Plants and Environmental Quality Research Group

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Phytoremediation of the urban environment

Table 1 Top productive countries/regions on botanical research in the indoor environment.

Countries/ Regions	TP	%TP	Years										TC
			2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	
USA	71	19.24	7	6	3	2	5	0	3	5	4	6	2006
AUSTRALIA	40	10.84	0	0	2	3	0	1	4	8	9	3	1414
CHINA	38	10.29	3	4	1	1	3	0	3	3	8	6	427
SOUTH KOREA	27	7.31	2	2	1	2	4	2	0	1	0	4	849
THAILAND	22	5.96	1	1	1	2	1	5	1	2	4	3	378
POLAND	17	4.60	1	0	0	0	4	2	1	0	5	3	494
IRAN	16	4.33	0	3	2	0	1	2	0	4	1	3	145
SPAIN	16	4.33	0	1	1	4	0	1	2	3	1	1	381

Tan et al 2022

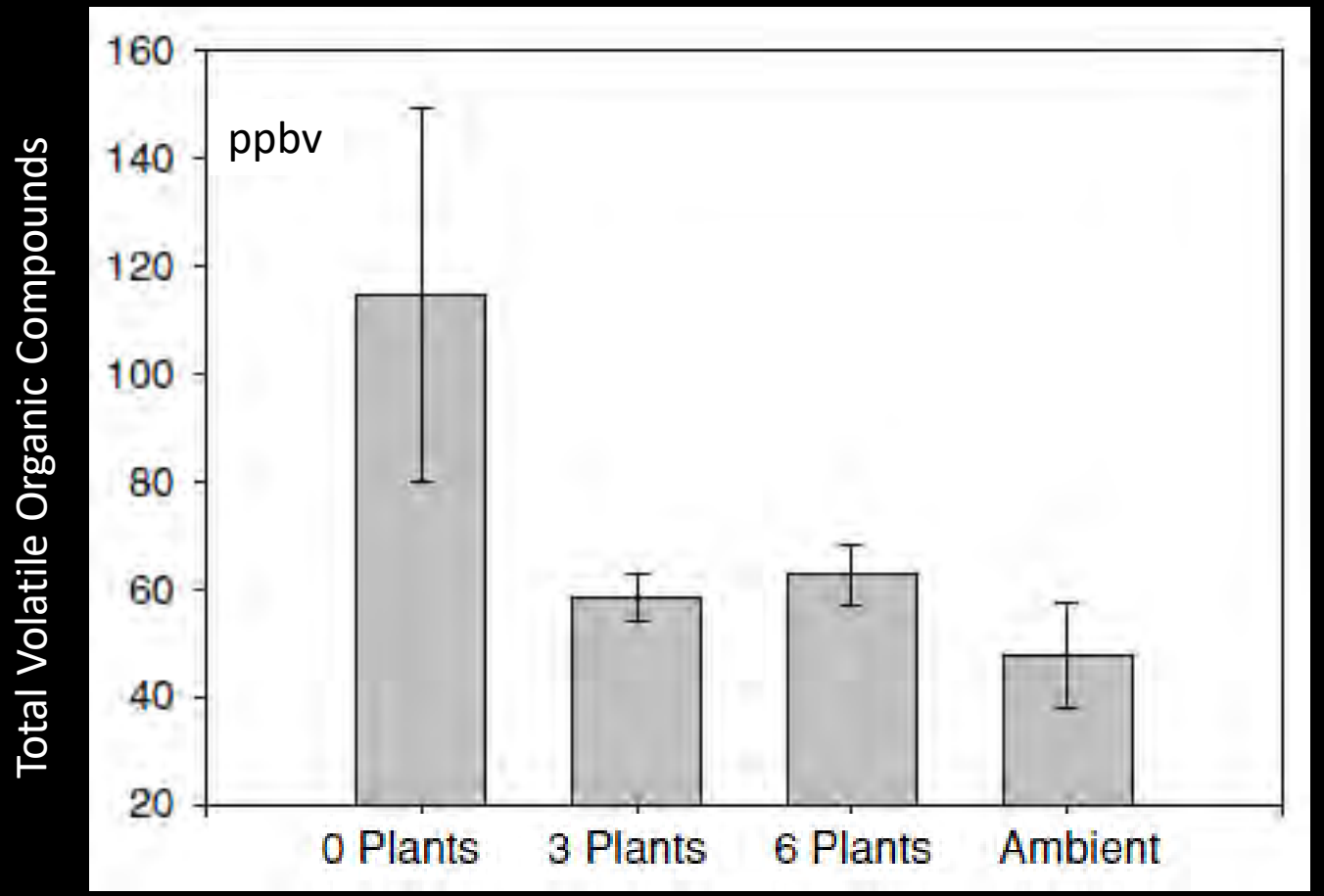
Urban environmental quality challenges

- Urbanization is increasing worldwide

The urban environment

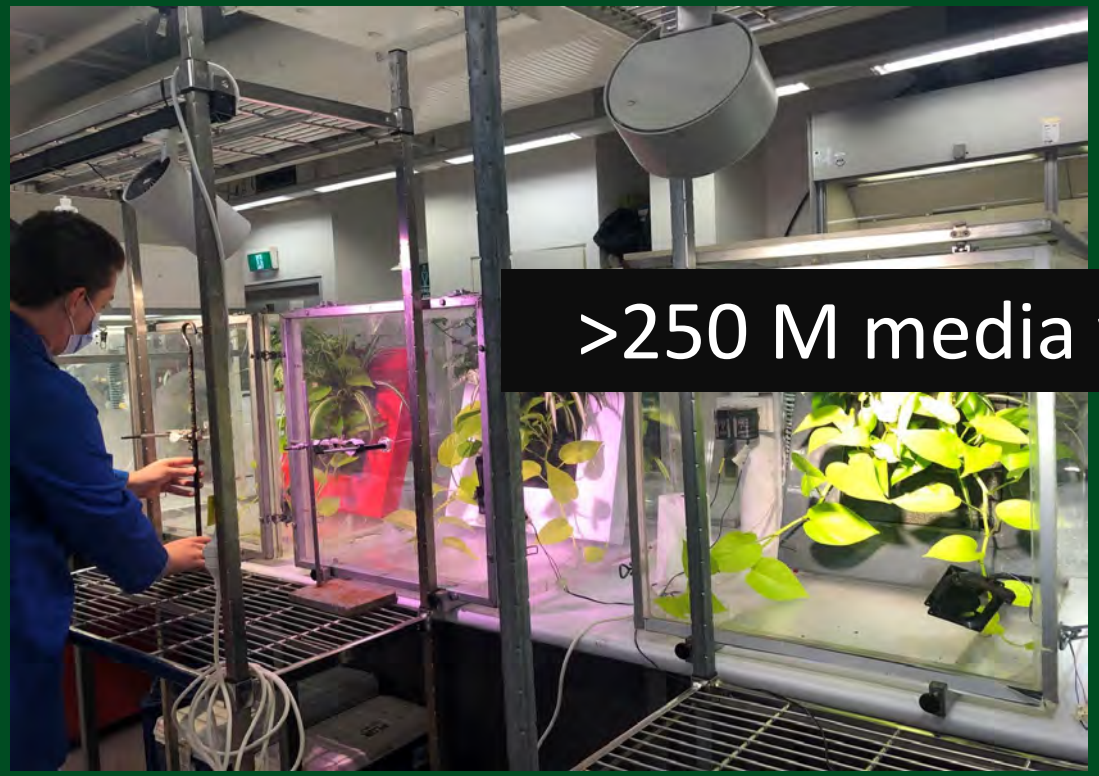
- *is polluted:* CO, NO_x, SO_x, Volatile Organic Compounds, particulate matter, ozone, bioparticles
- lacks *resilience*
- *uses energy* and *produces GHG*
- is heating up: *UHI*

Plants improve air quality indoors

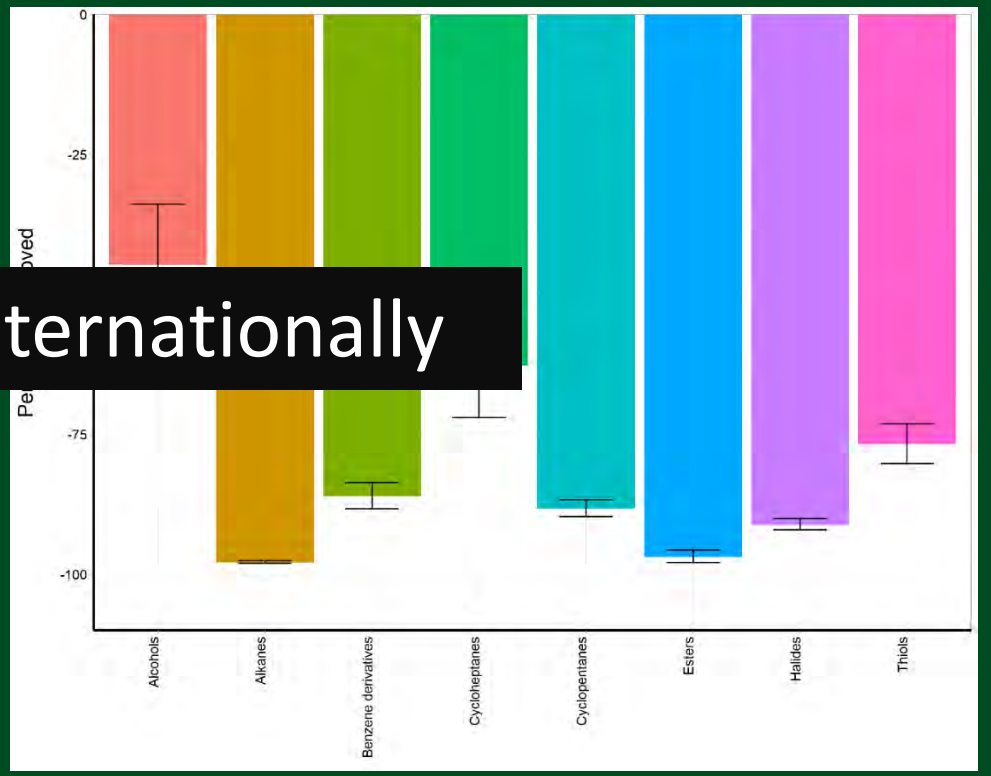


Wood et al. 2006

Phytoremediation of petrol VOCs



>250 M media views internationally

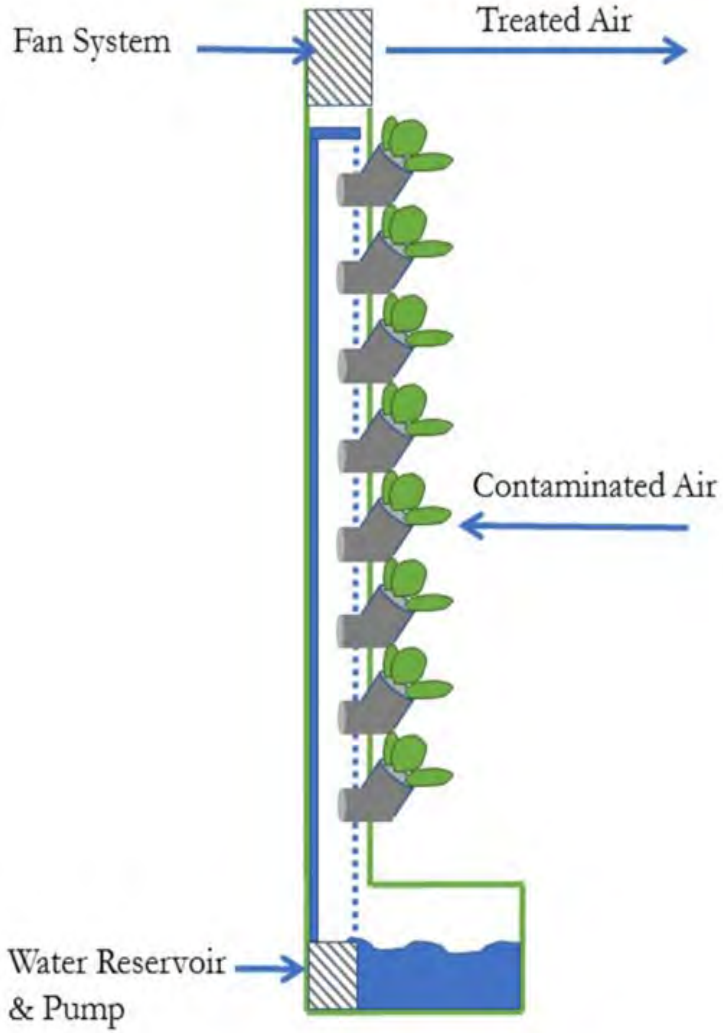


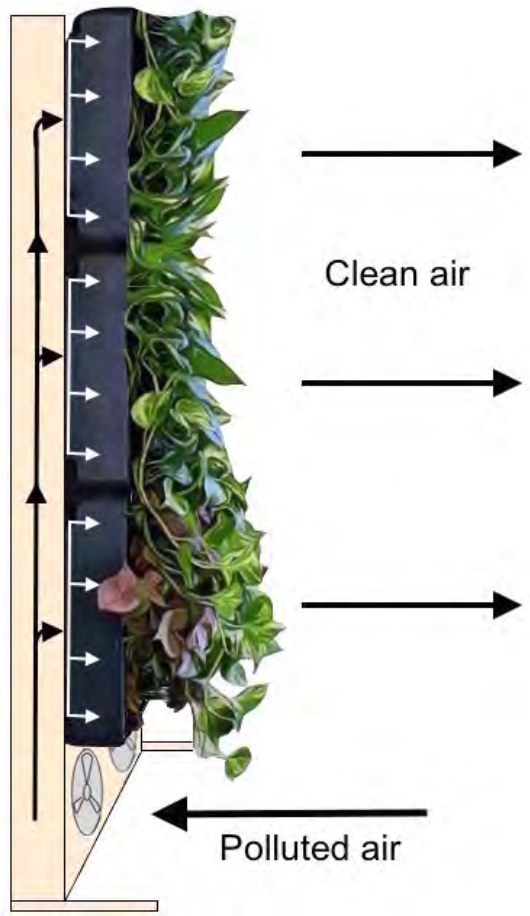
% removal within 8 h. Matheson et al., (2023)

More = better

- All pollutant removal rates increased

Indoor Plants Ver. 2: Active botanical biofiltration





Infrastructure scale phytosystems

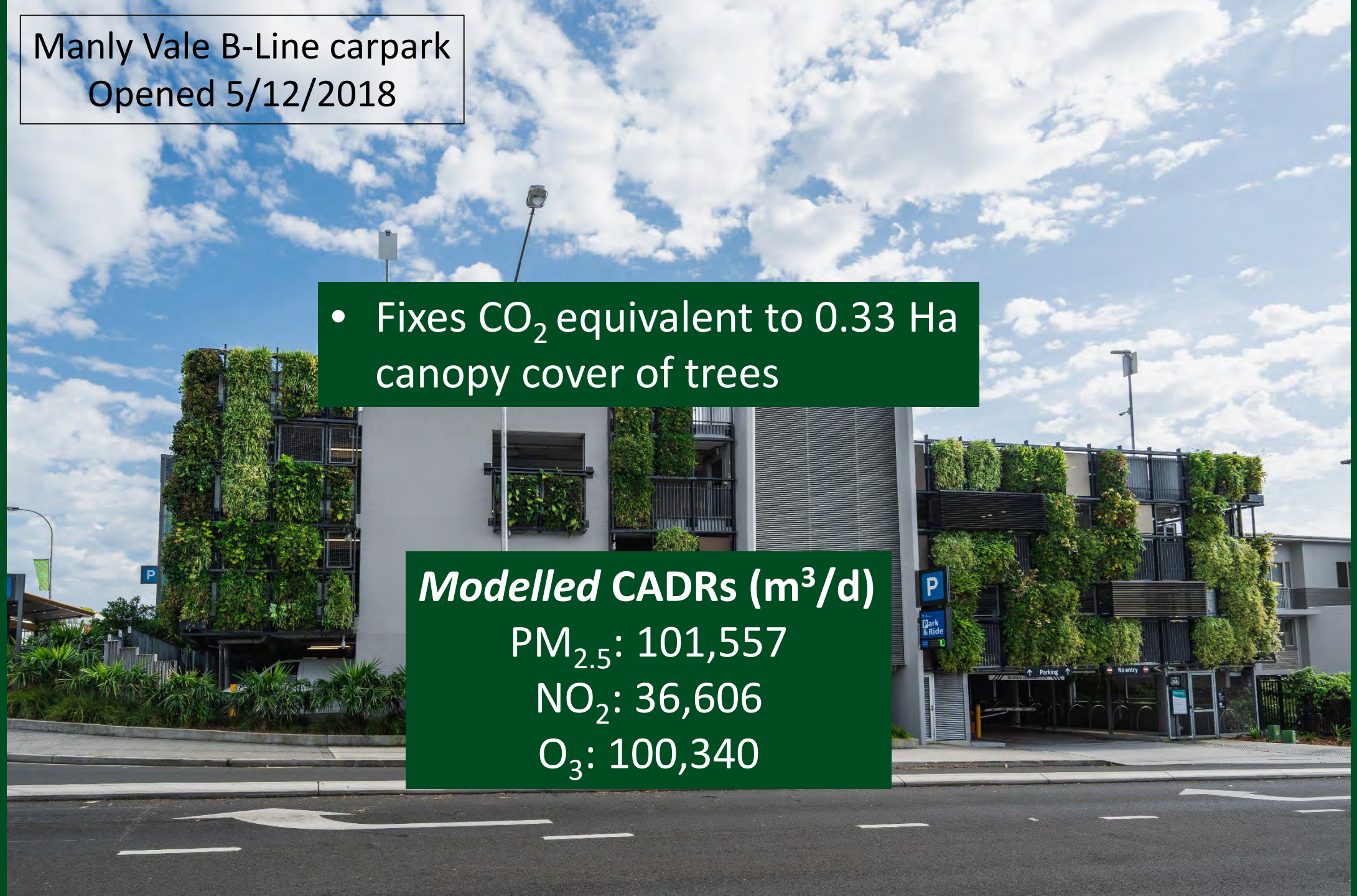
Campbelltown Rail

St Leonards

LendLease HQ, Barangaroo

Brisbane Airport Link

Manly Vale B-Line


Manly Vale B-Line carpark
Opened 5/12/2018
• Fixes CO_2 equivalent to 0.33 Ha canopy cover of trees
***Modelled* CADRs (m^3/d)**
$PM_{2.5}$: 101,557
NO_2: 36,606
O_3: 100,340
P
Park & Ride
Parking
No entry

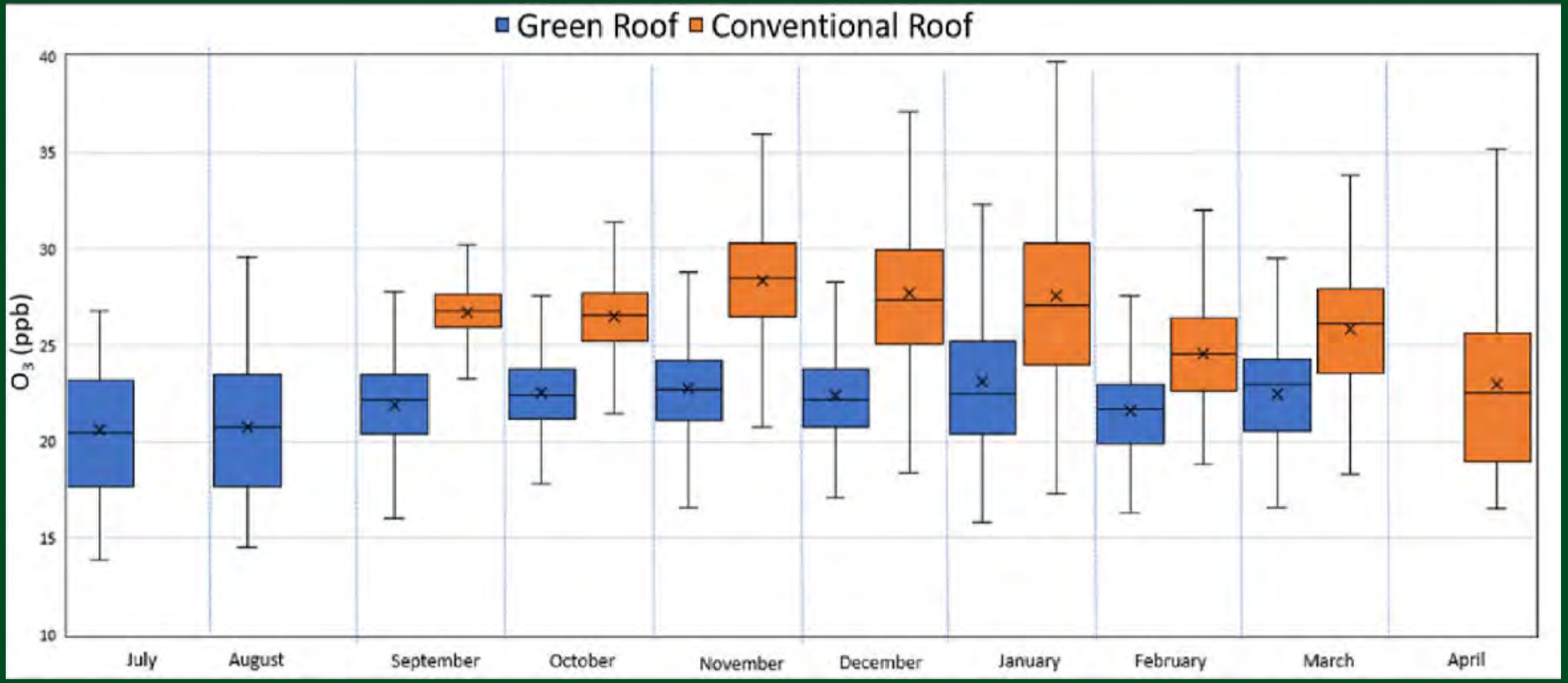
Active phytosystem road pollution CADR

Pollutant	CADR ($m^3.h^{-1}. m^{-2}$ biofilter area)
NO_2	121
O_3	50
$PM_{2.5}$	40

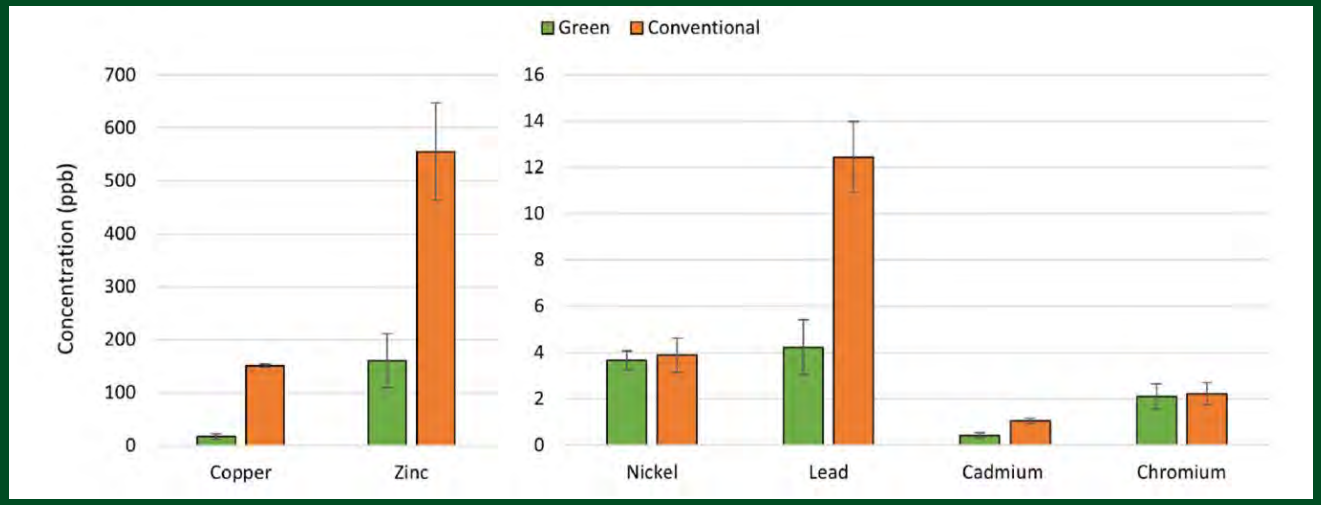
Pettit et al 2020, 2021

Daramu / International House, Barangaroo

Green roofs reduce air pollution

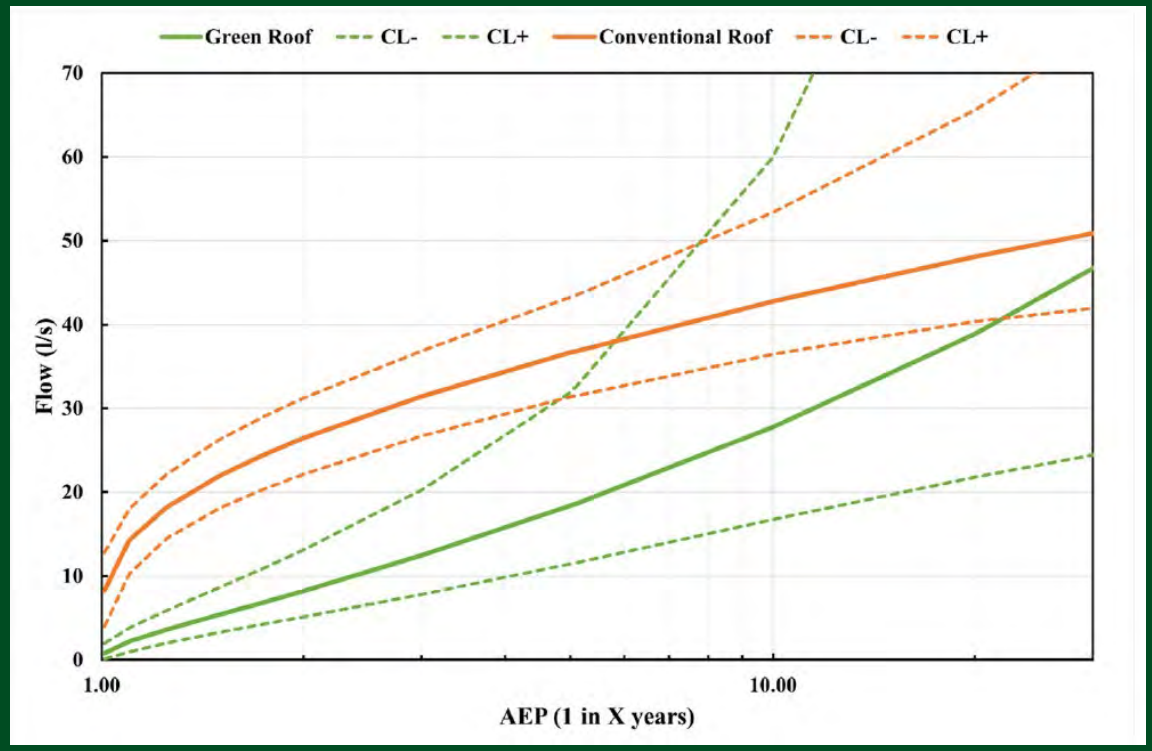


Urban resilience: green roofs manage stormwater

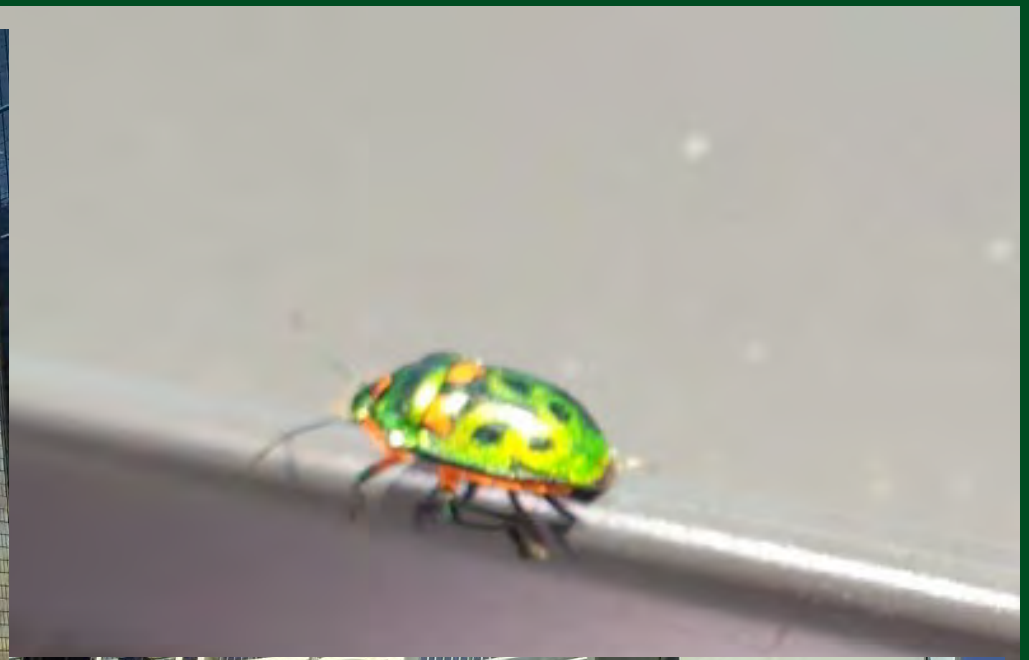


Capturing pollutants

Attenuating flow in storm events




BDO
91F
GRCAM02
02/19/2021 06:59PM

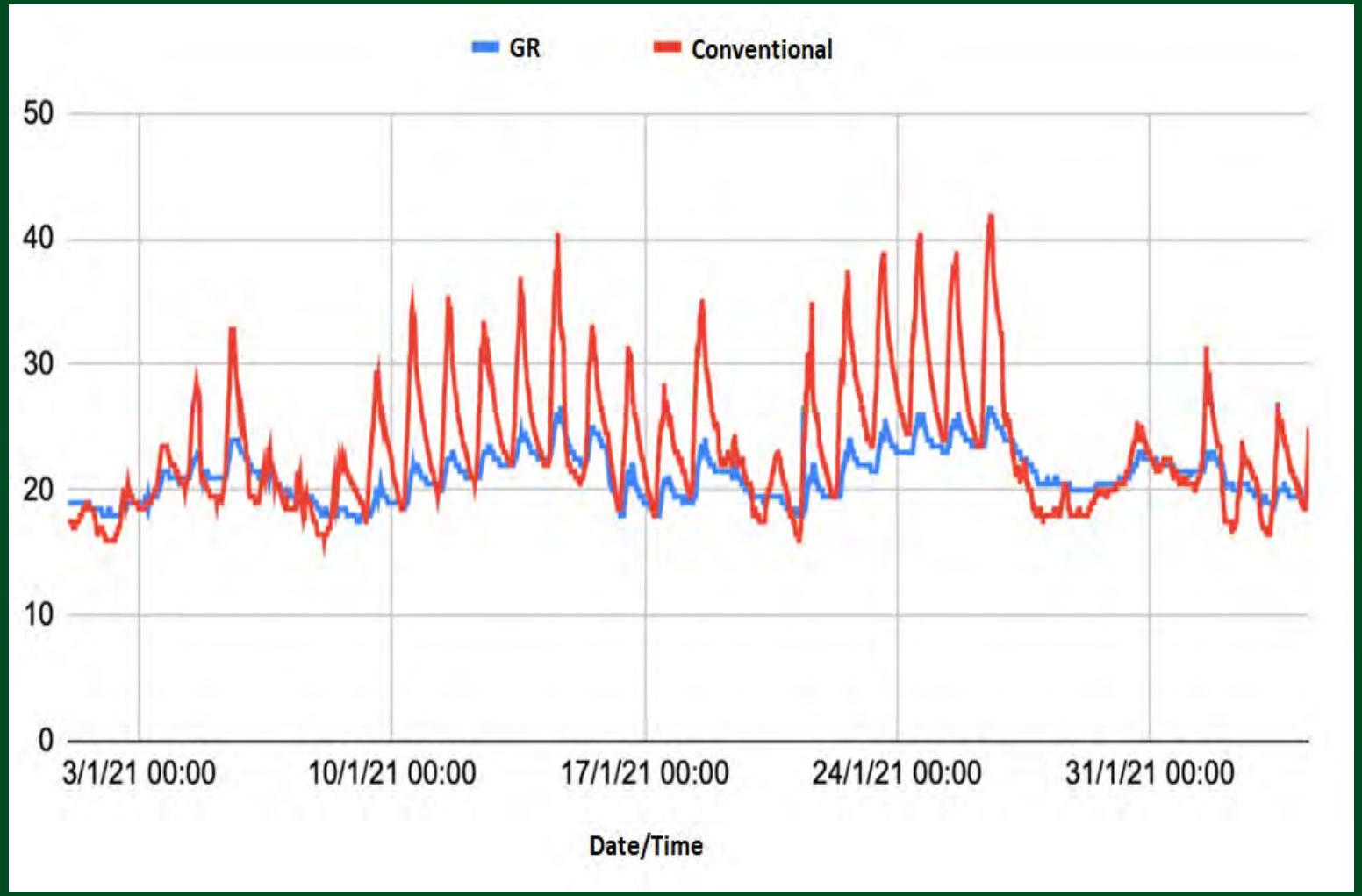



93 F
GRCAM01
11/14/2020 03:40PM


82 F
LCAM02
03/19/2020 05:44AM

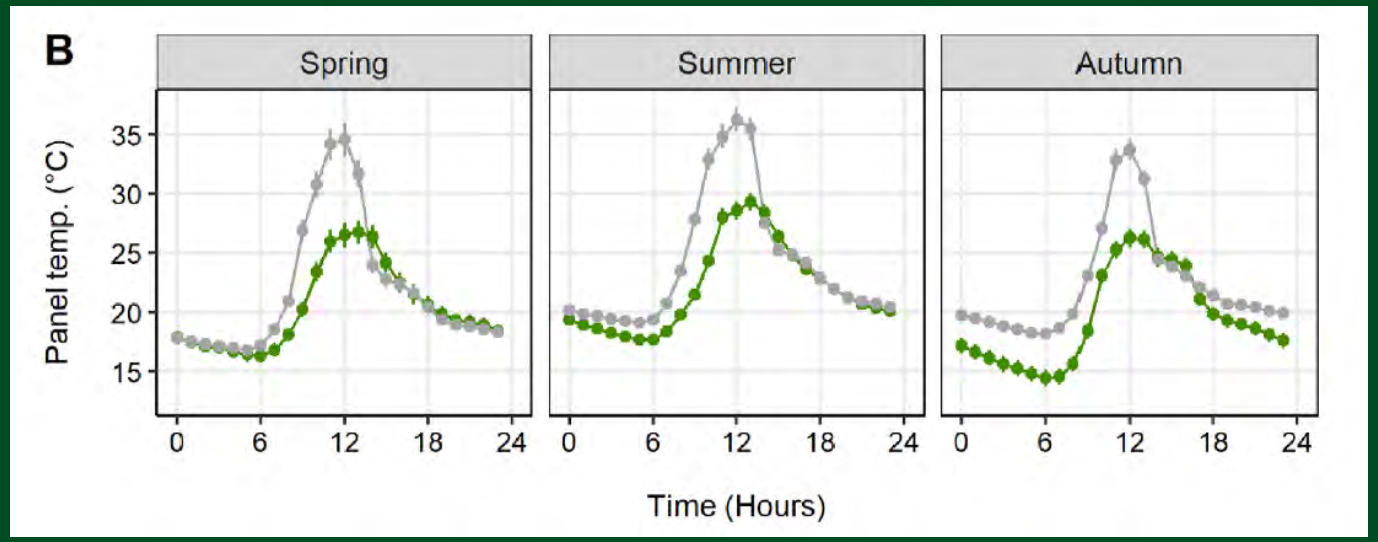
Urban resilience: Green roofs cool buildings

- Green roof was up to 20°C cooler on days >40 °C

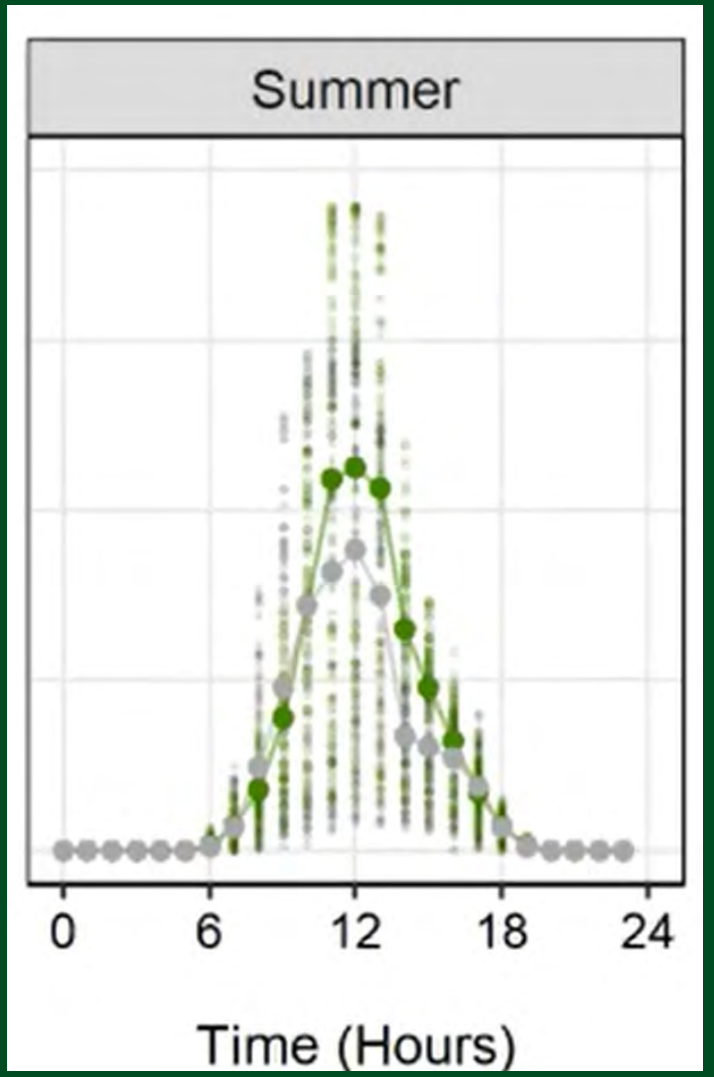


Green roofs increase solar energy output

- BSGR 4.5% greater output
- Value of additional energy $4526.22 AUD over 3 seasons



kWh



What now?

- Green infrastructure reduces the negative effects of urbanization
- Effect sizes are large

But

- Green systems are fixed on location
- Capital and maintenance costs are a barrier

PEQR Mission

- *Cleaner, cooler, resilient, greener cities*

- Support partners → client ESG
- Employment opportunities
- Research partner ROI


Plants are a universal
core component of
sustainable cities