



**Production of 2G HTS tape at Faraday Factory Japan**

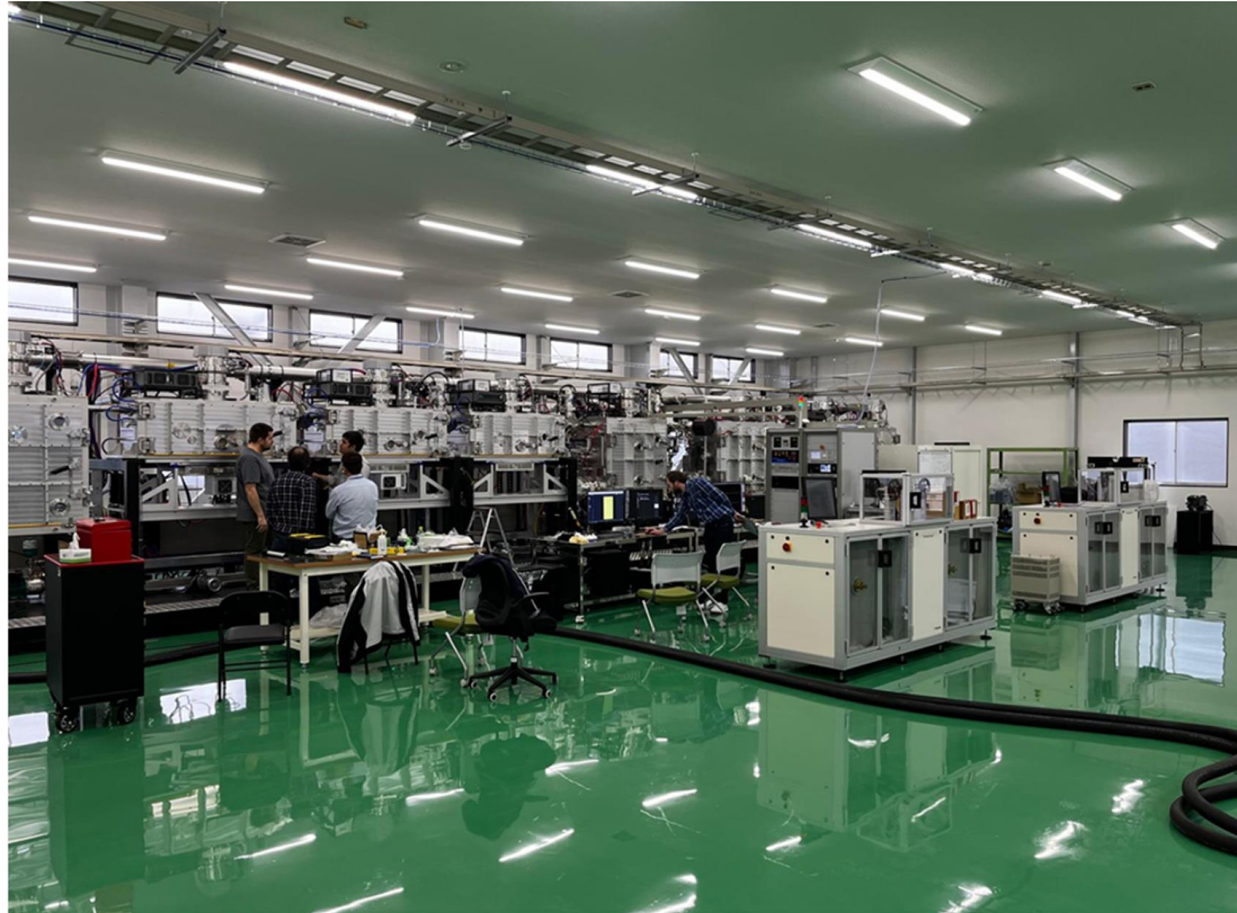


New 3,000 m<sup>2</sup> factory building opening: 19 April 2024





# New Factory building



Floor 1: EP; Cu; buffer;  $I_c$  meas.



Floor 2: HTS; Ag

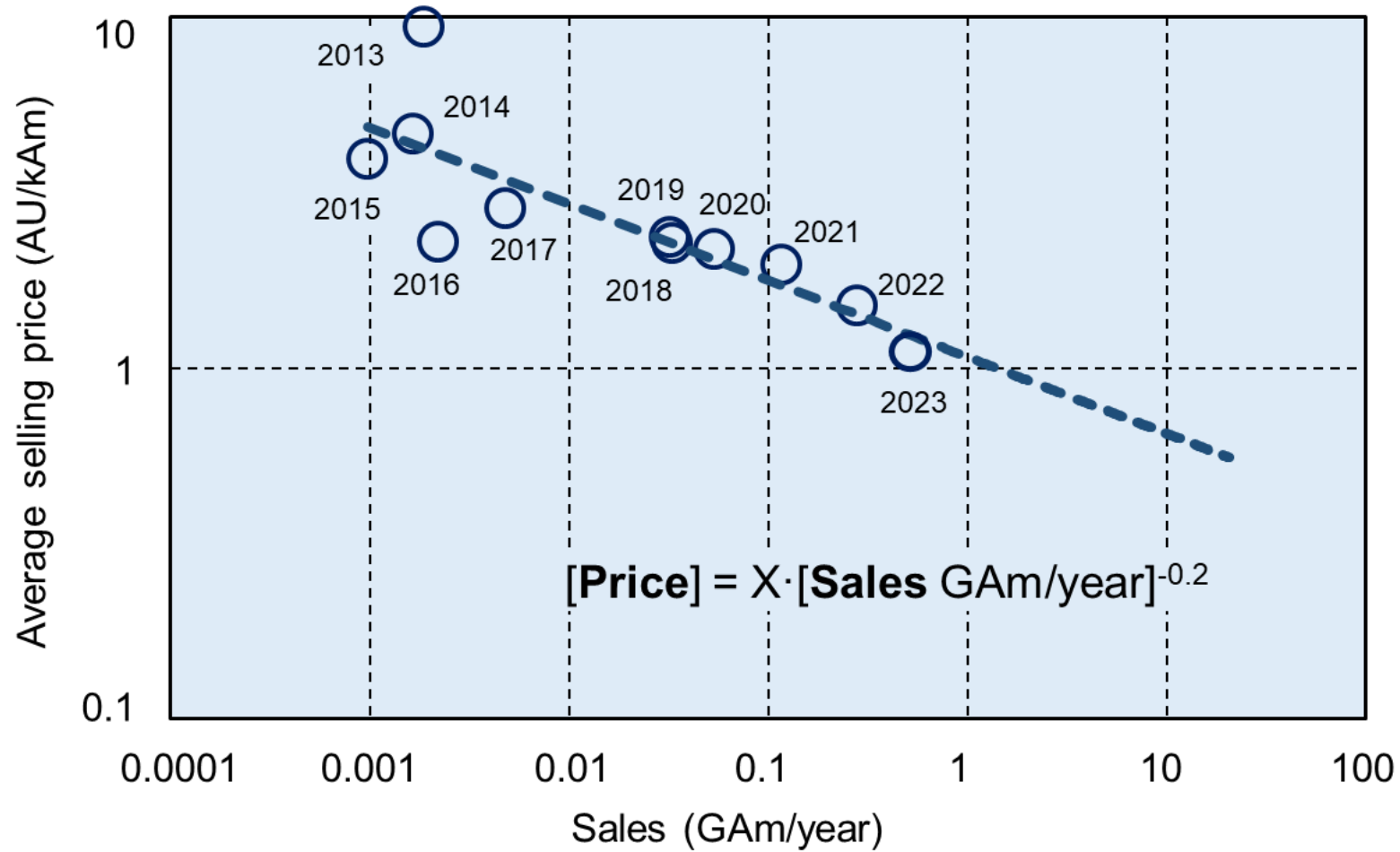


- Capacity in 2024: 1,000+ km @ 12 mm | 3,000+ km @ 4 mm
- Delivered since 2019: ~ 10,000 km @ 4 mm



Example of a 500 km shipment

# Actual price learning curve



- Fusion creates demand, promotes capacity; large volume drives the cost down
- HTS price halves with every 10-fold volume increase
- Other applications will benefit

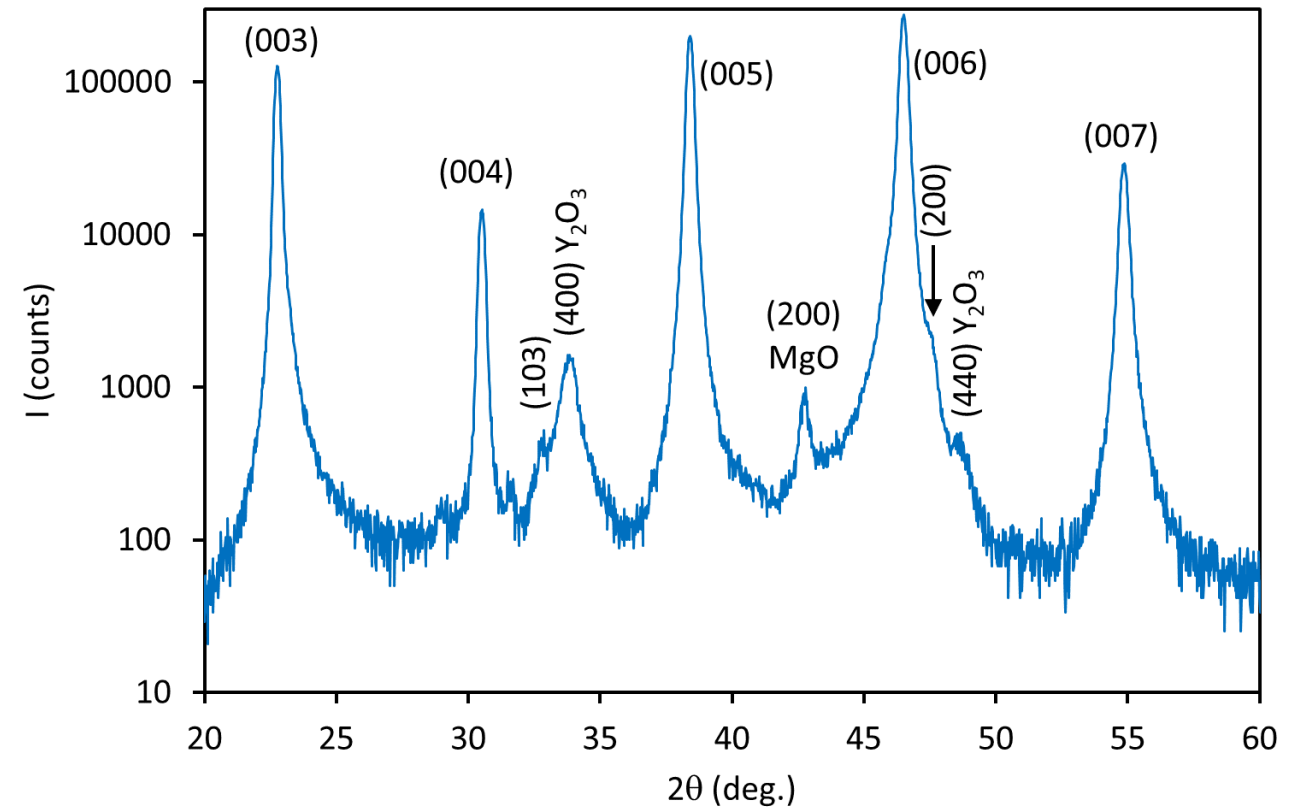
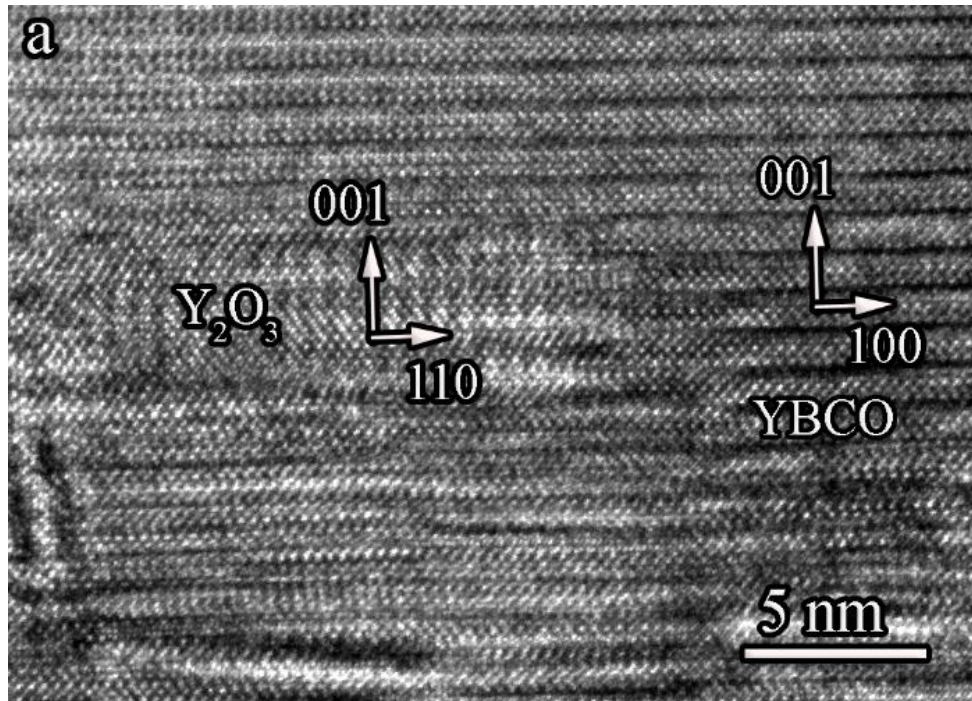
# Key components of success

- Demand
  - Compact fusion---hatched the egg
  - Other applications---are coming
- HTS layer formulation: YBCO + Y<sub>2</sub>O<sub>3</sub> nanoparticles
  - High superconducting performance
  - Robustness and amenability to industrial scale-up
- Industrial volume scale-up via process R&D and production system improvements
  - Tape speed
  - Yield
  - Up-time



Product: YBCO 2G HTS tape, since 2019

Pinning by randomly distributed  $Y_2O_3$  nanoparticles

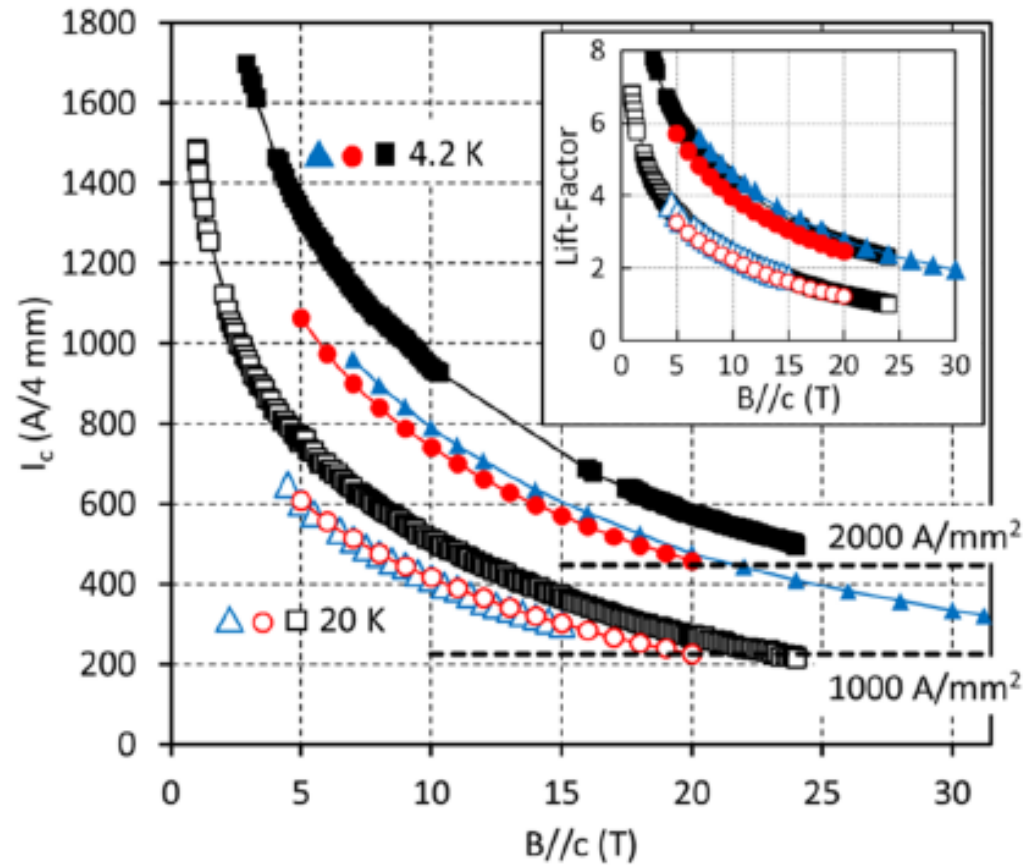


[doi.org/10.1038/s41598-021-81559-z](https://doi.org/10.1038/s41598-021-81559-z)

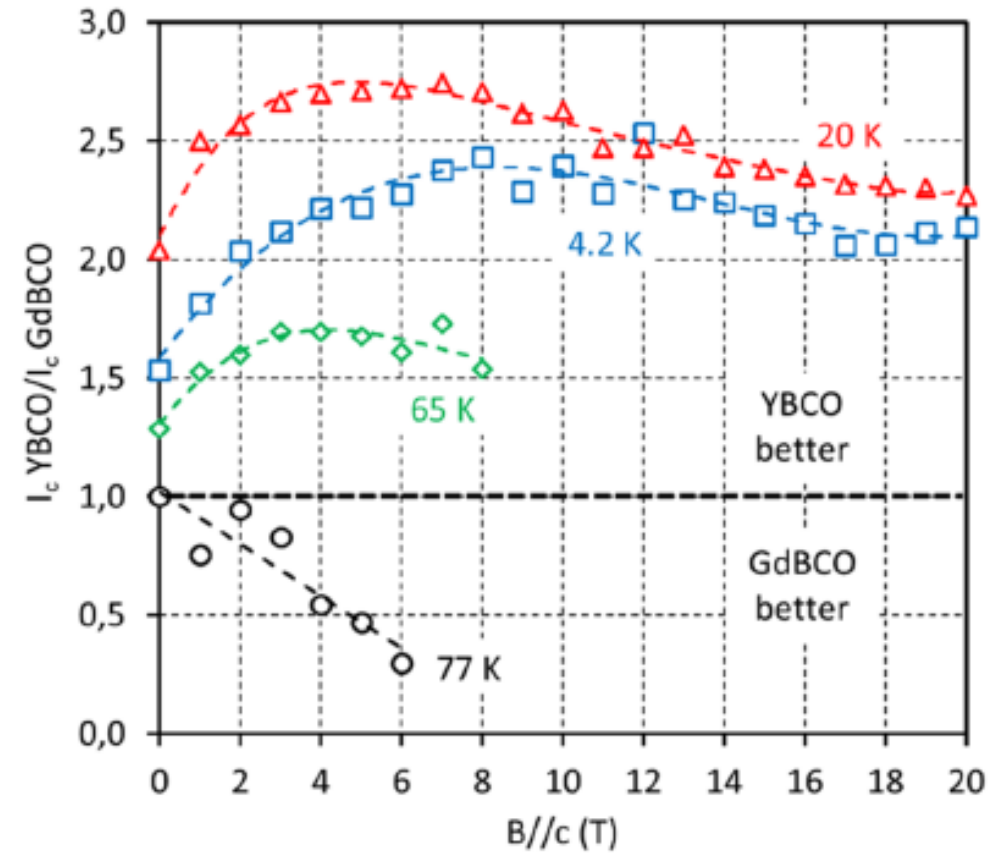
- ✓ Simple composition and nano-structure
- ✓ Easy to control
- ✓ Good reproducibility in manufacturing
- ✓ Amenable to high volume production

YBCO formulation has an excellent performance in magnetic field

YBCO in-field performance

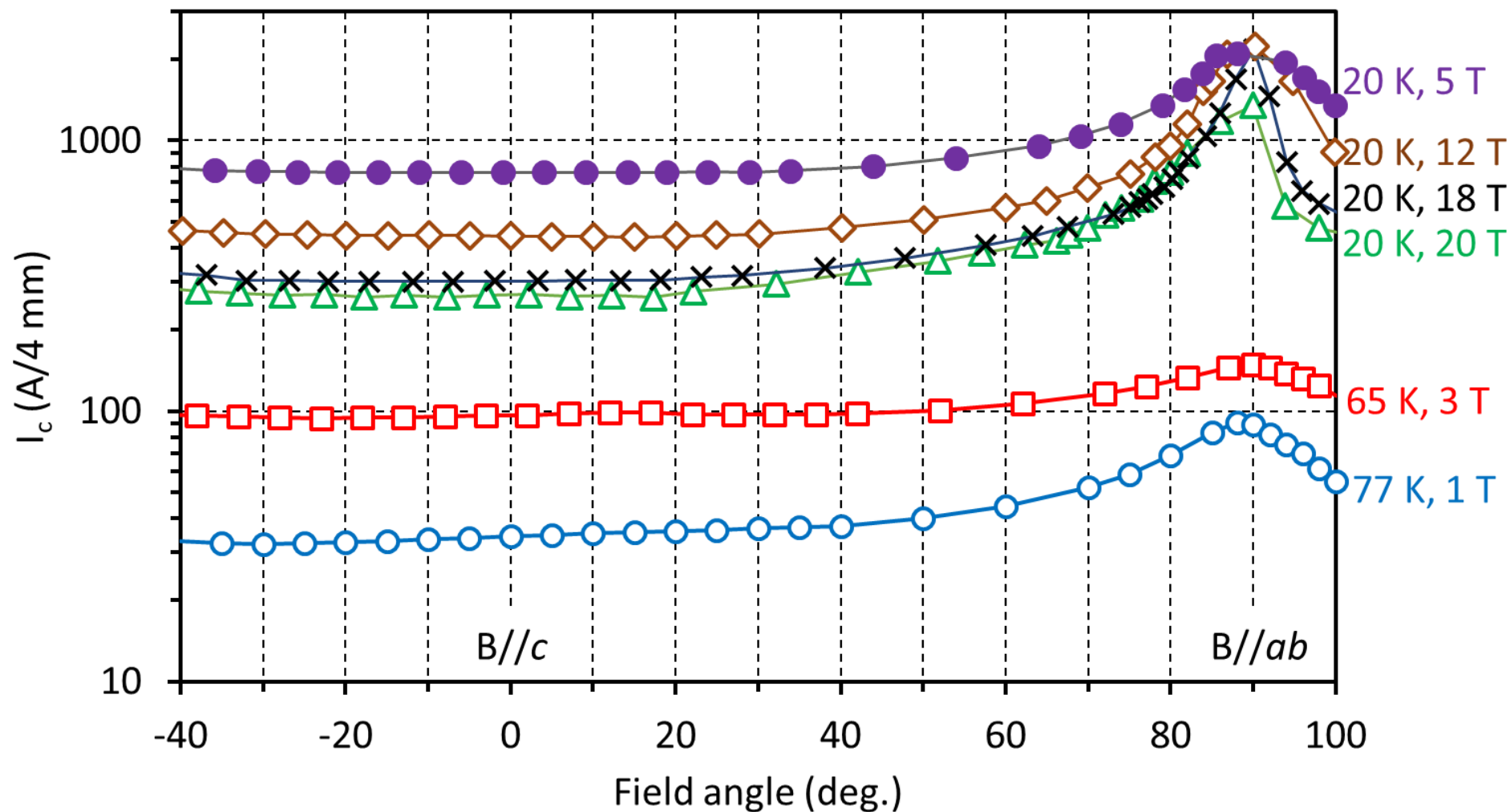


YBCO vs. GdBCO





# YBCO: angular dependence of critical current



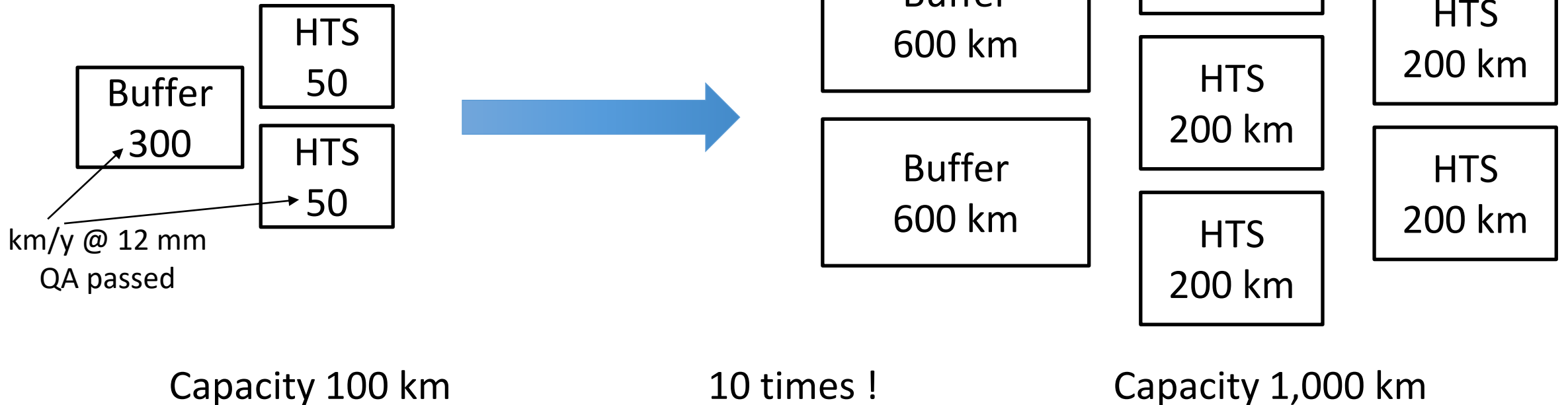
Focus: Large volume / Low cost

Action: (1) Increase unit throughput; (2) Multiply production units

(1\_a) speed

(1\_b) up-time

(1\_c) yield





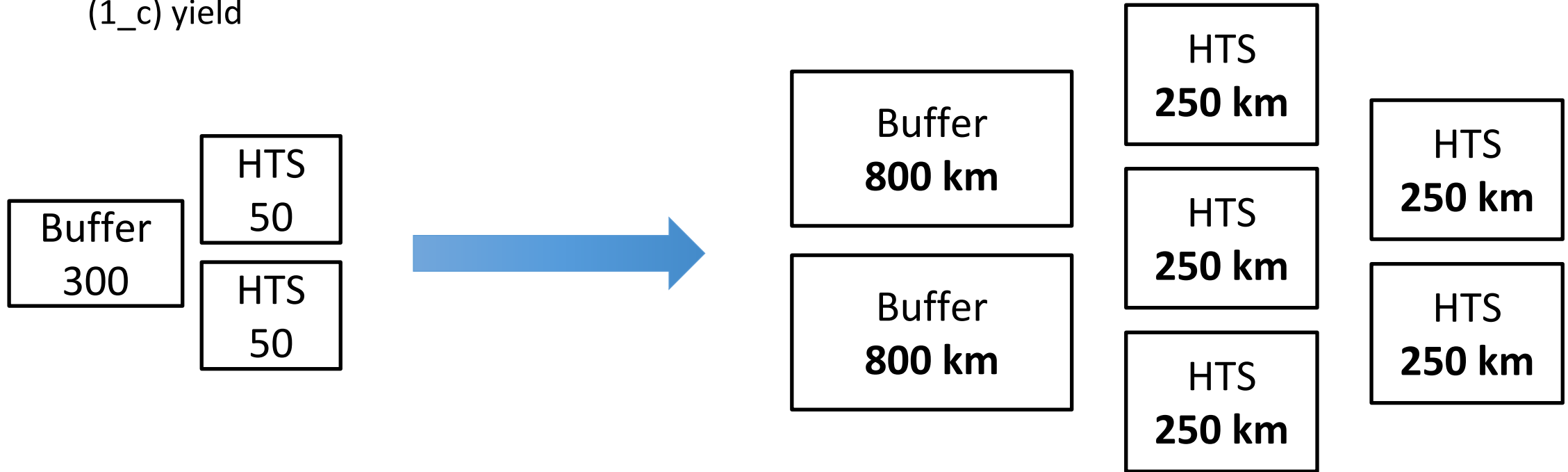
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R&D on throughput increase is ongoing

**Production status today**

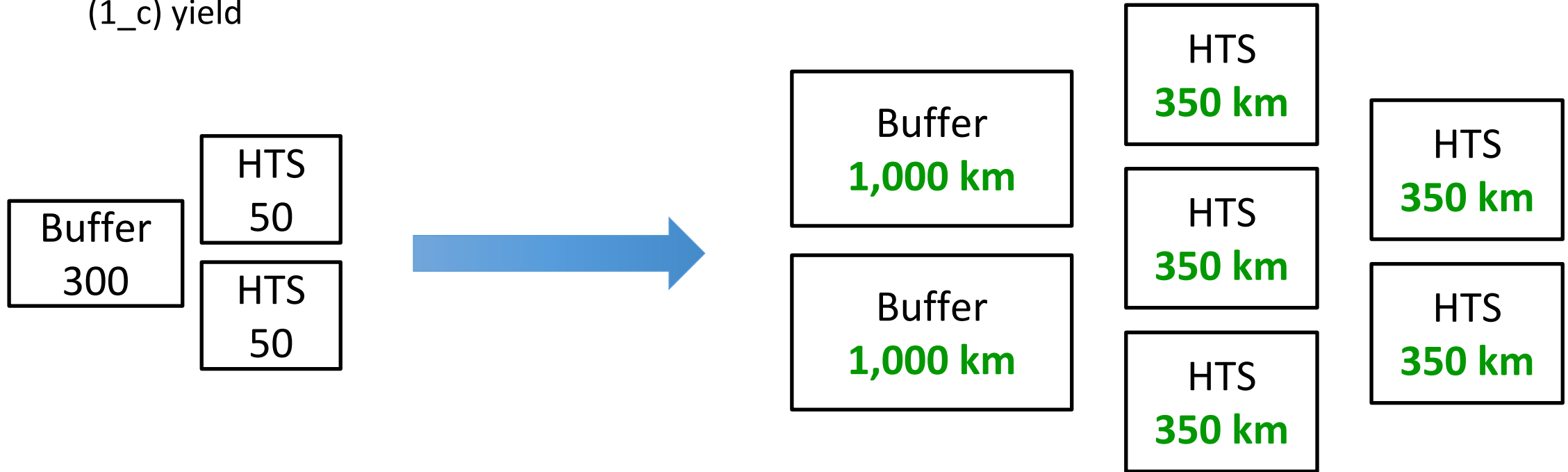
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**Demonstrated level, to be implemented in production**



TODAY :

major capacity for 2024 has been sold

we accept and deliver new orders on

tens of km of tape,

based on our mainstream production

2025-2026 :

actively filling the order list

potential demand is 300+% capacity

place large orders soon, or you may have to wait!




ONWARDS :

for large sustainable volume,

we will build dedicated factories, multi-GAm/year

## Mass production specs of today

Our entire production today works towards these specs from fusion for operation at 20 K, 20 T

Substrate	Hastelloy C276
Substrate thickness	38 +/- 3 um
Piece length	> 300 m
Cu thickness	5 +/- 1 um per side
Average $I_c$ (77-0)	> 130 A/4 mm
$I_c$ drops	allowed with a criterion 

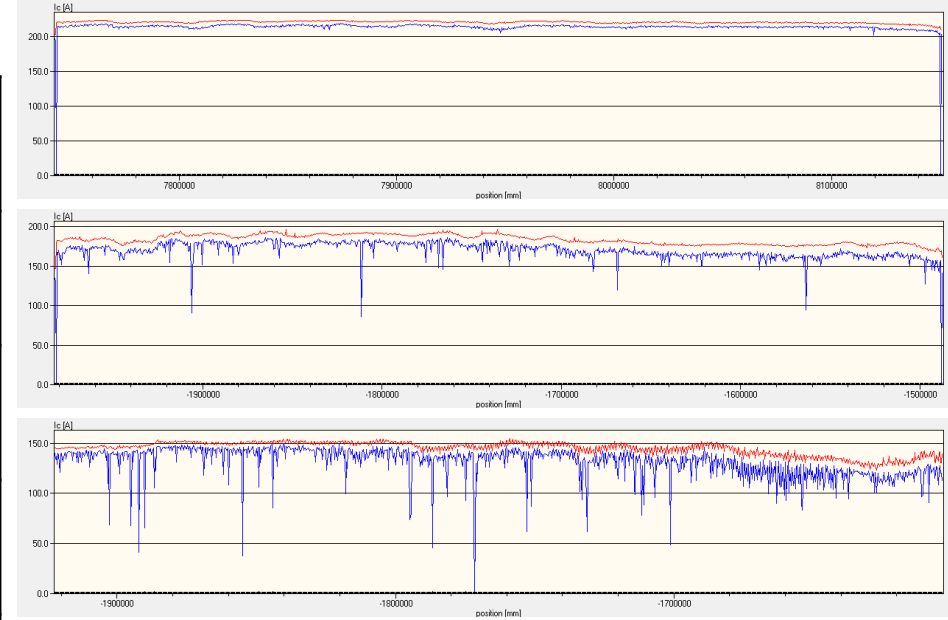
- NI coils
- Multi-strand cables with current sharing
- Near 100% yield!

There is synergy with almost all other applications

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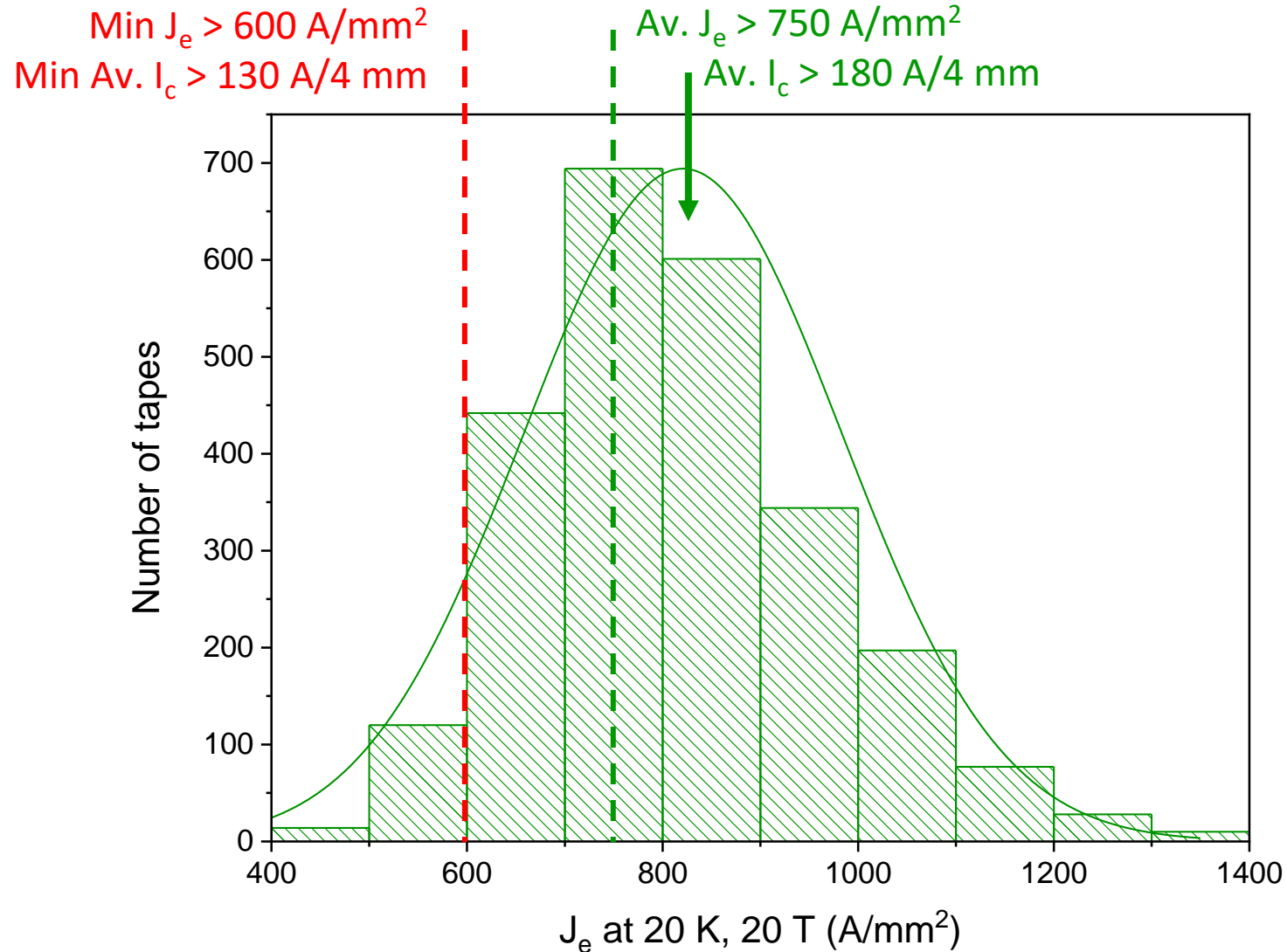
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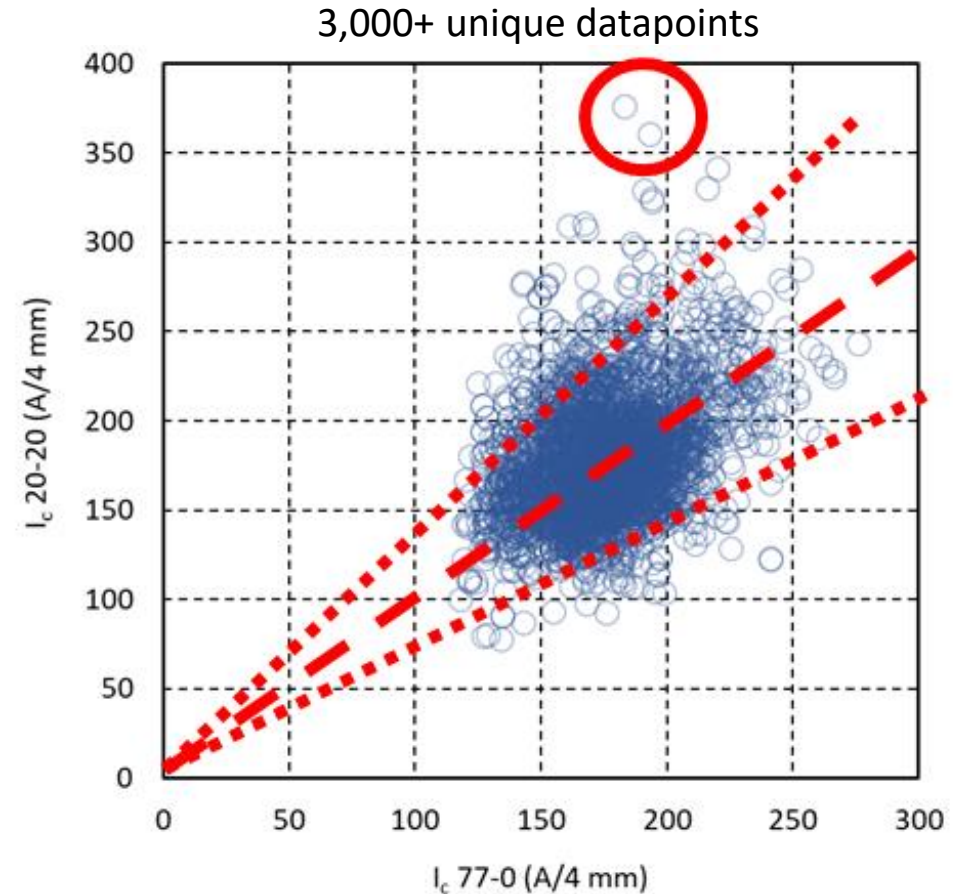
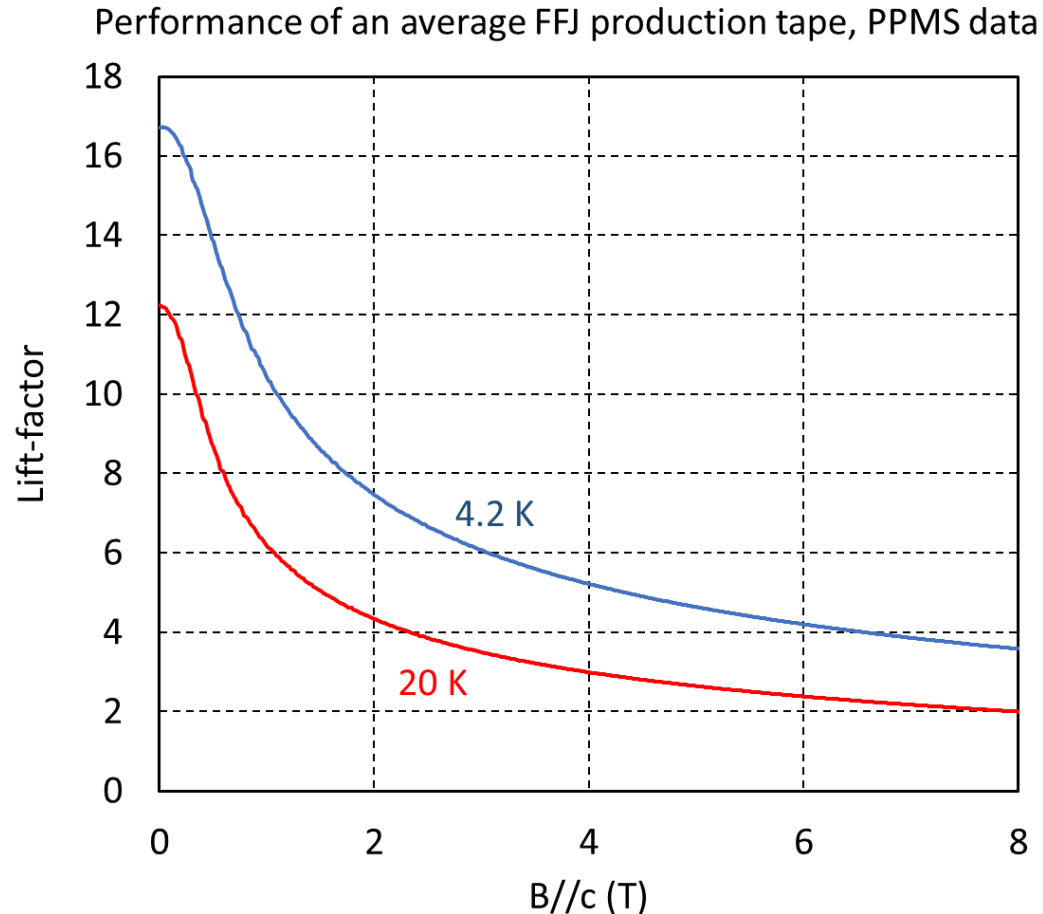
# Mass production of today, tuned to achieve specifications

- When we sell this, we can offer the best price
- Additional processing, within reason, may result in increased price  
 additional copper plating, solder-plating, insulation, soldered stacks



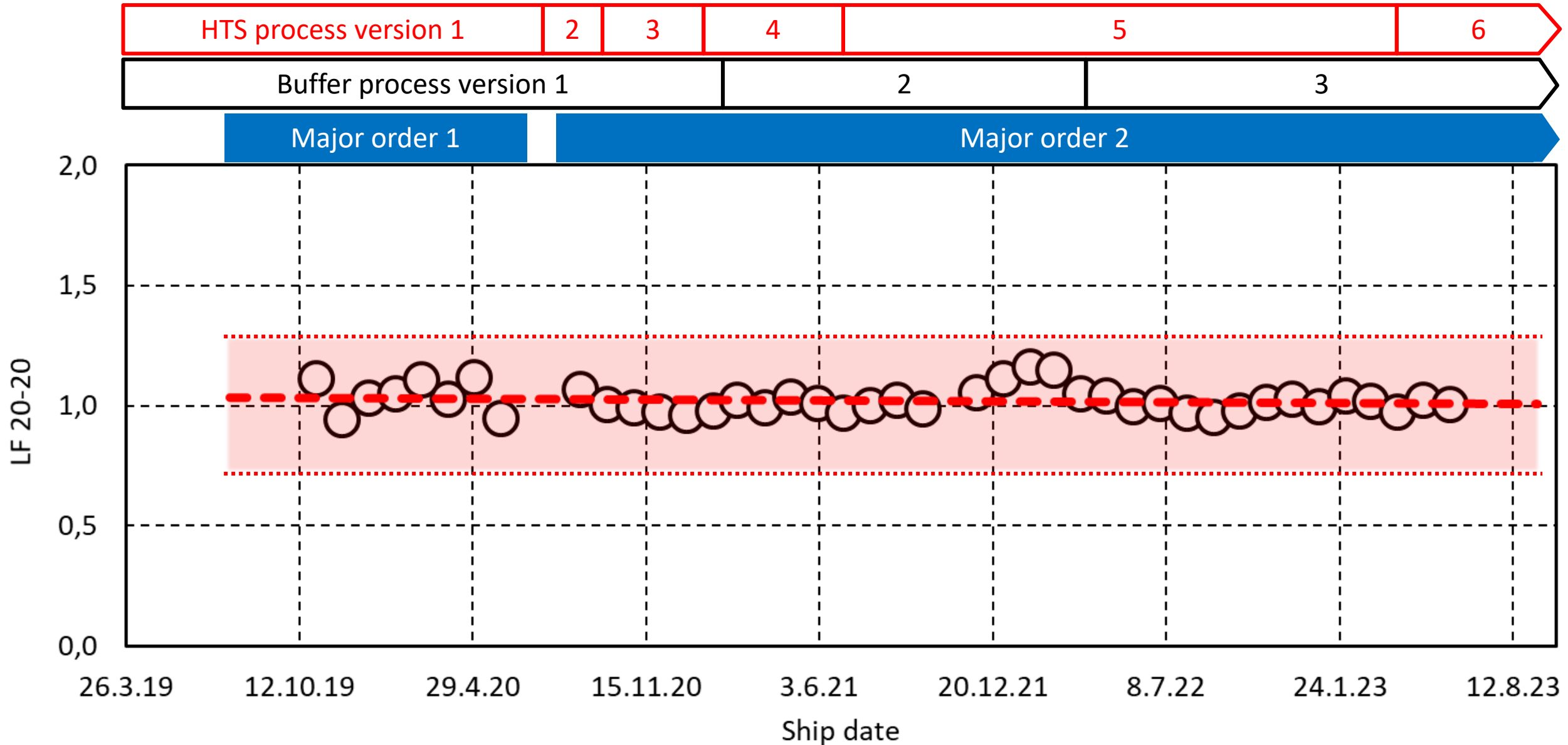
# Please build your designs on LF of routine production tapes: good and reliable

[https://figshare.com/articles/dataset/Critical\\_current\\_characterisation\\_of\\_SuperOx\\_YBCO\\_2G\\_HTS\\_superconducting\\_wire/13708690](https://figshare.com/articles/dataset/Critical_current_characterisation_of_SuperOx_YBCO_2G_HTS_superconducting_wire/13708690)



- Among different tapes: LF standard deviation 15-20%
- Within the same tape at different positions: LF standard deviation is 10-15%
- Statistical average LF better represents tape performance than a single measurement

# Historical data on lift-factor at 20 K, 20 T: Average LF by shipment lot





## Focus until now...

- + Large volume
- + Low cost
- + Reliable quality

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~~Fewer  $I_c$  drops~~

~~Continuous lengths > 500 m~~

## ...and onwards

- + Large volume
- + Low cost
- + Reliable quality
- + Fewer  $I_c$  drops

Continuous lengths > 500 m