Stadium Australia

Environmentally Sustainable Design Strategy

27/08/2019

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Document Control Record

Document control						
Report title		Environmentally Sustainable Design Strategy				
Document ID			**Project number**		TBC	
Client		Infrastructure NSW				
Client contact		Tom Kennedy	**Client reference**			
Rev	**Date**	**Revision details/status**	**Author**	**Reviewer**	**Verifier** (if required)	**Approver**
0	16/08/2019	DRAFT progress issue	Zofia Kuypers	Olivier Loyez	-	Marek Tomaszewski
1	27/08/2019	Development Application Issue	Zofia Kuypers	-	Quentin Jackson	Marek Tomaszewski
Current revision		**1**				

Revision					
Author Signature			**Approver Signature**		
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Environmentally Sustainable Design Strategy for Stadium Australia

Bringing ideas to life

The sustainability strategy for Stadium Australia addresses energy and water consumption, transport characteristics, material selection and emissions from the site. It has considered legislative requirements as well as best practice guidance and strives to achieve a holistic sustainability outcome. All of this is summarised in the image below. The key component of this sustainability strategy though, is the commitment to achieve a 5 Star Green Star rating

5 Star Green Star rating
to demonstrate a commitment to holistic sustainability

Low impact concrete and steel

Reused land

Responsible building materials

Heat island mitigation

High performance envelope

Energy metering and monitoring

Efficient water based heat rejection

Water metering and monitoring

Efficient fittings and fixtures

Best practice heat rejection management

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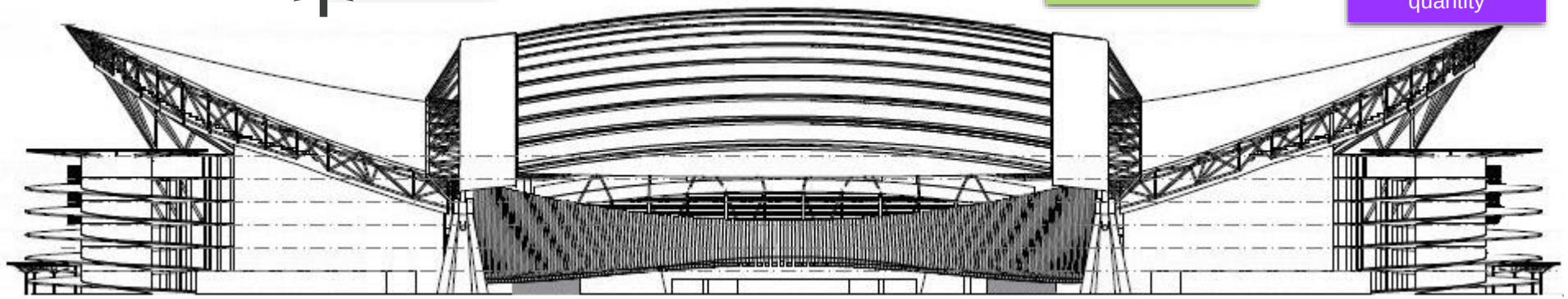

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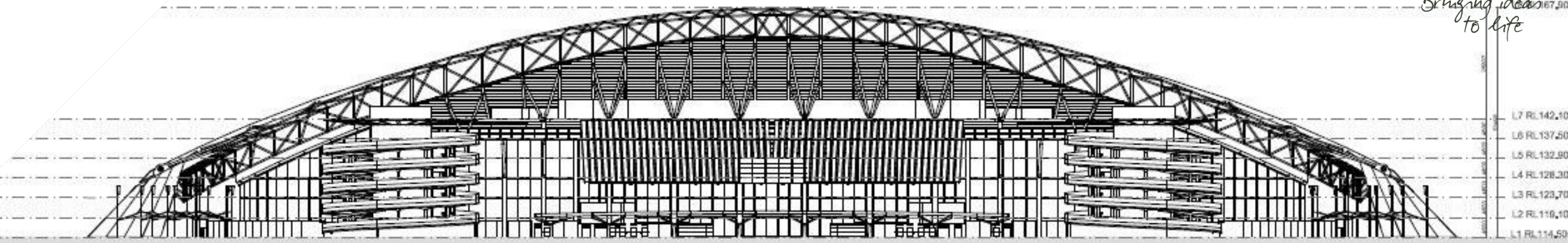
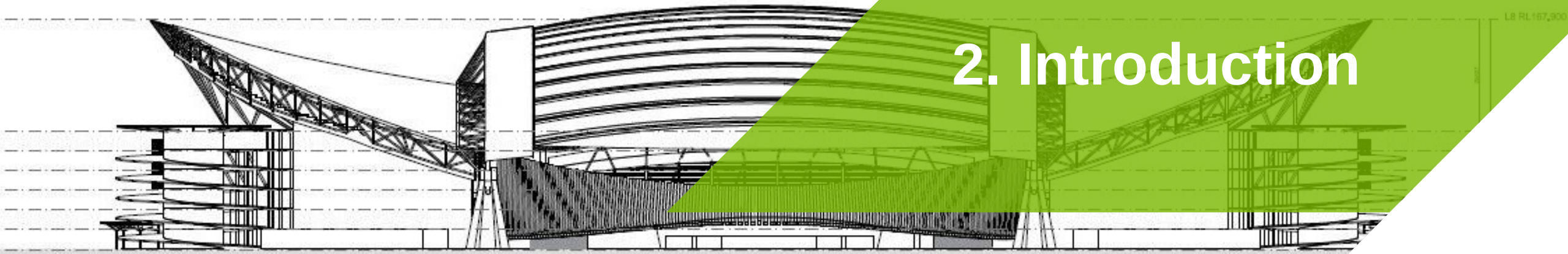
Secretary's Environmental Assessment Requirements (SEARs)

The Department of Planning, Industry and Environment (DPIE) has issued Secretary's Environmental Assessment Requirements (SEARs) to the applicant for the preparation of an Environmental Impact Statement for the proposed development. This report has been prepared having regard to the relevant SEARs as follows:

SEAR	Comment / Reference
Key Issues Address the relevant provisions, goals and objectives in the following: • Sydney Olympic Park Environmental Guidelines 2008	See Section 3 'Legislative Context'
8. Ecologically Sustainable Development (ESD)	
• detail how ESD principles (as defined in clause 7(4) Schedule 2 of the Regulation) will be incorporated in the design, construction and operation of the development	This requirement is addressed by this ESD Strategy
• outline resource, energy and water efficiency initiatives, including the use of sustainable technologies and or/renewable energy	See Section 4 'Environmentally Sustainable Design Principles'
• address how the redevelopment will have regard to achieving the minimum 4-star Green Star rating as set by the Green Building Council of Australia.	See discussion in Section 4 'Environmentally Sustainable Design Principles' and Section 5 'Sustainability Rating Frameworks'
15. Utilities	
• outline any sustainability initiatives that will minimise/reduce the demand for drinking water, including any alternative water supply and end uses of drinking and non-drinking water, and demonstrate water sensitive urban design principles are used and identify any proposed water conservation measures	See Section 4 'Environmentally Sustainable Design Principles'





2. Introduction

Introduction

This report supports a State Significant Development (SSD) Development Application (DA) for the refurbishment of Stadium Australia, which is submitted to the Minister for Planning pursuant to Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act). Infrastructure NSW is the proponent of the SSD DA.

Background

Stadium Australia opened in 1999 for the 2000 Sydney Olympic and Paralympic Games and, at the time, was the largest Olympic Stadium ever built and the second largest stadium in Australia. In March 2018, the NSW Premier announced plans to refurbish Stadium Australia to address deficiencies with the existing infrastructure and ensure that the stadium retains its status as a premier venue within a network of stadia and events infrastructure in NSW.

The NSW Stadia Strategy 2012 provides a vision for the future of stadia within NSW, prioritising investment to achieve the optimal mix of venues to meet community needs and to ensure a vibrant sports and event environment in NSW. A key action of the strategy includes developing Tier 1 stadia and their precincts covering transport, integrated ticketing, spectator experience, facilities for players, media, corporate and restaurant and entertainment provision. Stadium Australis is one of three Tier 1 stadia within NSW, the others being Sydney Football Stadium and the Sydney Cricket Ground.

In order to qualify for Tier 1 status, a stadium is required to include:

- seating capacity greater than 40,000;
- regularly host international sporting events;
- offer extensive corporate facilities, including suites, open-air corporate boxes and other function/dining facilities; and
- be the home ground for sporting teams playing in national competitions.

The refurbishment of Stadium Australia will address deficiencies in the existing infrastructure and improve facilities to be in line with contemporary Australian venue standards. The works ensure the stadium remains a modern, globally competitive venue that achieves the requirements for a Tier 1 stadium. The refurbishment of Stadium Australia addresses the following project objectives:

- transform the stadium into a ‘fan favourite’ destination for experiencing and enjoying sports and entertainment events;
- maximise the direct and indirect economic, social and cultural benefits to NSW from the project, including securing major, economically beneficial events within NSW to ensure the economic sustainability of the stadium into the future;
- deliver a multi-use contemporary rectangular venue that meets the needs of patrons, hirers and other users for rugby, football, concerts and other new forms of entertainment, and reaffirms the status of the stadium as Australia’s largest purpose-built rectangular venue in Australia;
- improve the facility’s sensitivity to the environmental conditions of the site by providing a roof which provides cover to 100% of seats (to the drip line);
- provide new and refurbished corporate areas, members areas and general admission areas to enhance the patron experience;
- promote universal accessibility, safety and security such that the stadium is welcoming, inclusive and safe for all stadium users, including persons requiring universal access;
- promote environmental sustainability and embrace a whole of life approach to operations and maintenance; and
- achieve a high standard of design and reinforce the Stadium’s status and identity within the NSW stadia network, and more broadly, nationally and internationally.

Site Description

The site is located at 15 Edwin Flack Avenue within the Sydney Olympic Park. It is bound by Edwin Flack Avenue to the west, Dawn Fraser Avenue to the south, Olympic Boulevard to the east and Qudos Bank Arena to the north. The site is located within the City of Parramatta Local Government Area.

The site is legally described as Lot 4000 in DP 1004512 and part of Lot 4001 in DP 1004512. In 2017, the Minister for Sport assigned Venues NSW as the trustee of Stadium Australia under the Sporting Venues Authorities Act 2008.

In a broader context, the site forms part of Sydney Olympic Park which is a sporting and economic centre in metropolitan Sydney that covers 680 hectares. Sydney Olympic Park comprises a range of sports and entertainment venues, parklands, and commercial, retail and residential developments. It benefits from convenient access to Homebush Bay Drive, Parramatta Road and the M4 Western Motorway, as well as Olympic Park railway station. The Parramatta Light Rail Stage 2 and Sydney Metro West will also significantly increase accessibility.

The locational context of the Site is shown in **Figure 1**, whilst the site boundaries and existing site features are shown in **Figure 2**.

Figure 1 locational context

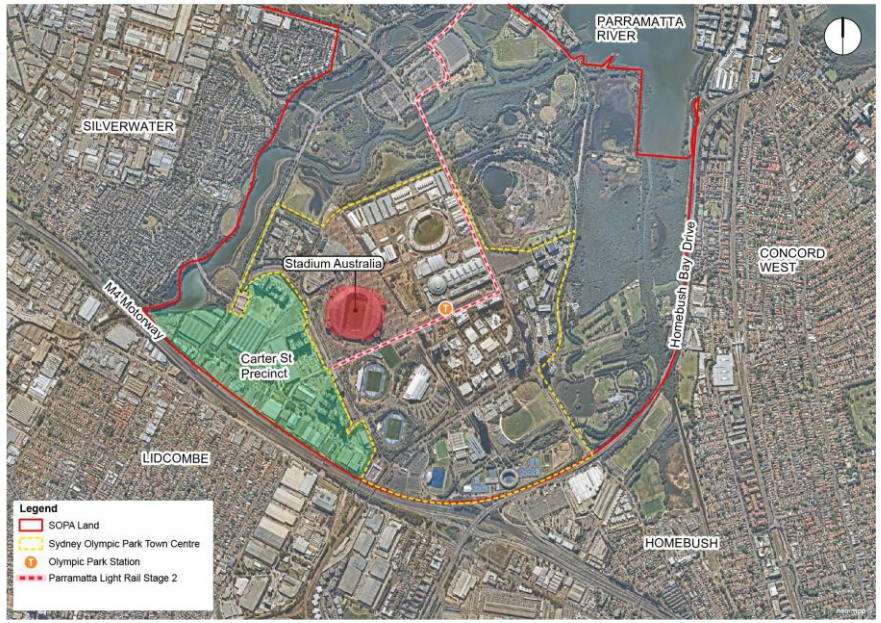


Figure 2 site boundaries and existing site features

Site Description

In March 2018 the NSW Government announced its commitment to refurbish the existing Stadium Australia and retain its status as a premier venue within a network of stadia and events infrastructure in NSW. This comprises the following:

- Reconfiguring the field of play to a permanent rectangular configuration.
- Redeveloping the lower and middle seating bowl to locate seating closer to the field and increase the pitch (steepness) of the seating bowl, which has the effect of reducing the capacity to approximately 70,000 seats (plus up to 20,000 persons on the field during concerts).
- Providing 100% drip-line roof coverage to all permanent seats by replacing the northern and southern sections of the roof and extending the existing eastern and western sections of the roof.
- Providing a new northern and southern public stadium entrance, including a new stadium facade and double-height concourse
- Renewing the food and beverage concessions, bathrooms, team facilities including new gender neutral changerooms, members and corporate facilities, press and broadcast facilities, and back of house areas.
- Providing new signage, high-definition video replay screens, LED lighting, and other functional improvements.
- Retaining the public domain areas surrounding the stadium that deliver a range of publicly accessible, event and operational areas, with minor works for tree removal..

Part of the existing stadium forecourt will be used as a construction compound during the construction phase and reinstated following the completion of works and prior to commencement of stadium operations.

Figure 3 - Indicative photomontage of proposed stadium

Definition of Sustainability

Sustainability is a broad and all-encompassing term which is often understood to mean different things by different people. This section of the report aims to provide the relevant background and context to understand what is meant by ‘Environmentally Sustainable Design’ in the context of the Stadium Australia.

The definition of sustainability that this strategy is working toward is:

The principles of ecologically sustainable development are as follows:

(a) "precautionary principle"

(b) "inter-generational equity”

(c) "conservation of biological diversity and ecological integrity"

(d) "improved valuation, pricing and incentive mechanisms"

This is as defined in clause 7(4) of Schedule 2 of the EP&A Regulation 2000.

The key sustainability focus areas in which respond to this definition are:

- Minimising greenhouse gas emissions from operational energy consumption, onsite emissions and transport to and from the site;
- Minimising consumption of natural resources such as water and materials;
- Maximising biodiversity on site through selection of native vegetation; and
- Working towards true social sustainability.

Sustainable Stadium Examples

Bringing ideas to life

In recent years there have been several stadiums developed across Australia. Sustainability has been a core consideration for many of these stadiums, with most including onsite energy generation, smart energy design and water sensitive design. The key sustainability initiatives implemented by these projects are summarised here.

Sydney Football Stadium

2020

- Capacity up to 45,000
- LEED Gold
- Design development still in progress

Western Sydney Stadium

2019

- Capacity for 30,000
- Targeting LEED Gold
- On-site renewable energy generation with roof mounted PV
- Rain water capture and energy efficient lighting

Perth Stadium

2018

- Capacity for 60,000
- Registered for a Green Star – Design & As Built rating
- No public car parking available on site

Perth Arena

2012

- Capacity for 15,500
- Displacement ventilation in the arena delivered from underneath the seats
- Mixed-mode natural ventilation in the public concourses
- Locally sourced materials (e.g. West Australian granite for entry foyers)
- Largest solar panel array in Perth Metropolitan area with 111kW capacity generation

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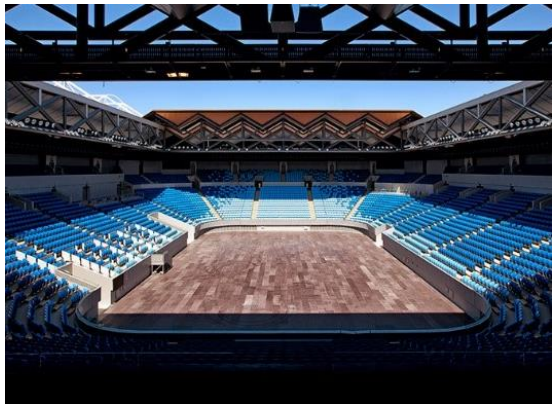
Sustainable Stadium Examples



Margaret Court Arena

2010

- LEED Gold
- Capacity for 6,000 to 7,500
- Retractable roof to minimize reliance on lighting and AC systems when external conditions are favorable
- Reuse of existing structure + recycling of construction waste generation
- Sustainably sourced timber
- Rainwater harvesting for toilets to maximize water savings

Metricon

2017

- Capacity for 35,000
- Solar halo consisting of 2,000 m² of roof mounted PV
- 215kW -peak generation, supplying up to 20% of the stadiums total energy needs
- Rain water harvesting for toilets, landscape irrigation and general wash down

Levi's Stadium (California)

2014

- Capacity for 75,000
- First United States football stadium to achieve LEED Gold certification
- PV generation from solar-paneled roof decks and solar paneled pedestrian bridges
- 2,500m² "Green Roof" on the top of the Stadium Suite Tower
- Water reclaim system for both potable and non-potable usages, including the playing field irrigation water
- Usage of reclaimed and recycling building products from local sites
- Live dashboard display featuring daily building statistics such as energy measurements, water and air monitors etc.

Metlife Stadium (New Jersey)

2010

- Capacity for 82,500
- Construction of stadium involved 40,000 tons of recycled steel, half of which was sourced from Giants stadium
- PV panel generating up to 350 kW to power lighting fixtures
- Solar Ring on a mile-long track running around the top of MetLife stadium, consisting of LED fixtures to display team colors and additional hues
- Large water savings by using synthetic turf for the playing field, waterless urinals, low-flow fixtures, sensor-controlled taps and native low-water plant species

3. Legislative Context

Sydney Olympic Park Environmental Guidelines 2008

The Sydney Olympic Park Authority (SOPA) is committed to the principles of ecologically sustainable development (ESD) within the meaning of the NSW Local Government Act (1993). This commitment is demonstrated through the Sydney Olympic Park Environmental Guidelines (2008).

The principal objective of the Environmental Guidelines is to set out a general scheme of environmental issues and commitments that aim to implement the Environmental Policy of the Sydney Olympic Park Authority with regards to the care, control, management, and development of Sydney Olympic Park.

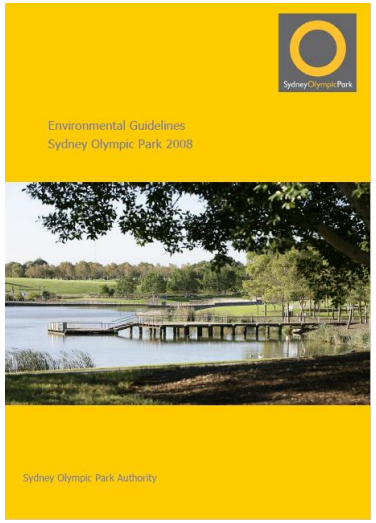
The Environmental Guidelines apply to the whole of the land identified as Sydney Olympic Park in the Sydney Olympic Park Act. In accordance with Section 20 of the Sydney Olympic Park Authority Act the Authority must before carrying out any proposed development, consider whether the proposed development is consistent with the Environmental Guidelines.

The environmental guidelines outline a series of general commitments, as well as sustainability issues and objectives.

General commitments

1. Involving people
2. Social capital
3. Liveable places
4. Environmental protection
5. Development planning & design
6. Adaptive management
7. Asset functionality

Sustainability issues



1. **Water Conservation**
   The Stadium Australia response to the water conservation objectives is outlined in the following pages.
2. **Energy Conservation**
   The Stadium Australia response to the energy conservation objectives is outlined in the following pages.
3. **Materials Selection**
   The Stadium Australia response to the material selection objectives is outlined in the following pages.
4. **Waste Management**
   The Stadium Australia response to the waste management objectives is outlined in the following pages.
5. **Transport Management**
   The transport management objectives have been addressed in full within the Transport Report.
   No commentary has been provided in the ESD report on these objectives.
6. **Pollution Control**
   The Stadium Australia response to the pollution control objectives is outlined in the following pages.
7. **Biodiversity**
   The scope of the stadium project includes the pitch and the stadium structure only. There are no external open spaces in which biodiversity initiatives could be implemented. As such, the biodiversity objectives have been found to be beyond the scope of the project.
   No commentary has been provided in this report on these objectives.
8. **Public Open Space**
   There is no public open space in this project scope.
   As such no commentary as been provided in this report on these objectives.

Sydney Olympic Park Environmental Guidelines 2008

Water Conservation Objectives	Stadium Australia Response
Minimising overall public domain water use at Sydney Olympic Park (potable and non-potable water) using best practice environmental design principles, innovative technology, water sensitive urban design, water efficient landscaping and other demand management practices	It is assumed existing arrangements will remain in-place for landscaping and public domain upkeep external to the site.
Requiring all new developments to maximise opportunities for building and infrastructure design to incorporate water collection and recycling systems	The stadium includes 4 rainwater tanks which are 500kL each. The collected rainwater is treated and used to irrigate the playing field. This objective is supported by Green Star.
Avoiding adverse impacts on water quality or quantity in local streams, wetlands and groundwater from operations, developments, and major event activities at Sydney Olympic Park	There is no external space included in the project scope. Water is collected and reused on site wherever possible with waste water sent to the site-wide Water Reclamation and Management System (WRAMS). Post-development water quality impacts are expected to be negligible owing to the zero-net gain in catchment size and stadium footprint. Changes to the in-ground drainage system will manage the quantity of stormwater runoff.
Working with lead agencies in the promotion of sustainable water resource management practices through integration of water infrastructure, sharing knowledge and experience, and supporting education and research programs	Digital water metering is to be provided to monitor consumption, and assist operators with sustainable water resource management.

Energy Conservation Objectives	Stadium Australia Response
Minimising overall public domain energy and peak load demand levels at Sydney Olympic Park.	There is no public domain within the project scope.
Prioritising in developments the use of passive solar design, natural ventilation and selection of energy efficient materials to enhance thermal performance	The refurbishment of the stadium is occurring within the footprint and overall building shape of the existing stadium. Where new building envelope components are introduced these will exceed minimum National Construction Code requirements. The commitment to achieve a 5 Star Green Star rating, which represents Australian best practice, strongly supports this objective.
Requiring energy-efficient: heating and cooling systems, building management systems, lighting, and energy consuming appliances to be incorporated in all new building projects at Sydney Olympic Park	This will be a core focus of the refurbishment and compliance with this objective will be demonstrated during detailed design with some preliminary initiatives identified in this report. The commitment to achieve a 5 Star Green Star rating, which represents Australian best practice, strongly supports this objective.
Adapting and applying best available environmental design principles, technology, demand-management, and procurement practices to progressively and significantly reduce greenhouse gas emissions	This will be a core focus of the refurbishment and compliance with this objective will be demonstrated during detailed design with some preliminary initiatives identified in this report. The commitment to achieve a 5 Star Green Star rating, which represents Australian best practice, strongly supports this objective.

Sydney Olympic Park Environmental Guidelines 2008

Materials Selection Objectives	Stadium Australia Response
Considering whole-of-life impacts on the environment when selecting materials for development and operations	Whole of life thinking has been applied to the early stage of the project and will continue to be applied as the design develops.
Prioritising the selection of natural non-toxic materials such as natural fibre insulation, and non-toxic paints, glues, varnishes, polishes, solvents and cleaning products	Compliance with this objective will be demonstrated during detailed design, as the final materials and finishes are specified in the construction drawings. This objective is supported by a number Green Star credits.
Maximising the use of recycled and recyclable materials in developments and operations, including for consumer packaging	Operational waste will be will be managed in the future operation of the stadium. The preliminary Waste Management Strategy identifies ways to prevent the accumulation of waste, and maximise recycling and reuse. There are a number of Green Star credits which support this initiative, including: - Operational Waste Management ; and - Construction and Demolition Waste Management
Encouraging material re-use for major event overlay (design for disassembly and re-use)	Operational waste will be will be managed in the future operation of the stadium. Event overlays will vary from event to event.
Prioritising non-use of chlorine, fluorine and hydrogen based carbon gases and promote as alternatives the use of non-ozone depleting, non-greenhouse warming gas refrigerants in construction, major events and other operations	Selection of low GWP refrigerants will be confirmed at the refrigerant selection process during the detailed design and construction of the stadium. This objective is supported by Green Star.
Minimising the need for use of chemical control of weeds, pests and diseases - maximising opportunities for integrated control methods	No change is proposed to external landscaping in the public domain. Aside from the pitch, the stadium will incorporate minor planter boxes on Level 3 that will be managed sustainably.
Minimising the use of known environmentally damaging or unhealthy products such as chlorine based products and chlorine bleached paper, and completely avoiding products that include toxic substances such as some treated timber products	These objectives will be reflected in the material selection process which will be confirmed in the detailed construction drawings. There is no external timber within project scope. This objective is supported by Green Star.
Prioritising the use of low impact timber products including low emission composite timber in construction and major event overlay activities, and timber from managed sustainable sources (verifiable where possible via a chain of custody process) - ensuring no imported or local rainforest timber is used in developments or other activities	This can be achieved in the material selection process, at the future detailed design stage. This objective is supported by Green Star.

Sydney Olympic Park Environmental Guidelines 2008

Waste Management Objectives	Stadium Australia Response
Maximising appropriate opportunities to increase the proportion of recycling for waste produced in the public domain including green waste collection, re-use, and composting	It is assumed existing arrangements will remain in-place for landscaping and public domain upkeep external to the site.
Requiring waste management performance and recycling targets for all developments throughout design, construction and operational activities, with a minimum of 80 percent of construction and demolition waste to be recycled or re-used for each development	Construction and demolition minimisation target in place, and is reflected in the preliminary Construction Management Plan. This objective is supported by Green Star.
Encouraging public domain concessionaires and service providers to minimise where practical the packaging of foodstuffs for visitor consumption, and otherwise to use non-toxic, recyclable, and biodegradable packaging and materials for their products	This will be targeted as part of the continued operation of the stadium.
Educating visitors, workers and residents regarding waste minimisation and management issues, and working in cooperation with venues and businesses to minimise waste generation and maximise recycling of materials	Refer to the Waste Management plan which outlines recommendations that can be implemented to minimize waste generation and maximise operational recycling rates.
Maximising appropriate opportunities to improve the sustainability of leachate treatment and disposal methods	Not applicable to the stadium.

Pollution Control Objectives	Stadium Australia Response
Complying with all relevant statutes and regulatory requirements	Project will meet this requirement.
Minimising light pollution by limiting use of lights at inappropriate times, locations, and intensities; and avoiding loss of habitat values or natural ambience for open spaces	New lighting is proposed for the stadium that will be designed to achieve relevant standards, and to consider light pollution. This objective is supported by Green Star.
Promoting the design and physical construction of new buildings so that they mitigate environmental impacts associated with major events;	The environmental impacts associated with major events are multi-facetted: they range from energy and water consumption through to material use and transport practices. The commitment to target a Green Star rating means that a holistic approach to reducing the environmental impact of the stadium will implemented.
Managing remediated landfills and leachate systems to ensure their integrity is maintained, human health and the environment is protected, and statutory compliance is achieved	Not applicable to the stadium.
Ensuring development, operations, and event activities do not adversely impact on the water quality of wetlands and watercourses	The building envelope and hardscape footprint of the stadium will not change as part of this refurbishment. The stadium currently includes a number of design strategies to manage the water quality leaving the site. Such strategies include onsite rainwater collection and reuse as well at connection to the district WRAMS system. These strategies will be maintained and, where possible, enhanced.
Validating all soils and 'fill' materials proposed to be imported into Sydney Olympic Park, and reject those that are not free from contamination	Not applicable. No soil or fill material in project scope.

NSW Government Energy Efficiency Action Plan

Bringing ideas to life

The NSW Resource Efficiency Policy (GREP) delivers specific actions from the NSW Energy Efficiency Action Plan.

The aim of GREP is to reduce the NSW Government's operating costs and lead by example in increasing the efficiency of the resources it uses.

This policy comprises a series of measures and targets which are summarised below, along with their applicability to the Stadium Australia refurbishment.

GREP Measure	Description	Application to Stadium Australia refurbishment
Energy		
E1: Targets to undertake energy efficiency projects	All clusters will undertake energy efficiency projects at sites representing 90% of their billed energy use by the end of 2023–24, with an interim target of 55% for Health and 40% for other clusters by the end of 2017–18.	Does not apply to the stadium project. However the stadium redevelopment will improve overall energy efficiency through: - Efficient LED lighting - Efficient HVAC - improved thermal performance of building envelope
E2: Minimum NABERS Energy ratings for offices and data centres	All large office buildings and datacenters will achieve and maintain high NABERS Energy ratings.	Does not apply The office spaces included in the stadium are predicted to be less than 2,000 m^2 in total size and are ancillary to the stadium operation. Should these office areas increase during design development this requirement will be readdressed.
E3: Minimum standards for new electrical appliances and equipment	All new electrical equipment purchased by the government must meet minimum energy efficiency ratings.	This measure will be addressed during detailed design.

GREP Measure	Description	Application to Stadium Australia refurbishment
E4: Minimum standards for new buildings	New buildings must be designed and built so that energy consumption is predicted to be at least 10% lower than if built to minimum compliance with National Construction Code requirements.	The stadium is committed to achieving a high level of energy efficiency and is committed to meeting this target. This measure will be addressed during detailed design. This requirement aligns with the Green Star Conditional Requirement for Energy Efficiency.
E5: Identify and enable solar leasing opportunities	Small government agencies will self-assess their suitability for solar leasing.	Does not apply This measure only applies to government sites where consumption is less than 100,000 kWh per annum.
E6: Minimum fuel efficiency standards for new light vehicles	Improve minimum fuel efficiency standards for new light vehicles	This measure is an operational requirement and is therefore not relevant at this early stage of the project.
E7: Purchase 6% GreenPower	Purchase a minimum of 6% GreenPower.	This measure is an operational requirement and is therefore not relevant at this early stage of the project.

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NSW Government Energy Efficiency Action Plan

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GREP Measure	Description	Application to Stadium Australia refurbishment
Water		
W1: Report on water use	All agencies will report on water use.	This measure is an operational requirement and is therefore not relevant at this early stage of the project. Digital water metering is to be provided to monitor consumption.
W2: Minimum water standards for office buildings	All new and refurbished owned office buildings and leased office buildings with a net lettable area of over 2000 m^2 will achieve a whole building NABERS Water rating of 4 stars where cost-effective.	Does not apply. The office spaces included in the stadium are predicted to be less than 2,000 m^2 in total size. Should these office areas increase during design development this requirement will be readdressed.
W3: Minimum standards for new water-using appliances	All new water-using appliances, shower heads, taps and toilets purchased by agencies must achieve specified levels of water efficiency.	The stadium is committed to achieving a high level of water efficiency. This measure will be addressed during detailed design.

GREP Measure	Description	Application to Stadium Australia refurbishment
Waste		
P1: Report on top three waste streams	All agencies will report on their top three waste streams by total volume and by total cost.	This measure is an operational requirement and is therefore not relevant at this early stage of the project. Note the project will have dedicated waste facilities that will be designed to facilitate effective waste management during operation as outlined in the waste management plan.
Clean Air		
A1: Air emission standards for mobile non-road diesel plant and equipment	Contractor-supplied and government-purchased equipment will comply with EU or US EPA standards.	Does not apply
A2: Low-VOC surface coatings	All surface coatings will comply with the Australian Paint Approval Scheme (APAS) where fit for purpose.	The stadium is committed to achieving excellent indoor environment quality. This measure will be addressed during detailed design.

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NSW Government Resource Efficiency Policy

In 2013 the New South Wales Government released its Energy Efficiency Action Plan (EEAP). An ambitious and wide-reaching plan to drive energy efficiency throughout NSW to ensure energy security into the future, reduce greenhouse gas emissions and lower electricity costs.

This plan is working to achieve the following goals:

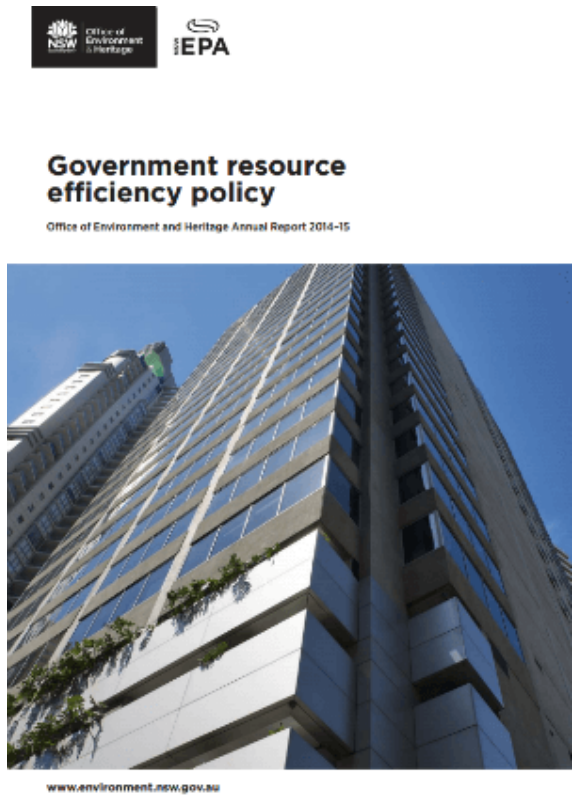
- realise annual energy savings of 16,000 gigawatthours by 2020
- support 220,000 low income households to reduce energy use by up to 20% by 2014
- deliver high standard building retrofit programs so 50% of NSW commercial floor space achieves a 4-star NABERS energy and water rating by 2020.

The energy efficiency action plan details 30 actions across five streams to deliver savings on bills and reduce pressure on future prices. The five streams are:

- strengthen the energy efficiency market
- energy efficient homes
- energy efficient business
- energy efficient government
- statewide delivery.

Synergies between this ESD Strategy and the EEAP

- Project is committed to achieving a higher level of energy efficiency than the current stadium
- The stadium is committed to achieving a high level of energy efficiency through the targeted 5 Star Green Star rating



National Construction Code

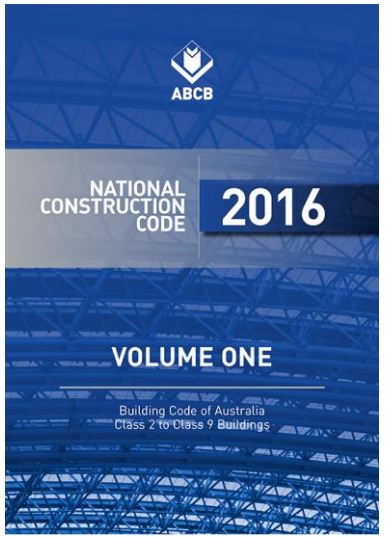
Bringing ideas to life

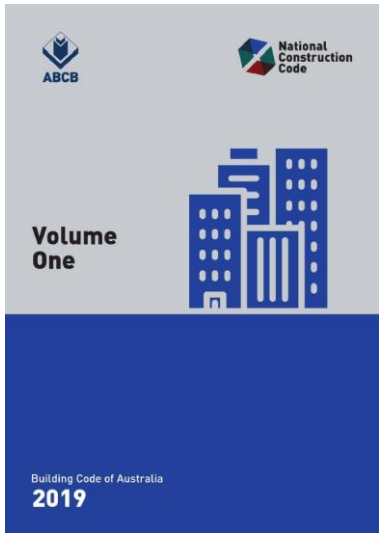
The *National Construction Code (NCC)* is a uniform set of technical provisions for the design, construction and performance of buildings throughout Australia. It is published and maintained by the Australian Building Codes Board, on behalf of and in collaboration with the Australian Government and each State and Territory Government.

Section J of the NCC outlines the minimum energy efficiency levels that must be achieved by all new developments.

Applying the NCC to an existing building?
Compliance with the NCC will be demonstrated for all new works only. Any elements of the stadium that are outside of the scope of the refurbishment will not be brought up to compliance.

For the components of Section J which are assessed on a 'per building' or 'per façade' basis, compliance will be calculated including the geometry of the existing building, but compliance will only be demonstrated for the new components.





2016 or 2019?
The current version of the National Construction Code is 2019 and this version will be applied to Stadium Australia.

However, Section J of the 2019 version of the NCC includes a grace period, whereby up until May 2020 projects can choose to comply with the Section J of 2016. This is to allow the building industry time to adjust to the significantly more stringent requirements present in 2019.

Sydney Olympic Park is located in Climate Zone 6 'mild temperate'.

Stadium Australia includes the following building classifications:

- Class 9b (assembly buildings)
- Class 6 (retail/restaurant)

Section J includes:

J1 Building Fabric – this section stipulates the minimum thermal performance of opaque building constructions i.e. roof, wall, floor. Requirements are determined by climate zone.

J2 Glazing – this section stipulates the minimum U-value and Solar Heat Gain Coefficient that must be achieved by any glazing. This is a function of the quantity and orientation of glazing included in the building.

J3 Building Sealing – outlines the minimum building sealing requirements that must be achieved.

J5 Air-conditioning and Ventilation Systems – minimum efficiency levels for HVAC equipment such as fans, pumps etc

J6 Artificial Lighting and Power – outlines minimum efficiency levels for lighting

J7 Heated Hot Water Supply

J8 Facilities for Energy Modelling

What is a JV3?
JV3 is an alternate methodology that can be used to determine compliance with the performance requirements of Section J. The JV3 methodology is used when compliance cannot be demonstrated with the prescriptive requirements as written i.e. the glazing thermal requirements cannot be achieved with products available on the market.

Green Star Approach
If the Stadium chooses to demonstrate compliance with NCC 2019, Green Star energy modelling is an approved alternate methodology for compliance.

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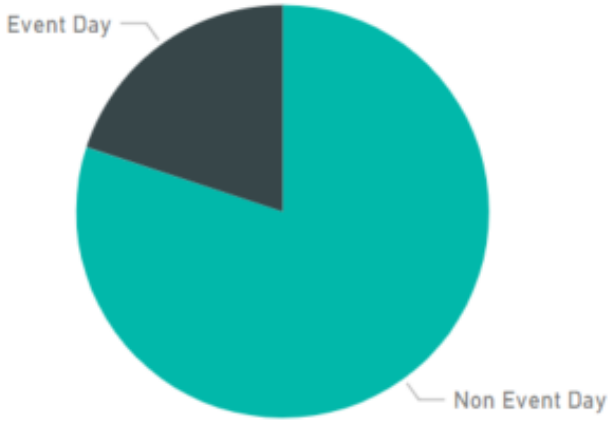
4. Environmentally Sustainable Design Principles

Energy Consumption Characteristics

Bringing ideas to life

Current stadium electricity consumption
2,651,859 kWh per year
2,333 tons of CO_2 per year
This equates to 1 million tonnes of coal burnt every year*



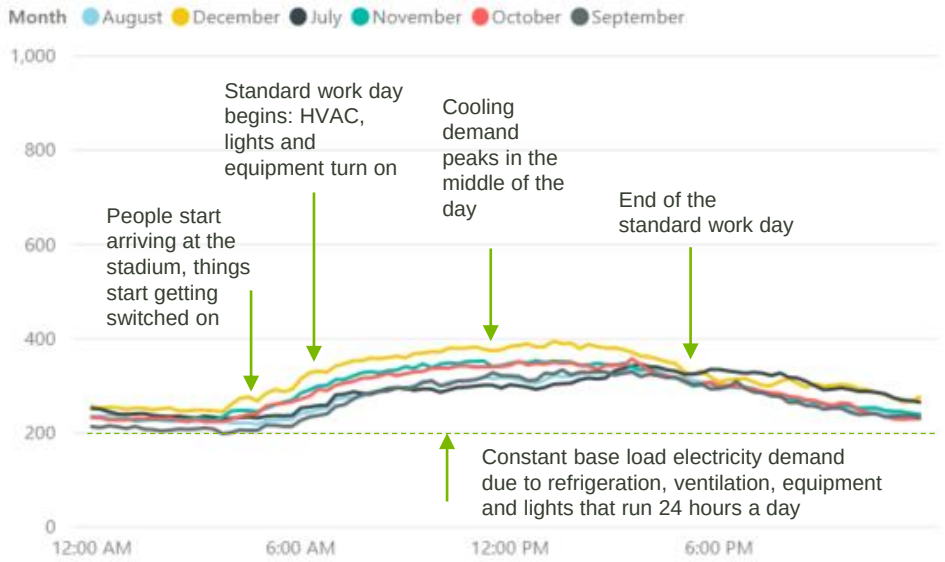
The vast majority of the energy consumed by the stadium, is consumed on non event days.

Non-event Day Energy Profile
Energy consumption data from the existing stadium has been analysed to help understand how the stadium operates, and what the opportunities are for energy improvements. The key take aways from this energy analysis are:

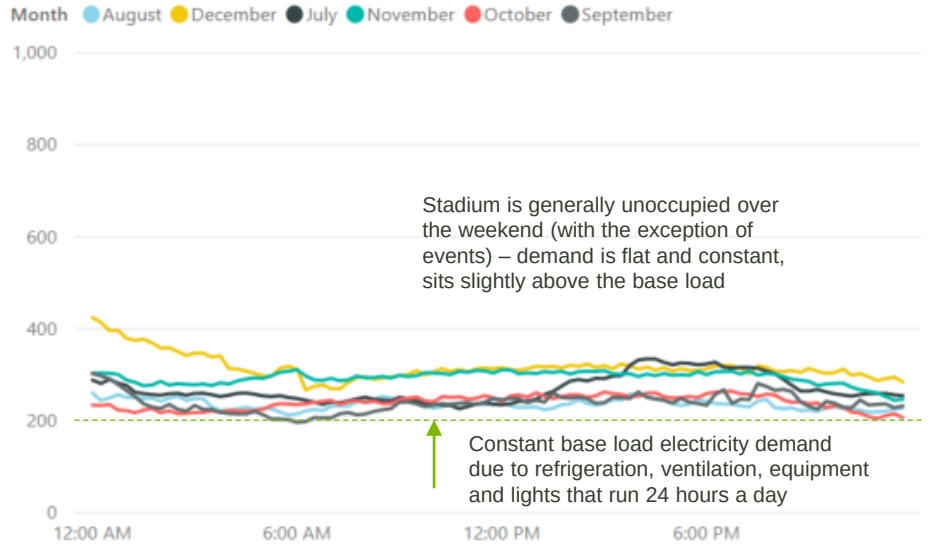
- The stadium has a very high 'base load' and the energy demand never drops below ~200kW
- Approximately 80% of the stadium's energy consumption occurs on non-event days
- The event day energy profile is very 'peaky' with the peak load time coinciding with the wider grid peak energy demand at ~7-8pm
- The energy demand of the stadium is not particularly responsive to changes in weather and there is very little difference between the energy used on a hot summer day compared with a cold winter day, this is due to:
    - Low ratio of façade to floor space, meaning a relatively small amount of the conditioned space is adjacent to the outdoors
    - Relatively low levels of occupied space, meaning the that outside air rates are relatively low
- The consistently high base load demand may be due to a number of factors such as:
    - High quantities of refrigeration units operating 24 hours a day, 7 days a week
    - There may be lights / equipment / HVAC which is not automatically shut off when not in use

* Calculated using the 2019 NSW Grid Emissions Intensity Figures

Non-Event day, week day profile



Non-Event day, weekend profile



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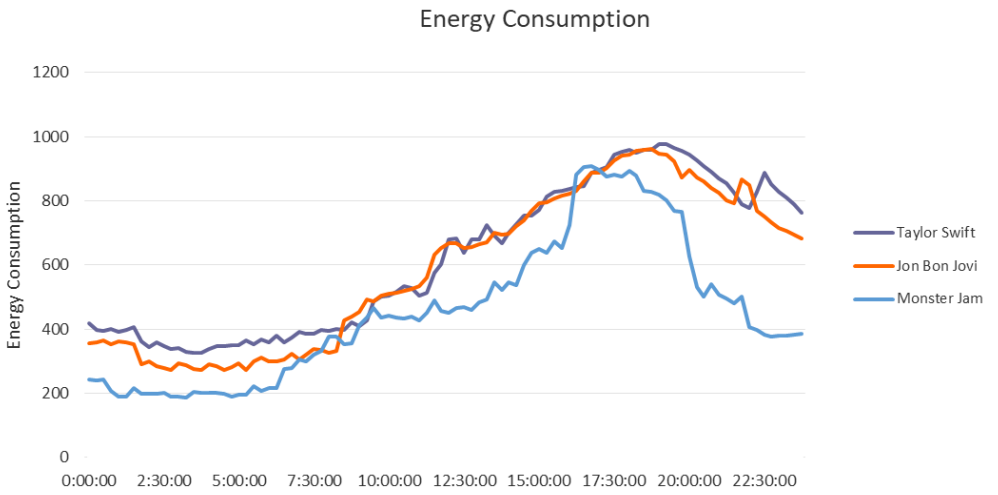
‘Event’ Energy Consumption

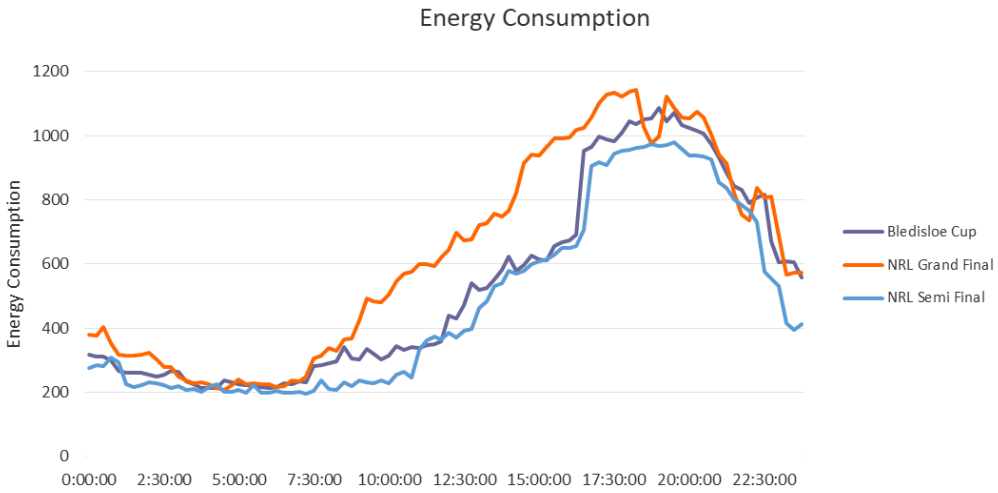
Event Day Energy Profile
There is a very clear spike in energy demand which is associated with major events such as Grand Final sport events, and major concerts. On these days the energy demand peaks at ~8pm and is approximately 5 times that of the ‘base load’.

This peak demand is due to the:
- Lights and audio-visual equipment
- Air-conditioning
- Other ancillary equipment

The key ways that this could be reduced in the refurbished design of the stadium are:
- Selection of audio-visual equipment with maximum efficiency
- Reduce HVAC loads by:
    - High performance building envelope
    - Efficient HVAC
- Intelligent monitoring and control throughout to allow for effective management of energy loads into the future

Future proof for battery installation
Some international stadiums are managing their peak electricity demand profile by installing large battery arrays. These are charged during non-event days and then used during peak times to minimise the stadium’s impact on event days.
While this is unlikely to be a ‘day 1’ strategy, the stadium could be future-proofed to allow for this in the future.





Pitch Grow Lights
Pitch Grow Lights are used to promote turf growth and achieve a high quality playing field. Usage of these lights is influenced by weather patterns, seasonal sun angle and event schedule.

The current pitch grow lights used by the stadium draw 216kW of power during operation and are typically run overnight for ~15.5 hours at a time. The energy consumption associated with the grow lights contributes approximately 10-15% of the annual energy demand.

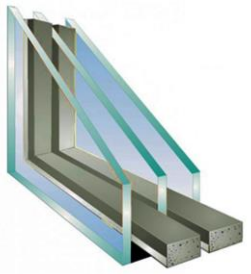
Energy consumption associated with the pitch grow lights is expected to increase following the development due to the expanded roof (and therefore decrease in sunlight), and the purchase of new grow lights.

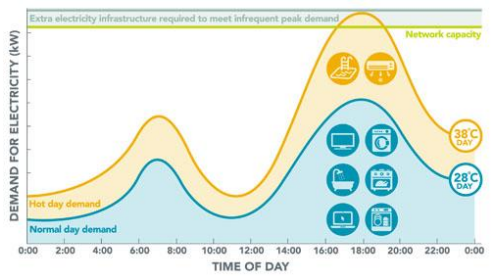
Strategies that can be implemented to help minimise the energy consumption associated with the pitch grow lights include:
- Purchasing LED grow lights. LED grow lights use ~ half of that of traditional grow lights
- Offsetting the energy demand through onsite renewables or the off-site carbon offset schemes

Energy Efficiency Opportunities

Bringing ideas to life

Opportunities for improvement
The refurbishment of Stadium Australia provides a unique opportunity to learn from the operation of existing stadium, and make informed design choices to create a more efficient stadium. In most areas, technology has progressed significantly in the 20 years since the stadium was first constructed – the opportunity exists to insert this new technology and developments into the redeveloped building. Key opportunities that will be explored for the stadium are summarised below.





LED Lights
LED lights are now being treated as standard practice. When compared to traditional fluorescent lights, the energy consumption of LED lights represents anything from a 50-70% reduction.
Selecting LED light fittings where ever possible will have a significant and positive impact on the stadium's energy consumption.

Intelligent control and monitoring
As shown in the analysis of the stadium's operational energy demand, the vast majority of the energy consumed by the stadium occurs when the stadium is not in event mode. This means that the ability to control energy usage and turn of systems when not in use, will be critical to minimising the ongoing energy demand of the stadium.

Efficient HVAC
HVAC is a significant contributor to the stadium's energy demand. New HVAC systems will achieve efficiencies levels in compliance with the National Construction Code Section J (which did not exist when the stadium was first constructed).

High performance Envelope
All new external envelope components will be designed to maximise thermal performance, and minimise air leakage, there by reduced the heating and cooling demand placed on the stadium's HVAC systems. Stadium energy demands are not dominated by envelope loads, but high performance envelope will still work to reduce the overall stadium demand.

Peak demand reduction
The stadium demand is very peaky, with peak demand occurring during event mode and typically peaking at ~8pm a night. This coincides with the overall grid peak demand. This is a negative characteristic of the stadium and during detailed design focus will be given to the efficiency of those systems used in event mode that are directly contributing to this peak demand.

Green Star Approach
Compliance with the Green Star Energy category is demonstrated through computer simulations of the stadium's energy demand. A 3D model of the stadium is created and simulated under Sydney weather conditions. The resultant energy demand is then compared against a 'reference' stadium (i.e. a stadium built to meet the NCC) and points are awarded based on the reduction in energy demand, and associated GHG emissions.

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Renewable Energy Opportunities

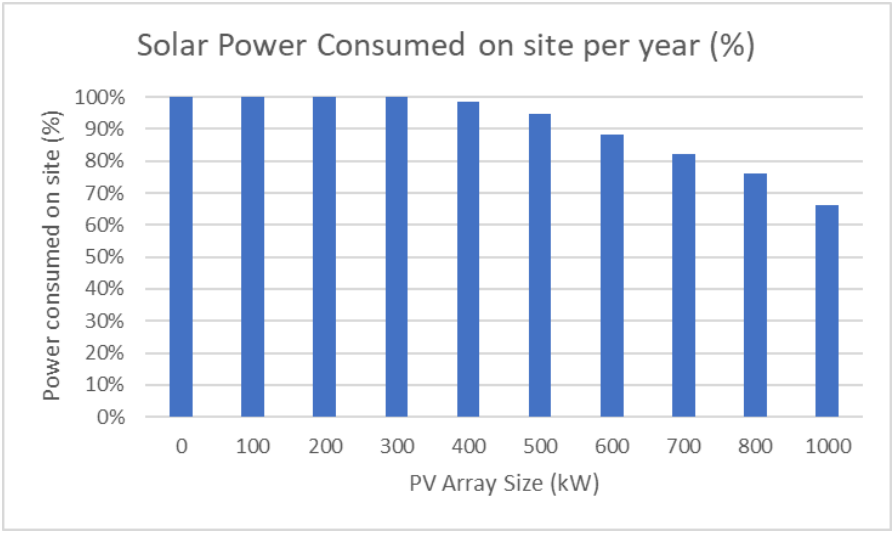
Bringing ideas to life

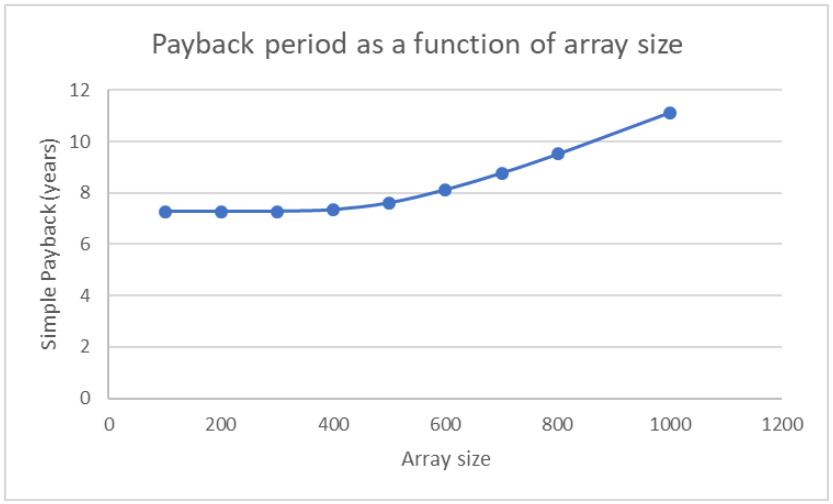
Photovoltaics
The stadium roof is a large, unshaded space which is well suited to a photovoltaic array.

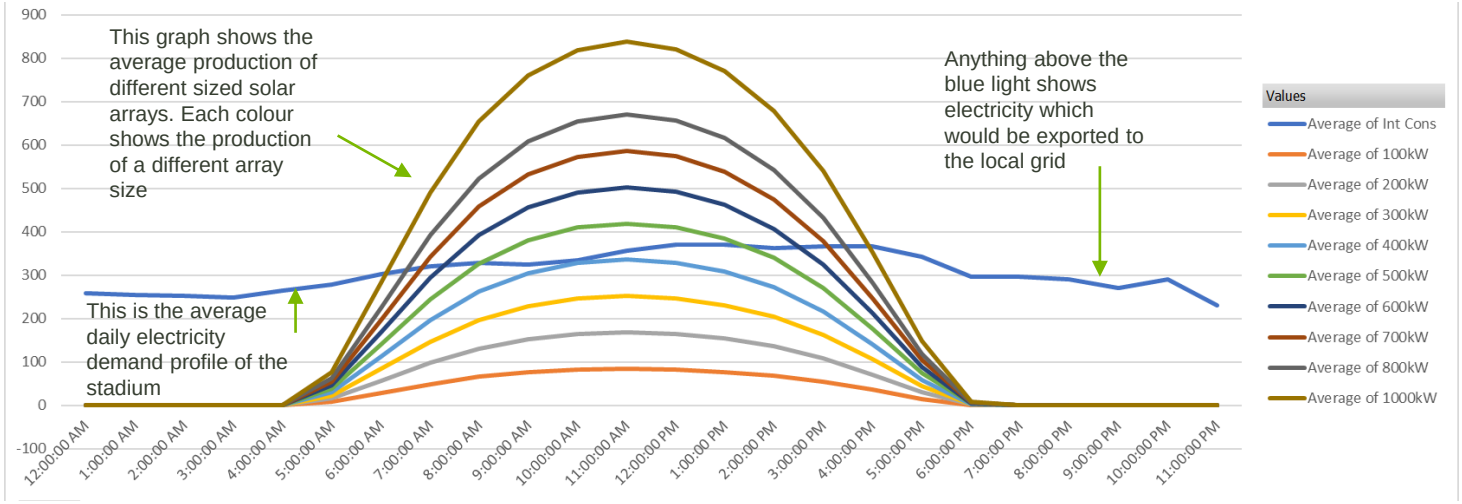
Using the historic stadium energy consumption data as a basis (acknowledging that the energy consumption will change when the stadium is refurbished) an assessment has been undertaken regarding an appropriate PV size.

Key findings
- Due to the high base load of the stadium, there is sufficient demand throughout most of the year to warrant a PV array which is producing power during sunlight hours
- An array size of 300kW and under would be entirely consumed on site with no power expected to be exported
- The expected payback of a PV system of 400kW and under is approximately 7 years

Key challenges
- PV presents an additional capital cost for a budget constrained project
- The additional weight of the PV system, and associated access for maintenance requirements, adds additional load to the light-weight stadium roof







Green Star Approach
The inclusion of renewable energy in the stadium refurbishment would contribute points towards the overall Green Star target. However renewable energy is not a mandatory Green Star requirement.

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Transport

Bringing ideas to life

Transport characteristics of ANZ Stadium
Travel to and from the stadium is dominated by spectator trips during event mode. The stadium has approximately 200 regular staff, and 1,500- 3,500 event day staff. In total this equates to ~130,000 round trips to the stadium by staff. By comparison, in a typical year the stadium experiences ~1,500,000 visitors.

Travel to and from the stadium has associated environmental impacts. These impacts range from almost nothing, for walking and cycling, through to large impacts associated with private vehicle usage. Ultimately these travel mode shares can be combined with their environmental impacts, with GHG emissions often used as a proxy, to determine the overall transport impact.

The most significant opportunity to reduce this impact lies with the travel by spectators to and from the stadium.

As shown in figure 4, the current spectator mode share to the stadium is heavily biased towards public transport, with a relatively small component of private vehicles. This is a positive attribute of the current stadium.

The key initiatives that the stadium can consider to improve the sustainability of travel to and from the stadium include:

- **Promoting public transport usage** through advertising and financial incentives such as integrated ticketing
- **Encourage travel by bicycle**, however this is unlikely to ever represent a significant mode share due to the location of the stadium

In the future, the expectation is that there will be a further shift away from private vehicle usage due to:

- Parramatta light rail and Sydney Metro West which will connect to SOPA, providing more public transport options
- The development of residential buildings within the SOPA site, increasing the proportion of local spectators

Green Star Approach
The Green Star rating tool allows for two approaches to the Transport category:

- **Prescriptive** where by points are awarded where specific requirements are demonstrate i.e. % of visitor bike parking provided
- **Performance** where points are awarded where it is demonstrated that the total impact of travel to and from the site results is reduced by the proposed development

Stadium Australia would pursue points using the performance pathway, a bespoke approach will be developed in consultation with the GBCA that will appropriately recognise the efforts made by the refurbishment to improve transport to and from the site.

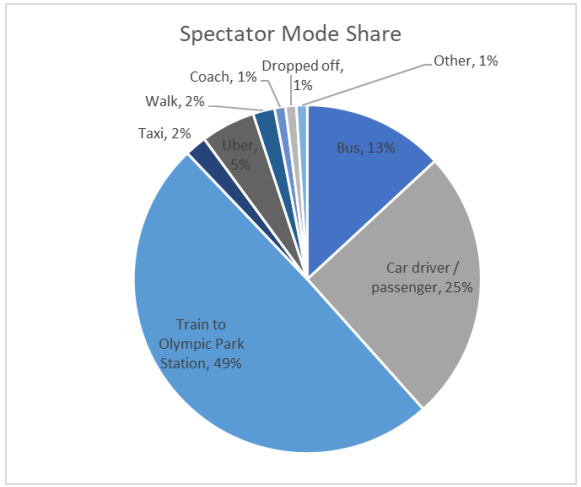

Figure 4 - spectator mode share

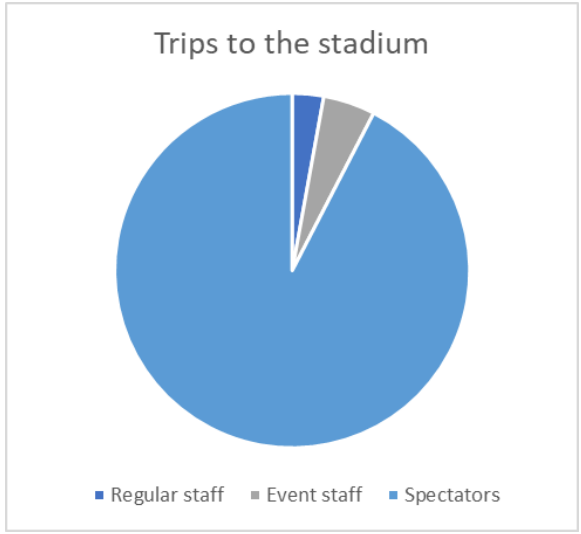

Figure 5 - trips by visitor type

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Water Efficiency

Bringing ideas to life

Opportunities for improvement
The refurbishment of Stadium Australia will enhance its already significant water management efforts.

Current stadium initiatives that will be retained

Rainwater collection and reuse
Rainwater is collected from the stadium roof, treated and used to irrigate the playing surface.
The rainwater is stored in 4 x 500 kL tanks.

Water Reclamation and Reuse System (WRAMS)
The stadium is connected to the sitewide water reclamation and reuse system. This recycled water is used to flush toilets and urinals within the stadium.
The WRAMS systems collects water from sewage and stormwater which is then treated and reticulated around the SOPA precinct.

Proposed additional initiatives

Efficient Fittings and Fixtures
All new fittings and fixtures will be selected for maximum water efficiency. The Green Star guidelines will be used as a guide.
- Taps 5 Star WELS
- Urinals 6 Star WELS
- Toilet 4 Star WELS
- Dishwashers 5 Star WELS
- Showers 3 Star WELS

Efficient Cooling Towers
Water used for heat rejection is a significant contribution to overall building water use. If the current cooling towers are replaced, they will be replaced with more water efficient alternatives. Any new cooling towers will be selected for maximum efficiency.

Metering and Monitoring
All new water systems installed as part of the refurbishment will include metering and monitoring in accordance with Green Star requirements. This will allow the building management team to effectively manage the water consumption of the building during operation.

Green Star Approach
The Green Star rating tool allows for two approaches to the Water category:
- **Prescriptive** where by points are awarded where specific requirements are demonstrate i.e. % efficiency threshold is met for fittings and fixtures
- **Performance** where points are awarded where it is demonstrated that the total water consumed by the stadium is less than that of a 'reference' stadium.

Stadium Australia would pursue points using the performance pathway, using the standard Green Star Potable Water Calculator.

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Climate Change Adaptation and Resilience

Bringing ideas to life

The refurbished Stadium Australia will exist in a changed climate. Over the short-term, and to an even greater extent the long-term, Sydney's climate will change. It will see hotter temperatures, more days of extreme heat, less predictable rainfall, more extreme weather events and rising sea levels.

The design of the refurbishment will need to consider these predicted changes and the impact they will have on the stadium, and the people within it. Outlined in Table 1 are the key climate factors that are predicted to change in the near and far future. Table 2 presents an indication of some climate resilience considerations for Stadium Australia. As the design of the stadium further resolves, a more detailed climate change resilience analysis will be undertaken to ensure that the stadium is capable of responding to a new, and less predictable climate.

Table 1 Changing climate factors

Climate Factor	2030 (near future)	2070 (far future)
Maximum temperature	Increase by 0.7° C	Increase by 1.9°C
Minimum temperature	Increase by 0.6°C	Increase by 2°C
Number of hot days (temp over 35°C) per year	Additional 5 - 10 days	Additional 10 -20 days
Cold nights	Decrease of 5.9 days	Decrease of 17.3 days
Sea level rise	0.09 - 0.19 m	0.19 – 0.59 m
Fire weather	Harsher (high confidence). 0.7 additional days over FFDI of 50	Harsher (high confidence). 2 additional days over FFDI of 50
Intensity of extreme rainfall events	Increase (high confidence)	Increase (high confidence)

Table 2 Example mitigation measures

Risk	Tangible Impacts on Stadium Australia	Mitigation Measure to Consider
Extreme heat	Reduced comfort of players and spectators. Potential risk to health.	Active cooling systems such as water misting. Provide cool refuge places around the stadium to cater for arriving spectators and to create meeting points.
Utility failure	Grid failures are expected to increase associated with extreme weather events.	Onsite electricity storage such as batteries
Increase in ambient air temperatures	HVAC systems may not be capable of providing comfort conditions.	Explore options for including additional redundancy in cooling systems. Look to reduce impact of outside temperature on HVAC loads as far as practicable through high performance envelope design.
Plant tolerance to increased heat and reduced rain	Pitch and other landscaping may not thrive in hotter conditions	Explore heat tolerant options for pitch and planter boxes

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5. Sustainability Rating Framework

Stadium Australia will pursue a
5 Star
certification using Green Star – Design & As Built v1.3

What is Green Star?

Green Star is an internationally recognised rating system that delivers independent verification of sustainable outcomes throughout the life cycle of the built environment.

Green Star encourages practices that:

- Reduce the impact of climate change.
- Enhance the health and quality of life of inhabitants and the sustainability of the built environment.
- Restore and protect the planet's biodiversity and ecosystems.
- Ensure the ongoing optimum operational performance of buildings.
- Contribute to market transformation and a sustainable economy.

Why Green Star?

- ✓ SOPA Precinct is in the process of achieving certification using Green Star - Communities
- ✓ Industry is familiar with Green Star and its requirements
- ✓ Green Star is an Australian rating scheme which has been written for Australian conditions, and references Australia Standards, guides and testing methodologies
- ✓ Green Star is located in Sydney and is very approachable. Historically they have proven themselves very willing to meeting and discuss project challenges
- ✓ The tool contains inherent flexibility
- ✓ Green Star is a local product which is administered in Australia. Supporting this scheme = supporting local jobs.

greenstar DESIGN & AS BUILT

NINE ENVIRONMENT IMPACT CATEGORIES

"Green Star is created by the Australian buildings industry, for the Australian built environment" - GBCA

% of points	Rating	Outcome
<10	-	Assessed
10-19	★	Minimum Practice
20-29	★★	Average Practice
30-44	★★★	Good Practice
45-59	★★★★ 4 Star	Australian Best Practice
60-74	★★★★★ 5 Star	Australian Excellence
75+	★★★★★★ 6 Star	World Leadership

Direct contact

Green Star is administrated by the GBCA – an organisation that is located in Sydney and has proven itself to be consistently approachable and flexible to challenging project requirements.

Inherent flexibility

Green Star has flexibility and adaptability at the core of it's rating scheme. Half of the impact categories include 'performance' pathways, meaning that if your project cannot meet the rating tool requirements as written, you can demonstrate compliance using an approach tailored to your project.

Green Star Communities 'Cross Claim'

Because the SOPA precinct is targeting a 6 Star Green Star Communities rating, there are a number of points that can be automatically carried over to the stadium project. The number of points is confirmed on a case-by-case basis however the expectation is that ~**12 points**, or **20% of a 5 Star rating** could be carried straight across from the communities rating. This means the Stadium is already on its way to achieving a Green Star rating.

Did you know?

The creation of the Green Star rating scheme was a direct result of the Sydney Olympics, and the push to create the first 'Green Games'.

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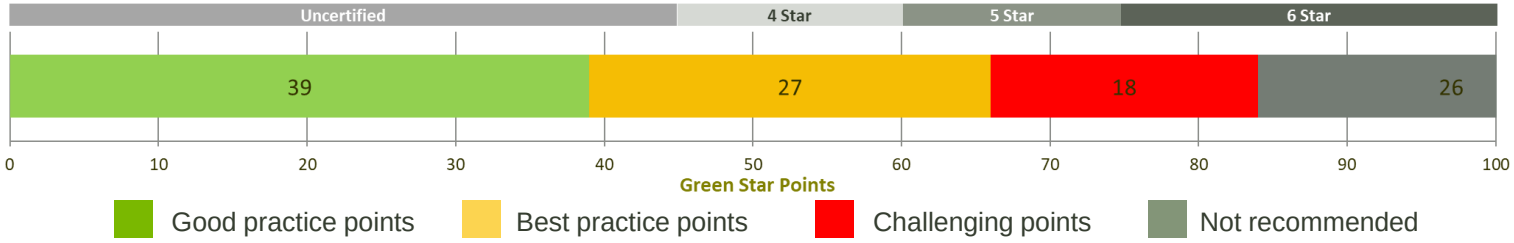
Proposed Green Star Pathway

Bringing ideas to life

To achieve a certified 5 Star Green Star rating, the Stadium must demonstrate compliance with at least **60 Green Star points**. A preliminary assessment of all available points shows that a 5 Star rating is achievable for the project. There are:

- 39 'good practice' points (items or initiatives which will be achieve by virtue of the project, or with minimal effort)
- 27 'best practice' points (items or initiatives which will require an element of effort, or add some cost, but are otherwise attainable for the stadium)



Management
10 '**good practice**' points targeted
3 '**best practice**' points targeted
Key initiatives:
- Best practice commissioning
- Operational Waste Management Plan
- Commitment to ongoing performance
- Excellent transfer of information to building users
- Climate Change Adaption and Resilience
- Metering and monitoring systems
- Responsible construction practices

Indoor Environmental Quality
5 '**good practice**' points targeted
7 '**best practice**' points targeted
Key initiatives:
- Selection of materials with low indoor pollutant loads
- Good thermal comfort due to HVAC and envelope design
- Internal noise and reverberation maintained to comfortable levels
- Increased outside air levels

Energy
3 '**good practice**' points targeted
4 '**best practice**' points targeted
Key initiatives:
- High performance building envelope
- LED lighting
- Efficient HVAC
- Potential for rooftop solar

Water
3 '**good practice**' points targeted
2 '**best practice**' points targeted
Key initiatives:
- Rainwater collection and reuse
- Efficient fittings and fixtures
- Supply of recycled water through WRAMS

Innovation
5 '**good practice**' point targeted
5 '**best practice**' point targeted
Key initiatives:
- Ultra low VOC paints
- Exceeding stormwater pollution targets
- Culture Heritage and Identity
- Financial Transparency
- High Performance Site Office
- Contractor Education
- Marketing Excellence
- Onsite renewables

Transport
3 '**good practice**' points targeted
2 '**best practice**' points targeted
Key initiatives:
- Proximity to public transport
- Low private car use

Materials
7 '**good practice**' points targeted
3 '**best practice**' points targeted
Key initiatives:
- Responsible material selection
- Low impact concrete and steel
- Construction and demolition waste management
- Reuse of building
- Best practice PVC

Land Use & Ecology
1 '**good practice**' point targeted
1 '**best practice**' point targeted
Key initiatives:
- Best practice urban heat island performance
- Reuse of land

Emissions
3 '**good practice**' point targeted
1 '**best practice**' point targeted
Key initiatives:
- Best practice stormwater performance
- Minimisation of light pollution
- Good practice refrigeration

Total
39 '**good practice**' points
+
27 '**best practice**' points
= 66 points

A 5 Star Green Star rating is very achievable for the stadium

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6. Conclusion

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Conclusion

To conclude, stadium Australia has the unique opportunity to learn, not only from the successes and failures of its own historical operation, but on the examples of sustainable stadiums present across Australia.

The proposed refurbishment of Stadium Australia has also considered the relevant legislative context, and responded to the requirements outlined in:

- The Sydney Olympic Park Environmental Guidelines 2008
- The New South Wales Energy Efficiency Action Plan
- New South Wales Government Resource Efficiency Policy
- National Construction Code

Building on these minimum compliance requirements, the stadium has outlined the sustainability principles it will apply to the refurbished stadium, addressing energy, water and materials efficiency as well as climate resilience.

These principles culminate in the commitment to achieve a 5 Star Green Star rating for the design, which is a commitment to achieve Australia Best Practice in Sustainable Design. This commitment will ensure that the stadium will consider a raft of holistic sustainability requirements throughout its design, construction and operation. Resulting in a stadium which rests more lightly on its environment, and provides a more enjoyable and healthier experience for spectators and staff.

Ultimately, though, sustainability is not a destination but a journey. As the design process develops and evolves, so to will the detail of the sustainability strategy.

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