Distributed benefits : Large wafer modules in rooftop PV a technical perspective

Aymeric BARRET PV Magazine Webinar

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DESIGN AND ENGINEERING SERVICES FOR GREAT SOLAR PV PROJECTS

PARTNERSHIP APPROACH

EFFICIENTLY DESIGNED AND DELIVERED

HIGH QUALITY

Subsidiary of everoze

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Subsidiary of everoze

WHY SKYRAY

Address urgent need for capability to design and engineer the world's PV future

Apply lessons learned from GWs of projects delivered (PV and storage) by Skyray shareholders

Help owners increase influence over design and construction of projects

WHAT IS SKYRAY

Scalable, adaptable, **pureplay solar PV and solar + storage engineering company**, backed by Everoze

Experienced team who understand what can and has gone wrong

Focused design and construction management services for solar PV and new-build solar storage

CORE SERVICES

Design

- Developer services
- Diagnosis
- Basic and detailed design

Owner's engineering

- Procurement & tender support
- Design review
- Construction monitoring
- FAT, PAC, IAC, FAC
- Operational testing

Agenda

How to implement larger new gen. modules on rooftops

- Layout & design
- Electrical configuration
- Mounting systems
- Design & Energy yield optimisation
- Summary

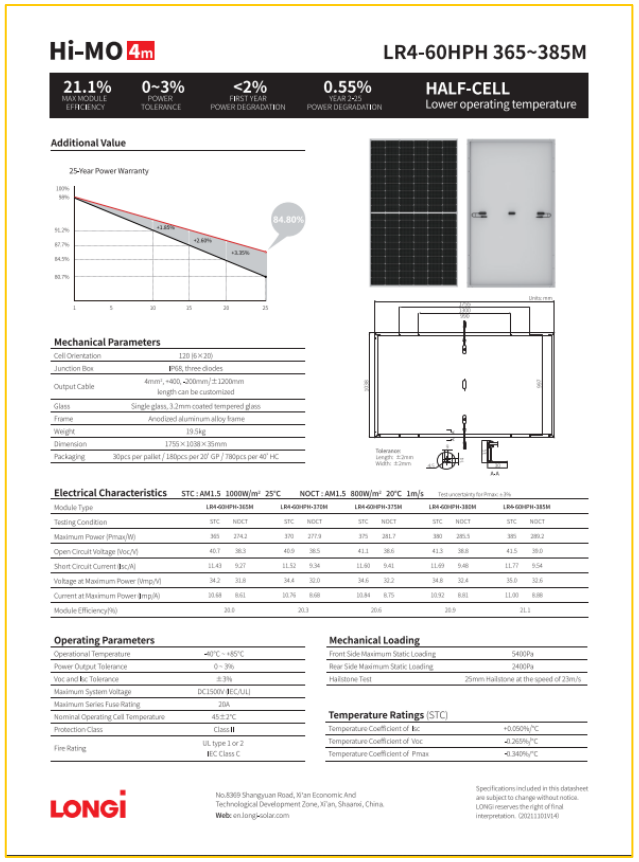
Layout & design

Layout & design

Mechanical characteristics & power density

Longi 120 half cells - 370Wp module

Hi-Mo 4m – 1755 x 1038 x 35 mm



Hi-MO 4m

LR4-60HPH 365~385M

21.1% MAX MODULE EFFICIENCY | 0~3% POWER TOLERANCE | <2% FIRST YEAR POWER DEGRADATION | 0.55% YEAR 2-25 POWER DEGRADATION | HALF-CELL Lower operating temperature

Additional Value

25-Year Power Warranty

Mechanical Parameters

Cell Orientation	120 (6×20)
Junction Box	IP68, three diodes
Output Cable	4mm², +400, -200mm/±1200mm length can be customized
Glass	Single glass, 3.2mm coated tempered glass
Frame	Anodized aluminum alloy frame
Weight	19.5kg
Dimension	1755×1038×35mm
Packaging	36pcs per pallet / 180pcs per 20' GP / 720pcs per 40' HC

Electrical Characteristics STC : AM1.5 1000W/m² 25°C NOCT : AM1.5 800W/m² 20°C 1m/s

Module Type	LR4-60HPH-365M		LR4-60HPH-370M		LR4-60HPH-375M		LR4-60HPH-380M		LR4-60HPH-385M	
Testing Condition	STC	NOCT	STC	NOCT	STC	NOCT	STC	NOCT	STC	NOCT
Maximum Power (Pmax/W)	365	274.2	370	277.9	375	281.7	380	285.5	385	289.2
Open Circuit Voltage (Voc/V)	40.7	38.3	40.9	38.5	41.1	38.6	41.3	38.8	41.5	39.0
Short Circuit Current (Isc/A)	11.43	9.27	11.52	9.34	11.60	9.41	11.69	9.48	11.77	9.54
Voltage at Maximum Power (Vmp/V)	34.2	31.8	34.4	32.0	34.6	32.2	34.8	32.4	35.0	32.6
Current at Maximum Power (Imp/A)	10.68	8.61	10.76	8.68	10.84	8.75	10.92	8.81	11.00	8.88
Module Efficiency(%)	20.0		20.3		20.6		20.9		21.1	

Operating Parameters

Operational Temperature	-40°C ~ +85°C
Power Output Tolerance	0 ~ 3%
Voc and Isc Tolerance	±3%
Maximum System Voltage	DC1500V (IEC/UL)
Maximum Series Fuse Rating	20A
Nominal Operating Cell Temperature	45±2°C
Protection Class	Class II
Fire Rating	UL type 1 or 2 IEC Class C

Mechanical Loading

Front Side Maximum Static Loading	5400Pa
Rear Side Maximum Static Loading	2400Pa
Hailstone Test	25mm Hailstone at the speed of 23m/s

Temperature Ratings (STC)

Temperature Coefficient of Isc	+0.050%/°C
Temperature Coefficient of Voc	-0.265%/°C
Temperature Coefficient of Pmax	-0.340%/°C

LONGi

No.8369 Shangyuan Road, Xi'an Economic And Technological Development Zone, Xi'an, Shaanxi, China.

Web: en.longi-solar.com

Specifications included in this datasheet are subject to change without notice. LONGi reserves the right of final interpretation. (20211101V14)

Key ratios

370Wp mod → 400Wp mod.

Similar power density

203Wp/m² → 205Wp/m²

+ 1% (Wp/m²)

19 kg/Wp → 18.6 kg/Wp

- 2% (kg/Wp)

Similar performance @ high temperature

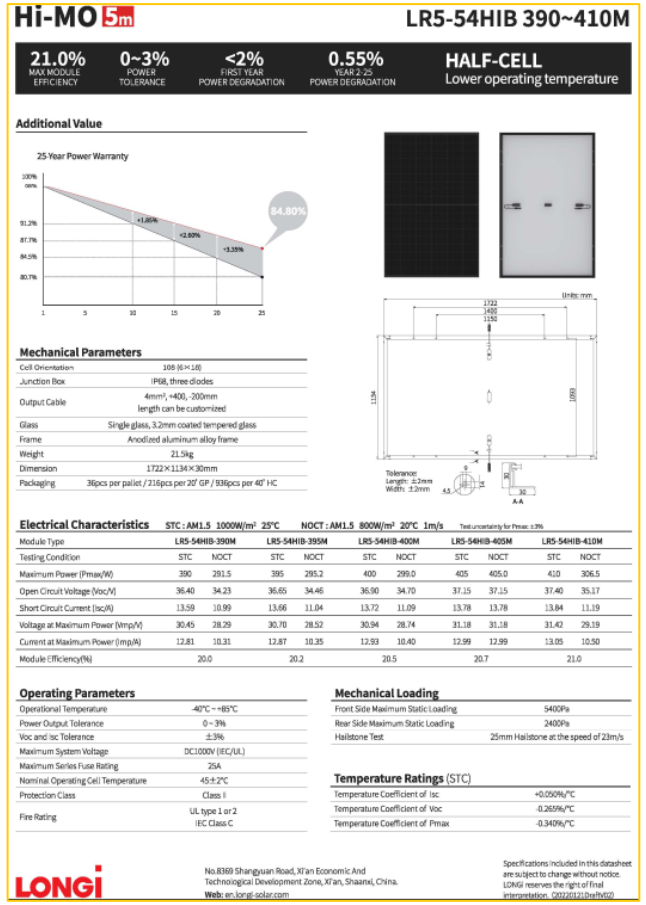
(good performance for P-type modules in 2022)

T° coef of Pmax

-0.34%/K

Longi 108 half cells - 400Wp module

Hi-Mo 5m - 1722 x 1134 x 30 mm



Hi-MO 5m

LR5-54HIB 390~410M

21.0% MAX MODULE EFFICIENCY | 0~3% POWER TOLERANCE | <2% FIRST YEAR POWER DEGRADATION | 0.55% YEAR 2-25 POWER DEGRADATION | HALF-CELL Lower operating temperature

Additional Value

25-Year Power Warranty

Mechanical Parameters

Cell Orientation	108 (6×18)
Junction Box	IP68, three diodes
Output Cable	4mm², +400, -200mm length can be customized
Glass	Single glass, 3.2mm coated tempered glass
Frame	Anodized aluminum alloy frame
Weight	21.5kg
Dimension	1722×1134×30mm
Packaging	36pcs per pallet / 216pcs per 20' GP / 936pcs per 40' HC

Electrical Characteristics STC : AM1.5 1000W/m² 25°C NOCT : AM1.5 800W/m² 20°C 1m/s

Module Type	LR5-54HIB-390M		LR5-54HIB-395M		LR5-54HIB-400M		LR5-54HIB-405M		LR5-54HIB-410M	
Testing Condition	STC	NOCT	STC	NOCT	STC	NOCT	STC	NOCT	STC	NOCT
Maximum Power (Pmax/W)	390	291.5	395	295.2	400	299.0	405	405.0	410	306.5
Open Circuit Voltage (Voc/V)	36.40	34.23	36.65	34.46	36.90	34.70	37.15	37.15	37.40	35.17
Short Circuit Current (Isc/A)	13.59	10.99	13.66	11.04	13.72	11.09	13.78	13.78	13.84	11.19
Voltage at Maximum Power (Vmp/V)	30.45	28.29	30.70	28.52	30.94	28.74	31.18	31.18	31.42	29.19
Current at Maximum Power (Imp/A)	12.81	10.31	12.87	10.35	12.93	10.40	12.99	12.99	13.05	10.50
Module Efficiency(%)	20.0		20.2		20.5		20.7		21.0	

Operating Parameters

Operational Temperature	-40°C ~ +85°C
Power Output Tolerance	0 ~ 3%
Voc and Isc Tolerance	±3%
Maximum System Voltage	DC1000V (IEC/UL)
Maximum Series Fuse Rating	25A
Nominal Operating Cell Temperature	45±2°C
Protection Class	Class II
Fire Rating	UL type 1 or 2 IEC Class C

Mechanical Loading

Front Side Maximum Static Loading	5400Pa
Rear Side Maximum Static Loading	2400Pa
Hailstone Test	25mm Hailstone at the speed of 23m/s

Temperature Ratings (STC)

Temperature Coefficient of Isc	+0.050%/°C
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Layout & design – Similar Power

Longi 120 c. - 370Wp module
5195 modules – 1.92 MWp

Power
+1.6%

Longi 108 c. - 400Wp module
4883 modules – 1.95 MWp

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Layout & design – Similar Power

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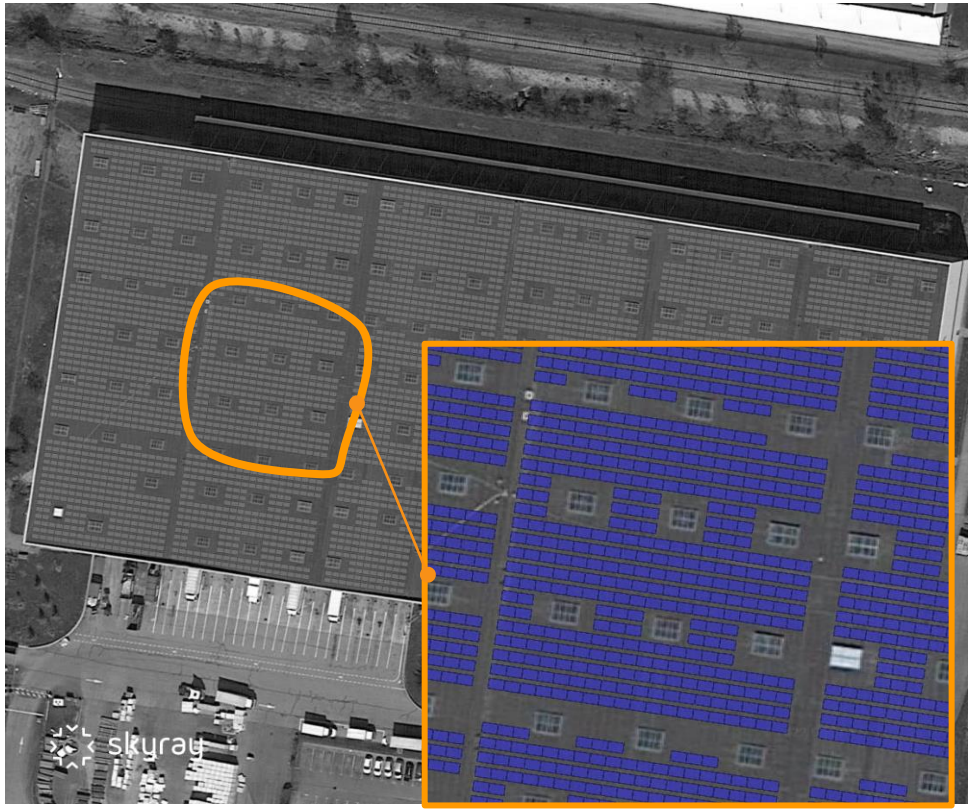

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Electrical configuration

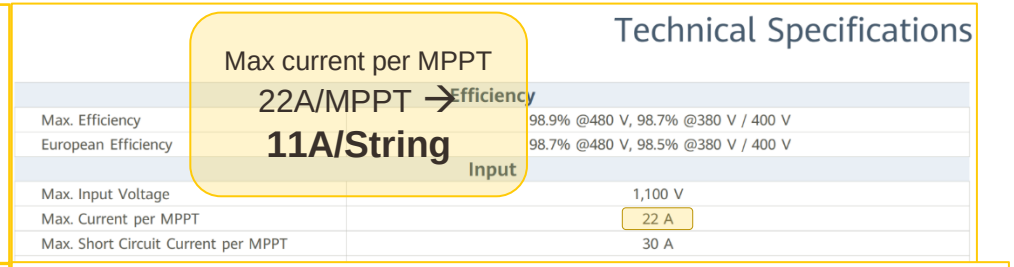
Electrical configuration

Module Datasheet

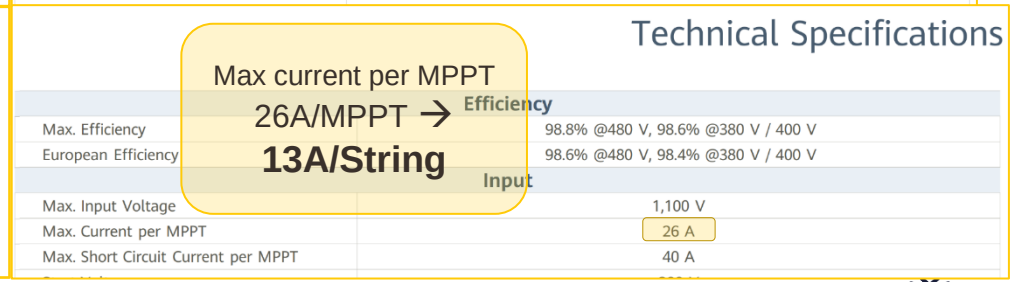
	370Wp module HiMo 4	400Wp module HiMo 5
Peak power (Wp)	**370**	**400**
Cell type (mm)	**M6** (166 x166)	**M10** (182x182)
Number of half-cells	**120**	**108**
Maximum Power Voltage – Vmpp (V)	34.4	30.94
Maximum Power Current – Impp (A)	**10.76**	**12.93**
Open Circuit Voltage – Voc (V)	40.9	36.90
Short Circuit Current – Isc (A)	11.52	13.72
Module Efficiency ηm (%)	20.3	20.5

- Lower Voltage (V) @ STC
  - Increase the number of modules per string
- Higher Current (A) @ STC
  - Choice of inverter should be in line with current (A) specifications !

Typical 60 kVA inverter



Typical 100 kVA inverter



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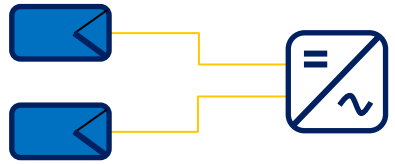
Electrical configuration



Example – **100kVA inverter** – Inputs : 10 MPPT with 2 strings/MPPT

Longi 120 c. - 370Wp module

Hi-Mo 4m – 1755 x 1038 x 35 mm

Configuration

- 330 modules / inverters
- **122 kWp / inverter**

Stringing

<1000VDC (400VAC output)

- 22 modules/strings
- **15 strings**

Longi 108 c. - 400Wp module

Hi-Mo 5m - 1722 x 1134 x 30 mm

Configuration

- 312 modules / inverters
- **125 kWp / inverter**

Stringing

<1000VDC (400VAC output)

- 24 modules/strings
- **13 strings**

➢ Less modules, less cables & connectors
➢ Less time & optimized cost

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Mounting systems

Mounting systems

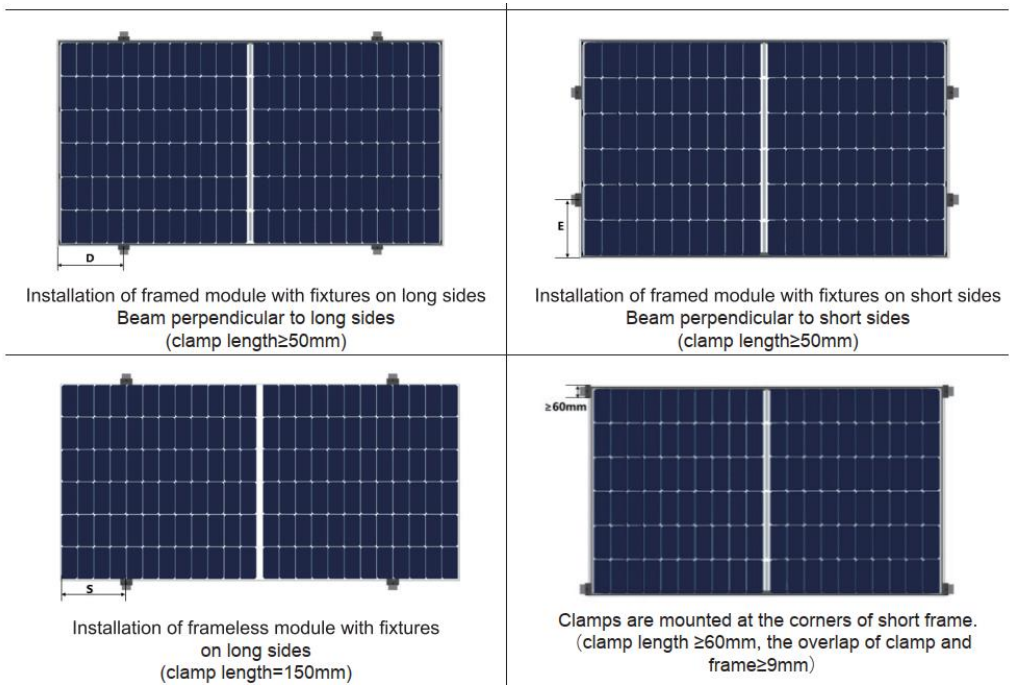
Longi 108 c. - 400Wp module
Hi-Mo 5m - 1722 x 1134 x 30 mm

	S-Dome
Scope of application	Flat roofs ≤ 5° with single ply membrane or bituminous roof covering, also on concrete roofs; also trapezoidal sheet metal roofs with continuous mounting rails
Fastening type/roof fixture	Ballasted; no roof penetration for inclination ≤ 3°
Requirements	Permissible module dimensions (L × W × H): 1386-2067 × 950-1100 × 30-50mm
	Minimum system size: 2 modules
	Module approved for corner clamping (see approved modules...)
	Thermal separation after max. 11m (trapezoidal sheet metal 8.4m)
	Minimum clearance to roof edge 600 mm
Inclination angle	10°

Lenght : 1386-2067 mm
Width : 950-1100 mm
Height : 30-50 mm

Check mounting systems specs with your supplier. Particularly permissible width dimensions.

Depending on location (snow & wind constraints) manufacturer could guarantee clamping on module frame long or short side.



Installation of framed module with fixtures on long sides
Beam perpendicular to long sides
(clamp length≥50mm)

Installation of framed module with fixtures on short sides
Beam perpendicular to short sides
(clamp length≥50mm)

Installation of frameless module with fixtures on long sides
(clamp length=150mm)

Clamps are mounted at the corners of short frame.
(clamp length ≥60mm, the overlap of clamp and frame≥9mm)

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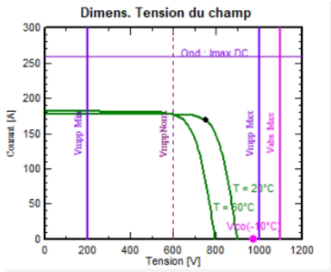
Design & Energy yield optimisation
Best practices

Design & Energy yield optimization - Best practices

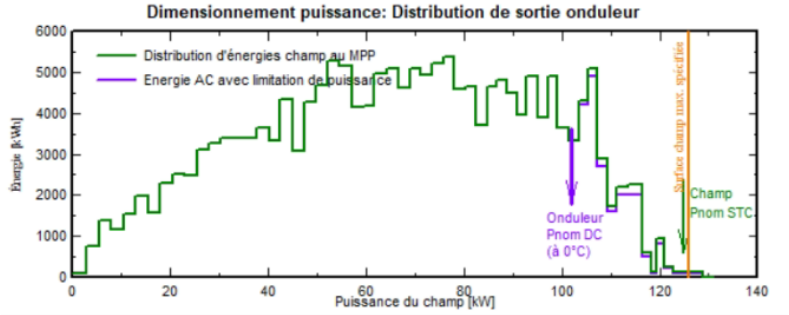
Improve cost and cable losses



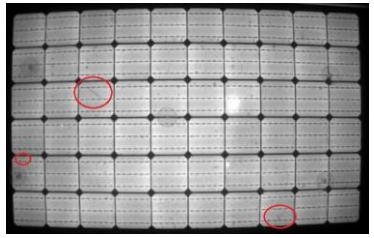
- Optimise number of modules per string matching
- The use of minimum temperature for project location
- And maximum inverter DC inputs (1000 VDC or 1500 VDC)

Optimise grid connection cost and DC power capacity

- Optimise DC/AC ratio to match with
- Grid connection target or existing electrical building installation (in case of self-consumption)



Optimise long term efficiency & maintenance cost



- Prefer >10° tilted PV modules to avoid soiling and water infiltration with adequate wind stability study in exécution design phase
- Do not walk on the modules (even at their edges) during construction & maintenance to avoid micro cracks

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Summary

Summary // Memo

Layout design, mechanical & electrical configuration

- No big difference for Layout rules & basic electrical configuration – don't forget **technical validation** for
  - Mounting systems - Check Mounting systems spec. – Mainly maximum module width admissible
  - Inverter - Check inverter input current (A) specifications

- Optimize construction cost & time by
  - Improving total number of modules
  - In addition to improving number of modules per string → less cables & connectors

- Allow installation on a wider range of roof types with Manufacturer warranty
  - by clamping on module frame long or short side

Sweet spot : Rooftop as this technology seems to be a **good compromise** (dimension & weight), between 72c. and 60c. mainstream module

Conclusion

This new generation of modules brings advantages

Optimizing power, time & cost with keeping reasonable dimension & weight for rooftop work

Without bringing new big challenges for design and construction

THANKS FOR LISTENING!

For more details:

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