. R., Priharti, W., & Silalahi, D. K. 2021. Rancang Bangun Sistem Pemanas Air Fotovoltaik. *eProceedings of Engineering*, 8(6).
- Wicaksono, A.D, Suwandi, & Ajiwiguna, T. A. 2017. Pengaruh Bahan Insulasi Terhadap Perpindahan Kalor Pada Tangki Penyimpanan Air Untuk Sistem Pemanas Air Berbasis Surya. *e-Proceeding of Engineering*, 4(3) : 3845.
- Witoko, J. P., Haryanto, D., Giarno, M. H., Kusuma, M. J., & Antariksawan, A. R. 2018. Perhitungan Kebutuhan Daya *Heater* Pada Kolam Pemanas Heat Pipe. In *Seminar Nasional Mesin dan Industri (SNMI XII)* (pp. 68-72).
- Widayana, G. 2012. Pemanfaatan energi surya. *Jurnal pendidikan teknologi dan kejuruan*, 9(1).

Lampiran 1. Tabel Hasil Pengukuran Volume Tangki 10 Liter (Data 1)

Waktu	Radiasi Matahari	Tegangan	Arus	Suhu
9:00	377.7	11.5	2.44	27.6
9:30	392.4	11.7	2.58	29.3
10:00	387.8	11.6	2.56	30.6
10:30	385.2	11.6	2.55	31.7
11:00	379.9	11.6	2.55	32.7
11:30	380.6	11.6	2.54	33.4
12:00	382.5	11.5	2.55	34.1
12:30	383.9	11.5	2.56	34.9
13:00	385.6	11.5	2.57	35.6
13:30	389.5	11.5	2.58	36.2
14:00	389.2	11.5	2.6	36.7
14:30	391.6	11.5	2.61	37.3
15:00	391.1	11.5	2.61	37.7
15:30	390.1	11.5	2.61	38.3
16:00	392.1	11.5	2.61	38.6

Lampiran 2. Tabel Hasil Pengukuran Volume Tangki 10 Liter (Data 2)

Waktu	Radiasi Matahari	Tegangan	Arus	Suhu
9:00	366.4	11.4	2.42	27.5
9:30	373.6	11.5	2.49	29.2
10:00	376.4	11.5	2.5	30.6
10:30	382.4	11.6	2.55	31.6
11:00	381.2	11.6	2.54	32.6
11:30	380.5	11.5	2.53	33.4
12:00	378.3	11.5	2.53	34
12:30	378.2	11.5	2.54	34.7
13:00	380.4	11.5	2.55	35.3
13:30	381.3	11.5	2.56	35.9
14:00	382.2	11.5	2.57	36.6
14:30	379	11.4	2.54	37
15:00	382	11.4	2.56	37.5
15:30	386.5	11.5	2.57	37.9
16:00	391.3	11.5	2.59	38.4

Lampiran 3. Tabel Hasil Pengukuran Volume Tangki 10 Liter (Data 3)

Waktu	Radiasi Matahari	Tegangan	Arus	Suhu
9:00	376.1	11.6	2.47	27.2
9:30	381.5	11.7	2.54	28.8
10:00	371.1	11.6	2.5	30.1
10:30	372.4	11.6	2.52	31
11:00	374.3	11.6	2.52	31.9
11:30	374.7	11.6	2.53	32.7
12:00	386.2	11.6	2.55	33.4
12:30	384.5	11.6	2.55	33.9
13:00	386.4	11.6	2.55	34.6
13:30	385.4	11.6	2.55	35.2
14:00	385.1	11.5	2.53	35.7
14:30	386.4	11.5	2.56	36.1
15:00	386	11.5	2.56	36.8
15:30	385.8	11.5	2.56	37.2
16:00	386.5	11.5	2.56	37.6

Lampiran 4. Tabel Hasil Pengukuran Volume Tangki 15 Liter (Data 1)

Waktu	Radiasi Matahari	Tegangan	Arus	Suhu
9:00	351.3	11.5	2.42	27
9:30	351.9	11.6	2.46	27.9
10:00	355	11.6	2.48	28.8
10:30	357.9	11.6	2.48	29.5
11:00	352.4	11.6	2.47	30.2
11:30	352.1	11.5	2.44	30.8
12:00	352.6	11.6	2.46	31.4
12:30	355.2	11.5	2.46	32.1
13:00	354.6	11.5	2.46	32.6
13:30	352.4	11.4	2.44	32.9
14:00	358.3	11.5	2.48	33.5
14:30	359.5	11.5	2.49	33.8
15:00	367.4	11.5	2.52	34.4
15:30	356.8	11.5	2.48	34.8
16:00	355.5	11.5	2.48	35.2

Lampiran 5. Tabel Hasil Pengukuran Volume Tangki 15 Liter (Data 2)

Waktu	Radiasi Matahari	Tegangan	Arus	Suhu
9:00	344.5	11.4	2.38	27.2
9:30	348	11.5	2.48	28
10:00	350.4	11.6	2.46	29
10:30	346.4	11.8	2.46	29.6
11:00	345.7	11.7	2.44	30.2
11:30	352.4	11.7	2.46	30.8
12:00	347.1	11.5	2.45	31.4
12:30	344.7	11.5	2.44	32
13:00	343.1	11.4	2.44	32.4
13:30	347.3	11.4	2.44	33
14:00	345.6	11.4	2.42	33.4
14:30	353	11.4	2.46	33.8
15:00	357.9	11.4	2.47	34.2
15:30	358.1	11.4	2.48	34.6
16:00	357.2	11.5	2.49	35

Lampiran 6. Tabel Hasil Pengukuran Volume Tangki 15 Liter (Data 3)

Waktu	Radiasi Matahari	Tegangan	Arus	Suhu
9:00	351.5	11.5	2.4	27.3
9:30	358.2	11.6	2.49	28
10:00	359.9	11.6	2.5	29
10:30	358.9	11.6	2.5	29.8
11:00	366.3	11.6	2.52	30.5
11:30	365.8	11.6	2.52	31.1
12:00	364.1	11.6	2.53	31.8
12:30	367.2	11.6	2.53	32.3
13:00	368.5	11.6	2.53	32.8
13:30	369.2	11.6	2.53	33.4
14:00	366.4	11.6	2.53	33.9
14:30	367.7	11.6	2.53	34.3
15:00	365.1	11.5	2.53	34.8
15:30	364.4	11.5	2.52	35.2
16:00	365.3	11.5	2.52	35.6

Lampiran 7. Tabel Hasil Pengukuran Volume Tangki 25 Liter (Data 1)

Waktu	Radiasi Matahari	Tegangan	Arus	Suhu
9:00	332.1	11.3	2.33	27.7
9:30	337.2	11.5	2.4	27.9
10:00	334.9	11.5	2.38	28.4
10:30	336.6	11.5	2.39	29
11:00	330.1	11.4	2.37	29.4
11:30	343.6	11.6	2.43	29.8
12:00	354.4	11.6	2.44	30.3
12:30	355.1	11.6	2.48	30.6
13:00	360.4	11.6	2.48	31
13:30	361.9	11.7	2.49	31.3
14:00	354.6	11.6	2.47	31.6
14:30	355.7	11.6	2.46	32
15:00	356.4	11.6	2.46	32.3
15:30	356.9	11.5	2.47	32.6
16:00	355.3	11.6	2.47	32.9

Lampiran 8. Tabel Hasil Pengukuran Volume Tangki 25 Liter (Data 2)

Waktu	Radiasi Matahari	Tegangan	Arus	Suhu
9:00	346.2	11.4	2.31	27.9
9:30	361.8	11.6	2.42	28.3
10:00	360.2	11.6	2.42	28.8
10:30	357.3	11.5	2.41	29.4
11:00	364.4	11.6	2.45	30
11:30	369.4	11.6	2.45	30.3
12:00	368.4	11.6	2.45	30.7
12:30	367.9	11.5	2.46	31.2
13:00	375.6	11.5	2.47	31.6
13:30	377.3	11.6	2.48	32
14:00	378.1	11.6	2.5	32.4
14:30	384.4	11.6	2.52	32.6
15:00	376.5	11.5	2.49	32.9
15:30	377.7	11.5	2.48	33.3
16:00	379.5	11.4	2.49	33.7

Lampiran 9. Tabel Hasil Pengukuran Volume Tangki 25 Liter (Data 3)

Waktu	Radiasi Matahari	Tegangan	Arus	Suhu
9:00	362.5	12	2.4	27.9
9:30	359.1	12.2	2.41	28.4
10:00	363.5	12.4	2.42	29
10:30	359	12.1	2.42	29.5
11:00	358.1	12	2.4	30
11:30	358.7	11.9	2.4	30.6
12:00	356.2	11.8	2.37	30.9
12:30	361.2	11.8	2.37	31.3
13:00	354.7	11.8	2.38	31.6
13:30	358.7	11.8	2.38	32
14:00	366.5	11.8	2.42	32.4
14:30	366.2	11.8	2.42	32.7
15:00	365.1	11.8	2.42	33.1
15:30	370	11.8	2.44	33.4
16:00	369.4	11.7	2.46	33.7

Lampiran 10. Tabel Hasil Perhitungan Volume Tangki 10 Liter (Data 1)

Waktu (Menit)	Radiasi Matahari (W/m^2)	Tegangan (V)	Arus (A)	A (m^2)	Pout (Watt)	Pin (Watt)	Efisiensi PV	T Awal	T Akhir	Kalor Air (Joule)	q air	q heater	Efisiensi Heater	Efisiensi Total	Efisiensi Aktual
9:00	377.7	11.5	2.44	1.071	28.060	404.5	6.937	27.6	27.6	0.0	0.000	30	0.000	0.000	0.000
9:30	392.4	11.7	2.58	1.071	30.186	420.3	7.183	27.6	29.3	87.2	3.459	30	11.530	0.828	0.823
10:00	387.8	11.6	2.56	1.071	29.696	415.3	7.150	27.6	30.6	153.8	6.104	30	20.347	1.455	1.470
10:30	385.2	11.6	2.55	1.071	29.580	412.5	7.170	27.6	31.7	210.2	8.342	30	27.808	1.994	2.022
11:00	379.9	11.6	2.55	1.071	29.580	406.9	7.270	27.6	32.7	261.5	10.377	30	34.590	2.515	2.550
11:30	380.6	11.6	2.54	1.071	29.464	407.6	7.228	27.6	33.4	297.4	11.801	30	39.338	2.843	2.895
12:00	382.5	11.5	2.55	1.071	29.325	409.7	7.158	27.6	34.1	333.3	13.226	30	44.086	3.156	3.228
12:30	383.9	11.5	2.56	1.071	29.440	411.2	7.160	27.6	34.9	374.3	14.853	30	49.512	3.545	3.613
13:00	385.6	11.5	2.57	1.071	29.555	413.0	7.157	27.6	35.6	410.2	16.278	30	54.259	3.883	3.942
13:30	389.5	11.5	2.58	1.071	29.670	417.2	7.112	27.6	36.2	441.0	17.499	30	58.329	4.149	4.195
14:00	389.2	11.5	2.6	1.071	29.900	416.8	7.173	27.6	36.7	466.6	18.516	30	61.720	4.427	4.442
14:30	391.6	11.5	2.61	1.071	30.015	419.4	7.157	27.6	37.3	497.4	19.737	30	65.789	4.708	4.706
15:00	391.1	11.5	2.61	1.071	30.015	418.9	7.166	27.6	37.7	517.9	20.551	30	68.502	4.909	4.906
15:30	390.1	11.5	2.61	1.071	30.015	417.8	7.184	27.6	38.3	548.6	21.772	30	72.572	5.214	5.211
16:00	392.1	11.5	2.61	1.071	30.015	419.9	7.147	27.6	38.6	564.0	22.382	30	74.606	5.332	5.330

Lampiran 11. Tabel Hasil Perhitungan Volume Tangki 10 Liter (Data 2)

Waktu (Menit)	Radiasi Matahari (W/m ²)	Tegangan (V)	Arus (A)	A (m ²)	Pout (Watt)	Pin (Watt)	Efisiensi PV	T Awal	T Akhir	Kalor Air (Joule)	q air	q heater	Efisiensi Heater	Efisiensi Total	Efisiensi Aktual
9:00	366.4	11.4	2.42	1.071	27.588	392.4	7.030	27.5	27.5	0.0	0.000	30	0.000	0.000	0.000
9:30	373.6	11.5	2.49	1.071	28.635	400.1	7.157	27.5	29.2	87.2	3.459	30	11.530	0.825	0.864
10:00	376.4	11.5	2.5	1.071	28.750	403.1	7.132	27.5	30.6	159.0	6.308	30	21.025	1.499	1.565
10:30	382.4	11.6	2.55	1.071	29.580	409.6	7.223	27.5	31.6	210.2	8.342	30	27.808	2.008	2.037
11:00	381.2	11.6	2.54	1.071	29.464	408.3	7.217	27.5	32.6	261.5	10.377	30	34.590	2.496	2.542
11:30	380.5	11.5	2.53	1.071	29.095	407.5	7.140	27.5	33.4	302.5	12.005	30	40.016	2.857	2.946
12:00	378.3	11.5	2.53	1.071	29.095	405.2	7.181	27.5	34	333.3	13.226	30	44.086	3.166	3.264
12:30	378.2	11.5	2.54	1.071	29.210	405.1	7.211	27.5	34.7	369.2	14.650	30	48.833	3.522	3.617
13:00	380.4	11.5	2.55	1.071	29.325	407.4	7.198	27.5	35.3	399.9	15.871	30	52.903	3.808	3.896
13:30	381.3	11.5	2.56	1.071	29.440	408.4	7.209	27.5	35.9	430.7	17.092	30	56.972	4.107	4.185
14:00	382.2	11.5	2.57	1.071	29.555	409.3	7.220	27.5	36.6	466.6	18.516	30	61.720	4.456	4.523
14:30	379	11.4	2.54	1.071	28.956	405.9	7.134	27.5	37	487.1	19.330	30	64.433	4.596	4.762
15:00	382	11.4	2.56	1.071	29.184	409.1	7.133	27.5	37.5	512.7	20.347	30	67.824	4.838	4.973
15:30	386.5	11.5	2.57	1.071	29.555	413.9	7.140	27.5	37.9	533.3	21.161	30	70.537	5.036	5.112
16:00	391.3	11.5	2.59	1.071	29.785	419.1	7.107	27.5	38.4	558.9	22.178	30	73.928	5.254	5.292

Lampiran 12. Tabel Hasil Perhitungan Volume Tangki 10 Liter (Data 3)

Waktu (Menit)	Radiasi Matahari (W/m ²)	Tegangan (V)	Arus (A)	A (m ²)	Pout (Watt)	Pin (Watt)	Efisiensi PV	T Awal	T Akhir	Kalor Air (Joule)	q air	q heater	Efisiensi Heater	Efisiensi Total	Efisiensi Aktual
9:00	376.1	11.6	2.47	1.071	28.652	402.8	7.113	27.2	27.2	0.0	0.000	30	0.000	0.000	0.000
9:30	381.5	11.7	2.54	1.071	29.718	408.6	7.273	27.2	28.8	82.0	3.256	30	10.852	0.789	0.797
10:00	371.1	11.6	2.5	1.071	29.000	397.4	7.297	27.2	30.1	148.7	5.901	30	19.669	1.435	1.485
10:30	372.4	11.6	2.52	1.071	29.232	398.8	7.329	27.2	31	194.8	7.732	30	25.773	1.889	1.939
11:00	374.3	11.6	2.52	1.071	29.232	400.9	7.292	27.2	31.9	241.0	9.563	30	31.877	2.325	2.386
11:30	374.7	11.6	2.53	1.071	29.348	401.3	7.313	27.2	32.7	282.0	11.191	30	37.303	2.728	2.789
12:00	386.2	11.6	2.55	1.071	29.580	413.6	7.151	27.2	33.4	317.9	12.615	30	42.051	3.007	3.050
12:30	384.5	11.6	2.55	1.071	29.580	411.8	7.183	27.2	33.9	343.5	13.633	30	45.442	3.264	3.311
13:00	386.4	11.6	2.55	1.071	29.580	413.8	7.148	27.2	34.6	379.4	15.057	30	50.190	3.587	3.638
13:30	385.4	11.6	2.55	1.071	29.580	412.8	7.166	27.2	35.2	410.2	16.278	30	54.259	3.888	3.944
14:00	385.1	11.5	2.53	1.071	29.095	412.4	7.054	27.2	35.7	435.8	17.295	30	57.650	4.067	4.193
14:30	386.4	11.5	2.56	1.071	29.440	413.8	7.114	27.2	36.1	456.3	18.109	30	60.363	4.294	4.376
15:00	386	11.5	2.56	1.071	29.440	413.4	7.121	27.2	36.8	492.2	19.533	30	65.111	4.637	4.725
15:30	385.8	11.5	2.56	1.071	29.440	413.2	7.125	27.2	37.2	512.7	20.347	30	67.824	4.832	4.924
16:00	386.5	11.5	2.56	1.071	29.440	413.9	7.112	27.2	37.6	533.3	21.161	30	70.537	5.017	5.112

Lampiran 13. Tabel Hasil Perhitungan Volume Tangki 15 Liter (Data 1)

Waktu (Menit)	Radiasi Matahari (W/m ²)	Tegangan (V)	Arus (A)	A (m ²)	Pout (Watt)	Pin (Watt)	Efisiensi PV	T Awal	T Akhir	Kalor Air (Joule)	q air	q heater	Efisiensi Heater	Efisiensi Total	Efisiensi Aktual
9:00	351.3	11.5	2.42	1.071	27.830	376.2	7.397	27	27	0.0	0.000	30	0.000	0.000	0.000
9:30	351.9	11.6	2.46	1.071	28.536	376.9	7.572	27	27.9	57.7	2.289	30	7.630	0.578	0.607
10:00	355	11.6	2.48	1.071	28.768	380.2	7.566	27	28.8	115.4	4.578	30	15.260	1.155	1.204
10:30	357.9	11.6	2.48	1.071	28.768	383.3	7.505	27	29.5	160.2	6.359	30	21.195	1.591	1.659
11:00	352.4	11.6	2.47	1.071	28.652	377.4	7.592	27	30.2	205.1	8.139	30	27.130	2.060	2.156
11:30	352.1	11.5	2.44	1.071	28.060	377.1	7.441	27	30.8	243.6	9.665	30	32.216	2.397	2.563
12:00	352.6	11.6	2.46	1.071	28.536	377.6	7.557	27	31.4	282.0	11.191	30	37.303	2.819	2.963
12:30	355.2	11.5	2.46	1.071	28.290	380.4	7.437	27	32.1	326.9	12.971	30	43.238	3.215	3.410
13:00	354.6	11.5	2.46	1.071	28.290	379.8	7.449	27	32.6	358.9	14.243	30	47.477	3.537	3.750
13:30	352.4	11.4	2.44	1.071	27.816	377.4	7.370	27	32.9	378.2	15.006	30	50.020	3.687	3.976
14:00	358.3	11.5	2.48	1.071	28.520	383.7	7.432	27	33.5	416.6	16.532	30	55.107	4.096	4.308
14:30	359.5	11.5	2.49	1.071	28.635	385.0	7.437	27	33.8	435.8	17.295	30	57.650	4.288	4.492
15:00	367.4	11.5	2.52	1.071	28.980	393.5	7.365	27	34.4	474.3	18.821	30	62.737	4.621	4.783
15:30	356.8	11.5	2.48	1.071	28.520	382.1	7.463	27	34.8	499.9	19.839	30	66.128	4.935	5.192
16:00	355.5	11.5	2.48	1.071	28.520	380.7	7.491	27	35.2	525.6	20.856	30	69.520	5.207	5.478

Lampiran 14. Tabel Hasil Perhitungan Volume Tangki 15 Liter (Data 2)

Waktu (Menit)	Radiasi Matahari (W/m ²)	Tegangan (V)	Arus (A)	A (m ²)	Pout (Watt)	Pin (Watt)	Efisiensi PV	T Awal	T Akhir	Kalor Air (Joule)	q air	q heater	Efisiensi Heater	Efisiensi Total	Efisiensi Aktual
9:00	344.5	11.4	2.38	1.071	27.132	369.0	7.354	27.2	27.2	0.0	0.000	30	0.000	0.000	0.000
9:30	348	11.5	2.48	1.071	28.520	372.7	7.652	27.2	28	51.3	2.035	30	6.782	0.519	0.546
10:00	350.4	11.6	2.46	1.071	28.536	375.3	7.604	27.2	29	115.4	4.578	30	15.260	1.160	1.220
10:30	346.4	11.8	2.46	1.071	29.028	371.0	7.824	27.2	29.6	153.8	6.104	30	20.347	1.592	1.645
11:00	345.7	11.7	2.44	1.071	28.548	370.2	7.711	27.2	30.2	192.3	7.630	30	25.434	1.961	2.061
11:30	352.4	11.7	2.46	1.071	28.782	377.4	7.626	27.2	30.8	230.7	9.156	30	30.521	2.328	2.426
12:00	347.1	11.5	2.45	1.071	28.175	371.7	7.579	27.2	31.4	269.2	10.682	30	35.608	2.699	2.874
12:30	344.7	11.5	2.44	1.071	28.060	369.2	7.601	27.2	32	307.6	12.208	30	40.694	3.093	3.307
13:00	343.1	11.4	2.44	1.071	27.816	367.5	7.570	27.2	32.4	333.3	13.226	30	44.086	3.337	3.599
13:30	347.3	11.4	2.44	1.071	27.816	372.0	7.478	27.2	33	371.7	14.752	30	49.172	3.677	3.966
14:00	345.6	11.4	2.42	1.071	27.588	370.1	7.453	27.2	33.4	397.4	15.769	30	52.564	3.918	4.260
14:30	353	11.4	2.46	1.071	28.044	378.1	7.418	27.2	33.8	423.0	16.786	30	55.955	4.151	4.440
15:00	357.9	11.4	2.47	1.071	28.158	383.3	7.346	27.2	34.2	448.7	17.804	30	59.346	4.360	4.645
15:30	358.1	11.4	2.48	1.071	28.272	383.5	7.372	27.2	34.6	474.3	18.821	30	62.737	4.625	4.907
16:00	357.2	11.5	2.49	1.071	28.635	382.6	7.485	27.2	35	499.9	19.839	30	66.128	4.950	5.186

Lampiran 15. Tabel Hasil Perhitungan Volume Tangki 15 Liter (Data 3)

Waktu (Menit)	Radiasi Matahari (W/m ²)	Tegangan (V)	Arus (A)	A (m ²)	Pout (Watt)	Pin (Watt)	Efisiensi PV	T Awal	T Akhir	Kalor Air (Joule)	q air	q heater	Efisiensi Heater	Efisiensi Total	Efisiensi Aktual
9:00	351.5	11.5	2.4	1.071	27.600	376.5	7.332	27.3	27.3	0.0	0.000	30	0.000	0.000	0.000
9:30	358.2	11.6	2.49	1.071	28.884	383.6	7.529	27.3	28	44.9	1.780	30	5.935	0.447	0.464
10:00	359.9	11.6	2.5	1.071	29.000	385.5	7.524	27.3	29	109.0	4.324	30	14.413	1.084	1.122
10:30	358.9	11.6	2.5	1.071	29.000	384.4	7.545	27.3	29.8	160.2	6.359	30	21.195	1.599	1.654
11:00	366.3	11.6	2.52	1.071	29.232	392.3	7.451	27.3	30.5	205.1	8.139	30	27.130	2.022	2.075
11:30	365.8	11.6	2.52	1.071	29.232	391.8	7.461	27.3	31.1	243.6	9.665	30	32.216	2.404	2.467
12:00	364.1	11.6	2.53	1.071	29.348	390.0	7.526	27.3	31.8	288.4	11.445	30	38.151	2.871	2.935
12:30	367.2	11.6	2.53	1.071	29.348	393.3	7.463	27.3	32.3	320.5	12.717	30	42.390	3.163	3.234
13:00	368.5	11.6	2.53	1.071	29.348	394.7	7.436	27.3	32.8	352.5	13.989	30	46.629	3.467	3.544
13:30	369.2	11.6	2.53	1.071	29.348	395.4	7.422	27.3	33.4	391.0	15.515	30	51.716	3.838	3.924
14:00	366.4	11.6	2.53	1.071	29.348	392.4	7.479	27.3	33.9	423.0	16.786	30	55.955	4.185	4.278
14:30	367.7	11.6	2.53	1.071	29.348	393.8	7.452	27.3	34.3	448.7	17.804	30	59.346	4.423	4.521
15:00	365.1	11.5	2.53	1.071	29.095	391.0	7.441	27.3	34.8	480.7	19.076	30	63.585	4.731	4.878
15:30	364.4	11.5	2.52	1.071	28.980	390.3	7.426	27.3	35.2	506.3	20.093	30	66.976	4.973	5.148
16:00	365.3	11.5	2.52	1.071	28.980	391.2	7.407	27.3	35.6	532.0	21.110	30	70.367	5.212	5.396

Lampiran 16. Tabel Hasil Perhitungan Volume Tangki 25 Liter (Data 1)

Waktu (Menit)	Radiasi Matahari (W/m ²)	Tegangan (V)	Arus (A)	A (m ²)	Pout (Watt)	Pin (Watt)	Efisiensi PV	T Awal	T Akhir	Kalor Air (Joule)	q air	q heater	Efisiensi Heater	Efisiensi Total	Efisiensi Aktual
9:00	332.1	11.3	2.33	1.071	26.329	355.7	7.402	27.7	27.7	0.0	0.000	30	0.000	0.000	0.000
9:30	337.2	11.5	2.4	1.071	27.600	361.1	7.642	27.7	27.9	21.4	0.848	30	2.826	0.216	0.235
10:00	334.9	11.5	2.38	1.071	27.370	358.7	7.631	27.7	28.4	74.8	2.967	30	9.891	0.755	0.827
10:30	336.6	11.5	2.39	1.071	27.485	360.5	7.624	27.7	29	138.9	5.511	30	18.369	1.400	1.529
11:00	330.1	11.4	2.37	1.071	27.018	353.5	7.642	27.7	29.4	181.6	7.206	30	24.021	1.836	2.038
11:30	343.6	11.6	2.43	1.071	28.188	368.0	7.660	27.7	29.8	224.3	8.902	30	29.673	2.273	2.419
12:00	354.4	11.6	2.44	1.071	28.304	379.6	7.457	27.7	30.3	277.7	11.021	30	36.738	2.740	2.904
12:30	355.1	11.6	2.48	1.071	28.768	380.3	7.564	27.7	30.6	309.8	12.293	30	40.977	3.100	3.232
13:00	360.4	11.6	2.48	1.071	28.768	386.0	7.453	27.7	31	352.5	13.989	30	46.629	3.475	3.624
13:30	361.9	11.7	2.49	1.071	29.133	387.6	7.516	27.7	31.3	384.6	15.260	30	50.868	3.823	3.937
14:00	354.6	11.6	2.47	1.071	28.652	379.8	7.544	27.7	31.6	416.6	16.532	30	55.107	4.158	4.353
14:30	355.7	11.6	2.46	1.071	28.536	381.0	7.491	27.7	32	459.3	18.228	30	60.759	4.551	4.785
15:00	356.4	11.6	2.46	1.071	28.536	381.7	7.476	27.7	32.3	491.4	19.499	30	64.998	4.859	5.109
15:30	356.9	11.5	2.47	1.071	28.405	382.2	7.431	27.7	32.6	523.4	20.771	30	69.237	5.145	5.434
16:00	355.3	11.6	2.47	1.071	28.652	380.5	7.530	27.7	32.9	555.5	22.043	30	73.476	5.532	5.793

Lampiran 17. Tabel Hasil Perhitungan Volume Tangki 25 Liter (Data 2)

Waktu (Menit)	Radiasi Matahari (W/m ²)	Tegangan (V)	Arus (A)	A (m ²)	Pout (Watt)	Pin (Watt)	Efisiensi PV	T Awal	T Akhir	Kalor Air (Joule)	q air	q heater	Efisiensi Heater	Efisiensi Total	Efisiensi Aktual
9:00	346.2	11.4	2.31	1.071	26.334	370.8	7.102	27.9	27.9	0.0	0.000	30	0.000	0.000	0.000
9:30	361.8	11.6	2.42	1.071	28.072	387.5	7.245	27.9	28.3	42.7	1.696	30	5.652	0.409	0.438
10:00	360.2	11.6	2.42	1.071	28.072	385.8	7.277	27.9	28.8	96.1	3.815	30	12.717	0.925	0.989
10:30	357.3	11.5	2.41	1.071	27.715	382.7	7.243	27.9	29.4	160.2	6.359	30	21.195	1.535	1.662
11:00	364.4	11.6	2.45	1.071	28.420	390.3	7.282	27.9	30	224.3	8.902	30	29.673	2.161	2.281
11:30	369.4	11.6	2.45	1.071	28.420	395.6	7.184	27.9	30.3	256.4	10.174	30	33.912	2.436	2.572
12:00	368.4	11.6	2.45	1.071	28.420	394.6	7.203	27.9	30.7	299.1	11.869	30	39.564	2.850	3.008
12:30	367.9	11.5	2.46	1.071	28.290	394.0	7.180	27.9	31.2	352.5	13.989	30	46.629	3.348	3.550
13:00	375.6	11.5	2.47	1.071	28.405	402.3	7.061	27.9	31.6	395.2	15.684	30	52.281	3.692	3.899
13:30	377.3	11.6	2.48	1.071	28.768	404.1	7.119	27.9	32	438.0	17.380	30	57.933	4.124	4.301
14:00	378.1	11.6	2.5	1.071	29.000	404.9	7.161	27.9	32.4	480.7	19.076	30	63.585	4.554	4.711
14:30	384.4	11.6	2.52	1.071	29.232	411.7	7.100	27.9	32.6	502.1	19.923	30	66.411	4.715	4.839
15:00	376.5	11.5	2.49	1.071	28.635	403.2	7.101	27.9	32.9	534.1	21.195	30	70.650	5.017	5.256
15:30	377.7	11.5	2.48	1.071	28.520	404.5	7.050	27.9	33.3	576.8	22.891	30	76.302	5.380	5.659
16:00	379.5	11.4	2.49	1.071	28.386	406.4	6.984	27.9	33.7	619.6	24.586	30	81.954	5.724	6.049

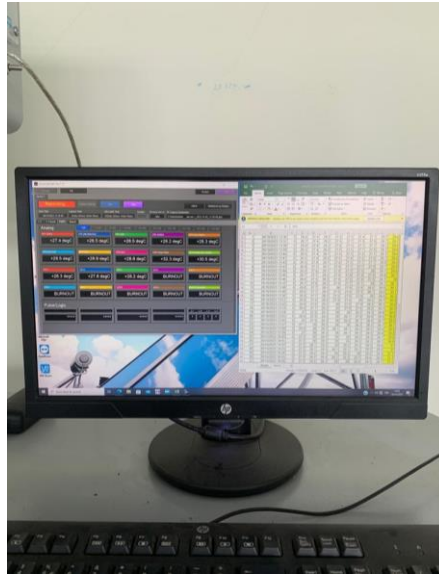
Lampiran 18. Tabel Hasil Perhitungan Volume Tangki 25 Liter (Data 3)

Waktu (Menit)	Radiasi Matahari (W/m ²)	Tegangan (V)	Arus (A)	A (m ²)	Pout (Watt)	Pin (Watt)	Efisiensi PV	T Awal	T Akhir	Kalor Air (Joule)	q air	q heater	Efisiensi Heater	Efisiensi Total	Efisiensi Aktual
9:00	362.5	12	2.4	1.071	28.800	388.2	7.418	27.9	27.9	0.0	0.000	30	0.000	0.000	0.000
9:30	359.1	12.2	2.41	1.071	29.402	384.6	7.645	27.9	28.4	53.4	2.120	30	7.065	0.540	0.551
10:00	363.5	12.4	2.42	1.071	30.008	389.3	7.708	27.9	29	117.5	4.663	30	15.543	1.198	1.198
10:30	359	12.1	2.42	1.071	29.282	384.5	7.616	27.9	29.5	170.9	6.782	30	22.608	1.722	1.764
11:00	358.1	12	2.4	1.071	28.800	383.5	7.509	27.9	30	224.3	8.902	30	29.673	2.228	2.321
11:30	358.7	11.9	2.4	1.071	28.560	384.2	7.434	27.9	30.6	288.4	11.445	30	38.151	2.836	2.979
12:00	356.2	11.8	2.37	1.071	27.966	381.5	7.331	27.9	30.9	320.5	12.717	30	42.390	3.107	3.334
12:30	361.2	11.8	2.37	1.071	27.966	386.8	7.229	27.9	31.3	363.2	14.413	30	48.042	3.473	3.726
13:00	354.7	11.8	2.38	1.071	28.084	379.9	7.393	27.9	31.6	395.2	15.684	30	52.281	3.865	4.129
13:30	358.7	11.8	2.38	1.071	28.084	384.2	7.310	27.9	32	438.0	17.380	30	57.933	4.235	4.524
14:00	366.5	11.8	2.42	1.071	28.556	392.5	7.275	27.9	32.4	480.7	19.076	30	63.585	4.626	4.860
14:30	366.2	11.8	2.42	1.071	28.556	392.2	7.281	27.9	32.7	512.7	20.347	30	67.824	4.938	5.188
15:00	365.1	11.8	2.42	1.071	28.556	391.0	7.303	27.9	33.1	555.5	22.043	30	73.476	5.366	5.637
15:30	370	11.8	2.44	1.071	28.792	396.3	7.266	27.9	33.4	587.5	23.315	30	77.715	5.647	5.883
16:00	369.4	11.7	2.46	1.071	28.782	395.6	7.275	27.9	33.7	619.6	24.586	30	81.954	5.962	6.214

Lampiran 19. Dokumentasi



Proses Pembuatan Tangki Air



Proses Pengambilan Data Pada Komputer dan Data Logger



Proses Pengambilan Data Intensitas Cahaya dengan Solar Cell



Proses Pengambilan Data Tegangan dan Arus