Sawit EcoTherm: NON-CONDUCTIVE COOLANTS FOR DATA CENTRES

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The rapid increase in heat flux within modern data centres, driven by high-performance computing, artificial intelligence, and hyperscale cloud infrastructure, has exposed the limitations of conventional air- and water-cooling systems (Al Kez et al., 2025; Li et al., 2025; Veigas et al., 2025). These traditional cooling approaches are associated with high energy consumption and, in the case of water cooling, significant water usage, leading to increased operational costs and an environmental burden (Almheiri et al., 2026; Alsmady et al., 2025; Davies et al., 2025). As global data centre energy demand continues to rise, estimated to account for a substantial fraction of total electricity consumption, the development of more efficient and sustainable cooling technologies has become a critical research focus (*Figure 1*).

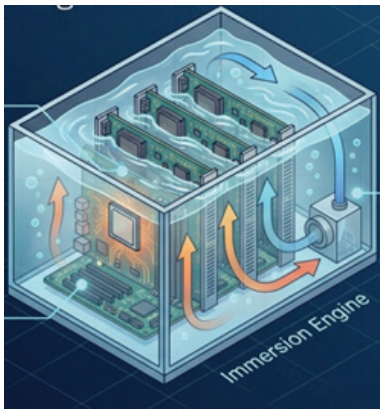

Figure 1. Cooling technology for a green data server, where server components: Motherboard, random access memory (RAM), central processing unit (CPU), network interface card (NIC), power supply unit (PSU), and graphics processing unit (GPU) are fully immersed in dielectric fluid.

Bio-based dielectric fluids (*Figure 2*), particularly palm oil-derived ester fluids, have gained increasing attention as sustainable alternatives. These fluids exhibit favourable dielectric strength, high flash point, good thermal conductivity, and excellent biodegradability, making them suitable for immersion cooling applications in information and communication technology systems (Qian et al., 2026). Overall, palm-based ester fluids offer a balanced combination of performance, safety, and environmental sustainability, positioning them as promising candidates for next-generation green immersion cooling systems.

Figure 2. Sawit EcoTherm 5s and Sawit EcoTherm 8s.

NOVELTY OF TECHNOLOGY

The novelty of this palm-based non-conductive coolant lies in its ability to combine electrical insulation with high-performance thermal management tailored for modern data centre demands. Formulated from sustainably derived palm oil fractions, the fluid exhibits high dielectric strength, ensuring safe direct contact cooling of high-density server components without risk of short circuits. Its optimised viscosity profile enables efficient flow and heat transfer at the lowest possible pumping energy, while enhanced thermal conductivity and high specific heat capacity improve heat dissipation under heavy computational loads. In addition, the fluid demonstrates strong oxidative stability, low volatility, and resistance to thermal degradation, extending service life and reducing maintenance frequency. Compared to conventional petroleum-based or synthetic coolants, this bio-based solution

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offers a reduced carbon footprint alongside reliable performance in immersion cooling systems, making it a sustainable alternative for next-generation green data centres.

ADVANTAGES

- Local resources
- Eligible for tax incentives for manufacturers
- Product technical benefits (*Table 1*)

Table 2 presents the technical specifications of Sawit EcoTherm 8s and Sawit EcoTherm 5s.

MARKET ANALYSIS

The global immersion cooling market size was estimated at USD286.8 million in 2024 and is projected to reach USD1,006.6 million by 2030, growing at a compound annual growth rate (CAGR) of 23.6% from 2025 to 2030 (Grand View Research, n.d.). The establishment of data centres globally to address the rapidly increasing use of artificial intelligence tools across industries is a primary market driver, as these facilities generally consume high levels of energy, which poses challenges to operational efficiency. Regionally, the Asia-Pacific data centre power system market size was valued at USD7.85 billion in 2025. The market is projected to grow from USD8.92 billion in 2026 to USD22.40 billion by 2034, exhibiting a CAGR of 12.2% during the forecast period (Intel Market Research, 2026). Within Southeast Asia, countries such as Malaysia, Singapore, Indonesia, and Thailand are emerging as strategic data centre hubs driven by favourable geographic positioning and increasing cloud infrastructure investment. In Malaysia, although detailed market quantification remains limited, the country is rapidly emerging as a regional data centre hub supported by strong government policies, strategic location, and increasing foreign investment in hyperscale facility.

ECONOMIC ANALYSIS

Market analysis indicates that commercial immersion cooling fluids are typically priced between RM50.00–RM80.00/kg, reflecting the high cost of synthetic and petroleum-based

TABLE 1. COMPARISON OF TECHNICAL BENEFITS ACROSS FLUID TYPES

Aspect	Sawit EcoTherm series	Mineral oil	Fluorinated two-phase fluid
Renewable	✓	✗	✗
Biodegradable	✓	✗	✗
PFAS-free	✓	✓	✗
Flash point	High	Moderate	Low
Environmental risk	Low	Moderate-high	High
Long term viability	High	Medium	Uncertain

Note: PFAS - Polyfluoroalkyl substances.

TABLE 2. TECHNICAL SPECIFICATIONS

Properties	Standard method	Sawit EcoTherm 8s	Sawit EcoTherm 5s
Appearance	-	Clear liquid	Clear liquid
Flash point COC (°C)	ASTM D92	200 min	160 min
Pour point (°C)	ASTM D97	-30 max	-25 max
Kinematic viscosity (mm^2/sec)	ASTM D445	8-10	3-5
Dielectric breakdown (kV)	IEC 60156	>75	>75
Dielectric dissipation factor at 90°C (tan ∂)	IEC 60247	<0.05	<0.05
Water content (mg/kg)	IEC 60814	<50	<50
Acidity (mg KOH/g sample)	IEC 62021	<0.03	<0.03

formulations currently dominating the industry. In contrast, the estimated raw material cost for producing palm-based non-conductive coolant is significantly lower, at approximately RM20.00–RM25.00/kg. This substantial cost advantage presents a strong value proposition, enabling competitive pricing while maintaining attractive profit margins.

REFERENCES

Al Kez, D., Foley, A. M., Wong, F. W. B. H., Dolfi, A., & Srinivasan, G. (2025). AI-driven cooling technologies for high-performance data centres: State-of-the-art review and future directions. *Sustainable Energy Technologies and Assessments*, 82, 104511.

Almheiri, M. J., Khalid, H. M., Ismail, A., Gulraiz, A., & Said, Z. (2026). Chilled water-based hybrid cooling solution for data centers: A comprehensive survey of technologies, developments, and regenerative energy transitions. *Energy Conversion and Management: X*, *30*, 101612.

Alsmady, E., Mahmood, F., & Al-Ansari, T. (2025). A review of water and energy efficient cooling systems: A case of air to water harvesting. *Journal of Building Engineering*, *110*, 113075.

Davies, W. G., Babamohammadi, S., Galloro, I., Gorbounov, M., Coletti, F., Nandy, M., & Soltani, S. M. (2025). Energy and techno-economic assessment of cooling methods in blue hydrogen production processes. *Processes*, *13*(8), 2638.

Grand View Research (n.d.). Immersion cooling market (2025–2030). Retrieved April 19, 2026, from https://www.grandviewresearch.com/industry-analysis/immersion-cooling-market

Intel Market Research (2026, April 12). Asia-Pacific data center power system market growth analysis, dynamics, key players and innovations, outlook and forecast 2026–2034. Retrieved April 19, 2026 from https://www.intelmarketresearch.com/asia-pacific-data-center-power-system-market-market-41315

Li, X., Zhao, Z., Jiang, X., Chen, Y., & He, R. (2025). A review on AI-driven optimization of data center energy efficiency and thermal management. *International Journal of Applied Science*, *8*(3), 108–127.

Qian, Y., Zhao, Y., Li, Z., Wang, Q., Tang, N., & Wang, C. (2026). Ester-based immersion coolant demonstrates superior safety for energy storage systems: A comprehensive comparative analysis. *Applications in Energy and Combustion Science*, *25*, 100436.

Veigas, K. L., Chinnici, A., De Chiara, D., & Chinnici, M. (2025). Towards energy efficiency of HPC data centers: A data-driven analytical visualization dashboard prototype approach. *Electronics*, *14*(16), 3170.