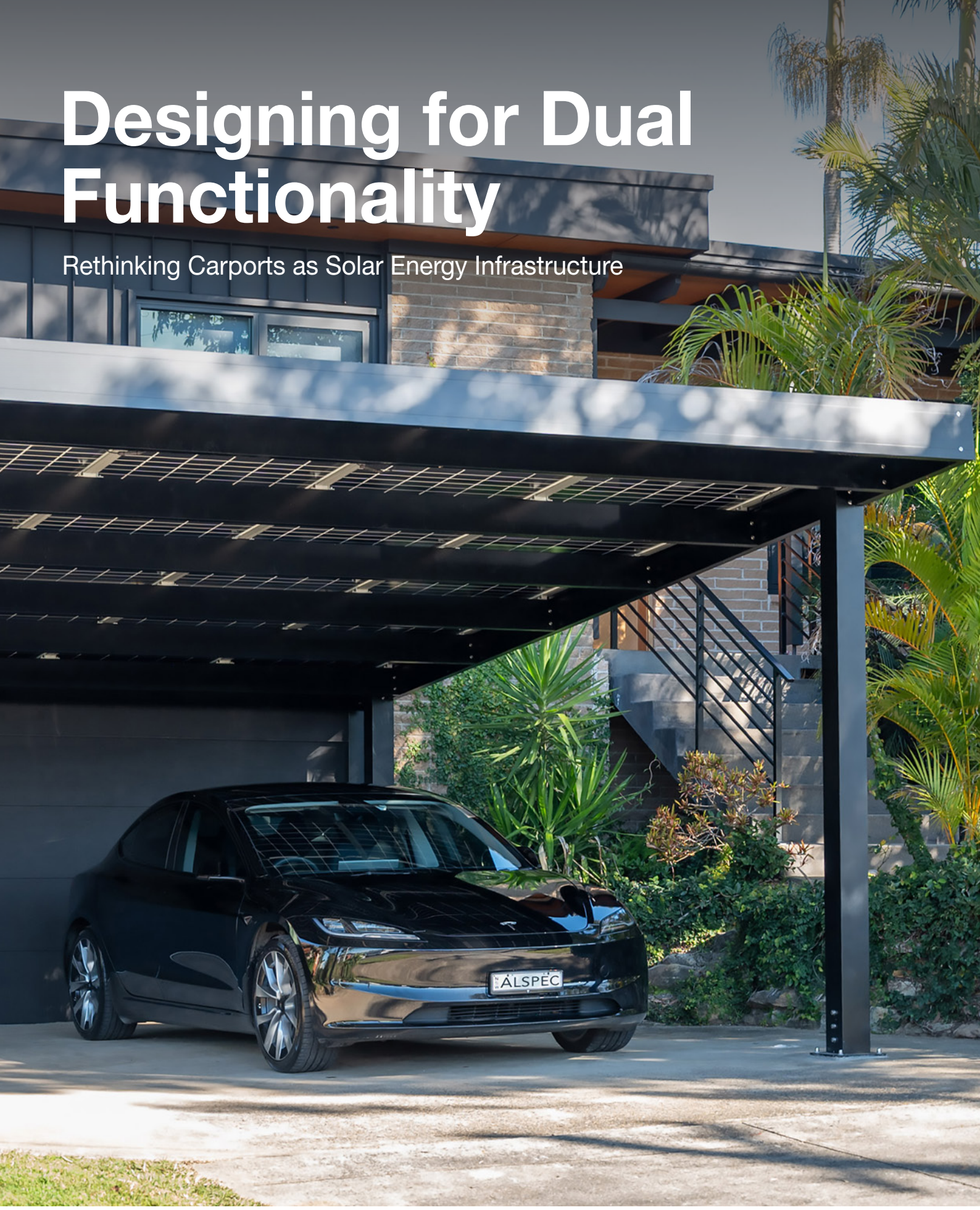
Designing for Dual Functionality

Rethinking Carports as Solar Energy Infrastructure



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INTRODUCTION

Cities and private developments across Australia are under increasing pressure to meet ambitious sustainability goals in line with federal climate targets. The national Net Zero Plan outlines a clear trajectory toward a carbon-neutral future, driven by emissions reduction legislation and supported by a growing suite of policies and funding initiatives. According to Australia's 2024 emissions projections, the nation is on track to reduce emissions by 42.7% below 2005 levels by 2030; just short of the legislated target of 43%.[1] This momentum signals a growing expectation for all sectors of the built environment to adopt design strategies that prioritise clean energy generation and operational efficiency.

As energy demand in urban areas intensifies, the integration of onsite solar generation has become a critical requirement in both public and private projects. Architects are increasingly tasked with incorporating renewable technologies into building and site layouts without compromising functional, aesthetic or spatial constraints. Traditional rooftop solar arrays are no longer the only solution. Urban planners and designers are now looking beyond the building envelope to identify new opportunities for solar integration across the entire site footprint.

As we will explore in this paper, solar carports offer a compelling answer to this challenge. By transforming parking areas into dual-purpose infrastructure, they enable energy generation without requiring additional land or compromising core site functions. These structures deliver tangible environmental benefits while also providing shade, protection from weather and a platform for future-ready smart technologies such as electric vehicle (EV) charging.

For architects, the value of solar carports lies in their versatility. They present an opportunity to contribute to project energy performance targets, enhance user experience and address sustainability certification requirements, all while turning an otherwise passive space into a high-performing asset.


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EMERGING EXPECTATIONS FOR ONSITE SOLAR GENERATION

The integration of solar photovoltaic (PV) systems has evolved from an optional upgrade to a core component of planning and design compliance across Australia. Many local governments now encourage or mandate the inclusion of solar PV in new residential, commercial and mixed-use developments. In the residential sector, minimum system sizes are often specified to meet baseline energy performance, while commercial projects face increasing pressure to install rooftop or car park-mounted solar systems to satisfy planning and environmental benchmarks.

In residential design, PV contributes directly to energy ratings under the Nationwide House Energy Rating Scheme (NatHERS), while in commercial buildings, it supports compliance with Section J of the National Construction Code (NCC) by offsetting regulated loads.

For multi-residential and mixed-use developments, state and local planning guidelines frequently promote the use of shared solar infrastructure to power communal areas, water heating systems and base building services.

From a sustainability perspective, solar PV contributes significantly to Green Star and other building rating tools by reducing operational energy demand and associated carbon emissions. These reductions align with broader net-zero policy objectives and appeal to stakeholders across both the public and private sectors. In addition, solar-equipped buildings are increasingly favoured by occupants, buyers and tenants who prioritise lower running costs and long-term energy performance. As electrification and EV adoption increase, solar also helps mitigate strain on local grid infrastructure by reducing peak demand.

By embedding solar technologies into everyday structures, architects can create cohesive designs that meet energy efficiency goals without compromising on aesthetics.

TOWARD SEAMLESS SOLAR INTEGRATION

Historically, solar technology was often treated as a bolt-on solution; functional but visually intrusive. Conventional PV panels were typically mounted on top of existing roof structures with little consideration for architectural harmony. In many cases, the panels disrupted rooflines, added visual clutter and detracted from the building's overall design integrity. As a result, early adopters of solar had to accept aesthetic compromises in exchange for performance and energy savings, limiting broader appeal particularly in architecturally sensitive or design-driven projects.

The integration of solar technologies into architectural elements has evolved beyond traditional rooftop installations, embracing innovative approaches that blend functionality with design. Building-Integrated Photovoltaics (BIPV) exemplify this trend by incorporating photovoltaic materials directly into building components such as facades, windows and shading devices.

In residential architecture, the adoption of solar-integrated structures like pergolas and carports is gaining momentum. These elements serve dual purposes: providing shade and generating renewable energy. For example, solar pergolas not only meet the demand for outdoor living spaces but also contribute to a home's energy needs. By embedding solar technologies into everyday structures, architects can create cohesive designs that meet energy efficiency goals without compromising on aesthetics.

The Alspec SolarPort integrates solar panels directly into the structure. Image credit: Alspec Solar.

THE CASE FOR SOLAR CARPORTS

Architects are increasingly challenged to integrate renewable energy solutions seamlessly into new and existing residential builds. While rooftops remain a common location for PV arrays, solar-ready carports present a versatile and underutilised opportunity, particularly in low-density residential projects where available roof space may be limited or fragmented.

Even when panels are not installed at the time of construction or handover, incorporating solar-ready features into carport designs can significantly streamline future upgrades. Structural provisions, such as roof framing capable of supporting PV weight, appropriate pitch and orientation, and concealed cable pathways, can be embedded at the outset. Similarly, pre-wiring during initial electrical rough-in avoids costly retrofitting later.

Instead of treating carports as secondary or generic structures, they can be designed as cohesive architectural elements from the outset. This is especially valuable in medium-density typologies such as duplexes, townhouses and small-lot housing, where every component contributes to the overall visual and spatial quality of the site. A well-integrated solar carport can simultaneously provide vehicle shelter, offer weather-protected access points and even function as an outdoor amenity zone.

Architectural integration elevates both performance and aesthetic. Carport structures can be designed to reflect the roof pitch, eave depth and material language of the main dwelling, creating a visually unified composition. Columns and beams can double as concealed conduits for solar cabling and rainwater drainage, allowing for clean and efficient service integration. The roof form itself can be optimised for solar generation, with orientation and tilt tailored to maximise output.

In addition to these functional and sustainability benefits, solar carports can enhance resale potential. Numerous real estate professionals and industry sources indicate that adding a carport can increase a property's overall appeal and marketability.[2] In certain markets where street parking is scarce, a well-executed carport design can make the property significantly more desirable to prospective buyers, especially when paired with energy-generating capability.

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ENERGY-RESPONSIVE COMMERCIAL DESIGN

In commercial settings, solar carports present a high-impact opportunity to integrate renewable energy without compromising usable floor area or roof space. By transforming existing parking lots into energy-generating infrastructure, solar carports allow building owners to maximise onsite generation while preserving rooftop space for HVAC, green roofs or other sustainability-focused upgrades.

Beyond their functional benefits, solar carports can contribute directly to sustainability certification frameworks such as Green Star, LEED and BREEAM. Early integration into master planning enables architects to align carport structures with broader site strategies, including passive design, circulation and landscape. These structures can also reinforce architectural identity. In retail or hospitality contexts, they may incorporate signage or branding; in campus or civic precincts, they support wayfinding, pedestrian comfort and amenity through integrated lighting and shading strategies.

Well-executed solar carports can also serve as expressive architectural elements. Using refined detailing, cantilevers or carefully selected materials, designers can mirror or complement the main building’s aesthetic. For owners and developers, the result is a visible demonstration of environmental leadership and a long-term reduction in energy costs. For tenants, solar carports enhance building performance and help meet ESG targets, making the asset more attractive from both a financial and sustainability perspective. A recent survey found that 92% of corporate tenants are more likely to remain in properties with strong green credentials, with nearly half willing to pay a premium of up to 5% for sustainable features.[3]

INTEGRATED SOLAR SOLUTIONS: ALUSHADE™

As integrated solar infrastructure becomes a cornerstone of sustainable site design, architects are looking for durable, adaptable solutions that provide both energy generation and refined aesthetics. The Alushade™ Solarport by Alspec Solar is a multi-faceted solution designed to meet the growing demand for solar energy, EV charging stations and practical shelter for vehicles. It is industry-leading in design and is made to impress, the merge of solar and aluminium is harmonious. Designed and certified to Australian standards, the Alushade™ Solarport stands out among normal and solar carports alike. With this structure being perfect for individuals who seek an architecturally friendly solar carport. Designed to maximise solar output without encroaching on internal building space, the Solarport system is particularly well-suited for Residential, Commercial and Civic developments where energy resilience, operational efficiency, and visual cohesion are equally important.

Available in single, double, and XL configurations, the system supports capacities of up to 10.44 kW using high-efficiency Alspec Solar Polaris Series 580W solar panels. These double-glass panels feature reinforced TOPCon cells, modular installation design, and integrated drainage for a fast and safe setup. Engineered for wind regions up to N4, the structure also accommodates flush EV chargers and is connectable into broader housing networks. With STC subsidy eligibility, NABERS compliance, and a 15-year panel warranty, the Solarport allows architects to design with confidence—meeting both environmental targets and client expectations for value-added infrastructure that performs across technical, regulatory, and aesthetic criteria.

Alspec's Alushade™ Patio System provides a high-performance, architecturally refined framing solution for these transitional spaces. Fully patented and engineer-certified, it is designed to perform in coastal, high-wind and high-UV conditions. Compatible with a wide range of roofing options, including single-skin sheeting, insulated sandwich panels, translucent polycarbonate, and the operable Alushade™ Louvre Roof System, it offers extensive design flexibility. Long-span internal beam profiling minimises structural bulk and enhances visual openness, while integrated features like concealed bracketry, drainage, LED lighting and louvre automation elevate functionality.

For projects seeking to integrate solar, Alspec Solar's Solarport System allows solar panels to be directly incorporated into the roof structure. The result is a dual-purpose canopy that delivers weather protection and clean energy generation.

Reference

1 Australian Government. “Net Zero.” DCCEEW. https://www.dcceew.gov.au/climate-change/emissions-reduction/net-zero (accessed 12 May 2025).

2 Giblin, Erinna. “A guide to adding a garage or carport in 2023.” Real Estate. https://www.realestate.com.au/advice/a-guide-to-garages-carports (accessed 12 May 2025).

3 EY. “Zeroing in on net zero buildings.” EY. https://www.ey.com/en_au/functional/forms/2024/zeroing-in-on-net-zero-buildings-report (accessed 12 May 2025).

All information provided correct as of July 2025