Energy Security Safeguard
Office of Energy and Climate Change

Lighting upgrades in the Energy Savings Scheme

Proposed Changes

21 September 2023

Agenda

10:00	Introduction and Background	Aarushi Kochhar, OECC
10:15	Presentation of Draft Proposals	Steven Beletich, Beletich Associates
10:45	Next steps	Aarushi Kochhar, OECC
11:00	Q&A	
11:30	Session closes	

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Acknowledgement of Country

We acknowledge that today we meet on many Aboriginal lands.

We acknowledge the traditional custodians of the lands and we show our respect for elders past, present and emerging through thoughtful and collaborative approaches to our work.

Nikita Ridgeway

Engage with us through Slido!

- #ESSLighting
- Answer poll questions launched every 10 minutes
- Put in any questions you have for us

Introduction and Background

Aarushi Kochhar
Office of Energy and Climate Change

The Energy Security Safeguard

The Energy Security Safeguard is part of the *NSW Electricity Strategy*, the government's plan for a reliable, affordable and sustainable electricity system. The Safeguard includes three schemes:

- The existing **Energy Savings Scheme (ESS)** creates a market and financial incentives to save energy and reduce energy bills. It runs to 2050, with targets increasing to 13% by 2030
- A new **Peak Demand Reduction Scheme (PDRS)** supporting activities that provide the capacity to reduce demand at peak times
- A new **Renewable Fuels Scheme (RFS)** to encourage the production of green hydrogen

The Energy Savings Scheme

NSW's largest energy efficiency program

44,000 GWh

Energy savings till 2030

$6.1 Billion

Energy bill savings till 2029

39.6 Million

ESCs created from 2009 to July 2021

Avoided 19 megatonnes

GHG emissions between 2009 and 2021

Why update the ESS Rule?

- Update existing methods to align with changes to GEMS Determinations, standards and the underlying programs.
- Incorporate stakeholder feedback and evaluation results.
- Maintain the effectiveness of the ESS Rule through:
  - updates to savings factors
  - changes to the Rule requirements
  - adding activity schedules for new technologies.
- Make other enhancements to the ESS Rule to maintain its integrity and/or reduce transaction costs.

Summary of lighting methods

Method	Activity	Co-payment	Calculation

Commercial lighting energy savings	Roads/public spaces
	traffic signals
	building lighting
	(excludes houses)
	(includes common areas of apartment buildings)
		Y
		$5/MWh of savings
			• 2 sets of equations:
			  • existing equipment baseline
			  • BCA J6 baseline
			• Hours of operation by building/space type (office, industrial, retail, etc)

Home energy efficiency retrofits	Residential small business	Y $30 per upgrade	• Electricity savings factors (MWh per lamp replaced) in look-up tables for specific lighting upgrade activities
Public lighting	Roads public spaces traffic signals	N	• Use of 3 equations to calculate energy savings • Cannot be network service activities under the National Electricity Law, including network infrastructure

History of lighting upgrades in the ESS

- 2017: Lighting Market Impact Evaluation study
  - ESS has brought forward LED uptake and upgrades in NSW by 7 to 10 years
  - LED lighting becoming the norm for new product sales
- Mid-2020: Review of Lighting in the ESS study
  - Beletich Associates, Common Capital and Light Naturally
  - 1 on 1 interviews with ACPs, industry bodies, product suppliers and lighting designers
- September 2020: Targeted Consultation
  - Draft findings and future options, 71 attendees
- July 2023: Beletich Associates to update lighting report and draft proposals

Review of lighting in the NSW ESS

Steven Beletich, Beletich Associates

21 September 2023

Contents

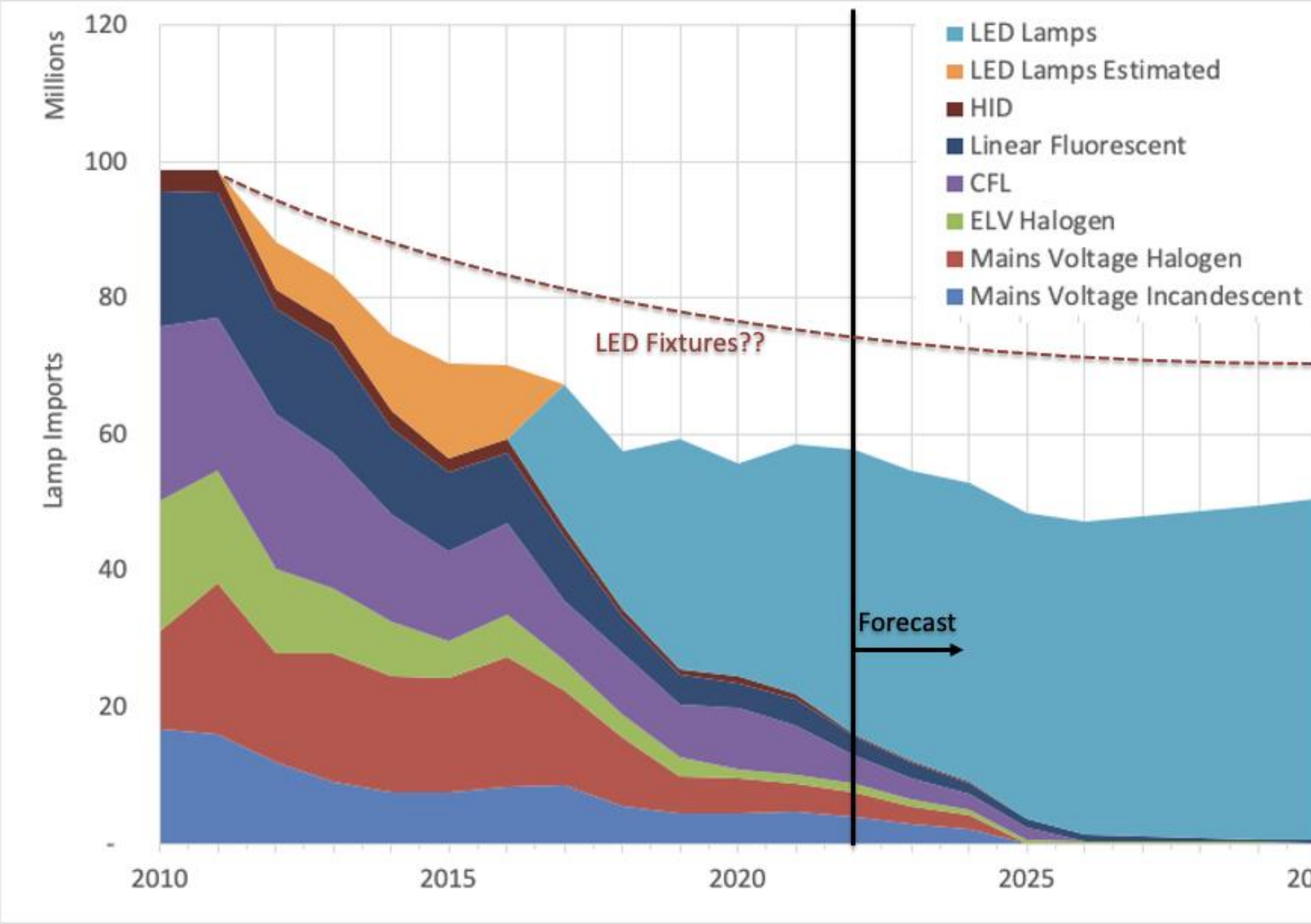
- Lighting market update
- New activity - replace LED with ‘super LED’
- Proposal for future of lighting
- Changes to control multipliers
- Public lighting - trimming, dimming and CLO
- Co payment
- Misc issues

Lighting market update

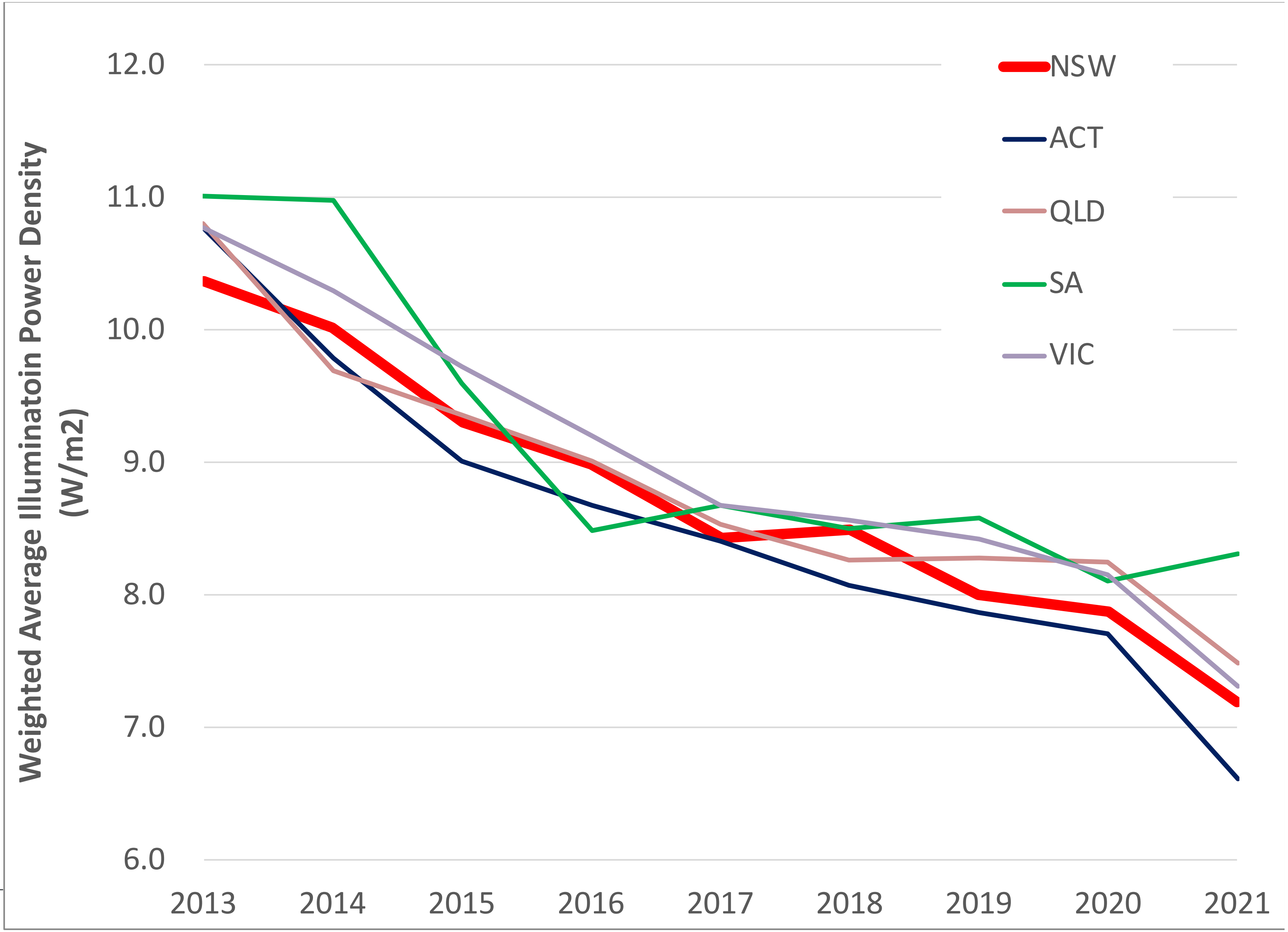
Lamp imports

Declines since 2010

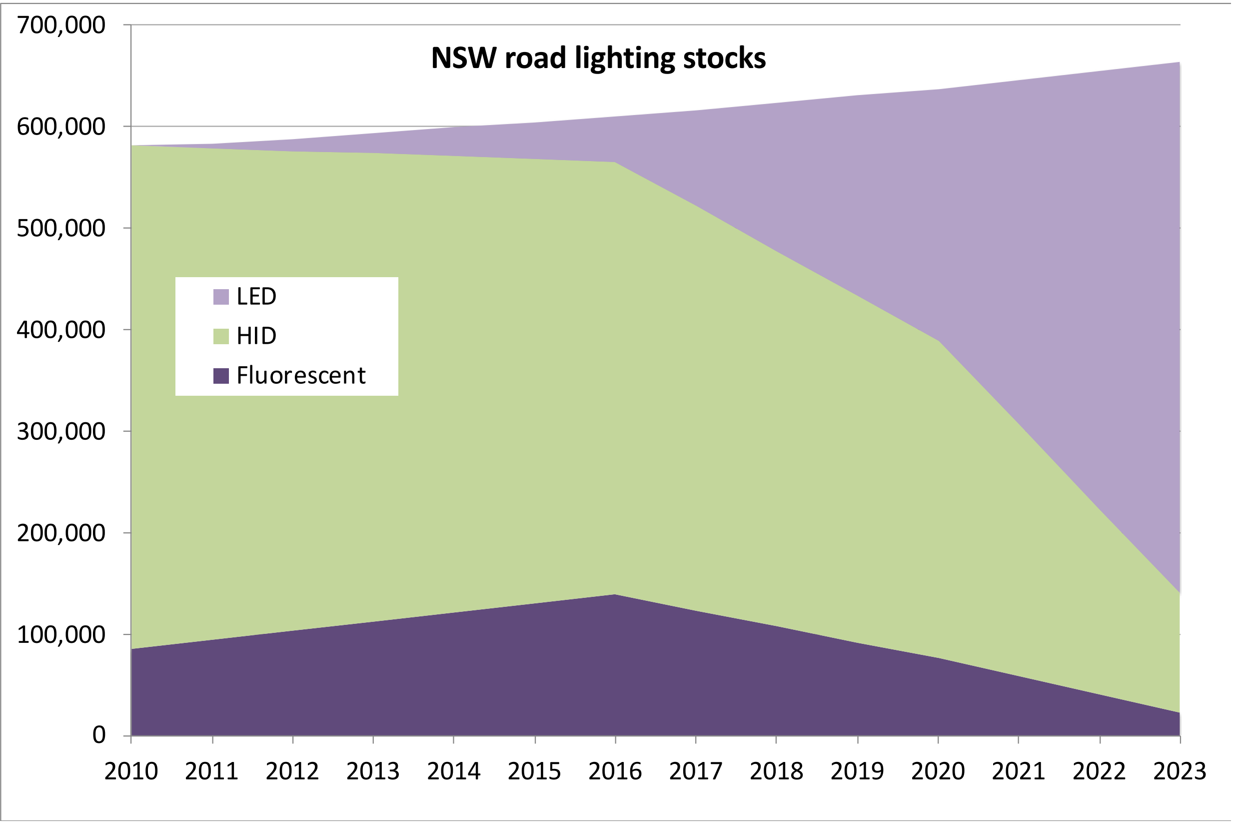
- Mains Voltage Inc 77%
- Mains Voltage Halogen 7
- ELV Halogen 93%
- CFL 84%
- Linear Fluorescent 85%
- HID, 92%

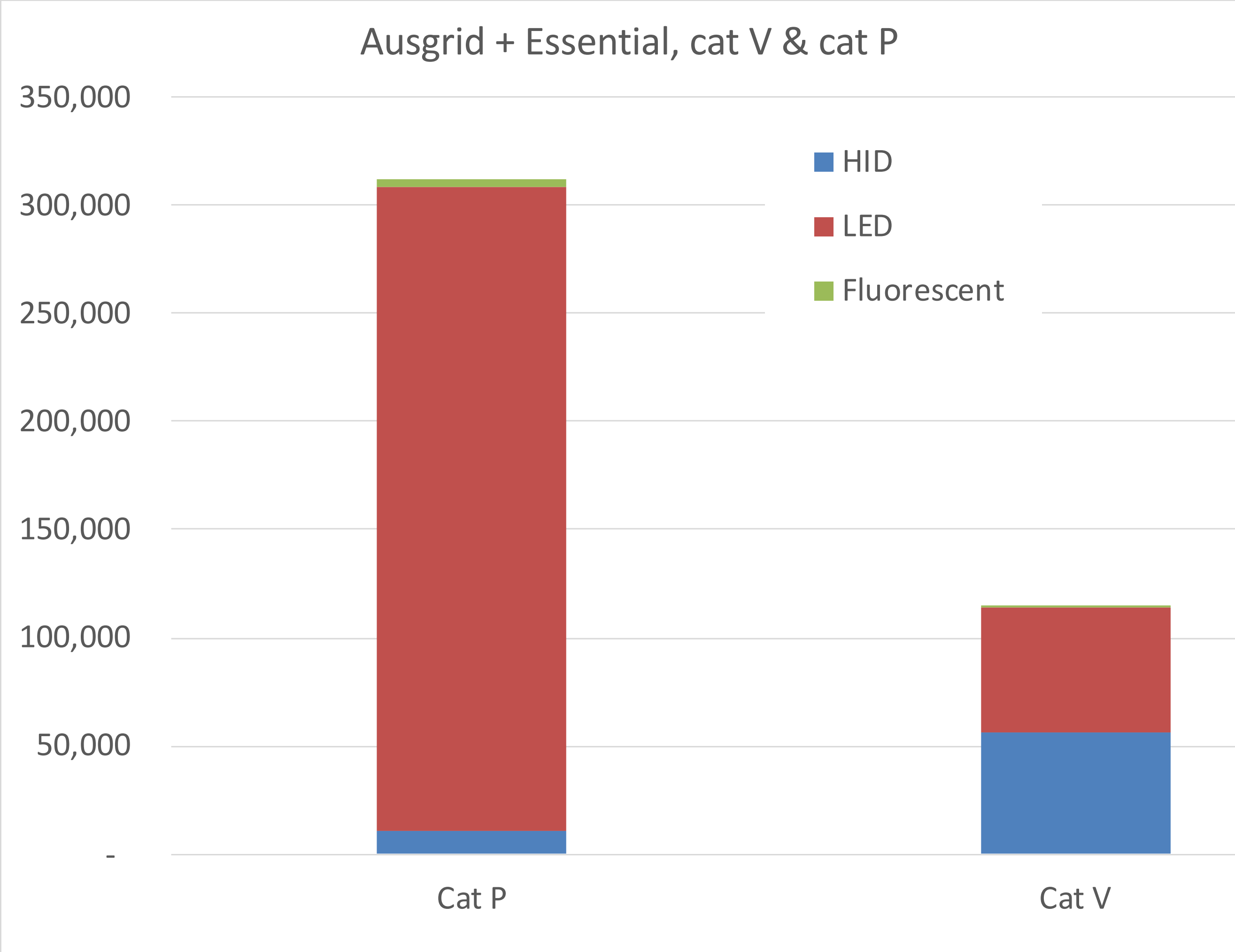


Commercial building disclosure, Tenancy lighting



Road lighting stocks





Regulations

- Australia MEPS
  - Phase out MV halogen lamps – 2025 ?
  - MEPS for LED lamps – 2025 ?
- Minamata Convention phase outs
  - Mercury vapour done
  - CFLi 2025
  - CFLn + linear fluoro - target 2025/26 (to be agreed at next COP)
- Europe phase outs
  - CFLi - 2021
  - Linear fluoros - Sept 2023
  - HID - investigations underway

Other schemes

- ERF retired commercial & public lighting method in 2022
- VEU lighting - Feb 2023
  - Removed residential
  - Commercial – all removed except linear fluoros & CFLn (life 5 to 4 yrs)
  - Removed mercury vapour
- SA REPS lighting
  - 5 yr transition factors applied
  - Pivot toward deeper retrofit activities and DR
- ACT EEIS
  - Modelled on NSW ESS

New activity
Replace LED with ‘super LED’

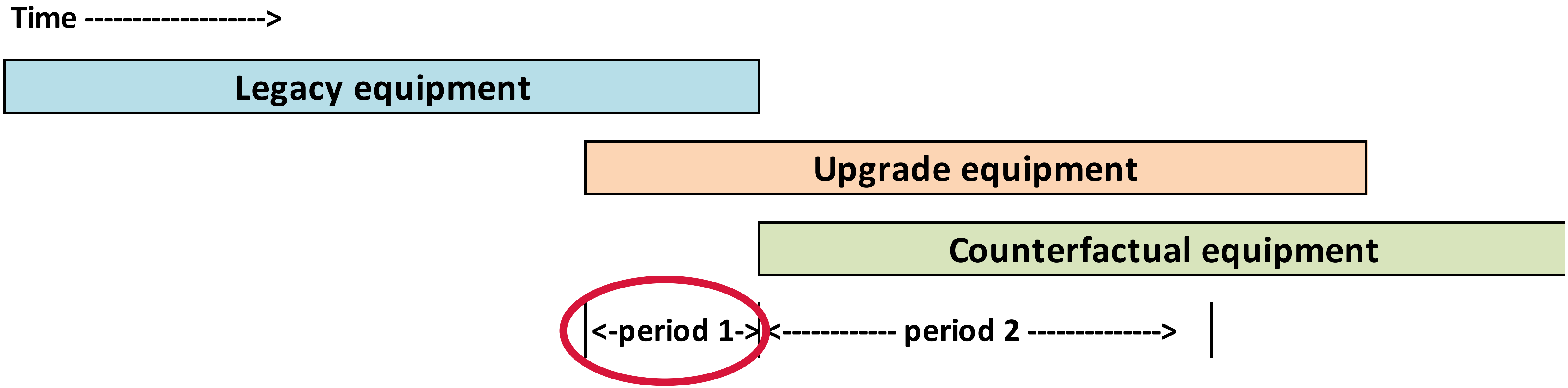
Replace LED with 'super LED' (transition time = 0 months)

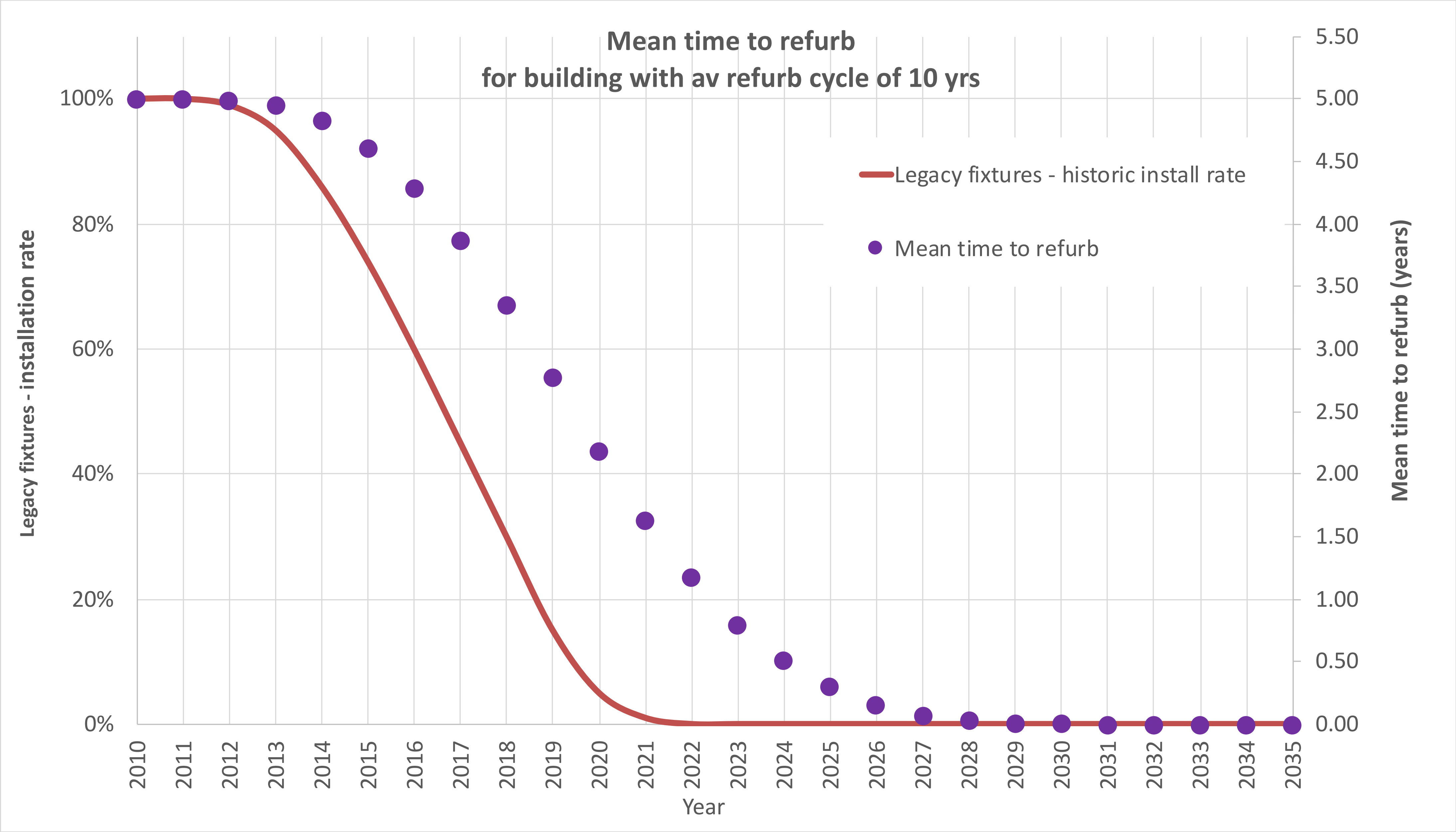
- 'Super LED' = high efficiency LED (see next section)
- Lifetime = ½ average refurb cycle
- LCP – need new entry in table 9.2 / 9.4
- Life cycle – use phase is biggest contributor
- Recycling requirement TBC

Source: https://www1.eere.energy.gov/buildings/publications/pdfs/ssl/2012_LED_Lifecycle_Report.p

Proposal for future of lighting

Mean time to refurb
= period 1





Mean time to refurb
for building with av refurb cycle of 10 yrs
Legacy fixtures - historic install rate
Mean time to refurb
Legacy fixtures - installation rate
Mean time to refurb (years)
Year
100%
80%
60%
40%
20%
0%
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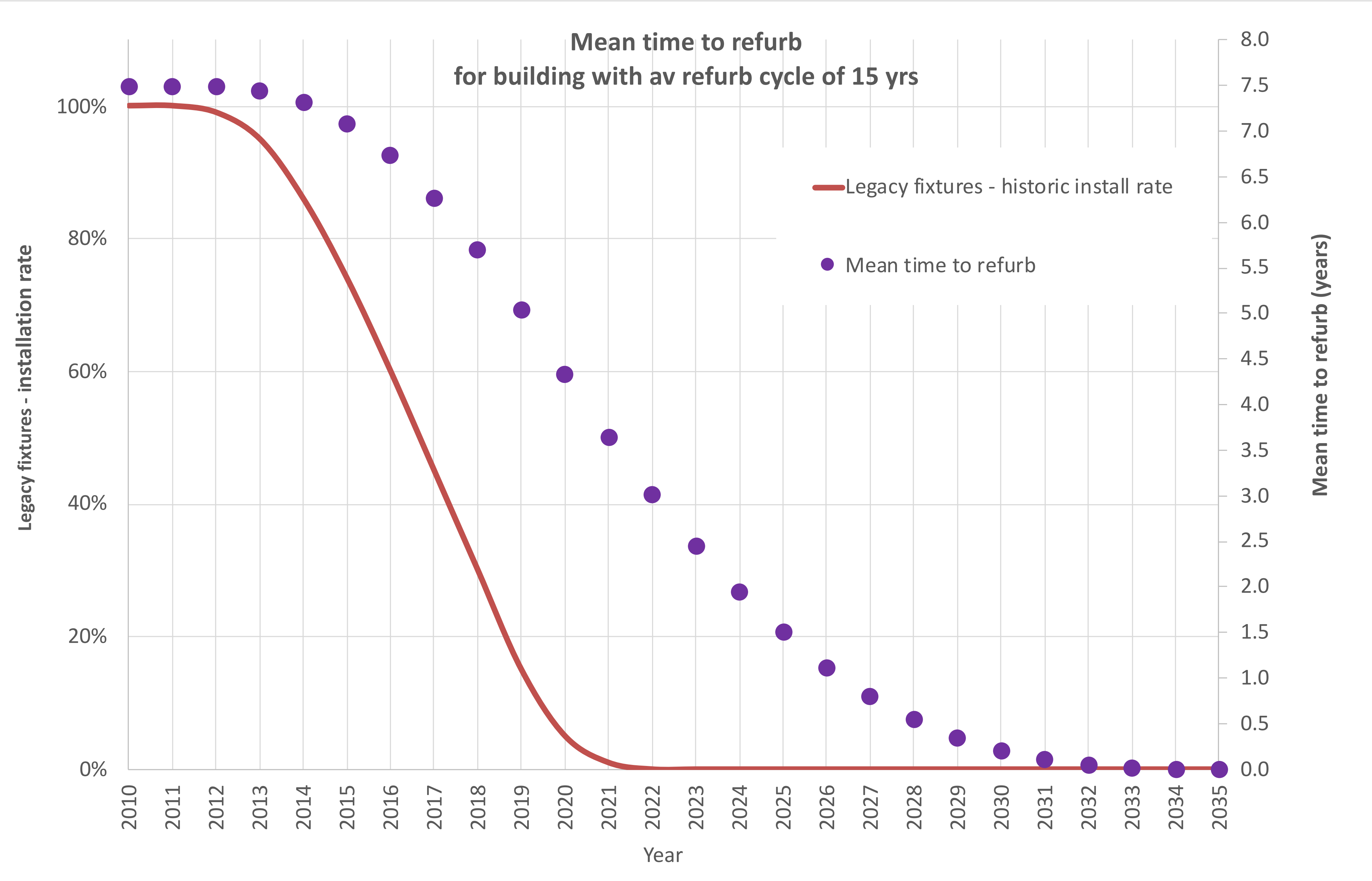

Mean time to refurb
for building with av refurb cycle of 15 yrs
Legacy fixtures - historic install rate
Mean time to refurb
Legacy fixtures - installation rate
Mean time to refurb (years)
Year
100%
80%
60%
40%
20%
0%
8.0
7.5
7.0
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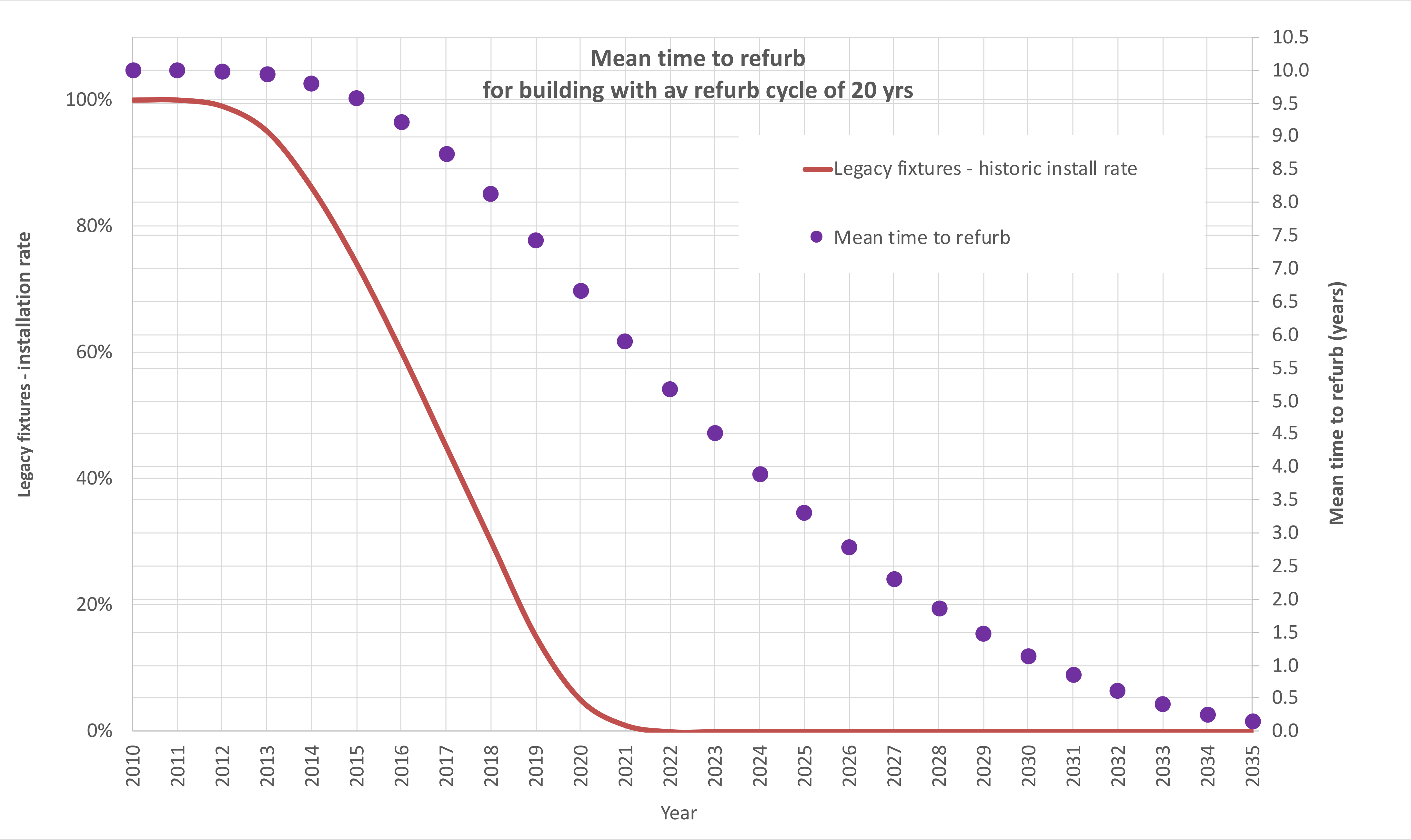
Mean time to refurb
for building with av refurb cycle of 20 yrs
Legacy fixtures - historic install rate
Mean time to refurb
Legacy fixtures - installation rate
Mean time to refurb (years)
Year
100%
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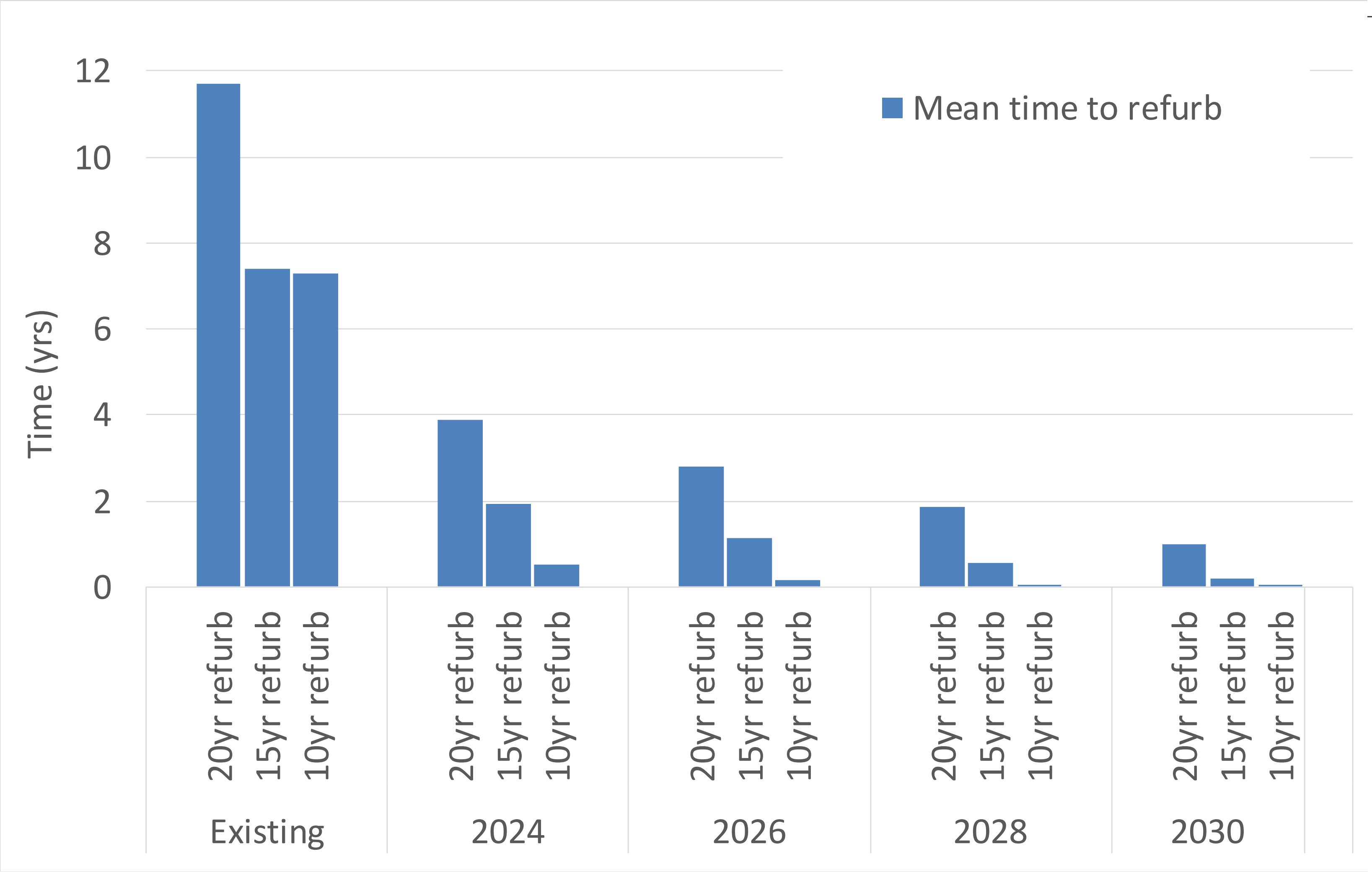
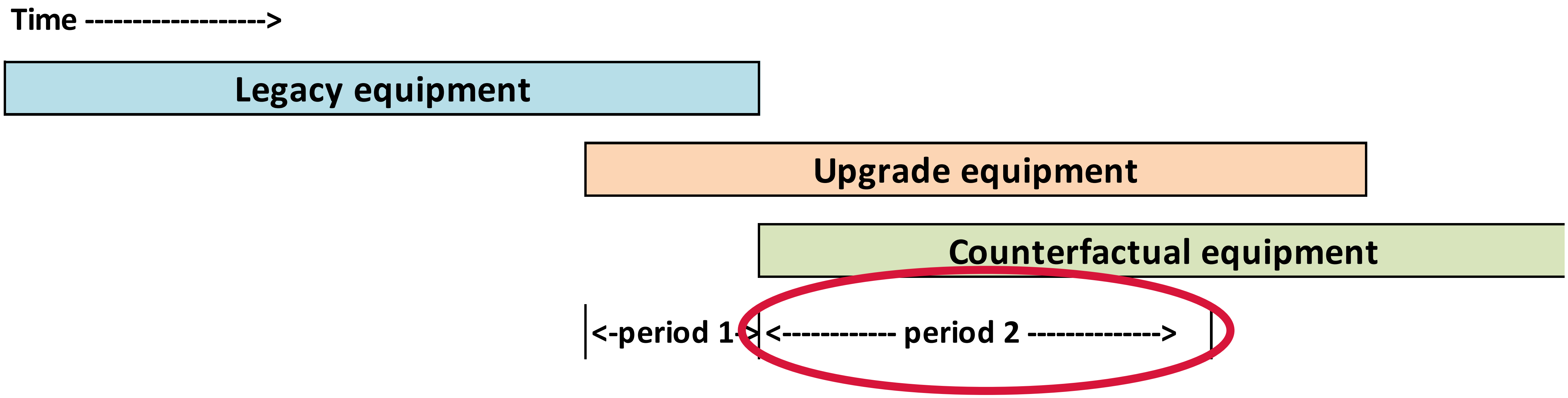
Mean time to refurb – summary



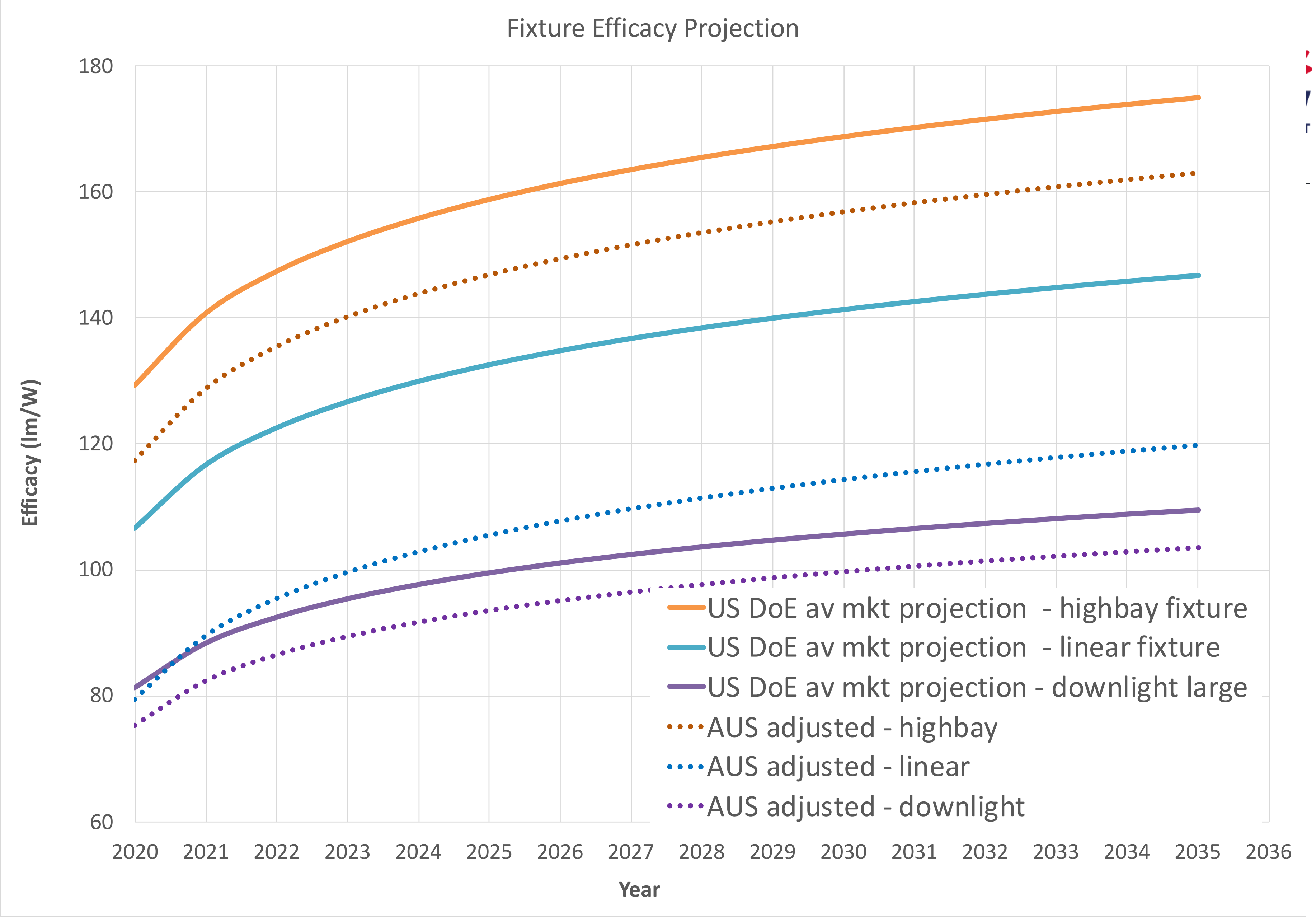
- 20yr refurb e.g. industrial, small office
- 15yr refurb, e.g. large office
- 10yr refurb, e.g. large retail/hotel

Install ‘super LED’

If we use a ‘super LED’, can we get savings in Period 2?



Counterfactual LED projection



Example calculation of ‘additional life’ added for super LED

Install ‘super LED’ in 2024

1 year mean time to refurb

10 yr global time horizon

200 lm/W LED.   Lower = reduced result, e.g. 175 lm/W reduces by 0.3 yrs

Upgrade twin 36W linear fluorescent fixture to LED in 2024, 1 year mean time to refurb					Lumens =	5000					
Year		2024	2025	2026	2027	2028	2029	2030	2031	2032	2033
Incumbent - efficacy (lm/W)		57									
Incumbent - power (W)		88									
Counterfactual - efficacy (lm/W)			105								
Counterfactual - power (W)			47								
ESS - efficacy (lm/W)		200	200								
ESS - power (W)		25	25								
Incumbent pwr - ESS pwr (W)		63									
Counterfactual pwr - ESS pwr (W)			22	22	22	22	22	22	22	22	22
Time horizon (yrs)	10										
Effective lifetime added (yrs)	3.2										

‘Additional life’ added for super LED

Install in 2024

1-4 years mean time to refurb

10 year total time horizon

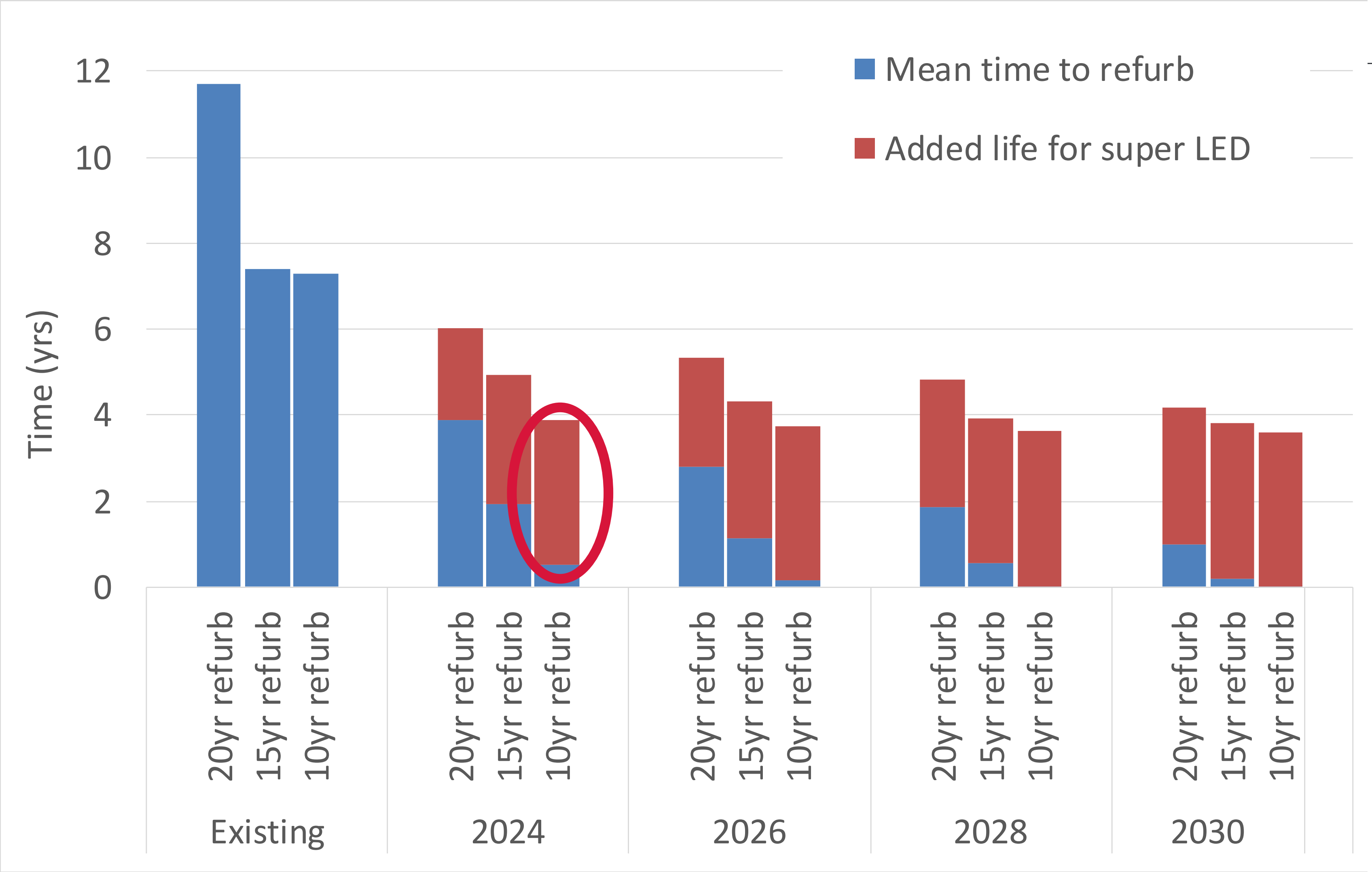
Super LED = 200 lm/W

Choose fluorescent upgrade = **most optimistic of the 3**

Summary of 'effective life added'

Mean time to refurb (yrs):	**1**	**2**	**3**	**4**
Fluorescent	3.2	2.7	2.3	1.9
Downlight	1.0	0.9	0.8	0.6
Highbay	1.4	0.9	1.0	0.8

Net result (200 lm/W super LED)



- 20yr refurb e.g. industrial, small office
- 15yr refurb, e.g. large office
- 10yr refurb, e.g. large retail/hotel

Changes to control multipliers

Propose use NCC multipliers

- Lower values for small spaces
- Refer Table J7D3b of:

https://ncc.abcb.gov.au/editions/ncc-2022/adopted/volume-one/j-energy-efficiency/part-j7-artificial-lighting-and-power

Item	Description	illumination power density adjustment factor
Motion detector	In a toilet or change room, other than a public toilet, in a Class 6 building	0.4
Motion detector	Where a group of light fittings serving less than 100 m^2 is controlled by one or more detectors	0.6
Motion detector	Where a group of light fittings serving 100 m^2 or more is controlled by one or more detectors	0.7
Programmable dimming system Note 3	Where not less than 75% of the area of a space is controlled by programmable dimmers	0.85
Fixed dimming Notes 3 and 4	All fittings with fixed dimming	Whichever is greater of (a) 0.5; or (b) 0.2+0.8L where L = the illuminance turndown for
Lumen depreciation dimming Note 3	All fittings with lumen depreciation dimming	0.85
Two stage sensor - equipped lights with minimum power of 30 % of peak power or less	Fire stairs and other spaces not used for regular transit	0.4
Two stage sensor - equipped lights with minimum power of 30% of peak power or less	Transitory spaces in regular use or in a carpark	0.7
Daylight sensor and dynamic lighting control device - dimmed or stepped switching of lights adjacent windows Notes 3 and 5	In a Class 5, 6, 7, 8 or 9b building or a Class 9a building, other than a ward area, where the lights are adjacent windows, other than roof lights, for a distance from the window equal to the depth of the floor to window head height	0.5 Note 3
Daylight sensor and dynamic lighting control device - dimmed or stepped switching of lights adjacent windows Notes 3 and 5	Serving a Class 3 or 9c building, or a Class 9a ward area, where the lights are adjacent windows, other than roof lights, for a distance from the window equal to the depth of the floor to window head height	0.75 Note 3
Daylight sensor and dynamic lighting control device - dimmed or stepped switching of lights adjacent windows Notes 3 and 5	In a Class 5, 6, 7, 8 or 9b building or a Class 9a building, other than a ward area, where the lights are adjacent roof lights	0.6 Note 3
Daylight sensor and dynamic lighting control device - dimmed or stepped switching of lights adjacent windows Notes 3 and 5	In a Class 3 or 9c building, or a Class 9a ward area, where the lights are adjacent roof lights	0.8 Note 3

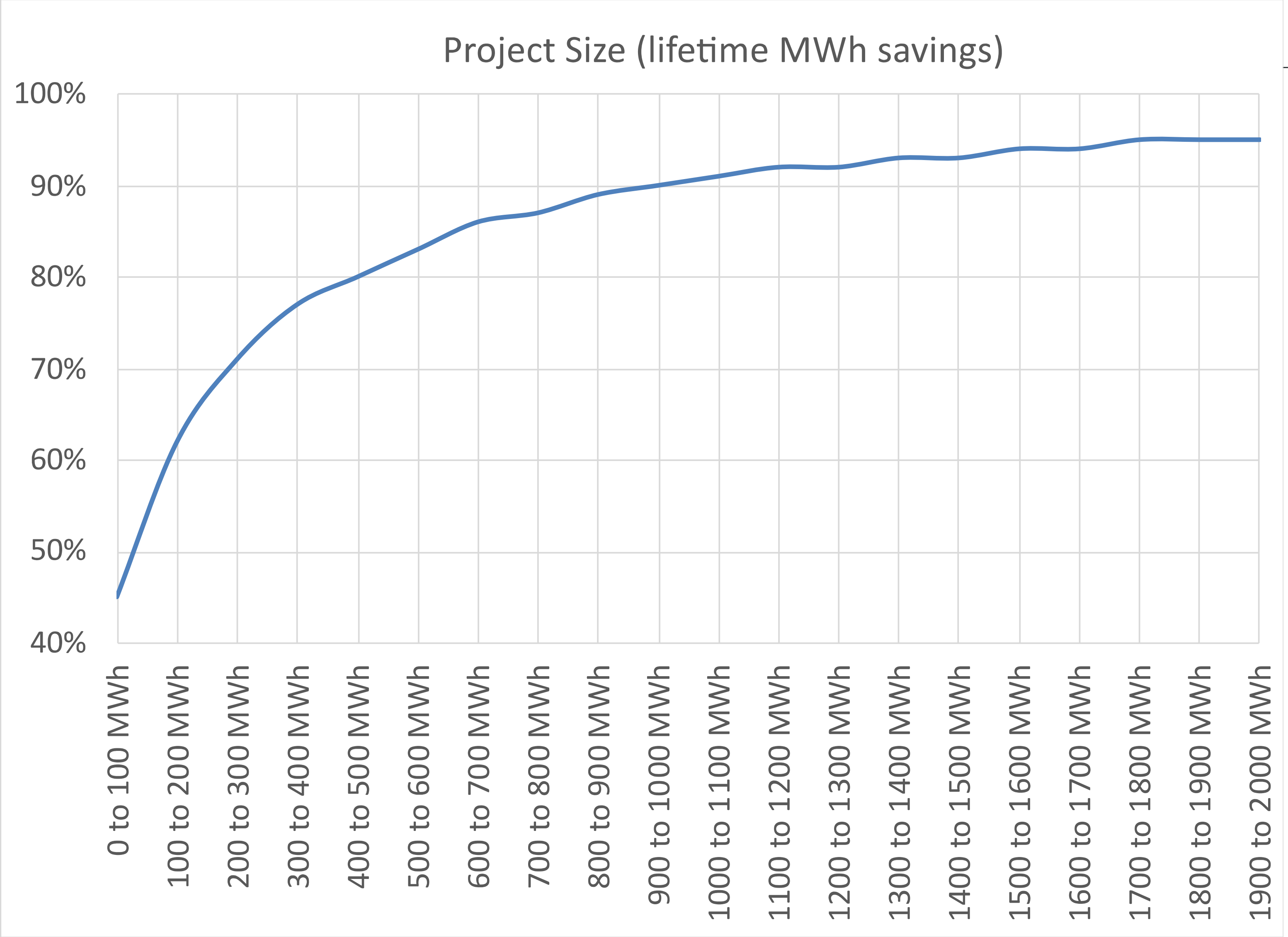
Public lighting: Trimming, dimming and CLO

Proposal for trimming, dimming and CLO

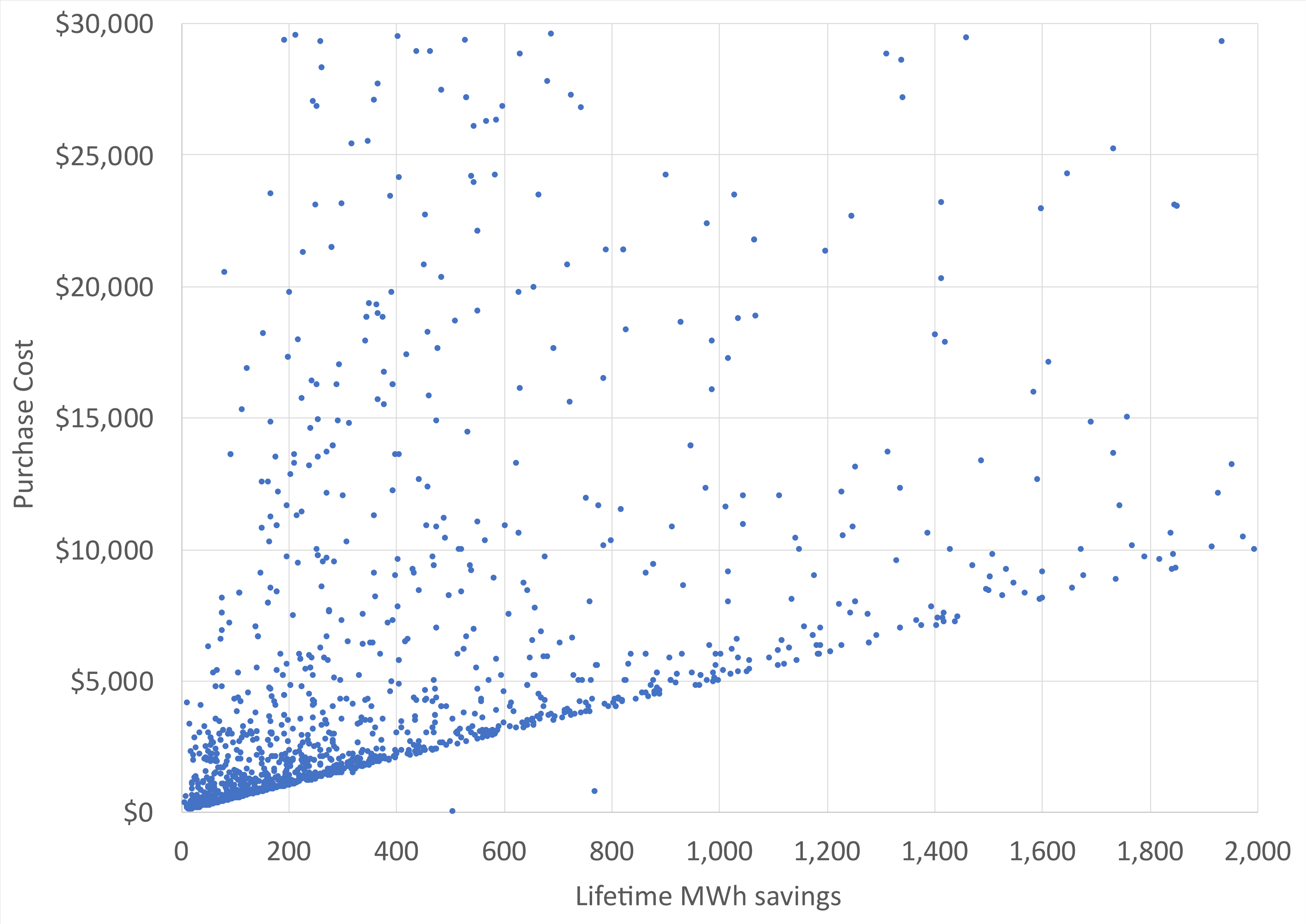
- In 9.4A (road lighting) not 9.4 (commercial lighting)
- Require declaration of compliance with AS/NZS 1158
  - May non-conform if justification attached (need to develop)
- Eq 9A: energy consumption = $\Sigma (P_j \times t_j) \times \text{Asset Lifetime} \div 10^6$ where:
  - P_j = the power of j^{th} period
  - t_j = duration of j^{th} period
  - Asset lifetime as per ESS rule
  - Total operating hours must correlate with eq 7A (baseline)
- 1158 area / density calculation not required
- Unpredictable scheduling (e.g. live traffic) may be impractical – PIAM&V ?

Co-payment

Project size



Equipment cost



Co-payment – customer ability to pay

Existing

- Commercial lighting
  - $5/MWh savings
- HEER
  - $30/site
- Business appliances
  - $200/cabinet

The problem

- Instal less efficient fittings to reduce co

Per fitting:	**Industrial HID**	**Office Fluorescent**
Lumens	15,000	5,000
Incumbent - efficacy (lm/W)	60	57
Incumbent - power (W)	250	88
ESS - efficacy (lm/W)	150	150
ESS - power (W)	100	33
Power saving (W)	150	54
Op. hours p.a.	7000	3000
Energy savings p.a. (MWh)	1.050	0.163
Life (yrs)	11.7	7.4
Energy savings over lifetime (MWh)	12.3	1.2
Co payment ($/MWh)	$5.00	$5.00
Co payment per fitting	$61.43	$6.04
Cost per fitting	$100	$75
ESC revenue (@ $30/ESC)	$369	$36

Proposal

- Cap at $5000 / site

Co-payment – other issues

- In-house installation means no invoice
  - Suggestions?
- Customer finance
  - $5000 cap per site should take this problem away to some extent (the rest can be finance)

Misc issues

Removal of various upgrade types (transition time = 12 months)

Due to quality / redundancy

- HEER E1, halogen downlight (lamp only replacement)
- HEER E4, install T5 fixture

Due to MEPS

- HEER E3, replace PAR lamp
- HEER E11, replace inc/ halogen lamp

Due to Minamata

- HEER E11, replace CFLi
- CLESF & PLESF, replace merc vap
- To be confirmed
  - CFLn in 2025
  - Linear fluoro 2026

HEER equations - eliminate discrete value tables

Residential:

$$Deemed\ Activity\ Electricity\ Savings$$
$$= 0.00084 \times LCP_{NEW} \times \left(\frac{efficacy_{NEW}}{efficacy_{\mathrm{BASELINE}}} - 1\right) \times asset\ lifetime$$

Small Business:

$$Deemed\ Activity\ Electricity\ Savings$$
$$= 0.003 \times LCP_{NEW} \times \left(\frac{efficacy_{NEW}}{efficacy_{\mathrm{BASELINE}}} - 1\right) \times asset\ lifetime$$

Miscellaneous – from previous report

Metrics

- 24hr open cut mining: op hrs = 4500 hrs
- 24hr underground mining = 7000 hrs
- Indoor common areas of apartment buildings: reduced lifetimes

Definition of ‘Working order’

- “Working Order”, when referring to an existing Lamp or Luminaire, means being capable (to the satisfaction of the Scheme Administrator) of providing continuous, fault-free illumination at a level which is at least 50% of the level provided by the equipment when new

Product quality requirements

Previous consultation - stakeholders suggested product quality requirements to mitigate use of low quality products (=low co-payment)

IPART currently require:

For commercial lighting:

- LCP verification
- Safety conformance
- Min power factor
- L70 min 30,000 hrs
- EMC conformance

For HEER:

- Min CRI 80
- Min efficacy 48 lm/W
- Min light output 462 lm
- L70 min 30,000 hrs
- EMC conformance
- Dimmer compatibility
- Beam angle

Discussion

- Super LED to match IEA-4E SSL tier 3?
- Others LEDs tier 2?
- Subset of these requirements?

- See https://www.iea-4e.org/ssl/our-work/product-performance/

	Product & Parameter	Tier 1	Tier 2	Tier 3
Energy-Efficiency				
	Minimum luminous efficacy, η			
CAT 1: Residential Lighting Products	**Non-directional lamp**	105 lm/W	150 lm/W	180 lm/W
	Concessions (additive): Lumens < 400 lm CCT < 2300 K CRI ≥ 90		subtract 10 lm/W subtract 10 lm/W subtract 10 lm/W	
	Directional lamp	80 lm/W	115 lm/W	130 lm/W
	Concessions (additive): Beam Angle < 20° CCT < 2300 K CRI ≥ 90		subtract 10 lm/W subtract 10 lm/W subtract 10 lm/W	
	Downlight and downlight retrofit kits	90 lm/W	115 lm/W	130 lm/W
	Concession: Retrofit kits		subtract 10 lm/W	
	Strip light	80 lm/W	90 lm/W	100 lm/W
	Concession: CCT < 2300 K		subtract 10 lm/W	
CAT 2: Commercial & Industrial Lamps	**Double-capped linear lamp**	125 lm/W	175 lm/W	205 lm/W
	Concession: CCT < 2300 K		subtract 10 lm/W	
	Single-capped high luminous flux lamp	105 lm/W	140 lm/W	155 lm/W
	Concession: CCT < 2300 K		subtract 10 lm/W	
CAT 3: Commercial & Industrial Luminaires	**Linear, troffer, and commercial retrofit kits**	110 lm/W	150 lm/W	170 lm/W
	Panel (planar)	90 lm/W	130 lm/W	150 lm/W
	High bay, low bay, and industrial retrofit kits	125 lm/W	155 lm/W	185 lm/W

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Next Steps

Aarushi Kochhar
Office of Energy and Climate Change

Effective from 2024 (Proposed)

Introduce	Change	Remove
Introduction of ’super LED’	1st reduction in lifetimes for all lighting activities	HEER E4, replace T8/T12 luminaire with T5 luminaire
Introduction of ‘replace LED with super LED'	Changes to co payment	Replace mercury vapour
Introduce lighting product quality requirements	Change definition of working order	
Introduce HEER equations		
Introduce new lighting control factors		
Introduce road lighting control factors		
Introduce new metrics for mining, apartment common areas.		

Effective from 2025-26 (Proposed)

Change	Remove
2nd reduction in lifetimes where appropriate	HEER E1, replace halogen downlight (with LED lamp)
	HEER E3, replace PAR lamp
	HEER E11, replace incandescent / halogen lamp
	HEER E11, replace CFLi

Effective from 2026-27 (Proposed)

Change	Remove
3rd reduction in lifetimes where appropriate	Replace linear fluorescent (assuming Minamata goes ahead)
	Replace CFLn (assuming Minamata goes ahead)

Your Feedback

- The feedback from today will be incorporated into the research recommendations.
- We will propose changes to the Rule, based on the research recommendations.
- Public Consultation on proposed Rule changes is scheduled for late 2023.
- We expect to finalise the Rule changes in the first quarter of 2024.
- We are seeking your feedback on how much transition time you need for the proposed changes.

Submissions close 29 September 2023

How to provide a response:

- complete the online form
- email sustainability@environment.nsw.gov.au

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Thank you for attending today's session