

Energy Efficiency in Outdoor LED Display Technology White Paper

A25 Low-Carbon Outdoor Display Series: A Full-Chain Energy Efficiency & ROI Guide



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Table of Contents

Preface

Industry Landscape & Key Challenges	03
Purpose & Value of This White Paper	04
Absen R&D Foundation	04

01 Outdoor LED Energy Consumption and the Sources of Power Loss

Energy Consumption Breakdown of Traditional Outdoor Displays	06
Four Primary Sources of Invalid Power Consumption	07
Light Source-Level Loss: Low Chip Efficacy, Voltage Mismatch, and Optical Waste	07
Power Transmission Loss: Inefficient Conversion, Reactive Power, and Light-Load Inefficiency	07
Control Algorithm Loss: Lack of Dynamic, Content-Aware Power Management	07
Thermal Design Loss: The Added Energy Cost of Forced Cooling	07
Limitations of 'Pseudo Energy-Saving' Solutions	08

02 A System-Wide Approach to Energy Efficiency

Light Source & LED Package Efficiency	10
High-Efficiency Power Conversion	11
IDES Intelligent Energy Management System	11
Fanless Passive Cooling Architecture	12
High-Thermal-Conductivity, All-Aluminum Cabinet	12
Balanced, Low-Impedance PCB Layout	12
IP66 Fully Sealed Protection	12
Cloud-Based Intelligent Display Management	12
A25 Series Energy-Efficiency Benchmarks	13
Optional Factory Warranty of Up to 10 Years	13
"0 Down Payment" Policy	13

03 Quantifying Energy & Cost Savings by Application

Baseline Calculation Parameters	15
Estimated Savings by Application	15
Comparison of Energy-Saving Approaches	16
Energy & Cost Savings for International Markets	16
Additional Value Across the Display Lifecycle	17

04 A25 Series in Real-World Applications

Commercial Landmark	19
Case Study 1: 750 m² A25 Display in Kuala Lumpur's Golden Triangle	19
Transportation Media	20
Case Study 2: Clear Channel Landmark Advertising Towers in the United Kingdom	20
Sports Stadium	20
Case Study 3: 2,570 m² 360° Canopy Ring Display at Prince Moulay Abdellah Stadium, Morocco	20

05 Energy-Efficiency Standards & Compliance Certification

Energy & Environmental Standards for the Chinese Market	22
International Certifications & Compliance	23
European Union Market Requirements	23
Additional Global Certifications and Testing	23
Business Value of Comprehensive Compliance	23

06 The Future of Outdoor LED Energy Efficiency

Long-Term Energy-Efficiency Trends in Outdoor LED	25
Absen Energy-Efficiency R&D Roadmap	25
Near-Term Deployment: 2025-2026	25
Mid-Term Technology Development: 2027-2028	26
Long-Term Advanced Research: 2029 and Beyond	26

07 Support from Planning Through Long-Term Operation

Customized Energy Planning	28
Standardized Installation & Commissioning	28
Global Service & Long-Term Support	28
Energy-Efficiency Upgrades for Existing Displays	28
Frequently Asked Questions (FAQ)	29

08 Conclusion & Next Steps

Take the Next Step	31
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Preface

Industry Landscape & Key Challenges

Key Takeaway: The trade-off between display brightness and electricity costs is no longer simply an operational concern. It is increasingly becoming a compliance consideration that can determine eligibility for—and competitiveness in—project tenders.

With the rapid global adoption of Digital Out-of-Home (DOOH) advertising, demand continues to grow across glass-free 3D, cultural tourism, transportation, commercial applications, and other outdoor LED display environments. Outdoor displays have become an important part of urban digital communications infrastructure. At the same time, national dual-carbon strategies and coordinated global carbon-neutrality policies are creating increasingly significant challenges for the industry:

- **High Brightness Requirements vs. High Power Consumption:** Outdoor environments with high ambient light require high display brightness. Traditional displays operate continuously at full load, converting significant amounts of electrical power into heat. Electricity costs and hardware aging expenses can substantially reduce operator profit margins.
- **Persistently High Long-Term Operating Costs:** Electricity typically accounts for more than 30% of total operating expenses (OPEX). For large landmark displays, annual utility costs can reach millions of RMB. Excessive heat also accelerates component degradation, continually increasing hidden costs associated with hardware replacement and power grid upgrades.
- **Increasingly Stringent Low-Carbon Compliance Requirements:** Numerous municipalities are restricting high-power displays. Environmental certifications, energy ratings, and Product Carbon Footprint (PCF) reports have become mandatory prerequisites for international bidding. High-power products face direct disqualification from tenders.
- **Proliferation of “Pseudo Energy-Saving” Solutions:** Products on the market often rely solely on reducing display brightness to achieve surface-level energy savings, compromising daytime advertising visibility. Mature, full-chain solutions that balance superior image quality with substantial power reduction remain extremely limited.

High energy consumption is significantly affecting operator profitability and the international expansion of enterprises. Energy efficiency has evolved from an optional feature into a core competitive advantage and an essential requirement for outdoor LED displays.

Purpose & Value of This White Paper

Focusing on energy consumption across the full lifecycle of outdoor LED displays, this white paper examines energy-saving technologies and provides three key areas of reference:

- **Product Evaluation:** Helps users clearly distinguish “True Energy Saving” from “Brightness-Depression Pseudo Energy Saving,” identify sources of invalid display loss, and establish standardized technical evaluation criteria.
- **Investment Analysis:** Provides a unified calculation model for evaluating combined financial benefits—including electricity savings, reduced maintenance costs, and compliance advantages—enabling direct assessment of long-term payback periods.
- **Industry Development:** Outlines the technological evolution of low-carbon outdoor displays, providing a strategic reference for future product selection and technology roadmaps.

Absen R&D Foundation

Recognized as a National Manufacturing Single Champion and National Green Factory, Absen brings 26 years of experience in outdoor display innovation, supported by continued investment in energy-efficient technology research and development.

Absen's expertise spans the full LED display ecosystem, from LED chips and driver ICs to power supplies, AI algorithms, and cloud-based platforms. This integrated approach to research and development led to the A25 Low-Carbon Outdoor Display Series, designed to address energy efficiency across the entire display system.

The A25 achieves a daily power consumption of less than 1kWh per square meter under partial-load conditions, with overall electricity savings exceeding 50%. The series is also available with an optional 10-year factory warranty and a “0 Down Payment” financing program, combining energy-efficient technology with long-term support and flexible financing for customers worldwide.

01

Outdoor LED Energy Consumption and the Sources of Power Loss

Key Takeaway: More than half of the electricity consumed by traditional outdoor displays is effectively used to generate heat rather than picture brightness. This is the fundamental challenge the A25 Series is engineered to address.

Traditional outdoor LED displays experience significant energy loss. A substantial portion of the electricity they consume is not converted into effective visible light. Instead, it is lost through heat generation, idle standby consumption, and active cooling systems.

This chapter examines the complete energy consumption structure of outdoor displays, identifies four major sources of invalid power loss, and explores the inherent limitations of pseudo energy-saving approaches.

Energy Consumption Breakdown of Traditional Outdoor Displays

Total power consumption consists of four primary components: LED lamps, driver and control circuitry, switching power supplies, and auxiliary cooling systems. Actual proportions vary depending on product structure and operating environment.

- **LED Lamps (60%–70%):** Power consumption is determined by LED luminous efficacy, target display brightness, and pixel density. Outdoor displays operating in high ambient light require 6,000 to 10,000 nits. Pure white content approaches peak power consumption, while dynamic video averages 30% to 50% of peak consumption.
 - **Driver and Control Circuitry (10%–20%):** Large quantities of driver ICs, power distribution lines, PCB traces, and control hardware generate static losses. Under a traditional Common Anode 4.5–5.0 V uniform power supply architecture, voltage mismatches across Red, Green, and Blue LEDs generate an estimated 10%–15% excess thermal loss compared with Common Cathode/Dual-Voltage designs.
 - **Switching Power Supply Conversion Loss (15%–20%):** Standard AC/DC power supply conversion efficiency averages 80%–85%, with unconverted electricity dissipated as heat. Conversion efficiency declines further under light-load conditions.
 - **Auxiliary Cooling Systems (5%–20%):** Traditional products rely on forced fan ventilation. When combined with external air conditioning in hot climates, higher ambient temperatures dramatically increase cooling power consumption. Passive cooling through natural convection theoretically eliminates this additional energy burden.
- Overall Analysis:** In traditional outdoor displays, only 40%–45% of electricity contributes to effective light output. More than 55% represents invalid power loss, including:
- **Thermal Loss (35%–40%):** Caused by chip inefficiencies and voltage mismatch.
 - **Fan Cooling Loss (5%–10%):** Active cooling devices consume power while contributing to a high-temperature, high-power-consumption cycle.
 - **Standby Loss (5%–10%):** Continuous energy waste caused by fixed high-voltage supplies and idle power supplies.

Four Primary Sources of Invalid Power Consumption

Light Source-Level Loss: Low Chip Efficacy, Voltage Mismatch, and Optical Waste

Traditional LED chips have low electro-optical conversion efficiency, requiring higher drive currents to achieve the same brightness while generating excessive heat. Common Anode 4.5–5 V uniform power architectures apply identical voltage to Red, Green, and Blue chips despite their different forward-voltage requirements, creating resistive line losses.

In addition, weak light focusing increases sunlight reflection, forcing operators to drive displays harder to maintain visibility. This compounds LED degradation and drives continuous increases in power consumption over a 2–3 year period.

Power Transmission Loss: Inefficient Conversion, Reactive Power, and Light-Load Inefficiency

Standard switching power supplies operate below 85% efficiency, converting more than 15% of total input power directly into thermal waste. During video playback, the Power Factor (PF) often drops below 0.75, drawing excessive reactive power from the grid.

This requires larger transformers, thicker cables, and expanded distribution boxes, increasing initial CAPEX. Inefficiency under light-load conditions, such as nighttime dimming and dark content, further increases energy waste.

Control Algorithm Loss: Lack of Dynamic, Content-Aware Power Management

Legacy control systems use fixed, constant-power output logic. They cannot dynamically match power output based on video content, ambient light, or display zoning.

As a result, driver circuits operate at near-full power regardless of whether the display is showing bright text, dark video content, or sitting idle. Without automated ambient-light dimming, displays can maintain full daytime brightness at midnight, wasting energy and contributing to urban light pollution.

Thermal Design Loss: The Added Energy Cost of Forced Cooling

Traditional cabinet fans consume electricity continuously. In dusty or humid outdoor environments, accumulated dust can clog airflow channels and progressively reduce cooling efficiency. Poorly optimized PCB routing can also create areas of increased internal resistance and localized heat, raising LED operating impedance over time.

In extreme climates, air-conditioning systems may be required, adding significant capital and operating costs. Industry data shows that traditional displays can experience a 5%–15% increase in power consumption after just two years of operation.

Limitations of 'Pseudo Energy-Saving' Solutions

Some low-cost “energy-saving” displays reduce power consumption primarily by lowering peak screen brightness. While this can reduce overall power draw, it does not address the underlying sources of energy loss within the light source, power supply, control algorithms, or thermal design. As a result, these approaches present four significant limitations:

- **Reduced Commercial Advertising Value:** In bright midday sunlight, lower screen brightness can result in washed-out or unclear visuals, reducing the display’s appeal to advertisers and its potential to generate advertising revenue.
- **No Meaningful Improvement in Maintenance or OPEX:** Energy losses associated with chip heat, voltage drop, and inefficient power conversion remain unaddressed. As a result, component aging and failure rates show no meaningful improvement.
- **Shorter Overall Display Lifespan:** Long-term operation at degraded power settings can lead to color shift and accelerated visual imbalance, often requiring complete display replacement after only 2–3 years.
- **Restricted Eligibility for Bids and Tenders:** Products that fail to meet official energy-efficiency ratings are disqualified from municipal projects and high-end international tenders.



02

A System-Wide Approach to Energy Efficiency

Key Takeaway: The Absen A25 Series combines five core energy-saving technologies into an integrated system designed to reduce power consumption across the display. Combined with an optional 10-year factory warranty and "0 Down Payment" policy, this approach addresses energy consumption, long-term maintenance, and upfront procurement costs.

Rather than relying on isolated hardware modifications, the Absen A25 integrates five areas of energy-efficient design:

Light Source Efficiency → Power Conversion Efficiency → IDES Intelligent Energy Management → Fanless Passive Cooling → Cloud-Based System Management

Real-time data exchange across these five areas dynamically adjusts power consumption to reduce energy loss across power generation, transmission, usage, thermal management, and cloud-based control. Together, these technologies enable the A25 Series to achieve more than 50% energy savings.

Light Source & LED Package Efficiency

High-Efficacy Outdoor LED Lamps

The A25 Series features proprietary high-efficacy outdoor LED lamps that use optimized quantum well light-emitting layer materials. Under standard test conditions—rated current and an ambient temperature of 25°C—white-light luminous efficacy reaches 18 cd/W, significantly exceeding the national standard baseline of 2.2 cd/W established in the Technical Specification for Energy Conservation Certification of LED Display Units.

At equivalent outdoor display brightness, the higher luminous efficacy substantially reduces the drive current required and the amount of heat generated by the LED chips. The lamps also incorporate UV-resistant and high-temperature-resistant packaging materials designed to withstand extreme heat, freezing conditions, and coastal salt spray while maintaining exceptional lumen maintenance.

标准编号: YD22060701337-137227 第 12 页 共 14 页 规格编号: 27501-701337221421

试验结果判定				
序号	检测项目	技术要求	实测值	判定
1	能源效率 (cd/W)	2.2	/	N/A
		(最小值, 最大值)		
		(平均值, 最大值)	18.10	P
2	峰值模式功率密度 (W/m²)	110	/	N/A
		(最小值, 最大值)		
		(平均值, 最大值)	15.10	P

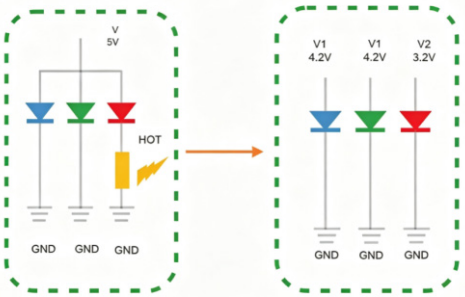
备注: 该产品没有峰值模式, 检测技术规范要求, 峰值功率密度是通过对调整 LED 显示单元输入电流状态测试计算得出。

判定: P 试验结果符合要求
F 试验结果不符合要求
N/A 要求不适用于该产品, 或不进行该项测试

A25 Energy-Saving Test Report

Common Cathode / Dual-Voltage Independent Power Supply Architecture

In place of the industry-standard 4.5–5.0 V high-voltage common anode design, the A25 uses independent dual-voltage power routing. Red LEDs operate at a lower voltage of 2.8–3.2 V, while Green and Blue LEDs operate at 3.8–4.2 V. Eliminating excess voltage reduces resistive heat loss, resulting in a baseline hardware power reduction of more than 15% at the same brightness. Eliminating voltage-dividing resistors for Red LEDs also reduces thermal stress, balances operating temperatures across the Red, Green, and Blue LEDs, prevents long-term color drift, and minimizes the need for field color calibration.



Dual-Voltage Power Supply Principle Schematic

High-Efficiency Light Extraction and Optical Focusing

The A25 combines integrated optical and thermal packaging with patterned LED chips, highly reflective mirror brackets, and high-refractive-index, low-yellowing optical silicone. Together, these technologies minimize total internal reflection, wire-bond shadowing, and cavity absorption while increasing photon extraction efficiency and optimizing the light output path. In direct midday sunlight, the display maintains crisp, vivid visuals without requiring peak drive power.

High-Efficiency Power Conversion

Ultra-High Power Factor (PFC) Optimization

Dedicated smart power supplies deliver a Power Factor (PF) of up to 0.99 when displaying a static pure-white image and maintain a PF greater than 0.90 under dynamic video loads.

Compared with conventional power supplies with a PF below 0.75 under dynamic video, this represents an improvement of more than 20%, significantly reducing reactive current from the grid and thermal losses in cabling.

For new installations, the higher PF allows transformer capacity and cable specifications to be reduced, lowering initial electrical CAPEX. For retrofit projects, existing main power cabling can be reused.

High-Efficiency Switching Power Supply

Using synchronous rectification topology, the A25's power conversion efficiency consistently exceeds 90%. Compared with conventional power supplies operating at 80%–85% efficiency, thermal loss is reduced by half, saving an estimated 500 to 1,000 kWh for every 10,000 kWh of input power.

For a 300 m² outdoor display operating over five years, power supply efficiency alone saves approximately 100,000 kWh. Wide-voltage-range compatibility supports industrial power grids worldwide while helping stabilize operation during power fluctuations.

IDES Intelligent Energy Management System

Absen's proprietary Intelligent Display Energy-Saving System (IDES) uses dynamic, content-aware power algorithms to manage energy consumption across five operating functions:

- **Tiered Power Distribution for White-Screen Content:** IDES automatically adjusts RGB drive ratios for frequently used commercial content, such as promotional backgrounds and logos, reducing white-screen power consumption by more than 50%.
- **Frame-by-Frame Zone Recognition:** The system analyzes video content frame by frame and reduces drive current in dark or static areas. Standard commercial video content saves approximately 25% in power, while advertisements with black backgrounds significantly reduce power consumption.
- **High-Precision, Closed-Loop Ambient Light Dimming:** Industrial-grade external light sensors continuously monitor ambient lux levels and adjust display brightness linearly, maintaining daylight visibility while eliminating nighttime light pollution.
- **Customizable Multi-Level Scheduling:** Custom sleep and wake schedules can be configured for weekdays, weekends, and holidays, eliminating the need for manual onsite intervention.
- **Temperature-Linked Power Protection:** The system continuously monitors module temperatures. If heat begins to accumulate, power is subtly optimized to prevent thermal runaway without altering perceived visual quality.

Fanless Passive Cooling Architecture

High-Thermal-Conductivity, All-Aluminum Cabinet

The A25 uses a 100% fanless, natural-convection thermal architecture that eliminates the 5%–10% continuous power consumption associated with mechanical fans while helping prevent dust and moisture intrusion.

Thickened aluminum-alloy structures combined with high-conductivity nano-aluminum substrates rapidly transfer heat away from the modules. Operating temperatures remain significantly lower than those of fan-cooled units, reducing internal LED resistance and creating a positive efficiency cycle:

Lower Power → Cooler Operation → Reduced Circuit Resistance

Balanced, Low-Impedance PCB Layout

The PCB layout is optimized in conjunction with the common cathode architecture. Shorter high-current trace paths, wider copper foils, and lower line impedance help eliminate localized thermal hot spots and reduce unnecessary resistance within the system.

IP66 Fully Sealed Protection

Full IP66 dustproof and waterproof sealing protects the cabinet against environmental degradation, including conditions found in coastal environments.

Traditional fan-cooled displays can lose more than 20% of their cooling capacity within two years as dust accumulates and restricts airflow. In comparison, the A25 maintains near-zero thermal performance degradation over 5 to 10 years. Stainless steel breathable valves equalize internal and external air pressure to help prevent condensation inside the cabinet.

Cloud-Based Intelligent Display Management

Through the Absen Cloud Platform, display networks can be remotely monitored, diagnosed, and managed in real time:

- **24/7 Monitoring and Early Fault Detection:** The platform collects real-time module voltage, temperature, and operating-status data and automatically sends alerts, helping prevent faulty modules from continuing to consume power while idle.
- **Centralized Energy Policy Management:** Brightness curves, ambient-light dimming thresholds, and seasonal power profiles can be managed centrally across thousands of displays.
- **Multi-Level User Permissions:** Tiered administrative permissions help prevent unauthorized onsite overrides that could increase display brightness and unnecessary power consumption.

 A25 Series Energy-Efficiency Benchmarks

Standardized Test Parameters: 14 hours of daily operation, adaptive ambient-light dimming enabled, and standard outdoor midday brightness settings.

Metric / Parameter	A25 Performance Value
Traditional Outdoor Display Power Draw	300 W/m² (Average)
Absen A25 Power Draw	112 W/m² (Average)
Pure-White Commercial Content Power Reduction	≥ 50%
Standard Dynamic Video Content Power Reduction	≥ 60%
Black Background / Night Standby Power Reduction	≥ 40%

 Optional Factory Warranty of Up to 10 Years

Typical industry warranty coverage ranges from 2–3 years, leaving display owners exposed to long-term maintenance costs and operational risk. To address these concerns, the A25 Series is available with an optional factory warranty of up to 10 years. This extended coverage is supported by five key areas:

- **Rigorous Reliability and Quality Design:** Semiconductor-grade Pressure Cooker Test (PCT) evaluates performance under high temperature, humidity, and pressure. The all-aluminum cooling system reduces operating temperatures by more than 10°C, significantly slowing the aging of electronic components in accordance with Arrhenius’s Law, also known as the 10-Degree Rule.
- **High-Standard Supply Chain Collaboration:** Absen establishes unified 10-year component standards with core upstream suppliers to support material consistency and long-term spare-parts availability.
- **Full Product Lifecycle Traceability:** Each module features a unique QR code that tracks raw materials, manufacturing batches, and historical operating data.
- **Global AbsenCare Service Network:** AbsenCare service hubs provide onsite inspections, rapid fault response, and localized spare-parts inventory.
- **Responsibility Grounded in Absen’s Corporate Values:** Guided by its commitment to integrity and accountability, Absen assumes warranty responsibility for all product-related issues.

 “0 Down Payment” Policy

For standard A25 purchases, Absen offers a “0 Down Payment” commercial payment model that allows customers to place an order without an upfront deposit and inspect the hardware and verify its performance before making final payment.

Traditional outdoor display projects require an advance deposit of 30% or more at the time of signing, creating financial exposure for buyers if actual energy savings do not meet advertised performance.

Supported by standardized quality control and large-scale production capabilities, Absen allows customers to inspect display quality, visual performance, and actual power consumption onsite before payment is made. This policy significantly reduces the amount of customer capital tied up during procurement while eliminating financial risk.

03

Quantifying Energy & Cost Savings by Application



Key Takeaway: For a 300 m² display, total cost savings over five years exceed RMB 1,000,000 (approximately USD 140,000+). These savings reflect the combined impact of lower electricity costs, reduced power infrastructure CAPEX, and lower maintenance OPEX.

All financial figures in this chapter are based on standardized theoretical simulation models. Commercial electricity rates and tiered pricing structures vary by market; actual savings will depend on local utility rates and billing structures.

Baseline Calculation Parameters

Parameter	Baseline Value
Display Size	300 m² Outdoor LED Display
Daily Operating Time	14 Hours/Day
Evaluation Period	5 Years (1,825 Days)
Electricity Rate	RMB 1.00/kWh (Commercial Rate)
Traditional Display Power Draw	300 W/m² Average (4.20 kWh/ m²/ Day)
Absen A25 Power Draw	112 W/m² Average (1.568 kWh/ m²/ Day)

Energy Savings Summary

Traditional display daily power consumption: 300 m² × 4.2 kWh/m² = **1,260 kWh**

Absen A25 daily power consumption: 300 m² × 1.568 kWh/m² = **470 kWh**

Daily energy savings: **~790 kWh**

Annual energy savings: **288,350 kWh**

Five-year cumulative energy savings: **1,441,750 kWh**

When savings from auxiliary cooling, reduced transformer and cabling CAPEX, lower maintenance labor and spare-parts costs, and carbon tax offsets are included, total five-year financial savings for a 300 m² display exceed RMB 1,440,000 (approximately USD 200,000).

Estimated Savings by Application

Note: All scenarios assume 14 hours of operation per day. Transportation displays operating 24/7 generate proportionally higher energy savings.

Application	Traditional 5-Yr Power Cost	A25 5-Yr Power Cost	5-Yr Direct Power Savings	Infrastructure & Maintenance Savings	Total 5-Yr Combined Financial Savings
Commercial Landmark 3D Screen (600 m²)	RMB 4.60 M (~USD 0.66M)	RMB 1.72 M (~USD 0.25M)	RMB 2.88 M (~USD 0.41M)	> RMB 250,000 (~USD 35,700)	~ RMB 3.13 Million (~USD 0.44M)
Transit Media Display (200 m², 14h Basis)	RMB 1.53 M (~USD 0.22M)	RMB 0.57 M (~USD 0.08M)	RMB 0.96 M (~USD 0.14M)	> RMB 90,000 (~USD 12,800)	~ RMB 1.05 Million (~USD 0.15M)
Outdoor Digital Billboard (100m²)	RMB 0.76 M (~USD 0.11M)	RMB 0.28 M (~USD 0.04M)	RMB 0.48 M (~USD 0.07M)	> RMB 60,000 (~USD 8,500)	~ RMB 540,000 (~USD 7,800)

Comparison of Energy-Saving Approaches

Note: Data is compiled from Absen’s internal product comparison testing and publicly available product documentation. Actual performance should be based on real-world measurements.

Comparison Dimension	Brightness Reduction Route (Industry Solution A)	Partial Hardware Upgrade (Industry Solution B)	Absen A25 Full-Chain Solution
Power Saving Margin	20% – 30% (Sacrifices Brightness)	15% – 25% (Single Component)	> 50% (Full-Chain Synergy)
Daytime Visibility	Severe Washed-Out Effect	Maintains Basic Brightness	Full Visibility & Color Depth
Ad Commercial Value Impact	YES (Negative Impact)	NO	NO
Cooling Method	Traditional Forced Fans	Fan-less design with insufficient heat dissipation	Fan-less design with efficient heat dissipation
Typical Factory Warranty	2 – 3 Years	2 – 3 Years	Up to 10 Years
Energy / PCF Certification	Partially Compliant	Partially Compliant	Fully Certified

Brightness-reduction solutions offer a relatively low-cost approach to reducing energy consumption, but the resulting loss of brightness can directly affect display performance and advertisers’ willingness to place ads.

Partial hardware upgrades focused only on components such as power supplies or LEDs can provide additional energy savings, but their impact remains limited because they do not address energy consumption associated with thermal management.

A full-chain approach requires simultaneous optimization across four areas: the light source, power supply, control algorithms, and thermal management. By addressing energy consumption across all four areas, the A25 Series achieves significantly greater energy savings.

Energy & Cost Savings for International Markets

Direct Electricity Cost Savings

Based on an international industrial electricity rate of USD 0.25/kWh, five-year energy savings of 1,441,750 kWh translate to approximately USD 360,000 in direct electricity cost savings for a 300 m² display.

Reducing total electricity consumption can also help prevent displays from reaching higher tiered electricity-rate brackets in international markets. By significantly reducing annual energy use, the A25 Series can help users remain within lower pricing tiers.

In addition, A25 products maintain a high power factor under video operating conditions, reducing reactive power losses on the electrical grid. In theory, this can provide an additional 5%–15% reduction in

EU ErP Compliance & Additional Financial Benefits

- **Market Access:** EU ErP directives establish strict energy-efficiency limits. Non-compliant products face exclusion from European tenders, potentially putting multimillion-euro media contracts at risk.
- **Carbon Tax Savings:** Reducing energy consumption by more than 50% lowers corporate carbon tax liabilities under EU carbon border adjustment frameworks.
- **ESG Procurement Advantage:** Third-party TÜV SÜD Product Carbon Footprint (PCF) reports fulfill mandatory ESG procurement criteria for global Fortune 500 brands.

International Maintenance & Power Infrastructure Savings

With international technical labor costs running three to five times higher than domestic rates, the A25's fanless, low-failure design reduces the need for field service calls.

For new installations, lower peak power draw allows transformer and distribution cabinet specifications to be reduced by approximately 30%. For retrofit projects, existing main power-feed cables can be retained, avoiding the cost of replacement.

Additional Value Across the Display Lifecycle

Energy savings represent only one component of the A25's long-term financial impact. Additional value can be realized across display lifespan, advertising performance, compliance, and available sustainability incentives.

- **Extended Display Lifespan:** Lower operating temperatures slow lumen degradation and power-component aging, extending display service life by 3 to 5 years.
- **Protected Advertising Revenue:** Energy savings are achieved without reducing brightness, preserving daytime visual clarity and advertising yield rates.
- **Streamlined Approvals and Tender Compliance:** Comprehensive certifications simplify municipal and enterprise approval processes while eliminating tender risks associated with non-compliance.
- **Policy Incentives and Carbon Credits:** Projects qualify for government energy-efficiency grants, green building incentives, and carbon credits.

04

A25 Series in Real-World Applications



Key Takeaway: Real-world installations demonstrate how the A25 Series addresses the distinct performance, energy-efficiency, environmental, and operational requirements of different outdoor LED applications.

Energy consumption, long-term operation and maintenance, environmental conditions, and compliance requirements can vary significantly by application. Even standardized display solutions must account for the specific demands of each installation.

The following projects highlight the A25 Series across three major outdoor applications: commercial landmarks, transportation media, and sports venues. Each demonstrates how the technology can be applied to address real-world operational requirements while delivering the energy-efficiency benefits outlined throughout this white paper.

Commercial Landmark

Case Study 1: 750 m² A25 Display in Kuala Lumpur's Golden Triangle

Located in the heart of Kuala Lumpur's Golden Triangle near the Petronas Twin Towers, where daily foot traffic exceeds 500,000, this 750 m² A25 display delivers glasses-free 3D creative content in one of the city's most prominent commercial districts.

The installation operates in a demanding tropical environment characterized by high temperatures, high humidity, and heavy rainfall. In these conditions, the A25 achieves more than 50% energy savings compared with competing displays. IP66 protection and a 10-year warranty further support reliable 24/7 operation while minimizing operational overhead.



Transportation Media

Case Study 2: Clear Channel Landmark Advertising Towers in the United Kingdom

Absen supplied more than 1,000 m² of outdoor LED displays across major transportation corridors in the United Kingdom, including the North London Tower, Chiswick Tower, and Manchester Tower.

Replacing legacy digital billboards reduced total site energy consumption by one-third. The displays combine common cathode dual-voltage driving, dynamic dimming, and 10,000-nit brightness to reduce heat generation and extend operating life.

The project also earned a TÜV SÜD Carbon Footprint Verification Report, supporting alignment with Clear Channel's 2030 Carbon Neutrality Strategy.

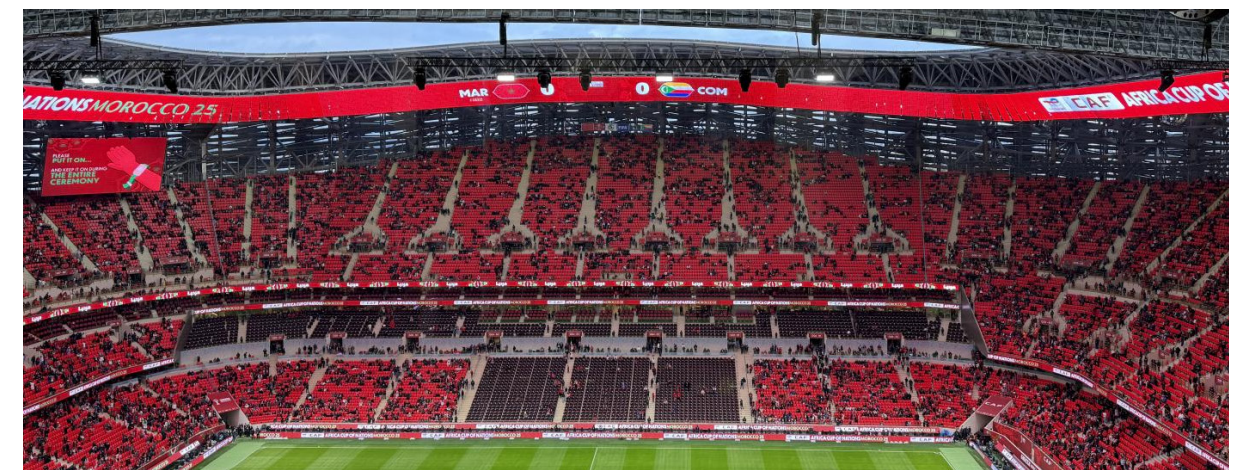


Sports Stadium

Case Study 3: 2,570 m² 360° Canopy Ring Display at Prince Moulay Abdellah Stadium, Morocco

For the main venue of the Africa Cup of Nations, Absen engineered a 2,570 m², 360° canopy ring display using the A25 Series.

Custom-designed to accommodate the stadium's complex curved geometry, the display combines IP66 weather protection, 10,000-nit brightness, a 15,000 Hz refresh rate, and full-chain energy reduction. The result establishes a benchmark for low-carbon LED display infrastructure in large-scale sports venues.



Key Takeaway: Energy-efficiency and environmental certifications are becoming increasingly important requirements for project qualification and international market access. Without the appropriate documentation, even technically competitive products may be at a disadvantage—or become ineligible—during the bidding process.

Energy-consumption requirements and environmental standards continue to evolve in both domestic and international markets. Certifications and documentation related to energy efficiency, product carbon footprint, and ErP compliance have become important considerations for project bidding and international exports. This chapter outlines the certifications and compliance documentation supporting the A25 Series, with separate sections covering requirements for the Chinese market and international markets.

Energy & Environmental Standards for the Chinese Market

- **Technical Specification for Energy Conservation Certification:** The A25 achieves a white-light LED luminous efficacy of 18 cd/W, significantly exceeding the national baseline standard of 2.2 cd/W.
- **China Energy Conservation Certification:** The A25 has obtained official energy-efficiency certification labels, which can serve as specific evaluation criteria in municipal and state-owned project tenders.
- **Green Factory and Low-Carbon Product Status:** Absen is recognized as a National Green Factory, and the A25 Series qualifies for municipal green procurement subsidies.
- **Protection and Environmental Standards:** The A25 is certified for IP66 dust and water protection, RoHS 2.0 heavy-metal restrictions, and domestic Class A/B EMC standards.

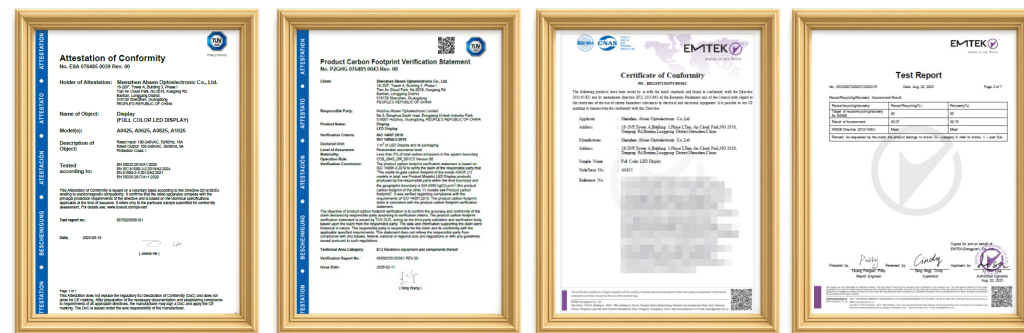


A25 Energy-Saving Certification

International Certifications & Compliance

European Union Market Requirements

- **TÜV CE Certification:** Covers compliance with the Electromagnetic Compatibility (EMC) Directive and Low Voltage Directive (LVD) safety requirements.
- **ErP Energy Directive Certification:** Provides mandatory energy-efficiency verification covering power factor, light-output efficacy, and automated dimming.
- **TÜV SÜD Lifecycle Carbon Footprint Certification:** Provides comprehensive lifecycle carbon auditing covering raw materials, manufacturing, and transportation.
- **RoHS 2.0 and WEEE Environmental Compliance:** RoHS 2.0 addresses restrictions on hazardous substances, while WEEE establishes requirements for the collection and recycling of electronic waste.



A25 TÜV CE / Carbon Footprint / RoHS / WEEE Certificates or Reports

Additional Global Certifications and Testing

The A25 Series is supported by additional certifications and testing for international markets, including Class B Commercial EMC, IP66 Ingress Protection, Accelerated Weathering Aging Reports, and CB Global Safety Certification.

Business Value of Comprehensive Compliance

Certifications and compliance documentation extend beyond technical validation. They can directly affect project eligibility, procurement decisions, and access to sustainability-related programs in different markets.

- **Reduce Barriers to Market Entry:** Products with high power consumption and insufficient certification may be at a disadvantage when competing for municipal and large-scale international projects. Comprehensive compliance documentation helps support qualification during the bidding and procurement process.
- **Support Corporate ESG Procurement Requirements:** Large domestic and international chain brands and publicly listed companies generally require suppliers to provide low-carbon and environmental credentials as part of their procurement processes.
- **Support Eligibility for Low-Carbon Programs and Incentives:** Energy-efficiency certification commonly serves as a basis for applying for programs such as domestic energy-saving subsidies, EU carbon tax relief, and North American green infrastructure incentives.

06

The Future of Outdoor LED Energy Efficiency

Key Takeaway: Adopting a system-wide approach to energy efficiency today can help organizations prepare for increasingly stringent global energy and compliance requirements over the next three years.

Long-Term Energy-Efficiency Trends in Outdoor LED

Energy efficiency in outdoor LED is moving beyond improvements to individual components. The next stage of development will increasingly combine advances in LED technology, power conversion, intelligent controls, thermal management, renewable energy, and cloud-based operations.

- **More Efficient LED Packages:** Continued improvements in chip electro-optical efficiency will be accompanied by broader adoption of low-voltage common cathode architectures, reducing the amount of energy required to achieve high-brightness outdoor performance.
- **Higher-Efficiency Power Supplies:** Synchronous rectification power supplies with ultra-high power factor (PF) and near-zero standby power loss are expected to become more widely adopted, reducing energy loss throughout the power-conversion process.
- **Smarter, More Responsive Brightness Control:** AI-driven dynamic dimming will increasingly account for content type, time of day, and local ambient-light conditions, allowing display brightness and power consumption to respond more precisely to real-world operating requirements.
- **Advances in Thermal Design:** High-thermal-conductivity die-cast aluminum cabinets and fully fanless passive cooling architectures are expected to play a larger role in large-format outdoor LED, reducing the additional energy requirements associated with active cooling.
- **Integration of Renewable Energy and Storage:** Photovoltaic (PV) solar generation and battery storage systems will increasingly be integrated directly into display power infrastructure, creating new opportunities to reduce dependence on grid-supplied electricity.
- **More Intelligent, Cloud-Based Operations:** Cloud platforms will increasingly combine local weather data with advertising playback schedules, enabling display operators to automatically optimize energy-consumption strategies throughout the year.

Absen Energy-Efficiency R&D Roadmap

Absen follows a rolling R&D strategy centered on three parallel stages: one generation in commercialization, one generation in active technology development, and one generation in advanced research. Strategic collaboration with upstream LED package and power supply manufacturers further supports the development of this technology ecosystem.

Near-Term Deployment: 2025–2026

Absen is scaling the A25 product portfolio across commercial, transportation, and municipal applications while continuing to optimize power design.

For SMD products operating at 10,000 nits, maximum power draw is reduced from approximately 700 W/m² to approximately 560 W/m². This phase also includes the deployment of fanless passive cooling and standard IDES algorithms.

Mid-Term Technology Development: 2027–2028

The next stage introduces Ultra-Energy-Saving editions, reducing power draw for 10,000-nit SMD displays further to approximately 450 W/m².

This phase also transitions to integrated, die-cast sealed cabinets and introduces cloud-connected dynamic energy balancing across regional display networks.

Long-Term Advanced Research: 2029 and Beyond

Long-term research will focus on chip-level Micro-LED technology for outdoor applications, near-zero standby-power driver systems, integrated photovoltaic and energy-storage systems for self-powered displays, and closed-loop raw-material recycling frameworks.



07

Support from Planning Through Long-Term Operation

Key Takeaway: From the initial site survey and installation through annual system health checks during the 10-year warranty period, customers have a dedicated point of contact within Absen's global service network.

Backed by the global AbsenCare service network, Absen supports both new installations and retrofit projects from initial planning through long-term operation. ACE-certified engineers and standardized operating procedures (SOPs) help provide a consistent approach to project planning, installation, commissioning, and ongoing service.

Customized Energy Planning

Effective energy planning begins with understanding how and where a display will operate. Absen conducts onsite surveys to evaluate display dimensions, local electricity rates, operating hours, and solar exposure.

Using this project-specific information, Absen provides a customized 5- or 10-year ROI analysis that quantifies projected energy and cost savings. The planning process also includes power distribution optimization and evaluation against applicable international standards, including EU ErP and Product Carbon Footprint (PCF) requirements.

Standardized Installation & Commissioning

A25 displays arrive preloaded with IDES intelligent energy-management algorithms, minimizing the amount of field calibration required during commissioning.

Onsite installation is performed by ACE-certified engineers following standardized operating procedures. For retrofit projects, this approach is designed to streamline installation and minimize disruption to normal operations.

Global Service & Long-Term Support

Absen's service network spans 165 countries, with onsite response times of 24 hours domestically and 48 hours internationally.

Annual onsite system health checks include evaluations of cabinet cooling performance, real-time power draw, and lumen maintenance. This ongoing support helps verify system performance throughout the warranty period and identify potential issues before they affect normal display operation.

Energy-Efficiency Upgrades for Existing Displays

Existing outdoor displays can be upgraded through one of two approaches, depending on the age, condition, and infrastructure of the current system.

- **Full Display Replacement:** The existing display is replaced with A25 Series hardware, delivering more than 50% power reduction. This option is recommended for displays that have been in operation for more than three years and are experiencing high failure rates.
- **Module and Power Supply Retrofit:** Display modules and smart power supplies are upgraded while structurally sound existing cabinet frames are retained. This approach minimizes retrofit CAPEX by allowing usable portions of the existing display infrastructure to remain in place.

Frequently Asked Questions (FAQ)

Q1: Does reducing energy consumption compromise visual quality or brightness?

No. The A25's energy savings come from efficiency improvements across the LED chips, power supply, intelligent algorithms, and thermal architecture—not from reducing peak brightness. High daylight visibility is fully maintained.

Q2: Will retrofitting an existing display disrupt normal operations?

The module replacement option reuses the existing main electrical lines, reducing the construction window by half. Based on the onsite survey and project plan, outages can be scheduled during off-peak hours to minimize disruption to normal commercial operations.

Q3: How are warranty claims and repairs handled during the 10-year warranty period?

The A25 Series includes annual onsite system health checks. If a fault occurs, Absen dispatches local service teams within 24 hours domestically or 48 hours internationally, in accordance with the service agreement.

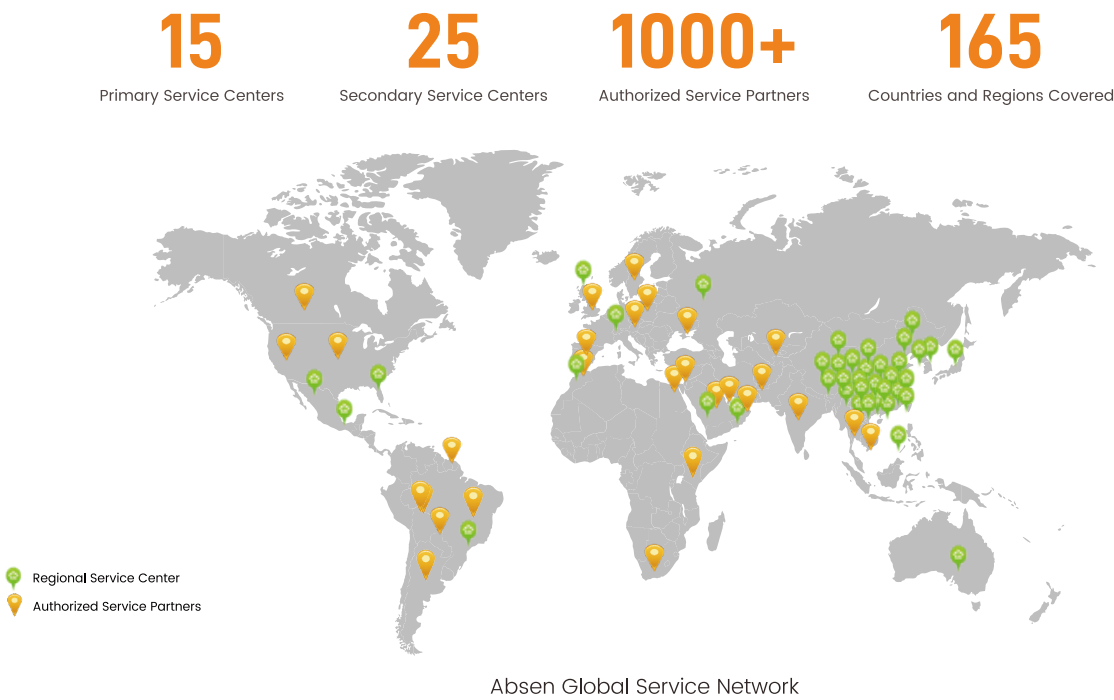
Q4: How can international projects confirm compliance with local requirements?

During the pre-bid phase, Absen provides comprehensive test reports and certification documentation covering ErP, Product Carbon Footprint, RoHS, WEEE, and CE requirements.

Q5: Can the projected energy savings in the calculation report be verified onsite?

Yes. Absen provides customized energy calculations and supports live third-party power metering and side-by-side verification.

Global Service Network



08 Conclusion & Next Steps

The outdoor LED display industry is changing as global carbon-neutrality goals place greater emphasis on energy consumption, operating costs, and long-term sustainability. As the market moves away from high-power, high-maintenance legacy systems, energy efficiency across the entire display system is becoming an increasingly important consideration for outdoor LED projects.

Drawing on 26 years of display R&D experience, Absen developed the A25 Series around an integrated approach to energy efficiency. High-efficacy LEDs, common cathode power architecture, IDES intelligent energy management, fanless passive cooling, and cloud-based control work together to reduce energy consumption across the display system.

With daily power consumption below 1 kWh per square meter under partial-load conditions and energy savings exceeding 50%, the A25 Series is designed to help customers reduce OPEX while maintaining the visual performance required for outdoor applications. An optional factory warranty of up to 10 years and Absen's "0 Down Payment" policy further address the long-term maintenance and procurement considerations associated with outdoor LED investments.

Together, these technologies and services provide a comprehensive approach to outdoor LED—one that balances visual performance, energy efficiency, long-term operating costs, and evolving low-carbon requirements.

Take the Next Step

Key Takeaway: If you are planning a new outdoor display installation or upgrading an existing display, follow these three steps to receive a precise, quantitative evaluation of your project.

1. Request a Customized Energy Analysis

Provide your display dimensions, local electricity rates, and operating hours. Absen will prepare a customized 5- or 10-year analysis of projected energy savings and payback within three business days.

2. Schedule an Onsite Engineering Survey

Absen's engineering team can evaluate site electrical conditions, structural integrity, and retrofit feasibility to help determine the appropriate approach for your project.

3. Request Compliance and Certification Documentation

For projects requiring documentation during the bidding or procurement process, Absen can provide applicable ErP, Product Carbon Footprint, RoHS, and CE documentation.

To get started, contact your Absen account representative or reach out through Absen's official customer service channels.

Dedicated Service Exceptional Experience

Please feel free to contact us. Our team is here to support you.

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0086 400-700-3278

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