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Environmentally Sustainable Design (ESD) Guidelines for Kidney Care Facilities

Australian and New Zealand Society of Nephrology (ANZSN)

HIP V. HYPE

ANZSN

Environmental Sustainability Committee

WHO WE ARE

HIP V. HYPE Sustainability provides advice that is commercially grounded, yet ambitious. We pursue exceptional outcomes that are socially, economically and environmentally sustainable and enable action across government, institutions and organisations.

We seek to partner with those who are willing to think strategically to achieve better. We lead, collaborate and support others to deliver impact and build Better Cities and Regions, Better Buildings, and Better Businesses.

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Contents

Introduction

This document aims to provide a robust set of best practice guidelines for Environmentally Sustainable Design (ESD) in kidney care facilities. The guidelines will help to improve the environmental performance of facilities and minimise resource use associated with kidney care.

Developed by HIP V. HYPE Sustainability for the Environmental Sustainability Committee (ESC) of the Australian and New Zealand Society of Nephrology (ANZSN), these guidelines can be used by new facilities or support the improvement of existing facilities.

The minimum requirements detailed in these guidelines are categorised in the following opportunity areas:

- Energy
- Water
- Waste and resource recovery
- Additional sustainability

These guidelines provide the kidney care sector with a set of general (i.e. applicable to hospital / health buildings broadly) and dialysis-specific opportunities which can be pursued to drive best practice sustainability outcomes in kidney care facilities.

Use of these guidelines can demonstrate industry leadership, with the opportunity for best practice sustainability initiatives applied in kidney care to then be pursued in the broader healthcare sector.

An assessment of energy and water use in two Victorian kidney care centres is currently being undertaken and may provide additional insights through an update of these Guidelines.

BACKGROUND

HIP V. HYPE Sustainability was engaged by the Environmental Sustainability Committee (ESC) of the Australian and New Zealand Society of Nephrology (ANZSN) to develop a robust set of best practice guidelines for ESD in kidney care facilities. These guidelines respond to the ESC's three year stategy (2021-2023) and its four key strategic priorities to Lead, Inspire, Support and Drive the necessary transformation of the sector.

The development of these guidelines has been informed by a literature review, facility assessments and stakeholder consultation. This process has aimed to ensure opportunities detailed in these guidelines are both ambitious and achievable.

PURPOSE

The purpose of these guidelines is to provide a tailored resource for the kidney care sector, to support the integration of best practice sustainability considerations in the design, construction and operation of kidney care facilities.

Doing so will deliver significant benefit to facility managers, staff, patients and the broader community including:

- Reduce the cost of delivering leading sustainability outcomes through earlier and more considered design integration
- Deliver reduced future cost of operating assets, including lower resource costs (e.g. energy, waste disposal), avoided maintenance costs and reduced exposure to climate risk
- Streamline the process of briefing internal and external stakeholders on sustainability expectations for facilities
- Drive practical application of existing climate and sustainability related strategies and actions
- Deliver broad carbon reduction, water conservation, climate adaptation and circular economy benefits
- Improve comfort and health related outcomes for users (workers, patients and carers)
- Demonstrate 'best environmental practice' and leadership to the sector

SCOPE

These guidelines outline objectives and minimum requirements across four opportunity areas. These aim to achieve improved outcomes above business-as-usual across different stages of the dialysis unit asset lifecycle.

Application of these guidelines to new and existing kidney care facilities is encouraged. Note several of the recommended initiatives are not specific to dialysis, and would require consideration as part of a whole of hospital / health service approach.

While there are methods of treatment outside of purpose built facilities (i.e. home dialysis), these guidelines have been developed for the specific context of dialysis units.

Barwon Health North dialysis unit in Geelong, Victoria.
Photography by Steve Moller

Context

The provision of healthcare and more specifically kidney care occurs in the context of a changing climate and increasing demand for haemodialysis treatment, with greater awareness of the impact of such services on the environment.

Improvements to kidney care facilities and the provision of haemodialysis treatment can contribute to broader efforts to reduce environmental impact across a range of sectors while also increasing the resilience of healthcare services into the future.

Integrating sustainability into the design, construction and operation of kidney care facilities is supported by a range of policies and responds to calls for greater acknowledgement of environmental sustainability by the healthcare sector.

CLIMATE CHANGE AND HEALTH

Climate change has long been viewed as a critical environmental issue, peripheral to public health. However it is quickly becoming a more prominent public health issue in Australia and across the world. It has been recognised as the greatest threat to public health by the World Health Organisation[1] and the Lancet Commission on Health and Climate Change found that it could be the greatest global health opportunity of the 21st century[2].

The vulnerability of the health and human services system has the potential to increase due to a changing climate, with possible impacts including[3]:

- Increased client demand for services
- Disruption of workforce attendance at their workplace
- Psychosocial impacts on staff
- Damage to built assets from, for example, floods, storms, and bushfires
- Disruption or failure of service infrastructure such as telecommunications, transport, electricity, and water supplies
- Disruption of supply chains

Consideration of climate change, and taking measures to respond to this issue, is important to ensure a sustainable future for all. Integral to this is the efficient use of resources and reduction of environmental impacts, with the healthcare sector well positioned to contribute to these goals.

ENVIRONMENTAL IMPACT OF HEALTHCARE AND DIALYSIS

Medical care for kidney failure, particularly dialysis therapy, has one of the highest environmental impacts on a recurrent per capita basis of any part of the health care sector.

The three greatest opportunity areas for reducing the environmental impact of kidney care are:

- Energy (e.g. energy efficiency and renewable energy)
- Water (e.g. increased efficiency and alternative water sources)
- Waste and Resource Recovery (e.g. specialised recycling streams)

Additional opportunities for improvement are categorised as Additional Sustainability.

In 2019, it was estimated that 16,799 people were receiving dialysis for kidney failure in Australia and New Zealand, with 75% (Australia) and 56% (New Zealand) receiving haemodialysis[4]. With many patients having to visit a unit three times a week, the cumulative environmental impact is significant.

Australia is also seeing a growing demand for haemodialysis services and the sector is calling for purpose-built modern dialysis centres to meet demand and minimise the environmental impact.

In addition to reducing the environmental impact, improving design and construction for kidney care facilities is likely to deliver co-benefits in health and wellbeing for staff and patients as well as potentially reducing operating expenses.

Context

POLICY AND STRATEGIC CONTEXT

A range of existing resources from a diversity of organisations provide guidance for the healthcare sector in responding to climate change, detail sustainability measures for facilities and provide the strategic direction for pursuing best practice guidelines for ESD in kidney care facilities.

Examples of resources include:

- World Health Organisation (WHO) Guidance for Climate Resilient and Environmentally Sustainable Health Care Facilities (2020)
- Australian Medical Association (AMA) Environmental Sustainability Position Statement (2019)
- ANZSN Environmental Sustainability Committee (ESC) Three-year Strategy (2021-2023)

Refer to the Appendix at the end of these guidelines for a more extensive list of resources which form the policy and strategic context.

The guidelines have been developed in the context of this policy and strategic setting, drawing on a range of sources as relevant in addition to broader best practice sustainable building design.

This presents two layers of opportunities:

- Built form and healthcare practice opportunities that cut across the majority if not all healthcare settings (these are highlighted as general opportunities in these guidelines)
- Those specific to kidney care - these opportunities exist because of the nature of the haemodialysis process and are not easily translated to other healthcare settings (these are noted as dialysis specific opportunities in these guidelines)

The latter are linked to the specific equipment used in haemodialysis.

Environmental Sustainability Committee

THREE-YEAR STRATEGY 2021-2023

TO TRANSFROM THE WAY KIDNEY CARE IS DELIVERED IN AUSTRALIA AND NEW ZEALAND.

WE BELIEVE that we can provide optimum kidney care to our patients without harming the planet.

WE BELIEVE that delivering kidney care in an environmentally sustainable way can generate health and economic benefits.

WE BELIEVE that the Australia New Zealand Society of Nephrology, as the peak body for health professionals caring for people with kidney disease, is ideally placed to drive the necessary change.

Implementation

These guidelines can be used by multiple stakeholders at different stages in the lifecycle of a dialysis unit, and can be used as a complete reference document or as a guide for specific initiatives.

The effective integration of sustainability into kidney care facilities is largely dependent on:

- **Early consideration during the design process**
- **Expertise from relevant stakeholders being harnessed**
- **Adequate resourcing for incorporating ESD**
- **Operational requirements clearly outlined during handover**
- **Continuous improvement through facility assessment and ongoing monitoring and evaluation**

The following implementation guidance will help support improved environmental performance outcomes in kidney care facilities.

INTEGRATING ESD

The integration of ESD into the design, construction and operation of buildings is dependent on multiple factors. The following provides guidance to support more effective integration to ensure the best outcomes possible.

Early consideration

For the design of new facilities, early consideration of sustainability opportunities is key to ensuring they are embedded in the early concept and design, and have continued consideration through to construction and operation. Having sustainability objectives clearly defined from the beginning of the project means the objectives are held to improved accountability in following stages, and that there is less chance of sustainability initiatives being value managed out later in the process.

Expertise

A number of opportunities listed in these guidelines may require expertise outside that of standard consultant disciplines (e.g. architects and engineers). It is therefore beneficial to engage a dedicated sustainability professional to guide the integration of sustainability opportunities into a project.

Additionally, when considering building systems it is important that operational staff are engaged for their input at the design stage. This can help to test the practical application of initiatives and harness operational knowledge to inform potential design solutions.

Resourcing

Increased sustainability requirements and standards may have an impact on project capital costs, however this increase in capital investment can deliver significant operational benefit. While the financial impact is detailed next to some initiatives outlined later in these guidelines, it should be noted that where resource conservation is an outcome (particularly reductions in energy use), this will in most cases also result in financial savings.

It is beneficial to adopt a whole of lifecycle approach to the development of projects, having regard to the life of materials, operating costs, future maintenance, and renewal timeframes.

For existing facilities, operational benefits (e.g. cost savings, improved health outcomes) can be communicated to support the business case for retrofit opportunities.

Handover

To ensure the design intent of sustainability opportunities is realised during operation, it is important that operation and maintenance requirements are well documented to allow for ongoing and consistent management. The development of a Building Users Guide (or similar) can detail such information and provide guidance to a range of users including facility managers and other staff, and reduce the risk of single person dependency.

Continuous improvement

Monitoring and evaluation during operation allows for the identification of optimisation opportunities. This could be to ensure performance of the facility continues to align with or exceed design intent throughout operation, or to determine retrofit opportunities for existing facilities.

Information which can commonly be used for this purpose is utility data (i.e. water and energy consumption), management costs (e.g. waste disposal) and maintenance costs (e.g. replacement of building components). A detailed facility assessment is a comprehensive method for identifying and refining retrofit opportunities in an existing facility.

The sharing of knowledge and experiences post project delivery, and feeding back learnings into future projects can facilitate continual improvement and is encouraged across project teams.

Barwon Health North treatment area. Photography by Steve Moller

HOW TO USE THESE GUIDELINES

These guidelines outline a range of best practice requirements or standards for integration into new or existing kidney care facilities.

The best practice requirements and standards can be used at a range of asset lifecycle stages by:

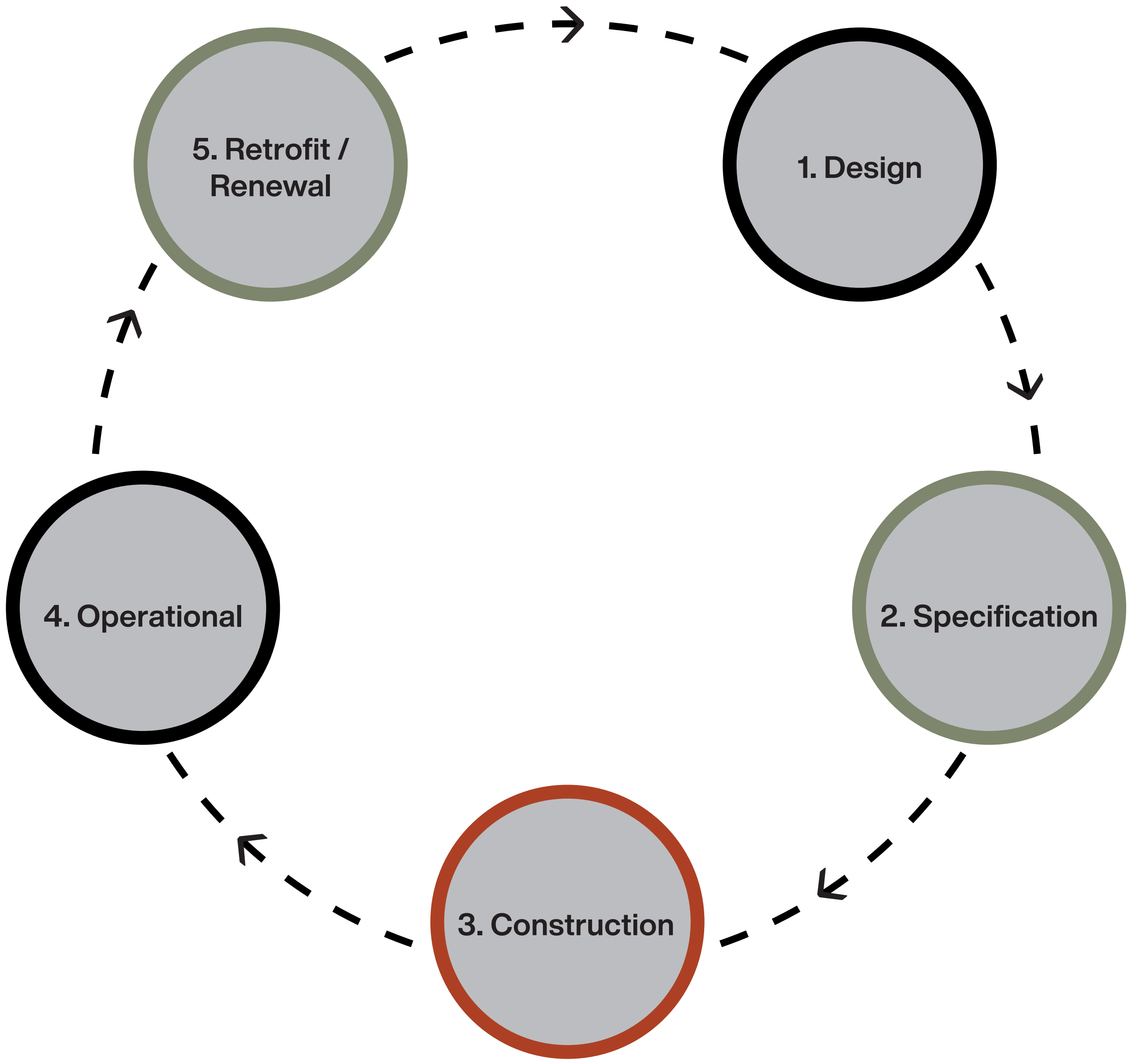
- Design and construction teams (including consultants of disciplines such as architecture, engineering and ESD)
- Facility managers (e.g. for the optimisation of existing facilities)
- Clinical staff (e.g. to provide guidance if seeking improvements to facilities for operational matters)

Individual requirements or standards can be used selectively to inform retrofit design or construction briefs, while the guidelines as a whole can be used as a 'sustainability brief' for the development of new facilities. Some initiatives also include 'Design investigations' which are opportunities dependent on site-specific investigations rather than defined standards.

These guidelines should be used in conjunction with other guidance documents relevant to the design, construction and operation of kidney care facilities, and not as a replacement to any relevant statutory and legislative requirements. These guidelines complement any existing State sustainability guidance.

Implementation

The following diagram outlines the main lifecyle stages of a building. Initiatives detailed in these guidelines are mapped to relevant lifecycle stages for users to better understand their application.



Offers significant scope for embedding sustainability, with early consideration and integration in design key to achieving sustainability outcomes in later stages.

Ensures decisions are detailed for construction, and are progressed from design through to built outcomes. This may also include procurement of equipment.

Critical to ensuring design intent is realised through as-built outcomes, requiring strict adherence to design and specification for the facility.

Offers the opportunity to monitor and evaluate performance, and the ability to adjust systems and practices to continually improve.

Provides the opportunity at end of life for a considered approach to retrofit or renewal of the facility by upgrading building fabric, systems and processes.

Energy

Human-induced climate change is having wide ranging impacts on a range of natural and human systems both globally and locally. More specifically, the hazards resulting from climate change are impacting health and human services, while also effecting the health and wellbeing of our population.

The contribution of Australia's healthcare system itself to national carbon emissions has been estimated as 7 per cent and in Victoria alone, public hospitals and health services contributed a quarter of the government's reported carbon emissions from stationary energy in 2017–18[5].

Given the resource use associated with kidney care facilities, there is significant opportunity to optimise energy management through design and operation to create a more sustainable service and help to protect the most vulnerable members of society, while also possibly reducing operational costs.

All energy saving activities reduce carbon, but this has not been noted as an impact on the following pages as it is universal and the carbon reduction is dependent on the existing emissions intensity of the grid, therefore variations will exist due to locational differences.

ENERGY OBJECTIVES

- Maximise passive design through site layout and design features
- Be net zero emissions in operation using a combination of energy efficiency, on-site generation and renewable energy procurement
- Maximise renewable energy generation and support storage
- Be 'smart' enabled allowing for improved energy management
- Respond to the impact of embodied carbon

CASE STUDY: ON-SITE RENEWABLE ENERGY GENERATION

A home haemodialysis training unit in Geelong, Australia was fitted with a 24m², 3kW solar array to provide an alternative energy source for the facility[6]. Over a 12 month period, energy usage of dialysis machines and reverse osmosis units was tracked and generation from the solar array recorded to determine the benefit provided.

It was found that the solar array provided 91% of the energy required to run the four combined equipment pairings and was cost-effective, with a potential return on investment less than 8 years.

Although other facilities may have a greater number of patients and operating hours than this training unit, this study demonstrates the potential for on-site renewable energy generation to reduce emissions and the need to source from energy from the grid.

Rooftop solar panels. Photography by Jake Roden

Energy

INITIATIVE	APPLICATION	IMPACT	RECOMMENDED REQUIREMENT / STANDARD
1.1 Thermal performance and passive design	**Lifecycle stage** Design and Specification **Opportunity type** General	Energy savings (reductions from less reliance on energy intensive mechanical heating, ventilation and air conditioning (HVAC) systems and improvement in system efficiencies) Occupant amenity (reduced temperature differential across facility allowing for improvements to patient comfort) Financial (note that a 10% improvement above minimum regulatory requirements is unlikely to have major capital cost implications)	**Retrofit** Facility assessment to identify cost-effective retrofit options such as external shading, insulation and glazing improvements to improve thermal performance. **New Builds** Passive design considerations and features (e.g. orientation, shading) incorporated into design brief and early concepts. 10% improvement on the energy efficiency requirements of the National Construction Code (NCC), demonstrated through JV3 modelling. Meet Green Star Buildings airtightness minimum requirements.
1.2 Low-energy lighting and motion sensors	**Lifecycle stage** Design and Specification **Opportunity type** General	Energy saving (power requirements of LED are approximately 75% less than other lighting types; motion sensors help avoid unnecessary lighting use in transitory space)	**Retrofit** Facility assessment to identify upgrades for existing lighting to highly efficient LED (capitalising on rebate schemes where possible). Installation of motion sensors or daylight harvesting in transitory spaces. **New Builds** Lighting power density of >20% improvement beyond the current NCC with consideration of individual controls available to all patients (noting minimum lux levels for health related tasks). Highly efficient LED lighting, with motion sensors or daylight harvesting in transitory spaces.
1.3 Minimum energy ratings for standard appliances (e.g. refrigerators)	**Lifecycle stage** Specification and Operational **Opportunity type** General	Energy saving (reduced energy consumption e.g. a 5 star fridge uses approximately half as much energy as a 2.5 star of the same size)	**Retrofit** Procurement standard for standard appliances (included in end of life replacement regime) specifying a minimum rating (MEPS) standard within one efficiency star of best available. **New Builds** Specification of minimum rating (MEPS) standard within one efficiency star of best available.
1.4 On-site renewable energy generation	**Lifecycle stage** Design and Specification **Opportunity type** General	Energy saving (generation at between 2.5 to 4.5 x the photovoltaic capacity (e.g. 30kWp system produces on average 108kWh daily), resulting in avoided costs of electricity purchased from main grid depending on energy cost) Carbon reduction (scalable depending on size of solar photovoltaic system, up to 1.5 tonnes CO_2-e annually for every kW of capacity depending on location) Financial (payback generally 4-6 years for commercial system, but may be longer if the energy cost to kidney care facilities is very low)	**Retrofit** Facility assessment / solar feasibility to determine optimal sizing. **New Builds** Recommended sizing of rooftop solar generation for each building is at least 75% of unencumbered rooftop capacity. Encumbered refers to plant and equipment, green roofs, rooftop common areas etc. Battery storage considered if a large export is predicted for during the day.

INITIATIVE	APPLICATION	IMPACT	RECOMMENDED REQUIREMENT / STANDARD
1.5 Specify all-electric and procure electricity from renewable off-site sources	**Lifecycle stage** Specification and Operational **Opportunity type** General	Carbon reduction (net zero emissions from operational electricity or energy completely if gas excluded) Financial (accredited GreenPower can come with an additional cost, currently approximately 4 cents/kWh, less through a power purchase agreement - but this would require a number of sites to be aggregated. Electrification (i.e. no gas) of facilities can capitalise on low electricity prices which many healthcare facilities receive)	**Retrofit** Facility assessment to determine existing gas appliances to be replaced with electric appliances and all gas appliances transitioned to electric at end of life replacement. Evaluate electrical switchboard condition and capacity to convert to all electric solution. If able, electricity from off-site renewable sources procured through Power Purchase Agreement (PPA) or GreenPower. Emissions from unavoidable gas used addressed through purchase of carbon offsets. **New Builds** Specify 100% all electric (no provision for gas). Governance (billing) arrangements through new builds and tenancy arrangements that allow for independent energy procurement. Electricity from off-site renewable sources procured through Power Purchase Agreement (PPA) or GreenPower.
1.6 Heat Recovery Ventilation (HRV)	**Lifecycle stage** Design and Specification **Opportunity type** General	Energy saving (by recovering energy from exhaust air to preheat/cool incoming fresh air, heating and cooling energy associated with outside air supply can be reduced by 75 to 80%)	**Retrofit** Facility assessment to determine efficiency for HRV as a retrofit activity. **New Builds** Heat Recovery Ventilation specified, with planning of equipment locations to minimise connecting ductwork.
1.7 Economy cycle for free cooling using extra outside air when conditions are suitable	**Lifecycle stage** Design and Specification **Opportunity type** General	Energy saving (reductions of 40 to 50% of cooling energy in Melbourne - savings reduce in warmer, more humid climates)	**New Builds** Design investigation to determine benefit of air handling units in cooler climates where not mandated by the NCC (refer to NCC Part J5.2 Air-conditioning system control for detail).
1.8 HVAC - Central plant optimisation	**Lifecycle stage** Design and Specification **Opportunity type** General	Energy saving (potential for savings up to 40% of total HVAC energy usage by adjusting system temperature and timing to match changing loads)	**Retrofit** Facility assessment to review high level opportunity, commission a HVAC engineer to determine relevant strategies, feasibility and cost effectiveness. **New Builds** HVAC engineer engaged as part of design team.

INITIATIVE	APPLICATION	IMPACT	RECOMMENDED REQUIREMENT / STANDARD
1.9 HVAC - Controls for Comms/Server room AC	**Lifecycle stage** Specification and Operational **Opportunity type** General	Energy saving (every degree higher that the thermostat for the supply air can be raised reduces the energy consumption of the air conditioning unit)	**Retrofit** Facility assessment to review operational settings for Comms / Server Rooms. **New Builds** Design specification and commissioning to determine operational settings for Comms / Server Rooms at optimal levels.
1.10 Heat pump hot water	**Lifecycle stage** Design and Specification **Opportunity type** Dialysis-specific	Energy saving (60 to 70% less energy used compared to direct electric heating)	**Retrofit** Facility assessment to identify potential for replacement of existing system with efficient heat pump alternative (minimum coefficient of performance (COP) > 3.5). **New Builds** Specify electric heat pumps (minimum coefficient of performance (COP) > 3.5) to preheat water for dialysis, powered by on-site solar PV or renewable energy procured off-site (subject to external siting of the outdoor unit of heat pump being possible). For locations where cooling water may be required to reach 36 degrees (e.g. Alice Springs) locate HWS tanks in full shade.
1.11 Metering configuration optimisation	**Lifecycle stage** Design and Specification **Opportunity type** Dialysis-specific	Energy saving (feedback on energy usage over time can assist in optimising operational settings)	**Retrofit** Facility assessment to determine feasibility of sub-metering reverse osmosis system and dialysis machines (in aggregate). **New Builds** Sub-metering specified for reverse osmosis system and dialysis machines (monitored by Building Management System where installed).
1.12 Shut down switch and automated constrols for specific energy consuming appliances	**Lifecycle stage** Specification **Opportunity type** Dialysis-specific	Energy saving (due to reduced operational times)	**New Builds** Design investigation to determine potential for central shutdown switch to key (major energy using) equipment. Consider timed automation of controls on a case by case basis.
1.13 Heat exchangers on dialysis machines to capture and reuse heat from dialysis effluent to warm incoming dialysate	**Lifecycle stage** Equipment procurement **Opportunity type** Dialysis-specific	Energy saving (exact energy reduction not certain, older data indicates 0.5kWh per treatment for retrofit or 530-730 kWh per machine per year)	**Retrofit** Facility assessment to consider retrofitting older machines based on monitored ‘per treatment’ benchmark through cost-benefit / return on investment, in the context of machine’s age and lifespan. **New Builds** Dialysis machines with heat exchangers specified.

ABOVE AND BEYOND

The standards and targets outlined in the previous table are proposed as minimum requirements or design investigations for improving the environmental performance of kidney care facilities.

Several other opportunities are highlighted below as future areas of innovation.

Energy efficiency improvements to medical equipment/dialysis machines through setting procurement standards

This latter opportunity would be driven through relationships and communication with manufacturers and suppliers to keep informed of efficiency improvements and efficient equipment options.

The opportunity exists to develop a standard metrics for measuring energy intensity of dialysis machines e.g by energy use per treatment (this could be standardised to enable accurate comparisons).

Much as manufacturers of televisions and refrigerators are required to disclose energy efficiency, this standard metric could be required by equipment purchasers to be disclosed to inform decision making, accompanied by an increased weighting for 'sustainability' in procurement decisions. In the medium term, it could be used to set a minimum benchmark for equipment purchases for new builds or major retrofits.

Reducing run times for reverse osmosis (RO) machines

There is the possibility of energy savings due to reduced operational times of RO machines, potentially in excess of 10%. The aim would be to optimise start up and shut down times to avoid unnecessary operational energy consumption.

The opportunity could be pursued through the development of a program / system change process which could support modification to run times at multiple centres. Given this would require practice change, it would benefit from being trialled at one or two centres to better understand any barriers, then sharing learnings (including a suggested approach to how centres can implement the change) with the sector.

For new builds, optimised RO system run times could be embedded in facility management / operational guidelines and ingrained as part of induction / commissioning processes.

Dialysis machine. Photography by Steve Moller

Water

Significantly influenced by climate change, water availability has and will continue to be impacted by decreases in rainfall and more severe droughts. For example, over the past two to three decades, southeast Australia has experienced a 15 per cent decline in late autumn and early winter rainfall[7].

Regional and remote areas in particular are increasingly dealing with low water availability, and in some cases issues associated with increased water temperatures[8].

Representing on average 4 per cent of water used in Victorian hospitals and healthcare facilities[9], haemodialysis services are a high water user in the healthcare sector and present a significant opportunity for increased water conservation.

Through a combination of efficiency measures and alternative water source measures, potable water consumption can be reduced and the environmental impact of healthcare lessened.

OBJECTIVES

- Improve water efficiency
- Increase alternative water sources through reuse
- Reduce potable water consumption
- Minimise stormwater runoff

CASE STUDY: AQUACULTURE & HYDROPONICS USING REJECT WATER

A hospital dialysis unit in Malaysia which services 90 patients and operates 19 haemodialysis machines has created a program using RO reject water for the purpose of aquaculture, hydroponics and horticulture[10].

Estimated to be between 10,000 and 12,000 litres per day, the reject water is redirected to fish tanks and for plant irrigation. Nutrient-rich water from the fish tanks is used by the vegetables which are planted on growing beds using both vertical towers, horizontal gutters and land-based vegetable plots.

The harvested fish and vegetables are given to staff and dialysis patients.

Aquaculture and hydroponics systems. Photography sourced from Reference 10

Water

INITIATIVE	ASSET LIFECYCLE STAGE	IMPACT	RECOMMENDED REQUIREMENT / STANDARD
2.1 High efficiency fixtures, fittings and appliances (for standard building components)	**Lifecycle stage** Design and Specification **Opportunity type** General	Water saving (potable water use reduction e.g. 5 Star tap (6L/min) versus 1 Star tap (16L/min))	**Retrofit** Procurement standard for fixtures, fittings and standard appliances (included in end of life replacement regime) specifying a minimum rating standard consistent with the prescriptive pathway of Green Star Buildings (minimum WELS ratings - Taps 5 star, Urinal 5 star, Toilets 4 star, Showers 3 star, Clothes washing machine 4 star, Dishwashers 5 star). **New Builds** Compliance with the prescriptive pathway of Green Star Buildings.
2.2 Harvesting of rainwater off facility roofs for non-potable uses (e.g. toilet flushing)	**Lifecycle stage** Design and Specification **Opportunity type** General	Water saving (potable water use reduction for some uses) Stormwater quality (stormwater flow reduction)	**Retrofit** Facility assessment to determine whether rainwater harvesting can be delivered as part of major refurbishments of wet areas. **New Builds** Incorporate tank(s), sourcing from rooftop collection (and RO reject water see below). Optimise sizing to meet all on-site non-potable water demands, including toilets and on-site non-edible vegetation.
2.3 Reuse of RO reject water for a range of uses (e.g. irrigation, toilet flushing, collection by community or authorities)	**Lifecycle stage** Design and Specification **Opportunity type** Dialysis-specific	Water saving (in a typical facility, can reduce potable water use by approximately 20kL per week)	**Retrofit** Facility assessment to determine whether RO reject water outlet can be connected to water storage with further connection to end uses such as toilet flushing, cooling for plant and equipment and irrigation for green spaces. **New Builds** Incorporate tank infrastructure, sourcing from rooftop collection (see above) and RO reject water (where a demand for reuse is identified). Optimise sizing to meet all on-site non-potable water demands, including toilets and on-site non-edible vegetation.

ABOVE AND BEYOND

The standards and targets outlined in the previous table are proposed as minimum requirements for improving the environmental performance of kidney care facilities.

The following initiatives are also worth considering as stretch goals for even greater benefit.

Reverse osmosis reject water to supply off-site demands such as nearby open space

In some jurisdictions, water cannot be supplied across a property boundary without meeting stringent environmental guidelines or in some cases, requiring a retail water supply license. Therefore opportunities to irrigate nearby open space using RO reject water need to be considered on a case by case basis.

Higher reverse osmosis water recovery settings

There is a split incentive for equipment suppliers to increase RO water recovery settings. Higher RO water recovery settings decreases the lifespan of membranes and in turn increases the operational costs. The split incetive exists because the cost of RO membrane replacement is typically borne by equipment suppliers, generally recovered through a per treatment cost, while the cost of the water usage is covered by the facility.

An opportunity exists to investigate the benefit of removing membrane replacement from standard per treatment contracts with suppliers. This could potentially result in a more balanced approach between optimising membrane replacement timeframes and the cost of water supply.

Water efficiency improvements to medical equipment/dialysis machines through setting procurement standards

As per the recommendation in relation to energy, the opportunity exists to extend the development of standard metrics to include water as well as energy efficiency. The process of development would follow the same path as outlined on p. 12.

Alternative water purification methods

Water purification for haemodialysis typically occurs via reverse osmosis. With greater attention on the resource inefficiencies of this process, there is growing interest in alternative water purification methods such as vapour compression distillation using the Slingshot unit or the potential future application for haemodialysis of the Ellen Medical Affordable Dialysis System. As technology advances, more efficient alternatives should continue to be considered.

Reusing haemodialysis wastewater

Haemodialysis wastewater (spent dialysate that exits the dialyser) has been treated in some instances either by recirculating through a sorbent dialysis machine or with a second RO pass, with the water then reused for applications such as landscaping or agriculture. While there are currently simpler ways to capture and reuse water, this opportunity may be worth considering further in future.

The consumption of goods and provision of services results in high levels of resource use worldwide, causing a range of issues ranging from virgin resource depletion to pollution.

In 2020-21, Victorian public health services generated approximately 39,177 tonnes of solid waste (9,329 tonnes recycled, 6,386 tonnes clinical waste and the rest general waste)[11].

Addressing how waste is managed in kidney care can help improve resource recovery in the healthcare sector and drive more responsible consumption practices in order to reduce the environmental impact of kidney care facilities.

WASTE AND RESOURCE RECOVERY OBJECTIVES

- Maximise landfill diversion throughout construction and operation
- Support the growing economy for recycled and recyclable products and materials through procurement processes
- Promote strategies which improve materials consumption practices and behaviours

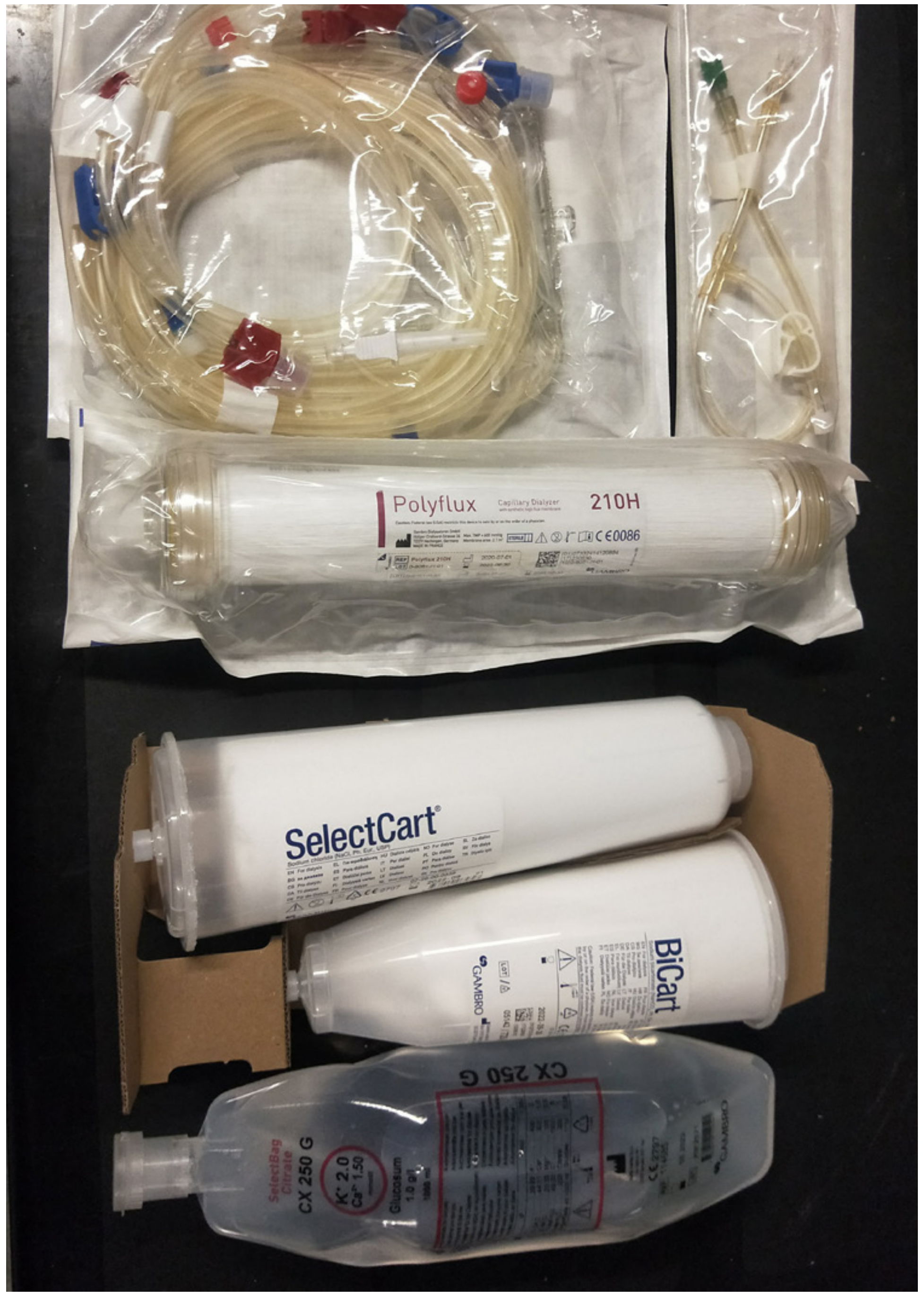
CASE STUDY: CENTRAL DELIVERY OF ACID CONCENTRATE

Acid concentrate used during haemodialysis treatment is commonly provided to patients at each individual machine (Single Patient Dialysis Delivery, SPDD), usually supplied in liquid form in plastic bags. An alternative to this process is the centralised mixing of acid concentrate and distribution to each patient when a dialysis machine requires it.

A haemodialysis unit in Italy adopted an automated Central Concentrate Delivery System (CCDS) and used the system in 85% of the patients. A total of 11,000 treatments were performed over one year with CCDS, saving €25,220 for the avoided disposal of 11,470 kg of plastic material and 7,150 kg of concentrate residuals[12]. Additionally, the movement and management of 59,180 kg of material was avoided, reducing effort of the operators and caregivers. No clinical implications were recorded.

The use of CCDS has the potential to reduce the amount of packaging waste per treatment, as well as avoid concentrate wastage.

Note that the process for CCDS may create manual handling issues which should also be considered.



Example of items used per dialysis treatment. Photography by Nick Chester

Waste and resource recovery

INITIATIVE	APPLICATION	IMPACT	RECOMMENDED REQUIREMENT / STANDARD
3.1 Ensure space and bins for a range of waste streams	**Lifecycle stage** Design and Operational **Opportunity type** General	Operational (increased resource recovery) Financial (value associated with recycled waste streams and avoided landfill levies where applicable, and reduced expenditure associated with processing clinical waste if waste is appropriately diverted to other streams)	**Retrofit** Facility assessment to determine opportunities for sufficient area for waste separation and establishment of additional streams (including specialised recycling streams), noting existing waste streams and capacity to accommodate space requirements. **New Builds** Incorporate space requirements for a range of waste streams (including contingency) and access for collection early in design. Separation should be considered for streams such as general waste, clinical waste, paper/cardboard, glass, plastic, food waste and any specialised recycling streams (e.g. PVC) associated with medical consumables. Develop an operational waste management plan which explores all relevant waste streams fully and ensures guidance for facility management.
3.2 Recycled and recyclable materials	**Lifecycle stage** Design, Specification and Demoliton / Reuse **Opportunity type** General	Environmental (increased resource recovery)	**Retrofit** Replacement materials in refurbishments preference materials which are recyclable or reusable at end of life. **New Builds** Materials specified are 95% recyclable or reusable (by volume) at end of life. Portland cement content of concrete reduced by 30% through use of supplementary cementitious materials (SCMs).
3.3 Construction waste targets	**Lifecycle stage** Construction **Opportunity type** General	Environmental (increased resource recovery) Financial (value associated with recycled waste streams and additional financial benefit from the avoided cost of any waste levy or similar)	**Retrofit** Construction waste recycling target of at least 90% for any major retrofit / refurbishment. **New Builds** Construction waste recycling target of at least 90%.
3.4 Product stewardship	**Lifecycle stage** Operational **Opportunity type** General	Environmental (increased resource recovery)	**Retrofit / New Builds** Maintain relationships with product suppliers and develop operational agreements for product stewardship arrangements (e.g. suppliers could retrieve items such as containers and pallets on delivery). Product stewardship could be formalised as minimum clause/s in contracts, with the major opportunity to do so as part of new contracts or during periods of contract renewal.

Waste and resource recovery

Waste room. Photography by Steve Moller

ABOVE AND BEYOND

The standards and targets outlined in the previous table are proposed as minimum requirements for improving the environmental performance of kidney care facilities.

The following initiatives are also worth investigating as stretch goals for even greater benefit.

Increased product stewardship

To drive increased product stewardship in the sector, an industry wide procurement policy could be developed which specifies target dates for full product stewardship of all consumables used in kidney care treatment. This may begin with a policy statement from ANZSN detailing the intention, then ongoing conversations between ANZSN (with input from centres and clinicians from a variety of locations) and product manufacturers and suppliers to determine how improvements can be made to the products themselves and to processes for collection and reusing/recycling.

Waste education resources and programs

Improved resource recovery and potential costs savings based on reduced general and medical waste disposal can be facilitated by better waste practices during operation.

Education opportunities can be informed by a facility assessment to determine waste practices which could be improved (e.g. waste stream contamination / resource separation rates). For new builds, waste education resources and programs can be developed and aligned to facility opening (ensuring waste behaviour is established at the outset).

To reduce cost, waste education resources and programs can leverage existing programs (e.g. Department of Health Sustainability in Healthcare online resources).

Central delivery of acid concentrate

As highlighted in the earlier case study, there is opportunity to reduce packaging waste associated with liquid form concentrate and increase operational efficiency through the adoption of CCDS technology. Such technology is more common in Europe and some Asian countries than in Australia and New Zealand.

Investigation regarding increasing uptake of CCDS in the Australian and New Zealand context (e.g. discussions between ANZSN and manufacturers) should be undertaken with the aim of trialling and reporting on the system in a future new build(s) to demonstrate suitability.

The are potential cost savings associated with less liquid wasted, reduced transport costs and reduced waste processing. This would however require an increased capital investment for CCDS and a change in clinical practice.

Note that the process for CCDS may create manual handling issues which should also be considered.

Hazardous waste processing

Given the high cost of hazardous waste disposal compared to general waste or recycling, there is incentive to explore alternative methods for processing this waste stream.

One example is to steam, microwave or chemically sterilise then shred hazardous waste at the point of care, using purpose-built processing equipment. There is then the potential (subject to environmental approvals) of disposal in general waste or in the future as recycling streams.

Note that hazardous waste management would require consideration as part of a whole of hospital / health service approach.

Additional sustainability

While the sustainability themes of energy, water and waste explored earlier in this report will likely have the greatest environmental impact during the provision of kidney care, there are other sustainability opportunities which should be considered for kidney care facilities.

Indoor Environment Quality (IEQ) is integral to the experience of building users and is therefore important in healthcare, where patients and staff may spend many hours indoors. This can be enhanced by a range of strategies including comfort related building measures, but also access to views of green space and / or indoor plants[13].

Engagement and education is also an important aspect of embedding sustainability in broader medical practice, whether that is to build the capacity of individuals to take positive action or to shift the behaviours and culture of an entire organisation. This is an ongoing process of continual improvement.

Additionally, internal processes for monitoring and reporting will ensure that desired sustainability outcomes can continually be achieved.

While some initiatives relating to additional sustainability are specific to the built form of a kidney care facility, others shape the ongoing operation and management practices which is also an important part of achieving best practice sustainability outcomes.

ADDITIONAL SUSTAINABILITY OBJECTIVES

- Promote occupant wellbeing as a core driver of design
- Anticipate the future impacts of climate change
- Integrate the built form with local, natural systems
- Maximise habitat-supporting vegetation in facility landscaping
- Strengthen workplace knowledge and leadership on sustainability issues

CASE STUDY: BIOPHILIC DESIGN IN HEALTHCARE

Biophilic design aims to better connect users of the built environment with nature, and can support improved health and wellbeing outcomes.

The new Bendigo Hospital opened in 2017 and used biophilic design principles. The project included landscapes with many spaces for relief and distraction, as well as areas for recovery and rehabilitation. The public realm incorporated elements such as natural and local materials, moving water, tree canopy cover and green links[14].

Internal courtyards with a higher density of planting were included for patients who may spend hours in the facility, and borrowed (or secondary experiences) of nature were considered, with importance placed on natural light and views to outside[15].

Internal courtyard in Bendigo Hospital. Photography by Tom Adolph

Natural light in Bendigo Hospital. Photography by Peter Clarke

Additional sustainability

INITIATIVE	APPLICATION	IMPACT	RECOMMENDED REQUIREMENT / STANDARD
4.1 Increased access to daylight and natural views	**Lifecycle stage** Design **Opportunity type** General	Occupant amenity (increased comfort and improved health outcomes)	**New Builds** Minimum daylight factor of 2% for 60% floor area of patient treatment areas. Maximise access to natural views for as many patient chairs as possible.
4.2 Appropriate shading to provide comfortable patient areas	**Lifecycle stage** Design **Opportunity type** General	Occupant amenity (increased comfort) Operational (increased energy efficiency) Financial (capital cost dependent on shading type)	**Retrofit** Facility assessment to identify significant issues with existing provision of shading and to consider the benefit of additional shading. **New Builds** Optimised shading (fixed or active) to all facades, as necessary to ensure high levels of daylight, reduced glare and to eliminate summer comfort issues.
4.3 Material selection to improve IEQ (e.g. low Volatile Organic Compounds)	**Lifecycle stage** Design and Specification **Opportunity type** General	Occupant amenity (increased comfort and health outcomes)	**Retrofit** Replacement materials in refurbishments meet Green Star Buildings ‘Exposure to Toxins’ Credit Achievement criteria or meet requirements of the Victorian Health Building Authority (VHBA) ‘Guidelines for sustainability in capital works’. **New Builds** Materials specifications meet Green Star Buildings ‘Exposure to Toxins’ Credit Achievement criteria or meet requirements of the Victorian Health Building Authority (VHBA) ‘Guidelines for sustainability in capital works’.
4.4 Consideration of biophilic principles in design (facilitating our innate instinct to connect to nature)	**Lifecycle stage** Design **Opportunity type** General	Occupant amenity (increased comfort and improved health outcomes) Financial (possible additional capital cost but potentially outweighed by increased staff productivity and patient recovery)	**Retrofit** Facility assessment to determine opportunities for 'nature in the space' such as incorporation of plants, water and animals into the built environment. Examples include potted plants, water features, aquariums. **New Builds** Include 'biophilic design principles' in building design briefs. Each facility to determine how this is interpreted in individual kidney care centres.

Additional sustainability

INITIATIVE	APPLICATION	IMPACT	RECOMMENDED REQUIREMENT / STANDARD
4.5 Assess climate change risk and implement adaptation response measures	**Lifecycle stage** Design and Operational **Opportunity type** General	Operational (reduced risk of service disruptions) Financial (reduced risk of costs associated with building repairs and maintenance)	**Retrofit** Facility assessment to assess building vulnerability to major climate hazards (e.g. increased temperatures, extremes rainfall events). **New Builds** Undertake a site-specific climate change risk assessment aligned with process outlined in Green Star Buildings 'Climate Change Resilience' Credit (utilising formal standards for climate change adaptation and risk management). Design informed by findings of climate change risk assessment, incorporating adaptation measures in response to risks identified.
4.6 Landscaping to enhance biodiversity and reduce the heat island effect	**Lifecycle stage** Design **Opportunity type** General	Occupant amenity (increased thermal comfort in local microclimate and increased connection to nature)	**Retrofit** Facility assessment to determine opportunities for expanding landscaped areas and permeable surfaces, increasing the diversity of plant species and preferences use of climate resilient and indigenous plants. **New Builds** Landscaping includes a diversity of plant species and preferences use of climate resilient and indigenous plants. Landscape design of outdoor areas delivers 30% canopy cover.
4.7 Heat island effect reduction through surface materials selection	**Lifecycle stage** Design and Specification **Opportunity type** General	Occupant amenity (increased thermal comfort and improved health and wellbeing outcomes) Environmental (contribution to mitigation of local urban heat related climate impacts)	**Retrofit** Replacement materials in refurbishments meet Green Star Buildings 'Heat Resilience' Credit Achievement criteria. **New Builds** 75% of horizontal surface materials classified as reducing the heat island effect (e.g. light coloured roofing and paving, vegetation) as outlined in Green Star Buildings 'Heat Resilience' Credit.
4.8 Responsibly sourced timber	**Lifecycle stage** Design and Specification **Opportunity type** General	Environmental protection (support responsible timber production)	**Retrofit** At least 95% (by cost) of all timber used in the refurbishments is either certified by forest certification schemes such as FSC (preferred) or PEFC, or is from a reused source. **New Builds** At least 95% (by cost) of all timber used in the building and construction works is either certified by forest certification schemes such as FSC (preferred) or PEFC, or is from a reused source.

ABOVE AND BEYOND

The standards and targets outlined in the previous table are proposed as minimum requirements for improving the environmental performance of kidney care facilities.

The following initiatives are also worth considering as stretch goals for even greater benefit.

Ongoing training and support to staff (and leadership/executive) to help improve the workplace culture on sustainability issues

Resources and programs should be designed, leveraging existing corporate sustainability programs, with the aim of embedding sustainability as business-as-usual during operation to achieve ongoing sustainable outcomes.

Such resources extend further than those relating to waste practices, and would address key operational improvements which are behaviour driven.

Sustainability criteria in procurement processes to ensure less resource intensive materials, products and suppliers

There is opportunity to improve broader sustainability outcomes through purchasing decisions, achieved through procurement processes and policies (e.g. tender documentation, evaluation criteria, supplier agreements).

Existing processes and policies could be reviewed to determine improvements which can optimise sustainability outcomes but maintain the quality and safety of clinical practice, while such considerations should be embedded when developing new processes and policies.

While there may be some cost implications dependent on product (with some alternatives cost neutral and some with a premium), increased capital cost may often be outweighed by lifecycle cost (e.g. reduced rate of replacement).

Building-based green infrastructure

Related to initiatives such as biophilic design and external landscaping, there is opportunity to incorporate green infrastructure (e.g. green roofs, walls and facades) into the building.

Targeting coverage (horizontal or vertical) equivalent to 40% of building footprint would be considered best practice and help support urban temperature regulation, stormwater runoff mitigation and habitat.

Upfront embodied carbon reduction target

Embodied carbon relates to the supply chain and construction impacts attributable to the building until the commencement of its operational phase.

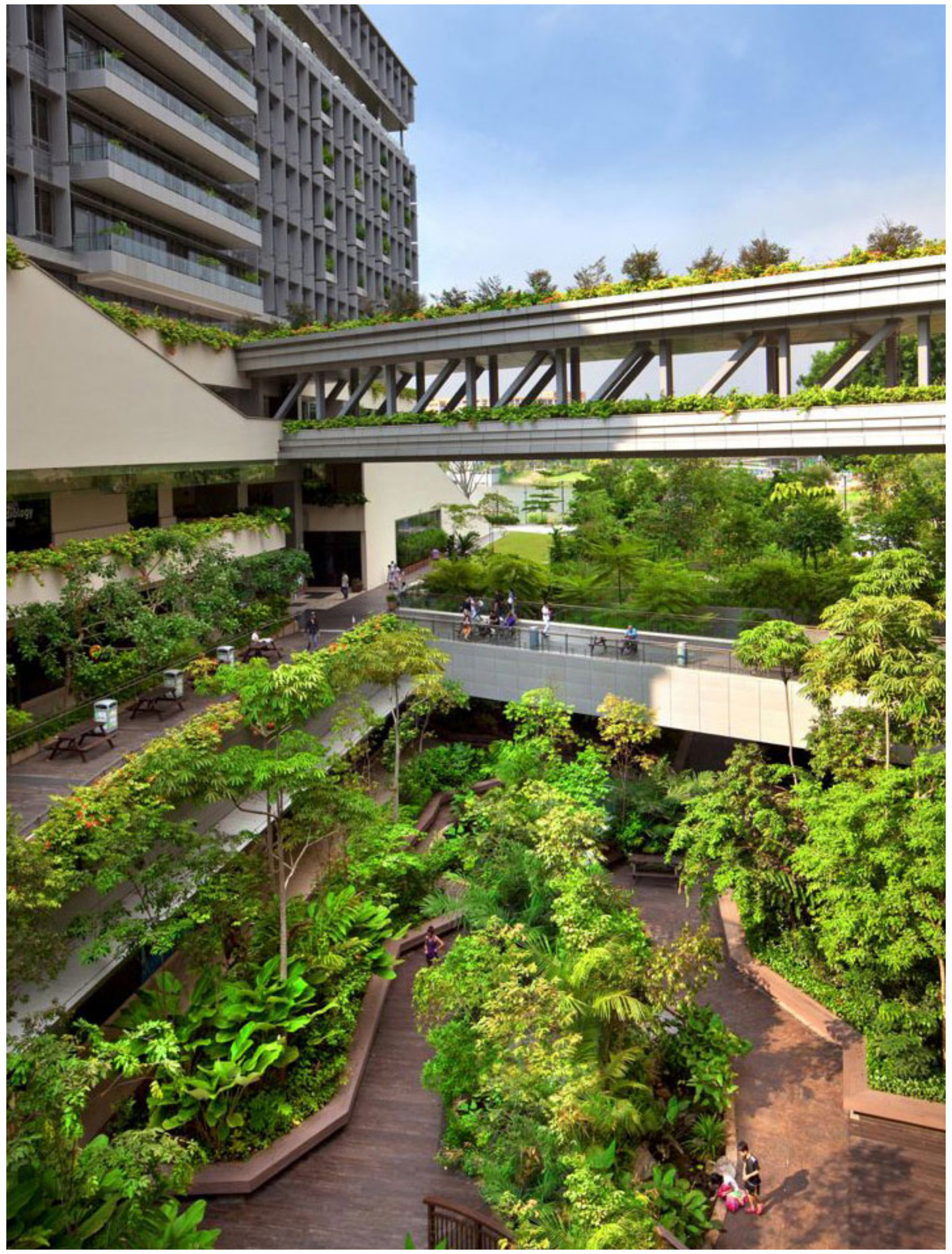
With carbon emissions associated with facility operation addressed through a range of initiatives earlier in these guidelines, upfront embodied carbon can be addressed through a target of 20% reduction (compared to a reference case) with the remainder of upfront embodied carbon offset.

Application of the WELL Building Standard

The WELL Building Standard is a global voluntary standard which aims to deliver spaces that enhance human health and wellbeing. The Standard was developed by integrating research and literature on environmental health, behavioural factors, health outcomes and risk factors with leading practices in building design, construction and management.

Criteria are detailed across 10 ‘concepts’, each consisting of features with distinct health intents. Features are either preconditions (mandatory) or optimisations. An additional Innovation category captures excellence beyond the base concepts.

Application of the WELL Building Standard could extend upon the initiatives outlined in these guidelines, provide greater accountability as well as industry recognition.



Building-based green infrastructure at Khoo Teck Puat Hospital.
Photography sourced from www.worldachitecturenews.com

Appendix

GLOSSARY

- **Biodiversity:** The variety of plant and animal species in an environment, genetic differences within and between species and differences between the ecological systems in which they live.
- **Carbon reduction:** Reduction in the amount of carbon emissions (or equivalent) produced by the asset.
- **Circular economy:** A model which aims to keep resources within a loop and retain value throughout the life cycle of materials, designing waste out of the system and using outputs from one process as inputs in another.
- **Climate adaptation:** The process of responding to actual or expected climate change impacts with the aim to moderate or avoid harm, and where possible deliver other benefits.
- **Climate resilient:** Able to respond to and recover from disturbances related to a changing climate.
- **Climate change risk:** The risk that climate change poses to organisations, assets and communities, largely determined by the severity of a hazard, exposure to a hazard and the level of vulnerability.
- **Coefficient of Performance (COP):** Ratio that describes the efficiency of a heat pump system, based on the relationship of useful heat (or cold) produced compared to the power input.
- **Embodied carbon:** The carbon emissions associated with manufacturing of materials and construction processes throughout the whole life cycle of a building.
- **Heat island effect:** The higher levels of heat in urban areas compared to non-urban areas, commonly resulting from large amounts of surfaces that absorb heat and re-radiate it at night.
- **Heat Recovery Ventilation (HRV):** Mechanical ventilation system which recovers heat (and energy) from exhaust air to preheat or cool incoming fresh air.
- **Heating, Ventilation and Air Conditioning (HVAC):** The range of systems providing thermal control and occupant comfort for indoor environments.
- **National Construction Code (NCC):** Australia's primary set of technical design and construction provisions for buildings, setting the minimum required level for the safety, health, amenity, accessibility and sustainability of certain buildings.
- **Power Purchase Agreement (PPA):** Long term contract to buy electricity generated by an off-site renewable energy project.

POLICY AND STRATEGIC CONTEXT

While not exhaustive, the following documents contribute to the policy and strategic context for the healthcare sector in responding to climate change and integrating environmentally sustainable outcomes in kidney care facilities:

- World Health Organisation (WHO) Guidance for Climate Resilient and Environmentally Sustainable Health Care Facilities (2020)
- Climate and Health Alliance (CAHA) Joint Statement on Recognising Climate Change in the National Preventive Health Strategy
- Australian medical association (AMA) Environmental sustainability position statement (2019)
- Australasian Health Facility Guidelines: Part B - Health Facility Briefing and Planning 0620 Renal Dialysis Unit (2020)
- Doctors for the environment (DEA) Australia Net Zero carbon Emissions Report (2020)
- Climate Health WA Inquiry Final Report (2020)
- Department of Health and the Department of Families, Fairness and Housing Health and Human Services Climate Change Adaptation Action Plan 2022–2026
- Environmental Sustainability Committee (ESC) Three-year Strategy (2021-2023)
- Victorian Health and Human Services Building Authority (VHHSBA) Environmental Sustainability Strategy 2018-19 to 2022-23
- Victorian Health Building Authority (VHBA) Guidelines for Sustainability in Capital Works (2021)

FURTHER RESOURCES

The following can provide additional guidance for the design, construction and operation of kidney care facilities, and the incorporation of sustainability initiatives:

- Green Building Council of Australia
- New Zealand Green Building Council
- Living Future Institute Australia
- International WELL Building Institute

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16. NSW Agency for clinical innovation, Water for dialysis A guide for in-centre, satellite and home haemodialysis in NSW. https://aci.health.nsw.gov.au/__data/assets/pdf_file/0007/306088/water-for-dialysis2018.pdf

We respectfully acknowledge that every project enabled or assisted by HIP V. HYPE in Australia exists on traditional aboriginal lands which have been sustained for thousands of years.

We honour their ongoing connection to these lands, and seek to respectfully acknowledge the traditional custodians in our work.

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