



In the studio: a 24-patch test chart, eighteen colour patches and six greys. Illustrative scene, not a calibrated chart.

NLC Academy | Episode 12

CRI · TLCI · TM-30

Three metrics. One decision.

CRI and TM-30 describe colour rendition for visual lighting. TLCI predicts colour performance through a television camera and display. This episode: what each number measures, and the line to write instead of "CRI > 80".

What the number describes

Same comparison, different questions.

⚠ Illustrative rendering, not measured product data

Reference

the benchmark at
the same CCT



Lower fidelity

chroma drains,
reds furthest



Higher fidelity

close to the
reference



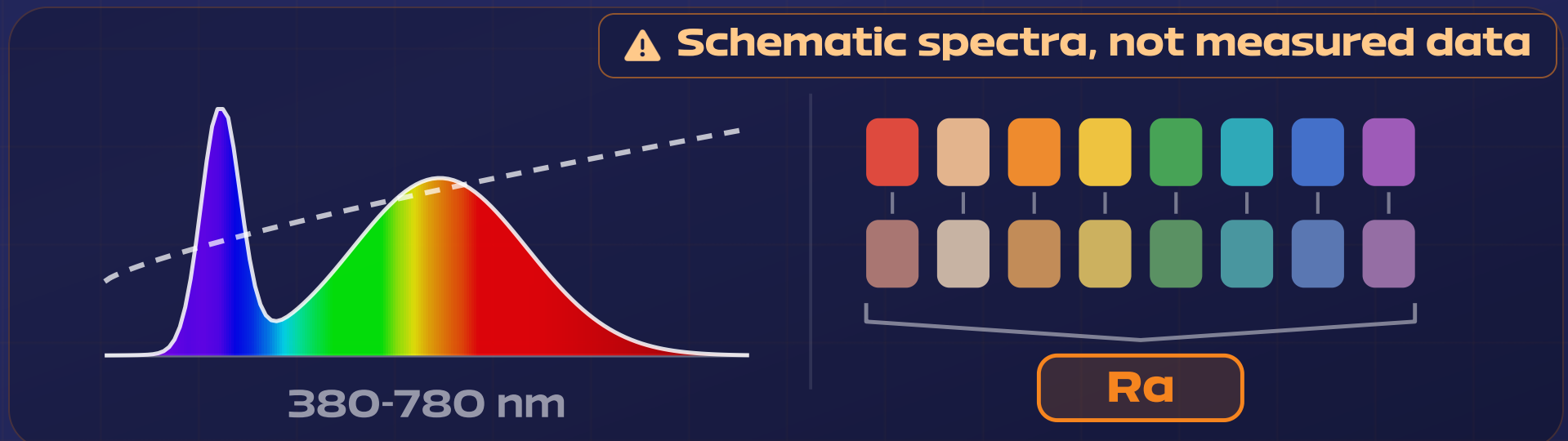
- 1 All three compare a test source with a reference, but they use different observers or camera models, colour samples, colour spaces and calculation methods. Their numbers therefore answer different questions. [1][3][5]

A colour metric is a number derived from that comparison,
not a verdict on lighting quality.

How Ra is built

CRI Ra: eight samples, averaged.

- 1 The method dates to 1965 (CIE 13), updated in 1974 for chromatic adaptation. Current edition: CIE 13.3-1995, a corrected republication with unchanged technical recommendations. [1]
- 2 Ra is the mean of R1-R8: eight Munsell samples, moderately saturated, evenly spread in hue and similar in lightness. Nothing more saturated is in the average. [1]
- 3 Each method sets its reference differently. CRI: Planckian below 5000 K, daylight at or above. TM-30: its own blend between 4000 and 5000 K. TLCI: Planckian below 3400 K, daylight above 5000 K, interpolation between. [1][4][5]

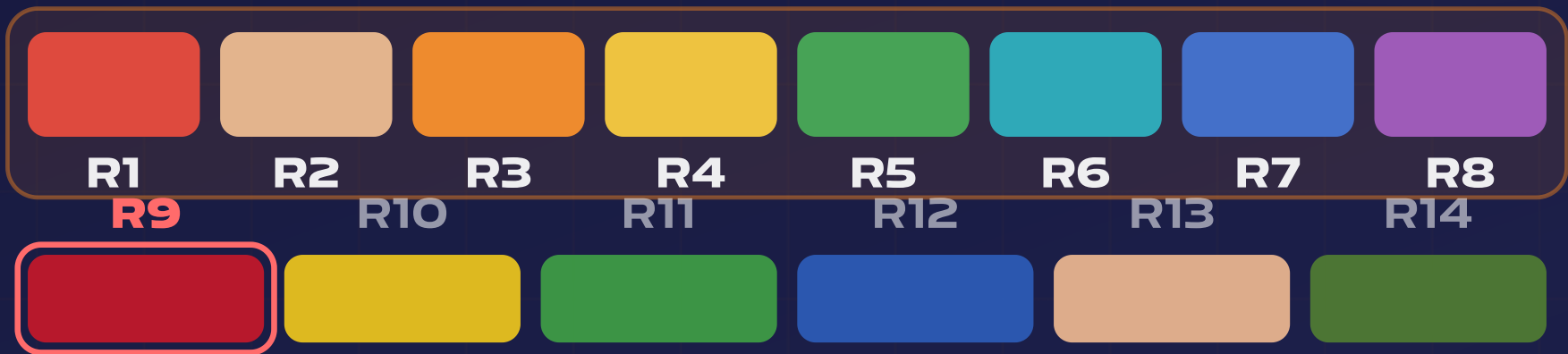


Filled: the source's own spectrum, coloured by wavelength. Dashed: a reference at the same CCT. Right: the same eight samples under each, their differences averaged into one number. [1][3]

Ask which reference and which CCT before comparing two numbers. **Different CCT, different reference, different question.**

The blind spot

R9 is the red that Ra never averages.



1 CIE 13.3 also defines six special samples: R9 strong red, R10 yellow, R11 green, R12 blue, R13 complexion and R14 foliage. None of them is in Ra. [1]

2 R9 uses the same $R_i = 100 - 4.6 \Delta E_i$ formula as every other sample, but is not included in Ra. Because it represents saturated red, and CRI uses a non-uniform colour space, it varies far more sharply than Ra and can fall below 0. [1] [14]

TM-30 addresses the red region differently, not equivalently: $R_{f,h1}$ is average local fidelity in its first hue-angle bin, and $R_{cs,h1}$ reports local red chroma shift. Both add context; neither is mathematically equal to R9. [3][4]

A source can pass on Ra and still render skin and red badly.
Ask for the red sample by name.

How many samples

Three methods, **three sample sets.**

8

CRI (Ra)

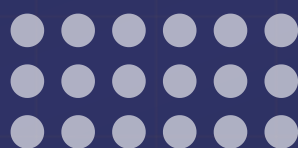
Munsell test-colour
samples, moderate
saturation [1]



18

TLCI-2012

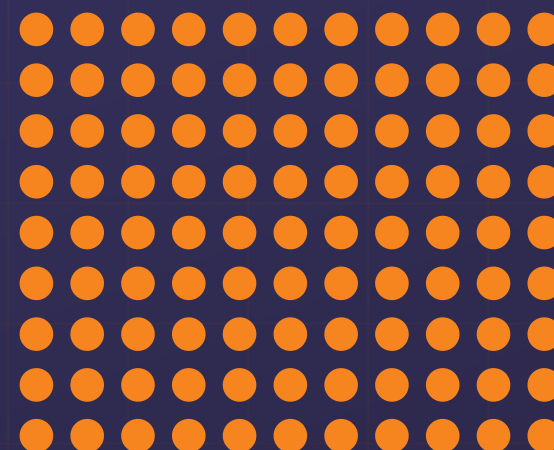
of the 24
ColorChecker
patches, greys
excluded [5]



99

TM-30

colour evaluation
samples, real
measured objects [3]

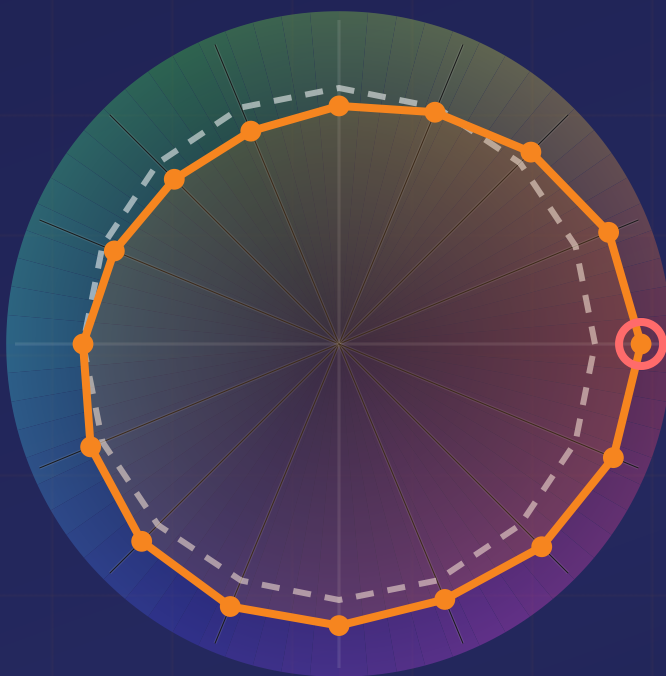


Sample counts are exact; the dots are drawn stand-ins, not the actual reflectances. TM-30's 99 CES were down-selected from over 100,000 measured object spectra, and two skin-tone reflectances were deliberately forced into the set. [4]

More samples do not automatically make a better metric.
They cast a wider net; a wider net is harder to fool.

TM-30

Rf and Rg: **two numbers, not one.**



- Rf** Fidelity. Average colour fidelity against the reference across the 99 samples, on a 0-100 scale. [3][4]
- Rg** Gamut. A ratio of gamut areas from 16 hue-bin averages. Above 100 is average gamut expansion, below 100 average reduction. It does not disclose local hue or chroma behaviour. [3][4]

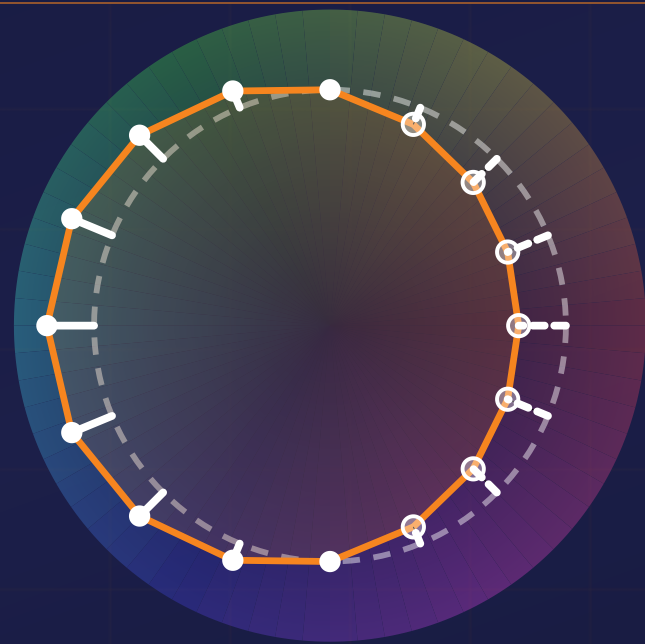
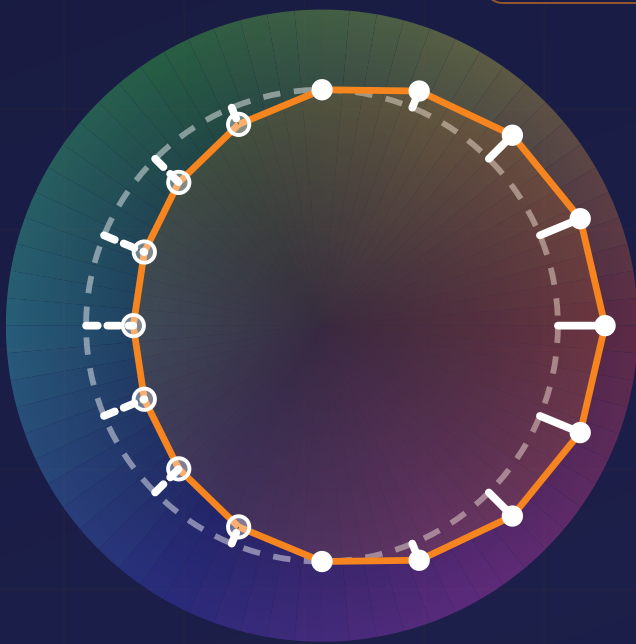
Dashed ring: the reference polygon. Orange: a drawn example whose 16 bin averages give $R_g = 110$, computed from the areas painted here. Red ring: hue bin 1, the red bin $R_{cs,h1}$ and $R_{f,h1}$ report on.

Gamut SHAPE and hue shifts move R_g too. One number cannot show where the colour went. [3][4]

Why averages hide

Same R_f , same R_g , **different light.**

⚠ Illustrative shapes, not measured sources



1 Two sources can share an R_f and an R_g and still shift different hues in different directions, which is exactly why TM-30 publishes 16 local values and a vector graphic alongside the averages. [4]

2 There is no universal threshold for a noticeable difference, but about five points of R_f or R_g is usually treated as meaningful. [4]

If two products quote the same pair of numbers, **ask for the vector graphic** before you call them equivalent.

The real specification table

TM-30 Annex E: pick an intent, then a level.

Preference (P)		Vividness (V)		Fidelity (F)	
P1	$R_f \geq 78$ $R_g \geq 95$ $-1\% \leq R_{cs,h1} \leq 15\%$	V1	$R_g \geq 118$ $R_{cs,h1} \geq 15\%$	F1	$R_f \geq 95$
P2	$R_f \geq 75$ $R_g \geq 92$ $-7\% \leq R_{cs,h1} \leq 19\%$	V2	$R_g \geq 110$ $R_{cs,h1} \geq 6\%$	F2	$R_f \geq 90$ $R_{f,h1} \geq 90$
P3	$R_f \geq 70$ $R_g \geq 89$ $-12\% \leq R_{cs,h1} \leq 23\%$	V3	$R_g \geq 100$ $R_{cs,h1} \geq 0\%$	F3	$R_f \geq 85$ $R_{f,h1} \geq 85$

Reproduced from ANSI/IES TM-30-20 Annex E and NOT re-validated against the current TM-30-24. Criteria apply to polychromatic spaces at 200-700 lux. The highest preference, vividness and fidelity levels impose partly incompatible colour-shift requirements, so no source satisfies all three Level 1 cells at once. [3][4]

Annex E does not always state an explicit maximum R_g ; **other criteria can impose implicit limits.** The explicitly bounded quantity is $R_{cs,h1}$. [3][4]

TLCI

TLCI models a camera, **not an eye.**

Film-style

intercut, graded
in post



At Qa 70:
"can get some
colours right"

Live multi- camera

sport, news, no
grade



At Qa 70:
"Good"



White marker: a published NLC GRANDEUR product value, $TLCI \geq 70$ [10]. It is not evidence that 70 is a universal broadcast threshold. The EBU's two readings overlap and it states they "do not form hard definitions". [5]

EBU R 137 sets no universal pass mark. **The acceptable score depends on production type, correction workflow, cameras and the broadcaster.** [5][6]

What the codes actually say

Three documents, **three different asks.**

WELL v2 feature LO7, part 1

Three routes, any one passes: $R_a \geq 90$; or $R_a \geq 80$ with $R_9 \geq 50$; or $R_f \geq 78$, $R_g \geq 100$, $-1\% \leq R_{cs,h1} \leq 15\%$. [8]

EN 12464-1 indoor workplaces, 2021

Many occupied indoor task and activity areas require $R_a \geq 80$, but the required value varies by application and table entry. [7]

SASO 2927 street lighting, 2019

Includes explicit CCT and colour-consistency provisions, 3000-6000 K and a 5-step MacAdam ellipse, but does not establish a general minimum CRI for LED street luminaires. [9]

WELL routes are from feature LO7 part 1 of WELL v2 [8]. The SASO row is read from the official SASO workshop deck, an explanatory document, not the normative standard text [9]. Nothing here is an NLC requirement.

Two of the three never mention TM-30. **Write the metric the project is actually judged on.**

From the NLC range

Four products, **four different numbers.**

GRANDEUR

Stadium flood light

CRI ≥ 70 / ≥ 80

TLCI ≥ 70

The one product in the catalogue that publishes a TLCI value. Sports venues get filmed.



CUBE

Adjustable outdoor spotlight

CRI > 80

Exterior accent duty, where the job is to be seen, not to grade merchandise.



BRASS

Recessed downlight

CRI > 90

opt. > 95

Interior downlight duty, where skin and finishes are judged up close.



CANNON

Track light

CRI > 90

opt. > 95

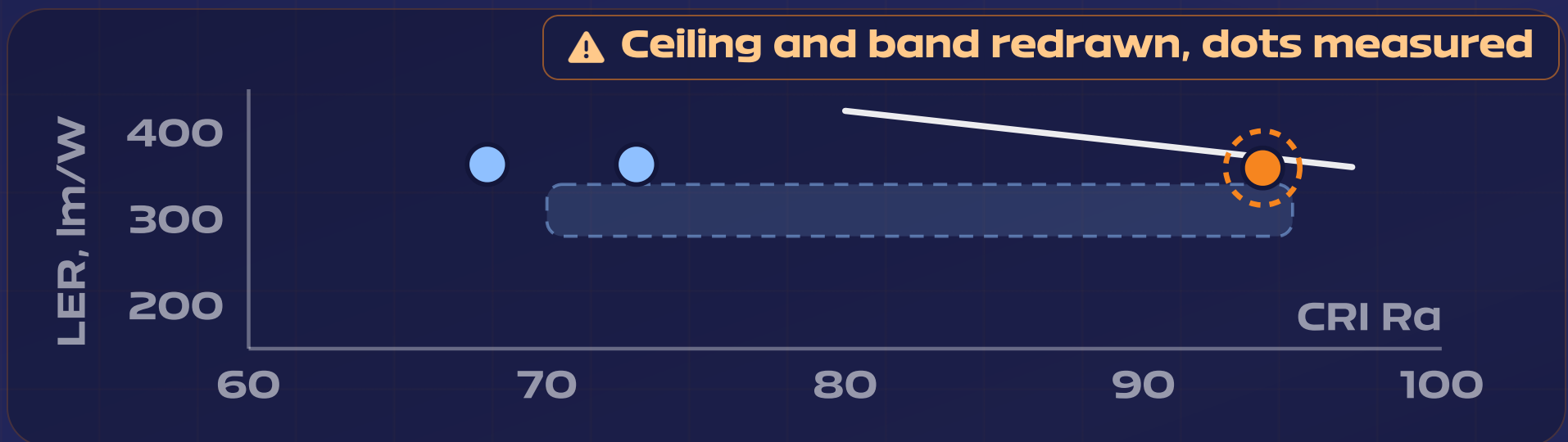
Retail and gallery track: where the merchandise colour IS the product.



CRI and TLCI values quoted verbatim from each product page, accessed 2026-08-25. None of the four product pages reviewed for this carousel currently publishes R9, Rf or Rg. [10]

The efficacy cost

Colour quality is paid for in **lumens per watt**.



- Achievable ceiling
- ▭ Where products sit
- Three measured sources

Redrawn from the DOE figure across the range it bounds. Dots are exact: Ra 68 and Ra 73 at LER 363, Ra 94 with R9 88 at LER 359. [13]

- 1 LER is lumens per watt of EMITTED OPTICAL RADIATION, not a luminaire's electrical lm/W: DOE gives 323 lm/W for a typical CRI 80 phosphor-converted white and 414 lm/W for a colour-mixed white. [11]
- 2 DOE reports the CRI 80 to 90 step costing about 10% of maximum achievable efficacy, 15 to 20% in practical PC-LED data. Reported figures, not a fixed cost for every product. [11]

But look where the dots sit: **Ra 94 with R9 88 costs about 1% of LER against Ra 68**. TM-30 criteria buy the same quality for less efficacy than raising Ra. [12][13]

The line to write

Five lines that beat "CRI > 80".

- ☐ Name the metric AND its edition: report Rf, Rg, Rf,h1 and Rcs,h1 in accordance with ANSI/IES TM-30-24; Ra per CIE 13.3-1995; Qa per EBU Tech 3355. [1][3][5]
- ☐ Ask for the red separately: R9 on the CRI route, or Rf,h1 and Rcs,h1 on the TM-30 route. Ra alone cannot answer it. [1][4]
- ☐ Use an Annex E category when it matches the project intent. If custom limits are necessary, state and justify them. [3]
- ☐ Values at different CCTs use different CCT-matched references. Compare them cautiously: equal scores do not guarantee equal appearance. Always report CCT and Duv. [1][4]
- ☐ For anything filmed, ask for Qa and name the production type. The same Qa reads two ways. [5][6]

Sources

Where these numbers come from.

- [1] CIE 13.3-1995, colour rendering · [2] CIE 224:2017, CIE Rf
- [3] ANSI/IES TM-30-20 Annex E (current edition TM-30-24)
- [4] Royer 2022, LEUKOS 18(2):191-231 · [5] EBU Tech 3355 (2017)
- [6] EBU R 137 v2.0 (2016) · [7] BS EN 12464-1:2021
- [8] WELL v2, feature LO7 part 1 · [9] SASO 2927:2019 workshop deck
- [10] NLC product pages, accessed 2026-08-25
- [11] DOE 2022 SSL R&D Opportunities · [12] Royer 2019, OSAC 2(8):2308
- [13] Royer, DOE SSL Workshop Portland 2017, slides 19 and 25
- [14] NIST, Color rendering of light sources · [15] CIE PS 002:2025

Standards are cited by edition. CIE PS 002:2025 now recommends beginning to adopt CIE Rf in place of Ra, and reporting both in parallel during the transition. [15] Full citations with pages, figures and access dates are on the article page.

NLC ACADEMY

Read the full episode



Scan for Episode 12

<https://nlc.com.sa/academy/cri-tlci-tm30.html>



Next episode
Lux in Real Life