LOW CARBON LIVING CRC

Guide to Low Carbon Landscapes

Acknowledgements

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Title
Guide to Low Carbon Landscapes

Date
June 2019

The authors wish to acknowledge the support and guidance from Paul Osmond of the Faculty of the Built Environment, University of New South Wales, and Stewart Wallace from the CRC for Low Carbon Living at the University of New South Wales.

The authors would also like to acknowledge the time, support and contributions of the designers of the case studies included in this guide.

This guide is funded by the CRC for Low Carbon Living Ltd and supported by the Cooperative Research Centres Program, an Australian Government Initiative.

Cover Photo: Bowden Main Park
Image: Sweet Lime Photo

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Introduction

This guide supplements the series of guides for low carbon buildings produced by the Cooperative Research Centre for Low Carbon Living (CRC LCL).

This supplement addresses landscapes associated with four specific building types: Residential Retrofit, Small-Medium Enterprise, Commercial, and Precinct. Like the building guides, this supplement addresses the need to reduce carbon emissions and enhance opportunities for carbon sequestration in the planning and design of our built environment.

This is a brief introduction that offers practical insights for homeowners, builders and designers to illustrate what low carbon landscapes are, how they function and the benefits they provide. Four residential retrofit landscape projects are featured, followed by one example from each of the other building types.

Key Terms

Carbon dioxide (CO_2)
Carbon dioxide, also known as CO_2, is a naturally occurring gas and a by-product of burning fossil fuels or biomass. It is the principal anthropogenic greenhouse gas that contributes to climate change.

Carbon footprint
Also referred to as carbon miles. Measure of the total amount of emissions of carbon dioxide (CO_2) resulting directly and indirectly from an activity or accumulated over the life stages of a product.

Carbon neutrality
Commonly refers to a situation in which carbon consumption and emissions are offset by carbon sequestration or 'sinks'.

Carbon sequestration
The uptake of carbon containing substances, in particular carbon dioxide (CO_2), in terrestrial or marine reservoirs. Biological sequestration includes removal of CO_2 from the atmosphere through land-use change, afforestation, reforestation, revegetation, carbon storage in landfills, and practices that enhance retention of soil carbon in agriculture.

Climate change
Climate change refers to a change in the state of the climate that can be identified (e.g. using statistical tests) by changes in its properties, and that persists for an extended period, typically decades or longer. Climate change may be due to natural processes or persistent anthropogenic changes resulting from land use and industrial production.

Climate literacy
Climate literacy is the ability to identify, assess and communicate information relating to the influence of the Earth's climate on human systems and the impact of human activity on the Earth's climate.

Direct emissions
Emissions that can be traced directly to sources within well-defined boundaries of, for instance, a region, an economic sector, a company, or a process.

Indirect emissions
Emissions produced in relation to activities within a well-defined area, but which originate outside the specified boundaries.

Landscape performance
A measure of how well and to what extent landscape designs and systems achieve their intended purpose, particularly in relation to sustainability.

Resilience
The capacity of social, economic, and environmental systems to respond to a hazardous event, trend or disturbance by reorganising or adapting in ways that maintain their essential function, identity, and structure.

Key References

IPCC, 2007: Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, Pachauri, R.K and Reisinger, A. (eds.)]. IPCC, Geneva, Switzerland, pp. 76-89. https://www.ipcc.ch/report/ar4/syr/

Landscape Architecture Foundation (2018) Evaluating Landscape Performance: A Guide book for metrics and methods selection. LAF: Washington, D.C. https://www.landscapeperformance.org/guide-to-evaluate-performance

Low Carbon Landscapes

Landscapes are interconnected systems of plants, water, and soils, which function across a range of scales and change continuously over time in response to cultural and natural influences.

Low carbon landscapes integrate materials, processes and spatial arrangements which contribute to the reduction of carbon emissions. They also use material and processes in a variety of ways to enhance carbon sequestration

Benefit and functions of low carbon landscapes

Low carbon landscapes help create resilient, climate-friendly spaces and communities. They also provide multiple benefits: they contribute to energy efficiency, reduce waste and excessive material production, and they enhance biodiversity, thermal comfort and air quality. Benefits to human health include access to local, fresh food, clean water, improved air quality, and access to recreation opportunities.

When creating low carbon landscapes, the aim is to work towards carbon neutrality by reducing carbon sources and/or increasing carbon sinks. This means considering the life-cycle of landscape projects, including site planning, materials selection, construction and maintenance processes, in terms that minimise the use of fossil fuels and enhance carbon retention. Low-carbon landscape design examples include simple activities like recycling stone and soils on site when retrofitting a house, as well as more complex approaches such design strategies to encourage community gardening, cycling and walking at the precinct and community scales.

Landscape performance

High-performing, low-carbon landscapes achieve improved environmental conditions, social or economic conditions for the defined areas and the systems connected to them.

Because landscapes consist of a range of natural and constructed systems, they are subject to influences beyond the boundaries of a defined site. The overall performance of a landscape can be assessed in terms of benefits within and beyond a project's site boundaries. For example, low-carbon landscapes can be measured in relation to their influence on three broad types of emissions:

- direct emissions, or those that occur on site within the site's boundaries;
- indirect emissions, or those that occur outside the site's boundaries; and
- other indirect emissions, which include upstream and downstream emissions, such as those resulting from raw material extraction or transportation

Above: Camperdown Commons
Image: OUTHOUSE Design

Key factors in establishing and maintaining a low carbon landscape

The landscapes in which people live, work and recreate are critical in communicating and influencing the possible solutions to low carbon futures. The case studies that follow illustrate four broad principles to guide the planning and design of low carbon landscapes at a range of scales and across a range of uses:

1) make it local;

2) use as much vegetated cover as possible

3) reuse and recycle

4) make it pedestrian friendly and connected.

Importantly, these principles are accessible to a variety of stakeholders including homeowners, tenants, community groups, government, public sector groups, private consortia.

Summary

The development of low carbon landscapes is necessary to support the transition towards zero carbon.

The case studies illustrate the ease with which homeowners, designers, business owners and community organisations can integrate energy efficient and low-carbon approaches into the design and maintenances of their landscapes.

Many low carbon landscape strategies are cost efficient and readily accessible to homeowners. In residential, community and commercial settings, landscape architects and designers can create spaces that interpret low carbon elements in ways that engage people and promote a high-quality, healthy lifestyle and a vibrant built environment.

Above left: Niblock House,
Image: Marisa Fontes

Above right, upper: Mt Nelson House
Image: Jonathan Wherrett

Above right, lower: Rouse Hill Town Centre
Image: Oculus

Residential Retrofit Case Studies

Niblock House
Image: Marisa Fontes

Forest Edge Garden

This garden was designed to tread lightly on the landscape, and to transition seamlessly into its beautiful bushland setting. The plant selection and materials are resilient and hardy, requiring minimal ongoing maintenance. Some of the planting was sourced from the site itself. The garden and house use rainwater that is collected and stored on site in a dam and rainwater tanks.

Above: The new buildings have been thoughtfully located within the shade of existing mature trees.
Image: Dianna Snape

Below: Stone steps cut from upcycled or recycled quarry or stoneyard waste, with permeable gravel surfaces.
Image: Jane Irwin Landscape Architecture

PROJECT PROFILE

Climatic Region:
Warm Summer, Mild Winter

Location:
Lower Hunter Valley, New South Wales

Date of completion:
2013

Landscape Architect:
Jane Irwin Landscape Architecture, Sydney

Above left: Stone paving cut from upcycled or recycled quarry or stoneyard waste, with permeable gravel areas adjacent.
Image: Jane Irwin Landscape Architecture

Above right: The dam, together with ten 20 000L rainwater tanks, collects and stores stormwater.
Image: Jane Irwin Landscape Architecture

Above: A sculptural piece of sandstone has been repurposed as a garden trough.
Image: Jane Irwin Landscape Architecture

LOW CARBON LANDSCAPE INDICATORS

- Site soil has been retained where possible. The project re-used five tonnes of excavated material on site to sculpt the landform.
- Over 6000 plants were grown locally from seed collection undertaken by a bush regeneration expert.
- Approximately 210 plants were transplanted from elsewhere on the site, contributing to the local ecology and creating new areas of habitat.
- A kitchen garden reduces the reliance on commercially produced food.
- The terrace walls use upcycled roughback stone from quarries and the paths are constructed from waste stone.
- There is no mains water supply. All water is collected on site and stored in rainwater tanks (200 000L total capacity) and a dam. The water is used for general household use and in emergencies.

Niblock House

This 1958 suburban Darwin property has been dramatically transformed to create an energy and water efficient family home. The renovation included a focus on recycled and locally sourced materials. The property has a greywater system and 10 000L rainwater tank, both of which are connected to the garden. The edible garden and broader landscape of water wise plants are irrigated via a drip irrigation system that can be controlled via the residents' smartphone for easy monitoring.

Below: Old concrete stair treads were repurposed as stepping stones.
Image: Marisa Fontes

Right: The property's rainwater tank supplies the laundry, toilets and garden.
Image: Marisa Fontes

PROJECT PROFILE

Climatic Region:
Hot Summer, Warm Winter

Location:
Darwin, Northern Territory

Date of completion:
2015

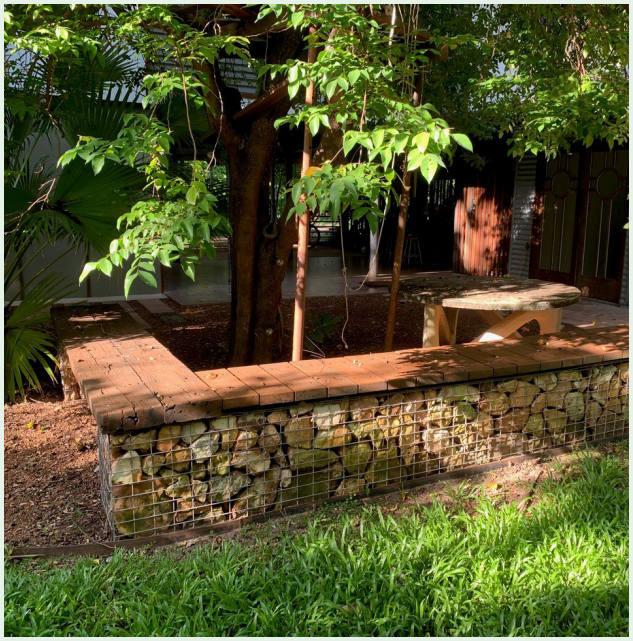
Landscape Architect:
Outsidesign, Darwin

Above: Recycled Jarrah sourced from the property was used to construct the family's bike shed.
Image: Marisa Fontes

Niblock House

Above: The property and pool are shaded by mature trees, including this Frangipani.
Image: Marisa Fontes

Below: Gabion seating wall built from local rock and stair treads from the original house.
Image: Marisa Fontes



LOW CARBON LANDSCAPE INDICATORS

- Recycled materials were used within the garden. Jarrah from the original house was used to construct a bike shed, roof sheeting was used to build planter beds and a gabion seating wall was built from local rock and old stair treads.
- Soil disrupted during renovations was reused on site to create drainage swales and avoid landfill.
- A variety of swales, constructed of lawn, gravel and dry-creek beds are used to mitigate impact of large rainfall events.
- A 4.5kw solar system on the roof supports household electricity useage and the pool system. The house has had no electricity bills in over three years.
- A 10 000L corrugated iron tank for laundry, toilet and garden, and a greywater system that waters planting to the garden perimeter.
- The garden retained a variety of original mature shade trees as well as edible plants.

Mt. Nelson Residence

At this home in the outer suburbs of Hobart, the owners worked with designers to create a variety of functional outdoor spaces for the family. The planting and materials complement the bushland setting, with stone and plants either reused or sourced locally.

Above: Local stone was used to construct retaining walls within the landscape.
Image: Jonathan Wherrett

Below: A series of large, composite timber decks extend formal living spaces to overlook the adjacent bushland.
Image: Jonathan Wherrett

PROJECT PROFILE

Climatic Region:
Mild Summer, Cold Winter

Location:
Mt Nelson, Tasmania

Date of completion:
2009

Landscape Architect:
Inspiring Place, Hobart

PLAN KEY

1. Existing turning area retained and resurfaced, minimising soil disruption and requirement for new materials.
2. Outdoor living space with recycled, low-maintenance composite timber decking.
3. Local site rock is used to retain embankments throughout the site.
4. Local stone walls are used to separate garden areas.
5. A permeable gravel path with timber edging borders the property.
6. Existing infrastructure, such as a rainwater tank and wastewater outlet, has been retained in the new garden design.
7. A generous, fenced productive garden for locally sourced food.
8. Water collected from the garage roof is used to irrigate the productive garden.

Above: Master plan and key
Image: Inspiring Place

Below: The garden is a combination of predominantly Tasmanian native plant species and is enclosed by local bushland
Image: Jonathan Wherrett

LOW CARBON LANDSCAPE INDICATORS

- The garden retained some of the original site planning, including drive and access which were resurfaced.
- Materials were salvaged from site for reuse, including bricks and large boulders. This reduced the need for imported materials and associated carbon footprint.
- Retaining walls were constructed with local dolerite.
- Permeable gravel, stone and sand surfaces were used for paths, planting beds and the play area, reducing water runoff from the site.
- Rainwater collection is for fire fighting, irrigation of productive garden and lawns and small water feature top up.
- Ornamental plantings are predominantly locally indigenous species, contributing to the local biodiversity.

Sustainable House

This ambitious transformation of a terrace house, initiated by its own residents, has inspired ground-up change within its inner-city location. The terrace house is now an off-grid retreat, capturing and reusing stormwater, generating its own electricity, and even treating wastewater on site.

Above left: The terrace is located in Chippendale, only 2.5kms from the Sydney CBD.
Image: Michael Mobbs

Above right: The garden is a mix of plant species, all watered with stormwater or blackwater.
Image: Michael Mobbs

PROJECT PROFILE

Climatic Region:
Warm Summer, Mild Winter

Location:
Sydney, New South Wales

Date of completion:
1996

Designers:
Water, sewage and garden design by resident Michael Mobbs

LOW CARBON LANDSCAPE INDICATORS

- Solar panels installed to provide electricity to the property.
- A composting waste system has allowed the property to be disconnected from the municipal sewerage system.
- The garden is irrigated using blackwater.
- Stormwater on the site is captured for reuse on site.
- Three chickens reside in the garden, providing the household with fresh eggs and reducing their reliance on commercial food production.

To read more go to www.sustainablehouse.com.au

Small-Medium Enterprise Case Study

Camperdown Commons
Image: OUTHOUSE Design

Camperdown Commons

This initiative by Canterbury-Hurlstone Park RSL Club, in collaboration with Pocket City Farms and Acre, has transformed a former bowling green into a community asset, with edible garden, playground and large market garden, all within the inner-city suburb of Camperdown.

Below: The tree 'umbrella' uses upturned tree trunks, roots and limbs.
Image: OUTHOUSE Design

Right: The community garden is located adjacent the market garden.
Image: OUTHOUSE Design

PROJECT PROFILE

Location:
Sydney, New South Wales

Date of completion:
2016

Designer (playground and edible garden): OUTHOUSE Design

Initiative of: Canterbury-Hurlstone Park RSL

Above: The site before construction.
Image: OUTHOUSE Design

Above: The edible garden is planted with seedlings that have been grown on site from seed.
Image: OUTHOUSE Design

Below: The play equipment is themed around farming and food production
Image: OUTHOUSE Design

LOW CARBON LANDSCAPE INDICATORS

- Playground design and location allows children to learn about food production, local food systems and recycled materials, increasing their climate literacy.
- The playground is constructed of natural materials, including a tree 'umbrella' and other sculptural play items. A stage is constructed of recycled decking boards, and walls are filled with excavated site materials, reducing the import of virgin materials to site.
- The market garden uses organic growing methods and supplies the on-site restaurant with seasonal produce. A farm stall enables the community to shop locally and reduce food miles.
- A chicken coop with rescued hens supplies eggs and contributes to the site's waste management. Composting bays located in the market garden also reduce the organic waste leaving the site.
- A series of educational events, workshops and talks is run throughout the year, educating the community about the principles of low carbon living.

Commercial Case Study

Rouse Hill Town Centre
Image: Brett Boardman

Rouse Hill Town Centre

This town centre forms the heart of a new masterplanned community, prepared in partnership with the NSW Government. The town centre has strong connections to its surrounding natural and cultural landscapes. Future streets and spaces are able to be connected to the community through physical and visual links to the surrounding residential area. The town centre is underpinned by a range of environmental initiatives, including targets for biodiversity, energy, water, materials and waste.

Above: The square provides a communal gathering space surrounded by mature trees and low-water use vegetation, irrigated with recycled water.
Image: Oculus

Below: WSUD initiatives, including this raingarden, filter and cleans stormwater run-off before it enters the local catchment
Image: Oculus

PROJECT PROFILE

Location:
Sydney, New South Wales

Date of completion:
2008

Landscape Architect:
Oculus

Rouse Hill Town Centre

Above left: The streets have generous footpaths with mature trees, raingardens and public amenities including seats and bike hoops.
Image: Oculus

Above right: Pedestrian malls are constructed as laneways, with a combination of built canopies and tree canopies, allowing natural ventilation and passive cooling across the site.
Image: Brett Boardman

Above: Simple, legible signage educates the community and visitors about the environmental processes of the site, improving low carbon literacy
Image: Oculus

LOW CARBON LANDSCAPE INDICATORS

- Good solar access to the Town Centre is achieved through the master plan's structure. Passive control measures including the use of trees for shade and canopies for weather protection, mitigate the effects of weather extremes while supporting the local microclimate.
- A network of pedestrian and cycle paths, including a pedestrian loop, provides a continuous and clear circuit of movement throughout the Town Centre. There is parking for 300 bicycles, further supporting active transport participation.
- Local ecology is retained and enhanced, with weeds removed to allow for revegetation. The planting design uses 80% endemic vegetation.
- A site wide WSUD strategy manages and filters stormwater run off before it enters the nearby rehabilitated Caddies Creek.
- The landscape is irrigated with recycled water from Sydney Water's recycled water supply.

Precinct Case Study

Bowden Main Park
Image: Sweet Lime Photo

Bowden Main Park

Originally earmarked for an urban town square, this new park on the site of the former Clipsal Factory provides a green oasis in the heart of the urban infill site. The park incorporates repurposed wharf timber as seats, and recycled red brick paving throughout the park, referencing the site's industrial heritage and Victorian-era cottages.

Below: The park incorporates both trees and built structures for shade and weather protection.
Image: Sweet Lime Photo

Right: The park includes generous areas of permeable paving.
Image: Sweet Lime Photo

PROJECT PROFILE

Location:
Bowden, Adelaide, South Australia

Date of completion:
2016

Landscape Architect:
ASPECT Studios

Above: The planting palette is a diverse mix of drought tolerant and hardy plants, including endemic, native and exotic species.
Image: Sweet Lime Photo

Bowden Main Park

Above: The playground incorporates recycled wharf timber as seats and for play.
Image: Sweet Lime Photo

Below: Recycled red bricks are used as paving throughout the park.
Image: Sweet Lime Photo

LOW CARBON LANDSCAPE INDICATORS

- The park is central to the broader development, providing a green heart to the community, and is accessible via a street network designed to encourage walking.
- A bike repair station and bike racks throughout the park support active transport, and its proximity to the train station and the city reduce the reliance on private vehicular transport.
- The park and the broader Bowden development is serviced with reclaimed stormwater through the local Council's 'Waterproofing the West' strategy.
- Recycled red bricks used as pavers are a reference to the site's industrial past and the repurposed wharf timbers are used as play and seating elements, reducing the manufacture of new materials for site.
- Drought tolerant and hardy plants throughout the park reduce reliance on irrigation and contribute to the local ecology. Over 40 semi-mature trees provide valuable weather protection.

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This research is funded by the CRC for Low Carbon Living Ltd supported by the Cooperative Research Centres program, an Australian Government initiative.